ORIGINAL CONTRACT COPY

250832

Bond #B 35768

CITY OF SEATTLE
BOARD OF PUBLIC WORKS

DEPARTMENT OF LIGHTING

BOUNDARY PROJECT

PEND OREILLE RIVER, WASHINGTON

CONSTRUCTION OF
ARCH DAM, POWER PLANT
AND APPURTENANT WORKS

SPECIFICATION NO. 1782

INCLUDING ADDENDUM NO. 1

SEATTLE, WASHINGTON

1964

FILED
CITY OF SEATTLE
'64 MAY 12 PM 12:30
COMPTROLLER AND CITY CLERK

CITY OF SEATTLE
DEPARTMENT
OF LIGHTING

CITY LIGHT BUILDING • 1015 THIRD AVENUE • SEATTLE, WASHINGTON 98104 • Telephone MAin 3-7600

JOHN M. NELSON, Superintendent
MEMBER, BOARD OF PUBLIC WORKS

October 31, 1967

Mr. C. G. Erlandson
City Clerk, City of Seattle
Seattle Municipal Building
Seattle, Washington 98104

Dear Mr. Erlandson:

Boundary Project
Boundary Dam Constructors
Specification No. 1782

Enclosed are copies of documents pertaining to the assignment of the interests of Frontier Construction Company, Inc. to The Foundation Company of Canada Limited in the Specification No. 1782 contract.

Please attach the enclosed copies of documents, and the signed original "Consent" by the Board of Public Works, to the original copy of Specification No. 1782, "Construction of Arch Dam, Power Plant, and Appurtenant Works for Boundary Project" (File No. CF 250832).

Yours very truly,

JOHN M. NELSON
Superintendent of Lighting

By H. V. Strandberg
H. V. STRANDBERG
Chief Engineer

RGR:rb
Enc. (1) Consent
(2) Approval of Sureties
(3) Assurance of continued indemnification to sureties from remaining joint venturers

SEATTLE CITY LIGHT

CITY OF SEATTLE
DEPARTMENT
OF LIGHTING

CITY LIGHT BUILDING • 1015 THIRD AVENUE • SEATTLE, WASHINGTON 98104 • Telephone MAin 3-7600

JOHN M. NELSON, Superintendent
MEMBER, BOARD OF PUBLIC WORKS

October 31, 1967

Mr. C. G. Erlandson
City Clerk, City of Seattle
Seattle Municipal Building
Seattle, Washington 98104

Dear Mr. Erlandson:

Boundary Project
Boundary Dam Constructors
Specification No. 1782

Enclosed are copies of documents pertaining to the assignment of the interests of Frontier Construction Company, Inc. to The Foundation Company of Canada Limited in the Specification No. 1782 contract.

Please attach the enclosed copies of documents, and the signed original "Consent" by the Board of Public Works, to the original copy of Specification No. 1782, "Construction of Arch Dam, Power Plant, and Appurtenant Works for Boundary Project" (File No. CF 250832).

Yours very truly,

JOHN M. NELSON
Superintendent of Lighting

By
H. V. STRANDBERG
Chief Engineer

RGR:rb
Enc. (1) Consent
(2) Approval of Sureties
(3) Assurance of continued indemnification to sureties from remaining joint venturers

cc: Hoidal
Strandberg
J M Nelson
A C Amundsen
File

SEATTLE CITY LIGHT

CONSENT

The Board of Public Works hereby consents to the assignment by Frontier Construction Company, Inc. to The Foundation Company of Canada Limited as of November 1, 1966, of all the right, title and interest of Frontier Construction Company, Inc. in a Contract dated April 29, 1964, between Frontier Construction Company, Inc., Mannix Construction, Inc., SGS Contractors, Inc., McLaughlin, Inc., and the City, hereinafter referred to as 'Specification 1782'.

This consent and the consents, or verified copies thereof, of Mannix Construction, Inc., McLaughlin, Inc., SGS Contractors, Inc., to General Insurance Company of America approving such assignment and agreeing to indemnify the sureties, together with the consent to such assignment of the co-sureties under Contract Bond No. 522023 furnished in connection with Specification 1782, shall be attached to said Specification 1782 in lieu of the endorsement requirements of Paragraph 8 of the general conditions thereof.

THE CITY OF SEATTLE
BOARD OF PUBLIC WORKS

By R W Morse
Chairman of Board of Public Works

E. D. Henry
Secretary of Board of Public Works

_____ (SEAL)

_____ (SEAL)

_____ (SEAL)

APPROVAL OF SURETIES

Whereas Mannix Construction, Inc., SGS Contractors, Inc., McLaughlin, Incorporated, and Frontier Construction Company, Inc., as joint venturers, as principals, and the undersigned sureties, jointly and severally entered into a contract bond to The City of Seattle, Washington under General Insurance Company of America Bond No. 522023; and

Whereas Frontier Construction Company, Inc., has entered into an agreement dated as of November 1, 1966 to transfer and assign to Foundation Company of Canada, Limited all its rights, title and interest in that certain contract with The City of Seattle for the construction of the Boundary Project dated April 29, 1964 and in the agreement of joint venture in connection therewith; and

Whereas Mannix Construction, Inc., SGS Contractors, Inc., and McLaughlin, Incorporated, have consented to such assignment to Foundation Company of Canada, Limited; and

Whereas the Board of Public Works of The City of Seattle requires that prior to its consent to such assignment that the sureties under the above contract bond to The City of Seattle also consent to such assignment; Now, Therefore,

The undersigned co-sureties do hereby approve the assignment and transfer as of November 1, 1966 of all the right, title and interest of Frontier Construction Company, Inc.'s interest in the contract dated April 29, 1964 between the above joint venturers and The City of Seattle and that certain joint venture agreement in connection therewith dated April 22, 1964 to Foundation Company of Canada, Limited, and further agree that the undersigned shall be held and firmly bound to The City of Seattle, jointly and sever-

ally, under the terms and conditions of Bond No. 522023 as if the Foundation Company of Canada, Limited, were a party thereto in the place and in stead of Frontier Construction Company, Inc.

DATED this 16th day of October, 1967.

GENERAL INSURANCE COMPANY OF AMERICA

By W. J. Jedusor

GENERAL REINSURANCE CORPORATION

By W. J. Jedusor

AMERICAN RE-INSURANCE COMPANY

By W. J. Jedusor

SEABOARD SURETY COMPANY

By W. D. Callender

ST.PAUL FIRE AND MARINE INSURANCE COMPANY

By Mary D. White

FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By John Bowen

EMPLOYERS REINSURANCE CORPORATION

By John Bowen

NORTH AMERICAN REINSURANCE CORPORATION

By John Bowen

OCT 17 1967

GENERAL INSURANCE COMPANY OF AMERICA

Home Office: 4347 Brooklyn Ave. N.E., Seattle, Washington 98105

SAFECO INSURANCE

POWER OF ATTORNEY

No. 590-A

KNOW ALL MEN BY THESE PRESENTS:

That General Insurance Company of America by R. E. BANGERT, its Vice-President, in pursuance of authority granted by Section 13, Article VI, of the By-Laws of said company, a copy of which section is printed below, does hereby nominate, constitute and appoint W. D. PEDERSON

its true and lawful attorney-in-fact, to make, execute, seal and deliver for and on its behalf, and as its act and deed any and all bonds and undertakings, in its business of guaranteeing the fidelity of persons holding places of public or private trust and the performance of contracts other than insurance policies, and executing and guaranteeing bonds or other undertakings required or permitted in all actions or proceedings, or by law required or permitted.

All such bonds and undertakings as aforesaid to be signed on behalf of General Insurance Company of America and the corporate seal of the company affixed thereto by W. D. Pederson, individually.

And the execution of such bonds or undertakings in pursuance of these presents shall be as binding upon said company, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the company at its Home Office, Seattle, Washington, in their own proper persons.

IN WITNESS WHEREOF, the said R. E. BANGERT has hereunto subscribed his name and affixed the corporate seal of the said General Insurance Company of America this 23 day of August 19 66

(SEAL)

(signed) R. E. Bangert
Vice-President

STATE OF WASHINGTON, COUNTY OF KING, } ss.

On this 23 day of August A.D. 19 66, before the subscriber, a Notary Public of the State of Washington, in and for the County of King, duly commissioned and qualified, came R. E. BANGERT Vice-President of General Insurance Company of America, to me personally known to be the individual and officer described in, and who executed, the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, deposeth and saith, that he is the officer of the company aforesaid, and that the seal affixed to the preceding instrument is the corporate seal of said company, and the said corporate seal and his signature as such officer was duly affixed and subscribed to the said instrument by the authority and direction of said Corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

(SEAL)

(signed) Ida Dahl
Notary Public

Extract from By-Laws of General Insurance Company of America, adopted July 28, 1966, by the Stockholders:

"Article VI, Section 13. – FIDELITY AND SURETY BONDS. In addition to the authority previously stated, the Chairman of the Board of Directors, the President, any Vice-President, and the Secretary shall each have authority to appoint individuals under appropriate titles with authority to execute on behalf of the company fidelity and surety bonds and other documents of similar character issued by the company in the course of its business and to authorize such individuals to attach thereto the official seal of the company.

The power of appointment granted in this paragraph to the officers enumerated may be exercised by each of them severally, regardless of the availability or unavailability of the other officers enumerated."

I, R. E. BANGERT Vice-President of General Insurance Company of America, hereby certify that the foregoing is a true copy of Section 13, Article VI, of the By-Laws of said company and is still in force.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name as Vice-President and affixed the corporate seal of General Insurance Company of America, this 23 day of August A.D. 19 66.

(SEAL)

(signed) R. E. Bangert
Vice-President

STATE OF WASHINGTON, COUNTY OF KING, } ss.

I, M. W. OCHSNER Assistant Secretary of General Insurance Company of America, do hereby certify that the foregoing is a true copy of Section 13, Article VI, of the By-Laws of said company, and is now in force; and I do hereby certify that the above and foregoing Power of Attorney is a true and correct copy of a Power of Attorney, executed by said General Insurance Company of America, which is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said company, at the City of Seattle, this 16th day of October, A.D. 19 67.

M W Ochsner
Assistant Secretary

S-634 R2 7/66

OCT 19 1967

PRINTED IN U.S.A.

Power of Attorney

NO. _____

FROM

GENERAL INSURANCE COMPANY
OF AMERICA

Home Office: 4347 Brooklyn Ave. N.E., Seattle, Washington 98105

SAFECO
INSURANCE

TO

_____

_____

DATED _____

FILED _____

Certified Copy

POWER OF ATTORNEY
From
GENERAL REINSURANCE CORPORATION
400 PARK AVENUE, NEW YORK 22, N. Y.

Know All Men By These Presents: That the GENERAL REINSURANCE CORPORATION, a corporation organized and existing under the laws of the State of New York, with Executive Offices at 400 Park Avenue, in the City of New York, N. Y., does hereby nominate, constitute and appoint

R. E. Bangert, W. D. Pederson or Willard G. Sweany, individually, all of Seattle, Washington

---

its true and lawful Attorney(s)-in-fact with full power and authority to make, execute and deliver, for and on its behalf as surety, and as its act and deed, any and all bonds or undertakings - including consents in connection therewith - which are written on a co-surety basis and duly executed by . . . . **General Insurance Company of America** . . . . . as a co-surety; provided the co-surety share of General Reinsurance Corporation on any single bond shall not exceed . . . . **Two million five hundred thousand ($2,500,000) dollars** . . . . .

and the execution of such bond(s), undertaking(s), or writing(s) obligatory, in pursuance of these presents, shall be as binding upon said Corporation, to all intents and purposes, as if duly executed by the President or Vice President of the Corporation, sealed with its corporate seal, and attested by its Secretary or Assistant Secretary; and said Corporation hereby ratifies and confirms the acts of said Attorney(s)-in-fact done pursuant to the power and authority herein given.

This Power of Attorney is made and executed by authority of the By-laws of said Corporation of which the following excerpt is a true and exact copy.

"ARTICLE VII, SECTION 2.—The Chairman of the Board, the President or any Vice President shall have the power and authority to appoint in writing attorneys-in-fact and to empower them to the extent set forth in such written affidavit to execute on behalf of the Corporation, and to attach the Seal of the Corporation thereto, bonds and undertakings, recognizances, contracts of indemnity and other similar writings obligatory.

ARTICLE VII, SECTION 3.—The Secretary or any Assistant Secretary shall have the power and authority to acknowledge, and to make and verify any affidavit required to be attached to, any instrument duly executed by this Corporation; and to certify to the correctness and effectiveness of any copy of any by-laws or resolutions of the Board of Directors; and to the powers of any officers of the Corporation; and to the correctness of a copy of any power of attorney, and the names of persons holding offices in this Corporation and to affix the Seal of the Corporation to any of the foregoing verifications or certifications; and any such verification or certification shall be binding upon the Corporation."

All power and authority hereby conferred shall hereby expire and terminate without notice at midnight of the 31st day of March, 1968 as respects executions subsequent thereto.

In Witness Whereof: the GENERAL REINSURANCE CORPORATION has caused these presents to be signed by its Vice President and its corporate seal to be affixed this 31st day of March, 1966.

GENERAL REINSURANCE CORPORATION

Attest: (Signed) Stanley D. LeWand
Stanley D. LeWand Asst. Secretary

By (Signed) Vincent T. Schuster
Vincent T. Schuster Vice President

STATE OF NEW YORK }
COUNTY OF NEW YORK } SS.:

On this 31st day of March 1966, before me, a Notary Public in and for the State of New York, personally came Vincent T. Schuster to me known, who acknowledged execution of the preceding instrument and, being by me duly sworn, did depose and say, that he is Vice President of General Reinsurance Corporation, the corporation named in and which executed said instrument; that the seal affixed to said instrument is the corporate seal of General Reinsurance Corporation; that said corporate seal was affixed and his signature subscribed to said instrument by authority and order of the Board of Directors of said Corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal at New York, N. Y., the day and year first above written.

JOSEPH H. PRAETZ
Notary Public, State of New York
No. 30-5128700
Qualified in Nassau County
Certificate filed in New York County
Term Expires March 30, 1968

(Signed)
Notary Public

I, the undersigned Stanley D. LeWand Asst. Secretary of the General Reinsurance Corporation, do hereby certify that the original Power of Attorney, of which the attached is a true and correct copy, remains in full force and effect; that the Attorney(s)-in-fact, nominated and appointed therein, is duly empowered to execute for said Corporation to the extent, and for the purposes, recited in said Power of Attorney; and that the Sections of By-laws, copied in said instrument, have not been amended and remain in full force and effect.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the General Reinsurance Corporation this 16th day of October A.D., 1967.

Stanley D. LeWand
Stanley D. LeWand Asst. Secretary

Power No. 480 - 4

NOV 17 1967

CERTIFIED COPY

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That AMERICAN RE-INSURANCE COMPANY, a corporation of the State of New York, with offices at No. 99 John Street, New York, N. Y. 10038, has made, constituted and appointed, and by these presents, does make, constitute and appoint

R. E. Bangert, W. D. Pederson and Willard G. Sweany

its true and lawful Attorney-in-Fact, at Seattle in the State of Washington each of them alone to have full power to act without the other or others, to make, execute and deliver on its behalf, as Surety or co-Surety, bonds and undertakings given for any and all purposes, also to execute and deliver on its behalf as aforesaid renewals, extensions, agreements, waivers, consents or stipulations relating to such bonds or undertakings provided, however, that no single bond or undertaking so made, executed and delivered shall obligate said Company for any portion of the penal sum thereof in excess of the sum of

TWO MILLION, FIVE HUNDRED THOUSAND Dollars ($2,500,000).

Such bonds and undertakings for said purposes, when duly executed by said Attorney(s)-in-Fact, shall be binding upon said Company as fully and to the same extent as if signed by the President of said Company under its corporate seal attested by its Secretary.

This appointment is made under and by authority of a certain Resolution adopted at a meeting of the Board of Directors of said Company duly held on the 26th day of May, 1965, a copy of which appears below.

This Power of Attorney shall expire and all authority hereunder shall terminate without notice at midnight (Standard Time where said Attorney(s)-in-Fact is authorized to act) of June 30, 1969.

In Witness Whereof, AMERICAN RE-INSURANCE COMPANY has caused these presents to be signed by its President or one of its Vice-Presidents thereunto duly authorized, and its corporate seal to be hereunto affixed and attested by its Secretary or one of its Assistant Secretaries, this 12th day of January, 1967, at New York, N. Y.

(Corporate Seal)

Attest: P. P. Rossetti Assistant Secretary

AMERICAN RE-INSURANCE COMPANY

By W. J. French Vice-President

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

On the 12th day of January, 1967, before me personally came W. J. French, to me known, who being by me duly sworn, did depose and say that he resides in Albertson, New York; that he is a Vice-President of AMERICAN RE-INSURANCE COMPANY, the Corporation described in and which executed the above instrument; that he knows the seal of said Corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said Corporation, and that he signed his name thereto by like order.

(Notarial Seal)

Albert J. Schmuck Notary Public
Notary Public, State of New York
No. 41-8826775
Qualified in Queens County
Term Expires March 30, 1968

CERTIFICATE

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

The undersigned K. Le Strange hereby certifies:

1. That the undersigned is an Assistant Secretary of AMERICAN RE-INSURANCE COMPANY, a corporation of the State of New York;

2. That the original power of attorney of which the foregoing is a copy was duly executed on behalf of said Corporation on the day of its date, and has not since been revoked, amended or modified; that the undersigned has compared the foregoing copy thereof with said original power of attorney, and that the same is a true and correct copy of said original power of attorney and of the whole thereof;

3. That the original resolution of which the following is a copy was duly adopted at, and recorded in the minutes of, a regular meeting of the Board of Directors of said Corporation duly held on May 26, 1965, and has not since been revoked, amended or modified:

"RESOLVED that each of the following officers of this Company, namely, Merl L. Rouse, President, Donald R. MacKay, Executive Vice President, and W. J. French, C. H. Kahrs, Robert A. Lum, Lester A. Menegay, J. A. Sellon and C. Urban, Vice Presidents, be, and he hereby is, authorized, from time to time in his discretion, to appoint such agent or agents or attorney or attorneys-in-fact as deemed by him necessary or desirable for the purpose of carrying on this Company's business, and to empower such agent or agents or attorney or attorneys-in-fact to execute and deliver, in this Company's name and on its behalf, and under its seal or otherwise, bonds, obligations and recognizances, whether made by this Company as surety thereon or otherwise, indemnity contracts, reinsurance treaties, contracts and certificates, and any and all other contracts and undertakings made in the course of this Company's insurance and reinsurance business, and renewals, extensions, agreements, waivers, consents or stipulations renewing, extending, amending, supplementing, reinstating or cancelling contracts or undertakings so made, or approving or consenting to the modification, alteration or assignment of agreements or specifications referred to in contracts or undertakings so made."

that the undersigned has compared the foregoing copy thereof with said original resolution as so recorded, and that the same is a true and correct copy of said original resolution as so recorded and of the whole thereof.

Witness the hand of the undersigned and the seal of said Corporation this 16th day of October, 1967.

(Corporate Seal)

K. Le Strange, Assistant Secretary

Power No. GIA 165

OCT 17 1967

Certified Copy

SEABOARD SURETY COMPANY

HOME OFFICE

100 WILLIAM STREET, NEW YORK 38, N.Y.

No. 5262

Power of Attorney

Know all Men by these Presents: That SEABOARD SURETY COMPANY, a corporation of the State of New York, has made, constituted and appointed and by these presents does make, constitute and appoint A. M. Nikischer or R. D. Callender,

of Seattle, Washington,
its true and lawful Attorney-in-Fact, to make, execute and deliver on its behalf as Surety, bonds, undertakings and other obligatory instruments of similar nature as follows: Without Limitations.

Such bonds, undertakings and obligatory instruments for said purposes, when duly executed by the aforesaid Attorney-in-Fact, shall be binding upon the said Company as fully and to the same extent as if such bonds, undertakings and obligatory instruments were signed by the duly authorized officers of the Company and sealed with its corporate seal; and all the acts of said Attorney-in-Fact, pursuant to the authority hereby given, are hereby ratified and confirmed.

This appointment is made pursuant to the following By-Laws which were duly adopted by the Board of Directors of the said Company on December 8th, 1927, and are still in full force and effect:

ARTICLE VI, Paragraph 6.7:
"Attorneys-in-Fact may be appointed by the President or a Vice-President upon such terms and with such powers and duties as he may prescribe."

ARTICLE XI, Paragraph 11.1:
"All policies, bonds, recognizances, stipulations and all underwriting undertakings shall be valid:
(a) when signed by the President, or a Vice-President, or a Resident Vice-President, and by a Secretary, or an Assistant Secretary, or a Resident Assistant Secretary or other duly authorized official or agent of the Company; or
(b) when executed by an Attorney-in-Fact."

In Witness Whereof, SEABOARD SURETY COMPANY has caused these presents to be signed by its Vice-President, and its corporate seal to be hereunto affixed and duly attested by its Assistant Secretary, this 7th day of October, 19 64

Attest:

SEABOARD SURETY COMPANY,
By

(Seal) Lillian Miller
Assistant Secretary

W. S. Wehrell
Vice-President

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

On this 7th day of October, 19 64 before me personally appeared W. S. Wehrell Vice-President of SEABOARD SURETY COMPANY, with whom I am personally acquainted, who, being by me duly sworn, said that he resides in the State of New Jersey; that he is Vice-President of SEABOARD SURETY COMPANY, the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of the said Company; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said Company; and that he signed his name thereto as Vice-President of said Company by like authority.

(Seal)

Batty C. Rode
Notary Public
State of New York
No. 03-8611400 Qualified in Bronx County
Certificate filed in New York County
Commission Expires March 30, 1966.

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

I, Lillian Miller Asst. Secretary of SEABOARD SURETY COMPANY, do hereby certify that the above and foregoing is a true and correct copy of a power of attorney executed by said SEABOARD SURETY COMPANY, which is still in full force and effect.

In Witness Whereof, I have signed this certificate at New York, New York, this 16th day of October, 1967

Lillian Miller
Assistant Secretary

SEABOARD SURETY COMPANY 1927 STATE OF NEW YORK

Form 147 Rev. 1958

OCT 17 1967

Class 1

CERTIFIED COPY OF POWER OF ATTORNEY

(A Capital Stock Company)

Original on File at Home Office of Company. See Certification.

FIDELITY AND SURETY DEPARTMENT

ST. PAUL FIRE and MARINE Insurance Company

HOME OFFICE: ST. PAUL, MINNESOTA

KNOW ALL MEN BY THESE PRESENTS: That the St. Paul Fire and Marine Insurance Company, a corporation organized and existing under the laws of the State of Minnesota, and having its principal office in the City of Saint Paul, Minnesota, does hereby constitute and appoint

Mary D. White

Seattle, Washington

its true and lawful attorney(s)-in-fact to execute, seal and deliver for and on its behalf as surety, any and all bonds and undertakings, recognizances, contracts of indemnity and other writings obligatory in the nature thereof, which are or may be allowed, required or permitted by law, statute, rule, regulation, contract or otherwise, and the execution of such instrument(s) in pursuance of these presents, shall be as binding upon the said St. Paul Fire and Marine Insurance Company, as fully and amply, to all intents and purposes, as if the same had been duly executed and acknowledged by its regularly elected officers at its principal office.

This Power of Attorney is executed, and may be certifed to and may be revoked, pursuant to and by authority of Article V, —Section 8, of the By-Laws adopted by the Board of Directors of the St. Paul Fire and Marine Insurance Company at a meeting called and held on the 17th day of January, 1952, of which the following is a true transcript of said Section 8:

"The President or any Vice President, Resident Vice President, Secretary or Resident Secretary, shall have power and authority

(1) To appoint Attorneys-in-fact, and to authorize them to execute on behalf of the Company, and attach the Seal of the Company thereto, bonds and undertakings, recognizances, contracts of indemnity and other writings obligatory in the nature thereof, and

(2) To appoint Special Attorneys-in-fact, who are hereby authorized to certify to copies of any power-of-attorney issued in pursuance of this section and/or any of the By-Laws of the Company, and

(3) To remove, at any time, any such Attorney-in-fact or Special Attorney-in-fact and revoke the authority given him."

Further, this Power of Attorney is signed and sealed by facsimile pursuant to resolution of the Board of Directors of said Company adopted at a meeting duly called and held on the 5th day of May, 1959, of which the following is a true excerpt:

"Now therefore the signatures of such officers and the seal of the Company may be affixed to any such power of attorney or any certificate relating thereto by facsimile, and any such power of attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with respect to any bond or undertaking to which it is attached."

IN TESTIMONY WHEREOF, the St. Paul Fire and Marine Insurance Company has caused this instrument to be signed and its corporate seal to be affixed by its authorized officer, this 2nd day of May A. D. 19 66

ST. PAUL FIRE AND MARINE INSURANCE COMPANY

STATE OF MINNESOTA
County of Ramsey } ss.

W. E. King
Vice President.

On this 2nd day of May 19 66, before me came the individual who executed the preceding instrument, to me personally known, and, being by me duly sworn, said that he is the therein described and authorized officer of the St. Paul Fire and Marine Insurance Company; that the seal affixed to said instrument is the Corporate Seal of said Company; that the said Corporate Seal and his signature were duly affixed by order of the Board of Directors of said Company.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal, at the City of Saint Paul, Minnesota, the day and year first above written.

C. L. Jaeger

C. L. JAEGER
Notary Public, Ramsey County, Minn.
My Commission Expires June 2, 1967.

CERTIFICATION

I, the undersigned officer of the St. Paul Fire and Marine Insurance Company, do hereby certify that I have compared the foregoing copy of the Power of Attorney and affidavit, and the copy of the Section of the By-Laws of said Company as set forth in said Power of Attorney,* with the ORIGINALS ON FILE IN THE HOME OFFICE OF SAID COMPANY, and that the same are correct transcripts thereof, and of the whole of the said originals, and that the said Power of Attorney has not been revoked and is now in full force and effect.

IN TESTIMONY WHEREOF, I have hereunto set my hand this 16th day of October 1967

Walker Bordsen
Secretary.

*Unlimited as to character and amount.

10870 CPS Rev. 5-64

OCT 17 1967

Power of Attorney

FIDELITY AND DEPOSIT COMPANY OF MARYLAND

HOME OFFICE, BALTIMORE, MD.

KNOW ALL MEN BY THESE PRESENTS: That the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, a corporation of the State of Maryland, by WM.H.C. GRIFFITH, Vice-President, and JOHN C. GARDNER, Assistant Secretary, in pursuance of authority granted by Article VI, Section 2, of the By-Laws of said Company, which reads as follows:

"The President, or any one of the Executive Vice-Presidents, or any one of the additional Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Resident Assistant Secretaries and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertakings, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgments, decrees, mortgages and instruments in the nature of mortgages, and also all other instruments and documents which the business of the Company may require, and to affix the seal of the Company thereto."

does hereby nominate, constitute and appoint John W. Bowen of Seattle, Washington.....

its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: any and all bonds and undertakings.....

And the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Company, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its office in Baltimore, Md., in their own proper persons.

The said Assistant Secretary does hereby certify that the aforegoing is a true copy of Article VI, Section 2, of the By-Laws of said Company, and is now in force.

IN WITNESS WHEREOF, the said Vice-President and Assistant Secretary have hereunto subscribed their names and affixed the Corporate Seal of the said FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 17th day of April, A.D. 19 64.

ATTEST: **FIDELITY AND DEPOSIT COMPANY OF MARYLAND**

(SIGNED) JOHN C. GARDNER *Assistant Secretary*

By WM.H.C. GRIFFITH *Vice-President*

(SEAL)

STATE OF MARYLAND
CITY OF BALTIMORE } ss:

On this 17th day of April, A.D. 19 64, before the subscriber, a Notary Public of the State of Maryland, in and for the City of Baltimore, duly commissioned and qualified, came the above-named Vice-President and Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and they each acknowledged the execution of the same, and being by me duly sworn, severally and each for himself deposeth and saith, that they are the said officers of the Company aforesaid, and that the seal affixed to the preceding instrument is the Corporate Seal of said Company, and that the said Corporate Seal and their signatures as such officers were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal, at the City of Baltimore, the day and year first above written.

(SIGNED) GLORIA L. FAGAN

(SEAL)

Notary Public Commission Expires May 3, 1965

CERTIFICATE

I, the undersigned, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the original Power of Attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this certificate; and I do further certify that the Vice-President who executed the said Power of Attorney was one of the additional Vice-Presidents specially authorized by the Board of Directors to appoint any Attorney-in-Fact as provided in Article VI, Section 2 of the By-Laws of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND.

This Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 19th day of October, 1966.

RESOLVED: "That the facsimile or mechanically reproduced signature of any Assistant Secretary of the Company, whether heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed."

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seal of the said Company, this 16 day of October, 1967.

J J Moore
Assistant Secretary

L1419—Ctf.

POWER OF ATTORNEY

EMPLOYERS REINSURANCE CORPORATION

INSURANCE EXCHANGE BUILDING
KANSAS CITY, MISSOURI

Know all Men by these Presents:

That the EMPLOYERS REINSURANCE CORPORATION, by its Vice President, in pursuance of authority granted by Article V, Sections 2, 3 and 3a, of the By-Laws of said Corporation, which reads as follows:

Article V, Section 2. POWERS AND DUTIES OF THE PRESIDENT. - - - The President may appoint process agents to accept service of process in legal proceedings against the Corporation, Resident Vice Presidents, attorneys-in-fact to do and perform any and all acts delegated to them to do and perform in accordance with the power of attorney by which such appointment shall be made, and trustees or substitute trustees to be named in mortgages or deeds of trust held by this Corporation. - - -

Section 3. POWERS AND DUTIES OF THE VICE PRESIDENTS. - - - Each Home Office Vice President may appoint process agents to accept service of process in legal proceedings against the Corporation, Resident Vice Presidents, and attorneys-in-fact to do and perform any and all acts delegated to them to do and perform in accordance with the power of attorney by which such apointment shall be made, and trustees or substitute trustees to be named in mortgages or deeds of trust held by this Corporation. - - -

Section 3a. A Home Office Vice President shall be understood to be a person, the major part of whose duties is performed in the principal office of the Corporation, who shall be elected by the Board of Directors to the office of Vice President of this Corporation.

does hereby nominate, constitute, and appoint, for the term expiring without further notice at midnight of September 30, 1969, John W. Bowen or Paul G. Rusch of Seattle, Washington./

its true and lawful agent and Attorney-in-Fact, to make, execute, seal, and deliver for and on its behalf, and as its act and deed, any and all bonds, undertakings or obligations in cosuretyship with FIDELITY AND DEPOSIT COMPANY of MARYLAND, of Baltimore, Maryland, whether or not there are other cosureties, wherein the cosurety participation of Employers Reinsurance Corporation does not exceed Three Million Dollars ($3,000,000) in amount.

And the execution of such bond, obligation, or undertaking in pursuance of these presents, shall be as binding upon said Corporation, as fully and amply, to all intents and purposes, as if said bond, obligation, or undertaking had been duly executed and acknowledged by the regularly elected officers of the said Corporation at its office in Kansas City, Missouri, in their own proper persons.

The said Vice President does hereby certify that the foregoing excerpts from the By-Laws of said Corporation now in force are a true and correct copy of all of the provisions of such By-Laws pertaining to the appointment of attorneys-in-fact.

In Witness Whereof the said Vice President has hereunto subscribed his name and affixed the Corporate Seal of the said EMPLOYERS REINSURANCE CORPORATION, this 15th day of August, A. D. 1966

ATTEST: EMPLOYERS REINSURANCE CORPORATION,

J. J. Malsick (signed)
Assistant Secretary

By W. Emerson Smith (signed)
Vice President

(SEAL)

ACKNOWLEDGMENT

STATE OF MISSOURI, } ss.
COUNTY OF JACKSON, }

On this 15th day of August, A. D. 1966, before me, appeared the above-named Vice President of the EMPLOYERS REINSURANCE CORPORATION, to me personally known, who being by me duly sworn, did say that he is a Home Office Vice President of the EMPLOYERS REINSURANCE CORPORATION, a body corporate, and that the seal affixed to the foregoing instrument is the corporate seal of said Corporation and that said instrument was signed and sealed in behalf of said Corporation by authority of its Board of Directors, and further acknowledged said instrument to be the free act and deed of said Corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in Kansas City, Missouri, the day and year last above written.

(seal)

Claudia Johnson (signed)
Notary Public within and for said County and State.

My commission expires August 9, 1969.

I, J. J. Malsick or William B. Harding or Charles M. Orear or C. Lindsay Fisher or John Pelot or Reginald Geiser or James Estes or Royal Youngs or Robert D. Brown or Robert R. Cross or R. H. McIntosh or Donald E. Parker or Louis O. Nelson, Assistant Secretary of EMPLOYERS REINSURANCE CORPORATION, do hereby certify that the foregoing is a full and true copy of the Power of Attorney granted by EMPLOYERS REINSURANCE CORPORATION to John W. Bowen or Paul G. Rusch./

and that said Power of Attorney has not been revoked.

Given under my hand and seal of said Corporation at Kansas City, Missouri.
this 16th day of October, 19 67.

J. J. Malsick
Assistant Secretary

OCT 17 1967

ERC 1536-9 D Fidelity & Deposit

POWER OF ATTORNEY

NORTH AMERICAN REINSURANCE CORPORATION

NEW YORK

Know all Men by these Presents: That the **NORTH AMERICAN REINSURANCE CORPORATION** of New York, New York, a corporation of the State of New York, having its principal office in the city of New York, New York, pursuant to the following By-Law, which was adopted by the Board of Directors of the said Company on December 18, 1950, to wit:

Article III, Section 8—All treaties for reinsurance or coinsurance shall be signed by the president or by a vice-president. All other underwriting undertakings and documents pertaining thereto shall be signed (a) by the president or by a vice-president, or by the secretary or by an assistant secretary; or (b) by an attorney-in-fact appointed under a written instrument signed by the president or by a vice-president, and attested by the secretary or by an assistant secretary, and such attorney-in-fact also shall have power to affix the corporate seal of the company.

All other documents or instruments, excepting checks, drafts and other negotiable instruments, shall be signed by the president or by a vice-president, or by any other officer or employee, or agent or attorney-in-fact, authorized in writing by the president or by a vice-president to sign such document or instrument; and, persons so authorized also shall have the power to affix the corporate seal of the company.

does hereby nominate, constitute and appoint John W. Bowen and Paul G. Rusch of Seattle, Washington, each in his individual capacity as its true and lawful attorney(s)-in-fact, to make, execute, seal and deliver for and on its behalf, and as its act and deed: any and all bonds, undertakings or obligations in co-suretyship with Fidelity and Deposit Company of Maryland, of Baltimore, Maryland, whether or not there are other co-sureties, wherein the co-surety participation of North American Reinsurance Corporation does not exceed Two Million, Five Hundred Thousand ($2,500,000.) Dollars

and reserving to itself full power of substitution and revocation.

The execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Company, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its office in New York, State of New York, in their own proper persons.

In Witness Whereof, William Adams has hereunto subscribed his name and affixed the corporate seal of the said **NORTH AMERICAN REINSURANCE CORPORATION,** of New York, New York, this 25th day of October, 1965

NORTH AMERICAN REINSURANCE CORPORATION

By (Signed) William Adams
Vice President

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.

On this 25th day of October, A.D., 1965, before the subscriber, a Notary Public of the State of New York in and for the County of New York, duly commissioned and qualified, came

William Adams

of the **NORTH AMERICAN REINSURANCE CORPORATION,** of New York, New York, to me personally known to be the individual and officer described in, and who executed the preceding instrument, and he acknowledged the execution of the same, and, being by me duly sworn, deposeth and saith, that he is the officer of the Company aforesaid, and that the seal affixed to the preceding instrument is the corporate seal of said Company, and the said corporate seal and his signature as officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Company, and that By-Law, Article III, Section 8, adopted by the Board of Directors of said Company, referred to in the preceding instrument, is now in force.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal at the City of New York, the day and year first above written.

My Commission expires March 30th, 1966 (Signed) Doris M. duMouchel
Notary Public.

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.

I, Richard Saxe, Assistant Secretary of the **NORTH AMERICAN REINSURANCE CORPORATION,** a corporation of the State of New York, do hereby certify that the above and foregoing is a full, true and correct copy of Power of Attorney issued by said **NORTH AMERICAN REINSURANCE CORPORATION,** and that I have compared same with the original and that it is a correct transcript therefrom and of the whole of the original. Said Power of Attorney is still in force and effect and has not been revoked.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said Company, at the City of New York, this 16th day of Oct. 1967

Richard Saxe
Assistant *Secretary.*

OCT 17 1967

Reply to: P. O. Box 2828,
Calgary, Alberta
July 7, 1967.

General Insurance Company of America,
4347 Brooklyn Avenue N.E.,
SEATTLE, Washington 91805

Attention: Mr. W. D. Pedersen

Dear Sir:

Re: Performance Bond No. 522027 Applicable to Boundary Arch Dam Contract, April 29, 1964.

We hereby approve of the Assignment from Frontier Construction Company, Inc. to the Foundation Company of Canada Limited of Frontier Construction Company, Inc.'s interest in the above contract and we shall continue to indemnify you and your co-sureties in regard to your obligation under the above bond.

Yours very truly,

MANNIX CONSTRUCTION INC.
ORIGINAL SIGNED BY
DERRIL T. WARREN

Derril T. Warren,
Secretary & General Counsel

DTW/fc
cc: Foundation Company of Canada Limited,

CERTIFIED to be a true copy of a copy of a letter from Mannix Construction Inc. to General Insurance Company of America, dated July 7, 1967.

A Notary Public in and for
the Province of Ontario.

JUL 21 1967

COPY

MEMBER

Skill, Integrity and Responsibility

McLAUGHLIN—INCORPORATED

GENERAL CONTRACTORS
GREAT FALLS, MONTANA 59401

ADDRESS ALL COMMUNICATIONS TO:
P. O. Box 2206

June 24, 1967

General Insurance Company of America
4047 Brooklyn Avenue N.E.
Seattle, Washington 91805

Attention: Mr. W. D. Pedersen

Re Performance Bond No. 522027 Applicable to Boundary Arch Dam Contract dated April 29, 1954

Gentlemen:

We hereby approve of the assignment from Frontier Construction Company, Inc. to The Foundation Company of Canada Limited of Frontier Construction Company, Inc's. interest in the above Contract, and we shall continue to indemnify you and your co-sureties in regard to your obligations under the above Bond.

Yours very truly,

McLAUGHLIN, INCORPORATED

CWM:s

By: O. W. McIntyre,
President

cc: Frontier Construction Company, Inc.
G. L. Sandler, Vice President
and Secretary-Treasurer

CERTIFIED to be a true copy of a copy of a letter from McLaughlin-Incorporated to General Insurance Company of America, dated June 24, 1967.

A Notary Public in and for
the Province of Ontario.

JUL 21 1967

SGS CONTRACTORS, INC.

(A DELAWARE CORPORATION)

Box 5900, Postal Station "A",
Calgary, Alberta, Canada.

June 27, 1967.

General Insurance Company of America,
4347 Brooklyn Avenue N. E.,
Seattle, Washington, 91805.
U. S. A.

ATTENTION: Mr. W. D. Pederson

Gentlemen:

Re: Performance Bond No. 522027
Applicable to Boundary Arch Dam
Contract dated April 29, 1964

We hereby approve of the assignment from Frontier Construction Company, Inc. to The Foundation Company of Canada Limited of Frontier Construction Company, Inc's. interest in the above Contract, and we shall continue to indemnify you and your co-sureties in regard to your obligations under the above Bond.

Yours very truly,

SGS CONTRACTORS, INC.,

J. J. Denholm,
Secretary-Treasurer.

JJD:ew

c.c. Frontier Construction Company,
✓ Attention: Mr. G. L. Sandler.

Mannix Construction Inc.,
Attention: Mr. Derril T. Warren.

McLaughlin, Incorporated,
Attention: Mr. O. W. McIntyre.

CERTIFIED to be a true copy of a copy of a letter from SGS Contractors, Inc. to General Insurance Company of America, dated June 27, 1967.

A Notary Public in and for
the Province of Ontario.

JUL 21 1967

C.F. 250832

HARBOR INSURANCE COMPANY

HOME OFFICE

3450 WILSHIRE BOULEVARD, LOS ANGELES 5, CALIFORNIA



THIS IS A TRUE AND EXACT COPY OF

CTF. No. 101728

SIGNED E. Carroll

HARBOR INSURANCE COMPANY

3450 WILSHIRE BOULEVARD, LOS ANGELES 5, CALIFORNIA

(A Stock Insurance Company, herein called "The Company")

Agrees with the insured named in the declarations made a part of this policy (hereof), in consideration of the payment of the premium and in reliance upon the statements in the declarations to provide insurance to the insured in accordance with the terms stated in the declarations and in the documents attached hereto and incorporated in this policy, subject to the undermentioned GENERAL POLICY CONDITIONS.

A. **CANCELLATION.** This policy may be cancelled by the named insured by surrender thereof to the company or representative or by mailing to the company written notice stating when thereafter the cancellation shall be effective. This policy may be cancelled by the company by mailing to the named insured at the address shown in this policy written notice stating when not less than ten days thereafter such cancellation shall be effective. The mailing of notice as aforesaid shall be sufficient proof of notice. The time of the surrender or the effective date of cancellation stated in the notice shall become the end of the policy period. Delivery of such written notice either by the named insured or by the company shall be equivalent to mailing.

If the named insured cancels, earned premiums shall be computed in accordance with the customary short rate table and procedure. If the company cancels, earned premium shall be computed pro rata. Premium adjustment may be made either at the time cancellation is effected or as soon as practicable after cancellation becomes effective, but payment or tender of unearned premium is not a condition of cancellation.

B. **CHANGES.** The terms of this policy shall not be waived or changed, except by endorsement issued to form a part of this policy, signed by the duly authorized representative of the company.

C. This policy shall not be assigned in whole or in part without the written consent of the company or its authorized representative.

D. Loss of or damage to property insured occasioned by war, invasion, acts of Foreign enemies, civil war, rebellion, insurrection, military or usurped power or martial law or confiscation by order of any government or public authority not covered.

E. This insurance is made and accepted subject to all the provisions, conditions and warranties set forth herein and in any forms or endorsements attached hereto, all of which are to be considered as incorporated herein and any provisions or conditions appearing in any forms or endorsements attached hereto which alter the policy provisions stated above shall supersede such policy provisions in so far as they are inconsistent therewith.

IN WITNESS WHEREOF, The Harbor Insurance Company has caused this policy to be signed by its President and Secretary, but the policy shall not be binding upon the company unless countersigned by a duly authorized representative of the company.

LELAND B. SWETT
L B Swett
Secretary

JOHN C. SPENCER
J C Spencer
President

DECLARATIONS

No. ⇨ 101728

INSURED NAME	MANNIX CONSTRUCTION, ET AL (SEE NAME ENDORSEMENT)
INSURED ADDRESS	737 8TH AVENUE SW CALGARY, ALBERTA, CANADA
TYPE OF COVERAGE	AS PER FORM
AMOUNT OR LIMITS	AS PER FORM
PERIOD OF INSURANCE	COMMENCING MAY 11, 1964 ENDING APRIL 1, 1967 12:01 A.M. STANDARD TIME AT THE PLACE OF LOCATION OF RISKS INSURED

INFORMATION HERE ABBREVIATED. IN EVENT OF INCONSISTENCY WITH WORDINGS AND/OR ENDORSEMENTS ATTACHED HERETO, SAID WORDINGS AND/OR ENDORSEMENTS PREVAIL.

INITIAL INSTALLMENT PREMIUM	TOTAL
$84,000.00	$84,000.00

HARBOR INSURANCE COMPANY

By W. F. Fellows
W. F. Fellows
AUTHORIZED REPRESENTATIVE

DATED AT LOS ANGELES, CALIF. THIS 11TH DAY OF MAY, 1964

DUPLICATE ORIGINAL

HU 6000-CFS (ED. 3-62) 2M (1-63)

ENDORSEMENT

NO. 4

INSURED MANNIX CONSTRUCTION, ET AL
PRODUCER TRANSWEST INSURANCE BROKERS
POLICY NO. 101729
THE EFECTIVE DATE OF THIS ENDORSEMENT IS MAY 11, 1964
TYPE OF COVERAGE GENERAL AND AUTOMOBILE LIABILITY AND BUILDERS RISK

IT IS UNDERSTOOD AND AGREED THAT THE CITY OF SEATTLE IS ADDED AS AN ADDITIONAL ASSURED AS RESPECTS TO THE OPERATIONS PERFORMED IN CONNECTION WITH THE CONSTRUCTION OF THE ARCH DAM, POWER PLANT AND APPURTENANT WORKS ON THE BOUNDARY PROJECT.

NOTHING HEREIN CONTAINED SHALL BE HELD TO VARY, ALTER, WAIVE OR EXTEND ANY OF THE TERMS, CONDITIONS, OR LIMITATIONS OF THE POLICY TO WHICH THIS ENDORSEMENT IS ATTACHED OTHER THAN AS ABOVE STATED.

HARBOR INSURANCE COMPANY

DATED AT LOS ANGELES, CALIF. THIS 11TH DAY OF MAY, 1964

BY Wm. Sidney Hellbaum
AUTHORIZED REPRESENTATIVE

HU 8003-P (4-62) 10M

ENDORSEMENT NO. 3

ASSURED MANNIX CONSTRUCTION, ET AL
PRODUCER TRANSWEST INSURANCE BROKERS
THE EFFECTIVE DATE OF THIS ENDORSEMENT IS MAY 11, 1964
TYPE OF COVERAGE AS PER FORM

POLICY
NO. 101728

U.S.A.

RADIOACTIVE CONTAMINATION EXCLUSION CLAUSE — PHYSICAL DAMAGE — DIRECT

~~(Approved by Lloyd's Underwriters' Fire and Non-Marine Association)~~

This ~~certificate~~ POLICY does not cover any loss or damage arising directly or indirectly from nuclear reaction, nuclear radiation, or radioactive contamination however such nuclear reaction, nuclear radiation, or radioactive contamination may have been caused *NEVERTHELESS if Fire is an insured peril and a Fire arises directly or indirectly from nuclear reaction, nuclear radiation, or radioactive contamination, any loss or damage arising directly from that Fire shall (subject to the provisions of this ~~certificate~~ POLICY) be covered EXCLUDING however, all loss or damage caused by nuclear reaction, nuclear radiation, or radioactive contamination arising directly or indirectly from that Fire.

*Note — If Fire is not an insured peril under this policy the words from "NEVERTHELESS" to the end of the clause do not apply and should be disregarded.

THIS ENDORSEMENT SHALL NOT BE VALID UNLESS SIGNED BY SWETT & CRAWFORD

HARBOR INSURANCE COMPANY
SWETT & CRAWFORD
By W. S. Fellows
(AUTHORIZED REPRESENTATIVE)

DATED AT LOS ANGELES, CALIF. THIS 11TH DAY OF MAY, 1964

U6062-CFS (7-61) 5M-N.M.A. 1191(5)—PRINTED IN U.S.A.

ENDORSEMENT NUMBER 2

IT IS UNDERSTOOD AND AGREED THAT THE PREMIUM FOR THE COVERAGE PROVIDED HEREIN FOR THE TERM OF THIS POLICY SHALL BE $210,000.00 AND SHALL BE PAID IN THE FOLLOWING INSTALLMENTS:

INSTALLMENT	DUE DATE	PREMIUM
INITIAL	MAY 11, 1964	$84,000.00
2ND ANNUAL	MAY 11, 1965	$63,000.00
FINAL	MAY 11, 1966	$63,000.00

ATTACHED TO AND FORMING PART OF POLICY NO. 101728

ISSUED TO: MANNIX CONSTRUCTION, ET AL

DATED: MAY 11, 1964

HARBOR INSURANCE COMPANY

BY _____
(AUTHORIZED REPRESENTATIVE)

ENDORSEMENT

NO. 1

INSURED MANNIX CONSTRUCTION, FRONTIER CONSTRUCTION CO., S G S CONTRACTORS & MC LAUGHLIN CONSTRUCTION CO., A JOINT VENTURE

PRODUCER TRANSWEST INSURANCE BROKERS

POLICY NO. 101728

THE EFFECTIVE DATE OF THIS ENDORSEMENT IS MAY 11, 1964

TYPE OF COVERAGE GENERAL AND AUTOMOBILE LIABILITY AND BUILDERS RISK

IN CONSIDERATION OF THE PREMIUM HEREIN PROVIDED, IT IS AGREED THAT IF, UNDER ANY CIRCUMSTANCES, IT IS DETERMINED THAT ANY EMPLOYEE OF THE INSURED WHO IS REPORTED AND DECLARED UNDER THE WORKMEN'S COMPENSATION LAW OR LAWS OF THE STATE(S) OF WASHINGTON IS INJURED IN THE COURSE OF HIS EMPLOYMENT BUT IS NOT ENTITLED TO RECEIVE (OR ELECTS NOT TO ACCEPT) THE BENEFITS PROVIDED BY THE AFOREMENTIONED LAW, THEN THIS POLICY SHALL COVER THE LEGAL LIABILITY OF THE INSURED FOR SUCH BODILY INJURY, DISEASE, OR DEATH.

THE COMPANY'S LIABILITY UNDER THIS ENDORSEMENT ON ACCOUNT OF BODILY INJURY, DISEASE, OR DEATH OF ONE PERSON, INCLUDING DAMAGES FOR CASE AND LOSS OF SERVICES, AS THE RESULT OF ONE OCCURRENCE, IS LIMITED TO THE SUM OF ONE MILLION FIVE HUNDRED THOUSAND ($1,500,000) DOLLARS, AND, SUBJECT TO THE SAME LIMIT FOR EACH PERSON, THE COMPANY'S TOTAL LIABILITY FOR BODILY INJURY, DISEASE, OR DEATH AS A RESULT OF ONE OCCURRENCE IS LIMITED TO THE SUM OF ONE MILLION FIVE HUNDRED THOUSAND ($1,500,000) DOLLARS.

THE INSURANCE GRANTED BY THIS ENDORSEMENT SHALL NOT APPLY TO:

(a) BODILY INJURY, DISEASE OR DEATH SUFFERED OR CAUSED BY ANY EMPLOYEE WHOSE REMUNERATION HAS NOT BEEN INCLUDED IN THE TOTAL REMUNERATION UPON WHICH PREMIUM FOR THIS ENDORSEMENT IS BASED;

(b) AIRCRAFT OPERATION OR THE PERFORMANCE OF ANY DUTY IN CONNECTION WITH AIRCRAFT WHILE IN FLIGHT;

(c) ANY PREMIUM, ASSESSMENT, PENALTY, FINE, OR OTHER OBLIGATION IMPOSED BY ANY WORKMEN'S COMPENSATION LAW;

(d) ANY CLAIM FOR BODILY INJURY, DISEASE, OR DEATH WITH RESPECT TO WHICH THE INSURED IS DEPRIVED OF ANY DEFENSE OR DEFENSES OR IS OTHERWISE SUBJECT TO PENALTY BECAUSE OF DEFAULT IN PREMIUM PAYMENT UNDER, OR ANY OTHER FAILURE TO COMPLY WITH THE PROVISIONS OF THE WORKMEN'S COMPENSATION LAW OR LAWS OF THE STATE(S) ABOVE NAMED.

THE PREMIUM FOR THIS ENDORSEMENT SHALL BE COMPUTED UPON THE REMUNERATION EARNED BY SUCH EMPLOYEES AS ARE REPORTED UNDER THE WORKMEN'S COMPENSATION LAW OR LAWS OF THE STATE(S) ABOVE NAMED.

ESTIMATED ANNUAL REMUNERATION	RATE PER $100 OF REMUNERATION	ESTIMATED ANNUAL PREMIUM

ALL PREMIUMS TO BE DETERMINED BY AUDIT

NOTHING HEREIN CONTAINED SHALL BE HELD TO VARY, ALTER, WAIVE OR EXTEND ANY OF THE TERMS, CONDITIONS, OR LIMITATIONS OF THE POLICY TO WHICH THIS ENDORSEMENT IS ATTACHED OTHER THAN AS ABOVE STATED.

HARBOR INSURANCE COMPANY

BY W. L. Gillows
AUTHORIZED REPRESENTATIVE

DATED AT LOS ANGELES, CALIF. THIS 11TH DAY OF MAY, 1964

ORIGINAL ENDORSEMENT

HU 8003-5 (ED. 3-52) 10M (8-63)

ENDORSEMENT

NO. ▷ ---

INSURED MANNIX CONSTRUCTION, ET AL
PRODUCER TRANSWEST INSURANCE BROKERS
THE EFECTIVE DATE OF THIS ENDORSEMENT IS MAY 11, 1964
TYPE OF COVERAGE GENERAL AND AUTOMOBILE LIABILITY AND BUILDERS RISK

POLICY NO. 101728

NAME ENDORSEMENT

MANNIX CONSTRUCTION, FRONTIER CONSTRUCTION CO.,

S G S CONTRACTORS & MC LAUGHLIN CONSTRUCTION CO., A JOINT VENTURE

NOTHING HEREIN CONTAINED SHALL BE HELD TO VARY, ALTER, WAIVE OR EXTEND ANY OF THE TERMS, CONDITIONS, OR LIMITATIONS OF THE POLICY TO WHICH THIS ENDORSEMENT IS ATTACHED OTHER THAN AS ABOVE STATED.

DATED AT LOS ANGELES, CALIF. THIS 11TH DAY OF MAY, 1964

HARBOR INSURANCE COMPANY

BY _____
AUTHORIZED REPRESENTATIVE

HU 9003-P (4-62) 10M

GU 8679a
(Ed. 10-59)

A&G 661a

NUCLEAR ENERGY LIABILITY EXCLUSION ENDORSEMENT
(BROAD FORM)

This endorsement, effective MAY 11, 1964 (12:01 A. M., standard time), forms a part of policy No. 101728

issued to MANNIX CONSTRUCTION, ET AL

by HARBOR INSURANCE COMPANY

It is agreed that the policy does not apply:

I. Under any Liability Coverage, to injury, sickness, disease, death or destruction
(a) with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limit of liability; or
(b) resulting from the hazardous properties of nuclear material and with respect to which (1) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (2) the insured is, or had this policy not been issued would be, entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization.

II. Under any Medical Payments Coverage, or under any Supplementary Payments provision relating to immediate medical or surgical relief, to expenses incurred with respect to bodily injury, sickness, disease or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization.

III. Under any Liability Coverage, to injury, sickness, disease, death or destruction resulting from the hazardous properties of nuclear material, if
(a) the nuclear material (1) is at any nuclear facility owned by, or operated by or on behalf of, an insured or (2) has been discharged or dispersed therefrom;
(b) the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported or disposed of by or on behalf of an insured; or
(c) the injury, sickness, disease, death or destruction arises out of the furnishing by an insured of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility, but if such facility is located within the United States of America, its territories or possessions or Canada, this exclusion (c) applies only to injury to or destruction of property at such nuclear facility.

IV. As used in this endorsement:
"hazardous properties" include radioactive, toxic or explosive properties;
"nuclear material" means source material, special nuclear material or byproduct material;
"source material", **"special nuclear material"**, and **"byproduct material"** have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;
"spent fuel" means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a nuclear reactor;
"waste" means any waste material (1) containing byproduct material and (2) resulting from the operation by any person or organization of any nuclear facility included within the definition of nuclear facility under paragraph (a) or (b) thereof;
"nuclear facility" means
(a) any nuclear reactor,
(b) any equipment or device designed or used for (1) separating the isotopes of uranium or plutonium, (2) processing or utilizing spent fuel, or (3) handling, processing or packaging waste,
(c) any equipment or device used for the processing, fabricating or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235,
(d) any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste,
and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;
"nuclear reactor" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;
With respect to injury to or destruction of property, the word **"injury"** or **"destruction"** includes all forms of radioactive contamination of property.

HARBOR INSURANCE COMPANY

BY W. D. Williams
Authorized Representative

AUTHENTIC

THE HARBOR INSURANCE COMPANY, HEREINAFTER REFERRED TO AS THE COMPANY, IN CONSIDERATION OF THE PREMIUM CHARGED AND SUBJECT TO THE TERMS, CONDITIONS AND LIMITATIONS HEREINAFTER STATED, AGREES TO INSURE THE ASSURED, AS SET FORTH IN THE ATTACHED NAMED ASSURED ENDORSEMENT, IN RESPECT OF THE HAZARDS HEREINAFTER SPECIFICALLY DESCRIBED UNDER THE FOLLOWING HEADINGS:

SECTION A. PROPERTY INSURANCE - BUILDERS RISK AND CONTRACTORS EQUIPMENT

SECTION B. LIABILITY INSURANCE

INSURING AGREEMENTS

SECTION A. PROPERTY INSURANCE - BUILDERS RISK AND CONTRACTORS EQUIPMENT

1. THE PROPERTY INSURED UNDER SECTION A. SHALL BE ALL PROPERTY, REAL, PERSONAL OR MIXED, IN WHICH THE ASSURED HAS AN INSURABLE INTEREST, INCLUDING ITS OWN PROPERTY, HELD IN ITS OWN NAME OR IN THE NAME OF OTHERS, OR HELD BY IT IN TRUST, OR SOLD BUT NOT REMOVED, INCLUDING THE ASSURED'S INTEREST IN PROPERTY OF OTHERS OR FOR WHICH THE ASSURED IS LEGALLY LIABLE TO OTHERS, OR ON WHICH THE ASSURED HAS ASSUMED LIABILITY TO OTHERS, OR FOR WHICH THE ASSURED IS LEGALLY OBLIGATED TO MAINTAIN OR REPAIR, WHEREVER LOCATED, PROVIDED SUCH PROPERTY IS USED OR IS INTENDED FOR USE IN CONJUNCTION WITH THE CONSTRUCTION OF THE BOUNDARY DAM PROJECT. THIS SECTION SHALL ALSO INCLUDE PROPERTY OF AND INSURE THE INTERESTS OF SUBCONTRACTORS WITH RESPECT TO BUILDERS RISK EXPOSURE, INCLUDING EQUIPMENT, MATERIALS AND INCIDENTAL LABOR COSTS AFTER SAME HAVE BECOME A PART OF THE WORK INCLUDING FORMS OR OTHER MATERIALS OF A TEMPORARY NATURE NECESSARY FOR THE ACTUAL CONSTRUCTION OF THE PROJECT WHILE SUCH FORMS AND MATERIALS ARE INSTALLED OR IN PROCESS OF INSTALLATION AT THE PROJECT SITE ITSELF, EXCLUDING HOWEVER, EQUIPMENT OF THE SUBCONTRACTORS WHEREVER LOCATED AND MATERIALS WHILE NOT IN ACTUAL USE AT THE PROJECT SITE ITSELF OR WHILE STOCKPILED OR WHILE BEING WORKED UPON AT A SITE OTHER THAN THE PROJECT ITSELF.

2. SUCH PROPERTY SHALL BE INSURED AGAINST ALL RISKS OF LOSS, DAMAGE OR DESTRUCTION FROM ANY INTERNAL OR EXTERNAL CAUSE WHATSOEVER, INCLUDING THEFT OR WRONGFULL ABSTRACTION BY EMPLOYEES OR OTHERS, SUBJECT ONLY TO THE EXCLUSIONS APPEARING HEREINAFTER.

3. EXCLUSIONS APPLYING TO SECTION A.

THIS INSURANCE DOES NOT COVER:

A. LOSS OR DAMAGE CAUSED BY GRADUAL DETERIORATION, WEAR, TEAR OR DEPRECIATION, UNLESS AN ACCIDENT COVERED HEREUNDER ENSUES AND THEN ONLY FOR LOSS OR DAMAGE CAUSED BY SUCH ENSUING ACCIDENT;

B. ANY LOSS DUE TO LOSS OF USE OR OCCUPANCY OF ANY PROPERTY COVERED HEREUNDER OR CONSEQUENTIAL LOSS RESULTING FROM LOSS OF OR DAMAGE TO ANY SUCH PROPERTY OR OF BOOKS, RECORDS OR ACCOUNTS, BILLS, CURRENCY, DEEDS, EVIDENCES OF DEBT, MONEY OR SECURITIES, BULLION OR MANUSCRIPTS.

C. ANY LOSS OR DAMAGE FROM BOMBARDMENT, INVASION, OPERATION OF ARMED FORCES WHILE ENGAGED IN HOSTILITIES (WHETHER WAR BE DECLARED OR NOT), CIVIL WAR, REBELLION, REVOLUTION, INSURRECTION, MILITARY OR USURPED POWER, CIVIL COMMOTION ARISING FROM ANY OF THE FOREGOING, OR CONFISCATION BY ORDER OF ANY GOVERNMENT OR PUBLIC AUTHORITY.

D. THE COMPANY'S LIMITS OF LIABILITY HEREUNDER SHALL NOT BE EXCEEDED IRRESPECTIVE OF WHETHER ONE OR MORE OF THE COMPANIES, COLLECTIVELY AND SEVERALLY CALLED THE ASSURED, ARE INVOLVED.

E. THIS INSURANCE SHALL NOT APPLY TO PENALTIES FOR DELAY IN COMPLETION OF OR NONCOMPLETION OF CONTRACT OR NONCOMPLIANCE WITH CONTRACT CONDITIONS.

F. THIS INSURANCE DOES NOT COVER THE COST OF MAKING GOOD FAULTY WORKMANSHIP, CONSTRUCTION DESIGN OR DEFECTIVE MATERIALS; BUT THIS EXCLUSION SHALL NOT APPLY TO DAMAGE RESULTING FROM SUCH FAULTY WORKMANSHIP, CONSTRUCTION DESIGN, OR DEFECTIVE MATERIALS.

G. THIS INSURANCE SHALL NOT APPLY TO LOSS DUE TO DISAPPEARANCE REVEALED BY INVENTORY SHORTAGE ALONE.

H. THIS INSURANCE SHALL NOT APPLY TO LOSS OF OR DAMAGE TO COFFERDAMS AS A RESULT OF THE ANTICIPATED OVERTOPPING DURING THE NORMAL PERIOD OF HIGH RIVER DISCHARGES IN 1966 (MAY 1, 1966 TO SEPTEMBER 1, 1966); NOR SHALL THIS INSURANCE COVER THE COST OF CLEANING UP DEBRIS DEPOSITED IN THE DAM AREA AS A RESULT OF THIS OVERTOPPING.

4. <u>DEDUCTIBLES APPLYING TO SECTION A.</u>

A. AS RESPECTS LOSSES INVOLVING COMPLETED AND PARTIALLY COMPLETED PORTIONS OF THE PROJECT ITSELF, INCLUDING INSTALLED EQUIPMENT AND INCLUDING COFFERDAMS, BRIDGES, ROADS, TRANSMISSION LINES AND EXCAVATIONS THERE SHALL BE DEDUCTED THE SUM OF $1,000.00 FROM EACH AND EVERY LOSS OR SERIES OF LOSSES ARISING OUT OF ONE OCCURRENCE, UNLESS SUCH LOSS BE CAUSED BY FLOOD AND/OR INUNDATION AND/OR WATER DAMAGE AND/OR EARTHQUAKE IN WHICH EVENT THERE SHALL BE DEDUCTED THE SUM OF $50,000.00 FROM EACH AND EVERY LOSS OR SERIES OF LOSSES ARISING FROM ONE SUCH OCCURRENCE.

B. AS RESPECTS LOSSES COVERED UNDER SECTION A. INVOLVING CONTRACTOR'S EQUIPMENT AND/OR AUTOMOTIVE EQUIPMENT, THE FOLLOWING DEDUCTIBLES SHALL APPLY TO EACH LOSS:

1. ALL EQUIPMENT OTHER THAN VEHICLES AND TRAILERS LICENSED FOR HIGHWAY USE.....	$1,000.00	PER PIECE OF EQUIPMENT
2. VEHICLES AND TRAILERS LICENSED FOR HIGHWAY USE.....	$ 250.00	PER VEHICLE OR TRAILER

3. MAXIMUM TOTAL DEDUCTIBLE ANY ONE OCCURRENCE IRRESPECTIVE OF NUMBER OF VEHICLES OR PIECES OF EQUIPMENT INVOLVED.....$5,000.00

C. THE TERM "OCCURRENCE" SHALL BE CONSTRUED TO MEAN A SINGLE EVENT OR ORIGINATING CAUSE, AND SHALL INCLUDE ALL RESULTANT OR CONCOMITANT LOSS OR LOSSES, OR REPEATED EXPOSURE TO CONDITIONS RESULTING IN DAMAGE OR DESTRUCTION TO ONE OR MORE PARTS OR PORTIONS OF THE PROPERTY INSURED HEREUNDER.

AS RESPECTS EARTHQUAKE, ALL DAMAGE OCCURRING IN ANY CONSECUTIVE 72-HOUR PERIOD SHALL BE CONSTRUED AS A SINGLE CLAIM SUBJECT TO A SINGLE DEDUCTIBLE.

AS RESPECTS FLOOD AND RELATED WATER DAMAGES, ALL DAMAGE OCCURRING AS A RESULT OF ONE CONTINUOUS STORM OR FLOOD OR PERIOD OF HIGH OR RISING WATER OR SIMILAR OCCURRENCE SHALL BE CONSTRUED AS A SINGLE CLAIM SUBJECT TO A SINGLE DEDUCTIBLE.

D. THE COMPANY HEREON SHALL ONLY BE LIABLE FOR THE AMOUNT OF LOSS IN EXCESS OF SAID DEDUCTIBLE AMOUNTS.

5. DEBRIS AND RUBBISH

IT IS AGREED THAT THIS INSURANCE ALSO COVERS THE COST OF CLEANING UP DEBRIS AND RUBBISH ON PROPERTY INSURED AFTER ANY LOSS INSURED HEREUNDER, SUBJECT TO THE LIMITS OF THIS POLICY.

6. LOSS ADJUSTMENT APPLYING TO SECTION A.

LOSSES OCCURRING UNDER THIS SECTION SHALL BE ADJUSTED ON THE BASIS OF COST, NEW AT THE TIME OF THE LOSS, LESS PROPER DEPRECIATION OR ON THE BASIS OF COST TO REPRODUCE THE PROPERTY DAMAGED OR DESTROYED WITH PROPERTY OF LIKE KIND AND QUALITY.

SECTION B. LIABILITY INSURANCE

THE COMPANY DOES HEREBY AGREE WITH THE ASSURED, AS FOLLOWS:

1. TO PAY ON BEHALF OF THE ASSURED ALL SUMS WHICH THE ASSURED SHALL BECOME OBLIGATED TO PAY AS DAMAGES BECAUSE OF LIABILITY IMPOSED UPON HIM BY LAW OR BY WRITTEN CONTRACT BECAUSE OF BODILY INJURY, SICKNESS OR DISEASE INCLUDING DEATH AT ANY TIME RESULTING THEREFROM SUFFERED OR ALLEGED TO HAVE BEEN SUFFERED, BY ANY PERSON OR PERSONS OR INJURY TO OR DESTRUCTION OF PROPERTY (INCLUDING THE LOSS OF USE THEREOF FOLLOWING INJURY OR DESTRUCTION);

2. TO PAY ON BEHALF OF THE ASSURED ALL SUMS WHICH THE ASSURED SHALL BECOME OBLIGATED TO PAY BY REASON OF THE LIABILITY IMPOSED UPON THEM FOR LOSS OR DAMAGES ARISING OUT OF THE OPERATION OF HOSPITAL AND FIRST AID STATIONS OR FOR PROFESSIONAL SERVICES RENDERED, OR WHICH SHOULD HAVE BEEN RENDERED BY ANY PHYSICIAN, SURGEON, DENTIST, ANAESTHETIST, TECHNICIAN, NURSE OR ANY OTHER PERSON EMPLOYED BY OR ON BEHALF OF THE ASSURED, AND RESULTING FROM ANY CLAIM

OR SUIT BASED UPON MALPRACTICE, ERROR, NEGLIGENCE OR MISTAKE, BREACH OF IMPLIED CONTRACT, LOSS OF SERVICES, PROPERTY DAMAGE, AUTOPSIES, INQUESTS, PERSONAL RESTRAINT, THE DISPENSING OF DRUGS OR MEDICINE, ASSAULT, UNDUE FAMILIARITY, ANAESTHESIA HALLUCINATION. THE COVERAGE UNDER THIS CLAUSE AS RESPECTS ANY EMPLOYEE OF THE NAMED ASSURED SHALL APPLY ONLY WHILE SUCH EMPLOYEE IS ACTING IN THE CAPACITY OF AN EMPLOYEE, AND NOT OTHERWISE;

3. TO PAY ON BEHALF OF THE ASSURED ALL SUMS WHICH THE ASSURED SHALL BECOME OBLIGATED TO PAY BY REASON OF THE LIABILITY IMPOSED UPON THEM FOR LOSS OR DAMAGES ARISING OUT OF FALSE ARREST, DETENTION, IMPRISONMENT, MALICIOUS PROSECUTION, LIBEL, SLANDER, DEFAMATION OF CHARACTER OR INVASION OF PRIVACY OF A PERSON OR PERSONS BY THE ASSURED OR OTHERS FOR WHOSE ACTS OR OMISSIONS THE ASSURED IS ALLEGED TO BE RESPONSIBLE.

4. TO:

A. DEFEND ANY SUIT AGAINST THE ASSURED ALLEGING SUCH INJURY, SICKNESS, DISEASE OR DESTRUCTION AND SEEKING DAMAGES ON ACCOUNT THEREOF, EVEN IF SUCH SUIT IS GROUNDLESS, FALSE OR FRAUDULENT; BUT THE COMPANY MAY MAKE SUCH INVESTIGATION, NEGOTIATION AND SETTLEMENT OF ANY CLAIM OR SUIT AS IT DEEMS EXPEDIENT;

B. (1) PAY ALL PREMIUMS ON BONDS TO RELEASE ATTACHMENTS FOR AN AMOUNT NOT IN EXCESS OF THE APPLICABLE LIMIT OF LIABILITY OF THIS POLICY, ALL PREMIUMS ON APPEAL BONDS REQUIRED IN ANY SUCH DEFENDED SUIT, THE COST OF BAIL BONDS REQUIRED OF THE ASSURED IN THE EVENT OF AUTOMOBILE ACCIDENT OR AUTOMOBILE TRAFFIC LAW VIOLATION DURING THE POLICY PERIOD, NOT TO EXCEED $100.00 PER BAIL BOND, BUT WITHOUT ANY OBLIGATION TO APPLY FOR OR FURNISH ANY SUCH BONDS;

(2) PAY ALL EXPENSES INCURRED BY THE COMPANY, ALL COSTS TAXED AGAINST THE ASSURED IN ANY SUCH SUIT AND ALL INTEREST ACCRUING AFTER ENTRY OF JUDGMENT UNTIL THE COMPANY HAS PAID OR TENDERED OR DEPOSITED IN COURT SUCH PART OF SUCH JUDGMENT AS DOES NOT EXCEED THE LIMIT OF THE COMPANY'S LIABILITY THEREON;

(3) PAY EXPENSES INCURRED BY THE ASSURED FOR SUCH IMMEDIATE MEDICAL AND SURGICAL RELIEF TO OTHERS AS SHALL BE IMPERATIVE AT THE TIME OF THE ACCIDENT;

(4) REIMBURSE THE ASSURED FOR ALL REASONABLE EXPENSES, OTHER THAN LOSS OF EARNINGS, INCURRED AT THE COMPANY'S REQUEST;

AND THE AMOUNTS SO INCURRED, EXCEPT SETTLEMENTS OF CLAIMS AND SUITS ARE PAYABLE BY THE COMPANY IN ADDITION TO THE APPLICABLE LIMIT OF LIABILITY OF THIS POLICY.

5. DEFINITION OF ASSURED

THE UNQUALIFIED WORD "ASSURED" INCLUDES THE NAMED ASSURED AND ALSO INCLUDES (1) ANY SUBCONTRACTOR PERFORMING WORK FOR NAMED ASSURED, HOWEVER, THE INSURANCE PROVIDED BY THIS SECTION SHALL BE EXCESS OVER ANY VALID AND COLLECTIBLE

INSURANCE IN FORCE FOR THE SUBCONTRACTOR (2) ANY EXECUTIVE OFFICER, DIRECTOR OR STOCKHOLDER THEREOF WHILE ACTING WITHIN THE SCOPE OF HIS DUTIES AS SUCH, AND ANY ORGANIZATION OR PROPRIETOR WITH RESPECT TO REAL ESTATE MANAGEMENT FOR THE NAMED ASSURED, AND IF THE NAMED ASSURED IS A PARTNERSHIP, THE UNQUALIFIED WORD "ASSURED" ALSO INCLUDES ANY PARTNER THEREIN BUT ONLY WITH RESPECT TO HIS LIABILITY AS SUCH, AND (3) ANY PERSON WHILE USING AN OWNED AUTOMOBILE OR A HIRED AUTOMOBILE AND ANY PERSON OR ORGANIZATION LEGALLY RESPONSIBLE FOR THE USE THEREOF, PROVIDED THE ACTUAL USE OF THE AUTOMOBILE IS BY THE NAMED ASSURED OR WITH HIS PERMISSION, AND ANY EXECUTIVE OFFICER OF THE NAMED ASSURED WITH RESPECT TO THE USE OF A NON-OWNED AUTOMOBILE IN THE BUSINESS OF THE NAMED ASSURED. THE INSURANCE WITH RESPECT TO ANY PERSON OR ORGANIZATION OTHER THAN THE NAMED ASSURED DOES NOT APPLY UNDER DIVISION (3) OF THIS INSURING AGREEMENT:

A. WITH RESPECT TO AN AUTOMOBILE WHILE USED WITH ANY TRAILER OWNED OR HIRED BY THE ASSURED AND NOT COVERED BY LIKE INSURANCE IN THE COMPANY; OR WITH RESPECT TO A TRAILER WHILE USED WITH ANY AUTOMOBILE OWNED OR HIRED BY THE ASSURED AND NOT COVERED BY LIKE INSURANCE IN THE COMPANY;

B. TO ANY PERSON OR ORGANIZATION OR TO ANY AGENT OR EMPLOYEE THEREOF, OPERATING AN AUTOMOBILE SALES AGENCY, REPAIR SHOP, SERVICE STATION, STORAGE GARAGE OR PUBLIC PARKING PLACE, WITH RESPECT TO ANY ACCIDENT ARISING OUT OF THE OPERATION THEREOF, BUT THIS PROVISION DOES NOT APPLY TO A RESIDENT OF THE SAME HOUSEHOLD AS THE NAMED ASSURED, TO A PARTNERSHIP IN WHICH SUCH RESIDENT OR THE NAMED ASSURED IS A PARTNER, OR TO ANY PARTNER, AGENT OR EMPLOYEE OF SUCH RESIDENT OR PARTNERSHIP;

C. TO ANY EMPLOYEE WITH RESPECT TO INJURY TO OR SICKNESS, DISEASE OR DEATH OF ANOTHER EMPLOYEE OF THE SAME EMPLOYER INJURED IN THE COURSE OF SUCH EMPLOYMENT IN AN ACCIDENT ARISING OUT OF THE MAINTENANCE OR USE OF AN AUTOMOBILE IN THE BUSINESS OF SUCH EMPLOYER;

D. WITH RESPECT TO ANY HIRED AUTOMOBILE, TO THE OWNER, OR A LESSEE THEREOF OTHER THAN THE NAMED ASSURED, OR TO ANY AGENT OR EMPLOYEE OF SUCH OWNER OR LESSEE;

E. WITH RESPECT TO ANY NON-OWNED AUTOMOBILE, TO ANY EXECUTIVE OFFICER IF SUCH AUTOMOBILE IS OWNED BY HIM OR A MEMBER OF THE SAME HOUSEHOLD.

6. <u>EXCLUSIONS APPLYING TO SECTION B.</u>

THIS INSURANCE DOES NOT COVER:

A. EXCEPT WITH RESPECT TO LIABILITY ASSUMED UNDER CONTRACT COVERED BY THIS POLICY, TO BODILY INJURY TO OR SICKNESS, DISEASE OR DEATH OF ANY EMPLOYEE OF THE ASSURED WHILE ENGAGED IN THE EMPLOYMENT OF THE ASSURED, OTHER THAN A DOMESTIC EMPLOYEE WHOSE INJURY ARISES OUT OF AN AUTOMOBILE COVERED BY THIS POLICY AND FOR WHOSE INJURY BENEFITS ARE NOT PAYABLE OR REQUIRED TO BE PROVIDED UNDER ANY WORKMEN'S COMPENSATION LAW; OR TO ANY OBLIGATION FOR WHICH THE ASSURED OR ANY COMPANY AS HIS INSURER MAY BE HELD LIABLE UNDER ANY WORKMEN'S COMPENSATION LAW;

B. EXCEPT WITH RESPECT TO OPERATIONS PERFORMED BY INDEPENDENT CONTRACTORS,

TO THE OWNERSHIP, MAINTENANCE OR USE OF (1) ANY AIRCRAFT WHILE IN FLIGHT, LANDING, TAKING OFF, TAXIING OR MOVING UNDER ITS OWN POWER IN ANY MANNER, (2) ANY VESSEL OVER 30 FEET IN OVERALL LENGTH OWNED BY THE NAMED ASSURED OR CHARTERED BY THE NAMED ASSURED UNDER "BARE BOAT" CHARTER;

C. WITH RESPECT TO DAMAGE OR DESTRUCTION CAUSED INTENTIONALLY BY OR AT THE DIRECTION OF THE ASSURED;

D. WITH RESPECT TO INJURY TO OR DESTRUCTION OF: PROPERTY OWNED OR OCCUPIED BY OR RENTED TO THE ASSURED, PROPERTY USED BY THE ASSURED OR PROPERTY IN THE CARE, CUSTODY OR CONTROL OF THE ASSURED;

E. WITH RESPECT TO PROPERTY DAMAGE THE FIRST $500.00 EACH OCCURRENCE.

GENERAL CONDITIONS

1. LIMITS OF LIABILITY PROVIDED HEREUNDER:

SECTION A. - $10,000.000.00 ANY ONE OCCURRENCE
BUILDERS RISK AND/OR CONTRACTORS EQUIPMENT

SECTION B. - $ 1,500,000.00 ANY ONE OCCURRENCE
BODILY INJURY OR PROPERTY DAMAGE OR
BODILY INJURY AND PROPERTY DAMAGE COMBINED

2. PREMIUM

THE PREMIUM PAYABLE HEREUNDER SHALL BE FOR THE TERM HEREOF. IT IS FURTHER AGREED THAT THIS PREMIUM IS BASED ON THE PROJECT AS DESCRIBED. ANY MATERIAL CHANGE IN THE SPECIFICATIONS FOR SUCH PROJECT OR ADDITIONS THERETO SHALL BE COVERED SUBJECT TO RENEGOTIATION OF PREMIUM BETWEEN THE ASSURED AND THE COMPANY. AS A CONDITION OF COVERAGE THE ASSURED AGREES TO REPORT TO THE COMPANY ANY SUCH CHANGE.

3. NOTICE TO THE COMPANY

IN THE EVENT OF BODILY INJURY, DISEASE, ILLNESS, DEATH, INJURY TO OR DESTRUCTION OF PROPERTY, WRITTEN NOTICE SHALL BE GIVEN BY OR ON BEHALF OF THE ASSURED TO THE COMPANY AS SOON AS PRACTICABLE AFTER KNOWLEDGE OF SUCH EVENT IS HAD BY THE NAMED ASSURED IF AN INDIVIDUAL, OR BY THE MANAGER OF THE INSURANCE DEPARTMENT OF THE NAMED ASSURED IF A CO-PARTNERSHIP, FIRM OR CORPORATION, OR ANY OTHER EMPLOYEE WHO MAY BE DESIGNATED BY THE ASSURED TO GIVE SUCH NOTICE, SUCH NOTICE SHALL CONTAIN PARTICULARS SUFFICIENT TO IDENTIFY THE ASSURED AND ALSO REASONABLE OBTAINABLE INFORMATION RESPECTING THE TIME, PLACE AND CIRCUMSTANCES OF SUCH INJURY. THE NAMES AND ADRESSES OF THE INJURED AND/OR AVAILABLE WITNESSES.

4. LOSS WHEN PAYABLE

WITH RESPECT TO SECTION A., A LOSS HEREUNDER SHALL BE PAYABLE WITHIN THIRTY (30) DAYS AFTER THE AMOUNT THEREOF HAS BEEN ASCERTAINED EITHER BY AGREEMENT OR BY

APPRAISEMENT AS SET FORTH ELSEWHERE HEREIN, BUT IF SUCH ASCERTAINMENT IS NOT MADE WITHIN SIXTY (60) DAYS AFTER THE RECEIPT BY THE COMPANY OF THE PRELIMINARY PROOF OF LOSS, THEN THE LOSS SHALL BE PAYABLE IN NINETY (90) DAYS AFTER SUCH RECEIPT.

5. SUBROGATION

IT IS UNDERSTOOD AND AGREED THAT UPON PAYMENT OF ANY LOSS THE COMPANY IS TO BE SUBROGATED TO ALL THE RIGHTS AND CLAIMS OF THE ASSURED ARISING OUT OF SUCH LOSS AGAINST ANY PERSON OR CORPORATION WHATSOEVER, EXCEPT THAT THE COMPANY HEREBY WAIVES ALL RIGHTS WHICH IT MAY HAVE ACQUIRED THROUGH PAYMENT OF LOSS OR DAMAGE UNDER THIS INSURANCE, TO RECOVER THE AMOUNT PAID FOR SUCH LOSS OR DAMAGE FROM ANY PERSON OR CORPORATION WITH WHOM THE ASSURED HAS, PRIOR TO THE OCCURRENCE OF SUCH LOSS, MADE A WRITTEN AGREEMENT WAIVING ITS RIGHT TO RECOVERY FROM ANY LOSS WHICH MAY BE CAUSED BY SUCH PERSON OR CORPORATIONS TO THE PROPERTY DESCRIBED IN THIS CONTRACT; OR IN CASE NO WRITTEN AGREEMENT IS MADE, IF THE LOSS IS CAUSED BY A PERSON OR CORPORATION WHILE UNDERTAKING A GRATUITOUS SERVICE FOR THE ASSURED, AT A LOCATION WHERE THE ASSURED IS DOING CONSTRUCTION WORK FOR THAT PERSON OR CORPORATION.

NOTWITHSTANDING ANYTHING CONTAINED IN THIS SUBROGATION CLAUSE, IT IS UNDERSTOOD AND AGREED THAT SUBROGATION RIGHTS SHALL NOT BE EXERCISED AGAINST ANY NAMED ASSURED UNDER THIS CONTRACT OR ANY PROPRIETARY, SUBSIDIARY, ALLIED, OR AFFILIATED CORPORATION OR ITS EXECUTIVE OFFICERS, DIRECTORS OR EMPLOYEES.

6. DUE DILIGENCE CLAUSE

THE ASSURED SHALL USE DUE DILIGENCE AND DO AND CONCUR IN DOING ALL THINGS REASONABLY PRACTICABLE TO AVOID OR DIMINISH ANY LOSS OF OR DAMAGE TO THE PROPERTY HEREIN INSURED AND SHALL, WHEN REQUESTED BY THE COMPANY OR ITS REPRESENTATIVES, TAKE ALL STEPS THAT MAY BE REASONABLY NECESSARY TO PROTECT THE INTERESTS OF THE COMPANY.

7. MISREPRESENTATION AND FRAUD

THIS ENTIRE INSURANCE SHALL BE VOID IF THE ASSURED HAS WILFULLY CONCEALED OR MISREPRESENTATED ANY MATERIAL FACT OR CIRCUMSTANCE CONCERNING THIS INSURANCE OR THE SUBJECT THEREOF; OR IN CASE OF ANY FRAUD OR FALSE SWEARING BY THE ASSURED TOUCHING ANY MATTER RELATIVE TO THIS INSURANCE OR THE SUBJECT THEREOF; WHETHER BEFORE OR AFTER A LOSS.

8. APPRAISAL

IN CASE THE ASSURED AND THE COMPANY SHALL FAIL TO AGREE AS TO THE AMOUNT OF LOSS OR DAMAGE UNDER SECTION A. HEREIN, THE SAME SHALL BE ASCERTAINED BY TWO COMPETENT AND DISINTERESTED APPRAISERS, THE ASSURED AND COMPANY EACH SELECTING ONE, AND THE TWO SO CHOSEN SHALL FIRST SELECT A COMPETENT AND DISINTERESTED UMPIRE; THE APPRAISERS TOGETHER SHALL THEN ESTIMATE AND APPRAISE THE LOSS, STATING SEPARATELY THE SOUND VALUES AND DAMAGE, AND FAILING TO AGREE, SHALL SUBMIT THEIR DIFFERENCES TO THE UMPIRE, AND THE AWARD IN WRITING OF ANY TWO SHALL DETERMINE THE AMOUNT OF THE LOSS; THE PARTIES HERETO SHALL PAY THE APPRAISERS RESPECTIVELY SELECTED BY THEM, AND SHALL BEAR EQUALLY THE EXPENSE OF THE APPRAISAL AND UMPIRE.

9. OTHER INSURANCE

IN THE EVENT THAT THERE IS OTHER VALID AND COLLECTIBLE INSURANCE COVERING ANY LOSS HEREUNDER OR IN THE EVENT THE ASSURED COLLECTS FROM OTHERS FOR ANY LOSS COVERED HEREUNDER, THIS INSURANCE SHALL BE EXCESS INSURANCE ONLY, OVER AND ABOVE THE AMOUNTS OF SUCH OTHER INSURANCE OR COLLECTION.

10. CANCELLATION

THIS POLICY MAY BE CANCELLED BY THE COMPANY OR BY SWETT & CRAWFORD ON THEIR BEHALF BY MAILING TO THE NAMED ASSURED AT THE ADDRESS SHOWN IN THIS POLICY, WRITTEN NOTICE STATING WHEN NOT LESS THAN THIRTY DAYS THEREAFTER SUCH CANCELLATION SHALL BE EFFECTIVE. THE MAILING OF NOTICE AS AFORESAID SHALL BE SUFFICIENT PROOF OF NOTICE AND THE EFFECTIVE DATE OF CANCELLATION STATED IN THE NOTICE SHALL BECOME THE END OF THE POLICY PERIOD. DELIVERY OF SUCH WRITTEN NOTICE BY THE COMPANY OR BY SWETT & CRAWFORD ON THEIR BEHALF SHALL BE EQUIVALENT TO MAILING.

IF THE COMPANY CANCELS, EARNED PREMIUM SHALL BE COMPUTED PRO RATA. PREMIUM ADJUSTMENT MAY BE MADE AT THE TIME CANCELLATION IS EFFECTED AND, IF NOT THEN MADE, SHALL BE MADE AS SOON AS PRACTICABL AFTER CANCELLATION BECOMES EFFECTIVE. THE COMPANY'S CHECK OR THE CHECK OF THE REPRESENTATIVE MAILED OR DELIVERED AS AFORESAID SHALL BE A SUFFICIENT TENDER OF ANY REFUND DUE TO THE NAMED ASSURED.

IN THE EVENT OF CANCELLATION OF THE WORK BY THE PRINCIPAL FOR WHOM THE NAMED ASSURED IS PERFORMING THE WORK, THE COMPANY, UPON NOTIFICATION, WILL CANCEL AND COMPUTE THE EARNED PREMIUM PRO RATA.

11. MORE THAN ONE ASSURED

WHEREVER REQUIRED, THE TERMS "ASSURED" AND "NAMED ASSURED" SHALL BE UNDERSTOOD TO MEAN ANY ONE PERSON OR ORGANIZATION NAMED OR COVERED AS ASSURED, OR ANY TWO OR MORE OF SUCH PERSONS OR ORGANIZATIONS COLLECTIVELY. IF CLAIM IS MADE OR SUIT IS BROUGHT AGAINST ANY ASSURED, THE TERMS OF THIS POLICY SHALL BE CONSTRUED AS THOUGH SUCH ASSURED WERE THE ONLY ASSURED HEREUNDER, IRRESPECTIVE OF WHETHER SUCH CLAIM OR SUIT IS MADE OR BROUGHT BY ANOTHER ASSURED OR BY ANY OTHER PERSON OR ORGANIZATION, EXCEPT THAT THE INSURANCE WITH RESPECT TO ANY ASSURED SHALL NOT APPLY TO INJURY TO OR LOSS OR DESTRUCTION OF PROPERTY OWNED BY ANY NAMED ASSURED. NOTHING IN THIS PARAGRAPH SHALL OPERATE TO INCREASE THE LIMITS OF THE COMPANY'S LIABILITY.

ATTACHED TO AND FORMING PART OF POLICY NO. 101728

ISSUED TO: MANNIX CONSTRUCTION, ET AL

DATED: MAY 11, 1964

HARBOR INSURANCE COMPANY

BY R. W. Fellows
W. R. Fellows, Jr.
(AUTHORIZED REPRESENTATIVE)

Swett & Crawford

C.F. 250832

CERTIFICATE OF INSURANCE

SEATTLE BOARD OF PUBLIC WORKS
404 MUNICIPAL BUILDING
SEATTLE, WASHINGTON

ORD. NO. 91783
SPEC. 1782
L.I.D. ———

THIS IS TO CERTIFY as to the existence of insurance with Harbor Insurance Company, as described below:

Name of Assured: MANNIX CONSTRUCTION, FRONTIER CONSTRUCTION CO., S G S CONTRACTORS & MC LAUGHLIN CONSTRUCTION CO., A JOINT VENTURE

Address of Assured: 737 8TH AVENUE SW, CALGARY, ALBERTA, CANADA

ADDITIONAL ASSURED: CITY OF SEATTLE

Location of Risk:

Kind of Insurance: GENERAL AND AUTOMOBILE LIABILITY

Policy No. 101728 period from 5/11/64 to 4/1/67

Limits:

Bodily Injury	each person	$ 300,000.00		
	each accident	$ 1,000,000.00	aggregate	$ 1,000,000.00
Property Damage	each accident	$ 100,000.00	aggregate	$ 100,000.00

Kind of Insurance: CONTINGENT EMPLOYERS LIABILITY

Policy No. 101728 period from 5/11/64 to 4/1/67

Limits:

Bodily Injury	each person	$ 300,000.00		
	each accident	$ 300,000.00	aggregate	$ 300,000.00
Property Damage	each accident	$ ---	aggregate	$ ---

Kind of Insurance:

Policy No. period from to

Limits:

Should the above mentioned Policy be cancelled, assigned or changed by the undersigned in such manner as to affect this Certificate, we will endeavor to give written notice to the above named holder of this Policy; but failure to give such notice shall impose no obligation or liability of any kind upon the undersigned.

Dated at LOS ANGELES, CALIFORNIA this 11TH day of MAY, 1964

SWETT & CRAWFORD

BY W. E. Ashley

U 5454H-cfs 30M 5-63 Printed in U.S.A.

THE CITY OF SEATTLE

BOARD OF PUBLIC WORKS

* * * * *

DEPARTMENT OF LIGHTING

PEND OREILLE RIVER - BOUNDARY PROJECT

* * * * *

ADDENDUM NO. 1 TO SPECIFICATION NO. 1782

for

CONSTRUCTION OF ARCH DAM, POWER PLANT, AND

APPURTENANT WORKS FOR BOUNDARY PROJECT

Addendum prepared April 2, 1964

This addendum shall take precedence over the original specification insofar as it is modified herein.

This addendum consists of Pages 1 to 25 inclusive, the additional drawings as listed herein and the revised proposal.

This addendum is hereby made a part of Specification No. 1782 and shall be attached to the original specification when submitted with a proposal.

Submitted by C. R. Hoidal
Chief Civil Engineer

Approved by A. E. Strandberg
Chief Engineer

Joseph M. Nelson
Superintendent of Lighting

ADDENDUM NO. 1 TO SPECIFICATION NO. 1782

for

CONSTRUCTION OF ARCH DAM, POWER PLANT AND APPURTENANT WORKS FOR BOUNDARY PROJECT

BIDDERS SHALL SUBMIT THEIR BID IN THE FOLLOWING REVISED PROPOSAL.

Note: The following section, page and paragraph numbers refer to the section, page and paragraph numbers of the original specifications.

TABLE OF CONTENTS

PAGE A

Insert the following title above the word "CONTRACTUAL":

"SECTION 1B - GENERAL CONDITIONS"

SECTION 1A - PROJECT GENERAL REQUIREMENTS

PAGE 35

Line 4: Delete Drawing No. D-23223 Rev. 0 "Tunnels - Miscellaneous Details".

PAGE 45

The following drawings shall be added to the list of drawings:

311.	D-23360, Rev. 0	Arch Dam-Access Elevator, Sluice Gate Seal-Inflation System-Supply Tank and Piping Details
312.	D-23361, Rev. 0	Arch Dam-Sluice Gate, Seal Inflation System-Schematic and Control Cabinet
313.	D-23362, Rev. 0	Arch Dam-Sluice Gate, Seal Inflation System-Piping Details
314.	D-16587, Rev. 0	Boundary Plant Site, Field Measurement, River Elevations Vs. Discharge

PAGE 48

Paragraph 7: Add the following to the second paragraph:
"The analysis as submitted by the Contractor shall consist of the following:

a. Network Diagram. This diagram shall include all work involved in the Contract from the execution of the Contract to final completion of the work. It shall clearly depict the sequence, restraints and inter-dependence of all activities, the time estimated to perform each activity, and the slack or float for each activity. The breakdown into single activities shall be sufficient in the opinion of the Engineer, and each separate activity shall be shown. The diagram shall also make allowance for the necessary actions and times for submittal and approval of Contractor's drawings and data, and for procurement of materials and equipment. Adjustments of activities shall be made after submittal, if

PAGE 48 (Continued)

required by the Engineer, to coordinate with scheduled delivery dates of equipment and materials furnished by the City.

b. Supporting Statements. These statements shall identify by title and appropriate numbers keyed to the diagram, each activity covered therein, and shall fully define and describe the work contemplated in each activity. A brief statement of proposed construction methods, major equipment, hours and shifts per day and per week shall be included for each activity.

c. Tabulation of Activities. These tabulations shall indicate for each activity the earliest start time, latest start time, earliest finish time, latest finish time, total float, and free float. The tabulations shall identify each activity in the network by title and numbers keyed to the diagram and shall be prepared by computer print-out for computer based analysis.

d. Construction Program. This program shall show in a condensed form the construction schedule as determined by the network diagram. It shall indicate the percentage of work scheduled for completion at the end of each month. This program shall list all significant items of work and shall be in the form of a bar chart as shown on Drawing No. B-5506."

Paragraph 7. The third paragraph shall be deleted and substitute the following:

"At the end of each month during the period of construction, the Contractor shall submit to the Engineer a revised copy of the construction program described under d. above showing the progress of the work to date and any proposed changes in the schedule. Any proposed original and all revised programs shall be adequate, in the opinion of the Engineer, to meet the requirements for completion of work as set forth in the Contract. If significant changes from the original construction program are made, or if the Engineer determines that the actual progress is insufficient, or that the program submitted is inadequate as to the requirements of this specification, the Contractor shall submit a revised analysis. This revised analysis shall include a revised network diagram, supporting statements and tabulation of activities, and shall indicate actions proposed to restore the work to the original schedule."

Paragraph 7: The fourth paragraph shall be deleted and substitute the following:

"The Contractor shall furnish sufficient forces, construction plant and equipment and shall work such hours, including night shifts and overtime, as may be necessary to insure the prosecution of the work in accordance with the construction program then in effect. If, in the opinion of the Engineer, the Contractor's proposed schedule or the actual progress of the work is at any time insufficient to meet the specified requirements, the Engineer may, in addition to any other rights which the City has under this Contract, direct the Contractor to schedule slack-path tasks for optimum leveling of manpower or

PROPOSAL

Seattle, Washington Apr 22 1964

TO THE BOARD OF PUBLIC WORKS OF THE CITY OF SEATTLE:

The undersigned hereby certify that they have personally and carefully examined the plans, specifications, form of contract and foregoing instructions for

CONSTRUCTION OF ARCH DAM, POWER PLANT, AND APPURTENANT WORKS FOR BOUNDARY PROJECT

under Ordinance No. 91783 ; that they have examined the site of the work and the location where said work is to be done, that they fully understands the manner in which payment is proposed to be made for the cost thereof, and that they fully understand that the quantities shown on the proposal are for the purpose of comparing bids only and, having made the necessary examination, hereby propose to furnish all material and to perform all labor which may be required to complete said work within the time fixed and upon the terms and conditions provided in the said plans, specifications, contract and foregoing instructions at the following prices:

Certified Check Enclosed $ —— Bid Bond Enclosed FIVE PERCENT OF THE AMOUNT BID

Item No.	Approx. Quantity	Item (Prices to be written in words)	Unit Price Dollars	Unit Price Cts.	Amount Dollars	Amount Cts.
1.	Lump Sum	Mobilization Lump Sum of ONE MILLION DOLLARS	x x x	xx	1,000,000	00
2.	Lump Sum	Care of River and Unwatering at Diversion Tunnel Intake Lump Sum of Twenty three thousand and seventy three dollars	x x x	xx	23,073	00
3.	Lump Sum	Diversion and Care of River and Unwatering at Dam Site Lump Sum of Three hundred and eighteen thousand six hundred and forty dollars	x x x	xx	318,640	00
4.	Lump Sum	Care of River and Unwatering at Tailrace Lump Sum of Six hundred and fifty nine thousand three hundred and twenty nine dollars	x x x	xx	659,329	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
5.	Lump Sum	Closure of Diversion Tunnel Lump Sum of . . . . . Sixty four thousand, two hundred and forty three dollars	x x x	xx	64,243	00
6.	200,000 Cu. Yds.	Excavation, Common, for Forebay and Spillways . Two dollars and sixty . . two cents . . . Per Cu. Yd.	2.	62	524,000	00
7.	1,000,000 Cu. Yds.	Excavation, Rock, for Forebay and Spillways . . Two dollars and . . sixty two cents. Per Cu. Yd.	2.	62	2,620,000	
8.	60,000 Cu. Yds.	Excavation, Rock, for Dam Foundations and Sluice Discharge above El. 1725 . Four dollars and . . . forty two cents. . Per Cu. Yd.	4.	42	265,200	00
9.	80,000 Cu. Yds.	Excavation, Unclassified, for Dam Foundations below El. 1725 . Eight dollars and twenty . . cents . . . . . Per Cu. Yd.	8.	20	656,000	00
10.	5,000 Cu. Yds.	Excavation, Common, for Diversion Tunnel Intake . . Two dollars and sixty . two cents . . . . . Per Cu. Yd.	2.	62	13,100	00
11.	50,000 Cu. Yds.	Excavation, Rock, for Diversion Tunnel Intake . . Two dollars and sixty . . two cents . . . Per Cu. Yd.	2.	62	131,000	00
12.	2,500 Cu. Yds.	Excavation for Diversion Tunnel Upstream End . . Seventeen dollars and . . nineteen cents . Per Cu. Yd.	17.	19	42,975.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
13.	Lump Sum	Excavation for Diversion Tunnel Downstream End Lump Sum of Fifty four thousand eight hundred and eighty seven dollars	x x x	xx	54,887	00
14.	15,000 Cu. Yds.	Excavation of Disjointed Rock at Tailrace Ten dollars and thirteen cents Per Cu. Yd.	10.	13	151,950	00
15.	40,000 Cu. Yds.	Excavation, Common, for Tailrace in Open Cut Eighty six cents Per Cu. Yd.	0.	86	34,400	00
16.	60,000 Cu. Yds.	Excavation, Rock, for Tailrace in Open Cut Two dollars and eight cents Per Cu. Yd.	2.	08	124,800	00
17.	16,500 Cu. Yds.	Excavation for Draft Tube Tunnels Thirteen dollars and seventy eight cent Per Cu. Yd.	13.	78	227,370	00
18.	600 Cu. Yds.	Excavation for Penstock Fill Line Forty one dollars and sixty four cent Per Cu. Yd.	41.	64	24,984	00
19.	300 Cu. Yds.	Miscellaneous Excavation Twenty-five Dollars . . Per Cu. Yd.	25	00	7,500	00
20.	5,000 Sq. Ft.	Line Drilling Seven dollars and twenty six cents Per Sq. Ft.	7.	26	36,300	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
21.	200,000 Sq. Ft.	Cleanup of Excavated Surfaces . Seventy four cents . . . . . Per Sq. Ft.	0.	74	148,000	00
22.	100 Million Gallons	Handling Water in Underground Excavation Six Hundred Dollars Per Million Gallon	600	00	60,000	00
23.	130,000 Cu Yds.	Random Backfill . Ninety four cents . . . . . Per Cu. Yd.	0.	94	122,200	00
24.	700 Cu Yds.	Selected Backfill Thirteen dollars and . . thirty two cents. Per Cu. Yd.	13.	32	9324	00
25.	1,500 Cu. Yds.	Backfill in Contraction Joints . Twenty four dollars and . . seventy seven cents Per Cu. Yd.	24.	77	37,155	00
26.	3,000 Lin. Ft. Core	Exploratory Drilling Nine dollars and fifty one cents . . . . . Per Lin. Ft. Core	9.	51	28,530	00
27.	100,000 Lin. Ft.	Drilling EX Holes with Rotary Drills for Grouting . Three dollars and fifteen . . cents . . . . . Per Lin. Ft.	3.	15	315,000.	00
28.	3,000 Lin. Ft.	Drilling NX Holes with Rotary Drills For Drains Three dollars and fifteen . . . cents . . . . Per Lin. Ft.	3.	15	9450	00
29.	15,000 Lbs.	Furnishing and Installing Grout and Drainage Pipe and Fittings . Thirty six cents . . . . . Per Lb.	0.	36	5400	00
30.	100 Hours	Water Testing . . Twenty six dollars and . Twenty five cents. Per Hour	26.	25	2625	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
31.	5,000 Conns.	Hookup to Grout Holes . Fifteen dollars and seventy three cents . . . . Per Connection	15.	73	78,650	00
32.	100,000 Cu. Ft.	Pressure Grouting Foundations . Two dollars . . . . . Per Cu. Ft.	2.	00	200,000	00
33.	15,000 Lbs.	Furnishing and Installing Metal Tubing for Keyed Contraction Joints . Thirty one cents . . . . . Per Lb.	0.	31	4650	00
34.	15,000 Cu. Ft.	Pressure Grouting Contraction Joints and Systems . One dollar and eighty nine cents . . . . Per Cu. Ft.	1.	89	28,350	00
35.	5,000 Cu. Ft.	Contact Grouting . Two dollars and ten cents . . . . . Per Cu. Ft.	2.	10	10,500	00
36.	20,000 Lin. Ft.	Drilling holes for Anchor Bars and Grouting Bars in Place . Two dollars and fifty two cents . . . . Per Lin. Ft.	2.	52	50400	00
37.	1,000 Lin. Ft.	Furnishing and Installing Ungrouted Rock Bolts . Two dollars and ten . . . . Cents . . . . Per Lin. Ft.	2.	10	2100	00
38.	40,000 Lin. Ft.	Furnishing and Installing Grouted Rock Bolts . Two dollars and . . . . eighty nine cents Per Lin. Ft.	2.	89	115,600	00
39.	110,000 Cu. Yds.	Arch Concrete in Dam . . Thirty two dollars and . fifty five cents . . . Per Cu. Yd.	32.	55	3,580,500	00
40.	20,000 Cu. Yds.	Concrete in Arch Abutments . . Eighteen Dollars . . . . . Per Cu. Yd.	18	00	360,000	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
41.	1,500 Cu. Yds.	Structural Concrete on Dam. One hundred sixty four dollars and ninety cents. Per Cu. Yd.	164.	90	247,350	00
42.	20,000 Cu. Yds.	Concrete in Spillways and Retaining Walls. Thirty nine dollars and twenty Cents. Per Cu. Yd.	39.	20	784,000	00
43.	5,000 Cu. Yds.	Concrete in Trashrack Structure. Fifty dollars and forty cents. . . . . Per Cu. Yd.	50.	40	252,000	00
44.	6,500 Cu. Yds.	Concrete in Intake Gate Structures. Seventy five dollars. . . . . Per Cu. Yd.	75.	00	487,500	00
45.	9,500 Cu. Yds.	Concrete Lining in Penstocks. Ninety Dollars and ninety cents. . . . . Per Cu. Yd.	90.	90	863,550	00
46.	800 Cu. Yds.	Concrete in Crane Runway Foundations. Fifty three dollars. . . . . Per Cu. Yd.	53.	00	42,400	00
47.	26,000 Cu. Yds.	Concrete in Machine Hall Substructure. Thirty nine dollars and twenty cents. . Per Cu. Yd.	39.	20	1,019,200	00
48.	12,000 Cu. Yds.	Concrete in Machine Hall Intermediate Structure. Forty eight dollars and seventy five cents Per Cu. Yd.	~~122.~~ 48.	~~30~~ 75	585,000	00
49.	1,000 Cu. Yds.	Concrete in Machine Hall Superstructure. One hundred and twenty two dollars and 30 cents. . Per Cu. Yd.	~~40.~~ 122.	~~70~~ 30	122,300	00
50.	8,000 Cu. Yds.	Concrete in Draft Tubes. Forty dollars and seventy cents. . . . . Per Cu. Yd.	~~38.~~ 40.	~~00~~ 70	325,600	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
51.	11,000 Cu. Yds.	Concrete in Draft Tube Gate Shafts Thirty eight dollars . . . . . Per Cu. Yd.	38.	00	418,020	00
52.	700 Cu. Yds.	Concrete in Generator Bus Galleries Eighty eight dollars and thirty cents . . Per Cu. Yd.	88.	30	61,810	00
53.	120 Cu. Yds.	Concrete in Visitors Access Gallery Eighty five dollars . . . . . Per Cu. Yd.	85	00	10,200	00
54.	2,000 Cu. Yds.	Concrete in Tunnel Floors Thirty three dollars and thirty five cents . . . . . Per Cu. Yd.	33.	35	66,700	00
55.	3,000 Cu. Yds.	Concrete in Tunnel Linings One hundred and four dollars and eighty cents . Per Cu. Yd.	104.	80	314,400	00
56.	4,000 Cu. Yds.	Concrete in Tunnel Portals Forty two dollars and twenty five cents . Per Cu. Yd.	42.	25	~~169,000~~ 168,000	00
57.	5,000 Cu. Yds.	Concrete in Tunnel Plugs Twenty dollars and forty five cents Per Cu. Yd.	20.	45	102250	00
58.	200 Cu. Yds.	Concrete in Access Elevator One hundred and fifty seven dollars and forty cents . Per Cu. Yd.	157.	40	31,480	00
59.	7,000 Cu. Yds.	Backfill Concrete Behind Penstock Steel Thirty six dollars . . . . . Per Cu. Yd.	36.	00	252,000	00
60.	5,000 Cu. Yds.	Backfill Concrete at Structures Thirty six dollars & twenty cents . . . Per Cu. Yd.	36	20	181,000	00
61.	800 Cu. Yds.	Miscellaneous Concrete Seventy four dollars and Sixty five cents Per Cu. Yd.	74.	65	59,720	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
62.	400 Cu. Yds.	Precast Concrete . . . . . Per Cu. Yd.	223.	90	89560	00
63.	400 Cu. Yds.	Prestressed Concrete . . . . . Per Cu. Yd.	249.	00	99,600	00
64.	100 Cu. Yds.	Concrete Paving in Unit Bays No. 55 and 56 . . . . . Per Cu. Yd.	38.	60	3860	00
65.	100 Cu. Yds.	Concrete at Batch Plant . . . . . Per Cu. Yd.	10.	00	1000	00
66.	Lump Sum	Furnishing and Maintaining Gunite Plant Lump Sum of Twenty Thousand four hundred and thirty five dollars	x x x	xx	20,535.	00
67.	8,000 Cu. Ft.	Gunite . . Eleven dollars and . . ninety five cents . Per Cu. Ft.	11.	95	95,600.	00
68.	2,500 Cu. Ft.	Vermiculite Lining Twelve dollars and . . fifty four cents Per Cu. Ft.	12.	54	31,350.	00
69.	400,000 Barrels	Furnishing and Handling Cement . Three dollars and eighty . . . . Cents . . . . . Per Barrel	3.	80	1,520,000	00
70.	Lump Sum	Furnishing and Installing Refrigeration Equipment for Concrete Cooling Lump Sum of One hundred and forty three thousand seven hundred and twenty seven dollars	x x x	xx	143,727	00
71.	500 Shifts	Operation of Refrigeration Plant for Concrete Cooling . One hundred and fifty nine dollars . and seventy cents Per Shift	159.	70	79,850	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
72.	80,000 Cu. Yds.	Cooling Concrete ... One dollar and fifty .. cents ..... Per Cu. Yd.	1.	50	120,000	00
73.	100,000 Lin. Ft.	Furnishing and Installing Pipe and Tubing for Concrete Cooling Systems .. Sixty eight cents ... . Per Lin. Ft.	0.	68	68,000	00
74.	3,000 Lin. Ft.	Installing Thermocouples .. Sixty three cents .... Per Lin. Ft.	0.	63	1890	00
75.	13,000,000 Lbs.	Furnishing and Installing Reinforcement Steel and Welded Wire Fabric . Twelve and five one hundredths . of a cent ..... Per Lb.	0.	1205	1,566,500	00
76.	50,000 Lbs.	Furnishing and Installing Chain Wire Mesh ... Sixty seven cents ... . Per Lb.	0.	67	33,500	00
77.	40,000 Lin. Ft.	Furnishing and Installing Post Tension Cables .. Four dollars and seventeen ... cents ..... Per Lin. Ft.	4.	17	166,800	00
78.	1,400,000 Lbs.	Furnishing and Installing Sluice Liners .. Fifty one and nine tenths cents .... Per Lb.	0.	519	726,600	00
79.	150,000 Lbs.	Furnishing and Installing Diversion Closure Gate ... Forty cents .... Per Lb.	0.	40	60,000	00
80.	Lump Sum	Installing Trashracks and Guides Lump Sum of ..... . One hundred and three . Thousand dollars	x x x	xx	103,000	00
81.	4,000,000 Lbs.	Furnishing and Installing Penstock Steel Liners . Forty three and one half . .... Cents ..... Per Lb.	0.	435	1,740,000	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
82.	Lump Sum	Furnishing Penstock Inspection Car Lump Sum of . . . Seventeen thousand four hundred & thirty six dollars . . .	x x x	xx	17,436	00
83.	Lump Sum	Furnishing and Installing Corrugated Arch Ceiling Lump Sum of Three hundred and seventy seven thousand nine hundred and seventy five dollars . .	x x x	xx	377,975	00
84.	820,000 Lbs.	Installing Crane Runway Structural Steel . . . Sixteen cents . . . . . Per Lb.	0.	16	131,200	00
85.	12,000 Lbs.	Furnishing and Installing Metal Inserts . . . . Forty four cents . . . . . Per Lb.	0.	44	5280	00
86.	50,000 Lbs.	Furnishing and Installing Rails . . . . Thirty cents . . . . . Per Lb.	0.	30	15,000	00
87.	30,000 Lbs.	Installing Miscellaneous Metalwork . . Fifteen cents . . . . . Per Lb.	0.	15	4502	00
88.	600,000 Lbs.	Furnishing and Installing Miscellaneous Metalwork Fifty two and one half cents . . . . . Per Lb.	0.	525	315,000	00
89.	6,000 Lbs.	Furnishing and Installing Black Welded Steel Pipe and Malleable Iron Screwed Fittings, 2-1/2" and under . . Seventy eight cents . . . . . Per Lb.	0.	78	4680.	00
90.	1,600 Lbs.	Furnishing and Installing Black Welded Steel Pipe, Welded Fittings and Flanges 3" up to and incldg. 8" One dollar and fifty six cents . . . . . Per Lb.	1.	56	2496.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
91.	85,000 Lbs.	Furnishing and Installing Black Welded Steel Pipe, Welded Fittings and Flanges over 12" Seventy three cents . . . . . Per Lb.	0.	73	62,050.	00
92.	11,000 Lbs.	Furnishing and Installing Extra Strong Welded Steel Pipe, Welded Fittings and Flanges over 3" up to and including 12" Ninety one cents . . . . . Per Lb.	0.	91	10,010.	00
93.	3,500 Lbs.	Furnishing and Installing Extra Strong Welded Steel Pipe, Welding Fittings and Flanges, over 12" up to and including 20" Fifty seven cents . . . . . Per Lb.	0.	57	1995.	00
94.	4,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Malleable Iron Screwed Fittings, 3" and under One dollar and nine cents . . . . . Per Lb.	1.	09	4360.	00
95.	18,500 Lbs.	Furnishing and Installing Wrought Iron Pipe and Wrought Iron Welding Fittings and Steel Flanges, 3" up to and including 8" Ninety cents . . . . . Per Lb.	0.	90	16,650.	00
96.	28,000 Lbs.	Furnishing and Installing Wrought Iron Pipe and Wrought Iron Welding Fittings and Steel Flanges, over 8" up to and including 12" One dollar and four cents . . . . . Per Lb.	1.	04	29,120.	00
97.	8,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, 2-1/2" and under One dollar and four cents . . . . . Per Lb.	1.	04	8,320.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
98.	52,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, 3" up to and including 8" . . Ninety seven cents . . . . . Per Lb.	0.	97	50,440.	00
99.	6,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, over 8" One dollar and fourteen cents . . . . . Per Lb.	1.	14	6,840	00
100.	1,200 Lbs.	Furnishing and Installing Extra Heavy Acid Resisting Pipe with Extra Heavy Acid Resisting Fittings, and Acid Drain, 3" and under Two dollars and seven . . . . . cents . . . Per Lb.	2.	07	2484.	00
101.	500 Lbs.	Furnishing and Installing Double Extra Strong Seamless Steel Pipe and 3,000 Lb. Forged Steel Screwed Fittings, 3" and under . . Eighty three cents . . . . . Per Lb.	0.	83	415.	00
102.	325,000 Lbs.	Furnishing and Installing 36-inch Penstock Fill Line and Appurtenant Equipment Forty one cents . . . . . Per Lb.	0.	41	133,250.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
103.	6,500 Lbs.	Furnishing and Installing Wrought Iron Pipe and Malleable Iron Screwed Fittings, 1-1/4" & under . One dollar and twelve . . . . . cents . . . Per Lb.	1.	12	7280.	00
104.	Lump Sum	Furnishing and Installing Thirty (30) Special Wrought Iron Extra Heavy Couplings and Stainless Steel Orifice Plugs for Ice Prevention System Lump Sum of . Four hundred . and eighteen dollars	x x x	xx	418.	00
105.	2,000 Lbs.	Furnishing and Installing Copper Tubing and Screwed Fittings, 1/2" and under . Two dollars and seven . . . cents . . . . . Per Lb.	2.	07	4140.	00
106.	1,500 Lbs.	Furnishing and Installing Brass Pipe and 250 Lb. Brass Screwed Fittings, 3/4" and under . Two dollars and thirty . three cents . . . Per Lb.	2.	33	3495.	00
107.	500 Lbs.	Furnishing and Installing Stainless Steel Manually Operated Valves for Copper Tubing 1" and under . Two dollars and . . . . seven cents . . Per Lb.	2.	07	1035.	00
108.	2,000 Lbs.	Furnishing and Installing Mechanical Pipe Couplings, 20" and under . One dollar and thirty . . five cents . . . Per Lb.	1.	35	2700.	00
109.	2,600 Lbs.	Furnishing and Installing Metal Pipe Sleeves . One dollar and fifty . . five cents . . . . Per Lb.	1.	55	4,030.	00
110.	15,000 Lbs.	Furnishing and Installing Pipe Hangers and Supports . Forty seven cents . . . . . Per Lb.	0	47	7,050.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
111.		. . . . D E L E T E D	x x x	xx	x x x	xx
112.	Lump Sum	Furnishing and Installing One (1) Sluice Gate Control Cabinet and Appurtenant Equipment and One (1) Steel Tank and Appurtenant Equipment for the Seal Inflation System Lump Sum of Eight thousand nine hundred and eighty dollars	x x x	xx	8980.	00
113.	6 Valves	Furnishing and Installing 20-inch Cast-Iron Butterfly Valves complete with Operator, Torque Tube and Appurtenant Equipment Two thousand seven hundred and fifty dollars Per Valve	2750.	00	16,500.	00
114.	800 Lbs.	Furnishing and Installing O.S.& Y. Flanged 150 Lb. Steel Gate and Angle Valves, 3" up to and including 12" One dollar and twenty four cents Per Lb.	1.	24	992.	00
115.	1,800 Lbs.	Furnishing and Installing Cast Iron Flap Valves, Flanged Frame, up to and including 12" One dollar and ninety seven cents Per Lb.	1.	97	3546.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
116.	12 Valves	Furnishing and Installing 2-inch Back Pressure Valves Twenty dollars and Seventy five cents . . . Per Valve	20.	75	249.	00
117.	2 Valves	Furnishing and Installing 3-inch Back Pressure Valves Twenty one dollars . . . . . Per Valve	21.	00	42.	00
118.	12 Drains	Furnishing and Installing Square Top, Cast Iron Floor and Area Drains, 6" and under One hundred and four dollars . . . . . Per Drain	104.	00	1248.	00
119.	12 Drains	Furnishing and Installing Round Top, Cast Iron Floor and Area Drains with Trap, 3" and under Fifty two dollars . . . . . Per Drain	52.	00	624.	00
120.	50 Drains	Furnishing and Instaling Round Top, Cast Iron Floor and Area Drains, 3" and under Sixty two dollars . . . . . Per Drain	62.	00	3100.	00
121.	150 Drains	Furnishing and Installing Rectangular Top, Cast Iron Floor Gutter Drains, 3" and under Twenty six dollars . . . . . Per Drain	26.	00	3900.	00
122.	Lump Sum	Installing Draft Tube Gates, Frames and Guides Lump Sum of Seventy thousand one hundred and sixty six dollars	x x x	xx	70166	00
123.	Lump Sum	Installing Draft Tube Gantry Crane Lump Sum of . . . . . Six thousand one hundred and forty dollars	x x x	xx	6140	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
124.	Lump Sum	Installing Sluice Gates, Frames and Guides Lump Sum of Eighty One thousand eight hundred and sixty one dollars	x x x	xx	81,861	00
125.	Lump Sum	Installing Sluice Gate Hoists Lump Sum of Twenty three thousand three hundred & eighty nine dollars	x x x	xx	23,389.	00
126.	Lump Sum	Installing Intake Gates, Frames and Guides Lump Sum of One hundred and sixteen thousand nine hundred and forty four dollars	x x x	xx	116,944	00
127.	Lump Sum	Installing Intake Gate Hoists Lump Sum of Eighteen Thousand seven hundred and eleven dollars	x x x	xx	18,711	00
128.	425,000 Lbs.	Installing Sluice Maintenance Gate Embedded Metal ~~One hundred thousand seven hundred and forty four~~ Per Lb.	0.	237	100,725	00
129.	410,000 Lbs.	Installing Sluice Maintenance Gate Eleven and four tenths cents Per Lb.	0.	114	46,740	00
130.	Lump Sum	Installing Sluice Maintenance Gate Operator Lump Sum of Fourteen thousand and thirty three dollars	x x x	xx	14,033.	00
131.	Lump Sum	Installing Sluice Maintenance Gate Hoist Lump Sum of Two thousand three hundred and thirty nine dollars	x x x	xx	2339	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
132.	Lump Sum	Installing Spillway Radial Gates, Anchorages and Embedded Metal Lump Sum of Forty thousand nine hundred and thirty dollars	x x x	xx	40,930	00
133.	Lump Sum	Installing Spillway Radial Gate Hoists Lump Sum of Five thousand eight hundred & forty seven dollars	x x x	xx	5847	00
134.	Lump Sum	Installing Bascule Skimmer Gate and Embedded Metal Lump Sum of Five thousand eight hundred and forty seven dollars	x x x	xx	5847	00
135.	Lump Sum	Installing Bascule Skimmer Gate Operator Lump Sum of Seven hundred and two dollars	x x x	xx	702	00
136.	Lump Sum	Furnishing and Installing Air Conditioning Systems Lump Sum of Two hundred and sixty eight thousand nine hundred and seventy one dollars	x x x	xx	268,971	00
137.	Lump Sum	Furnishing and Installing Dam Elevator and Appurtenant Equipment Lump Sum of Forty two thousand five hundred and twenty dollars	x x x	xx	42,520.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
138.	Lump Sum	Furnishing and Installing Power Plant Elevator and Appurtenant Equipment Lump Sum of Forty thousand and fifty dollars	x x x	xx	40,050.	00
139.	Lump Sum	Installing the Embedded Items for Four (4) Turbines including Appurtenant Equipment Lump Sum of Three hundred and eleven thousand three hundred and fifteen dollars	x x x	xx	311,315	00
140.	Lump Sum	Erecting and Testing Two (2) Traveling Bridge Cranes and Appurtenant Equipment Lump Sum of Seventy three thousand five hundred dollars	x x x	xx	73,500	00
141.	Lump Sum	Erecting and Testing One (1) Traveling Rake and Hoist and Appurtenant Equipment Lump Sum of Twelve thousand six hundred dollars	x x x	xx	12,600	00
142.	Lump Sum	Furnishing and Installing One (1) Sewage Treatment Plant and Appurtenant Equipment Lump Sum of Thirty six thousand seven hundred and fifty dollars	x x x	xx	36,750	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
143.	4 Compressors	Furnishing and Installing 20 CFM Air Compressors and Appurtenant Equipment for Spillway Gate Ice Prevention System Five thousand two hundred fifty dollars . Per Compressor	5250	00	21000	00
144.	2 Compressors	Furnishing and Installing 65 CFM Air Compressors and Appurtenant Equipment for Trashrack Ice Prevention System Ten thousand five hundred dollars . . . . Per Compressor	10,500	00	21000	00
145.	Lump Sum	Furnishing and Installing One (1) 36-inch Cast Steel Spherical type Valve and Appurtenant Equipment Lump Sum of fifteen thousand seven hundred and fifty dollars	x x x	xx	15,750	00
146.	Lump Sum	Furnishing and Installing Emergency Generator Fuel Storage Tank Lump Sum of five thousand two hundred and fifty dollars	x x x	xx	5250	00
147.	Lump Sum	Furnishing and Installing Intake and Exhaust System for the Emergency Generator Lump Sum of Two thousand one hundred dollars	x x x	xx	2100	00
148.	Lump Sum	Furnishing and Installing Sump Discharge Slide Gate Lump Sum of Two thousand one hundred dollars	x x x	xx	2100	00

ITEM NO.	APPROX. QUANTITY	ITEM Prices to be written in words	UNIT PRICE Dollars	 Cts.	AMOUNT Dollars	 Cts.
149.	Lump Sum	Installing and Placing into Service Two (2) 13,800-480Y/277 Volt Main Station Service Switchgear Sections Lump Sum of Three thousand four hundred and sixty five dollars	x x x	xx	3,465	00
150.	Lump Sum	Installing and Placing into Service Thirteen (13) 480 Volt A.C. Distribution Panels Lump Sum of Eight hundred and ninety two dollars	x x x	xx	892	00
151.	Lump Sum	Installing and Placing into Service Four (4) 480Y/277 Volt A.C. Split Bus Lighting Distribution Panels Lump Sum of Two Hundred and forty two dollars	x x x	xx	242	00
152.	Lump Sum	Installing and Placing into Service Two (2) 480Y/277 Volt A.C. Lighting Distribution Panels Lump Sum of Ninety dollars	x x x	xx	90	00
153.	Lump Sum	Installing and Placing into Service Four (4) 208Y/120 Volt A.C. Distribution Panels Lump Sum of One Hundred and eighty four dollars	x x x	xx	184	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
154.	Lump Sum	Installing Four (4) 480 Volt A.C. Motor Control Centers Lump Sum of One thousand, five hundred and seventy five dollars	x x x	xx	1575	00
155.	Lump Sum	Installing and Placing into Service Nine (9) 480-208Y/120 Volt A.C. Auxiliary Service, A.C. Lighting and A.C. Emergency Lighting Transformers Lump Sum of Six hundred and nine dollars	x x x	xx	609	00
156.	Lump Sum	Installing and Placing into Service Two (2) 480 Volt A.C. Lighting Voltage Regulators and Integral 480Y/277 Volt A.C. Distribution Panels Lump Sum of Three hundred and fifty seven dollars	x x x	xx	357	00
157.	Lump Sum	Installing and Placing into Service Two (2) 480 Volt A.C. Lighting and A.C. Emergency Lighting Voltage Regulators Lump Sum of One Hundred and forty two dollars	x x x	xx	142	00
158.	Lump Sum	Installing and Placing into Service Four (4) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Distribution Panels Lump Sum of Two hundred and twenty dollars	x x x	xx	220	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
159.	Lump Sum	Installing and Placing into Service One (1) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Automatic Transfer Panel Lump Sum of Sixty-three dollars.	x x x	xx	63.	00
160.	Lump Sum	Installing and Placing into Service One (1) 480Y/277 Volt A.C. Diesel Engine Generating Set and Appurtenant Equipment Lump Sum of One thousand and forty dollars	x x x	xx	1040.	00
161.	Lump Sum	Installing and Placing into Service One (1) 13,800-480Y/277 Volt A.C. Pad Mounted Distribution Transformer and Appurtenant Equipment Lump Sum of One Hundred and fifty-seven dollars	x x x	xx	157.	00
162.	2,400 Lin. Ft.	Installing and Placing into Service 15 KV Main Station Service Power Cables Three dollars and seventy-eight cents . . . Per Lin. Ft.	3.	78	9072.	00
163.	6,000 Lin. Ft.	Furnishing and Installing 3/4-inch Rigid Steel Conduit Two dollars and ten cents . . . Per Lin. Ft.	2.	10	12,600.	00
164.	3,000 Lin. Ft.	Furnishing and Installing 1-inch Rigid Steel Conduit Two dollars and thirty-six cents . . . Per Lin. Ft.	2.	36	7,080.	00
165.	100 Lin. Ft.	Furnishing and Installing 1-1/4-inch Rigid Steel Conduit Two dollars and fifty-seven cents . . . Per Lin. Ft.	2.	57	257.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
166.	11,500 Lin. Ft.	Furnishing and Installing 1-1/2-inch Rigid Steel Conduit Two dollars and seventy three cents . . . Per Lin. Ft.	2.	73	31,395	00
167.	3,500 Lin. Ft.	Furnishing and Installing 2-inch Rigid Steel Conduit Three dollars and fifteen cents . . . . . Per Lin. Ft.	3.	15	11,025.	00
168.	400 Lin. Ft.	Furnishing and Installing 2-1/2-inch Rigid Steel Conduit Four dollars and four cents . . . . . Per Lin. Ft.	4.	04	1,616.	00
169.	2,000 Lin. Ft.	Furnishing and Installing 3-inch Rigid Steel Conduit Six dollars and four cents . . . . . Per Lin. Ft.	6.	04	12,080.	00
170.	4,700 Lin. Ft.	Furnishing and Installing 4-inch Rigid Steel Conduit ~~Forty~~ five dollars and thirty three cents Per Lin. Ft.	5.	33	25,051.	00
171.	2,300 Lin. Ft.	Furnishing and Installing 2-inch Asbestos-Cement Conduit One dollar and no cents . . . . . Per Lin. Ft.	1.	00	2300	00
172.	3,300 Lin. Ft.	Furnishing and Installing 4-inch Asbestos-Cement Conduit One dollar and thirty one cents . . . . Per Lin. Ft.	1.	31	4,323.	00
173.	2,400 Lin. Ft.	Furnishing and Installing 6-inch Asbestos-Cement Conduit Two dollars and fifty two cents . . . . Per Lin. Ft.	2.	52	6,048.	00
174.	300 Lin. Ft.	Furnishing and Installing 1-inch Rigid PVC Conduit One dollar and sixty three cents . . . Per Lin. Ft.	1.	63	489.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
175.	150 Lin. Ft.	Furnishing and Installing 1-1/2-inch Rigid PVC Conduit Two dollars and ten cents . . . . . Per Lin. Ft.	2.	10	315.	00
176.	5,000 Lbs.	Furnishing and Installing Special Boxes Two dollars and eighty nine cents . . . Per Lb.	2.	89	14,450.	00
177.	68 Recept.	Furnishing and Installing 440 Volt Receptacles Fifty dollars . . . . . Per Receptacle	50.	00	3,400.	00
178.	400 Lin. Ft.	Furnishing and Installing 18-inch Cable Trays and Cable Ladders Six dollars and ninety three cents . . . Per Lin. Ft.	6.	93	2772.	00
179.	4,500 Lin. Ft.	Furnishing and Installing 24-inch Cable Trays and Cable Ladders Four dollars and ~~forty~~ fifty five cents . . . Per Lin. Ft.	4. ~~4.~~	55 ~~45~~	20475.	00
180.	1,100 Lbs.	Furnishing and Installing #4 A.W.G. Ground Wire Four dollars and seventy two cents . . . . . Per Lb.	4.	72	5,192.	00
181.	500 Lbs.	Furnishing and Installing #2/0 A.W.G. Ground Cable Three dollars and twenty five cents . . . . . Per Lb.	3.	25	1.625.	00
182.	600 Lbs.	Furnishing and Installing #4/0 A.W.G. Ground Cable Two dollars and fifty two cents . . . . . Per Lb.	2.	52	1.512.	00
183.	21,000 Lbs.	Furnishing and Installing 500 MCM Ground Cable Two dollars and thirteen cents . . . . . Per Lb.	2.	13	44,730	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
184.	8,000 Lin. Ft.	Furnishing and Installing 1/C #12 A.W.G. Power Cable . Fifteen cents . . . . . Per Lin. Ft.	0.	15	1200.	00
185.	2,500 Lin. Ft.	Furnishing and Installing 1/C #10 A.W.G. Power Cable . Eighteen . cents . . . . . Per Lin. Ft.	0.	18	450.	00
186.	22,000 Lin. Ft.	Furnishing and Installing 1/C #8 A.W.G. Power Cable Twenty one cents . . . . . Per Lin. Ft.	0.	21	4,620.	00
187.	1,100 Lin. Ft.	Furnishing and Installing 1/C #6 A.W.G. Power Cable Twenty nine cents . . . . . Per Lin. Ft.	0.	29	319.	00
188.	15,000 Lin. Ft.	Furnishing and Installing 1/C #4 A.W.G. Power Cable Thirty one cents . . . . . Per Lin. Ft.	0.	31	4650.	00
189.	4,500 Lin. Ft.	Furnishing and Installing 1/C #2 A.W.G. Power Cable Forty two cents . . . . . Per Lin. Ft.	0.	42	1890.	00
190.	1,600 Lin. Ft.	Furnishing and Installing 1/C #2/0 A.W.G. Power Cable . Seventy nine cents . . . . . Per Lin. Ft.	0.	79	1264.	00
191.	100 Lin. Ft.	Furnishing and Installing 1/C #3/0 A.W.G. Power Cable . One dollar and thirty nine cents . . Per Lin. Ft.	1.	39	139.	00
192.	2,000 Lin. Ft.	Furnishing and Installing 1/C 350 MCM Power Cable One dollar and fifty two cents . . . . . Per Lin. Ft.	1.	52	3,040.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
193.	12,000 Lin. Ft.	Furnishing and Installing 1/C 500 MCM Power Cable One dollar and eighty nine cents . . . . . Per Lin. Ft.	1.	89	22,680.	00
194.	1,000 Lin. Ft.	Furnishing and Installing 1/C 750 MCM Power Cable Three dollars and fifteen cents . . . . . Per Lin. Ft.	3.	15	3,150.	00
195.	100 Lin. Ft.	Furnishing and Installing 1/C #12 A.W.G. Control Cable Thirty one cents . . . . . Per Lin. Ft.	0.	31	31.	00
196.	3,000 Lin. Ft.	Furnishing and Installing 2/C #12 A.W.G. Control Cable Forty six cents . . . . . Per Lin. Ft.	0.	46	1380.	00
197.	2,000 Lin. Ft.	Furnishing and Installing 3/C #12 A.W.G. Control Cable Fifty nine cents . . . . . Per Lin. Ft.	0.	59	1180.	00
198.	3,000 Lin. Ft.	Furnishing and Installing 5/C #12 A.W.G. Control Cable Ninety five cents . . . . . Per Lin. Ft.	0.	95	2850.	00
199.	1,000 Lin. Ft.	Furnishing and Installing 7/C #12 A.W.G. Control Cable One dollar and ten cents . . . . . Per Lin. Ft.	1.	10	1100.	00
200.	2,500 Lin. Ft.	Furnishing and Installing 9/C #12 A.W.G. Control Cable One dollar and twenty six . . . cents . . . . . Per Lin. Ft.	1.	26	3150.	00
201.	100 Lin. Ft.	Furnishing and Installing 1/C #10 A.W.G. Control Cable Thirty fours cents . . . . . Per Lin. Ft.	0.	34	34.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
202.	100 Lin. Ft.	Furnishing and Installing 2/C #10 A.W.G. Control Cable .Eighty one cents . . . . . Per Lin. Ft.	0.	81	81.	00
203.	100 Lin. Ft.	Furnishing and Installing 4/C #10 A.W.G. Control Cable One dollar and twenty . . . . . cents . . . Per Lin. Ft.	1.	20	120.	00
204.	Lump Sum	Furnishing and Installing Lighting System Lump Sum of One Hundred and forty eight thousand, six hundred and sixty six dollars . . .	x x x	xx	148,666.	00
205.	270 Sq. Ft.	Furnishing and Erecting Concrete Block Masonry . . One dollar and . . . . eighty cents . . . Per Sq. Ft.	1.	80	486.	00
206.	Lump Sum	Furnishing and Installing Movable Partitions Lump Sum of Twelve thousand nine hundred and thirty four dollars	x x x	xx	12,934.	00
207.	Lump Sum	Furnishing and Installing Hollow Metal Doors Lump Sum of Three thousand, eight hundred and seventy four dollars	x x x	xx	3,874.	00
208.	200 Lin. Ft.	Furnishing and Installing 36" CMP Seventeen dollars and . seventy cents. Per Lin. Ft.	17.	70	3,540.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
209.	200 Lin. Ft.	Furnishing and Installing 24" CMP Sixteen dollars and twenty five cents. Per Lin. Ft.	16.	25	3,250.	00
210.	200 Lin. Ft.	Furnishing and Installing 18" CMP Fifteen dollars and fifty cents..... Per Lin. Ft.	15.	50	3,100.	00
211.	400 Lin. Ft.	Furnishing and Installing 12" CMP Thirteen dollars and thirty cents... Per Lin. Ft.	13.	30	5,320.	00
212.	Lump Sum	Temporary Catwalks on Dam Lump Sum of One hundred and thirty two thousand and twenty dollars.....	x x x	xx	132,020	00
213.	Lump Sum	Furnishing and Installing Timber Bulkhead Lump Sum of Seven hundred and thirty five dollars.....	x x x	xx	735.	00
214.	Lump Sum	Furnishing and Installing Aluminum Railings Lump Sum of Seven hundred and eight dollars.....	x x x	xx	708.	00
215.	Lump Sum	Furnishing and Installing Roof Ventilators Lump Sum of Five hundred and thirty dollars.....	x x x	xx	530.	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
216.	Lump Sum	Installing Instruments in Dam Lump Sum of . Thirty five . . thousand dollars	x x x	xx	35,000,	00
217.	Lump Sum	Furnishing and Installing Window for Sluice Gate Control Center Lump Sum of . Two hundred . . and twenty one dollars	x x x	xx	221.	00
218.	100,000 Sq. Ft.	Cleaning Exposed Rock Faces . . Seventy . four cents . . . . . . Per Sq. Ft.	0.	74	74,000,	00
219.	1,000 Cu. Ft.	Sandblasting Rock Surfaces . Two dollars and forty . five cents . . Per Cu. Ft.	2.	45	2,450,	00

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
220.	20,000 Sq. Ft.	Furnishing and Applying Floor Hardeners .... Ten cents ..... Per Sq. Ft.	0.	10	2000.	00
221.	2,000 Lin. Ft.	Furnishing and Installing 8-Inch CMP Drains .. Three dollars and seventy nine cents Per Lin. Ft.	3.	79	7,580.	00
		*TOTAL ...			28,587,712	00

Date APRIL 22, 1964

Address 737-8th Ave W.

CALGARY, ALBERTA

Telephone AM 6-7631

MANNIX CONSTRUCTION INC.
(Contractor)

By W J Coggat Vice Pres.

By K G Ramsey
Asst Sec.

* Subject to State Sales Tax in accordance with the State Revenue Act of 1935.

FRONTIER CONSTRUCTION COMPANY, INC.

A. P. McLaren
Vice-President.

McLaughlin Inc.

C M McIntyre
President.

S.G.S. CONSTRUCTORS INC.

J. A. Anderson
Vice President

PAGE 48 (Continued)

equipment loading to permit greater concentration of effort on critical path tasks, reschedule work as necessitated by existing or foreseeable schedule slippage, and/or accelerate performance by increasing the manpower, augmenting equipment, increasing the number of shifts or days of work, and working longer hours. The cost of scheduling and analyzing construction progress, of added shifts, or of premium pay entailed by the requirements of this section, shall be borne by the Contractor with no additional cost to the City."

SECTION 1C - SPECIAL CONDITIONS

PAGE 73

Paragraph 3.a.: Delete the following item: "(27) Paint and Coating Materials".

PAGE 75

Paragraph 4.a., line 3: Change "performand" to "performance".

PAGE 76

Paragraph 4.a.: Delete the following items:
"(22) Asphalt paving for backfiil in unit bays."
"(24) Fencing."

Substitute the following for Item 22:
"(22) Paint and coating materials."

PAGE 78

Paragraph 5.a., third paragraph, last sentence: Change "furnished" to "finished".

SECTION 1B - GENERAL CONDITIONS

PAGE 70

Add the following paragraph to Section 1B:

"43. PREFERENCE FOR WASHINGTON MATERIALS

Special attention is called to the following provision in Section 15 of the Charter of the City of Seattle which states: "Contractors on all public improvements shall at all times use materials and supplies in such improvements that are manufactured or produced within the State of Washington, when same are available at not more than 5% over the price if produced elsewhere, and meet the specification requirements."

SECTION 3 - CLEARING

PAGE 89

First paragraph: Delete the last two sentences and substitute the following: "Clearing for the Contractor's access and facilities on the right bank and any other areas that may be authorized for use by the Contractor, shall conform to the following requirements."

SECTION 4 - DIVERSION AND CARE OF RIVER

PAGE 91

Paragraph 3.c.: Add the following to end of first sentence: ", and that all rock within the full cross section of the tunnel is shattered to a size which will be removed by water flows through the tunnel."

PAGE 97

Paragraph 8.d., last sentence: Delete this sentence and substitute the following: "Payment for all other work to close the diversion tunnel, including furnishing and installing lowering device, lowering the closure gate, controlling flow from the tailrace and removal of the flow plate and dished head from the mucking tunnel and reinstalling the dished head after completion of the diversion tunnel plug, will be made at the lump sum price bid in the Proposal for "Closure of Diversion Tunnel."

SECTION 5 - EXCAVATION

PAGE 100

Paragraph 1.c., line 7 and 8: Delete the following: "and excavation for transmission line structures".

Paragraph 1.c., line 13 from bottom of page: Change "or" to "and".

PAGE 101

Paragraph 1.f., line 8: After the words "required in," insert the words "the invert of".

PAGE 104

Paragraph 5.b., second paragraph: Delete the first sentence beginning "The upper limits . . . ." and ending " . . . . structures" and substitute the following: "The upper limits for canyon wall cleanup will be the crest of the cliff."

PAGE 107

Between paragraphs 10 and 11, add the following paragraph:

"10A. CLEANING EXPOSED ROCK FACES.

a. Cleaning with Water and/or Air Jet. The Contractor shall perform cleaning of permanently exposed wall and ceiling rock faces in underground excavations for the machine hall, permanent tunnels and elsewhere as directed by the Engineer by water and/or air jets. The purpose of this cleaning will be to prepare rock faces excavated by others for inspection or for appearance. This cleaning shall consist of the removal, to the satisfaction of the Engineer, of all dust, sand, dirt, loose rock and any other loose or foreign material from the exposed rock faces. Removal shall be achieved by application of water and/or air jets operated under sufficient pressure to loosen and transport such materials to a collection point where they shall be collected and disposed of. Cleaning, as specified in this paragraph does not apply to rock surfaces against which concrete or gunite is to be placed, since final cleanup for these surfaces will be required as specified in Sections 9A and 9B.

b. Sandblasting Rock Faces. The Contractor may be required to perform wet sandblasting of permanently exposed rock surfaces in the underground excavations for the machine hall, access tunnels and other areas as designated by the Engineer. The purpose of this cleaning will be the removal of oil, paint, cement stains, unsightly substances, calcinations or other deposits in order to enhance the appearance of the natural rock surface and in preparation of finish coating of such surfaces.

The sandblasting shall be performed only in areas as directed by the Engineer and shall be cleaned to the satisfaction of the Engineer. Sandblasting shall be followed by thorough washing with a water jet.

c. Scheduling of Cleaning Operations. The cleaning as specified herein shall be performed after major construction operations which stir up large amounts of dirt have been completed, but before beginning to install any mechanical or electrical equipment which could be damaged as a result of such cleaning operations. The Contractor shall collect and remove from the excavation all water used for cleaning as specified herein. The Contractor's existing system for dewatering underground excavations may be utilized for this purpose.

d. Measurement and Payment. Measurement for cleaning exposed rock faces in underground excavations will be the actual square feet of surface area, measured to the nearest one foot cleaned by water and/or air jet as directed by the Engineer. Return water which is collected and removed from the excavations shall be included in the payment quantities for handling water as specified in Section 6. Muck and debris removed from the excavations shall not be measured for payment. Payment for cleaning the rock faces will be made at the unit price per square foot bid in the Proposal for "Cleaning Exposed Rock Faces". Payment for handling the return water will be made at the unit price bid in the Proposal for

"Handling Water in Underground Excavation". No other payment will be made for this work and all costs for labor, materials and equipment required for performance of this work shall be included in the above unit prices.

Measurement for payment for sandblasting rock surfaces will be the actual number of cubic feet of sand measured to the nearest one cubic foot, of sand actually used in sandblasting as directed by the Engineer. Sand that is wasted, used in sandblasting concrete surfaces, or used in sandblasting rock surfaces other than those required by the Engineer, will not be measured for payment. Payment for sandblasting rock surfaces will be made at the unit price per cubic foot bid in the Proposal for "Sandblasting Rock Surfaces". Payment for collecting and disposing of the wash water will be made at the unit price bid in the Proposal for "Handling Water in Underground Excavation". No separate payment will be made for washing, cleanup after sandblasting and disposal of sand and material removed from the rock surfaces."

Paragraph 11.a., In second line from bottom of page change the word "or" to "and".

PAGE 108

Paragraph 11.b., line 7: Change "12,000 cubic yards" to "15,000 cubic yards".

SECTION 6 - UNWATERING AND CONTROL OF WATER

PAGE 114

Paragraph 1.a., At the end of this paragraph, add the following: "The northerly portion of the upper disposal area shall be built up to its full height at the beginning of disposal operations, and the shape of the southerly portion shall be adjusted according to the material available at the end of the operations."

PAGE 115

Paragraph 4., second paragraph, line 2: Change "D-23135" to "D-23144".

PAGE 116

Paragraph 6., line 1: After the word "backfill", insert "at drain lines under spillway slabs".

SECTION 8 - DRILLING AND GROUTING

PAGE 119

Paragraph 2.e., line 1: Delete the words "Sand, mineral" and substitute "Mineral".

PAGE 119 (Continued)

Paragraph 2.g., line 2: Change "paragraph 21" to "paragraph 25".

Paragraph 3.b.(1): Delete this paragraph in its entirety and substitute the following:

(1) Percussion Drilling Equipment. Holes for anchor bars and holes for rock bolts may be drilled with percussion drills. Holes drilled with percussion-type equipment shall be drilled with an independent full rotating rock bit with water fed to the face. Introduction of air into any hole during the drilling operation will not be permitted. It is not contemplated that any hole deeper than 30 feet will be drilled with percussion-type equipment.

PAGE 122

Paragraph 8.c., line 1: Change "AX-" to "EX-".

PAGE 128

Paragraph 13., first sentence: Delete this sentence and substitute the following:

"Backfill grouting consists of low pressure grouting which shall be performed to fill all voids between concrete tunnel linings and the rock surface, to fill all voids between mass concrete and rock surface at the tunnel plugs, to fill all voids between concrete and rock surface in the erosion cavity backfill in the left abutment of the dam, to fill all voids between backfill concrete around penstock and rock surface, to fill all voids between backfill concrete around draft tube liners and the rock surface, and/or other areas as directed by the Engineer."

Paragraph 14.b., first, third and fifth sentences: Delete these sentences entirely. For the fifth sentence, substitute the following:

"In these areas, the Contractor shall then be required to drill additional holes through the steel liner to complete contact grouting of the penstocks as directed."

PAGE 131

Paragraph 16.h.(1), line 6: After the word "all", insert "ungrouted", to make the sentence read "However, all ungrouted bolts . . . ".

SECTION 9A - CONCRETE - GENERAL

PAGE 144

Paragraph 7.b.: At the end of this paragraph, add the following:

"The sand, when tested in conformance with test ASTM Designation C40-60, shall produce a color equivalent to or lighter than Organic Plate No. 2, which will be considered as Standard under this specification."

PAGE 147

Paragraph 8.e., third paragraph, second sentence: After this sentence, add the following:

"It is further expected that material in the bar is deficient in 3-inch and 6-inch aggregates which shall be obtained from other approved sources or manufactured by crushing, except that not over 50% shall consist of broken rock."

Paragraph 8.f.: In last line at bottom of page:

Change "side" to "site".

PAGE 153

Paragraph 11.a., second paragraph: In the last line, delete the words "and interior".

PAGE 159

Paragraph 13.d., second paragraph: In line 4, change "50°F." to "40°F.".

PAGE 170

Paragraph 18.b.: Delete this paragraph in its entirety and substitute: "b. Mix for Drypack shall be as specified in Section 9B, Paragraph 17".

SECTION 9B - CONCRETE STRUCTURES

PAGE 173

Paragraph 2.a., sixth paragraph: Delete this paragraph which begins: "All concrete, except . . . ." and ends " . . . . on Dam", and substitute the following:

"All concrete, except precast and prestressed concrete, in projections,

PAGE 173 (Continued)

steps, columns, beams and slabs which are not placed monolithically with the concrete in the dam, including but not limited to concrete in the roadway slab, brackets, parapets at the dam crest and concrete in the vertical sluice maintenance gate guides, shall be included in "Structural Concrete on Dam."

PAGE 174

Paragraph 2.c.: At the end of the third sentence, insert the following:
"The Contractor shall construct and install protective covers at exposed sections of the inspection galleries prior to overtopping. The design, construction and installation of these covers should be adequate, to the satisfaction of the Engineer, to prevent sand, debris and other objectionable materials from entering and being deposited in the gallery during the period of overtopping."

PAGE 175

Paragraph 2.e., first paragraph at top of page: In line 2, change "prceding" to "preceding".

PAGE 176

Paragraph 2.h., second paragraph, first sentence: Delete this sentence and substitute the following:

"The City will furnish thermocouple wire, switches, and instruments for taking temperature readings."

PAGE 177

Paragraph 3.b., line 2: Change "overflor" to "overflow".

Paragraph 4, third sentence: Delete this sentence and substitute the following:

"If the Contractor elects to precast the struts (at El. 1933 and El. 1966) between the piers, these members shall be included in the item "Precast Concrete".

PAGE 179

Paragraph 6.c., first paragraph, line 3: Change "place" to "placement".

Paragraph 6.c., third paragraph, line 2: Change "placement or concrete" to "placement of concrete".

PAGE 181

Line 3 from top of page: Change "Concrete in Draft Gate Shaft" to read "Concrete in Draft Tube Gate Shafts".

Paragraph 11.a., second sentence: Change "on" to "in" to make the sentence read, "The limits for concrete in the tunnel floor . . . ".

Paragraph 11.b.: Change the last word of this paragraph from "Lining" to "Linings".

PAGE 183

Paragraph 15., last sentence: Delete this sentence and substitute the following: "Thirty days before fabrication of the prestressed concrete members, the Contractor shall submit to the Engineer the name of the subcontractors, if any, detail drawings and sufficient details of the members he proposes to use to enable the Engineer to verify compliance with this specification."

Paragraph 16.a., first sentence: Delete this sentence and substitute the following: "Cement and water for gunite and final cleanup of surfaces shall conform to the requirements of Section 9A."

PAGE 186

Paragraph 25.a.: Add the following sentence to the end of this paragraph: "It is estimated that approximately 30% of all reinforcement bars will be A432 steel."

PAGE 188

Paragraph 27.b.: Change "ASTM Designation C 133" to "ASTM Designation C 138".

PAGE 189

Paragraph 27.c., second paragraph, first sentence: Delete this sentence and substitute the following: "All cost to the Contractor directly pertaining to overtopping of the dam in 1966 for preparatory work before and cleanup work after overtopping will be paid for as extra work."

PAGE 190

Paragraph 27.e. (1): At end of first sentence, change the words "Furnishing and Installing Refrigeration Plant" to read "Furnishing and Installing Refrigeration Equipment For Concrete Cooling."

PAGE 192

Paragraph 27.: Add the following additional paragraphs after paragraph 27.i.:

"j. Curing. No direct payment will be made for water curing or for cold weather curing and the cost thereof shall be included in the unit price per cubic yard bid in the Proposal for the applicable concrete item.

"k. Water Stops. The cost of all labor, equipment and material for furnishing and installing water stops, seals, cork board joint fillers, mastic coating on embedded items and cork membrane sheets shall be included in the unit price per cubic yard bid in the Proposal for the applicable concrete items.

"l. Mortar. No direct payment will be made for grouting required and mortar used in structural steel and equipment installation, for dry-pack grout or grout at blockouts, and the cost of all labor and materials therefor are to be included in the unit price or lump sum price bid in the Proposal for the applicable installation item.

"m. Prestressed Concrete. No direct payment will be made for cement, reinforcement steel or post tension cables included in prestressed concrete, and the cost of all labor and material, therefor, are to be included in the unit price per cubic yard bid in the Proposal for "Prestressed Concrete".

"n. Blockout. Concrete in blockouts will not be paid separately, but measurement for payment of this concrete shall be included in the concrete for the structure where the concrete is located."

SECTION 10 - METALWORK

PAGE 194

Paragraph 2.b.: In first line, after "bars for" insert the words "sluice lirers and other".

PAGE 195

Paragraph 3., second paragraph: In line 1: after "penstocks", insert the words "and sluice liners".

PAGE 204

Paragraph 11.g., second paragraph: In line 3, delete the words "a portable winch" and substitute "an electric powered winch".

Paragraph 11.g., second paragraph: In line 7, after "The car", insert the words "and hoist".

PAGE 204 (Continued)

Paragraph 11.g., third paragraph: Delete this paragraph which begins: "The Contractor . . . " and ends ". . . spiral case inlet." and substitute the following paragraphs:

"Each platform on the car shall be constructed so that it can be maintained in a horizontal position by an operator riding on the car regardless at which point between vent shaft and spiral case inlet the inspection car is momentarily held. The car shall be steerable to prevent "riding-up" at inclined portions of the penstock. The car shall be designed for a minimum live load of 100 lb. per square foot of platform and a total live load of 3,000 lb. for the car. The hoist and appurtenances shall be designed so that the car with full live load can be safely lowered and raised, all within the safety provisions and safety factors specified in the applicable codes and safety standards.

"The Contractor shall also design, fabricate, and install anchorages and sheaves so that the cables cannot rub against the concrete or steel lining. All portions of anchorages and sheaves which protrude within the waterway shall be removable. The hoist and cable shall be suitable for maintaining the car in a stable position at any point between the vent shaft and the spiral case inlet."

PAGE 205

Paragraph 11.g., last paragraph, last sentence: After the word "car", insert "clean and repair as required, service all mechanical parts, apply one coat of red lead primer,".

Paragraph 12.b.(1): Delete address of Wonder Building Corporation of America and substitute "1000 S. Karlov Avenue, Chicago 24, Illinois."

PAGE 207

Paragraph 12.e.: Delete this paragraph and substitute the following:

"e. Protective Coating will not be required for the arch ceiling."

PAGE 208

Paragraph 16.a.: Delete second sentence and substitute the following: "This metalwork consists of generator anchor bolts; rotor erection plate and anchor bolts; and anchor bolts, embedded frames and leveling devices for auxiliary electrical and mechanical equipment to be installed by others."

Paragraph 16.b.(3): Delete subparagraph "(e). Rotor Erection Plate."

PAGE 209

Paragraph 16.b.(3) (g): Change "Access" to "Accessway".

SECTION 11 - METAL PIPE, VALVES AND FITTINGS

PAGE 217

Paragraph 2.a.: After subparagraph (3), add the following subparagraph:

"(4) Painting. The interior surface of the penstock fill line shall be shop-coated with Code Designation VX protective system; and, the exterior surface of portions of the fill line not to be embedded in concrete shall be shop-coated with Code Designation ZG protective system. Surface preparation, coating materials, application, and associated work shall be in accordance with Section 20.

Painting at the welds after completion of field welding and touch-up painting shall be as indicated in Coating Schedule - Classification B, Sheet 7 of Section 20, in a manner approved by the Engineer.

Exterior surfaces of portions of the fill line to be embedded in concrete are not required to be painted, but the surfaces shall be cleaned of oil, grease and other loose or deleterious matter, and shall be clean at the time of embedment."

PAGE 218

Paragraph 3.: Delete the entire paragraph and substitute the following:

"3. TAILRACE AND SUMP CONNECTING AND BALANCING LINES

a. General. The Contractor shall furnish and install the pipe, valves and fittings for connections from the draft tubes to the dewatering sump. All valves shall be complete with extension stems and watertight floor boxes.

b. Valves. The valves shall be 20-inch Class 125-16, flangeless, rubber seated-butterfly type with a cast iron body and disc capable of operating under a maximum shut off head of 135 feet with a maximum line velocity of 36 feet per second. The valves shall be equipped with a manual operator with miter gears, handwheel, torque tube and appurtenances. The operators shall be similar to Philadelphia Gear Corporation Series HB.

The design of the valve and all auxiliaries and hydrostatic and leakage tests shall be in strict accordance with AWWA C504.

c. Valve Shaft and Torque Tube. The valve shaft shall be solid, one piece construction of Type 304 or 316 stainless steel. The shaft extension shall be by means of a torque tube to enable operation of the valve from the floorstand above. The torque tube shall be approximately 40 feet long and shall be bolted in five foot sections using ASA flanges.

d. Painting and Protective Coatings. Except as otherwise provided, the manufacturer's standard painting system for miscellaneous auxiliary equipment will be satisfactory."

PAGE 218

Paragraph 5.e.: Delete "Penstock Drain Line" and substitute "Penstock Fill Line Drain".

PAGE 219

Paragraph 5: After subparagraph "e", add the following subparagraph:

"f. Spillway Drain Lines, comprising 8-inch diameter, perforated CMP, 16 gage, as described in Section 24, placed in selected backfill."

PAGE 220

Paragraph 12.b., second sentence: Delete this sentence and substitute the following: "The copper tubing and valving to be installed under this Contract shall be located as shown on Drawing D-23395 and covered herein."

PAGE 222

Paragraph 17.b.: After this paragraph, insert the following: "The weight of flange bolts, gaskets, welds, flashing, lead, joint compound and other such items which are incidental to the installation, shall not be measured for payment".

Paragraph 17.c.: Delete the last sentence, beginning "There shall be . . ." and ending " . . . Proposal".

SECTION 12 - GATES AND HOISTS

PAGE 225

Paragraph 5., third paragraph, last sentence: Delete this sentence and substitute the following: "All control equipment necessary for control of the heater and seal pressurizing systems will be furnished as part of the gate hoist control equipment."

PAGE 226

Paragraph 6.: At the end of this paragraph, add the following: "The rails for the sluice maintenance gate operator shall be furnished and installed as specified in Section 10."

PAGE 229

Paragraph 13.b., line 4 and 5: Change the words "Catalog weights and estimated weights" to read "catalog weights or estimated weights".

SECTION 13 - AIR CONDITIONING

PAGE 233

Paragraph 2.c.: Add the following paragraph after this paragraph:

"d. Drawings. In addition to the requirements in Section 1C, Paragraph 4.c., the Contractor shall submit to the Engineer for his approval, electrical schematic or wiring diagrams, where applicable for each item of equipment proposed for use. The Contractor shall also submit master electrical and pneumatic control schematics and a diagram of all interconnections between items of electrical equipment which will serve as a basis for future maintenance trouble-shooting. The Contractor shall, without additional cost to the City, make all adjustments to the equipment control systems or to the equipment proper which will be required by the approved control schematics."

PAGE 233

Paragraph 4.a.(1), last line: Change "strick" to "strict".

PAGE 237

Paragraph 7.a.(1), second line from top of page: Change "casting" to "cast".

PAGE 239

Paragraph 11.b.: Delete the entire paragraph and substitute the following:

"b. Elements shall be individually removable from heater enclosure without removal of heater section to facilitate maintenance or replacement."

PAGE 242

Paragraph 13.f., first sentence: Change "pump" to "pumps".

PAGE 244

Paragraph 15.b., first paragraph, line 4: Change "registers, and grilles", to read "registers, or grilles."

PAGE 250

Paragraph 17.b.(2), line 2: Change "pointer or a silver" to read "pointer on a silver".

PAGE 252

Paragraph 19.c., first sentence: Change "440V" to "480V".

PAGE 252 (Continued)

Paragraph 19.e.: After the first sentence add the following sentence:

"All other controllers required shall be furnished with the appropriate equipment."

PAGE 252

Paragraph 21.a., line 3: Change "width" to "with".

PAGE 253

Paragraph 24.: Delete the second sentence beginning "Painting of inner surfaces . . . " and ending " . . . Section 20."

SECTION 14 - ELEVATORS

PAGE 256

Paragraph 2.b.: Delete the description after "signals" and substitute "Car position indicator with direction arrows--lights at each landing call registered".

PAGE 257

Paragraph 2.c: Delete the description after "signals" and substitute "car position indicator with direction arrows--lights at each landing call registered".

PAGE 259

Paragraph 4.b.: Delete this paragraph in its entirety.

Paragraph 4.d.: In the first sentence, delete the word "spring".

PAGE 260

Paragraph 7.c: In line 6, change "bronze" to "extruded aluminum".

PAGE 261

Paragraph 7.d.(4): Delete this subparagraph and substitute the following:

(4) A stainless steel telephone cabinet shall be provided.

SECTION 15 - TURBINES, MACHINE HALL CRANES AND TRAVELING TRASH RAKE AND HOIST

PAGE 275

Paragraph 3.b.: In lines 2 and 3 from bottom of page, delete the words "assembling and installing".

PAGE 276

Paragraph 3.c., second paragraph, second sentence: Delete the entire sentence which begins "Erection of each . . . ." and ends " . . . upward."

Paragraph 3.e.: At the end of this paragraph, add the following paragraph:

"The draft tube of each unit will be furnished in approximately 20 sections. The upper conical section will be approximately 6 feet long and 2 inches thick, with a nominal diameter of 18 feet, furnished in four pieces. Below this will be

PAGE 276 (Continued)

a conical section similar to the above, except the plate thickness will be 1-inch and the nominal diameter will be 20 feet. The remainder of the draft tube will be furnished in approximately 12 sections of 3/8-inch plate."

PAGE 277

Paragraph 3.h., first paragraph, line 10: Change "rediced" to "reduced".

Paragraph 3.h., first paragraph, line 11: Delete the sentence which begins "Then the concrete shall be placed . . ." and substitute the following sentence:

"The top half of the spiral case shall then be coated with a mastic material approximately 1/8" thick and concrete shall be placed over and around the spiral case as specified in Section 9B."

Paragraph 3.h., second paragraph, line 5: Change "tested" to "tester".

PAGE 281

Paragraph 4.h., first paragraph below subparagraph (8), line 2: Change "required" to "repaired".

PAGE 282

Paragraph 5.b., line 4: Change "cifically" to "specifically".

Paragraph 6.a.: Change the last word "contact" to "contract".

PAGE 283

Paragraph 6.c., second paragraph, first sentence: After the words "bridge stops", delete the words "on the rails, ".

SECTION 16 - MECHANICAL EQUIPMENT

PAGE 291

Paragraph 4.d., first paragraph, in the first sentence, change "15S3E9" to "15TE" and change "65 cubic feet" to "60 cubic feet".

PAGE 293

Paragraph 5.: After paragraph c, add the following paragraph:

"d. Painting. All interior surfaces of the valve shall be shop coated with Code Designation VX and all exterior surfaces of the valve shall be shop coated with Code Designation ZG. The procedure for applying the coatings shall be in accordance with Section 20."

PAGE 294

Paragraph 7.a.: Delete the last sentence which begins "The gate and . . ." and ends ". . . 75 feet" and substitute the following:

"The gate and frame shall be designed to withstand a total unbalanced head of 150 feet on either side of the gate. The gate and accessories shall operate properly with a practical degree of water-tightness under an unbalanced head of approximately 50 feet when the conduit is empty".

PAGE 295

Paragraph 7.: After this paragraph, add the following paragraph:

" 7A SLUICE GATE SEAL INFLATION SYSTEM

a. General. The seal inflation system shall comprise the equipment as shown on Drawings D-23360, D-23361 and D-23362, and as described herein. The Contractor shall be responsible for furnishing and installing all equipment and appurtenances necessary to place the system in operation.

b. Storage Tank and Related Equipment. The storage tank shall be vertical, welded steel water storage tank, complete with manhole, level gauge, nozzle and welding fittings.

c. Sluice Gate Control Cabinet and Appurtenances. The control cabinet shall be furnished and installed in accordance with Drawings D-23360 and D-23361, and shall be a NEMA Type 3 enclosure. The removable panels shall be no lighter than No. 11 ga., U.S. Standard sheet steel. All outgoing and incoming cables shall enter the cabinet from below.. The dimensions of the cabinet shown on the drawings may be varied to suit the manufacturer's standard panels normally furnished for this type of equipment, but shall be subject to the approval of the Engineer.

d. Painting and Protective Coatings. Except as otherwise provided, the manufacturer's standard painting system for miscellaneous auxiliary equipment will be satisfactory. All exposed surfaces of the sluice gate control panel shall be shop finished with two coats of ASA Gray No. 61. The storage tank shall be galvanized in accordance with Section 10, paragraph 7b."

PAGE 297

Paragraph 10.e.: Delete the last sentence of this paragraph which begins: "All cost to . . ." and ends ". . . this pump." and substitute the following:

"All pipe and fittings to complete the sluice gate seal inflation system will be paid under the respective unit prices in the Proposal. The cost for furnishing and installing the three-way valves shall be included in the lump sum price for "Furnishing and Installing One (1) Sluice Gate Control Cabinet and Appurtenant Equipment and One (1) Steel Tank and Appurtenant Equipment for the Seal Inflation System"."

SECTION 17 - INSTALLATION OF ELECTRICAL POWER SUPPLY, DISTRIBUTION AND CONTROL EQUIPMENT

PAGE 301

Paragraph 6.: After the third item, insert the following additional item:

"One - 480-volt power distribution panel located in the sluice gate operating room in the vicinity of the dam."

Paragraph 7.: Delete the last sentence and substitute the following:

"The 480-volt heating and ventilating motor control center shall be installed, wired, tested, and placed into service. The three 480-volt sump pump motor control centers shall be installed and connected to the power supply cables only."

Paragraph 8.: In line 2 from the bottom of the page, change "15 KVA" to read "25 KVA".

SECTION 19 - LIGHTING SYSTEM

PAGE 319

Paragraph 4.b.: Delete the last sentence and substitute the following:

"Prior to acceptance by the City, the Contractor shall thoroughly clean all fixtures and fixture supports and replace any defective lamps."

SECTION 20 - PAINTING

PAGE 331

Paragraph 1.: Add the following sentence to the end of the last paragraph on this page:

"At his option, the Contractor may prepare and paint the trash rack panel surfaces at the Contractor's paint shop at the project site, in lieu of doing the work in place."

Paragraph 7.c.: In the first sentence at the top of this page, change the words "brush applied" to read "spray applied".

PAGE 351

Coating Schedule - Classification B, Sheet No. 5: Change the minimum dry film thickness as follows:

Description	Mils
Structural Steel	
Outdoor - Unprimed	from "8.0" to "4.0"
Outdoor - Primed	from "8.0" to "4.0"

PAGE 353

Coating Schedule - Classification B, Sheet No. 7: Make the following changes and additions:

Second line: In "TOUCH-UP COAT" column, change "S-1, ZS" to read "S-1, ZG".

Sixth line: In "DESCRIPTION" column, change "Valves, touch-up" to read "Valves, touch-up, exterior surface,"

In "FULL FIELD COATS, column 1," delete "VF". and

In "MILS" column, change "5.0", to "3.0".

Seventh line: Add the following item:

In "DESCRIPTION" column, add "Valves, touch-up, interior surface".

In "SURFACE PREPARATION" column, add "SP-3".

In "TOUCH-UP COAT" column, add "S-1, VX".

In "MILS" column, add "10.0".

SECTION 22 - MOVABLE PARTITIONS

PAGE 356

Paragraph 2.c.: At the end of this paragraph, add the following:

"Bottom offset pivots shall be No. 37-937 LH or No. 37-938 RH. Single doors shall be 3 feet wide and 7 feet high. Double doors shall be 6'-8" wide and 7'-0" high. Metal doors at Control Room Boards, El. 1759'-0" and at Men's Toilet, El. 1771'-6" are not part of this specification."

Paragraph 2.d.: Delete this paragraph and substitute the following:

"d. Plate glass shall be clear 1/4-inch polished plate glass, glazing quality as manufactured by Pittsburgh Plate Glass Company, or approved equal. Approximately 1,100 square feet will be required. Maximum size of panels will be 7'-3" wide and 6'-6" high. Tempered plate glass shall be 3/8" "Herculite" plate glass for panels over 6'-0" wide, as manufactured by Pittsburgh Plate Glass Company, or approved equal. Approximately 195 square feet will be required. Maximum size of panels will be 7'-3" wide and 6'-8" high. Tempered plate glass shall be 1/4" "Herculite" plate glass for panels under 6'-0" wide, as manufactured by Pittsburgh Plate Glass Company, or approved equal. Approximately 340 square feet will be required. Maximum size of panels will be 5'-11" wide and 6'-8" high.

SECTION 23 - HOLLOW METAL DOORS

PAGE 359

Paragraph 2.e.: In second line insert the word "Alumogrit" between the words "shall be" and "type" to make the sentence read "Thresholds . . . . shall be Alumogrit Type 115-S . . .".

SECTION 28 - INSTRUMENTATION OF DAM

PAGE 367

Paragraph 2.: In line 11, the sentence beginning "Type B" shall be changed to read:

"Type B deformetors are the same as Type A except with a linear variable differential transformer (L.V.D.T.) attached."

In line 6 from bottom of page change "fabbricated" to "fabricated".

PAGE 369

Paragraph 4.: In lines 1 and 4 change the words "deformation meters" to "deformeters".

At the end of Paragraph 4, add the following:

"Payment for installing thermocouples shall be as described in Section 9B, paragraph 27."

CONTRACT DRAWINGS

Changes in Drawing List accompanying the Contract Drawings

After Plate No. 146: Delete "D-23223, Rev. 0 - Tunnels-Miscellaneous Details and substitute "Deleted".

Add the following plates at the end of the list:

311.	D-23358, Rev. 0	Arch Dam-Foundation Gallery Pumping System-Pump & Piping Details
312.	D-23360, Rev. 0	Arch Dam-Access Elevator, Sluice Gate Seal-Inflation System-Supply Tank & Piping Details
313.	D-23361, Rev. 0	Arch Dam-Sluice Gate Seal Inflation System-Schematic and Control Cabinet
314.	D-23362, Rev. 0	Arch Dam-Sluice Gate Seal Inflation System-Piping Details

Changes in Contract Drawings

Plate 162. Drawing D-23317, under column "System", in line 6, delete the words: "Penstock Fill".

Plate 174. Drawing D-23312, delete the letters: "AO" in the four squares shown above the floor at El. 1686.

* * * * * * *

NOTE: Following are additional modifications of the original specifications supplementing the foregoing modifications:

SECTION 14 - ELEVATORS

PAGE 270

Paragraph 18.: Delete this paragraph in its entirety and substitute the following:

"Upon completion of the installation and testing of the elevators by the Contractor, or his subcontractor, and acceptance has been made thereof by the Engineer, the elevators will be available to the Contractor for his use along with its use by the City. The times of use of the elevators by the Contractor shall be subject to the approval of the Engineer.

"Parts of the elevators exposed to damage, including the interior of the cars, shall be adequately protected during this period.

"The Contractor shall supply maintenance on the entire elevator systems during the life of this contract. The maintenance work shall be done only by competent personnel under the supervision of and in direct employ of the Contractor or his subcontractor. This maintenance shall include the following:

"a. Systematic examination, adjustment and lubrication of all elevator equipment as recommended by the manufacturer's standard maintenance and instruction manual.

"b. Prompt replacement or repair without cost to the City, of electrical and mechanical parts of the elevator equipment whenever required for proper operation during the maintenance period. The Contractor shall use only standard parts produced by the manufacturer of the equipment concerned.

"c. All wire ropes shall be replaced as often as necessary to maintain an adequate factor of safety.

"Upon completion of the work, the elevators shall be reconditioned and restored by the Contractor to the satisfaction of the Engineer except that renewals or repairs necessitated by reason of any cause beyond the control of the Contractor shall not be at the expense of the Contractor."

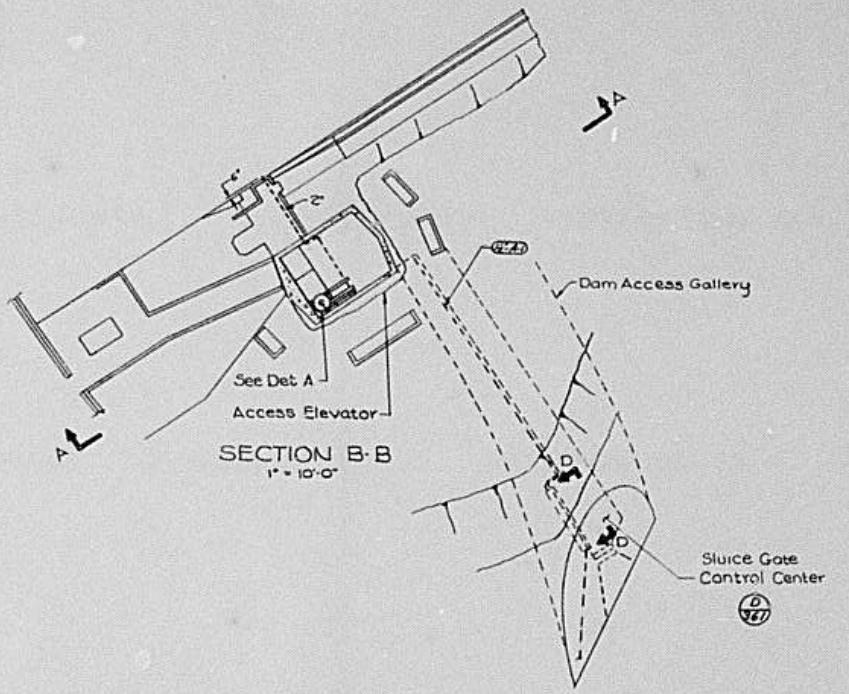
SECTION 1C - SPECIAL CONDITIONS

PAGE 85

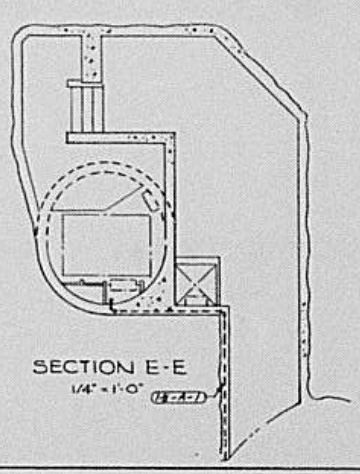
Paragraph 12.a.: Add the following:

"Drilling of additional exploratory holes is presently in progress at the site of the dam. The cores of these holes will be available for inspection at the Boundary Project office as this work progresses."

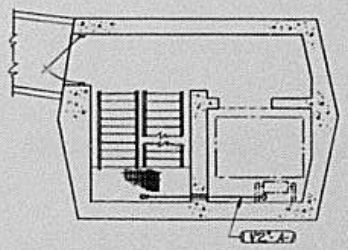
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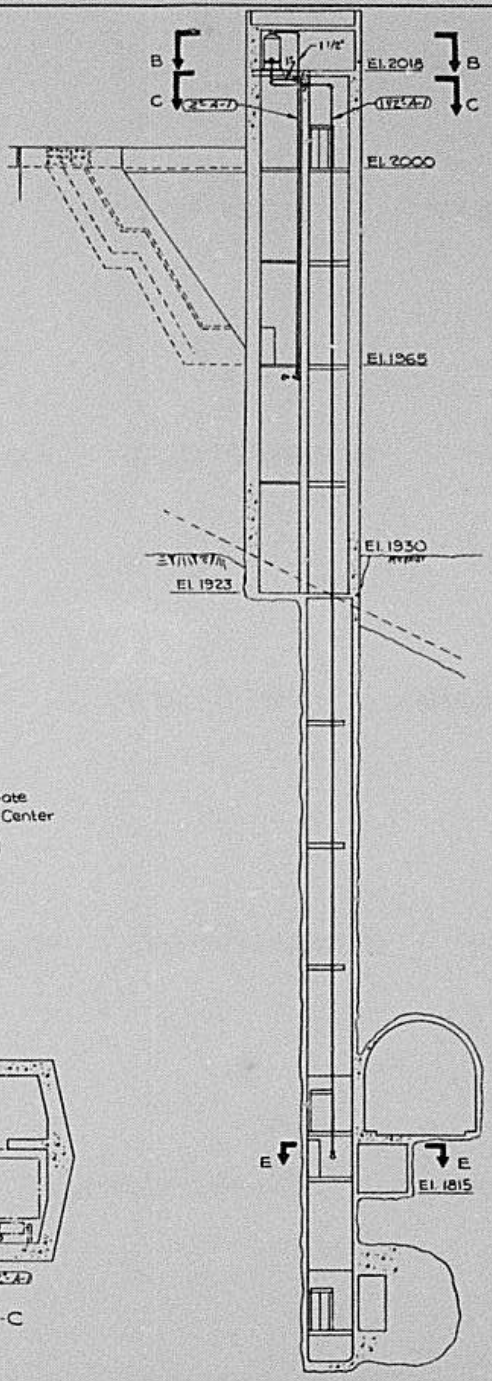
SECTION B-B
1" = 10'-0"



SECTION E-E
1/4" = 1'-0"



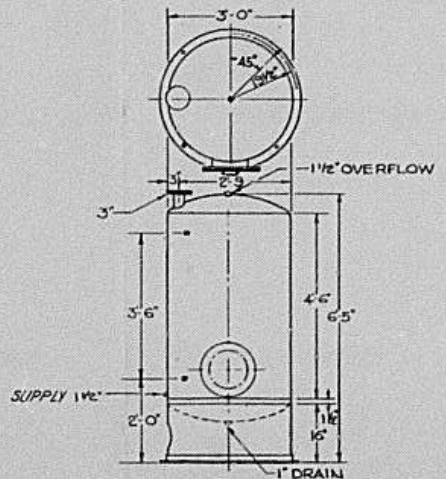
SECTION C-C
1/4" = 1'-0"



ELEVATION A-A
1" = 10'-0"

NOTES

1. The Contractor shall fill the entire Seal Inflation system with an anti-freeze solution suitable for operation at -40°F



DETAIL A
3/4" = 1'-0"

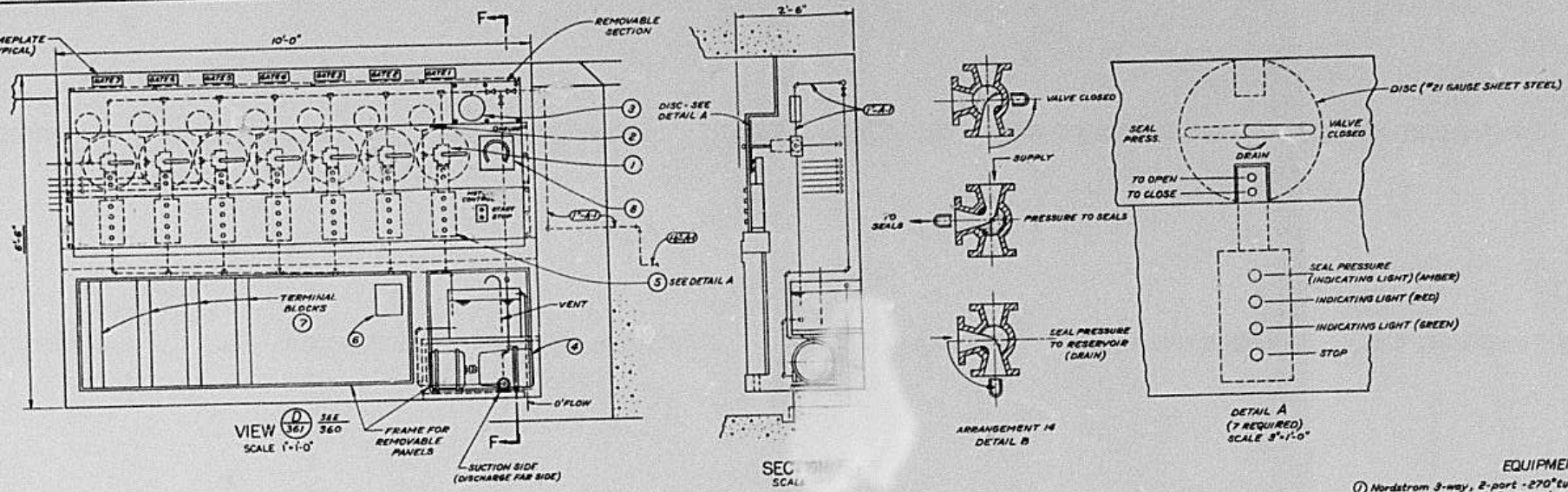
Scale 0 4 8 12 16 Ft

REVISIONS

MICROFILMED

BECHTEL-LEEDSHILL, SAN FRANCISCO		CITY OF SEATTLE DEPARTMENT OF LIGHTING	ARCH DAM SLUICE GATE SEAL INFLATION SYSTEM SUPPLY TANK AND PIPING DETAILS
DRAWN MB	APPROVED FOR DEPARTMENT OF LIGHTING		SCALE AS NOTED
TRACED DWB	8-31-64		DRAWING NO. D-23360
CHECKED MB			REV. 0
DESIGNED JPH			

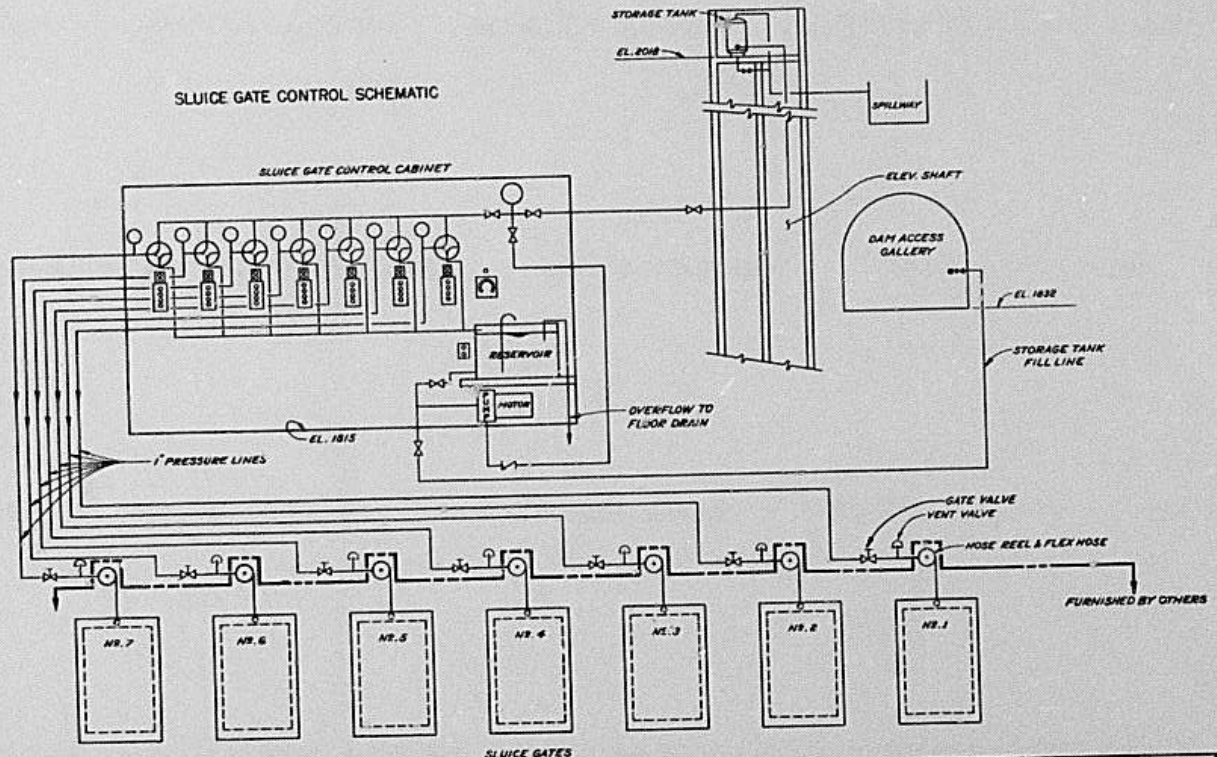
PEND OREILLE RIVER



EQUIPMENT

1. Nordstrom 3-way, 2-port -270° turn - three position, Fig. 3402 with arrangement 14. Seven valves are required equipped with manual operating handles and discs engraved with valve positions. (See detail A & B)
2. Mercoid type DA-31-127 Pressure Control, Range No. 6, 0-100 lb., bottom connection, general purpose case.
3. Trerice - 4½" Series 800, Indicating only, gauge. Maximum pressure of 100 p.s.i. and graduated from 0-10.
4. Fairbanks-Morse, Fig. 6830, Model BR 605 Motor Driven Peripheral Pump. Discharge 1½" dia; Media - water; Head - 250 Feet - 2 H.P., 440 Volt, 3 phase, 60 cycle.
5. Custom built control stations, seven required, with single pole, double throw, oil-tight push buttons with legend plates, 120 V. A.C. control circuit, arrangement per detail 7. NEMA I enclosure.
6. Magnetic Starter, size 0, 440 V., 3 phase, 60 cycle, with three thermal overload relays, NEMA I enclosure.
7. Terminal Blocks, Marathon 6000.
8. Water level indicator shall be Westinghouse KK-251 D.C. Milliammeter style number 2918B39A10 with a special dual scale. The outer scale shall be graduated from 1730' to 1910' and the inner scale shall be graduated from 1910' to 2000' in elevation.

SLUICE GATE CONTROL SCHEMATIC



NOTES



BECHTEL-LEEDSHILL, SAN FRANCISCO

CITY OF SEATTLE DEPARTMENT OF LIGHTING

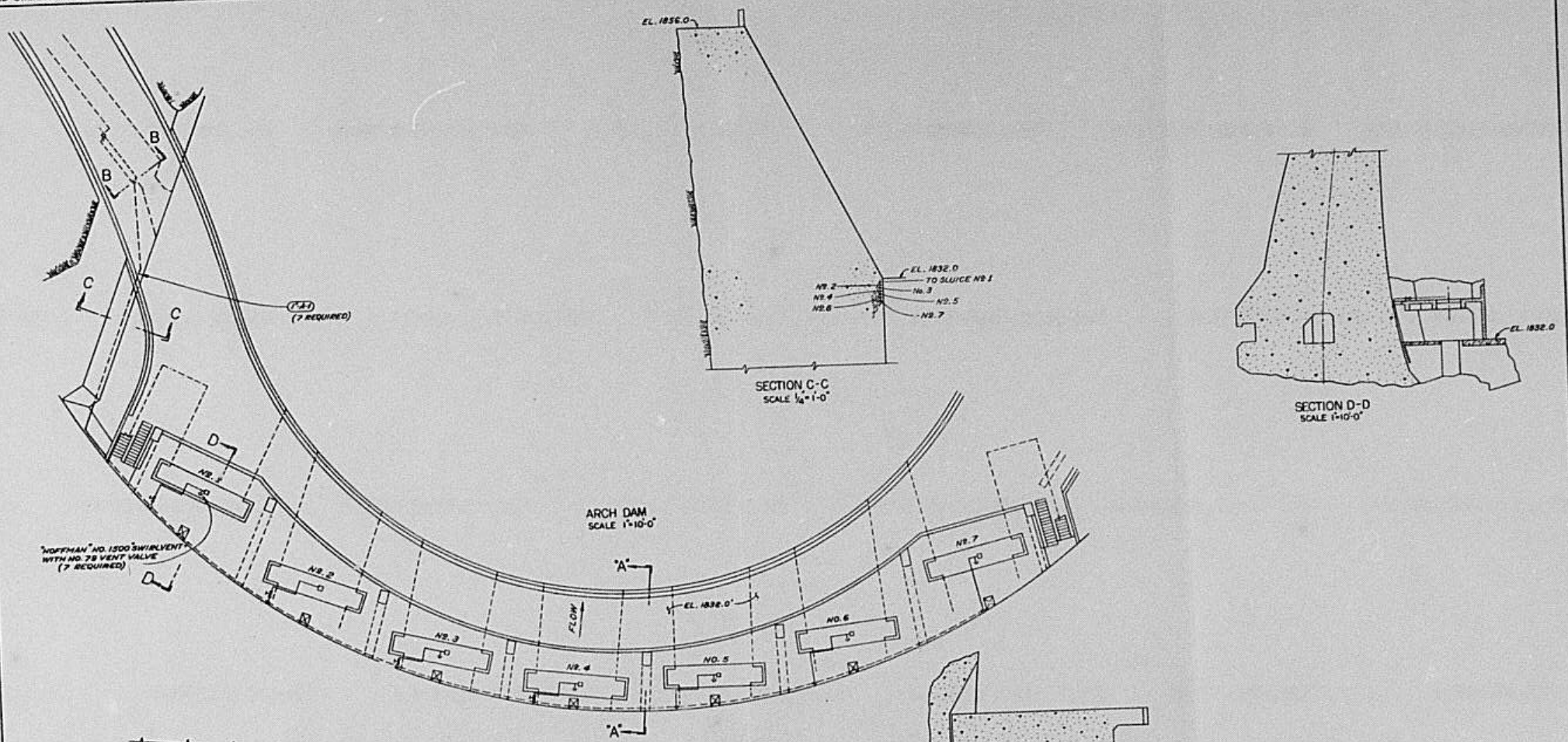
ARCH DAM
SLUICE GATE SEAL INFLATION SYSTEM
SCHEMATIC & CONTROL CABINET

SCALE AS NOTED
DRAWING NO. D-23361
REV. O

REVISIONS

MICROFILMED

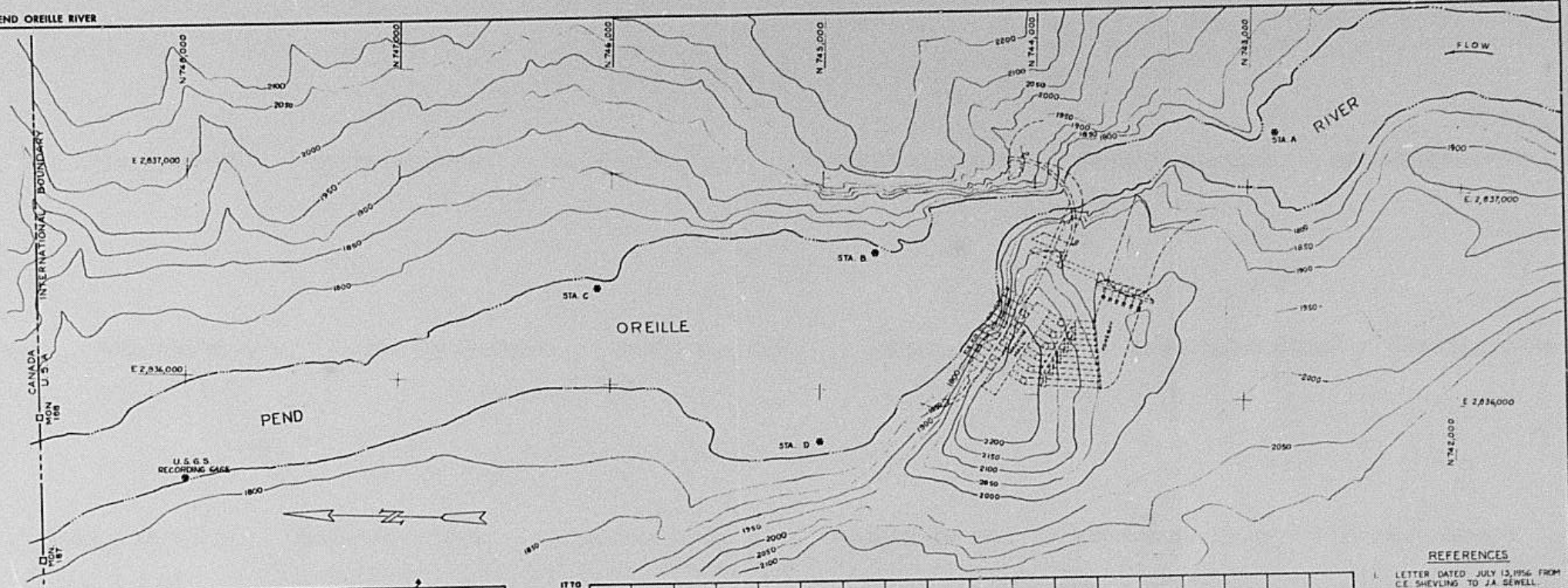
PEND OREILLE RIVER

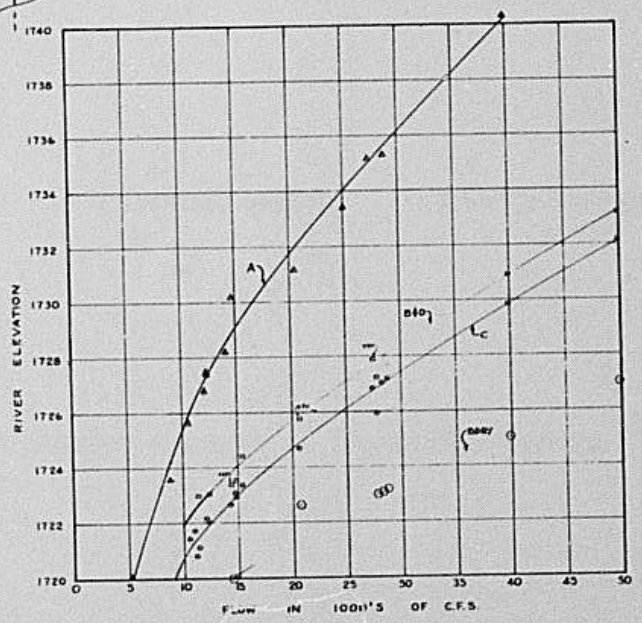


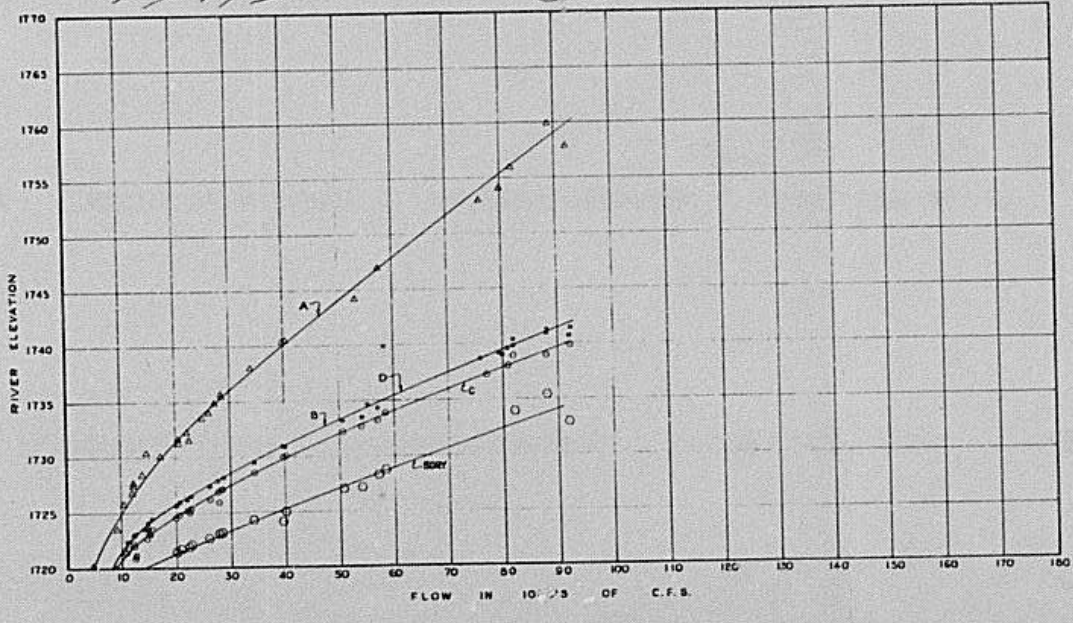
BECHTEL-LEEDSHILL, SAN FRANCISCO		CITY OF SEATTLE DEPARTMENT OF LIGHTING	ARCH DAM SLUICE GATE SEAL INFLATION SYSTEM PIPING DETAILS	SCALE AS NOTED
DESIGNED ARO		APPROVED FOR DEPARTMENT OF LIGHTING		DRAWING NO. D-23362
DRAWN BDC		DATE 6-21-64		REV. 0
CHECKED ARO				
ENGINEER 778				

MICROFILMED SHEET 1 OF 1 SHEETS

PEND OREILLE RIVER







REFERENCES

1. LETTER DATED JULY 13, 1956 FROM C.E. SHEVLING TO J.A. SEWELL.
2. LETTER DATED OCT. 24, 1956 FROM C.E. SHEVLING TO J.A. SEWELL.
3. LETTER DATED NOV. 2, 1956 FROM J.A. SEWELL TO C.E. SHEVLING.
4. LETTER DATED DEC. 17, 1956 FROM J.A. SEWELL TO C.E. SHEVLING.
5. LETTER DATED FEB. 1, 1957 FROM J.A. SEWELL TO C.E. SHEVLING.
6. LETTER DATED OCT. 10, 1957 FROM J.A. SEWELL TO C.E. SHEVLING.
7. LETTER DATED JUNE 30, 1958 FROM J.A. SEWELL TO HOIDAL.

MICROFILMED

REVISIONS

APPROVED BY SEATTLE BOARD OF PUBLIC WORKS

RECOMMENDED

CITY OF SEATTLE
DEPARTMENT OF LIGHTING
PAUL A. RAVER, SUPERINTENDENT

APPROVED FOR DEPARTMENT OF LIGHTING

BOUNDARY PLANT SITE
FIELD MEASUREMENT
RIVER ELEVATION VS. DISCHARGE

SCALE: 1" = 200'

DRAWING NO. D-16587

REV. 0

THE CITY OF SEATTLE

BOARD OF PUBLIC WORKS

* * *

DEPARTMENT OF LIGHTING

PEND OREILLE RIVER - BOUNDARY PROJECT

* * *

INSTRUCTIONS TO BIDDERS, PROPOSAL, CONTRACT, AND SPECIFICATION

* * *

CONSTRUCTION OF ARCH DAM, POWER PLANT, AND APPURTENANT WORKS FOR BOUNDARY PROJECT

As authorized by Ordinance No. 91783

Prepared by Bechtel-Leedshill, San Francisco
February, 1964

Submitted by C. R. Hoidal
Chief Civil Engineer

Recommended by H. W. Strandberg
Chief Engineer

Jesse M. Nelson
Superintendent of Lighting

Examined and Approved by
The Board of Public Works

Feb. 19, 1964

ATTEST: E. S. Henry
Secretary

R. W. Morse
Chairman, Board of Public Works

Specification No. 1782

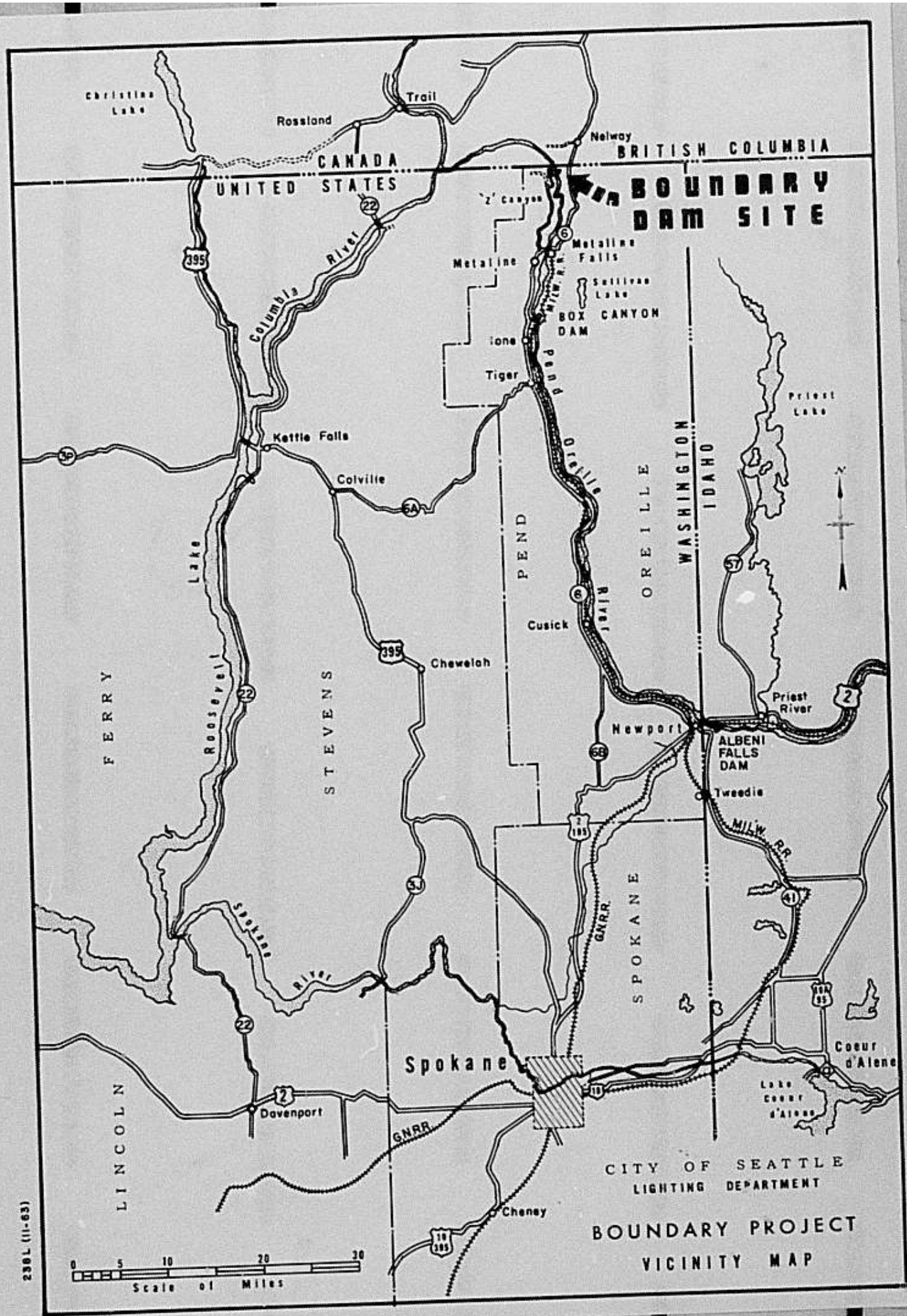

Christina Lake
Rossland
Trail
Nelway
BRITISH COLUMBIA
CANADA
UNITED STATES
BOUNDARY DAM SITE
'Z' Canyon
Metaline
Metaline Falls
Sullivan Lake
BOX CANYON DAM
Ione
Tiger
Columbia River
Pend Oreille River
Priest Lake
Kettle Falls
Colville
Lake Roosevelt
FERRY
STEVENS
PEND OREILLE
WASHINGTON
IDAHO
Cusick
Chewelah
Priest River
Newport
ALBENI FALLS DAM
Tweedie
Spokane River
SPOKANE
GNRR
Spokane
Coeur d'Alene
Lake Coeur d'Alene
LINCOLN
Davenport
Cheney
CITY OF SEATTLE
LIGHTING DEPARTMENT
BOUNDARY PROJECT
VICINITY MAP
Scale of Miles
0 5 10 20 30
238L (11-63)

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INSTRUCTIONS TO BIDDERS

Sealed proposals for this work will be received by the Board of Public Works of the City of Seattle until 2:00 P.M. Wednesday, APR 2 2 1964 in Room 404 Seattle Municipal Building, 600 Fourth Avenue, Seattle, Washington 98104.

All bids shall be accompanied by a certified check payable to the order of the City Comptroller, cash, or by a bid bond approved as to form by the Corporation Counsel in writing, for a sum of not less than five percent (5%) of the amount of the bid and no bid shall be considered unless accompanied by such cash, check or bid bond. A bid bond, the sum of which is not filled in may be approved by the Corporation Counsel in writing up to five (5) days prior to the submission of said bid to the Board of Public Works providing the following items appear thereon: (a) Ordinance number of the improvement, (b) name and nature of the improvement, (c) authorized signature of the company's or contractor's officer empowered to sign official papers. The sum of the bid bond must be filled in by the bidder prior to submitting the bid to the Board of Public Works in the amount and at the time and place specified above.

If the contract is let, all checks or cash shall be returned to the bidder, except that of the successful bidder, which shall be retained until a contract is entered into between the bidder and the City, in accordance with such bid. If the said bidder fails to enter into such contract in accordance with his bid within ten days from the date at which he is notified that he is the successful bidder, the said cash or check and the amount thereof shall be forfeited to the City, or, if a bid bond accompanied the bid, the necessary legal steps will be taken by the City to recover an amount equal to five percent (5%) of the amount of the bid. Before such contract between the successful bidder and the City shall be valid or binding against the City of Seattle, the Contractor shall enter into a joint and several bond with the City of Seattle, for the use of said City, and also for the use of all persons who may perform or cause to be performed any work or labor, or furnish or cause to be furnished any skill, labor or material in the execution of such contract, which bond shall be signed by the Contractor and two or more good and sufficient sureties or with a surety company as surety, and shall be in the amount of _____ Dollars ($_____) but not less than one hundred percent (100%) of the bid, plus estimated State Sales Tax.

All payments for this work shall be made by warrants drawn on the Light Fund.

The work embraced in the following proposal and contract shall be done in all respects in accordance with these instructions, the proposal, contract and specifications attached hereto; the accompanying plans, such detail plans as may be furnished during the progress of the work.

The work embraced in the following Proposal and Contract shall be under the direct supervision of the Superintendent of Lighting, subject to the acceptance and approval of the Board of Public Works. It shall be begun immediately upon

notice from the Superintendent of Lighting to begin work; and shall be completed within the time specified in Section 1A, paragraph 5.

Bidders are notified to examine thoroughly these instructions, the proposal, the form of contract, the plans and specifications. If there be any doubt or obscurity as to meaning of the same, intending bidders should ask the Superintendent of Lighting for an explanation before submitting their proposals.

Permission will not be given for the withdrawal or modification of any bid or proposal.

Bids will not be received if detached from the specification with which they are bound, nor shall any of the accompanying papers be detached therefrom, but the entire package must be unbroken, in good order and enclosed in a sealed envelope, endorsed with the name of the bidder and the name of the work.

Bids must be made on every item noted on the blanks and proposals provided for this improvement to the extent that the proposal represents a complete integral project.

Quantities listed on the proposal blanks are for the purpose of comparing bids only.

The advertisement for bids provides that a deposit for plans and specifications will be required from each bidder. This deposit will be returned to him upon the return of the plans and specifications in good condition to the office of the Department of Lighting designated in the advertisement for bids, within ten (10) days after the bid opening date. Failure to comply will result in forfeiture of the deposit for the plans and specifications.

The Board of Public Works reserves the right to reject any or all bids, and to waive informalities.

Any bulletins or addenda issued during the time of bidding are to be covered in the proposal, and in closing a contract will be a part thereof.

In order to establish a basis of quality, certain materials or articles are specified by designating a particular manufacturer's name, brand or number. It is not the intent of the specifications to exclude other materials or articles that measure up to the standard of those specified. Should the Contractor desire to make substitutions, he shall first secure the written approval of the Engineer or his accredited representative. Whenever an article is specified by giving the manufacturer's name, it is understood that the words "or equal" follow thereafter.

The Board of Public Works shall have the right to take such steps as it may deem necessary to determine the ability of the bidder to perform the work and the bidder shall furnish the Board of Public Works all such data for this purpose as the Board of Public Works may request.

PROPOSAL

Seattle, Washington_____19___

TO THE BOARD OF PUBLIC WORKS OF THE CITY OF SEATTLE:

The undersigned hereby certif_____that_____ha___personally and carefully examined the plans, specifications, form of contract and foregoing instructions for

CONSTRUCTION OF ARCH DAM, POWER PLANT, AND
APPURTENANT WORKS FOR BOUNDARY PROJECT

under Ordinance No. 91783 ; that_____ha___examined the site of the work and the location where said work is to be done, that_____fully understands___the manner in which payment is proposed to be made for the cost thereof, and that_____fully understand___that the quantities shown on the proposal are for the purpose of comparing bids only and, having made the necessary examination, hereby propose___ to furnish all material and to perform all labor which may be required to complete said work within the time fixed and upon the terms and conditions provided in the said plans, specifications, contract and foregoing instructions at the following prices:

Certified Check Enclosed $_____ Bid Bond Enclosed_____

Item No.	Approx. Quantity	Item (Prices to be written in words)	Unit Price Dollars	Unit Price Cts.	Amount Dollars	Amount Cts.
1.	Lump Sum	Mobilization Lump Sum of ONE MILLION DOLLARS	x x x	xx	1,000,000	00
2.	Lump Sum	Care of River and Unwatering at Diversion Tunnel Intake Lump Sum of	x x x	xx		
3.	Lump Sum	Diversion and Care of River and Unwatering at Dam Site Lump Sum of	x x x	xx		
4.	Lump Sum	Care of River and Unwatering at Tailrace Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
5.	Lump Sum	Closure of Diversion Tunnel Lump Sum of	x x x	xx		
6.	200,000 Cu. Yds.	Excavation, Common, for Forebay and Spillways . . . . . Per Cu. Yd.				
7.	1,000,000 Cu. Yds.	Excavation, Rock, for Forebay and Spillways . . . . . Per Cu. Yd.				
8.	60,000 Cu. Yds.	Excavation, Rock, for Dam Foundations and Sluice Discharge above El. 1725 . . . . . Per Cu. Yd.				
9.	80,000 Cu. Yds.	Excavation, Unclassified, for Dam Foundations below El. 1725 . . . . . Per Cu. Yd.				
10.	5,000 Cu. Yds.	Excavation, Common, for Diversion Tunnel Intake . . . . . Per Cu. Yd.				
11.	50,000 Cu. Yds.	Excavation, Rock, for Diversion Tunnel Intake . . . . . Per Cu. Yd.				
12.	2,500 Cu. Yds.	Excavation for Diversion Tunnel Upstream End . . . . . Per Cu. Yd.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
13.	Lump Sum	Excavation for Diversion Tunnel Downstream End Lump Sum of				
14.	40,000 Cu. Yds.	Excavation of Disjointed Rock at Tailrace . . . . . Per Cu. Yd.				
15.	40,000 Cu. Yds.	Excavation, Common, for Tailrace in Open Cut . . . . . Per Cu. Yd.				
16.	60,000 Cu. Yds.	Excavation, Rock, for Tailrace in Open Cut . . . . . Per Cu. Yd.				
17.	16,500 Cu. Yds.	Excavation for Draft Tube Tunnels . . . . . Per Cu. Yd.				
18.	600 Cu. Yds.	Excavation for Penstock Fill Line . . . . . Per Cu. Yd.				
19.	300 Cu. Yds.	Miscellaneous Excavation Twenty-five Dollars . . . Per Cu. Yd.	25	00	7,500	00
20.	5,000 Sq. Ft.	Line Drilling . . . . . Per Sq. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
21.	200,000 Sq. Ft.	Cleanup of Excavated Surfaces . . . . . Per Sq. Ft.				
22.	100 Million Gallons	Handling Water in Underground Excavation Six Hundred Dollars Per Million Gallon	600	00	60,000	00
23.	130,000 Cu Yds.	Random Backfill . . . . . Per Cu. Yd.				
24.	700 Cu Yds.	Selected Backfill . . . . . Per Cu. Yd.				
25.	1,500 Cu. Yds.	Backfill in Contraction Joints . . . . . Per Cu. Yd.				
26.	3,000 Lin. Ft.	Exploratory Drilling . . . . . Per Lin. Ft.				
27.	100,000 Lin. Ft.	Drilling Holes with Rotary Drills . . . . . Per Lin. Ft.				
28.	5,000 Lin. Ft.	Drilling Holes with Percussion Drills . . . . . Per Lin. Ft.				
29.	15,000 Lbs.	Furnishing and Installing Grout and Drainage Pipe and Fittings . . . . . Per Lb.				
30.	100 Hours	Water Testing . . . . . Per Hour				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
31.	5,000 Conns.	Hookup to Grout Holes . . . . . Per Connection				
32.	100,000 Cu. Ft.	Pressure Grouting Foundations . . . . . Per Cu. Ft.				
33.	15,000 Lbs.	Furnishing and Installing Metal Tubing for Keyed Contraction Joints . . . . . Per Lb.				
34.	15,000 Cu. Ft.	Pressure Grouting Contraction Joints and Systems . . . . . Per Cu. Ft.				
35.	5,000 Cu. Ft.	Contact Grouting . . . . . Per Cu. Ft.				
36.	20,000 Lin. Ft.	Drilling holes for Anchor Bars and Grouting Bars in Place . . . . . Per Lin. Ft.				
37.	1,000 Lin. Ft.	Furnishing and Installing Ungrouted Rock Bolts . . . . . Per Lin. Ft.				
38.	40,000 Lin. Ft.	Furnishing and Installing Grouted Rock Bolts . . . . . Per Lin. Ft.				
39.	110,000 Cu. Yds.	Arch Concrete in Dam . . . . . Per Cu. Yd.				
40.	20,000 Cu. Yds.	Concrete in Arch Abutments . . . . . Per Cu. Yd.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE		AMOUNT	
			Dollars	Cts.	Dollars	Cts.
41.	500 Cu. Yds.	Structural Concrete on Dam . . . . . Per Cu. Yd.				
42.	20,000 Cu. Yds.	Concrete in Spillways and Retaining Walls . . . . . Per Cu. Yd.				
43.	5,000 Cu. Yds.	Concrete in Trashrack Structure . . . . . Per Cu. Yd.				
44.	6,500 Cu. Yds.	Concrete in Intake Gate Structures . . . . . Per Cu. Yd.				
45.	9,500 Cu. Yds.	Concrete Lining in Penstocks . . . . . Per Cu. Yd.				
46.	800 Cu. Yds.	Concrete in Crane Runway Foundations . . . . . Per Cu. Yd.				
47.	26,000 Cu. Yds.	Concrete in Machine Hall Substructure . . . . . Per Cu. Yd.				
48.	12,000 Cu. Yds.	Concrete in Machine Hall Intermediate Structure . . . . . Per Cu. Yd.				
49.	1,000 Cu. Yds.	Concrete in Machine Hall Super-structure . . . . . Per Cu. Yd.				
50.	8,000 Cu. Yds.	Concrete in Draft Tubes . . . . . Per Cu. Yd.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
51.	11,000 Cu. Yds.	Concrete in Draft Tube Gate Shafts . . . . . Per Cu. Yd.				
52.	700 Cu. Yds.	Concrete in Generator Bus Galleries . . . . . Per Cu. Yd.				
53.	120 Cu. Yds.	Concrete in Visitors Access Galery . . . . . Per Cu. Yd.				
54.	2,000 Cu. Yds.	Concrete in Tunnel Floors . . . . . Per Cu. Yd.				
55.	3,000 Cu. Yds.	Concrete in Tunnel Linings . . . . . Per Cu. Yd.				
56.	4,000 Cu. Yds.	Concrete in Tunnel Portals . . . . . Per Cu. Yd.				
57.	5,000 Cu. Yds.	Concrete in Tunnel Plugs . . . . . Per Cu. Yd.				
58.	200 Cu. Yds.	Concrete in Access Elevator . . . . . Per Cu. Yd.				
59.	7,000 Cu. Yds.	Backfill Concrete Behind Penstock Steel . . . . . Per Cu. Yd.				
60.	5,000 Cu. Yds.	Backfill Concrete at Structures . . . . . Per Cu. Yd.				
61.	800 Cu. Yds.	Miscellaneous Concrete . . . . . Per Cu. Yd.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
62.	400 Cu. Yds.	Precast Concrete . . . . . Per Cu. Yd.				
63.	400 Cu. Yds.	Prestressed Concrete . . . . . Per Cu. Yd.				
64.	100 Cu. Yds.	Concrete Paving in Unit Bays No. 55 and 56 . . . . . Per Cu. Yd.				
65.	100 Cu. Yds.	Concrete at Batch Plant . . . . . Per Cu. Yd.				
66.	Lump Sum	Furnishing and Maintaining Gunite Plant Lump Sum of	x x x	xx		
67.	8,000 Cu. Ft.	Gunite . . . . . Per Cu. Ft.				
68.	2,500 Cu. Ft.	Vermiculite Lining . . . . . Per Cu. Ft.				
69.	400,000 Barrels	Furnishing and Handling Cement . . . . . Per Barrel				
70.	Lump Sum	Furnishing and Installing Refrigeration Equipment for Concrete Cooling Lump Sum of	x x x	xx		
71.	500 Shifts	Operation of Refrigeration Plant for Concrete Cooling . . . . . Per Shift				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
72.	80,000 Cu. Yds.	Cooling Concrete . . . . . Per Cu. Yd.				
73.	100,000 Lin. Ft.	Furnishing and Installing Pipe and Tubing for Concrete Cooling System . . . . . Per Lin. Ft.				
74.	3,000 Lin. Ft.	Installing Thermocouples . . . . . Per Lin. Ft.				
75.	13,000,000 Lbs.	Furnishing and Installing Reinforcement Steel and Welded Wire Fabric . . . . . Per Lb.				
76.	50,000 Lbs.	Furnishing and Installing Chain Wire Mesh . . . . . Per Lb.				
77.	40,000 Lin. Ft.	Furnishing and Installing Post Tension Cables . . . . . Per Lin. Ft.				
78.	1,400,000 Lbs.	Furnishing and Installing Sluice Liners . . . . . Per Lb.				
79.	150,000 Lbs.	Furnishing and Installing Diversion Closure Gate . . . . . Per Lb.				
80.	Lump Sum	Installing Trashracks and Guides Lump Sum of	x x x	xx		
81.	4,000,000 Lbs.	Furnishing and Installing Penstock Steel Liners . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
82.	Lump Sum	Furnishing Penstock Inspection Car Lump Sum of	x x x	xx		
83.	Lump Sum	Furnishing and Installing Corrugated Arch Ceiling Lump Sum of	x x x	xx		
84.	820,000 Lbs.	Installing Crane Runway Structural Steel . . . . . Per Lb.				
85.	12,000 Lbs.	Furnishing and Installing Metal Inserts . . . . . Per Lb.				
86.	50,000 Lbs.	Furnishing and Installing Rails . . . . . Per Lb.				
87.	30,000 Lbs.	Installing Miscellaneous Metalwork . . . . . Per Lb.				
88.	600,000 Lbs.	Furnishing and Installing Miscellaneous Metalwork . . . . . Per Lb.				
89.	6,000 Lbs.	Furnishing and Installing Black Welded Steel Pipe and Malleable Iron Screwed Fittings, 2-1/2" and under . . . . . Per Lb.				
90.	1,600 Lbs.	Furnishing and Installing Black Welded Steel Pipe, Welded Fittings and Flanges 3" up to and incldg. 8" . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
91.	85,000 Lbs.	Furnishing and Installing Black Welded Steel Pipe, Welded Fittings and Flanges over 12" . . . . . Per Lb.				
92.	11,000 Lbs.	Furnishing and Installing Extra Strong Welded Steel Pipe, Welded Fittings and Flanges over 3" up to and including 12" . . . . . Per Lb.				
93.	3,500 Lbs.	Furnishing and Installing Extra Strong Welded Steel Pipe, Welding Fittings and Flanges, over 12" up to and including 20" . . . . . Per Lb.				
94.	3,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Malleable Iron Screwed Fittings, 3" and under . . . . . Per Lb.				
95.	18,500 Lbs.	Furnishing and Installing Wrought Iron Pipe and Wrought Iron Welding Fittings and Steel Flanges, 3" up to and including 8" . . . . . Per Lb.				
96.	28,000 Lbs.	Furnishing and Installing Wrought Iron Pipe and Wrought Iron Welding Fittings and Steel Flanges, over 8" up to and including 12" . . . . . Per Lb.				
97.	8,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, 2-1/2" and under . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
98.	52,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, 3" up to and including 8" . . . . . Per Lb.				
99.	6,000 Lbs.	Furnishing and Installing Galvanized Wrought Iron Pipe and Galvanized Screwed Cast Iron Drainage Fittings, over 8" . . . . . Per Lb.				
100.	1,200 Lbs.	Furnishing and Installing Extra Heavy Acid Resisting Pipe with Extra Heavy Acid Resisting Fittings, and Acid Drain, 3" and under . . . . . Per Lb.				
101.	500 Lbs.	Furnishing and Installing Double Extra Strong Seamless Steel Pipe and 3,000 Lb. Forged Steel Screwed Fittings, 3" and under . . . . . Per Lb.				
102.	325,000 Lbs.	Furnishing and Installing 36-inch Penstock Fill Line and Appurtenant Equipment . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
103.	3,000 Lbs.	Furnishing and Installing Wrought Iron Pipe and Malleable Iron Screwed Fittings, 1-1/4" & under . . . . . Per Lb.				
104.	Lump Sum	Furnishing and Installing Thirty (30) Special Wrought Iron Extra Heavy Couplings and Stainless Steel Orifice Plugs for Ice Prevention System Lump Sum of	x x x	xx		
105.	2,000 Lbs.	Furnishing and Installing Copper Tubing and Screwed Fittings, 1/2" and under . . . . . Per Lb.				
106.	1,500 Lbs.	Furnishing and Installing Brass Pipe and 250 Lb. Brass Screwed Fittings, 3/4" and under . . . . . Per Lb.				
107.	500 Lbs.	Furnishing and Installing Stainless Steel Manually Operated Valves for Copper Tubing 1" and under . . . . . Per Lb.				
108.	2,000 Lbs.	Furnishing and Installing Mechanical Pipe Couplings, 20" and under . . . . . Per Lb.				
109.	2,600 Lbs.	Furnishing and Installing Metal Pipe Sleeves . . . . . Per Lb.				
110.	15,000 Lbs.	Furnishing and Installing Pipe Hangers, Supports and Inserts . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
111.	16 Stations	Furnishing and Installing Fire Hose Stations . . . . Per Station				
112.	Lump Sum	Furnishing and Installing the Seal Inflation System for the Sluice Gates and Appurtenant Equipment Lump Sum of	x x x	xx		
113.	6 Valves	Furnishing and Installing Cast-Iron 20-inch Butterfly Valve complete with Air Operator and Appurtenant Equipment . . . . Per Valve				
114.	800 Lbs.	Furnishing and Installing O.S. & Y. Flanged 150 Lb. Steel Gate and Angle Valves, 3" up to and including 12" . . . . Per Lb.				
115.	1,800 Lbs.	Furnishing and Installing Cast Iron Flap Valves, Flanged Frame, up to and including 12" . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
116.	12 Valves	Furnishing and Installing 2-inch Back Pressure Valves . . . . . Per Valve				
117.	2 Valves	Furnishing and Installing 3-inch Back Pressure Valves . . . . . Per Valve				
118.	12 Drains	Furnishing and Installing Square Top, Cast Iron Floor and Area Drains, 6" and under . . . . . Per Drain				
119.	12 Drains	Furnishing and Installing Round Top, Cast Iron Floor and Area Drains with Trap, 3" and under . . . . . Per Drain				
120.	50 Drains	Furnishing and Instaling Round Top, Cast Iron Floor and Area Drains, 3" and under . . . . . Per Drain				
121.	150 Drains	Furnishing and Installing Rectangular Top, Cast Iron Floor Gutter Drains, 3" and under . . . . . Per Drain				
122.	Lump Sum	Installing Draft Tube Gates, Frames and Guides Lump Sum of	x x x		xx	
123.	Lump Sum	Installing Draft Tube Gantry Crane Lump Sum of	x x x		xx	

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
124.	Lump Sum	Installing Sluice Gates, Frames and Guides Lump Sum of	x x x	xx		
125.	Lump Sum	Installing Sluice Gate Hoists Lump Sum of	x x x	xx		
126.	Lump Sum	Installing Intake Gates, Frames and Guides Lump Sum of	x x x	xx		
127.	Lump Sum	Installing Intake Gate Hoists Lump Sum of	x x x	xx		
128.	425,000 Lbs.	Installing Sluice Maintenance Gate Embedded Metal . . . . . Per Lb.				
129.	410,000 Lbs.	Installing Sluice Maintenance Gate . . . . . Per Lb.				
130.	Lump Sum	Installing Sluice Maintenance Gate Operator Lump Sum of	x x x	xx		
131.	Lump Sum	Installing Sluice Maintenance Gate Hoist Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
132.	Lump Sum	Installing Spillway Radial Gates, Anchorages and Embedded Metal Lump Sum of	x x x	xx		
133.	Lump Sum	Installing Spillway Radial Gate Hoists Lump Sum of	x x x	xx		
134.	Lump Sum	Installing Bascule Skimmer Gate and Embedded Metal Lump Sum of	x x x	xx		
135.	Lump Sum	Installing Bascule Skimmer Gate Operator Lump Sum of	x x x	xx		
136.	Lump Sum	Furnishing and Installing Air Conditioning Systems Lump Sum of	x x x	xx		
137.	Lump Sum	Furnishing and Installing Dam Elevator and Appurtenant Equipment Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
138.	Lump Sum	Furnishing and Installing Power Plant Elevator and Appurtenant Equipment Lump Sum of	x x x	xx		
139.	Lump Sum	Installing the Embedded Items for Four (4) Turbines including Appurtenant Equipment Lump Sum of	x x x	xx		
140.	Lump Sum	Erecting and Testing Two (2) Traveling Bridge Cranes and Appurtenant Equipment Lump Sum of	x x x	xx		
141.	Lump Sum	Erecting and Testing One (1) Traveling Rake and Hoist and Appurtenant Equipment Lump Sum of	x x x	xx		
142.	Lump Sum	Furnishing and Installing One (1) Sewage Treatment Plant and Appurtenant Equipment Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
143.	4 Com-pressors	Furnishing and Installing 20 CFM Air Compressors and Appurtenant Equipment for Spillway Gate Ice Prevention System . . . . . Per Compressor				
144.	2 Com-pressors	Furnishing and Installing 65 CFM Air Compressors and Appurtenant Equipment for Trashrack Ice Prevention System . . . . . Per Compressor				
145.	Lump Sum	Furnishing and Installing One (1) 36-inch Cast Steel Spherical type Valve and Appurtenant Equipment Lump Sum of	x x x	xx		
146.	Lump Sum	Furnishing and Installing Emergency Generator Fuel Storage Tank Lump Sum of	x x x	xx		
147.	Lump Sum	Furnishing and Installing Intake and Exhaust System for the Emergency Generator Lump Sum of	x x x	xx		
148.	Lump Sum	Furnishing and Installing Sump Discharge Slide Gate Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM Prices to be written in words	UNIT PRICE Dollars	 Cts.	AMOUNT Dollars	 Cts.
149.	Lump Sum	Installing and Placing into Service Two (2) 13,800-480Y/277 Volt Main Station Service Switchgear Sections Lump Sum of	x x x	xx		
150.	Lump Sum	Installing and Placing into Service Thirteen (13) 480 Volt A.C. Distribution Panels Lump Sum of	x x x	xx		
151.	Lump Sum	Installing and Placing into Service Four (4) 480Y/277 Volt A.C. Split Bus Lighting Distribution Panels Lump Sum of	x x x	xx		
152.	Lump Sum	Installing and Placing into Service Two (2) 480Y/277 Volt A.C. Lighting Distribution Panels Lump Sum of	x x x	xx		
153.	Lump Sum	Installing and Placing into Service Four (4) 208Y/120 Volt A.C. Distribution Panels Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
154.	Lump Sum	Installing Four (4) 480 Volt A.C. Motor Control Centers Lump Sum of	x x x	xx		
155.	Lump Sum	Installing and Placing into Service Nine (9) 480-208Y/120 Volt A.C. Auxiliary Service, A.C. Lighting and A.C. Emergency Lighting Transformers Lump Sum of	x x x	xx		
156.	Lump Sum	Installing and Placing into Service Two (2) 480 Volt A.C. Lighting Voltage Regulators and Integral 480Y/277 Volt A.C. Distribution Panels Lump Sum of	x x x	xx		
157.	Lump Sum	Installing and Placing into Service Two (2) 480 Volt A.C. Lighting and A.C. Emergency Lighting Voltage Regulators Lump Sum of	x x x	xx		
158.	Lump Sum	Installing and Placing into Service Four (4) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Distribution Panels Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
159.	Lump Sum	Installing and Placing into Service One (1) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Automatic Transfer Panel Lump Sum of	x x x	xx		
160.	Lump Sum	Installing and Placing into Service One (1) 480Y/277 Volt A.C. Diesel Engine Generating Set and Appurtenant Equipment Lump Sum of	x x x	xx		
161.	Lump Sum	Installing and Placing into Service One (1) 13,800-480Y/277 Volt A.C. Pad Mounted Distribution Transformer and Appurtenant Equipment Lump Sum of	x x x	xx		
162.	2,400 Lin. Ft.	Installing and Placing into Service 15 KV Main Station Service Power Cables . . . . Per Lin. Ft.				
163.	6,000 Lin. Ft.	Furnishing and Installing 3/4-inch Rigid Steel Conduit . . . . Per Lin. Ft.				
164.	3,000 Lin. Ft.	Furnishing and Installing 1-inch Rigid Steel Conduit . . . . Per Lin. Ft.				
165.	100 Lin. Ft.	Furnishing and Installing 1-1/4-inch Rigid Steel Conduit . . . . Per Lin. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
166.	11,500 Lin. Ft.	Furnishing and Installing 1-1/2-inch Rigid Steel Conduit . . . . . Per Lin. Ft.				
167.	3,500 Lin. Ft.	Furnishing and Installing 2-inch Rigid Steel Conduit . . . . . Per Lin. Ft.				
168.	400 Lin. Ft.	Furnishing and Installing 2-1/2-inch Rigid Steel Conduit . . . . . Per Lin. Ft.				
169.	2,000 Lin. Ft.	Furnishing and Installing 3-inch Rigid Steel Conduit . . . . . Per Lin. Ft.				
170.	4,700 Lin. Ft.	Furnishing and Installing 4-inch Rigid Steel Conduit . . . . . Per Lin. Ft.				
171.	2,300 Lin. Ft.	Furnishing and Installing 2-inch Asbestos-Cement Conduit . . . . . Per Lin. Ft.				
172.	3,300 Lin. Ft.	Furnishing and Installing 4-inch Asbestos-Cement Conduit . . . . . Per Lin. Ft.				
173.	2,400 Lin. Ft.	Furnishing and Installing 6-inch Asbestos-Cement Conduit . . . . . Per Lin. Ft.				
174.	300 Lin. Ft.	Furnishing and Installing 1-inch Rigid PVC Conduit . . . . . Per Lin. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
175.	150 Lin. Ft.	Furnishing and Installing 1-1/2-inch Rigid PVC Conduit . . . . . Per Lin. Ft.				
176.	5,000 Lbs.	Furnishing and Installing Special Boxes . . . . . Per Lb.				
177.	68 Recept.	Furnishing and Installing 440 Volt Receptacles . . . . . Per Receptacle				
178.	400 Lin. Ft.	Furnishing and Installing 18-inch Cable Trays and Cable Ladders . . . . . Per Lin. Ft.				
179.	4,500 Lin. Ft.	Furnishing and Installing 24-inch Cable Trays and Cable Ladders . . . . . Per Lin. Ft.				
180.	1,100 Lbs.	Furnishing and Installing #4 A.W.G. Ground Wire . . . . . Per Lb.				
181.	500 Lbs.	Furnishing and Installing #2/0 A.W.G. Ground Cable . . . . . Per Lb.				
182.	600 Lbs.	Furnishing and Installing #4/0 A.W.G. Ground Cable . . . . . Per Lb.				
183.	21,000 Lbs.	Furnishing and Installing 500 MCM Ground Cable . . . . . Per Lb.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
184.	8,000 Lin. Ft.	Furnishing and Installing 1/C #12 A.W.G. Power Cable . . . . . Per Lin. Ft.				
185.	2,500 Lin. Ft.	Furnishing and Installing 1/C #10 A.W.G. Power Cable . . . . . Per Lin. Ft.				
186.	22,000 Lin. Ft.	Furnishing and Installing 1/C #8 A.W.G. Power Cable . . . . . Per Lin. Ft.				
187.	1,100 Lin. Ft.	Furnishing and Installing 1/C #6 A.W.G. Power Cable . . . . . Per Lin. Ft.				
188.	15,000 Lin. Ft.	Furnishing and Installing 1/C #4 A.W.G. Power Cable . . . . . Per Lin. Ft.				
189.	4,500 Lin. Ft.	Furnishing and Installing 1/C #2 A.W.G. Power Cable . . . . . Per Lin. Ft.				
190.	1,600 Lin. Ft.	Furnishing and Installing 1/C #2/0 A.W.G. Power Cable . . . . . Per Lin. Ft.				
191.	100 Lin. Ft.	Furnishing and Installing 1/C #3/0 A.W.G. Power Cable . . . . . Per Lin. Ft.				
192.	2,000 Lin. Ft.	Furnishing and Installing 1/C 350 MCM Power Cable . . . . . Per Lin. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
193.	12,000 Lin. Ft.	Furnishing and Installing 1/C 500 MCM Power Cable . . . . . Per Lin. Ft.				
194.	1,000 Lin. Ft.	Furnishing and Installing 1/C 750 MCM Power Cable . . . . . Per Lin. Ft.				
195.	100 Lin. Ft.	Furnishing and Installing 1/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
196.	3,000 Lin. Ft.	Furnishing and Installing 2/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
197.	2,000 Lin. Ft.	Furnishing and Installing 3/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
198.	3,000 Lin. Ft.	Furnishing and Installing 5/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
199.	1,000 Lin. Ft.	Furnishing and Installing 7/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
200.	2,500 Lin. Ft.	Furnishing and Installing 9/C #12 A.W.G. Control Cable . . . . . Per Lin. Ft.				
201.	100 Lin. Ft.	Furnishing and Installing 1/C #10 A.W.G. Control Cable . . . . . Per Lin. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
202.	100 Lin. Ft.	Furnishing and Installing 2/C #10 A.W.G. Control Cable . . . . Per Lin. Ft.				
203.	100 Lin. Ft.	Furnishing and Installing 4/C #10 A.W.G. Control Cable . . . . Per Lin. Ft.				
204.	Lump Sum	Furnishing and Installing Lighting System Lump Sum of	x x x	xx		
205.	270 Sq. Ft.	Furnishing and Erecting Concrete Block Masonry . . . . Per Sq. Ft.				
206.	Lump Sum	Furnishing and Installing Movable Partitions Lump Sum of	x x x	xx		
207.	Lump Sum	Furnishing and Installing Hollow Metal Doors Lump Sum of	x x x	xx		
208.	200 Lin. Ft.	Furnishing and Installing 36" CMP . . . . Per Lin. Ft.				

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
209.	200 Lin. Ft.	Furnishing and Installing 24" CMP . . . . . Per Lin. Ft.				
210.	200 Lin. Ft.	Furnishing and Installing 18" CMP . . . . . Per Lin. Ft.				
211.	400 Lin. Ft.	Furnishing and Installing 12" CMP . . . . . Per Lin. Ft.				
212.	Lump Sum	Temporary Catwalks on Dam Lump Sum of	x x x	xx		
213.	Lump Sum	Furnishing and Installing Timber Bulkhead Lump Sum of	x x x	xx		
214.	Lump Sum	Furnishing and Installing Aluminum Railings Lump Sum of	x x x	xx		
215.	Lump Sum	Furnishing and Installing Roof Ventilators Lump Sum of	x x x	xx		

ITEM NO.	APPROX. QUANTITY	ITEM (Prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
216.	Lump Sum	Installing Instruments in Dam Lump Sum of	x x x	xx		
217.	Lump Sum	Furnishing and Installing Window for Sluice Gate Control Center Lump Sum of	x x x	xx		
		* T O T A L . . .				

Date _____ _____
(Contractor)

Address_____ By_____

_____ By_____

Telephone_____

* Subject to State Sales Tax in accordance with the State Revenue Act of 1935.

BIDDER'S CHECK LIST

1. Has the Proposal been properly signed?
2. Is the amount of cash, the Bid Bond or Certified Check at least 5% of the total of bid?
3. Has your Bid Bond been approved by the Corporation Counsel?

   (See Instructions to Bidders)
4. Do the written amounts of the Proposal agree with the amounts shown in figures?
5. Have you bid on all the items?

CONTRACT

THIS CONTRACT, made this _____ day _____, A. D. 19___, by and between THE CITY OF SEATTLE, a Municipal Corporation of the State of Washington, hereinafter called "City", and MANNIX CONSTRUCTION INC., FRONTIER CONSTRUCTION COMPANY INC., _____, hereinafter called "Contractor", SEE CONTRACTORS INC., AND A JOINT VENTURE MCLAUGHLIN INCORPORATED, WITNESSETH:

Section 1. That the Contractor agree s to perform the work covered by Specification No. 1782 for

CONSTRUCTION OF ARCH DAM, POWER PLANT, AND

APPURTENANT WORKS FOR BOUNDARY PROJECT

as authorized by Ordinance No. 91783, in all respects in accordance with the plans now on file in the office of the Superintendent of Lighting of said City, and also in accordance with the specifications and instructions hereto attached, and the Laws of the State of Washington, and Charter and Ordinances of the City of Seattle, as amended and now in force, all of which, so far as applicable, are hereby made a part of this Contract.

Section 2. The Contractor agree s to begin the work embraced in the Contract for this improvement immediately after written notice shall have been given to the Contractor by the Superintendent of Lighting, and to carry on said work regularly and uninterruptedly thereafter (unless the Superintendent of Lighting or the Board of Public Works shall otherwise, in writing, especially direct,) with such force as to secure its completion within the time specified in Section 1A-5, "Time of Completion", the time of beginning, rate of progress and time of completion being essential conditions of this Contract.

Section 3. That the City agrees to pay to the Contractor for the actual quantities in the completed work according to the schedule of unit prices set forth in the proposal hereto attached and made a part of this Contract.

Section 4. Subject to the provisions of Chapter 63, Laws of Washington of 1945, the Contractor hereby covenant s, stipulate s and agree s:

That the y will pay or cause to be paid to the employees on or in connection with this work or under this Contract not less than the current hourly rate of wages specified for the class of labor performed.

That the y will not enter directly or indirectly into any agreement with any person or persons for labor or employment at any less wage.

That the y will not make or permit any assignment or transfer of this Contract, or any of the work to be performed hereunder, not sublet said work or any part thereof in any manner or by any scheme, device or subterfuge which will permit or secure the performance of labor upon or in connection with this work or under this Contract, at a rate of wage less than herein specified.

That every scheme or device by which employees employed upon or in connection with this work or under this Contract shall sublet or subcontract the same, or take any transfer or assignment of this Contract or of any work herein provided for, as a co-partnership or other association, whereby in lieu of receiving the minimum rate of wages hereinabove specified, they shall receive a less sum in cash and become sharers in the profits or losses under this Contract in compensation for their labor, shall be deemed a subterfuge, device or scheme to evade the provisions of this Contract, and shall be null and void and shall render this Contract subject to forfeiture.

The above covenants are made for the benefit of the individual employees of the Contractor, and that any employee performing work or labor under this Contract shall have a cause of action against the Contractor for the difference between the wages herein specified and the amount actually paid to such employee.

That the y will keep complete and accurate payrolls upon which shall appear the following information with respect to each person employed upon or in connection with this work or under this Contract.

1. Employee's name and residence address,
2. Classification of work as defined by specifications,
3. Number of hours employed each day,
4. Total number of hours employed each payroll period,
5. Travel Time paid,
6. Rate of Wages,
7. Total amount earned,
8. Deductions for medical aid,
9. Net amount paid.

Work performed at straight time rate shall be shown on one line of the payroll for each day and any overtime worked or other additional compensation must be shown on a separate line for each day and extended at the premium rate. The payroll shall be at all times accessible and open to inspection by the Board of Public Works, and a copy thereof duly signed by the Contractor or his authorized agent and verified before a Notary Public, to be filed with the Secretary of said Board not later than seventy-two (72) hours after the expiration of each payroll period.

That all employees will be paid in full not less often than once each week, and in lawful money of the United States, in the full amount accrued to each employee at the time of closing of the payroll, which shall not be more than three (3) days prior to the date of payment.

IN WITNESS WHEREOF, the City has caused these presents to be signed by the Chairman of the Board of Public Works and to be attested by the Secretary of said Board; and the Contractors have hereunto set THEIR ~~hand~~ CORPORATE SEAL DULY ATTESTED BY THE HAND OF THEIR PROPER OFFICERS IN THAT BEHALF, the day and year first above written.

THE CITY OF SEATTLE

By R W Morse
Chairman of Board of Public Works

E. B. Hewett
Secretary of Board of Public Works

MANNIX CONSTRUCTION INC.
Resident Secretary (or Treasurer)
Re: A M Mannix (President)
(SEAL)

SGS CONTRACTORS, INC.
Re: [illegible] Secretary
(SEAL)

McLAUGHLIN, INCORPORATED
Re: [illegible] Pres.
Re: J. D. McLaughlin (SEAL)
Chmn. Board

FRONTIER CONSTRUCTION COMPANY INC.
PER: G. B. Morris V.P.

Subject to the provision of Chapter 246, Laws of Washington of 1943, the Contractor hereby covenant s and stipulate s and agree s :

That I he Y will employ ninety-five (95) percent or more bona fide Washington residents as employees where more than fifty (50) persons are employed, and ninety (90) percent or more where fifty (50) or less are employed.

The term "resident" as used herein shall mean any person who has been a bona fide resident of the State of Washington for a period of ninety (90) days prior to such employment; provided, that in contracts involving the expenditure of federal aid funds, this specification shall not be enforced in such manner as to conflict with or be contrary to the federal statutes, rules and regulations prescribing a labor preference to honorably discharged soldiers, sailors and marines, or prohibiting as unlawful any other preference or discrimination among the citizens of the United States.

That in the event a sufficient number of Washington residents shall not be available, I he Y shall immediately notify the Board of Public Works of such facts and shall state the number of non-residents needed. The Board of Public Works shall immediately investigate the facts and if the conditions are as stated, said Board shall, by a written order, designate the number of non-residents which may be employed on said contract, and the period of employment; provided, that should residents become available within said period, such residents shall be employed immediately and the period shortened consistent with the supply of resident labor.

Should I he Y employ a non-resident in excess of the percentage preferences, excepting as herein permitted, I he Y shall have deducted for every violation, from the amount due them , the prevailing wages which should have been paid for a displaced resident. The money so deducted shall be retained by the City of Seattle.

In accordance with said statute, any contractor violating any of the provisions of this act shall be guilty of a misdemeanor.

That to facilitate the enforcement of the above covenants, the Contractor agrees to prepare and file with the Board of Public Works a complete list containing the names and residence addresses of all of his employees and keep the same up to date at all times.

That in the event of violation of any of these covenants or any provision thereof, payment due from the City of Seattle on any work done under this Contract may be withheld until full compliance therewith, the work may be stopped or, at the discretion of said Board of Public Works, with the consent of the City Council, this Contract may be cancelled and forfeited.

BOARD OF PUBLIC WORKS
of
THE CITY OF SEATTLE
Office of the Secretary

CONTRACTOR'S QUESTIONNAIRE

Before the contract is awarded the successful bidder will be required to properly execute the following affidavit.

---

1. CORPORATION: Name _____ Address _____ Phone _____
2. President _____ Address _____ Phone _____
   Secretary _____ Address _____ Phone _____
   Treasurer _____ Address _____ Phone _____
3. Has Company paid its annual State License Fees for corporations? _____
4. Who is authorized to execute contracts and receipt for checks? _____

_____

Signed by _____ Title _____

---

1. PARTNERSHIP: Name _____ Address _____ Phone _____
2. Are you doing business under an assumed name? _____
3. Have you filed your certificate with the County Clerk of King County, in compliance with Chapter 145 of the Session Laws of the State of Washington for the year 1907? _____
4. State name, residence address, phone number, citizenship and what interest each partner holds in the partnership.

   Name _____ Address _____ Phone _____
   Citizenship _____ Interest _____

   Name _____ Address _____ Phone _____
   Citizenship _____ Interest _____

   Name _____ Address _____ Phone _____
   Citizenship _____ Interest _____

   Name _____ Address _____ Phone _____
   Citizenship _____ Interest _____

5. Who is authorized to execute contracts and receipt for checks?_____

_____

(All partners must sign and swear to affidavit.)

Signed by_____

_____

_____

---

1. SOLE TRADER: Name_____Address_____Phone_____
2. Are you doing business under an assumed name?_____
3. Have you filed your certificate with the County Clerk of King County in compliance with Chapter 145 of the Session Laws of the State of Washington for year 1907?_____
4. Are you an American citizen?_____

Signed by_____

STATE OF WASHINGTON)
) ss.
COUNTY OF KING)

I,_____,

_____,

_____,

_____, having first been duly sworn, on oath, hereby depose and say: That I have read all of the foregoing answers or know the contents thereof and that each and all of said answers are in all respects true.

Signed by_____

_____

_____

Subscribed and sworn to before me this _____day of _____, 19___

_____

_____
Notary Public

SEAL

PAYROLL AFFIDAVITS

1. AFFIDAVIT FOR AN AGENT. The affidavit for an agent to accompany the first payroll report shall be in substantially the following form:

I, _____ (Affiant), hereby certify that _____ (Agent) _____ (Title) pays or supervises the paying of the employees of _____ (Contractor) on the following project for the City of Seattle, _____ (Name of Project) _____ Ordinance No. _____, and is in a position to have full knowledge of the facts set forth in the affidavit respecting the payment of wages of employees working on the project herein mentioned.

_____ (Affiant)

Sworn to before me this _____ day of _____ 19__

_____
Notary Public

If the agent is changed, a new affidavit will be required.

2. PAYROLL AFFIDAVIT. The affidavit accompanying each payroll report shall be in substantially the following form:

I, _____ (Affiant) _____ (Title), hereby certify that I pay or supervise the payment of the persons employed by _____ (Contractor), on the following project for the City of Seattle _____, Ordinance No. _____.

That the attached payroll sets out accurately and completely the name, occupation, hourly wage rate, total number of hours worked and the full weekly wages earned, of each person employed on the above project for the weekly payroll period from the _____ day of _____ 19__, to the _____ day of _____, 19__;

That no laborer, workman or mechanic employed on the above project has been paid less than the prevailing rate of wage or less than the minimum rate of wage specified in the contract;

That no rebates have been made either directly or indirectly to or on behalf of said Contractor from the full weekly wages earned as set out on the attached payroll and that the full amount due has been paid.

_____
Signature of Affiant

Sworn to before me this _____ day of _____ 19__.

_____
Notary Public

The City Comptroller will withhold payment on all estimates of work performed by the Contractor under this contract until all payroll reports of said Contractor for work performed have been filed with the Secretary of the Board of Public Works.

MINIMUM WAGE RATES - PEND OREILLE COUNTY

Furnished for City of Seattle Department of Lighting by Industrial Relations Division Department of Labor and Industries State of Washington.

Attention is called to the fact that many of the crafts have Fringe Benefits such as Health and Welfare, Pension and Vacation Plans which must be paid in addition to the hourly wage rate listed.

Sole responsibility falls upon the Contractor to ascertain for himself the amount of such benefits.

Effective January 6, 1964

Job Classification	Per Hour
ASBESTOS WORKERS: (To 8/1/64)	
Asbestos Workers, Journeymen	$ 4.44
Asbestos Workers, Improvers:	
1st Year - 60% of Journeyman Rate	2.66
2nd Year - 70% of Journeyman Rate	3.11
3rd Year - 80% of Journeyman Rate	3.55
4th Year - 90% of Journeyman Rate	4.00
BOILERMAKERS: (To 9/30/65)	
Foreman	5.25
Assistant Foreman (Leadman)	5.00
Boilermaker	4.75
Boilermaker's Helper	4.45
BRICKLAYERS: (As of 1/1/64)	4.66
CARPENTERS AND ALLIED TRADES: (To 6/1/64)	
Carpenters	4.04
Carpenters working Burned, Charred, Creosoted or Similarly Treated Material	4.29
Sawfiler, Floor Layers, Floor Finishers, Floor Sanders	4.19
Operators of Stationary Power Woodworking Tools	4.19
Shingler, Wood or Composition	4.24
Millwrights and Machine Erectors	4.24
Piledrivers	4.19
Diver Tenders	4.19
Boom Men	4.29

Riggers, Burners and Welders shall be paid according to the Classifications in which they are working.

Foreman shall receive at least 37 1/2 cents per hour above the highest paid Journeyman working under him.

Job Classification	Per Hour
CEMENT MASONS: (To 6/1/64)	
Journeyman Cement Mason	$ 3.98
Power Troweling Machine	4.13
Troweling Magnesite or other Material with oxichloride Base, Power Machine and Power Tool Operators*	4.13
Gunnite Operator	4.13
*Power Tool includes but is not limited to the following: Chipping Gun, Bush Hammer and Diamond Saw.	
When working on Swinging Scaffold or Boatswain Chair, Masons shall be paid 20¢ per hour over the Classification of work assigned.	
CONSTRUCTION ELECTRICIANS: (To 4/1/64)	
Wood Pole Transmission and Distribution Lines:	
Cable Splicer Foremen	5.17
Cable Splicer	4.82
Line Crew Foreman	4.82
Journeyman Lineman	4.35
Pole Sprayer	4.35
Heavy Line Equipment Man	4.35
Line Equipment Man	3.88
Head Groundman	3.43
Powderman	3.43
Jackhammerman	3.43
Groundman	3.23
Hole Digger	3.17
Apprentice Lineman:	
1st 6 Months - 75.5% of Journeyman Rate	3.26
2nd 6 Months - 77.8% of Journeyman Rate	3.36
3rd 6 Months - 82.1% of Journeyman Rate	3.55
4th 6 Months - 85.7% of Journeyman Rate	3.71
5th 6 Months - 89.8% of Journeyman Rate	3.90
6th 6 Months - 92.8% of Journeyman Rate	4.03
Foreman, Tree Trimming	4.49
Tree Trimmer	3.88
Head Groundman (Chipper)	3.43
Tree Trimmer Helper	3.23
Steel Tower Transmission Lines and Steel Substations:	
Foreman	4.82
Lineman (Erection and Wire)	4.35
Lineman (Assembly)	3.88
Heavy Line Equipment Man	4.35
Line Equipment Man	3.88
Head Groundman	3.43
Groundman	3.23
Welder (Certified)	4.35

Job Classification	Per Hour
CONSTRUCTION ELECTRICIANS: (Continued)	
Apprentice Lineman:	
1st 6 Months - 75.5% of Journeyman Rate	$ 3.26
2nd 6 Months - 77.8% of Journeyman Rate	3.36
3rd 6 Months - 82.1% of Journeyman Rate	3.55
4th 6 Months - 85.7% of Journeyman Rate	3.71
5th 6 Months - 89.8% of Journeyman Rate	3.90
6th 6 Months - 92.8% of Journeyman Rate	4.03
Telephone Line Construction, Equipment Installation and Tree Trimming:	
Foreman	3.82
Cable Splicer	3.82
C. O. Installer	3.82
Apprentice Cable Splicer or C. O. Equipment Installer:	
1st 6 Months - 71.0% of Cable Splicer or Installer Rate	2.71
2nd 6 Months - 72.7% of Cable Splicer or Installer Rate	2.78
3rd 6 Months - 76.3% of Cable Splicer or Installer Rate	2.91
4th 6 Months - 80.0% of Cable Splicer or Installer Rate	3.06
5th 6 Months - 83.4% of Cable Splicer or Installer Rate	3.19
6th 6 Months - 85.9% of Cable Splicer or Installer Rate	3.28
7th 6 Months - 90.7% of Cable Splicer or Installer Rate	3.46
8th 6 Months - 95.2% of Cable Splicer or Installer Rate	3.64
Installer - Repairman	3.64
Lineman	3.53
Pole Sprayer	3.53
Powderman, Jackhammer and Head Groundman	3.07
Groundman	2.72
Hole Digger	2.67
Apprentice Lineman:	
1st 6 Months - 76.8% of Lineman Rate	2.71
2nd 6 Months - 78.7% of Lineman Rate	2.78
3rd 6 Months - 82.6% of Lineman Rate	2.92
4th 6 Months - 86.6% of Lineman Rate	3.06
5th 6 Months - 90.2% of Lineman Rate	3.18
6th 7 Months - 93.0% of Lineman Rate	3.28
Tree Trimming Foreman	3.71
Tree Trimmer	3.42
Tree Trimmer Helper	2.72
Head Groundman (Chipper)	3.07
ELECTRICAL WORKERS: (As of 1/1/64)	
General Foreman	5.25
Foreman	4.85
Journeyman Wireman	4.45
Journeyman Cable Splicer	4.70
Journeyman Technician	4.45

Job Classification	Per Hour
ELECTRICAL WORKERS: (Continued)	
Apprentices:	
First Year - 1st 6 Months	- 50% of Journeyman Wireman's Rate
2nd 6 Months	- 55% of Journeyman Wireman's Rate
Second Year	- 60% of Journeyman Wireman's Rate
Third Year	- 70% of Journeyman Wireman's Rate
Fourth Year	- 80% of Journeyman Wireman's Rate
Fifth Year	- 90% of Journeyman Wireman's Rate
ELEVATOR CONSTRUCTORS: (Eastern Washington Rates)	
Foreman	$ 4.78
Mechanic	4.25
Helpers	2.975
Probationary Helper	2.125
ELEVATOR CONSTRUCTORS: (Western Washington Rates)	
Foreman	4.93
Mechanic	4.38
Helpers	3.07
Probationary Helper	2.19
GLAZIERS: (To 7/1/64)	3.64
IRON WORKERS: (To 6/20/64)	
Structural Iron Worker	4.37
Machinery Mover, Erector and Setter	4.37
Welders and Burners	4.37
Riggers	4.37
Sheeters	4.37
Fence Erectors	4.37
Ornamental Iron Workers	4.37
Reinforcing Iron Workers	4.17
Apprentices:	
1st Year - 80% of Journeyman Iron Worker's Rate	
2nd Year - 90% of Journeyman Iron Worker's Rate	
3rd Year - 95% of Journeyman Iron Worker's Rate	
LABORERS - HEAVY AND HIGHWAY: (To 4/1/64)	
GROUP NO. 1:	
Car Loader	3.17
Choker Setter	3.17
Concrete Crewman	3.17
Corrugated Metal Culvert Pipe Layer	3.17
Crusher Feeder	3.17
Demolition Labor	3.17
Driller Helper	3.17
Dumpman	3.17
Fence Erector	3.17
Flagman	3.17
Form Stripper	3.17

Job Classification	Per Hour
LABORERS - HEAVY AND HIGHWAY: (Continued)	
GROUP NO. 1: (Continued)	
General Labor	$ 3.17
Railroad Track Laborer	3.17
Riprap Man	3.17
Scale Man	3.17
Stake Jumper	3.17
Structure Mover	3.17
Tailhose Man (Water Nozzle)	3.17
Timber Bucker and Faller	3.17
Truck Loader	3.17
GROUP NO. 2:	
Air, Steam, Water Nozzleman	3.32
Cement Handler	3.32
Cement Finisher Tender	3.32
Demolition Torch Operator	3.32
Dope Pot Fireman, Non-Mechanical	3.32
Form Cleaning Machine, Feeder and Stacker	3.32
Mechanical Railroad Equipment	3.32
Paving Form Setter	3.32
Pipe Wrapper	3.32
Pot Tender	3.32
Powderman Helper	3.32
Power Driven Wheelbarrow	3.32
Power Tool Operator, Gas, Electric or Pneumatic	3.32
Sandblast Tail Hose Man	3.32
Scaffold Erector, Steel Or Wood	3.32
Rod and Spreader	3.32
Well Point Man	3.32
Vibrator Operator up to 4"	3.32
GROUP NO. 3:	
Asphalt Raker	3.42
Asphalt Roller - Walking	3.42
Barco and Essex Tamper	3.42
Chain Saw Operator, with Attachments	3.42
Concrete Saw - Walking	3.42
Creosote Material Handler	3.42
High Scaler	3.42
Jackhammer Operator	3.42
Multi-Section Pipe Layer	3.42
Pavement Breaker Operator	3.42
Vibrator - 4" or over	3.42
Water Pipe Liner	3.42
Shawnee Trencher - Walking	3.42
Wagon Drills	3.42

Job Classification	Per Hour
LABORERS - HEAVY AND HIGHWAY: (Continued)	
GROUP NO. 4:	
Non-Metallic Clay and Concrete Pipe Layer	$ 3.47
Shorer and Lagger	3.47
GROUP NO. 5:	
Caisson Worker, Free Air	3.57
GROUP NO. 6:	
Gunnite Nozzleman and Machine Operator	3.62
Sand Blaster	3.62
Big Drills, Out of the Hole Drills, 4 1/2" Piston or larger	3.62
Down the Hole Drills, 3 1/4" or larger	3.62
Powderman	3.62
GROUP NO. 7:	
Tunnel and Shaft Laborers, Free Air:	
Brakeman	3.27
Bull Gang	3.22
Chuck Tender	3.27
Concrete Nozzleman	3.67
Dumpman	3.27
Miner	3.67
Nipper	3.22
GROUP NO. 8:	
Sand Hogs (Under Compressed Air Conditions):	
All Men Working under Air Pressure:	
1 to 18 pounds - 3 Hour On, 1 Off, 3 On	33.16
18 to 25 pounds - 2 Hours On, 4 Off, 2 On	34.16
25 to 33 pounds - 2 Hours On, 4 Off, 2 On	36.16
33 to 38 pounds - 1 1/2 Hours On, 4 1/2 Off, 1 1/2 On	36.16
Cofferdam Work:	
Where hazard is equivalent to Shaft Excavation on Cofferdam Work, there shall be a fifteen cents (15¢) per hour premium on all Classifications.	
Premium Pay:	
Men working on a Swinging Stage or Boatswain Chair or supported by a Life Belt off a Line or Block and Tackle shall receive twenty-five cents (25¢) per hour above his regularly established rate. This provision does not, however, apply to High Scalers.	
LABORERS - BUILDING: (To 4/1/64)	
GROUP NO. 1:	
General Laborers	3.17
Flagman	3.17
Carpenter Tender	3.17
Form Stripper	3.17

Job Classification	Per Hour
LABORERS - BUILDING: (Continued)	
GROUP NO. 1: (Continued)	
Mucker - Open Ditch	$ 3.17
Concrete Crew and Fine Graders	3.17
Applying Concrete Curing Compounds	3.17
Demolition Laborers (Includes Salvaging all Material, Loading, Cleaning Up, Wrecking & Burning)	3.17
Structure Mover - Includes: Foundation Separation, Preparation, Cribbing, Shoring, Jacking, Unloading of Structures	3.17
Truck Loader	3.17
GROUP NO. 2:	
Cement Finishers Tender	3.32
Power Tool Operators	3.32
Power-Driven Wheelbarrow (or Similar Equipment)	3.32
Handling Cement Sack or Bulk	3.32
Powderman Helper	3.32
Erecting Steel or Wood Scaffold	3.32
Steam Nozzleman (Building)	3.32
Pot Tender (Sand Blast)	3.32
Form Cleaning Machine Operator (Feeder and Stacker)	3.32
GROUP NO. 3:	
Jackhammer Operator	3.42
Barco and Essex Tamper Operator	3.42
GROUP NO. 4:	
Non-Metallic Clay and Concrete Pipe Laying Crews	3.47
Timberman - Open Ditch	3.47
GROUP NO. 5:	
Mortar Mixer and Hod Carriers	3.52
Laborers when working on Free Standing Concrete Stacks for Smoke or Fume Control above 40 feet	3.52
GROUP NO. 6:	
Powderman	3.62
Sandblaster and Gunitemen	3.62
LATHERS: (To 6/4/64)	4.17
LINOLEUM AND SOFT TILE LAYERS: (To 6/1/64)	3.75
MARBLE MASONS: (As of 1/1/64)	
Marble Masons - Exterior	4.66
Marble Masons - Interior	4.36
PAINTERS: (To 4/1/64)	
Painters - Brush	3.81
Painters - Spray	4.06
Painters - Steel	4.06
Painters - Sandblasting	4.06

Job Classification	Per Hour
PLASTERERS: (To 6/4/64)	$ 4.17
PLUMBERS: (As of 1/1/64)	4.57 - Incls. 19¢ Per Hour Vacation Pay
POWER EQUIPMENT OPERATORS: (To 5/31/64)	
Universal Equipment:	
Whirleys, All	4.70
Backhoes - 3 yards and over	4.70
Backhoes - Under 3 yards	4.45
Cableway Operators - 65 tons and over	4.70
Cableway Operators - Under 65 tons	4.45
Clamshell Operators - 3 yards and over	4.70
Clamshell Operators - Under 3 yards	4.45
Cranes - 65 tons and over	4.70
Cranes - Under 65 tons	4.45
Derricks - 65 tons and over	4.70
Derricks - Under 65 tons	4.45
Draglines - 3 yards and over	4.70
Draglines - Under 3 yards	4.45
Mucking Machines	4.45
Piledriver Engineers	4.45
Shovels - 3 yards and over	4.70
Shovels - Under 3 yards	4.45
Signal Men, Whirleys, Highline, Hammerhead and Similar	4.45
Asphalt Paving:	
Asphalt Plant Operator	4.15
Pavers and Spreaders, Adnum, Yeager, Barber Greene, etc.	4.00
Screed Operator	4.00
Rollerman, Finishing Pavement	4.00
Power Broom	3.90
Assistant Plant Operator, Fireman or Pugmixer	3.90
Spreader Box, Self-Propelled	3.90
Distributor Leverman	3.70
Roller, All Types on Subgrade or Compacting of Vibrators	3.60
Concrete and Aggregate Equipment:	
Paver - Dual Drum	4.45
Batch and Wet Mix Operator - Multiple Units	4.45
Crusher and Screening Plant Operator	4.15
Paver	4.15
Transverse Finishing Machine - Airport	4.15
Spreader Machine - Airport	4.15
Grout Pump	4.15
Pumpcrete	4.15
Mixermobile	4.15
Transverse Finishing Machine - Highway	4.00
Spreader Machine - Highway	4.00

Job Classification	Per Hour
POWER EQUIPMENT OPERATORS: (Continued)	
Concrete and Aggregate Equipment: (Continued)	
Batch and Wet Mix Operator	$ 3.90
Mixer - Portable	3.90
Longitudinal Float	3.90
Belt Finishing Machine	3.90
Concrete Saw, Multiple Cut	3.90
Spray Curing Machine	3.90
Cement Hog	3.90
Blower Operator - Cement	3.90
Loaders - Bucket Elevators and Conveyors	3.90
Bagley or Stationary Scraper	3.90
Pavement Breaker - Hydrahammer and Similar	3.60
Crusher Feeder - Mechanical	
Grading Equipment:	
Euclid or Sierra Elevating Grader	4.45
Euclid, TS-24 and Similar	4.30
Blade, Motor Patrol - Including Attachments	4.15
Tournapulls, DW-20, 21 and Similar Rubber Tired Scrapers	4.15
Tractor, Crawler Type, including Dozer, Scraper, Drills, Booms, etc.	4.15
Tractor, Rubber Tired Farm Type with Attachments, except Backhoe	3.90
Grade Checker - Optional with Contractor	3.60
Service Personnel:	
Mechanic or Welder, Heavy Duty	4.25
Oiler and Cable Tender, Mucking	3.90
Helper, Mechanic or Welder, Heavy Duty	3.60
Servicemen - Greasers and Oilers	3.60
Oilers on all other Equipment	3.60
Welding Machines	3.60
Pipeline Personnel not Covered by National Agreement:	
Trenching Machines - 7 ft. depth and over - Factory Rating	4.45
Trenching Machines - Under 7 ft. depth capacity	4.15
Boom Cats	4.15
Backfillers - Cleveland and Similar	4.15
Cleaning and Doping Machines	4.15
Bending Machines	3.90
Gin Trucks	3.90
Dope Pots - Power Agitated	3.90
Miscellaneous Equipment:	
Loader Operator, Front End and Overhead - 5 yards & over	4.45
A-Frame Truck - 2 or more Drums	4.15
Locomotive Engineer - 20 tons or over	4.15
Boring Machine, Earth or Rock - Joy, Quarrymaster and Similar Tractor Drills	4.15
Drills - Churn, Core, Calyx or Diamond	4.15

Job Classification	Per Hour
POWER EQUIPMENT OPERATORS: (Continued)	
Miscellaneous Equipment: (Continued)	
Generator Plant Engineers, Diesel Electric	$ 4.15
Refrigerator Plant Engineer	4.15
Hoist - 2 or more Drums or Tower Hoist	4.15
Loader Operator, Front End and Overhead - Over 3 yards, under 5 yards	4.15
Tug Boat	4.15
A-Frame Truck - Single Drum	3.90
Compressor - 1000 cu. ft. or over or 2 or more	3.90
Locomotive Engineer Under 20 tons	3.90
Battery Tunnel Locomotive	3.90
Hoist - Single Drum	3.90
Hydralift, Fork Life and Similar - When Hoisting	3.90
Loader Operator, Front End and Overhead - 3 yards & under	3.90
Compressor	3.60
Brakeman	3.60
Drillers Helper	3.60
Deck Hand	3.60
Pump Men	3.60
Fireman and Heater Tender	3.60
Any Machine not Classified Above - Subject to Negotiation	
Underground 10% Additional, except Mucking Machines, Tunnel Locomotives and Cable Tenders.	
Craft Foreman or Shifters shall be paid 25¢ per hour over Scale of highest paid Operating Engineer under his direction.	
ROOFERS: (To 7/1/64)	
Roofers and Kettlemen	3.90
Roofers working with Irritable Bituminous Materials	4.18
SHEET METAL WORKERS: (To 5/1/64)	4.40 - Incls. 15¢ Per Hour Vacation Pay
STEAM FITTERS: (As of 1/1/64)	4.57 - Incls. 19¢ Per Hour Vacation Pay
STONE MASONS: (As of 1/1/64)	4.66
TERRAZZO WORKERS: (As of 1/1/64)	4.38
TILE SETTERS: (As of 1/1/64)	4.38
TEAMSTERS: (To 5/1/64)	
"A" Frame	3.85
Buggymobile	3.65
Bus Driver	3.60

Job Classification	Per Hour
TEAMSTERS: (Continued)	
Dumptor - 6 yards and under	$ 3.75
Escort Driver	3.55
Flat Bed Truck - 2 Axle	3.55
Flat Bed Truck - 3 Axle	3.60
Flat Bed Truck - Using Power Take Off	3.75
Fork Lift - 3,000 lbs. and under	3.55
Fork Lift - Over 3,000 lbs.	3.75
Greaser - Grease Truck Driver and/or Fuel Truck	3.55
Helper	3.55
Leverman Loading Trucks at Bunkers	3.55
Semi Trailer, Low Bed, Truck and Trailer	3.65
Low Bed - 25 tons and over	3.75
Lumber Carrier	3.65
Oil Distributor Driver (Road)	3.75
Pickup Hauling Material	3.55
Transit Mixers and Truck Hauling Concrete:	
3 yards and under	3.65
Over 3 yards to 6 yards	3.75
6 yards and over	3.90
Trucks, Side, End and Bottom Dump and Spreaders:	
Under 6 yards	3.65
Over 6 yards to 12 yards	3.75
Over 12 yards including 20 yards	3.90
Over 20 yards	4.05
Trucks, Bottom Dump:	
12 yards and under	3.90
12 yards including 20 yards	4.05
Over 20 yards	4.10
Tournarocker, D.W.'s and Similar	4.10
Team Driver	3.55
Tireman No. 1	3.55
Tireman No. 2	3.75
Warehousemen	3.55
Water Tank Truck:	
1800 gallons	3.55
1801 - 4000 gallons	3.65
4001 - 6000 gallons	3.75
Over 6000 gallons	3.85

Truck - Tractor Pulling 2 Trailers - Add 10¢ to Yardage Scale.

Foreman or Dispatcher - 25¢ over Scale

Underground Work - 10% Additional

Provided further, that if a Water Tank is used on Earth-Moving Equipment, the regular Equipment Scale shall apply while in use as a Water Wagon.

Job Classification	Per Hour

TEAMSTERS: (Continued)

Water Tank Truck: (Continued)

Drivers and Helpers Handling Sack Cement shall receive 15¢ per hour premium pay.

Any Employee working any portion of a Shift in a higher rated Classification or higher rate of pay shall receive the higher Rate for the entire Shift.

SECTION 1A

PROJECT GENERAL REQUIREMENTS

1. DESCRIPTION OF THE WORK

Boundary Project will consist principally of a concrete arch dam approximately 400 feet high from lowest foundation to crest and an underground power plant with an ultimate total generating capacity of approximately 900,000 kilowatts.

In general, the principal features of the project will be constructed under three separate contracts. Work under the first contract for Specification No. 1731, "Underground Excavation for Machine Hall, Mucking Tunnels, Diversion Tunnel, Penstocks and Appurtenant Works", is presently being performed by others. The second contract for work covering construction of the arch dam and work for constructing the power plant, except underground excavation and installation of various equipment items, will be performed under these specifications. The third contract for installation of the remaining mechanical and electrical equipment items, required to complete the project will be performed by others under a separate contract which will be awarded before the second contract is completed. Following is a general description of the work required under these specifications.

The diversion tunnel will be a 42-foot horseshoe tunnel approximately 1000 feet long, excavated under the left abutment of the dam. This tunnel, except for a short length adjacent to each portal, will be excavated and lined as part of the underground excavation contract performed by others. Excavation at the portals and other work necessary to complete the construction of the diversion tunnel will be performed under this contract. Cofferdams, upstream and downstream of the dam will be required to divert the river.

Boundary Dam, to be constructed under this contract, will be a variable radius concrete arch dam. The height of the dam will be about 340 feet above the top of a concrete plug to be constructed in the river bottom. The crest length of the dam will be about 508 feet. Two identical radial spillway gates and hoists will be installed, one at each abutment at the crest. In addition there will be a Bascule-type skimmer gate for the discharge of trash at the left abutment. The total length of the crest including the spillways will be about 740 feet. Seven sluice gates and hoists will be installed at the downstream face of the dam, approximately 200 feet below the crest. A horizontally traveling maintenance gate for the sluice gates will be installed on the upstream face of the dam. A 12-foot wide roadway on the crest of the dam will provide access to the crest gates. A roadway on the downstream side of the dam above the sluice gates will connect with the dam access gallery and provide access to the sluice gates and hoists. All excavation and grouting for the dam will also be included in this Contract.

The underground power plant will ultimately have six generating units located in an underground machine hall, excavated by others, approximately 75 feet wide, 475 feet long and 130 feet high.

Work required in the machine hall under this contract includes the construction of the service bay and four unit bays, the installation of arched ceiling, cranes, spiral cases and draft tube liners for four turbines, and furnishing and installing elevator and an air conditioning system. Upstream of the machine hall the work under this contract will include construction of concrete linings and installation of steel liners for the six penstocks; construction of concrete structures and installation of gates, frames and hoists for six intake gates, completion of construction for six intake tunnels, performance of open-cut excavation for the forebay; construction of the trashrack structure, and installation of trash racks and trash rake; and completion of construction of the elevator shaft at the left abutment including furnishing and installing the elevator. The work required downstream of the machine hall include additional excavations required for draft tubes and open-cut excavation of the tailrace for six (6) units; construction of lining for six draft tubes and six draft tube gate chambers including installation of gates, guides and a gantry crane; construction of concrete structures for six transformer bays and bus galleries. Electrical work includes grounding, lighting, and connecting all equipment to be installed under this Contract.

2. LOCATION OF THE SITE

The Boundary Project is located on the Pend Oreille River in Pend Oreille County approximately 100 miles north of Spokane, Washington, and one mile south of the International Boundary. The site of the work can be reached via approximately 12 miles of existing roads located on the west side of the river north of the town of Metaline, Washington.

3. INSPECTION OF SITE

The project work area has been cleared by others. The approximate location of the main features to be constructed under this Contract are staked in the field. The site of the work has been explored by diamond drilling and by two 5 foot x 7 foot exploratory tunnels excavated in the abutments at the project site.

The exploratory tunnel in the left abutment passes through the machine hall excavation and continues into the left abutment of the dam. The second exploratory tunnel was excavated in the right abutment of the dam. The locations of these tunnels are shown on Drawings D-23041 and D-23058. The tunnel in the right abutment of the dam is available for inspection by the bidders. The tunnel in the left bank of the river will be partially removed as part of the machine hall excavation presently being performed under a separate contract, however, the portions of the tunnel accessible at the time of bidding will be available for inspection. The completed portions of underground excavation for the machine hall, intake tunnels, diversion tunnel and mucking tunnels will be also available for inspection.

Logs of the diamond drill cores are shown on Drawing Nos. D-23046 to D-23056, inclusive. The cores obtained from exploratory drilling are available for inspection at the site.

Prospective bidders must make prior arrangements for visiting the site of the work. Such arrangements may be made by communicating with the Project Manager, Post Office Box 507, Metaline Falls, Washington. Telephone: Hilltop 6-4501.

4. DRAWINGS

a. The following drawings are made a part of these specifications:

GENERAL

	Drawing No.	Title
1.	D-23034 Rev. 2	Reservoir Map
2.	D-19085 Rev. 0	General Plan
3.	D-23036 Rev. 4	Site Plan
4.	D-19018 Rev. 1	Graphs of Maximum Stream Flow - Precipitation and Temperature
5.	D-19041 Rev. 2	Project Works Area - Primary Survey Control
5a.	D-23057 Rev. 0	Upper Disposal Area - Grading Plan
6.	B-5506 Rev. 0	Arch Dam & Power Plant - Tentative Construction Schedule

HYDROGRAPHS

7.	D-23037 Rev. 0	Hydrographs - Pend Oreille River at Z-Canyon - Sheet 1 of 3
8.	D-23038 Rev. 0	Hydrographs - Pend Oreille River - Sheet 2 of 3
9.	D-23039 Rev. 0	Hydrographs - Pend Oreille River - Sheet 3 of 3

EXPLORATIONS

10.	D-23041 Rev. 4	Exploratory Tunnel - General Arrangement - Plan & Sections
11.	D-23058 Rev. 1	Dam Site - Right Abutment - Exploratory Tunnel - General Arrangement
12.	D-23044 Rev. 2	Exploratory Core Holes - Plan

	Drawing No.	Title
13.	D-23045 Rev. 1	Exploratory Core Holes - Sections
14.	D-23046 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 1
15.	D-23047 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 2
16.	D-23048 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 3
17.	D-23049 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 4
18.	D-23050 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 5
19.	D-23051 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 6
20.	D-23052 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 7
21.	D-23053 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 8
22.	D-23054 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 9
23.	D-23055 Rev. 1	Exploratory Core Holes - Graphic Logs - Sheet 10
24.	D-23056 Rev. 0	Exploratory Core Holes - Graphic Logs - Sheet 11

UNDERGROUND EXCAVATIONS

25.	D-23171 Rev. 1	Diversion Tunnel - Excavations - Plan, Profile & Sections
26.	D-23172 Rev. 3	Access & Mucking Tunnels - Excavation - General Arrangement
27.	D-23173 Rev. 3	Access & Mucking Tunnels - Excavation - Plans & Sections
28.	D-23174 Rev. 1	Access Elevator - Excavation

	Drawing No.		Title
29.	D-23175	Rev. 2	Machine Hall - Excavation - Plan & Sections
30.	D-23176	Rev. 2	Machine Hall - Excavation - Sections
31.	D-23177	Rev. 2	Draft Tubes & Transformer Bays - Excavation - Sheet 1 of 3
32.	D-23178	Rev. 2	Draft Tubes & Transformer Bays - Excavation - Sheet 2 of 3
33.	D-23179	Rev. 2	Draft Tubes & Transformer Bays - Excavation - Sheet 3 of 3
34.	D-23181	Rev. 4	Intake Tunnels & Penstocks - Excavation - Plan
35.	D-23182	Rev. 4	Intake Tunnels & Penstocks - Excavation - Sections
36.	D-23183	Rev. 0	Rock Reinforcement & Surface Treatment - Typical Details

ARCH DAM - CIVIL

37.	D-23060	Rev. 1	Arch Dam - General Arrangement
38.	D-23073	Rev. 1	Arch Dam - Plan
39.	D-23074	Rev. 1	Arch Dam - Upstream Elevation
40.	D-23075	Rev. 1	Arch Dam - Downstream Elevation
41.	D-23076	Rev. 1	Arch Dam - Vertical Sections
42.	D-23077	Rev. 1	Arch Dam - Basic Geometry
43.	D-23078	Rev. 1	Arch Dam - Section at El. 1800
44.	D-23079	Rev. 1	Arch Dam - Section at El. 1842
45.	D-23080	Rev. 1	Arch Dam - Plan of Hoist Deck
46.	D-23081	Rev. 1	Arch Dam - Sections Thru Sluices
47.	D-23084	Rev. 0	Arch Dam - Excavation - El. 1725 to El. 1930
48.	D-23088	Rev. 0	Arch Dam - Excavation - Below El. 1725

	Drawing No.		Title
49.	D-23089	Rev. 0	Arch Dam - Access Bridge - Precast Concrete Slabs - Details
50.	D-23090	Rev. 0	Arch Dam - Spray & Hoist Decks - Concrete Outline - Plans
51.	D-23091	Rev. 0	Arch Dam - Spray & Hoist Decks - Concrete Outline - Sections
52.	D-23092	Rev. 0	Arch Dam - Spray & Hoist Decks - Support Frames - Details
53.	D-23093	Rev. 0	Arch Dam - Access Bridge - Concrete Outline - Typical Sections & Bearings
54.	D-23094	Rev. 0	Sluice Gate Control Center - Concrete Outline & Typical Reinforcement
55.	D-23095	Rev. 0	Arch Dam - Typical Reinforcement - Sheet 1 of 2
56.	D-23096	Rev. 0	Arch Dam - Typical Reinforcement - Sheet 2 of 2
57.	D-23097	Rev. 0	Arch Dam - Sluiceway Steel Liners - Geometry
58.	D-23098	Rev. 0	Arch Dam - Sluiceway Steel Liners - Details
59.	D-23099	Rev. 0	Arch Dam - Miscellaneous Metalwork
60.	D-23100	Rev. 0	Arch Dam - Spray & Hoist Decks - Stairway - Plans & Details
61.	D-23101	Rev. 0	Arch Dam - Spray & Hoist Decks - Stairway - Sections & Details
62.	D-23102	Rev. 0	Arch Dam - Contraction Joints & Grouting - Details
63.	D-23103	Rev. 0	Arch Dam - Concrete Cooling
64.	D-23104	Rev. 0	Arch Dam & Power Station - Foundation Grouting - Plan Elevation & Sections
65.	D-23105	Rev. 0	Arch Dam & Power Station - Typical Grouting Details

Drawing No.		Title
66.	D-23086 Rev. 1	Arch Dam - Dam Instrumentation
67.	B-5507 Rev. 0	Arch Dam Forebay Areas - Door Schedules

SPILLWAY AREAS - CIVIL

68.	D-23082 Rev. 1	Spillways - Left Abutment - General Arrangement
69.	D-23083 Rev. 1	Spillway - Right Abutment - General Arrangement
70.	D-23106 Rev. 0	Spillways - Left Abutment - Excavation
71.	D-23107 Rev. 0	Spillway - Right Abutment - Excavation
72.	D-23108 Rev. 0	Spillways - Concrete Outline & Typical Reinforcement - Sheet 1 of 3
73.	D-23109 Rev. 0	Spillways - Concrete Outline & Typical Reinforcement - Sheet 2 of 3
74.	D-23110 Rev. 0	Spillways - Concrete Outline & Typical Reinforcement - Sheet 3 of 3
75.	D-23087 Rev. 1	Access Elevator - General Arrangement
76.	D-23111 Rev. 1	Access Elevator - Concrete Outline - Sections
77.	D-23112 Rev. 0	Access Elevator - Typical Reinforcement
78.	D-23113 Rev. 0	Spillway Structures - Access Elevator - Miscellaneous Metalwork - Sheet 1 of 2
79.	D-23114 Rev. 0	Spillway Structures - Access Elevator - Miscellaneous Metalwork - Sheet 2 of 2

STREAM DIVERSION

80.	D-23130 Rev. 0	Stream Diversion - General Arrangement
81.	D-23131 Rev. 0	Diversion Tunnel - Intake Structure - Concrete Outline & Reinforcement

	Drawing No.	Title
82.	D-23132 Rev. 0	Diversion Tunnel - Intake Structure - Closure Gate - Steel Details
83.	D-23133 Rev. 0	Diversion Tunnel - Intake Structure - Gate Lowering Mechanism - Steel Details
84.	D-23134 Rev. 0	Diversion & Lower Mucking Tunnel Plugs - Concrete Outline & Details

FOREBAY & INTAKES - CIVIL

85.	D-23135 Rev. 0	Forebay - General Arrangment - Plan & Sections
86.	D-23136 Rev. 0	Forebay - Excavation - Plan and Sections
87.	D-23137 Rev. 0	Trashrack Structure - Excavation - Plan & Sections
88.	D-23138 Rev. 0	Trashrack Structure - General Arrangement - Sheet 1 of 2
89.	D-23139 Rev. 0	Trashrack Structure - General Arrangement - Sheet 2 of 2
90.	D-23140 Rev. 0	Trashrack Structure - Typical Reinforcement
91.	D-23141 Rev. 0	Trashrack Structure - Trashracks & Guides - Steel Details
92.	D-23142 Rev. 0	Intake Gate Shafts - Units 51-55 - General Arrangement
93.	D-23143 Rev. 0	Intake Gate Shafts - Units 51-55 - Reinforcement
94.	D-23144 Rev. 0	Intake Gate Chamber - Unit 56 - Intake Gate Gallery Portal - General Arrangement
95.	D-23145 Rev. 0	Intake Gate Chamber - Unit 56 - Intake Gate Gallery Portal - Reinforcement
96.	D-23146 Rev. 0	Intake & Penstocks - Concrete Outline & Reinforcement - Sheet 1 of 2
97.	D-23147 Rev. 0	Intake & Penstocks - Concrete Outline & Reinforcement - Sheet 2 of 2

	Drawing No.	Title
98.	D-23148 Rev. 0	Penstock Liner - Steel Details
POWER PLANT - CIVIL		
99.	D-23021 Rev. 4	Powerplant - General Arrangement - Transverse Section
100.	D-23150 Rev. 3	Machine Hall - General Arrangement - Main Floor El. 1759
101.	D-23151 Rev. 1	Machine Hall - General Arrangement - Plan - El. 1759
102.	D-23152 Rev. 3	Machine Hall - General Arrangement - Generator Floor El. 1739
103.	D-23153 Rev. 3	Machine Hall - General Arrangement - Turbine Floor El. 1725
104.	D-23154 Rev. 0	Machine Hall - General Arrangement - Plan ℄ Spiral Case
105.	D-23155 Rev. 0	Machine Hall - General Arrangement - Floor Plans Above El. 1759
106.	D-23156 Rev. 3	Machine Hall - General Arrangement - Transverse Sections
107.	D-23157 Rev. 0	Machine Hall - General Arrangement - Sections
108.	D-23158 Rev. 3	Machine Hall - General Arrangement - Longitudinal Section - Sheet 1 of 2
109.	D-23159 Rev. 3	Machine Hall - General Arrangement - Longitudinal Section - Sheet 2 of 2
110.	D-23160 Rev. 0	Machine Hall - General Arrangement - Plan - El. 1686
111.	D-23161 Rev. 0	Machine Hall - General Arrangement - Plan - Draft Tube Drainage Gallery
112.	D-23162 Rev. 0	Machine Hall - General Arrangement - Transverse Sections

	Drawing No.	Title
113.	D-23163 Rev. 0	Machine Hall - General Arrangement - Access to Exploratory Tunnel & Ceiling
114.	D-23164 Rev. 0	Bus Galleries - General Arrangement - Plan - Sheet 1 of 2
115.	D-23165 Rev. 0	Bus Galleries - General Arrangement - Plan - Sheet 2 of 2
116.	D-23166 Rev. 1	Transformer Bays & Bus Galleries - General Arrangement - Sections
117.	D-23167 Rev. 1	Draft Tube-Plan - General Arrangement - Sheet 1 of 2
118.	D-23168 Rev. 1	Draft Tube-Plan - General Arrangement - Sheet 2 of 2
119.	D-23169 Rev. 0	Draft Tubes & Gate Shafts - General Arrangement - Sections
120.	D-23188 Rev. 1	Draft Tubes & Transformer Bays - General Arrangement - Elevation - Sheet 1 of 2
121.	D-23189 Rev. 1	Draft Tubes & Transformer Bays - General Arrangement - Elevation - Sheet 2 of 2
122.	D-23190 Rev. 1	Transformer Bays - General Arrangement - Plan - Sheet 1 of 2
123.	D-23191 Rev. 1	Transformer Bays - General Arrangement - Plan - Sheet 2 of 2
124.	D-23192 Rev. 0	Visitors Access Gallery - General Arrangement - Plan & Sections
125.	D-23193 Rev. 0	Draft Tubes & Afterbay - Excavation - Plan & Sections
125a.	D-23196 Rev. 0	Machine Hall - Arch. - Elevations - North & South Walks
126.	D-23198 Rev. 0	Machine Hall - Service Bay - Arch. - Floor Plans - El. 1796.5 & El. 1784.0
127.	D-23199 Rev. 0	Machine Hall - Service Bay - Arch. - Floor Plans - El. 1771.5 & El. 1759.0

	Drawing No.		Title
128.	D-23200	Rev. 0	Machine Hall - Service Bay - Arch. Floor Plan - El. 1749.0
129.	D-23201	Rev. 0	Machine Hall - Service Bay - Arch. Floor Plan - El. 1739.0
130.	D-23202	Rev. 0	Machine Hall - Service Bay - Arch. Floor Plan - El. 1725.0
131.	D-23203	Rev. 0	Machine Hall - Service Bay - Arch. Reflected Ceiling - Above El. 1759.0 & 1771.5
132.	D-23204	Rev. 0	Machine Hall - Service Bay - Arch. Reflected Ceiling - Above El. 1784.0
133.	D-23207	Rev. 0	Machine Hall - Service Bay - Arch. Wall Sections
134.	Deleted		
135.	D-23184	Rev. 0	Machine Hall - Water Seals - Details
136.	D-23186	Rev. 0	Machine Hall - Concrete Placement Schedule - Longit. Section
137.	D-23187	Rev. 0	Machine Hall - Concrete Placement Schedule - Transverse Section
138.	D-23215	Rev. 0	Machine Hall Unit Bay Typical Reinforcement - Transverse Section
139.	D-23216	Rev. 0	Machine Hall Service Bay Typical Reinforcement - Longitudinal Section
140.	D-23217	Rev. 0	Draft Tubes & Gate Shafts - Typical Reinforcement - Sections
141.	D-23218	Rev. 0	Transformer Bays & Bus Galleries - Typical Reinforcement
142.	D-23219	Rev. 0	Machine Hall - Spiral Case Erection Layout - Plan and Details
143.	D-23220	Rev. 0	Draft Tube - Steel Liner Erection Layout - Plan and Details

	Drawing No.	Title
144.	D-23221 Rev. 0	Access & Exploratory Tunnels - Portal Structures - Concrete Outline & Reinforcement
145.	D-23222 Rev. 0	Dam Access Gallery - Portal Structure - Concrete Outline & Reinforcement
146.	D-23223 Rev. 0	Tunnels - Miscellaneous Details
147.	D-23224 Rev. 0	Machine Hall - Arch Ceiling - General Arrangement
148.	D-23225 Rev. 0	Machine Hall - Arch Ceiling - Details - Sheet 1 of 4
149.	D-23226 Rev. 0	Machine Hall - Arch Ceiling - Details - Sheet 2 of 4
150.	D-23227 Rev. 0	Machine Hall - Arch Ceiling - Details - Sheet 3 of 4
151.	D-23228 Rev. 0	Machine Hall - Arch Ceiling - Details - Sheet 4 of 4
152.	D-23229 Rev. 0	Machine Hall - Bridge Crane Support - General Arrangement
153.	D-23230 Rev. 0	Machine Hall - Bridge Crane Support - Details
154.	D-23231 Rev. 0	Miscellaneous Metalwork - Sheet 1
155.	D-23232 Rev. 0	Miscellaneous Metalwork - Sheet 2
156.	D-23233 Rev. 0	Miscellaneous Metalwork - Sheet 3
157.	D-23234 Rev. 0	Miscellaneous Metalwork - Sheet 4
158.	D-23235 Rev. 0	Miscellaneous Metalwork - Sheet 5
159.	D-23236 Rev. 0	Miscellaneous Metalwork - Sheet 6
160.	D-23237 Rev. 0	Miscellaneous Metalwork - Sheet 7
161.	Deleted	

GENERAL - MECHANICAL

Drawing No.		Title
162.	D-23317 Rev. 0	Piping Material Schedule
162 a.	B-5505 Rev. 0	Piping Schematics - Legend

ARCH DAM - MECHANICAL

163.	D-23398 Rev. 0	Arch Dam - Spillway and Skimmer Gate - Bubbler Systems - Details
164.	D-23405 Rev. 0	Sluice Gates & Hoists - Gen'l. Arrangement
165.	D-23406 Rev. 0	Sluice Gates - Assembly
166.	D-23414 Rev. 0	Intake Gates - Assembly
167.	D-23419 Rev. 0	Spillway Gates & Hoists - General Arrangement
168.	D-23426 Rev. 0	Skimmer Gate & Operator - General Arrangement
169.	D-23428 Rev. 0	Sluice Maintenance Gate - General Arrangement
170.	D-23429 Rev. 0	Sluice Maintenance Gate Embedded Metal - General Arrangement

FOREBAY & INTAKE - MECHANICAL

171.	D-23394 Rev. 0	Trashrack Structure - Traveling Trash Rake and Hoist - Plans & Elevations
172.	D-23395 Rev. 0	Forebay - Reservoir and Tailrace - Level Sensing Devices - Piping

POWER PLANT - MECHANICAL

173.	D-23311 Rev. 0	Machine Hall - Piping Schematic - Drains to El. 1725 & Roof Drains
174.	D-23312 Rev. 0	Machine Hall - Piping Schematic - De-watering System & Drains Below El. 1725
174a.	D-23314 Rev. 0	Machine Hall - Piping Schematic - Fire, Service & Domestic Water
175.	D-23318 Rev. 0	Piping - Typical Hanger - Details
176.	D-23320 Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1759

	Drawing No.		Title
177.	D-23321	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1749
178.	D-23322	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1725
179.	D-23323	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1710
180.	D-23324	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1686
181.	D-23325	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Plan - El. 1666, 1642 & 1630
182.	D-23329	Rev. 0	Machine Hall - Unit 51 - Embedded Piping - Transverse Section - El. 1759 to 1675
182a.	D-23350	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Transverse Elev.
183.	D-23351	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Plans - El. 1796.5 & 1784
184.	D-23352	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Plans - El. 1771.5 & 1759
185.	D-23353	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Plan - El. 1749
186.	D-23354	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Plan - El. 1739
187.	D-23355	Rev. 0	Machine Hall - Service Bay - Embedded & Exposed Piping - Plan - El. 1725
188.	D-23356	Rev. 1	Machine Hall - Crane Clearance Diagram - Plan - Sections & Details
189.	D-23357	Rev. 1	Machine Hall - Crane Clearance Diagram - Miscellaneous Details
190.	D-23364	Rev. 0	Bus Gallery & Gate Shaft - Unit 51 - Embedded Piping - Plan - El. 1766.5
191.	D-23365	Rev. 0	Bus Gallery & Gate Shaft - Unit 52 - Embedded Piping - El. 1766.5
192.	D-23366	Rev. 0	Gate Shaft & Draft Tube - Unit 51 - Embedded Piping - Sections

	Drawing No.	Title
193.	D-23367 Rev. 0	Gate Shaft - Units 52 & 56 - Embedded Piping - Sections
194.	D-23393 Rev. 0	Machine Hall - Service Bay Elevator - General Arrangement

MACHINE HALL - AIR CONDITIONING

195.	D-23460 Rev. 0	Machine Hall - Air Conditioning - Schematic Diagram - Sheet 1 of 2
196.	D-23461 Rev. 0	Machine Hall - Air Conditioning - Schematic Diagram - Sheet 2 of 2
197.	D-23462 Rev. 0	Machine Hall - Air Conditioning = Instrument Control Diagram
198.	D-23463 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Plan & Sections - El. 1796.5
199.	D-23464 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Sections & Details
200.	D-23465 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Plans @ El. 1784, 1771.5 & 1759
201.	D-23466 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Plan, Sections & Details - El. 1749
202.	D-23467 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Plan & Sections - El. 1739
203.	D-23468 Rev. 0	Machine Hall - Service Bay - Air Conditioning - Plan & Sections - El. 1725
204.	D-23469 Rev. 0	Machine Hall - Unit Bay - Air Conditioning - Plan, Section & Detail - El. 1739
205.	D-23470 Rev. 0	Machine Hall - Unit Bay - Air Conditioning - Plan & Sections - El. 1725
206.	D-23471 Rev. 0	Machine Hall - Air Conditioning - Return Air Duct

	Drawing No.		Title
207.	D-23472	Rev. 0	Machine Hall - Service Bay - Air Conditioning - Refrigeration Equipment
208.	D-23473	Rev. 0	Machine Hall - Service Bay - Air Conditioning - Exhaust Fan System
209.	D-23474	Rev. 0	Machine Hall - Unit Bay - Air Conditioning - Embedded Pipes - Sheet 1 of 2
210.	D-23475	Rev. 0	Machine Hall - Unit Bay - Air Conditioning - Embedded Pipes - Sheet 2 of 2
211.	D-23476	Rev. 0	Machine Hall - Air Conditioning - Details - Sheet 1 of 3
212.	D-23477	Rev. 0	Machine Hall - Air Conditioning - Details - Sheet 2 of 3
213.	D-23478	Rev. 0	Machine Hall - Air Conditioning - Details - Sheet 3 of 3

GENERAL - ELECTRICAL

214.	D-23500	Rev. 2	Elementary One Line Diagram
215.	D-23512	Rev. 0	Station Service 480V - Single Line
216.	D-23514	Rev. 0	Station Service 480V - Main Distribution "WA"
217.	D-23515	Rev. 0	Station Service 480V - Main Distribution "WB"
218.	D-23516	Rev. 0	Station Service 480V - Essential Distribution
219.	D-23517	Rev. 0	Station Service 480V - Forebay Distribution
220.	D-23518	Rev. 0	Lighting Single Line
221.	D-23720	Rev. 0	General Notes, Symbols & Fixture Schedule
222.	D-23760	Rev. 2	Powerhouse Grounding - Ground Mat Arrangement

ARCH DAM & SPILLWAY AREAS - ELECTRICAL

	Drawing No.		Title
223.	D-23828	Rev. 0	Arch Dam - Conduit, Grounding & Lighting - Plan - El. 1832 & 1841.5
224.	D-23829	Rev. 0	Arch Dam - Conduit, Grounding & Lighting - Plan - El. 1860
225.	D-23830	Rev. 0	Spillway - Left Abutment - Conduit & Grounding - Plan - El. 2000
226.	D-23831	Rev. 0	Spillway - Right Abutment - Conduit & Grounding - El. 2000
227.	D-23832	Rev. 0	Arch Dam - Conduit & Grounding - Plan El. 2000
228.	D-23833	Rev. 0	Spillway - Left Abutment - Lighting - Plan - El. 2000
229.	D-23834	Rev. 0	Spillway - Right Abutment - Lighting - Plan - El. 2000
230.	D-23835	Rev. 0	Arch Dam - Lighting - Plan - El. 2000

FOREBAY AREAS - ELECTRICAL

231.	D-23836	Rev. 0	Trashrack Structure - Conduit, Grounding, & Lighting - Plan
232.	D-23837	Rev. 0	Upper Parking Area - Conduit, Grounding & Lighting - Plan
233.	D-23838	Rev. 0	Intake Gate Gallery - Conduit, Grounding & Lighting - Plan

POWER PLANT - ELECTRICAL

234.	D-23721	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plans - El. 1796.5 & El. 1784
235.	D-23722	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plan - El. 1771.5
236.	D-23723	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plan - El. 1759

	Drawing No.		Title
237.	D-23724	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plan - El. 1749
238.	D-23725	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plan - El. 1739
239.	D-23726	Rev. 0	Machine Hall - Service Bay - Conduit & Grounding - Plan - El. 1725
240.	D-23727	Rev. 0	Machine Hall - Unit # 51 - Conduit & Grounding - Plan - El. 1759
241.	D-23728	Rev. 0	Machine Hall - Unit #51 - Conduit & Grounding - Plan - El. 1749
242.	D-23729	Rev. 0	Machine Hall - Unit #51 - Conduit & Grounding - Plan - El. 1739
243.	D-23730	Rev. 0	Machine Hall - Unit #51 - Conduit & Grounding - Plan - El. 1725
244.	D-23731	Rev. 0	Machine Hall - Unit #51 - Conduit, Grounding & Lighting - Plan - El. 1710
245.	D-23732	Rev. 0	Machine Hall - Unit #51 - Conduit, Grounding & Lighting - Plan - El. 1686
246.	D-23733	Rev. 0	Machine Hall - Unit #51 - Conduit, Grounding & Lighting - Plan El. 1676, 1666 & 1642
247.	D-23738	Rev. 0	Machine Hall - Unit #52 - Conduit, Grounding & Lighting - Plan - El. 1710
248.	D-23739	Rev. 0	Machine Hall - Unit #52 - Conduit, Grounding & Lighting - Plan - El. 1686
249.	D-23744	Rev. 0	Machine Hall - Unit #53 - Conduit, Grounding & Lighting - Plan - El. 1710
250.	D-23745	Rev. 0	Machine Hall - Unit #53 - Conduit, Grounding & Lighting - Plan - El. 1686
251.	D-23750	Rev. 0	Machine Hall - Unit #54 - Conduit, Grounding & Lighting - Plan - El. 1710

	Drawing No.	Title
252.	D-23751 Rev. 0	Machine Hall - Unit #54 - Conduit, Grounding & Lighting - Plan - El. 1686
253.	D-23756 Rev. 0	Machine Hall - Unit #55 - Conduit, Grounding & Lighting - Plan - El. 1710
254.	D-23764 Rev. 0	Bus Gallery - Unit #51 - Conduit, Grounding & Lighting - Plan
255.	D-23765 Rev. 0	Bus Gallery - Unit #52 - Conduit, Grounding & Lighting - Plan
256.	D-23766 Rev. 0	Bus Gallery - Unit #53 - Conduit, Grounding & Lighting - Plan
257.	D-23767 Rev. 0	Bus Gallery - Unit #54 - Conduit, Grounding & Lighting - Plan
258.	D-23768 Rev. 0	Bus Gallery - Unit #55 - Conduit, Grounding & Lighting - Plan
259.	D-23769 Rev. 0	Bus Gallery - Unit #56 - Conduit, Grounding & Lighting - Plan
260.	D-23770 Rev. 0	Transformer Bays - Units #51, 52 & 53 - Conduit, Grounding & Lighting - Plan
261.	D-23771 Rev. 0	Transformer Bays - Units #54, 55 & 56 - Conduit, Grounding & Lighting - Plan
262.	D-23772 Rev. 0	Dam Access Gallery - Conduit, Grounding & Lighting - Plan - Sheet 1 of 2
263.	D-23773 Rev. 0	Exploratory Tunnel - Conduit, Grounding & Lighting - Plan
264.	D-23774 Rev. 0	Access Elevator - Conduit, Grounding & Lighting - Elevation - Sheet 1 of 2
265.	D-23775 Rav. 0	Access Elevator - Conduit, Grounding & Lighting - Elevation - Sheet 2 of 2
266.	D-23776 Rev. 0	Conduit Details
267.	D-23777 Rev. 0	Grounding Details

	Drawing No.		Title
268.	D-23778	Rev. 0	Cable Trays - Sections & Details
269.	D-23779	Rev. 0	Cable Trays - Sections & Details
270.	D-23780	Rev. 0	Cable Trays - Sections & Details
271.	D-23782	Rev. 0	208Y/120 Volt Power Distribution - Panel Schedules
272.	D-23786	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1796.5 & 1784
273.	D-23787	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1771.5
274.	D-23788	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1759
275.	D-23789	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1749
276.	D-23790	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1739
277.	D-23791	Rev. 0	Machine Hall - Service Bay - Lighting - Plan - El. 1725
278.	D-23792	Rev. 0	Machine Hall - Unit #51 - Lighting - Plan - El. 1759
279.	D-23793	Rev. 0	Machine Hall - Gallery - Lighting - Plan - El. 1749
280.	D-23794	Rev. 0	Machine Hall - Unit #51 - Lighting - Plan - El. 1739
281.	D-23795	Rev. 0	Machine Hall - Unit #51 - Lighting - Plan - El. 1725
282.	D-23796	Rev. 0	Machine Hall - Unit #52 - Lighting - Plan - El. 1759
283.	D-23797	Rev. 0	Machine Hall - Unit #52 - Lighting - Plan - El. 1739
284.	D-23798	Rev. 0	Machine Hall - Unit #52 - Lighting - Plan - El. 1725

Drawing No.	Title
285, D-23799 Rev. 0	Machine Hall - Unit #53 - Lighting - Plan - El. 1759
286. D-23800 Rev. 0	Machine Hall - Unit #53 - Lighting - Plan - El. 1739
287. D-23801 Rev. 0	Machine Hall - Unit #53 - Lighting - Plan - El. 1725
288. D-23802 Rev. 0	Machine Hall - Unit #54 - Lighting - Plan - El. 1759
289. D-23803 Rev. 0	Machine Hall - Unit #54 - Lighting - Plan - El. 1739
290. D-23804 Rev. 0	Machine Hall - Unit #54 - Lighting - Plan - El. 1725
291. D-23805 Rev. 0	Machine Hall - Unit #55 - Lighting - Plan - El. 1759
292. D-23806 Rev. 0	Machine Hall - Unit #55 - Lighting - Plan - El. 1739
293. D-23807 Rev. 0	Machine Hall - Unit #55 - Lighting - Plan - El. 1725
294. D-23808 Rev. 0	Machine Hall - Unit #56 - Lighting - Plan - El. 1759
295. D-23809 Rev. 0	Machine Hall - Unit #56 - Lighting - Plan - El. 1739
296. D-23810 Rev. 0	Machine Hall - Unit #56 - Lighting - Plan - El. 1725
297. D-23811 Rev. 0	Machine Hall - Access Tunnel - Lighting - Plan
298. D-23812 Rev. 0	Dam Access Gallery - Conduit & Lighting - Plan - Sheet 2 of 2
299. D-23813 Rev. 0	Lighting Panels - Schedules - Sheet 1 of 2
300. D-23814 Rev. 0	Lighting Panels - Schedules - Sheet 2 of 2

301.	D-23815 Rev. 0	Lighting Details - Sheet 1
302.	D-23816 Rev. 0	" " Sheet 2
303.	D-23817 Rev. 0	" " Sheet 3
304.	D-23818 Rev. 0	" " Sheet 4

MISCELLANEOUS

305.	D-23223 Rev. 0	Tunnels - Miscellaneous Details
306.	D-23309 Rev. 0	Machine Hall - Piping Schematic - Oil Fill and Drain System
307.	D-23319 Rev. 0	Machine Hall Service Bay - Sanitary System - Isometric
308.	D-23185 Rev. 1	Machine Hall - Inspection Walkway & Monorail
309.	D-23115 Rev. 0	Arch Dam - Catwalks for Construction
310.	D-23019 Rev. 0	Power Plant-Underground Excavation - Isometric View

Drawings listed under the heading "Underground Excavations" indicate work being performed by others under a separate contract, and the general arrangement drawings and architectural drawings listed under the heading "Power Plant - Civil" indicate the complete construction and installation of the power plant. These drawings are included for the bidders' information and it is not intended that they define the scope of the work to be performed under these specifications.

Reference drawings noted on attached drawings and not included herein, are not considered necessary for bidding purposes, but will be furnished to the Contractor where necessary for proper execution of the work.

Where drawings describe details in the machine hall for Unit No. 51 only, but omit details for Unit Nos. 52, 53 and 54, it shall be understood that Unit No. 51 is typical for but not necessarily identical to the other three units.

b. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Engineer of any omissions or discrepancies. Omission from the drawings or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of work, and they shall be performed as if fully and correctly set forth and described on the drawings.

c. Whenever necessary for proper execution of the work, the Engineer will furnish additional instructions with reasonable promptness by means of drawings, or otherwise. All such drawings and instructions will be consistent with the contract, true developments thereof, or reasonably inferrable therefrom.

d. All drawings furnished by the Engineer and delivered to the Contractor after execution of the Contract, and all revisions of these and of the bid drawings, shall be deemed written instructions to the Contractor.

e. The Engineer will furnish to the Contractor, free of charge, all copies of drawings and specifications reasonably necessary for the execution of the work.

5. TIME OF COMPLETION

In order to coordinate the work with other contractors and to take advantage of seasonal variations in river flows, the following written notices to proceed with the work will be issued to the Contractor.

Notice A - Proceed with surface work at the site.

Notice B- Proceed with underground work at the site.

Notice C - Proceed with work in the river.

Notice "A" will be issued after the signing of the contract. It is expected that Notice "A" will be dated and issued approximately May 15, 1964. The Contractor shall then complete the following work on or before the dates set forth below:

a. Complete construction of the diversion tunnel including mucking tunnel plug by April 1, 1965. (The Contractor will be permitted access to the diversion tunnel via the mucking tunnel by October 1, 1964.)

b. Complete excavation for the arch dam abutments above elevation 1725 by May 1, 1965.

c. Complete all work under this contract, including cleanup, by August 1, 1967.

It is expected that Notice "B" will be dated and issued not later than February 1, 1965. The Contractor shall then complete the following on or before the date set forth below:

d. Complete all work in the machine hall, and transformer bays by March 1, 1966.

It is expected that Notice "C" will be dated and issued on or before July 15, 1965. The Contractor shall then complete the following work on or before the dates set forth below:

e. Complete all work required for the successful diversion of the river at the dam site by September 1, 1965.

f. Complete construction of the dam including grouting to elevation 1765 by May 1, 1966.

g. Complete all required work by April 1, 1967 to permit diversion closure and reservoir filling.

If any of the dates of the Notices to Proceed are later than the expected dates given above, the completion dates will be extended by the number of calendar days between the expected date given herein and the actual date of the respective Notice to Proceed.

6. LIQUIDATED DAMAGES

Completion of the work under this contract in the time limit specified is necessary and vital in the maintenance of the schedule for completion of the entire project. Failure to meet such schedule will result in a loss to the City which is difficult of ascertainment.

In case the respective items of work specified in Section 1A-5, are not completed by the specified dates set forth in Section 1A-5, "Time of Completion," damage will be sustained by the City; and, as it is and will be impracticable to ascertain the actual damage which the City will sustain by reason of such delay, it is agreed that the Contractor shall pay to the City as fixed, agreed and liquidated damages the amount set forth herein for each and every day's delay. The Contractor agrees to pay said liquidated damages as herein provided, and in case the same are not paid, agrees that the City may deduct the amount thereof from any moneys due or that may become due the Contractor under the Contract.

The amount of fixed, agreed and liquidated damages to be deducted from the final contract price of the work shall be five thousand dollars ($5,000.00) per calendar day for failure to complete all work as set forth in Section 1A-5e within the time limit specified therein or within the time limit as extended by any extension of time granted by the Board of Public Works; five thousand dollars ($5,000.00) per calendar day for failure to complete all work as set forth in Section 1A-5d within the time limit specified therein or within the time limit as extended by any extension of time granted by the Board of Public Works; five thousand dollars ($5,000.00) per calendar day for failure to complete all work as set forth in Section 1A-5g within the time limit specified therein or within the time limit as extended by any extension of time granted by the Board of Pub-

lic Works; and two thousand dollars ($2,000.00) per calendar day for failure to complete all work as set forth in Section 1A-5c within the time limit specified therein or within the time limit as extended by any extension of time granted by the Board of Public Works.

7. CONSTRUCTION PROGRAM AND REQUIREMENTS FOR OVERTIME WORK

The completion dates for work to be performed under these specifications have been established so that commencement of additional construction required by others is not delayed and that commercial operation of the power plant will commence in accordance with system load requirements. A tentative construction schedule (Drawing No. B-5506) which has been coordinated with scheduled delivery dates for equipment and materials furnished by the City, has been included for the information of the Bidders. The Contractor's attention is particularly directed to the required completion dates and that it is the intent of these specifications that multi-shift operations will be required to complete the work within the specified time limit.

Within 60 days after issuance of Notice A to proceed with the work at the site, the Contractor shall submit to the Engineer a complete and detailed program of operations for the orderly performance and completion of the separable parts of the work and the entire work within the times specified in Section 1A-5. The Contractor shall use the Critical Path Method (CPM) or the Program Evaluation Technique (Pert) or a similar method for preparing and reviewing his construction program. The Contractor shall provide the Engineer with two copies of such analysis for review and approval.

At the end of each month during the period of construction, the Contractor shall submit to the Engineer a revised copy of the construction program showing the progress of the work to date and any proposed changes in the schedule. Any proposed original and all revised programs shall be adequate, in the opinion of the Engineer, to meet the requirements for completion of work as set forth in the Contract.

The Contractor shall furnish sufficient forces, construction plant and equipment, and shall work such hours, including night shifts and overtime, as may be necessary to insure the prosecution of the work in accordance with the construction program then in effect. If, in the opinion of the Engineer, the Contractor's actual progress is insufficient to meet the specified requirements, the Contractor shall take such steps as may be necessary to improve his progress and the Engineer may require him to increase the number of shifts, and/or overtime operations, days of work and/or the amount of construction plant, all without additional cost to the City. The cost of added shifts, or of premium pay entailed by such action, shall be borne by the Contractor with no additional cost to the City.

Failure of the Contractor to comply with the instructions of the Engineer under these provisions shall be grounds for determination that the Contractor is not

prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination the City may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with the applicable provisions of this Contract.

8. ADDRESSING CORRESPONDENCE

All correspondence directed to the City pertaining to this project should be addressed as follows:

Project Manager
Boundary Project Office
P. O. Box 507
Metaline Falls, Washington 99153

One copy of all such correspondence should also be mailed to:

Superintendent of Lighting
1015 - 3rd Avenue
Seattle, Washington 98104

Attention: Mr. H. V. Strandberg
Chief Engineer

SECTION 1B

GENERAL CONDITIONS

1. CONTRACT FOR THE PROJECT

All the parts, provisions and requirements of Specification No. 1782 together with the laws of the State of Washington and the Charter and ordinances of The City of Seattle, so far as applicable, together with such additional drawings as may be required during the progress of the work, shall constitute the Contract for the Project and shall be considered as a whole.

The Contract for the Project shall be held to cover any and all work, labor, implements and materials, (except City-furnished materials hereinafter specified) and all special methods of construction that could reasonably be required properly and satisfactorily to complete the work indicated. The work shown on the drawings and not mentioned in the written specifications or vice versa shall be accomplished the same as if shown by both, and in case of conflict the written specifications shall govern.

2. MEANING OF TERMS

The term "Engineer" as used in these specifications, shall mean the Superintendent of Lighting of the City of Seattle, or his duly designated assistants or inspectors limited by the particular duties entrusted to them. The words "City" and "Board of Public Works" as used herein shall mean the corporation of The City of Seattle, of which the Board of Public Works is the representative. The word "Contractor" as used herein shall mean the party or parties contracting with The City to do the work described herein and to furnish materials therefor, or the duly authorized representatives of such party or parties. The word "contract" as used herein shall mean the Contract for the Project as defined in Section 1B-1 above.

3. BIDDERS TO MAKE EXAMINATION

Bidders are required to read and examine carefully all the parts, provisions and requirements in the contract. The drawings show the location and extent of the area to be improved and the profiles and other drawings show conditions as they are believed to exist, but it is not intended or inferred that the conditions shown constitute a representation by the City that such conditions are actually existent. The Contractor assumes the risk of unforeseen conditions and agrees to complete the work under whatever circumstances that may develop. If unforeseen conditions are encountered at the site of the work, appropriate action by the Engineer may be undertaken pursuant to Section 1B - 13.

The bidders shall examine the location and surroundings of the Project and judge for themselves the nature of the work to be accomplished, the proper method of doing the work, and all conditions affecting performance. The Contractor agrees that he has satisfied himself by his own investigation and research regarding all conditions and that his conclusion to enter into the proposed contract is based

upon such investigation, and that he will make no claim against the City because of any of the estimates, tests, or representations of any kind affecting the work made by any officer or agent of the City which may prove to be in any respect erroneous.

4. ERRORS AND OMISSIONS

The Board of Public Works will not take cognizance of claims of errors or omissions made by bidders on public work, when such claims are made after the opening of the bids.

5. DIMENSIONS

All dimensions shall be taken from the figures on the drawings and not by scaling thereon.

6. QUANTITIES FURNISHED TO BIDDERS

Quantities listed in the Proposal are estimated quantities of work to be performed and stated for the purpose of comparing bids only and may be increased or diminished. Payment shall be made only for the actual quantities included in the finished work measured as hereinafter specified, and at prices stated in the bid, provided, however, that no payment shall be made for unauthorized work or material not shown on the drawings or specified.

7. CONTRACT - WHEN TO TAKE EFFECT

The contract for this improvement shall not take effect or be in force until the approval of the Contractor's bond by the Mayor and the City Comptroller, and until same shall be filed with the City Comptroller as required by law.

8. ASSIGNMENT OF CONTRACT

No assignment of the moneys to become due under this contract shall be made without the written approval of the Contractor's bondsmen and the consent of the Board of Public Works being first obtained and endorsed thereon. Such assignment, however, shall not release the Contractor or his sureties from any obligations or liabilities arising under or because of said contract.

9. SUBLETTING OF CONTRACT

No part of the work to be performed under this contract may be sublet except for the furnishing of materials therefor, without the consent of the Engineer in writing. In no event shall the total dollar value of all subcontracts hereunder exceed 40% of the total dollar value of this contract.

Any such work performed by any person or persons or any firm or corporation, entering into a subcontract or other agreement with the Contractor to furnish

labor or material for or upon any improvement constructed under this contract, shall be considered the responsibility of the Contractor; and any such person or persons, or the employees of any such firm or corporation, when employed directly upon such improvement, shall be subject to all the provisions respecting workmen, orders, rates and payment of wages, hours of labor, and all other provisions regarding employees herein specified.

The Contractor shall be held responsible for the full and faithful performance of the contract.

Each subcontract shall contain a suitable provision for suspension or termination thereof should (1) the work on the project or any pertinent portion thereof be suspended or terminated, or (2) should the subcontractor neglect or fail to conform to every provision of this contract insofar as such provisions are relevant. Subletting by a subcontractor shall be subject to the same limitations.

The Contractor shall be as fully responsible to the City for the acts or omissions of each subcontractor and of persons either directly or indirectly employed by each subcontractor as he is for the acts or omissions of persons directly employed by himself. Nothing in this contract shall create any contractual relation between any subcontractor and the City or any obligation on the part of the City to pay or cause to be paid any sums to any subcontractor.

10. EXTENSION OF TIME

If the work be delayed at any time by reason of a suspension ordered by the Engineer, or because of any negligent act of the City without contributory fault or neglect on the part of the Contractor or his agents or employees or subcontractors, or if the work should be delayed by reason of strikes, or for any other unforeseeable cause beyond the control and without the fault or negligence of the Contractor, or for any other reason which in the opinion of the Engineer is proper justification for such delay, then the Contractor shall be granted an extension of time determined to be equivalent to the time actually lost by such delay, which opinion or determination by the City shall be final. The Contractor shall file a written request with the Engineer for an extension of time within ten days of the beginning of each delay, and failure to so do shall constitute a waiver thereof, provided that in case of a continuing cause of delay only one request shall be necessary.

A request for an extension of time or the granting of an extension of time shall not constitute a basis for any claim against the City for additional compensation. The Contractor shall be deemed to have waived any claim for additional compensation and does thereby waive any such claim, unless he shall at the time of filing a request for an extension of time likewise file a claim for additional compensation on account of such delay.

11. CHANGES IN DRAWINGS AND QUANTITIES

The Engineer reserves the right to make changes in the drawings for this improvement, to make variations in the quantity of the work to be done, and to eliminate any items of work at any time, either before commencement or during the progress of the work, without thereby altering or invalidating any of the prices herein named. The Contractor shall proceed without delay to perform all work or make any reduction thereby required.

In case such action or any order contemplated in Section 1B-12 or 1B-13 hereof should diminish the amount of work, no claim shall be allowed for damages on the ground of loss of anticipated profits: Provided, that if such action should be taken after the commencement of any particular piece of work, and should thereby result in extra cost to the Contractor, the Engineer shall make a fair and equitable estimate of the amount to be allowed therefor.

12. CHANGE ORDERS

Change orders may be issued by the Engineer in writing when changes in drawings or instructions from the Engineer result in an increase or decrease in work, payment for which in the judgment of the Engineer is not provided for in applicable unit price or lump sum bid items and for which a price must be agreed upon or paid for in accordance with the provision of Section 1B-15.

The change order shall contain a description of the change, an estimate of the increase or decrease in quantities involved, the agreed unit or other price therefore and the estimated total dollar amount thereof.

No individual change order shall be considered cause for an extension of time but at such time as the dollar value of all change orders exceeds 5% of the amount earned under the contract the Contractor may apply for an extension of time in the manner provided in Section 1B-10.

Each such written change order shall be effective the date of issue and shall become a part of and be subject to all the provisions of the contract. The Contractor regardless of the basis of compensation therefor shall proceed without delay to perform all work or make any reductions required therein.

13. EXTRA WORK ORDERS

Extra work orders may be issued by the Engineer in writing in the following circumstances:

a. When field conditions are encountered by the Contractor which materially differ from conditions generally recognized as likely to be encountered

in the performance of work of the character provided in the contract and could not reasonably have been anticipated by him prior to the execution of the contract, and which require such major changes in the drawings, specifications, quantities or methods of performing the work that in the judgment of the Engineer the contract unit or lump sum prices do not provide appropriate compensation with respect to the work affected by such conditions. In such event the Contractor shall immediately inform the Engineer that he believes such conditions to exist. The Engineer shall thereupon promptly investigate such conditions.

b. When design changes result in major changes in quantities or methods of performing work so that in the judgment of the Engineer the contract unit or lump sum prices do not provide appropriate compensation with respect to work affected by such design changes.

c. When it is desired to add to the contract, with the consent of the Contractor, items of work not directly related to the completion of or contemplated in the work generally described in Section 1A-1.

The extra work order shall contain a description of the change, an estimate of the quantities involved, the agreed unit or other price therefor and the total estimated dollar amount thereof and extra time, if any, required to perform the extra work.

Each such written extra work order shall be effective the date of issue and shall become a part of and be subject to all the provisions of the contract. The Contractor regardless of the basis of compensation therefor shall proceed without delay to perform all work required therein.

14. CLAIMS AND PROTESTS

a. Claims. All claims of the Contractor against the City under this contract and all questions which the Contractor has concerning the interpretation of the contract shall be presented to the Engineer in writing. Where such claim or question relates to an increased cost to the Contractor, such claim or question with supporting data shall be presented to the Engineer within twenty (20) days after the date such cost is incurred. The Engineer shall within a reasonable time after presentation to him, make decisions in writing on all such claims and questions.

b. Protests. If the Contractor considers any record, ruling or work demanded of him by the Engineer to be improper, he shall immediately upon such work being demanded or such ruling being made, proceed without delay to perform the work or to conform to ruling, and within twenty (20) days after date of receipt of the instructions, record or ruling, he shall file a written protest with the Engineer, stating clearly and in detail the basis of his objection, and include an itemized statement of any extra costs which may have resulted. Except for such protests or objections as are made of record in the manner specified in this Section 1B-14 and within the time limit stated, the records, rulings, instructions, or decisions of the Engineer shall be final and conclusive.

15. PAYMENT FOR CHANGE ORDER AND EXTRA WORK

If the work is done upon a written change order or extra work order issued by the Engineer, and a price for such work has not been agreed upon, it shall be paid for as follows:

a. For all labor and foremen and working superintendents in direct charge of the specific operation, the Contractor shall receive an amount equal to the current wages paid such labor, foremen, and working superintendents, for the time actually engaged in such work, plus an amount equal to twenty (20) percent thereof. Such labor does not include job superintendents, timekeepers, or other office personnel.

b. For all materials used the Contractor shall receive the actual cost thereof, less sales tax, to which amount shall be added fifteen (15) percent thereof. No material shall be purchased until approved by the Engineer. Material invoice data covering the material furnished shall be submitted by the Contractor. Freight and handling charges in direct connection with the transportation to the jobsite of material used in the work shall be considered as a part of the actual cost thereof.

c. For any machine, power tools or equipment furnished by the Contractor and necessary for use on extra work, the Contractor will receive payment on a rental basis to which no percentage shall be added. The rental rate shall be on an hourly basis and shall apply to the actual number of hours that the machine, power tools, or equipment are in actual use or on standby as authorized by the Engineer except that when on standby no payment in excess of 8 hours a day or 40 hours a week (Saturday and Sunday excluded) will be made. The rental rate, shall not exceed the monthly rate for the machine, power tool or equipment as listed in the latest "Rental Rate Blue Book" published by National Research Division, Pacific Appraisal Co. All rental rates shall be submitted for approval and agreed upon in writing before the work commences.

The City shall have the option of supplying City-owned equipment to the job and supplying rented equipment at its own expense and no charge in conjunction with City supplied equipment shall be made by the Contractor and no percentage for overhead profit or loss will be allowed.

d. For equipment already in area, the Contractor will receive payment for the use of any machines, power tools, or equipment on extra work at the rental rates established above. The time shall be taken from the time equipment is delivered at the location where it stands, to the time equipment is returned to that location or to some nearer point as desired by the Contractor. In the case where the Engineer elects to have the Contractor move the equipment to and from the site of this work, payment will be made at the regular prevailing truck rental rates established in the area, plus labor furnished by the Contractor for loading and unloading. Where the Contractor elects to use such equipment on other work than change order or extra work, the move to and from the job site shall be divided in proportion to the number of 8-hour days used on each job.

e. For equipment shipped in specifically for change order or extra work, the Contractor will receive payment for the use of any machines, power tools or equipment on this work at the rental rates as established above, to which no percentage shall be added. The Contractor shall be allowed the actual cost of transportation of the equipment in and out to which fifteen percent may be added. Should the Contractor elect to use equipment specifically shipped in for the work on work other than said change order or extra work, the Contractor shall pay all rental, maintenance, and repair for the period, so used in addition a proportionate share of the cost of bringing the equipment in and out, which shall be determined by the ratio of the number of 8-hour days retained on each job. Provided; that should the Contractor elect to retain the equipment beyond the time when it would otherwise be returned, he shall assume all costs on maintenance and repair beyond that date, together with the total cost of transportation out and other charges incidental to its return. In this case, all reconditioning of the equipment for its return to the Lessor shall be assumed by the Contractor.

f. Maintenance. The Contractor shall provide maintenance and repairs of all plant not constructed specifically for the work to be done by change order or extra work order at his own expense.

The Contractor will receive payment for all normal maintenance, repair, parts, lubrication, inspection, maintenance, materials, fuel and oil on all machines, power tools, or equipment rented from or by the Contractor, or an hourly rate, and the rate shall comprise the total cost of these items to which no percentage shall be added and shall include the cost of all direct maintenance and repair labor, transportation and handling. These rates shall be mutually agreed upon between the Contractor and the City before any work is done and before any payments for equipment rental will be made, and payments at these rates will be made only for the actual number of hours that the equipment is in operation. No payment will be made during maintenance for standby time. Major maintenance or repairs shall be made by the Contractor after approval by the Engineer and payments will be made as provided in change order or extra work order. Repairs necessary due to the Contractor's carelessness shall be made by the Contractor at his own expense.

 15. PAYMENT FOR CHANGE ORDER AND EXTRA WORK (Contd.)

Whenever City-owned or City-rented equipment is delivered to the job, the Contractor shall receive payment for maintenance, repair, parts, lubrication, inspection, maintenance materials, fuel and oil at the same rates agreed upon for equipment rented by and from the Contractor.

The Contractor shall be allowed compensation for payments made to the State Department of Labor and Industries which are occasioned by the change order or extra work order. These payments shall include Industrial Insurance premium and fifty (50) percent of the Medical Aid payments. Compensation for such premiums shall be in the amount of the actual payments made by the Contractor to which no percentage shall be added. The Contractor will also be allowed payment for Federal Old Age Benefits, State Unemployment, Federal Unemployment, Public Liability and Property Damage Insurance, fringe benefits paid by the Contractor on change order work or extra work. To these charges the Contractor may add fifteen (15) percent. Before the first invoice for extra work is submitted, the Contractor shall transmit to the Engineer a copy of the rates for the above items. The compensation herein provided shall be payment in full for all change order or extra work and shall cover all expenses of every nature, kind and description, including overhead expenses, use of small tools and equipment for which no rental is allowed and profit.

A separate payment covering sales tax, will be made, in accordance with the State Revenue Act of 1935 and later amendments thereto, on all work involving the construction of a facility which does not fall within the meaning of the clause, "Publicly owned street, place, road, highway, bridge or trestle which is used or is to be used primarily for foot or vehicular traffic . . ." as defined in "Rules relating to the Revenue Act", issued by the Excise Division of the Tax Commission of the State of Washington revised May 1, 1943. The amount and cost of any such work shall be invoiced by the Contractor and the amount certified by the Engineer. All invoices for the work shall be invoiced within 30 days after completion of the work.

When the Contractor is authorized by the Engineer to have change order or extra work performed by a subcontractor, the subcontractor shall prepare his invoice for the work in accordance with the requirements of this section. The Contractor shall submit the subcontractor's invoice for payment and may add 10 percent to the total amount of the invoice (sales tax excluded) to cover all the Contractor's costs and charges in connection with the change order or extra work.

Method for Processing Change Order or Extra Work Data for the Purpose of Billing

The following procedure shall be used:

a. Daily Shift Forms. The daily shift forms for labor and material provided by the City are authorized and shall be used solely to record quantities and numbers of hours worked or description of equipment and number of hours

used. Discrepancies or disagreements as to quantities or numbers of hours on these forms shall be settled in the field as the tickets are jointly signed. This also includes decisions as to whether a quantity is chargeable to the change order or extra work, or is the responsibility of the Contractor. Should the Contractor's foreman or working superintendent be unable to agree with the City inspector upon any items, that item and a copy of the work ticket shall be immediately referred to the Engineer for decision. No payment will be made on these items until such agreement has been reached.

b. After all known discrepancies occurring on labor and material forms have been settled, the Contractor and City field office should independently enter the data on master forms as follows:

(1) Labor Hours - Dates and Shifts versus Titles and Numbers
(2) Rental Hours - Dates and Shifts versus Equipment Rented
(3) List materials from forms

c. Contractor and City field offices then compare master forms, for each shift and total the quantities. Agreement between the Contractor's totals and the City's totals should be reached at this point.

d. The quantities being correct at this stage, the Contractor shall prepare a bill and submit it with supporting material invoices and payroll data to the Engineer for inclusion in the monthly estimate. Sample copies of suggested invoice forms will be made available to the Contractor by the Engineer upon request. The monthly estimate and payments shall be made as provided in this specification.

16. COOPERATION WITH OTHER CONTRACTORS

In order to provide for the complete and proper coordination of all phases of the project, the Contractor shall cooperate to the fullest extent with contractors working on other phases of the project. The Contractor shall confer with the Engineer regarding details of pertinent phases of the work which may affect the work to be performed under this contract and shall schedule and carry out his work in such a manner as to avoid interference with the facilities and work of other contractors. The Engineer may direct that certain facilities be used mutually by the Contractor and by such other contractors.

17. INTERFERENCE WITH OTHER CONTRACTS

Nothing contained in these specifications and nothing marked on the drawings shall be interpreted as giving the Contractor exclusive occupancy of the territory provided. When two or more contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, the Engineer will decide which contractor shall cease work, and which shall continue, or whether the work on both contracts shall progress at the same time, and in what manner. Such decisions will be

directed towards minimizing interference between or among contractors. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the Engineer to the Contractor so desiring to the extent, amount, in the manner, and at the times deemed proper by the Engineer. No such decision as to the method or time of conducting the work or the use of territory shall be made the basis of any request for delay or claim of damage.

18. FEES AND ROYALTIES AND TITLE TO MATERIALS

All fees, royalties and costs arising from patents, trade marks and copyrights in any way involved in or connected with the work or with these specifications, shall be included in the price stated in the bid, and the Contractor shall appear and defend and indemnify and save harmless the City from any and all claims for infringement or for such fees and royalties by reason of the use of any such patented invention, design, device, material or process; and shall indemnify said City from any cost, expense and damages which it may be obliged to pay by reason of any such infringement, or use, whether such demands or claims be filed during the life of the Contract or after its completion.

Except as otherwise provided, the title to all water and to the right to the use of all water, to all soil, stone, gravel, sand, minerals, timber and all other materials developed or obtained in the excavation or other operations by the Contractor or any subcontractor or any of their employees, and the right to use or dispose of the same, are hereby expressly reserved to the City and neither the Contractor, nor any subcontractor, nor any of their employees shall have any right, title, or interest in or to any part thereof; neither shall they, nor any of them, assert or make any claim thereto. The Contractor will be permitted to use in the work without charge any such materials which meet the requirements of these specifications, subject to the prior approval of the Engineer.

19. WORK AREAS

The Contractor shall confine his work within the areas indicated on the drawings and to such other areas as may be approved by the Engineer.

20. USE AND OCCUPANCY PRIOR TO COMPLETION

The City of Seattle reserves the right to use and occupy any portion of this improvement which has been completed sufficiently to permit use and occupancy, and such use and occupancy shall not be construed as an acceptance of the work, or any part thereof; and any claims which the City of Seattle may have against the Contractor shall not be deemed to have been waived by such occupancy.

However, if the use of the work or part thereof increases the cost of or delays the completion of the remainder of the work, the Contractor shall be entitled to

such extra compensation, or extension of time, or both, as The City may determine to be proper.

Prior to the date of final acceptance of the work by The City, all necessary repairs or renewals in the work or part thereof so used, not due to ordinary wear and tear, but due to defective materials or workmanship or to the operations of the Contractor, shall be at the expense of the Contractor.

21. RIGHT TO SUSPEND OR TERMINATE CONTRACT

a. If at any time during the contract period it becomes necessary to stop the work to be performed under the contract temporarily or indefinitely due to a lawsuit, injunction, stay order or other legal action against the City, the City reserves the right to suspend or terminate the contract upon written notice to the Contractor.

In event of termination the City will compensate the Contractor for all costs incurred by the Contractor up to the time of the contract termination and in addition the costs of demobilizing, moving out and cleaning up the site together with a reasonable allowance for profit on all of these costs, but no allowance shall be made for anticipated profits. Progress payments previously made will be deducted from the total cost.

In event of suspension the City will compensate the Contractor for all actual, reasonable, and necessary costs resulting therefrom.

b. If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed for the Contractor on account of his insolvency and not be discharged within ten days after his appointment, or if the Contractor, or any of his subcontractors, should persistently refuse or fail to diligently prosecute the work or to supply enough properly skilled workmen or proper materials, or if the Contractor should fail to make prompt payment to subcontractors or for material or labor, or should persistently disregard laws, ordinances, or the instructions of the Engineer, or if he should unreasonably delay the commencement of the work or the delivery of materials, or otherwise substantially violate any provision of the Contract, then the City, upon the certification of the Engineer that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy, and after giving the Contractor and his surety thirty days' written notice, terminate the employment of the Contractor and take possession of the premises and of all equipment, materials, tools and other facilities thereon and finish the work by whatever method the City may deem expedient; provided, however, that the surety may upon giving written notice to the City, take over and perform the Contract if it begins work thereon within said thirty-day period. The Contractor shall not be entitled to receive any payments for work after the effective date of termination; provided, if upon completion of the work the total cost to the City in connection therewith from the date of said termination to the date of completion shall be less than the amount

which the Contractor would have been paid if the work had been completed by him in accordance with the terms of the Contract, then said difference shall be paid to the Contractor in the same manner as the final payment under the Contract. On the other hand, if the expense incurred by the City, on account of termination of employment of the Contractor, and subsequent completion of the work by the City by whatever method the City may deem expedient, shall exceed said amount which the City would otherwise have been paid, the Contractor and his surety shall be liable to the City for the full amount of such excess cost and for any damages incurred by the City incidental thereto.

22. CONSTRUCTION COST RECORDS

When any claim for additional compensation is filed the Contractor shall furnish the Engineer upon request adequate facilities and all information necessary for determining the actual cost of the work performed, such as the number of men employed, their pay, the actual time during which they worked upon the various and different classes of construction, and worked upon all services and operations entering into the costs of the different parts and classes of the work and into the total cost thereof; copies of all invoices, if requested, for materials and supplies, copies of freight bills and other transportation charges on all men, materials, machinery and supplies transported to and from the project, or used, in connection with the work under the Contract and chargeable as part of the cost of the work. He shall also furnish, if requested, such information as accurate data and records of the cost or value of all equipment and materials as brought upon the work, used upon the work, and/or incorporated in the work and the actual value of any such equipment and materials removed from the work at any time or at completion thereof, as of date of removal. The above information shall be made available in the same form that the Contractor's cost accounts are broken down in his monthly record of costs, and shall be available monthly during the progress of the work. The Engineer shall determine the validity of the "claim for additional compensation" based upon his verification of such claim including allowances for overheads and profits as set forth in Section 1B - 15. The Contractor shall also furnish a complete breakdown of the lump sum prices included in the proposal. The values employed in making up any of these schedules or breakdown of prices will be used only for determining the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the contract price.

23. ESTIMATES AND PAYMENTS

There will be reserved from the moneys earned by the Contractor on estimates during the progress of the work, a sum equal to ten percent (10%) of such estimates, as a trust fund for the protection and payment of any person or persons, mechanics, subcontractors or material men who shall perform any labor upon such contract or the doing of said work, and all persons who shall supply such person or persons or subcontractors with provisions and supplies for thirty (30) days following the final acceptance of said work as completed and every person performing labor or furnishing supplies towards the com-

pletion of said work, shall have a lien upon such fund so reserved; provided, such notice of the lien of such claimant shall be given in the manner and within the time provided by the Laws of the State of Washington; provided, however, that at any time after fifty percent (50%) of the original contract work has been completed, the Board of Public Works may, if it finds that satisfactory progress is being made, authorize any of the partial payments subsequently made in full.

The work to be performed under the contract will not be deemed completed until the Board of Public Works shall have filed with the City Clerk a statement signed by a majority of the members of said Board, declaring the same to have been completed.

During the time allowed for the completion of the Contract, the Engineer shall, on or about the tenth day of each month, prepare an estimate of the amount of work completed by the Contractor during the preceding month; provided, that after the expiration of the time allowed for such completion, no estimate other than the final estimate shall be issued.

After the issuance of the estimate by the Engineer, the City Comptroller shall, on or about the 25th day of the month, deliver to the Contractor money or warrants, in an amount equal to such estimate less the percentage to be retained therefrom as herein provided. After the expiration of thirty (30) days following the final acceptance of the work and the expiration of the time for the filing of lien claims as provided by law, and after receipt of necessary releases as provided by law, said reserve, or all amounts thereof in excess of a sufficient sum to meet and discharge the claims of material men and laborers who have filed their claims as provided by law, together with a sum sufficient to defray the cost of such action, and to pay attorneys' fees, will be paid to said Contractor.

24. PAYMENT FOR MATERIAL DELIVERED TO SITE

Upon request, 85% payment, less the required retained percentage will be made for the cost of material delivered to the site which will be incorporated in the finished work under the contract. The cost of this material will be determined from invoices to the Contractor, a copy of which shall be furnished to the Engineer. No advance payment will be made for a single item less than $500.00 in cost.

Payment for the above material delivered but not installed, will not constitute acceptance and any faulty material will be condemned, although payment may have been made for same in the estimate. Deductions at the same rates and equal in amount to that made for the material, will be made on the monthly estimate as the material is used.

25. TAXES

The State of Washington Revenue Act of 1935, as amended, requires the City to pay the Contractor, for transmittal to the State, a 4% sales tax on the total charges made for the work to be performed under this contract wherever such work is taxable. The Contractor shall also pay all sales taxes properly levied on materials, supplies, or equipment purchased by him and used on or incorporated into the work, and all other taxes properly assessed against his equipment or other property used in connection with the work.

26. BILLS OF CITY - HOW PAID

The Contractor shall pay all proper bills of the City for labor, materials, and services or supplies furnished in connection with the performance of this work.

If bills due the City are not paid within thirty (30) days after the due date thereon, the City Comptroller shall deduct in payment thereof the amount of said unpaid bills from any moneys payable to the Contractor on the next or any succeeding monthly estimate.

27. BID ITEMS - COST TO BE INCLUDED

The prices bid in the Proposal for the work to be performed shall include all costs of supervision, labor, skill, tools, material (except City-furnished material), equipment, overhead and all other costs and expenses of all kinds to perform the work complete in accordance with the contract.

28. PAYMENT OF WAGES

The Contractor agrees to perform the contract according to the terms, conditions and stipulations, and to pay as they become due all just claims for all work and labor performed on or about the work, and all skill or labor and material purchased for or furnished in the execution of the contract, and further agrees to comply with all the provisions of state law and with all the requirements of the charter and ordinances of the City and the amendments thereto; and the City may withhold from payments due to the Contractor under the contract such sums as will fully cover such claims, and such retained sums shall not be paid to the Contractor until a sufficient release from such claimant, endorsed by the surety of said Contractor, shall be presented to and approved by the Board of Public Works to guarantee that the provisions of this section have been fully complied with.

The City Comptroller shall not pay to the Contractor any portion of the amount due on the contract, unless at the time of payment all claims filed with the City Comptroller for material purchased or labor performed thereon shall have been fully paid. If at any time during the progress of the contract it shall appear to the City Comptroller that the Contractor has neglected, refused or failed to pay in cash for any labor performed thereon, and that time checks or other evidences

of indebtedness have been issued by such Contractor, then the City Comptroller, upon presentation to him of such time checks or other evidences of indebtedness, shall issue to such labor claimants a warrant or warrants therefore upon the appropriate City fund. The City Comptroller shall charge the amount of all warrants so issued against the account of the Contractor for the work, and shall deduct the amounts thereof, together with an agreed charge of ten percent (10%) thereon, from the next or succeeding payments to be made to said Contractor. Any sum or sums so paid may be deducted from the ninety percent (90%) to be paid to such Contractor, as provided in the contract, or from any other sum or sums due said Contractor.

29. CONTRACTOR'S SUPERINTENDENTS AND FOREMEN

The Contractor shall give his personal superintendence to the work or have a competent representative, satisfactory to the Engineer, on the work at all times during progress, with authority to act for the Contractor. His superintendents and foremen shall be competent to receive and carry out any instructions that may be given to him or them by the Engineer, and the Contractor shall be responsible for the faithful observance of any instructions delivered to him or to his authorized representatives on the work.

The Contractor shall give efficient supervision to the work and shall carefully study all drawings, specifications and other instructions and inform the Engineer immediately of any error, inconsistency or omission which may be discovered therein.

30. ACCOMMODATIONS FOR EMPLOYEES

The Contractor shall erect and maintain at all times while men are employed upon the work a building or buildings where workmen may take their lunches, change clothes, etc., and he shall provide such sanitary facilities and first aid equipment as are or may be required by the laws of the State of Washington.

31. NONDISCRIMINATION IN EMPLOYMENT

In connection with the performance of work under this contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Forest Service setting forth

the provisions of this nondiscrimination clause.

b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the purchaser, state that all qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Forest Service, advising the said labor union or workers' representative of the purchaser's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor will comply with all provisions of executive Order No. 10925 of March 6, 1961, and of the rules, regulations and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

32. AUTHORITY AND DUTIES OF INSPECTION

The Engineer will appoint assistants to inspect all material used and the manner in which work is being done. Such inspection may extend to any and all parts of the work and to the preparation or manufacture of all materials to be used.

The inspector will not be authorized to revoke, alter, enlarge or relax the provisions of the contract but will have authority to reject defective material and to suspend any work that he determines is being improperly done. Failure of the inspector to call to the attention of the Contractor, faulty work or deviations from the drawings and specifications, shall not, however, imply acceptance of said work or approval thereof. The Contractor shall allow a reasonable time to permit inspection of any portion of the work before it may be embedded or otherwise covered.

33. INSPECTION AND TESTING OF WORK AND MATERIALS

All material shall be subject to inspection, examination and test by the Engineer. He will select samples of such material and subject the same to such tests as may be necessary to determine whether their qualities conform to the requirements herein specified, and the Engineer will have the right to accept or reject the materials in accordance with the results of such tests. Unless otherwise specified such tests will be repeated as frequently as may be necessary to insure the rejection of all materials which fail to comply with the provisions of the Contract. All materials rejected by the Engineer shall be removed from the work and adjacent surroundings by the Contractor at his own expense within forty-eight (48) hours after he has been notified of their rejection. If this condition is not strictly complied with, the Engineer reserves the right to have such rejected materials removed by other parties and the cost of such removal shall be deducted from any moneys which may be or become due

and payable to the Contractor.

In order to facilitate the inspection of materials, or the preparation, manufacture or fabrication of materials, the Engineer or his authorized representative shall at all times have free access to any shop, plant, or other place where such materials are being prepared and/or manufactured.

The Engineer will inspect work in progress generally and specifically when requested by the Contractor. Any work done without inspection by the Engineer which may not properly be inspected subsequently shall be subject to rejection.

Should it be considered necessary or advisable by the Engineer, any time before final acceptance of the entire work, to make an examination of work already completed, by removing or tearing out same, the Contractor shall on request promptly furnish all necessary facilities, labor and material. If such work is found to be defective in any material respect, or if it is found that such work is not in conformity with the contract, the Contractor shall defray the expense of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the contract, the Contractor will be paid therefor as provided in Section 1B - 15, for cost of labor, equipment and material necessarily involved in the examination and replacement and he will, in addition, if completion of the work has been delayed thereby, be granted a suitable extension of time on account of the additional work involved, provided, however, that no such payment will be made if the Contractor, before embedding or covering, did not allow a reasonable time for inspection thereof as provided in Section 1B - 32.

Inspection of material and finished articles to be incorporated into the work at the site will be made at the place of production, manufacture, or shipment, whenever the quantity justifies it, unless otherwise stated in the specifications; and such inspection and written or other formal acceptance, unless otherwise stated in the specifications, will be final, except as regards latent defects, departures from specific requirements of the contract, damage, loss in transit, or fraud. Subject to the preceding sentence, the inspection of material and workmanship will be made at the site. Nothing contained in this subparagraph shall in any way restrict the City's rights under any warranty or guaranty.

34. SAFETY AND SANITARY REQUIREMENTS

Precautions shall be exercised at all times by the Contractor for the protection of persons, employees and property. The safety and sanitary provisions of applicable laws and local building and construction codes shall be observed. The operations of the Contractor for the protection of persons, and for guarding against hazards of machinery and equipment, shall meet the requirements of state law and all safety regulations as set out in "Safety Standards for Construction", "General Safety Standards", "Safety Standards for Tunnels, Shafts and Subways", and all other applicable safety standards of the State of Washington, published and in effect at the time of call for bids, and as amended

from time to time thereafter. These publications may be obtained from the Department of Labor and Industries, Olympia, Washington.

35. EXPLOSIVES

All operations involving the handling, storage and use of explosives shall be conducted with all precaution, and shall be done in accordance with the applicable requirements of the laws and safety standards of the State of Washington, Pend Oreille County, and rules and regulations of the U. S. Forest Service. Blasting permits required by applicable laws and regulations shall be obtained by the Contractor before explosives are brought to the work site. Magazine locations shall be subject to review and exceptions, if any, of the Engineer. Only competent, reliable men working under experienced supervision shall be permitted to use explosives. The Contractor will be responsible for and shall save the City harmless from damages arising from injury or damage to persons or property resulting from blasting or from his possession or use of explosives.

36. CONTRACTOR'S INSURANCE

The Contractor shall not commence or continue work under the contract or under any special condition until he has obtained and kept in full force and effect all insurance as required under the following subparagraphs, and until such insurances and any renewals thereof have been approved by the Engineer, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurances required of the subcontractor have been obtained and approved.

a. Compensation Insurance. The Contractor shall take out and maintain during the life of this contract Workmen's Compensation Insurance for all of his employees employed at the site of the project and, in case any work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation Insurance for all the latter's employees unless such employees are covered by the protection afforded by the Contractor. In case any class of employees engaged in hazardous work under this contract at the site of the project is not protected under Workmen's Compensation statutes, the Contractor shall provide, and shall cause each subcontractor to provide compensation insurance with a private company in an amount equivalent to that provided by the Workmen's Compensation statute for the protection of his employees not otherwise protected.

b. Public Liability and Property Damage Insurance. The Contractor shall obtain and keep in force during the term of the contract, public liability and property damage insurance in companies and in form to be approved by the Engineer. Said insurance shall provide coverage to the Contractor, any subcontractor performing work provided by this contract, and the City. The City shall be named as an additional insured on any such policies. The coverage so provided shall protect against claims for personal injuries, including accidental death, as well as claims for property damages which may arise from any act

or omission of the Contractor or subcontractors, or by anyone directly or indirectly employed by any of them, on the work under the contract.

The minimum policy limits of such insurance shall be as follows:

Bodily injury liability coverage with limits of not less than $300,000 for bodily injury, including accidental death, to any one person, and subject to that limit for each person, in an amount not less than $1,000,000 for each accident; and property damage coverage in an amount of not less than $100,000 for each accident.

A copy of the insurance policy, together with a copy of the endorsement naming the City as an additional insured, shall be provided to the Engineer within a reasonable time after receiving notice of award of contract. Copies of any new policies or renewals of policy shall be provided to the Engineer prior to the expiration of the previous policies.

c. Indemnify Owner from Loss. The Contractor hereby agrees to save the City harmless from all loss or damage occasioned to it or to any third person or property by reason of any act or omission on the part of the Contractor, subcontractors, agents, and employees in the performance of the contract and will, after reasonable notice thereof, defend and pay the expense of defending any suit which may be commenced against the City by any third person alleging injury by reason of such act, or omission, and will pay any judgment which may be obtained against the City in such suit.

37. CONTRACTOR'S PLANT AND WORK METHODS

In addition to the construction program required under Section 1A-7 the Contractor shall submit a detailed description of the work methods and construction plant proposed to be used in each phase and type of work and demonstrate to the Engineer by appropriate calculation, rating data and production statistics that the proposed plant is adequate to accomplish the work at a rate which will insure completion of the several parts within the times stated in the contract.

38. MATERIALS AND WORKMANSHIP

Unless the specifications provide otherwise, all materials, and articles incorporated in the work covered by this Contract are to be new and of the most suitable grade of their respective kinds for the purpose, and all workmanship shall be first class. Drawings and prints in detail of articles or fabricated materials entering into permanent construction which are by these specifications required to be furnished by the Contractor shall be submitted to the Engineer by the Contractor reasonably in advance of the time of use. The Engineer will promptly review such drawings and advise the Contractor of his approval thereof or exceptions thereto.

When required by the specifications, or when called for by the Engineer, the Contractor shall furnish the Engineer full information concerning any materials which he contemplates incorporating into the work. Samples of materials shall be submitted to the Engineer for his examination whenever he so requests. The Engineer will promptly advise the Contractor of his approval of or objections to each such item of material.

Unless specifically provided otherwise, all reference in these specifications to ASTM Designations or other standards shall refer to the edition of the publication in effect at the date of approval of Specification No. 1782 by the Board of Public Works.

39. GUARANTEES

The Contractor shall guarantee all equipment supplied by him for the duration of the contract and for one year after acceptance by the Board of Public Works. If any equipment during the period indicated above is adjudged by the Engineer to be below the standards prescribed by the contract, it shall be promptly replaced, or repaired where allowed for in the contract, by the Contractor. The entire cost of this remedial work shall be borne by the Contractor.

In addition to the guarantees provided expressly in this contract, or implied in fact or in law, the Contractor shall leave the entire installation in satisfactory working order and shall repair or replace at his own expense any part of his own work which develops defects due to faulty material or workmanship within a period of two years after the work is accepted by the Board of Public Works. The Contractor shall at his sole expense repair or replace any other work or equipment damaged as the result of such defects. Where equipment supplied by the Contractor is operated for its permanent use for the City previous to the final payment for the Contract, the one year guarantee period shall be in effect from the beginning of such operation.

In the event that the Contractor, after due notice refuses to remedy such work adjudged defective by the Engineer, the City may correct such work at his own discretion, billing the Contractor for the full expense incurred in this work.

40. USE OF UNSATISFACTORY MATERIALS

If any articles or materials furnished by the Contractor under this contract are found to be unsatisfactory, as determined by the Engineer, the City shall have the right to use and/or operate such unsatisfactory articles or materials until they can be replaced with satisfactory articles or materials without damage to the City; provided that the period of such use and/or operation pending replacement, or the correction of latent defects, errors, or omissions to the satisfaction of the Engineer shall not exceed the specified guarantee periods of such articles and materials as provided herein without written consent of the Contractor.

41. METHOD OF MEASUREMENT FOR PAYMENT

Measurements and computations will be made by such methods as the Engineer may consider appropriate for the class of work measured, including, but not limited to the methods of average end areas computed from cross sections, grid system, or topographic contours. If considered advisable by the Engineer for greater accuracy, prismoidal corrections, or correction for curvature in alignment will be employed. For the purpose of computing quantities, the planimeter shall be considered an instrument of precision adapted to the measurement of areas. The dividing limits, lines or planes between adjacent items or classes of excavation, concrete, or other types of work where not definitely indicated on the drawings, or in these specifications, will be as determined by the Engineer. The method of measurement of the weight of equipment, metalwork, metal pipe, and other metal parts, the furnishing, installing, handling or placing of which is to be paid for on the basis of weight shall be as provided in the respective section of this specification under which the item is specified.

42. CLEAN-UP

The Contractor shall keep the premises free from unnecessary equipment, materials, waste and rubbish during the course of his work, and nothing shall be allowed to accumulate at locations which would interfere with the work of others.

At the completion of his work, the Contractor shall remove all debris resulting from his work, all his equipment, tools, surplus materials and portable sanitary installations and other installations except those specified hereinafter to remain, and shall put the premises in a clean and orderly condition. The Contractor shall clean up portions of the work which are to be occupied prior to completion when directed by the Engineer.

In the event the Contractor fails to perform any portion of the clean-up specified above, the work will be performed at the Contractor's expense.

SECTION 1C

SPECIAL CONDITIONS

1. RIGHT OF WAY

The right of way for the work covered by these specifications including ingress and egress across public and private property, except as otherwise noted on the drawings, will be furnished by the City.

2. LAYOUT OF WORK

A primary survey control has been established in the project works area as shown on Drawing D-19041-R2. Additional monuments of the tangent point (TP) at each end of the reference cylinder of the dam and bench marks near each abutment of the dam will be furnished by the City for use in layout work in connection with dam construction. Details of this layout work will be made available to the Contractor. Unit centerlines, the longitudinal centerline and bench marks will be established by the City in the machine hall. The Contractor shall lay out all work as required according to the design drawings, and shall be responsible for the correct location of all constructed features with respect to the controls established by the City.

The Contractor shall carefully preserve all reference points and stakes established by the City, and in the case of negligent destruction due to the Contractor's operations, he shall be charged with the resulting expense for their replacement and shall be responsible for any mistakes caused by their loss or disturbance. Monuments which must be moved because of interference with the construction will be moved by the City. Reasonable notice shall be given by the Contractor prior to the required relocation.

The City reserves the right to check all work laid out by the Contractor during the progress of the work as deemed necessary to verify conformance with the drawings, and the Contractor shall allow a reasonable time to permit such checks before completing the work. These checks will be made during the regular working hours. The City will cooperate with the Contractor to minimize such delays. The City will not be responsible for any delays incurred while making such checks.

3. EQUIPMENT AND MATERIALS FURNISHED BY THE CITY

a. Equipment. The following items of equipment will be furnished to the Contractor without cost at the City's warehouse or storage yard shown on Drawing D-19085. Handling of the equipment as necessary for installation shall be by the Contractor at his expense.

(1) Structural steel and rails for the crane runway in the machine hall.

(2) Structural steel framing and trashrack panels for the trashrack. structures.

(3) Thermocouple wire, measurement devices, and appurtenant equipment for instrumentation of the dam.

(4) Seven (7) fixed wheel gates, with hoists, guides and rails for the sluice openings in the dam.

(5) One (1) bulkhead maintenance gate with operator, guides and rails for the sluice openings in the dam.

(6) One (1) 30-ton hoist with lifting beam for the bulkhead maintenance gate.

(7) Two (2) radial gates with hoists for the spillways at the dam.

(8) One (1) Bascule-type skimmer gate with screw stem operator for the left abutment of the dam.

(9) One (1) engine generator set for emergency power supply to be installed in the dam access gallery.

(10) Control panel for the gate control center in the left abutment of the dam.

(11) One (1) traveling trash rake for the forebay.

(12) Six (6) fixed wheel gates with hoists, guides and rails for the power intake tunnels.

(13) Two (2) 200-ton, single trolley bridge cranes for the machine hall.

(14) The embedded parts of four (4) hydraulic turbines, including elbow type draft tube liners, stay rings, spiral cases, pit liners, anchor bolts, servomotor supports and temporary test bulkheads.

(15) Twelve (12) bulkhead gates with guides and dogging devices for the draft tubes.

(16) One (1) 30-ton gantry crane with lifting beam and controls for the draft tube gates.

(17) 13,800-480Y/277 Volt Main Station Service Switchgear Sections.

(18) 480 Volt, 480Y/277 Volt and 208Y/120 Volt A.C. Power Distribution Panels.

(19) 480 Volt Motor Control Centers.

(20) 480-208Y/120 Volt A.C. Auxiliary Services, A.C. Lighting, and A.C. Emergency Lighting Transformers.

(21) 480 Volt A.C. Lighting Voltage Regulators.

(22) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Distribution Panels.

(23) 208Y/120 Volt A.C. and 125 Volt D.C. Emergency Lighting Transfer Panel.

(24) 13,800-480Y/277 Volt Pad Mounted Transformer and Appurtenant Equipment.

(25) 15 KV Main Station Service Power Cables.

(26) Miscellaneous Metalwork for electrical and mechanical equipment to be installed by others, consisting of generator anchor bolts, pedestal plates, frames and leveling devices.

(27) Paint and coating materials.

b. Weights. The weights of the heaviest components of the major items of Paragraph a. above are approximately as follows:

		Total Weight (Pounds)	Weight of Heaviest Lift (Pounds)
Twelve	Draft tube gates, frames & guides	516,000	10,000
	Draft tube gantry crane	20,000	10,000
Seven	Sluice gates, frames & guides	1,311,000	60,000
Seven	Sluice gate hoists	420,000	50,000
Six	Intake gates, frames & guides	1,260,000	55,000
Six	Intake gate hoists	240,000	40,000
	Sluice maintenance gate	440,000	160,000
	Sluice maintenance gate-embedded metal	380,000	20,000

		Total Weight (Pounds)	Weight of Heaviest Lift (Pounds)
	Sluice Maintenance gate operator	15,000	15,000
	Sluice Maintenance gate hoist	40,000	20,000
Two	Spillway radial gates, anchorage and embedded metal	540,000	40,000
Two	Spillway radial gate hoists	100,000	30,000
	Bascule skimmer gate	20,000	15,000
	Bascule skimmer gate hoist	6,000	6,000
	Trashrack panels and guides	700,000	10,800
	Trash rake	65,000	8,000
	Trashrack support beams		50,000
	Prestressed girders for access bridge on dam		60,000
Two	Machine hall bridge cranes	520,000	115,000
	Crane trolleys	230,000	115,000
	Crane Lifting Beam	20,000	20,000
Four	Turbines	2,832,000	57,000
	Draft tube liners	380,000	30,000
	Spiral cases	1,280,000	35,000
	Stay rings	912,000	57,000
	Pit liners	140,000	16,000
	Stay ring bulkhead	65,000	30,000
	Spiral case bulkheads	70,000	35,000

c. Information Available from the City. In addition to the information included in these specifications, the City's procurement specifications and manu-

facturer's detail drawings as far as available for the items listed may be reviewed by Bidders as described in Paragraph 12 below. Detail drawings of City-furnished equipment will be furnished to the Contractor as required for the installation work.

d. Handling. The Contractor shall receive at the City's warehouse or storage yard, load and haul to the installation site the equipment enumerated under a. above. He shall provide suitable protection as required and shall care for the equipment in the most suitable manner from the time it is received to the time it is accepted. The Contractor shall report to the Engineer in writing within 24 hours after receipt, any shortage or damage to material and equipment when received.

The Contractor will be charged, for any items of equipment lost or damaged beyond repair after delivery or receipt, or for any such items not incorporated in the work and not returned to the City, the same amount the said items cost the City delivered to the site of the work, or an amount equal to the replacement cost to the City whichever is higher; or if directed by the Engineer, during the progress of the work, the Contractor shall replace, at his expense, such items with equivalent grades of equipment as approved by the Engineer, and shall deliver same to the site of the work. Any equipment damaged after delivery to the Contractor, which in the opinion of the Engineer can be repaired satisfactorily, shall be repaired at the expense of and by the Contractor.

e. Materials. The City will make available without cost to the Contractor materials for processing into concrete aggregates as they are obtained from the Metaline Bar Deposit near Metaline, Washington.

4. EQUIPMENT AND MATERIALS FURNISHED BY THE CONTRACTOR

a. List of Equipment and Materials. The Contractor shall furnish all tools, equipment, materials, supplies and manufactured articles of all kinds whatsoever, necessary or required for the performand and completion of the work included in this Contract except as enumerated in Paragraph 3 above or as specified elsewhere herein. These items shall include but not be limited to the following:

(1) Cement, admixtures and water for concrete, mortar gunite and grout.

(2) Precast concrete components.

(3) Reinforcement steel, wire fabric and wire mesh.

(4) Seals and joint fillers.

(5) Seven (7) steel sluice liners for the dam.

(6) Diversion tunnel closure gate and lowering device.

(7) Steel Liners for six (6) penstocks.

(8) Corrugated arched ceiling for machine hall.

(9) Structural steel and metalwork for hatch covers, gratings, handrails, stairs, ladders, platforms, monorails and miscellaneous items.

(10) Rails for sluice maintenance gate operator, trash rake and draft tube gate gantry.

(11) Exposed and embedded piping, fittings, valves, pipe sleeves, hangers and supports.

(12) Two (2) elevators.

(13) Air conditioning system.

(14) Post-tensioned gate anchorages, rockbolts and anchor bars.

(15) Seal pressurizing system for seven (7) sluice gates.

(16) Seal heating systems for seven (7) sluice gates and two (2) spillway gates.

(17) Bubbler systems for skimmer gate, spillway gates and trashracks.

(18) Construction power and lighting facilities.

(19) Embedded and buried conduit, grounding, junction and outlet boxes, cable trays, power outlets, wire and cable.

(20) Lighting conduit, fixtures, switches and wiring.

(21) Doors, ventilators, louvers and movable partitions.

(22) Asphalt paving for backfill in unit bays.

(23) Concrete block masonry.

(24) Fencing.

(25) Corrugated metal pipe culverts.

(26) Timber bulkhead for turbine access gallery in unit No. 54.

(27) Penstock fill line from dam to power plant, including branch lines, penstock connections and valve.

(28) Sewage Treatment Plant.

(29) Grout Gallery Dewatering Pump

(30) Sump Discharge Slide Gate.

b. Protection of Materials and Equipment. The Contractor shall at all times during manufacture, shipment and installation take care to protect and preserve all materials, supplies, and equipment of every description, and all work performed. The Contractor shall comply with all reasonable requests of the Engineer to enclose or specially protect such properties. If, as determined by the City, material, equipment, supplies and work performed are not adequately protected by the Contractor, such properties may be protected by the City and the cost thereof may be charged to the Contractor or deducted from any payments due to him.

c. Drawings. Where drawings are required for manufacturing and/or installing of equipment and other items of work including elevators, and air-conditioning equipment, these drawings shall be submitted by the Contractor to the Engineer before fabrication or installation is commenced, allowing sufficient time for approval by the Engineer. All drawings submitted for this purpose, which are approved by the Engineer, shall form a part of the Contract. They shall include matchmarks, erection diagrams and other details, such as field connections, for proper installation and erection in the field.

The sequence of submission of all drawings shall be such that all information is available for checking each drawing when it is received. The Contractor shall furnish one (1) transparent positive to the Engineer for approval. Within twenty (20) calendar days after receipt, the Engineer will return one copy of the drawings marked "Approved", "Approved as Noted", or "Returned for Correction". The notations "Approved" and "Approved as Noted" authorize the Contractor to proceed with the fabrication of the equipment covered by such drawings subject to the corrections, if any, indicated thereon. When prints of drawings have been marked "Returned for Correction", the Contractor shall make the necessary revisions on the drawings and submit one (1) transparent positive of these drawings for approval in the same routine as before. Every revision shall be shown by number, date, and subject in a revision block.

Approval of the Contractor's drawings by the Engineer shall not be held to relieve the Contractor of any of his obligations to meet all the requirements of these specifications or relieve the Contractor of the responsibility for the correctness of such drawings. Any fabrication done prior to the approval of drawings shall be at the Contractor's risk. The Contractor shall make any changes in the design which are necessary to make the equipment conform to the provisions and intent of these specifications without additional cost to the City.

d. Parts Catalogs and Operating Instructions. The Contractor shall furnish complete and detailed installation and operating instructions for the power plant and dam elevators and the air conditioning equipment with particular emphasis on sequence and methods to be used in future maintenance, disassembly and reassembly. Special precautions, sequence of work, recommendations on methods of assembly and adjustment of all parts requiring adjustments shall be covered in detail. Catalogs and other data shall be included for easy identification of parts for ordering replacements. The above

requirements shall be assembled together with one set of all major drawings reduced to suitable size and bound in a permanent common cover. Twelve (12) copies shall be furnished at least thirty (30) days prior to operation of the equipment.

e. Gauges, Templates, and Patterns. All parts which may require renewal or replacement from time to time shall be made to template and gauge so that the original and spare parts will be interchangeable. All special gauges and templates necessary for field erection shall become the property of the City.

5. REQUIREMENTS FOR MATERIALS FURNISHED BY THE CONTRACTOR

a. General. All bolts, nuts, screws, rivets, threads, pipe, gauges, gears, and measurements or dimensions shown on the drawings shall conform to United States and American Standard. All work for furnishing and installing equipment shall be performed in accordance with the most advanced practice for this class of equipment, and unless otherwise specified herein, all materials and all work performed shall be in accordance with the requirements of the latest ASA, AIEE, ASTM, NEMA, AISE, or ASME Specifications. All steel castings used in the manufacture of the equipment shall conform to the requirements of the Steel Castings Handbook as published by the Steel Founder's Society of America.

All equipment and materials not specifically indicated elsewhere as being supplied by the City and which are required for a complete and satisfactorily installation, shall be supplied by the Contractor. These items shall include but not be limited to: instruments and specialty items; all pipe sleeves, hangers and supports; bolting and gaskets for connection; paint and painting equipment; shims, leveling plates, fitting-up bolts and grouting material; identification tags for valves; miscellaneous support steel and steel for attachment of pipe hangers and any and all other similar items required for a complete and satisfactory installation.

All materials used in the work shall be suitable for the work and the best of their respective kinds and shall be subject to the approval of the Engineer. All materials shall be the products of recognized reputable manufacturers. Where materials are specified as to trade name or manufacturer, it shall mean products as specified or approved equal subject to the approval of the Engineer. Other materials may be substituted for those specified only with the written consent and approval of the Engineer. If the Contractor desires to furnish equivalent materials normally furnished to other standard specifications, he shall submit copies of these standard specifications for the Engineer's approval. All parts and drawings shall be made accurately to American Standard gage of weights and measurements. All furnished surface quality shall be in accordance with ASA No. B 46.1.

All parts, which may require renewal or replacement shall be made to template,

gauge or jig so that original and spare parts will be interchangeable.

Sufficient technical and descriptive data shall be submitted to the Engineer for approval and such approval secured prior to fabrication or use of Contractor furnished materials. This approval shall not relieve the Contractor of his responsibility for adequacy and proper performance of the equipment.

b. Materials Specifications. Unless otherwise shown on the drawings or specified elsewhere all materials and materials for equipment furnished by the Contractor shall conform to the following requirements:

(1) Special Bolts and Nuts. Corrosion-resisting steel shall be used for all bolts and nuts for all portions of the work when either or both are subject to frequent adjustment or removal, and for bolts projecting from concrete with nuts subject to frequent removal.

(2) Steel Castings. Steel castings shall conform to ASTM Designation A 27, "Standard Specifications for Mild to Medium Strength Carbon-Steel Castings for General Application", Grade 65-35 or Grade 70-36 with the following additional chemical limitations:

Copper, max. percent	0.30
Nickel, max. percent	0.50
Chromium, max. percent	0.20
Molybdenum, max. percent	0.20

Before proceeding with foundry work, the Contractor shall submit to the Engineer drawings of all major steel castings, showing thereon the location of tension test specimens. The Contractor shall notify the Engineer in time to have an inspector present at the foundry when the castings are cleaned and defects chipped to sound metals as determined by magnetic particle examinations, and before any repairs are made; after the repairs have been made and before castings are annealed; and after the castings are annealed and before they are shipped to the machine shop. No major repairs shall be made to castings without the knowledge and approval of the Engineer. Welding shall be performed only by properly qualified welders and in accordand with the best welding practice. Cracks and other defects disclosed when castings are cleaned or during machining operations shall be chipped to sound, clean metal before any repairs are made. If the removal of metal to uncover a crack or defect reduces the stress-carrying cross section of the casting more than 50 percent, the casting may, at the option of the Engineer be rejected or repaired. Castings requiring welding repairs at any stage of manufacture after the first annealing, and castings involving welding fabrications, shall be stress-relieved.

Thickness and other dimensions of the castings as called for on the drawings shall not be reduced by shop or foundry practice to the extent that the resulting stresses in the metal will exceed the stresses allowed under these specifications. Castings shall not be warped or otherwise distorted, nor shall their dimensions be oversize to such an extent as to interfere with proper fit and with other parts of the equipment.

(3) Iron Castings. Iron castings shall conform to the requirements of ASTM Designation A 48, "Tentative Specifications for Gray Iron Castings", Class 30, except that Class 25 will be permitted for castings for low stress-carrying parts.

(4) Steel Forgings. Steel forgings shall have physical properties at least equal to those required by ASTM A 235 for "Carbon Steel Forgings for General Industrial Use", Class E.

(5) Structural Steel. Steel plates shapes and bars for welded structural parts shall conform to ASTM A 36 for "Structural Steel". Steel plates, shapes and bars for non-welded structural parts shall be of a type and grade suitable as approved by the Engineer for the class of service and method of manufacture used.

(6) Bronze. Bronze castings shall be of a quality at least equal to that required by ASTM Designation B 143, "Standard Specifications for Tin Bronze and Leaded Tin Bronze Sand Castings", Classification and Alloy No. 1B or 2B as required or ASTM Designation B 148, "Standard Specifications for Aluminum Bronze Sand Castings", Classification and Alloy No. 9A. Bronze bearings, bushings, thrust discs, wearing rings etc., shall conform to ASTM B 144, "Specifications for High-Lead Tin Bronze Sand Castings", Alloy 3A. Bronze for bolts and nuts shall be of a quality at least equal to that required by the ASTM B21 for "Naval Brass Rod, Bar and Shapes", Alloy A, half hard (Naval Brass).

(7) Copper Tubing. Copper Tubing shall conform to the requirements of ASTM Designation B 88, "Standard Specifications for Seamless Copper Water Tube", type as required.

(8) Rigid Conduit. Rigid conduit shall conform to the requirements as ASA Standard C 80.1, "Specifications for Rigid Steel Conduit, Zinc Coated", hot-dip galvanized.

(9) Anti-Friction Bearings. Anti-friction bearings shall meet the requirements of and be identified in accordance with the current standards of the Anti-Friction Bearing Manufacturers Association, Inc.

(10) Steel Pipe. Steel pipe shall conform to the requirements of ASTM A 53, Type S Grade B "Schedule 80, Seamless Steel Pipe ", except as otherwise specified.

(11) Electrical. All electrical equipment and wiring shall conform to the requirements of the National Electric Code, National Electrical Safety Code, the Standards of The American Institute of Electrical Engineers, and the Standards of the National Electrical Manufacturers Association, each as they apply except as otherwise specified.

c. Working Stresses. Liberal factors of safety shall be used throughout the design and especially in the design of all parts subject to alternating stresses or shock. For all parts of the equipment, the maximum stresses in tension or compression due to the most severe conditions occurring in normal operation shall not exceed one-third (1/3) of the yield strength nor one-fifth (1/5) of the ultimate strength of the material. Maximum stresses in shear shall not exceed 3,000 psi in cast iron, nor 60 percent of the allowable stresses in tension for other materials. Upon request, information regarding unit stresses used in the design shall be furnished.

6. TEMPORARY BUILDINGS

The Contractor may construct such temporary buildings as necessary for the performance of the required work. No buildings for housing or mess halls will be permitted, nor will any residential trailer camps be allowed within the Project boundaries. An area will be available for temporary buildings as shown on Drawing No. D-19085.

The Contractor shall not establish, or issue concessions or permits of any kind to third parties for establishing commercial, amusement or other establishments upon lands owned or controlled by the City.

7. DOMESTIC AND CONSTRUCTION WATER

The City has developed a supply of domestic water from a spring as shown on Drawing D-19085. A 6-inch buried line extends to the City's camp area and the Contractor will be permitted to install a 2-inch tap for his supply. The Contractor shall provide all material and install and maintain all piping from this tap to his own buildings and services. This water shall be limited to domestic use and no charge will be made for the quantity used. Upon completion of the work the domestic water installation shall be left in place without cost to the City.

The Contractor shall provide water for his own construction purposes from other sources subject to approval of the Engineer.

8. CONSTRUCTION POWER

Electric power for construction purposes will be furnished to the Contractor at nominal cost. The supply consists of a three-phase, four wire, 12,470 volt feeder having a capacity of 4000 kva. This feeder, which is served from a construction power substation one-half mile from the site, runs along the West Side Access Road for approximately the entire length of the construction area. At present, the City has two buildings served from this feeder.

The Contractor shall install taps to this feeder, and construct such feeder and distribution facilities as may be necessary to facilitate the execution of his work. The Contractor shall furnish, install, and maintain all equipment, and the cost therefor shall be included in the prices bid for the various items in the Proposal.

A second similar feeder is presently being used by the excavation contractor. This second feeder will be available for the Contractor's use upon completion of the excavation contract (scheduled about May 1, 1965).

Construction of these power and distribution facilities shall in all respects conform to the National Electric Safety Code. Conductors at primary voltage shall not be smaller than No. 4 copper or equivalent. The Contractor shall submit for the approval of the Engineer a layout of the proposed facilities and details describing the materials to be used.

Upon completion of the Contract, all power lines to the various areas of the work, including poles, wires, and switches shall remain in place and shall become the property of the City without cost. All transformers and related equipment as may be determined by the Engineer to be essential to continued operation of certain loads shall also remain in place and become the property of the City without cost.

The City will make every reasonable effort to maintain a steady supply of power to the Contractor but will not be responsible for delays or damage resulting from any failure of power supply which may occur in spite of these efforts.

Meters for measuring the energy used will be furnished and installed by the City at the construction power substation and at the City's building services. The energy consumed by the City buildings will be subtracted from the energy delivered to the feeder at the substation, and the balance will be billed to the Contractor once each month at the rate of 0.75 cents per kilowatt hour.

9. TELEPHONE SERVICE

The Contractor shall make his own arrangements for telephone service and/or other means of communication. Local telephone service is provided in this vicinity by the General Telephone Company of the Northwest, 623 Wallace Ave., P. O. Box 1031, Coeur d'Alene, Idaho.

10. FOREST SERVICE REQUIREMENTS

As the project area is within the fire protection boundary of the Colville National Forest, the Contractor shall abide by all rules and regulations of the U. S. Forest Service applicable to the performance of the work required under this Contract. The Contractor shall also be responsible for compliance with all state and local laws and regulations relative to fire precautions in the area of the work, and burning of slash and debris.

The Contractor and subcontractors and their employees shall do everything reasonably within their power, both independently and upon request of officers of the agency of the United States concerned, to prevent, make advanced preparations for suppression, and suppress fires on lands occupied under FPC License 2144.

The Contractor and his subcontractors shall agree to the following:

a. Arrange any material that is to be disposed of by burning at a safe distance from green trees to prevent damage to the residual timber.

b. Make all of their employees and equipment available for the suppression of any fires started as a result of their operations.

c. Pay for damages and suppression costs for any fires resulting from any phase of their operation.

d. Make their employees and equipment available to the Forest Service in the event of an emergency created by a fire not caused by the Contractor, subcontractors, or their employees within 10 miles outside the project boundary. Men and equipment so employed by the Forest Service shall be paid for by the Forest Service for similar services. Men and equipment when so employed by the Forest Service shall be released as soon as suitable replacements can be obtained.

During the forest fire season as designated by the State of Washington, the Contractors, and his subcontractors shall comply with the following requirements unless amended in writing by the Forest Service:

Burning Permits. Burning permits shall be obtained before kindling any open fires and all fires shall be completely extinguished when required by the Forest Service.

Tool Boxes. A minimum of one tool box shall be provided on each side of the river at the damsite in accordance with Chapter 76.04.250, Washington Forestry Laws.

During clearing operations, the Contractor or each clearing subcontractor shall provide a tool box for each crew in accordance with said Chapter 76.04.250.

When burning is in progress during the designated fire season, the Contractor and his subcontractors shall furnish additional fire fighting hand tools to adequately equip all men for fire suppression work engaged in clearing and burning operations.

Pumper Trucks. One serviceable truck shall be provided for the dam construction area and stationed as directed by the Forest Service. Such truck shall be equipped with a water tank of not less than 500 gallons capacity, a power pumper with a rated capacity of not less than 20 gallons of water per minute under 150 pounds pressure, a pressure relief system which allows the operator to open and shut the nozzle as needed, and not less than 500 feet of one inch inside diameter, rubber lined, leak-proof hose equipped with a shut-off nozzle which can be adjusted from spray to straight stream. At least 100 feet of said hose to be mounted on a live reel ready for instant use.

Spark Arresters. All internal combustion engines used in connection with this operation shall be equipped with an adequate muffler or spark arrester except diesel-powered trucks on which the exhaust may be turned up perpendicular and extended above the cab.

Tools and Fire Exteinguishers on Trucks and Tractors. Each truck or tractor operating within 1/8 mile of forested areas shall be equipped with one shovel, round point, long or "D" handle, one axe of not less than 3# head with 32" handle and one fire extinguisher of not less than one quart capacity, dry chemical preferred.

Power Saws. Each power saw shall be equipped with an adequate spark arrester and shall have one fire extinguisher of 8-ounce capacity and one long handle round point or "ladies" shovel immediately available to the operator.

Smoking and Warming Fires. Smoking and warming fires shall not be permitted except in gravel pits, clearings or other areas free of flammable material, and then must be extinguished before leaving.

Ash Trays. Each vehicle operating through forest areas must be equipped with an ash try in each compartment.

Watchmen. During periods when in the judgment of the Forest Service such precautions are necessary, one or more watchmen after hours and on non-work days may be required when clearing fires or blasting are in progress.

Storage of Inflammables. Gasoline, oil, grease and other flammable material shall be stored in a place from which grass, slash, brush, timber and debris has been cleared for a distance of at least 50 feet in each direction.

11. TRAFFIC CONTROL

The City has established and will maintain a Traffic Control Station on the West

Side Access Road near the entrance to the project work area for control of and admittance thereto.

In order to facilitate entrance of the Contractor's vehicles to the project work area, they shall be appropriately identified by the Contractor.

12. SUPPLEMENTAL INFORMATION FOR BIDDERS

In addition to information contained in this specification and/or shown on the drawings, the following supplemental information will be made available to prospective bidders at the Engineering Services Office, Room No. 201, City Light Building, Seattle, and the Boundary Project Office at the site:

a. Cores from exploratory drill holes (at Boundary Project Office only).

b. Procurement specifications and manufacturers' drawings for City-furnished equipment, insofar as available.

c. Report on hydraulic model testing for the Boundary Project.

d. Location map of Metaline Bar aggregate deposit and description of bench mark.

e. Rating curve for Pend Oreille River at Metaline Bar.

f. Logs of test pits at Metaline Bar aggregate deposit and information on previous use of the materials.

g. Results of tests made on concrete aggregate samples.

13. STREAM POLLUTION

The Contractor shall construct at his own expense settling basins of sufficient capacities, or equivalent facilities, to prevent the introduction of any materials into stream flow below any of his operations which would pollute the stream or would constitute substances or materials deleterious to fish life as covered by laws of the State of Washington.

The Contractor shall submit to the Engineer for approval, drawings showing his proposed facilities. If the facilities as constructed prove inadequate, he shall make such improvements as necessary to fulfill the requirements of the laws stated above.

14. ACCESS TO AREAS OF WORK UNDER FIRST CONTRACT

In order that the Contractor for the first contract presently in progress, shall have access to the penstock tunnels through the intake mucking tunnel until the penstocks have been completely excavated, the Contractor for the work under this Specification No. 1782 shall conduct the excavation for the forebay and other work in this area in such a manner as will not interfere with the work of the present Contractor and will not obstruct access to intake mucking tunnel at such times as access is necessary by the first Contractor.

15. SNOW REMOVAL AND SANDING OF ACCESS ROADS

The Contractor for the first contract, presently in progress, will remove snow and will sand the West Side Access Road and the County Road No. 62 from its junction with Washington State Highway No. 6 as necessary to provide access to the area of the work on the west side of the river during the winter of 1964-65.

During subsequent winters the Contractor for the work under Specification No. 1782 shall continue the operation of snow removal and road sanding throughout the period of this contract. The work shall be done at the direction of the Engineer.

For this work the City will provide the Contractor with a truck-mounted snow plow and sander and a front end loader presently at the site.

The Contractor shall provide labor, for operation of the equipment and such other labor and additional equipment as may be necessary for snow removal and road sanding. The Contractor shall also make minor repairs and maintain the City-furnished equipment in serviceable condition, and furnish fuel and supplies for operation of the equipment.
Payment for the work of snow removal and road sanding of the access roads described above shall be made as provided in Section 1B, paragraph 15.

SECTION 2

MOBILIZATION

1. SCOPE

The work to be performed under this Section includes the following:

a. Transporting construction plant and equipment to the work sites and setting up the same.

b. Construction of temporary access to the work sites on the left abutment, including diversion tunnel intake and cofferdams.

c. Construction of temporary access to the work sites on the right abutment of the dam.

2. CONSTRUCTION PLANT AND EQUIPMENT

The Contractor shall mobilize and transport his construction plant and equipment including materials and supplies to the site of the work, construct such temporary buildings as may be necessary for the work to be performed, and assemble the equipment at the site. An area which the Contractor may use for initial setting up of plant and storage yards is shown on Drawing No. D-19085.

3. ACCESS TO WORK SITES

The Contractor shall provide his own access from the West Side Access Road, shown on Drawing No. D-19085, to the work sites on the left bank of the Pend Oreille River. When constructing access to the diversion tunnel intake and upstream cofferdam at the dam site, the Contractor shall use a minimum amount of fill upstream of the diversion tunnel intake. Any material from this fill which has been dis-located during high runoffs in summer, 1966, and is obstructing the flow to the diversion tunnel intake shall be removed by the Contractor at no extra cost to the City.

The Contractor shall also provide his own access to the work site on the right bank of the Pend Oreille River. Access to the vicinity of the right bank is via the East Side Access Road which branches off State Highway No. 6 at Crescent Lake. The City will improve this road during the summer of 1964 from the State Highway to a visitors' viewpoint shown on Drawing D-19085. Access via this road will be maintained during the period of improvement.

Any road the Contractor builds from the East Side Access Road to the right abutment of the dam, or roads which are above reservoir level will remain as permanent roads and must therefore have a maximum grade of 10% and a minimum curve radius of 50 feet to meet Forest Service standards. The roadbed width shall be not less than 12 feet.

Prior to commencing work on any access construction, drawings showing the location of the proposed roads shall be submitted to the Engineer for review and approval. The East Side Access Road and the roads constructed by the Contractor shall be maintained throughout the contract period by the Contractor, and kept open during winter months, sufficiently for the Contractor's purposes and for use by the Engineer as necessary for supervision of the work.

4. PAYMENT

Payment for all work performed under this Section will be made at the lump sum allowed in the Proposal for "Mobilization". Fifty percent (50%) of the lump sum will be deemed to have been earned when the Contractor has suitable plant and equipment for excavating spillways and forebay on the site and has maintained a rate of not less than 1,000 cubic yards per day for excavation and disposal of materials for a period of five consecutive days. An additional twenty-five percent (25%) of the lump sum will be deemed to have been earned when the Contractor's equipment for placing concrete in the dam is completely erected and ready to operate. The remaining twenty-five percent (25%) of the lump sum will be deemed to have been earned when the Contractor's concrete plant as required by this specification is completely erected and has produced concrete for a permanent feature.

SECTION 3

CLEARING

1. CLEARING

Clearing of most of the construction area has been performed under separate contracts by others. Clearing of the Contractor's camp area, shown on Drawing D-19085, and reservoir clearing will also be done by separate contract. Clearing under this specification, includes areas for muck disposal on the right bank, and for the Contractor's access and facilities on the right bank. Clearing of these areas, and any other areas that may be authorized for use by the Contractor, shall conform to the following requirements:

Stumps shall be cut as low as practicable but shall not be more than 14 inches on the side adjacent to the highest ground except that when this requirement is impractical, higher stumps may be authorized. Brush shall be cut as close to the ground as practical. No timber on the clearing area shall be felled across the clearing boundary or into the area which will not be cut over except where it is unavoidable. Doubtful trees on the boundary line shall be cut or left as directed.

Brush shall include shrubs, bushes, vines and all trees smaller than six inches in diameter at height of four and one-half feet above ground.

A down log is a log, rotted or sound, existing on the ground. Waste material shall include building debris, down logs, windfalls, tops, limbs, brush, uprooted stumps, unmerchantable logs and other debris.

All merchantable timber within the area to be cleared shall become the property of the Contractor for disposal by removal from the site or burning at his option.

No special payment will be made for the above described clearing. The costs shall be included in the various items bid in the Proposal.

SECTION 4

DIVERSION AND CARE OF RIVER

1. GENERAL

This section stipulates the requirements of diversion and care of river at the diversion tunnel, dam site and tailrace areas; and, the restoration of these areas when the associated facilities therein are no longer required. The Contractor shall complete the diversion tunnel, construct and maintain all necessary cofferdams, conduits, channels, flumes, drains, sumps, bulkheads, log booms and other temporary diversion and protective works, and furnish all materials required therefor in accordance with this section. Section 6 stipulates the requirements of unwatering the work areas and maintaining this condition.

The Contractor shall be responsible for, and shall repair at his own expense, any damage to the foundations or any part of the work caused by floods, water or failure of any part of the diversion or protective works.

Before construction is started for any of the work described in this section, the Contractor shall submit to the Engineer for his review and exceptions, if any, a detailed "river diversion and water control plan" showing the locations, typical sections and details of all cofferdams, cribs and other means of diverting or bulkheading the water for the work under this section; and, for unwatering and water control under Section 6.

Any debris that is allowed to escape downstream shall be immediately removed from the river by the Contractor for disposal by him at a convenient time. Should the Contractor refuse, neglect, or delay compliance with this requirement, the work will be performed by others under the direction of the Engineer and the cost therefor will be deducted from any amounts due or to become due the Contractor. In the event it becomes necessary to determine how much debris has escaped downstream for which the Contractor is responsible, the Engineer will determine the amount chargeable to the Contractor.

2. STREAMFLOW

Hydrographs of the Pend Oreille River at Z-Canyon are shown on the drawings solely for the purpose of aiding the Contractor in estimating flows in the Pend Oreille River at the project site so that he can time his construction operations and provide protection as may be necessary against such flows. The City does not guarantee the reliability or accuracy of the hydrographs and assumes no responsibility for any deductions, conclusions, or interpretations which may be made from them, nor for any conclusions drawn from the operation of power projects and control works upstream of the Boundary Project area.

3. COMPLETION OF DIVERSION TUNNEL

a. Completion of Diversion Tunnel. The diversion tunnel which is located in the left abutment of Boundary Dam will have been, to a large extent, excavated and gunite-lined by others. The Contractor shall complete the construction of the diversion tunnel, which includes the following items of work:

(1) Construction of cofferdam and open cut excavation for diversion tunnel channel and intake structure.

(2) Tunnel excavation at the intake and outlet ends of the diversion tunnel.

(3) Construction of the tunnel intake structure.

(4) Completion of the gunite lining in the tunnel.

(5) Installation of the flow plate in the tunnel.

(6) Construction of the concrete plug in the mucking tunnel and installation of the dished head.

Details for the work under (1) through (6) above are shown on the drawings and described in other sections of this specification.

b. Care of River at Diversion Tunnel Intake. The Contractor shall design, construct, and maintain cofferdams or any other features necessary to protect the work area at the diversion tunnel intake during the required excavation and construction work there. He shall wherever possible, obtain materials for these protective works from required excavations, but may also obtain the materials from any other source approved by the Engineer. The Contractor shall be responsible for the safety of all structures and other features which he constructs to protect or facilitate his work.

c. Care of River at Diversion Tunnel Outlet. It is anticipated that the Contractor will drill and blast the last portion of the diversion tunnel in the immediate vicinity of the outlet portal in such a manner that most of the loose material from the last round is deposited in the river. This operation may be performed without constructing a cofferdam at the diversion tunnel outlet and unwatering this portion of the work. No removal of the material excavated in this manner will be required. However, nothing in this specification shall be construed as preventing the Contractor from using a different method of excavation for the downstream portion of the diversion tunnel provided that the minimum cross section of the diversion tunnel is maintained through this area, and that the costs to the City are not increased.

e. Model Tests. Hydraulic model testing performed in conjunction with the project design included tests for evaluating the problems involved in constructing a cofferdam in the flowing river. Information on these tests is contained in a report which may be reviewed by bidders at the City Light office in Seattle or the Boundary Project office at the site; but, with the explicit understanding that the City does not assume any responsibility for, or guarantee the accuracy or reliability of, the data and any deductions, conclusions or interpretations presented in the report, and that any application the Contractor makes thereof shall be at his own option and responsibility.

5. CONTROL OF RIVER IN TAILRACE AND DRAFT TUBE WORK AREAS

The Contractor shall construct a cofferdam to protect the tailrace and draft tube work areas during tailrace excavation and completion of excavation of the draft tube portals. The design, construction and maintenance of this cofferdam shall be the Contractor's responsibility. The location shall be such that the cofferdam does not encroach into the excavation of the tailrace, and does not extend beyond the straight line extension of the left wall (looking downstream) of the diversion tunnel having the same bearing as the centerline of the tunnel at the outlet end. The suggested layout shown on Drawing No. D-23193 is for general guidance only and shall in no way relieve the Contractor of his responsibility as stipulated herein. The crest shall be constructed to a minimum elevation of 1732, and have a width of not less than 20 feet. Design and construction shall be such that water seepage through the cofferdam is held to an amount and rate which the Contractor can control as required in Section 6 of this specification.

It is expected that due to the restricted space in the vicinity of the diversion tunnel outlet, the use of timber cribs, bin walls or similar type of construction will be required. The Contractor shall furnish all materials for the construction of the cofferdam, including rip rap, rock filled wire cages and other means required to prevent erosion due to discharge from the diversion tunnel. Earth and rockfill materials shall in general be obtained from the riverbed, the lower disposal area, or required excavations; but, may also be obtained from other sources approved by the Engineer.

6. CLOSURE OF THE DIVERSION TUNNEL

a. General. Closure of the diversion tunnel shall not be made until the following requirements have been met and closure is authorized by the Engineer in writing:

(1) The dam, including sluice and spillway gates in place, is accepted.

(2) Draft tube gates accepted in place in closed position.

(3) Tailrace and draft tube excavation completed.

(4) Contractor fully mobilized to construct diversion tunnel plug and complete the mucking tunnel plug.

4. RIVER DIVERSION AT DAM SITE

a. General. After the City has issued to the Contractor the Notice to Proceed with Work in the River, the Contractor shall construct cofferdams both upstream and downstream of the dam foundation excavation area and divert the river flow through the completed diversion tunnel to develop a "dry" work area for foundation excavation and construction of the lower portion of the dam.

b. Location of Cofferdams. The cofferdams shall be located so that no part is closer than 50 feet from the anticipated intersection of the dam foundation excavation slopes with the existing riverbed; and so that no part obstructs or otherwise interferes with the flow to and from the diversion tunnel portals. The approximate location of these cofferdams is shown on Drawing No. D - 23130.

c. Design and Construction of Cofferdams. The design and construction of the cofferdams and the materials to be used shall be the responsibility of the Contractor; except, that the following minimum dimensions will be required:

(1) The crest of the cofferdams shall be not less than 20 feet wide.

(2) The crest of the upstream cofferdam shall be not lower than elevation 1765.

(3) The crest of the downstream cofferdam shall be not lower than elevation 1732.

However, this specification shall not prevent the Contractor from constructing cofferdams with a higher crest elevation, and/or raising the crest during construction.

Material for cofferdam construction shall be from required excavation and existing muck disposal areas. A limited amount of material may also be obtained from approved borrow areas located within the project boundaries or on property owned and controlled by the City.

The cofferdams shall be designed and constructed with sufficient structural strength and stability to safely withstand the forces imposed by water impounded to an elevation three feet below the crest on the river side. The cofferdams shall be sufficiently impervious to ensure that seepage through the dam can be controlled in accordance with the requirements of Section 6 of this specification.

d. Overtopping During High River Discharge. With the crest elevations stipulated above, it is anticipated that the cofferdams will be overtopped and partially destroyed during the period of high river discharges in 1966. However, the construction schedule as specified in Section 1A requires completion of the dam to El. 1765 before the flood discharges of 1966 occur. Provided this schedule requirement is met, the cofferdams will not be needed after the 1966 flood season and consequently repair or replacement will be unnecessary.

(5) Arrangements have been made by the Engineer to coordinate operation of upstream power plants.

(6) Contractor fully mobilized to handle the closure gate.

(7) The closure gate accepted and ready for lowering into its final position.

b. Scope of Work. The following work will be required for the purpose of closing the diversion tunnel:

(1) Furnishing and installing the closure gate in standby position.

(2) Furnishing and installing lowering device for the closure gate.

(3) Controlled lowering of the closure gate.

(4) Diversion and control of flow from tailrace into diversion tunnel at outlet end.

(5) Removal of the flow plate and dished head from the mucking tunnel.

(6) Construction of diversion tunnel plug.

(7) Completion of mucking tunnel plug.

(8) Grouting at tunnel plugs.

Details for the work under (1), (5), (6), (7) and (8) above are shown on the drawings and described in other sections of this specification. Work required under (2), (3) and (4) shall be as described below.

c. Lowering Device and Lowering of Closure Gate. The Contractor shall furnish and install the lowering device for the closure gate including all appurtenances, as shown on the drawings. He shall furnish all labor, material and equipment, and supervision required for the safe lowering of the gate, which shall include the following:

(1) Checking out the closure gate and lowering device to establish that everything is in working condition.

(2) Checking and cleaning, if required, of the diversion tunnel intake structure to ensure that no foreign matter or obstructions exist which will prevent the gate from closing properly.

(3) Lowering the gate into its closed position.

(4) Rendering the gate sealing surfaces sufficiently water-tight, if required, by introducing suitable materials into the water ponded upstream of the closed gate. Any leakage past the gate shall be reduced by such means to a rate which will enable the Contractor to properly construct the diversion tunnel plug. The Contractor shall submit a plan for such supplemental sealing prior to lowering the closure gate.

d. Control of Flow from Tailrace. After lowering the closure gate the Contractor shall control the flow of water from the tailrace into the diversion tunnel by means of a cofferdam, bulkhead or similar structure between the diversion tunnel outlet and the location of the diversion tunnel plug in order to facilitate subsequent unwatering of the diversion tunnel, removal of the flow plate and dished head, construction of the tunnel plugs, and grouting as required.

7. REMOVAL OF COFFERDAMS

Removal of the upstream and downstream cofferdams protecting the dam site is not required. However, any portion of the upstream and downstream cofferdams which may have been washed into the vicinity of the diversion tunnel portals during high river discharges shall be removed to the extent required to prevent obstruction of the flow entering or discharging from the diversion tunnel.

The cofferdam and protective works at the diversion tunnel intake shall be removed when no longer required; and, the materials in them shall be disposed of in the vicinity of the diversion tunnel intake as directed by the Engineer.

The portion of the tailrace cofferdam within the excavation lines for the tailrace and the portion outside these excavation lines above El. 1690 shall be removed under balanced head. Sand, gravel and similar materials from this cofferdam may be deposited in the tailrace downstream of the required excavation and below El. 1690. All other materials in this cofferdam shall be disposed of as directed by the Engineer.

The cofferdam, or other means provided by the Contractor to divert and control flow from the tailrace into the diversion tunnel during closure of the diversion tunnel and construction of the plugs, need not be removed; except, that an adequate opening shall be provided to permit passage of a nominal flow of drainage water from the plug area to the tailrace.

8. MEASUREMENT AND PAYMENT

a. Completion of Diversion Tunnel. Payment for the following work will be made at the applicable prices referred to in other sections of this specification:

(1) Tunnel excavation and open cut excavation at the diversion tunnel.

8. MEASUREMENT AND PAYMENT - Continued

(2) Construction of intake portal structure and gunite lining of diversion tunnel.

(3) Construction of concrete plug in mucking tunnel and furnishing and installing dished head and flow plate.

Payment for all other work, including cofferdam construction and unwatering foundations at diversion tunnel intake as described in Paragraph 3a above and Section 6 will be made at the lump sum price bid in the Proposal for "Care of River and Unwatering at Diversion Tunnel Intake".

b. River Diversion at Dam Site. The Proposal Item "Diversion and Care of River and Unwatering at Dam Site" provides payment for: Construction and maintenance of both the upstream and downstream cofferdams adjacent to the dam foundation excavation area; construction of any access roads, embankment placing and handling facilities and any other works required to construct and maintain diversion facilities to protect the dam foundation excavation area and the dam construction to El. 1765; and all costs to the Contractor for unwatering the dam foundations as described in Section 6.

Payment will be made at the lump sum price bid for "Diversion and Care of River and Unwatering at Dam Site" as follows: Sixty percent (60%) of the lump sum will be paid when the Contractor has successfully accomplished river diversion and has lowered the water table between both cofferdams at the dam site below the lowest riverbed elevation. An additional five percent (5%) of the lump sum will be paid to the Contractor for each of eight months thereafter during which the dam foundation excavation has been successfully kept in the required unwatered condition. If, during this eight month period, the Contractor has completed construction of the dam to El. 1765, or the Engineer determines that unwatering of the dam foundations is no longer required, the balance of the lump sum will be paid to the Contractor, all within the limitations of Section 1B-23.

c. Control of River at Tailrace and Draft Tube Work Areas. The Proposal item "Care of River and Unwatering at Tailrace" includes: Construction, maintenance and leveling and/or removing, of the tailrace cofferdam, crib or bin bulkheads, and any other item provided to protect the tailrace and draft tube work areas during excavation and construction operation therein; construction, maintenance and removal or leveling to the satisfaction of the Engineer, of any access roads required to obtain or place materials; materials placing or handling facilities and any other access facilities or installations required to perform the work; all costs to the Contractor for unwatering the tailrace excavation as described in Section 6.

Payment will be made at the lump sum price bid for "Care of River and Unwatering at Tailrace".

d. Closing of the Diversion Tunnel. Payment for the following work will be made at the applicable prices stipulated in other sections of this specification:

(1) Furnishing and installing the closure gate in its standby position.

(2) Construction and grouting of tunnel plugs.

Payment for all other work to close the diversion tunnel, including furnishing and installing lowering device, lowering the closure gate, controlling flow from the tailrace and removal of the flow plate and dished head from the mucking tunnel will be made at the lump sum price bid in the Proposal for "Closure of Diversion Tunnel".

e. Removal of Cofferdams. No separate payment will be made for removal of cofferdams when required by this specification, but the cost thereof shall be included in the prices bid in an applicable item, or items, of the Proposal.

SECTION 5

EXCAVATION

1. EXCAVATION - GENERAL

a. Scope of Work. The work covered by this section of the specification consists of furnishing all plant, labor, equipment and materials and performing all work required to accomplish satisfactorily the excavation and disposal of excavated materials from the forebay and spillway areas, dam foundation, diversion intake, diversion tunnel, draft tubes, tailrace and all other excavation required to complete the construction as shown on the drawings. Disposal of excavated materials and backfill shall be in accordance with Section 7.

The Contractor will be required to complete all excavation and to perform all cleanup work required to prepare the excavated areas and, if required, remove potential slide material. The Contractor shall examine the site of the work, the logs of drill holes, the core samples, and shall inspect the exploratory tunnels and other underground excavation which is completed at the time of bidding. The Contractor shall further decide for himself the character of materials to be excavated and the equipment and processes to be employed to complete the work.

b. Classification of Excavation. Excavation will be either unclassified, or will be classified as rock excavation, or common excavation, defined as follows:

(1) Rock Excavation. This classification includes all solid rock in situ which cannot be removed until loosened by blasting, barring or wedging. It also includes boulders or detached pieces of solid rock greater than four cubic yards in volume. Solid rock under this classification is defined as sound rock of such hardness and texture that it cannot be loosened or broken down by a power shovel in good operating condition, handled by an experienced operator. No material, except boulders or detached pieces of solid rock, will be classified as rock excavation, which is not actually loosened by blasting before removal unless blasting is prohibited and barring, wedging or similar methods are prescribed by written order of the Engineer.

(2) Common Excavation. This classification includes the excavation of all material other than rock excavation including but not restricted to earth, sand, gravel and talus. It also includes boulders or detached pieces of solid rock not exceeding four cubic yards in volume, and such hard and compact material as hardpan, cemented gravel, and soft or disintegrated rock. Included as common excavation will be removal of any overburden materials which, as determined by the Engineer, are liable to slide or fall and are in a condition dangerous to the completed project and safety of the work-

men engaged in constructing any portion of the work. The methods used shall be such as to prevent rendering unstable any materials that were originally sound and safe.

(3) Unclassified Excavation may be either rock or common excavation described above. If the excavation is unclassified, the Contractor shall make his own determination as to the nature of the material to be removed.

c. Paylines and Tolerances. Excavation shall be performed to the elevations, lines and grades as shown on the drawings or established by the Engineer. All necessary precautions shall be taken to preserve in a sound and unshattered condition all rock below and beyond the limits of excavation. Where the specifications or drawings require excavation to suitable rock, the elevation of acceptable rock will be determined by the Engineer. Where the foundation elevation is fixed by structural requirements and is so indicated by specific elevations on the drawings, additional excavation may be required if foundation conditions encountered at the specified elevation are unsatisfactory. Excavation lines shown on the drawings or as modified by the Engineer shall be paylines for all excavation performed under this contract. Any excavation beyond the paylines performed by the Contractor for any purpose or reason, except as may be ordered in writing by the Engineer, shall be at the expense of the Contractor and all such unauthorized over-excavation shall be refilled, where required to complete the work, with approved materials furnished and placed at the expense of and by the Contractor.

No blasting that might damage the work will be permitted and any damage done to the work by blasting, including shattering of material beyond the required excavation lines shall be repaired at the expense of and by the Contractor and in a manner satisfactory to the Engineer. Slopes shattered or loosened by blasting shall be taken down at the expense of and by the Contractor. No separate payment will be made for rehandling material stockpiled by the Contractor for future use, unless specifically authorized in writing by the Engineer.

All material inside the paylines shall be removed by the Contractor except that:

(1) Fillets of undisturbed rock, maximum dimension 6 inches, may be left in place at re-entrant corners of paylines.

(2) Occasional projections of undisturbed rock will be permitted to extend within the paylines by the amounts specified below. Rock projections are defined as occasional projections, when their cross section area as measured at the payline does not exceed 10 square feet in any 10 feet square area.

Area	Permitted Occasional Projections
Cut slopes in forebay above roadway elevation, sluiceway discharges, tailrace above El. 1725, surfaces against which mass concrete will be placed, and excavation for transmission line structures.	12 inches
Cut slopes in forebay below roadway elevation, approach channel to spillways and skimmer gate, road surfaces, invert of forebay, abutments of arch dam, diversion tunnel, draft tubes, tailrace below El. 1725.	6 inches
Areas against which reinforced concrete will be placed	3 inches

Vertical and near vertical rock faces of excavation shall be formed by line drilling where directed by the Engineer. Line drilling may also be required by the Engineer to develop finished rock faces which are shaped more accurately than can be achieved by rock excavation methods which otherwise meet the requirements of the specification.

Should it be found necessary or advisable, during the progress of the work, to change the paylines of the excavations from those shown on the drawings or established by the Engineer, such changes shall be carried out, and the Contractor shall not be entitled to compensation above the unit prices in the Proposal on account of such changes. However, if such changes are ordered and constructed after a portion of the excavation in the area affected by such changes has been completed to the slopes, grades or dimensions established, or if it is determined by the Engineer that the unit cost to the Contractor of making said changes will be increased or decreased as a result thereof, an equitable adjustment will be made in accordance with the provisions of Section 1B-12.

d. Explosives. No separate payment will be made for furnishing and handling explosives as specified in Section 1B, paragraph 35, and the cost thereof shall be deemed to have been included in the appropriate item in the Proposal.

Blasting may be done only to the depth, amount and extent approved. The depth and spacing of the holes for blasting shall be determined by observation of the manner in which the rock breaks as the blasting operations progress. The quantities, type of explosives and number of delays shall at all times be subject to the approval of the Engineer. As an excavation approaches its final lines, the depth of holes for blasting and the amount of explosive used per hole shall be

reduced progressively. Whenever, as determined by the Engineer, further blasting may injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation shall be continued by wedging, barring, broaching, channeling or other suitable means. No blasting shall be done within 100 feet of any previously grouted area or previously placed concrete unless approved in writing by the Engineer.

e. Existing Tunnels and Shafts. When the excavation by the Contractor approaches existing tunnels and shafts, the Contractor shall modify his drilling pattern, reduce the loading of holes or shall refrain from blasting and apply other excavation methods as required by the Engineer, to preserve the rock surrounding existing tunnels and shafts in an undisturbed condition. Tunnel supports or ungrouted rockbolts installed by others in existing excavations shall be frequently checked for adequacy while excavation in the vicinity is in progress.

f. Scaling of Tunnel Surfaces. All surfaces of the roof and side walls of tunnels shall be scaled of all material that is loose or will not safely stand. Periodic checking of previously excavated areas shall be made and scaling shall be performed as required or as directed to remove loose or unsafe pieces of rock which may develop. Scaling surfaces shall also include removal of shattered material by hand tools. No separate payment will be made for scaling. Removal of loose material below the paylines or reference grades shown on the drawings will not be required in the diversion tunnel. However, all loose material below grade on the invert of the draft tubes shall be removed.

g. Line Drilling, Broaching and Presplitting. The diameter and spacing of holes for line drilling shall be such to insure the rock will break along the specified lines and within the tolerances specified. No blasting will be permitted in the holes along the sides of the excavation but controlled light blasting will be permitted in the areas adjacent to lines of holes. Whenever, as determined by the Engineer, blasting will injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation completed by wedging, barring or other suitable methods. If presplitting is deemed advisable, the Contractor shall submit his plan for this method to the Engineer for approval.

2. EXCAVATION IN FOREBAY AND SPILLWAY AREA

a. General. The excavation required in the forebay and spillway area will be classified as common or rock excavation.

b. Roadways and Parking Areas. All top soil and other unsuitable material as determined by the Engineer shall be removed from roadway and parking area surfaces which are to be covered with backfill materials. In rock excavation, the roadways and parking areas shall be excavated six inches below the elevations shown on the drawings to provide for roadway surfacing. The Contractor shall excavate ditches along the sides of roads and parking areas as shown on the drawings. Excavation for drainage ditches shall

be as specified in Paragraph 8 below. Any road surfacing material that the Contractor places for his own convenience in the areas of rock excavation shall be at his own expense and only materials which are approved by the Engineer shall be used.

c. Cut Slopes. The cut slopes for the forebay below roadway elevation shall be as shown on the drawings. Should they result in unstable surfaces, then the Engineer will direct the Contractor which method he shall employ to stabilize the excavated surfaces. These methods may include rockbolting, wire meshing, guniting or further excavation. The excavation for forebay and spillways above roadway elevation shall be to lines and grades as shown on the drawings or as directed by the Engineer. If the originally adopted slopes are not permanently stable as determined by the Engineer, the slopes shall be flattened and berms shall be incorporated as required for their stability.

3. EXCAVATION FOR DAM FOUNDATION AND SLUICE DISCHARGE

a. General. The excavation for the foundation of the dam shall be made to a sufficient depth to secure foundation on sound rock, free from weathered materials, open joints or other objectionable defects as determined by the Engineer. All material shall be removed which may permit sliding along the contact surface, interferes with the proper bonding of the concrete with the foundation or interferes with the water tightness of the rock-concrete joint.

The contemplated alignments and cross-sectional dimensions of the excavations are shown on the drawings but the alignments and dimensions shown will be subject to such changes as may be found necessary by the excavations. Accurate trimming of slopes of the excavation will not be required but irregularities and discontinuities in the abutment slopes shall be eliminated, overhangs shall be removed as required, and the excavation should conform as closely as possible to the paylines of the concrete structure as shown on the drawings or established by the Engineer.

b. Classification. The excavation for the dam abutment above El. 1725 and the excavation for sluice discharge will be classified as rock excavation. Any common excavation in this area will be considered as rock excavation for payment purposes. However, the excavation for the dam below El. 1725 will be unclassified.

c. Abutment Excavation. The structural lines upon which the stress analysis of the dam was based, are shown on Drawing No. D-23077 for the dam between El. 1930 and 1660. In general all material within the structural abutment line shall be excavated. After the excavation to the structural abutment line is accomplished the Engineer will inspect the rock conditions and decide if the rock is competent for the arch dam abutment or if the excavation should be continued further to secure competent foundation rock. If sound and competent rock is exposed by the Contractor before excavating to the structural abutment line, the Engineer may direct the Contractor to trim

the rock to conform to a new abutment line in order to avoid unnecessary excavation of otherwise sound rock, provided that no detrimental influence on the stress distribution in the dam is to be expected.

d. Excavation for Foundation Plug. The excavation for the dam below El. 1660 shall consist of three distinct phases:

(1) Excavation of all loose material including sand, gravel and boulders in the riverbed in an area as shown on the drawings. The cut slopes for this excavation shall be stable during construction as determined by the Contractor.

(2) Excavation of a minimum of 5 feet into the exposed bedrock within the concrete-rock contact area and removal of all unsuitable foundation material within this area as may be uncovered by the excavation.

(3) Inspection of the exposed foundation rock by the Engineer and determination of any additional excavation rock required to provide keying action and stability for the foundation plug of the dam.

4. DIVERSION TUNNEL

a. Diversion Intake. The Contractor shall perform the open cut excavation at the diversion intake. The location of the diversion intake and portal structure shown on the drawings is approximate and the actual location of these structures will be determined by the Engineer in the field during excavation.

The Contractor shall clean the areas above the portal of all loose and potential slide material; shall provide safety fences above the intake portal, shall install steel supports at the portals if required; and shall provide any other means to make the tunnel portals safe and conform with relevant safety regulations. No separate payment will be made for these safety provisions at portals but the cost thereof shall be included in other items of work.

b. Diversion Tunnel Excavation. The Contractor shall excavate approximately 35 feet of tunnel between the open cut at the intake portal and station 2+25 plus the excavation of approximately 60 feet of tunnel between station 11+34 and the natural surface of the river bank at the outlet portal. The diversion tunnel between station 2+25 and 11+34 will be excavated by others under a separate contract. It is expected that the water surface of the Pend Oreille River will be above the elevation of the invert of the completed diversion tunnel during the entire construction.

The Contractor may at his option perform the tunnel excavation adjacent to the intake portal from inside the tunnel, with access via the lower mucking tunnel,

and/or from outside the tunnel at the intake portal, provided the intake area is protected from flooding in accordance with the provisions of Section 4.

The Contractor will be permitted to perform the tunnel excavation adjacent to the outlet portal from inside the tunnel. In this case the Contractor shall drill, load and blast the final section of tunnel excavation such that excavated materials are thrown into the river clear of the tunnel portal insofar as practicable. Before commencing work thereon, the Contractor shall submit to the Engineer for his review and exceptions, if any, a detailed plan showing the methods he proposes to use to accomplish excavation of the downstream end of the diversion tunnel.

5. TAILRACE AND DRAFT TUBE EXCAVATION

a. General. Before performing any excavation in the tailrace area the Contractor shall clean the canyon wall and perform excavation for transmission line structures as outlined below and shall complete the construction of the tailrace cofferdam in accordance with Section 4, "Diversion and Care of River."

b. Cleanup of Canyon Walls. The Contractor shall remove from the canyon wall above the draft tube outlets all trees, brush, topsoil, loose material, semi-detached rock and any material which might become detached during future construction operations. He shall for this purpose provide the necessary scaffolding, anchors, ropes, lifting devices and safety measures. The Contractor shall also provide chair lifts or similar means to enable the Engineer to closely inspect the canyon walls for potentially loose materials. The materials removed may be dropped onto the beach or into the water below, provided that no floating material is allowed to escape downstream beyond the general works area for the project. Any material from this cleanup shall be finally removed and disposed of as described in Section 7.

The upper limits for canyon wall cleanup will be the limit for the excavation for transmission line structures. The lower limit is the water or beach line at the foot of the canyon wall. Other limits for canyon wall cleanup are shown on the drawings. The cleanup shall be performed before work at the transformer galleries or the tailrace is commenced. The necessary safety precautions for traffic below the area of work shall be the responsibility of the Contractor.

c. Removal of Disjointed Rock at Tailrace. The Contractor shall remove from the vicinity of the draft tube portal No. 56 a pinnacle of rock, approximately 300 feet high, which is separated from the rock mass by a system of intersecting joints. The removal of this material shall start from the top down and shall be performed in steps not exceeding 20 feet in height. This work shall be completed prior to excavation of the downstream end of the diversion tunnel. All material deposited in the stream which may obstruct the flow from diversion tunnel or draft tubes in the opinion of the Engineer shall be removed. The limits for this excavation shall be determined by two intersecting nearly vertical joint faces and a horizontal plane at El. 1735. The Contractor shall exercise great care during the removal of this rock to insure that no material outside the limits

for this excavation is loosened or disturbed.

d. Open Cut at Tailrace. The Contractor shall remove all material required to excavate the tailrace to the lines and grades shown on the drawings or established by the Engineer including any material deposited from excavation previously performed at higher elevations or from cofferdam construction. Excavation for the tailrace will be classified for payment purposes as common or rock in accordance with Paragraph 1 of this section.

e. Draft Tube Excavation. The draft tubes will be excavated by others under a separate contract, except for approximately 40 feet at the portal of each draft tube. The Contractor shall complete the draft tube excavation to the dimensions shown on the drawings. The excavation shall be started at the canyon wall and progress toward the machine hall. The draft tube gates, guides, seals and hoist shall be installed and be fully operable, before the Contractor will be permitted to perform the draft tube excavation. The draft tube gates shall be raised to the open position during the performance of excavation but once the excavation is "holed through," it shall be the Contractor's responsibility to prevent water from entering and flooding the machine hall from the afterbay by closing the gates and maintaining them in a closed position. Any damage which results from the Contractor's failure to protect the machine hall against flooding shall be repaired to the satisfaction of the Engineer at the Contractor's expense. The length of each round and the amount of explosives shall be reduced progressively as the excavation approaches the previously excavated draft tubes.

The Contractor shall exercise care during the excavation of the draft tubes to insure that no damage is done to any structure in the completed portion of the draft tubes or draft tube gates. Any damage to the gates, seals, guides, piers, or any other part of the draft tube or gate structures caused by careless or negligent actions in performance of the work shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

6. EXCAVATION FOR CUTOFF

The Contractor shall perform common and rock excavation in open cut in the vicinity of Station 0+50 of the West Side Access Road for the purpose of constructing a concrete cutoff wall below the existing ground surface. The location of the cutoff is shown on Drawing No. D-23135. The excavated slopes may be as steep as will be temporarily stable during construction. The excavation shall be continued until a trench 4 feet wide and 3 feet deep into sufficiently firm and watertight bedrock as determined by the Engineer is achieved. All excavation for the cutoff will be paid as common or rock excavation for forebay and spillways.

7. EXCAVATION FOR PENSTOCK FILL LINE

The Contractor shall perform excavations in the exploratory tunnel below

existing tunnel grade for the penstock fill line as shown on Drawing No. D-23223. Materials from this excavation shall be deposited in the lower disposal area. Only the excavation in the exploratory tunnel between the machine hall and the erosion cavity shall be included in the item, "Excavation for Penstock Fill Line". Other excavations for this fill line required under this contract will be paid as specified for miscellaneous excavation in Paragraph 8 below.

8. MISCELLANEOUS EXCAVATION

As the work progresses, the Contractor may be required to perform miscellaneous excavation outside the defined pay limits. This miscellaneous excavation will be common or rock excavation in open cut or underground. It will include, but will not be limited to excavation of trenches, chases, pockets, ditches, recesses, enlargements of tunnels, excavation of niches or slots, excavation of seams and faults, and "dental" excavations in the dam foundations. In general it will not be possible to use excavating machines for the removal of materials from miscellaneous excavations.

9. SUPPORT OF EXCAVATED SURFACES

a. General. The Contractor shall stabilize excavations and support surfaces of open cut or tunnel excavations by rock reinforcement, structural support, steel supports and other means as required during progress of the work.

b. Rock Reinforcement. Rock reinforcement shall consist of ungrouted or grouted rockbolts and accessories as specified in Section 8, paragraph 16, and as shown on Drawing D-23183.

c. Structural Support. Structural support shall consist of reinforced gunite as specified in Section 9B, paragraph 16b and as shown on Drawing D-23183.

d. Steel Tunnel Supports. If steel tunnel supports are required they shall consist of steel shapes, foot plates, tie members, lagging and other accessories. The Contractor shall furnish all materials for steel tunnel supports as required.

If required, the Contractor shall install the tunnel supports outside the defined paylines and extra excavation performed for this purpose will be classified as miscellaneous excavation.

e. Other Means of Support. Nothing in these specifications shall prevent the Contractor from providing other means of support, as he may consider necessary. However, the use of timber for supports of tunnel excavations will not be permitted.

10. CLEANUP OF SURFACES FOR INSPECTION

When foundation excavation has been completed to the lines and grades established, the Engineer may direct the Contractor to perform cleanup for inspection. This cleanup shall consist of the removal of all loose rock, sand, silt or other unsatisfactory materials and the excavated surfaces shall be thoroughly cleaned with air and/or water jets under high pressure for the purpose of inspection. If the foundation is found to be unsatisfactory, addition excavation shall be made and such area shall again be cleaned for inspection as directed. This procedure may be repeated until satisfactory foundation is reached. Immediately prior to placing concrete thereon, the excavated surfaces shall be cleaned up finally as specified in Section 9A, paragraph 12.

11. MEASUREMENT FOR PAYMENT

a. General. Measurement for payment of excavation will be made by cross sections taken before and after the applicable items of excavation have been accomplished, except that no cross sections will be taken after completed excavations when payment will be made to the excavation lines shown on the drawings or established by the Engineer. Payments for excavation shall constitute full compensation for all work in connection with excavating the material including any drilling, blasting and other incidental work. It shall also include full compensation for transporting and disposal of the excavated materials.

The City has taken cross sections of the existing ground surface in the dam, spillway and forebay areas and the Contractor shall agree to the adequacy of the original cross sections prior to commencement of open cut excavation.

Measurement of common excavation will be the number of cubic yards of material in situ classified as common, satisfactorily excavated between the original ground surface and rock surface or pay lines as shown on the drawings or established by the Engineer.

Measurement of rock excavation will be the number of cubic yards of material in situ classified as rock satisfactorily excavated between the surface of the rock at the beginning of rock excavation and the pay lines as shown on the drawings or established by the Engineer.

Measurement of tunnel excavation will be the number of cubic yards of material in situ excavated between the paylines as shown on the drawings or established by the Engineer.

Measurement of unclassified excavation will be the number of cubic yards of material in situ satisfactorily excavated between the original surface and the paylines as shown on the drawings or established by the Engineer.

Material excavated beyond the lines and grades shown on the drawings or not directed by the Engineer, will not be measured for payment under any

item in the Proposal.

b. Forebay and Spillway. Measurement of excavation for forebay and spillway shall include all excavation shown on Drawings No. D-23136 and D-23137 within the limits shown on these drawings. It includes also the material removed under future backfill and road fills. The volume of the upper mucking tunnel excavated by others will be deducted from these quantities. For this purpose the volume of the upper mucking tunnel will be considered to measure 12,000 cubic yards. Excavation for duct banks, roadway drainage ditches and cable trenches to be performed in the forebay and spillway areas will be measured for payment as miscellaneous excavation.

c. Dam Foundations. The items of excavation for dam foundations and sluice discharge above El. 1725 shall include all excavation required for the dam abutments between El. 1930 and 1725, all removal of unsuitable foundation rock and unstable rock along the abutments between these elevations, removal of rock between the dam abutment and the erosion cavity on the left abutment, all excavation in the erosion cavity, and all excavation required for the flow to and from the sluice discharges in the dam.

The items of excavation for dam foundations below El. 1725 shall include all material which the Contractor was permitted to drop into the stream while excavating above El. 1725, including material which due to no fault of the Contractor will have been washed into the area while placing the upstream cofferdam. It is the intent of this specification that the cost for hauling or disposal of materials be not included in the unit price for excavation for dam foundations and sluice discharge above El. 1725, but be included in the unit price for dam foundations below El. 1725.

The material removed from pockets and seams in the dam foundations which are too narrow to permit the use of the smallest suitable excavating machines will be measured for payment under "Miscellaneous Excavation".

d. Diversion Tunnel. Measurement of excavation for the upstream end of the diversion tunnel will be based upon the excavation lines as shown on the drawings or established by the Engineer between the tunnel portal as established by open cut excavation and the end of the tunnel excavation performed by others. No measurement of quantities for payment of the excavation for the downstream end of the diversion tunnel is required, as payment for this item of work will be at the lump sum price bid in the Proposal.

e. Draft Tube Tunnels. Measurement of excavation for draft tube tunnels will be based upon cross sections of the excavation lines as shown on the drawings

or established by the Engineer between the face of draft tube excavation performed by others and the face of the portals as obtained by open cut excavation under this Contract.

f. Cleanup of Excavated Surfaces for Inspection. Measurement for cleanup of excavated surfaces for inspection will be the actual number of square feet of foundations cleaned for the purpose of inspection. Measurement will be made each time the Engineer directs the surfaces to be cleaned up. When measuring areas for this purpose, all rock projections or recesses smaller than 10 square feet in cross sectional area will be disregarded.

The final cleanup of foundations as described in Section 9A, paragraph 12, will not be measured for payment but the cost thereof will be deemed to be included in the applicable unit price bid for concrete.

g. Line Drilling. Measurement for payment of line drilling, as approved by the Engineer, will be the square feet of rock face in the applicable vertical or sloping plane excavated in rock within a tolerance of three inches from the specified centerline or rock face as shown on the drawings. Areas where the excavated rock surface is outside the specified three-inch tolerance line will not be measured for payment under this item.

12. PAYMENT

Payment for excavation for the downstream end of the diversion tunnel will be the lump sum price bid therefor. All other excavation items will be paid at the respective unit prices bid therefore in the Proposal. As the amount of work required for the cleanup of the canyon walls above the draft tube outlets can only be determined in the course of the work, payment for this item will be made as defined for extra work under this specification.

If support of excavated surfaces is required, payment will be made as follows: Payment for rock reinforcement and structural support with reinforced gunite will be made as specified in Sections 8 and 9B, respectively. If the Contractor elects to use steel tunnel supports, no separate payment will be made for them, but the cost thereof shall be included in the price bid for the respective excavation.

SECTION 6

UNWATERING AND CONTROL OF WATER

1. GENERAL

This section stipulates the requirements of unwatering work areas, and maintaining the unwatered condition as long as needed, at the diversion tunnel intake, dam site, tailrace, and other surface excavations; also, of preventing surface water from entering underground excavations and maintaining these excavations in a dry working condition. The Contractor shall furnish all equipment, materials and labor necessary to accomplish these requirements to the extent of enabling, to the satisfaction of the Engineer, the proper inspection, maintenance and performance of the work to be executed in the stipulated areas. The Contractor shall make, and be responsible for, his own determination and estimates of the quantities and rates of water inflow and the type and capacity of plant and equipment he shall furnish to accomplish the requirements of this Section.

Sumps, trenches and other additional excavations required for unwatering of foundation excavations shall be kept to a minimum and shall require approval of the Engineer prior to their construction.

The Contractor shall furnish all materials and equipment and perform grouting, blanketing, bulkheading or other work necessary to restrict leakage or seepage flows through, around and under all cofferdams to a rate which the unwatering system furnished by Contractor can collect and discharge.

Nothing in these specifications shall relieve the Contractor from full responsibility for the adequacy of his methods and equipment for unwatering excavations and controlling water to the satisfaction of the Engineer.

2. DIVERSION TUNNEL INTAKE

The Contractor shall include with the "river diversion and water control plan" specified under Section 4, details of the collection pumping and discharge system (including arrangements and capacities of the pumps) proposed for unwatering and control of water in the excavations for the diversion intake and portal structure; and, facilities for preventing surface flow from entering the diversion tunnel.

The Contractor will be required to operate and maintain the pumps and other unwatering and control facilities during the entire period of excavation and completion of the diversion tunnel and intake construction; and, until the diversion system is accepted by the Engineer as complete.

3. DAM SITE

The Contractor shall include in the "river diversion and water control plan" specified under Section 4, details of the pumping and discharge system, (including the arrangement and capacities of the pumps), proposed for unwatering and

control of water during foundation excavation and construction of the dam.

The Contractor will be required to operate and maintain unwatering facilities as necessary to develop and maintain in the dam foundation area an essentially dry condition enabling proper foundation excavation, inspection, grouting, and cleanup, concrete placement and curing, and performance of any other work for the dam foundation which would be adversely affected by the presence of surface water. Should inadequacy of the water control at any time prevent proper performance of the work, the Contractor shall immediately take steps to reduce the inflow and/or increase the capacity of the unwatering facilities as necessary to establish proper conditions satisfactory to the Engineer.

4. TAILRACE

The Contractor shall include in the "river diversion and water control plan" specified under Section 4, details of the collection, pumping and discharge system, (including arrangement and capacities of pumps), proposed for unwatering and control of water during tailrace and draft tube excavation.

The Contractor will be required to operate and maintain the unwatering facilities as necessary to develop and maintain the tailrace and draft tube areas in an essentially dry condition during excavation and other operations; and shall control the water as to prevent surface water from flowing past the draft tube gates at any time. The Contractor will be required to close the draft tube gates whenever it is beyond the capability of his water control system to prevent surface water from any source, from entering the machine hall. Should such inadequacy of the water control system at any time prevent proper inspection of the foundation or side slopes, or proper performance of the work, the Contractor shall immediately take steps to reduce the inflow and/or increase the capacity of the unwatering facilities as necessary to establish proper conditions satisfactory to the Engineer.

5. OTHER SURFACE EXCAVATIONS

The Contractor shall maintain all other foundation excavations continuously unwatered as long as required for proper inspection, construction and associated operations, as determined by the Engineer.

6. UNDERGROUND EXCAVATIONS

The Contractor shall construct and maintain such intercepting works as may be required to prevent surface water from entering underground excavation or interfering with any of his operations in the underground excavations. The Contractor shall also furnish, install and operate any pumps, sumps, ditches, pipe and fittings required for the disposal of water encountered in the excavations. The diverted surface water and water from excavations shall be conveyed away from material disposal areas. Pumping shall be done only where gravity flow to an outlet cannot be secured. Where required, the Contractor shall divert the water

by panning.

The underground excavations which are performed by others under a separate contract are being dewatered by equipment installed and operated under the same contract. The Contractor will be responsible for maintaining the continuity of unwatering the underground excavation after 30 days have elapsed since issue of the "Notice to Proceed with Underground Work at the Site." The Contractor will be required to continue the unwatering of the underground excavation until such date as the Engineer may direct.

7. SEALING OFF FLOWS

The Contractor shall, when and as directed by the Engineer, perform drilling and grouting to diminish or seal off flows of water at locations of leakage. Such work shall be performed in accordance with Section 8.

8. PUMPING AND DIVERTING EQUIPMENT

The equipment used for diverting and pumping water, location and size of pump recesses and the capacity of pumps shall be satisfactory to the Engineer. However, the Engineer's approval shall not operate to release the Contractor from his responsibility for handling and disposing of water from all excavations in the manner required by this specification; and, the Contractor shall at any time install additional equipment needed to accomplish these requirements.

9. MEASUREMENT AND PAYMENT

a. Surface Excavations. No separate payment will be made for unwatering or controlling water in surface excavations, but the cost thereof shall be included in the prices bid in the Proposal as follows:

(1) Diversion Tunnel Intake. The cost of unwatering and control of water at the diversion tunnel intake shall be included in the lump sum bid in the Proposal for "Care of River and Unwatering at Diversion Tunnel Intake".

(2) Dam Site. The cost of unwatering and control of water at the Dam site shall be included in the lump sum bid in the Proposal for "Diversion and Care of River and Unwatering at Dam Site".

(3) Tailrace. The cost of unwatering and control of water in the tailrace area shall be included in the lump sum bid in the Proposal for "Care of River and Unwatering at Tailrace".

(4) Other Surface Excavations. The cost of unwatering and control of water for other surface excavations shall be included in the unit prices bid in the Proposal for the appropriate excavation item.

The prices included in the Proposal for the foregoing items shall include the cost of furnishing all labor, equipment and materials for construction and operation of flumes, drains, channels, grouting of sumps and drains, grouting of cofferdams, treating of cofferdams to improve their water tightness, pumping including cost of power, and all other work incidental to unwatering and water control, not paid for otherwise.

b. Underground Excavations.

(1) Handling Water. Measurement for payment for handling water in underground excavation will be made in units of one million gallons delivered at the final point of disposal by the pump. Measurement will be made by means of a calibrated meter, weir, or other suitable means furnished by the Contractor and satisfactory to the Engineer. Water handled by gravity flow and work therefor will not be measured for payment. Payment for handling water by pump will be made at the unit price in the Proposal for "Handling Water in Underground Excavation". When surface water and water from open cut excavations enters underground excavations, the Engineer will determine its quantity, and the adjusted quantity for payment under the Proposal item of "Handling Water in Underground Excavation".

(2) Measurement and payment for drilling and grouting to seal off flows will be made in accordance with Section 8 of this specification.

(3) No separate payment will be made for excavating ditches and sumps; or furnishing, installing and maintaining pumps and other equipment including any pumps or other components of existing unwatering systems which the Contractor is directed to operate and/or maintain, or other expenses incidental to handling water in underground excavations; but the cost thereof will be deemed to be included in the unit price per million gallons allowed for "Handling Water in Underground Excavation".

SECTION 7

DISPOSAL AND BACKFILL

1. DISPOSAL AREAS

The following three disposal areas will be available to the Contractor for disposal of excavated materials:

a. Upper Disposal Area. This area is located on the left bank of the stream upstream of the forebay as shown on Drawing No. Drawing-23057. A grounding mat for the project has been installed in the northwestern corner of this area and the Contractor shall take care not to damage its features. The material shall be graded to the contours shown on the drawings in order to provide an area suitable for recreational development. Material which in the opinion of the Engineer will be unstable due to changing water surface elevations in the reservoir shall not be placed in the slopes adjacent to the reservoir.

b. Lower Disposal Area. This area is located at the left bank of the tailrace as shown on Drawing D-23036. It contains principally the material from underground excavations performed by others.

c. Right Bank Disposal Area. This area is located upstream of the right abutment of the dam as shown on Drawing No. D-19085.

2. DISPOSAL OF EXCAVATED MATERIALS

a. The following schedule for disposal areas shall be observed, unless other locations of disposal are approved by the Engineer.

Location of Excavation Work		Place of Disposal
(1)	Forebay including roadways and parking area	Upper disposal area - left bank
(2)	Spillway on right abutment	Right bank disposal area
(3)	Spillway at left abutment	Upper disposal area - left bank
(4)	Dam abutments, sluiceway discharge, erosion cavity and other excavations in vicinity of dam abutments, all below El. 1930 but above El. 1725	No immediate disposal required; drop into river bed
(5)	Dam foundation below El. 1725	On crest or outside slopes of cofferdams as approved by the Engineer

Location of Excavation Work		Place of Disposal
(6)	Diversion Intake	Vicinity of work as directed
(7)	Diversion tunnel, upstream part	Vicinity of diversion intake as directed
(8)	Diversion tunnel, downstream part	Vicinity of work (see Section 5, para. 4)
(9)	Tailrace and draft tubes	Lower disposal area
(10)	Cut-off at West Side Access Road	Vicinity of work as directed
(11)	Exploratory Tunnel	Lower Disposal Area
(12)	Miscellaneous excavation	As directed

3. DISPOSAL OF OTHER MATERIALS

a. Combustible Materials. Combustible waste material shall be deposited at locations in the disposal areas designated by the Engineer and shall be burned to ashes. All burning shall be in accordance with Section 1C, paragraph 10 of this specification and all applicable laws and regulations.

b. Non Combustible Materials. Non combustible waste materials and ashes from burning operations shall be buried at locations in the disposal areas designated by the Engineer. A minimum cover of 2 feet of sand, gravel or similar materials shall be provided over such buried materials.

4. RANDOM BACKFILL

The Contractor shall place random backfill behind retaining walls, in a depression at the parking area at the left abutment of the dam, at the cut off wall at the West Side Access Road, and elsewhere as directed. Material for this backfill shall be from required excavations. Gradation shall be by visual means only and the material shall be of a kind that will suitably compact. No moisture control will be required for this backfill and compaction shall be as achieved by normal operation of hauling or spreading equipment. No brush, roots, sod or other perishable or unsuitable materials as determined by the Engineer shall be placed in this backfill. Any settlement occurring before completion of all works under this Contract shall be remedied by placing additional fill to the required grade.

The Contractor shall erect a dry rubble wall to contain the fill along the cut slope of the forebay as shown on Drawing No. D-23135. The material for this wall shall be rocks of suitable size from required excavations.

5. BACKFILL IN FUTURE UNIT BAYS

The Contractor shall place backfill in unit bay Nos. 55 and 56 up to El. 1724.5. The material shall be tunnel spoil from the lower disposal area to be taken from locations determined by the Engineer. In general, this backfill shall be compacted only as achieved by normal operation of hauling or spreading equipment and the fill shall be placed in layers not exceeding 3 feet. However, the 20-foot zone immediately below the concrete pads for generator assembly shall be placed in lifts not to exceed 12 inches and shall be compacted by approved power tampers or vibratory compactors.

6. SELECTED BACKFILL

Selected backfill shall be placed at drain openings in random backfill, along the drainage gallery side of random backfill in unit bay Nos. 55 and 56, and elsewhere as shown on the drawings or as directed by the Engineer. Selected backfill shall be concrete aggregate of the sizes specified for sand and coarse aggregates in Section 9A, paragraph 8, and shall be placed in receding order of size.

7. BACKFILL IN CONTRACTION JOINTS

The contraction joint wells in the dam above El. 1845 shall be filled with coarse aggregate conforming to the requirements of Section 9A and proportioned as directed by the Engineer.

Progressively, as successive lifts of concrete in adjacent monoliths of the dam are completed, each contraction joint well shall be filled with washed, clean, well-graded coarse aggregate having a minimum size of 3/4 inch and maximum size of 3 inches. All such aggregate shall be consolidated thoroughly in layers approximately 12 inches in thickness, using air tamping equipment. During all times of placement and tamping of such aggregate, clear water shall be passed through it at the greatest rate practicable without building up the water level in the well more than 10 feet above the lowest outlet (grout pipe) in that well.

The Contractor shall provide covers as shown on Drawing No. D-23102 and shall prevent any dirt, concrete or other foreign matter from getting into a contraction joint well prior to filling with aggregate or during the process of filling or thereafter. If any of the aggregate becomes contaminated with dirt, concrete or other foreign matter, the Contractor shall remove such aggregate and replace it with clean aggregate.

8. MEASUREMENT AND PAYMENT

a. Disposal. No separate payment will be made for disposal of materials but the cost therefor shall be included in the appropriate prices bid in the Proposal.

b. Random Backfill. Measurement for payment of random backfill will include all fill, except selected backfill and contraction joint fill, placed behind retaining walls, for road embankments in depressions at the parking area, at the cutoff wall at West Side Access Road, in the unit bay Nos. 55 and 56 of the machine hall and where directed by the Engineer. Measurement will be the number of cubic yards of materials in place as determined from mutual cross-sections taken before placing any backfill. Payment will be made at the unit price per cubic yard bid for "Random Backfill".

c. Selected Backfill. Measurement for payment of selected backfill will include all coarse and fine aggregate material placed at drain openings in random backfill along drainage gallery, and where directed by the Engineer. Payment will be made at the unit price per cubic yard bid for "Selected Backfill".

d. Backfill in Contraction Joints. Measurement for payment of backfill in contraction joints will be the number of cubic yards of joint well filled with aggregate, based on the nominal dimensions. Payment will be made at the unit price per cubic yard bid for "Backfill in Contraction Joints".

e. Dry Rubble Wall. No separate payment will be made for the dry rubble wall required to confine the random backfill. Its volume shall be included in the measurement for payment of the random backfill placed adjacent to the dry rubble wall.

f. Covers. Contraction joint well covers will be paid for as miscellaneous metalwork as defined in Section 10.

SECTION 8

DRILLING AND GROUTING

1. GENERAL

This section specifies the requirements for the following items of work:

a. Drilling of exploratory core holes.

b. Consolidation grouting of foundations.

c. Curtain grouting in dam and power plant area.

d. Grouting of the contraction joints and cooling systems in the dam.

e. Backfill grouting.

f. Contact grouting behind steel and concrete linings.

g. Furnishing and installing anchor bars.

h. Furnishing and installing rock bolts.

i. Control of water inflow during construction.

j. Drilling of drain holes.

All labor, equipment and materials required for work under this section, except as specified in paragraph 2e shall be furnished by the Contractor.

2. MATERIALS

a. General. Grout shall be composed of a mixture of neat cement and water with the possible addition of sand, mineral fillers, and fluidifiers or other admixtures. The grout mixes will be varied to meet the characteristics of each hole as determined by the Engineer.

b. Cement. Cement shall be as specified in Section 9A and shall be supplied in waterproof bags of 94 pounds each.

c. Sand. Sand will be as specified in Section 9A. In addition, the fineness of sand required for grouting will be as follows: 100 percent shall pass a No. 16 U. S. Standard Screen and not less than 50 percent shall pass a No. 50 U. S. Standard Screen.

d. Water. The water used in the grout shall be as specified for concrete in Section 9A.

e. Admixtures. Sand, mineral fillers, fluidifiers, and any other admixtures, if required, will be furnished by the City to the Contractor at the City's warehouse.

f. Grout and Drain Pipe and Fittings. Grout pipe and fittings shall be standard steel pipe conforming to ASTM Designation A 120, Schedule 40. Black steel pipe shall be used throughout except on the downstream face of the dam where galvanized pipe shall be installed. The size of pipe shall be as shown on the drawings and as determined by the Engineer.

g. Anchor Bars. Material for anchor bars shall be reinforcement steel bars as specified in Section 9B, paragraph 21.

h. Rock Bolts. Rock bolts shall be one inch nominal diameter steel rounds with a rolled thread at least 6 inches in length at one end, and fitted at the other end with an approved type of expansion shell anchorage as manufactured by Williams Form Engineering Corporation, Grand Rapids, Michigan, or approved equal. The minimum yield strength of a bolt shall be 30,000 pounds. Each rock bolt shall be complete with a bearing plate, beveled washers as required, a hard steel flat washer and a nut. Material for bearing plates shall conform to ASTM Designation A 36 and the nuts to ASTM Designation A 307, Grade B. The bearing plates shall normally be 6 x 6 x 3/8 inch, except that the Engineer may direct that 8 x 8 x 3/8 inch plates shall be used when soft material is encountered.

3. EQUIPMENT

a. General. Prior to shipment of drilling and grouting equipment to the site, the Contractor shall submit drawings and description of all equipment he proposes to use for the approval of the Engineer.

b. Drilling Equipment.

(1) Percussion Drilling Equipment. Holes required to be drilled with percussion-type equipment shall be drilled with an independent full rotating rock bit with water fed to the face. Introduction of air into any hole during the drilling operation will not be permitted. It is not contemplated that any hole deeper than 30 feet will be drilled with percussion-type equipment.

(2) Rotary Drilling Equipment. All grout and drain holes and other holes, as determined by the Engineer, shall be drilled by rotary drills equipped with diamond plug or diamond core bits. The maximum depth of holes will be 300 feet. A selected number of grout holes and other holes where core recovery is required shall be drilled with hydraulic feed rotary drills using double-tube, free-floating inter-swivel core barrels and bits of better than "M" series for maximum recovery of unpredictable soft or friable materials.

c. Grouting Equipment. All equipment used for mixing and injecting grout shall be maintained in excellent operating condition at all times. Equipment shall be capable of mixing, pumping and injecting sand-cement grouts. The minimum equipment furnished for each grout plant shall include but not be restricted to:

(1) A horizontal shaft paddle-type mixer or colloidal high-speed impeller type pump mixer with a minimum capacity of ten cubic feet.

(2) A vertical shaft paddle-type agitator tank with a minimum capacity of ten cubic feet equipped with suitable screens between the mixer and the agitator with provision for gravity flow from mixer to agitator.

(3) Two grout pumps of Moyne design and/or approved duplex piston type capable of operating at maximum discharge pressure, at the grout hole, of 300 pounds per square inch.

(4) Air compressor capacity capable of providing air to each piece of drilling and grouting equipment at a minimum pressure of 90 pounds per square inch.

(5) Auxiliary water supply tank with a minimum capacity of 20 cubic feet available for use in pressure testing, flushing and washing operations.

(6) Adequate water supply to insure that all equipment can be operated at maximum capacity as required by the Engineer.

(7) A water meter graduated in cubic feet and tenths of a cubic foot with bypass so water can be measured either into the mixer or the auxiliary water tank.

(8) Adequate number and quality of valves, pressure gauges, gauge savers, pressure hose, pipe, fittings, packers of all types and required sizes, tools and other accessories as are necessary to insure a successful drilling and grouting operation.

(9) Capacity of the grout plant shall be not less than six cubic feet of grout per minute when operating at a discharge pressure of 100 pounds per square inch at the hole or grout connection.

(10) Inside diameter of all grout supply lines and fittings shall be not less than 1-1/2 inches and capable of withstanding maximum water and grout pressures required.

(11) Inside diameter of packer supply pipes shall be not less than one inch.

The arrangement of the grouting equipment shall be such as to provide a continuous circulation of grout throughout the system and to permit accurate pressure control by operation of valves on the grout return line regardless of how small the grout takes may be. On open holes, it may be necessary at times to use a single line system to the grout hole.

d. Communication System. The Contractor shall provide an acceptable telephone communication system between grout plant, grout pumps and any foundation grout hole to be washed, tested and grouted. In addition to the above, the Contractor shall furnish an acceptable telephone, signal light and horn or bell system between plant and all joint hookups for use during the washing, testing and grouting of all contraction joints and other joint systems. The system will be composed of one or more units each consisting of two modern type approved telephones, alarms, and two or more colored flasher lights for communication for distances up to one mile.

4. DRILLING OPERATIONS

a. General. The depths, spacing and pattern of holes shown on the drawings is tentative and will be finalized by conditions encountered during the progress of the work. All drilling shall be done in the presence of and with the approval of the Engineer. The use of "drill mud," "rod dope," oil, grease, or other lubricants on the drill rods or in the drill hole will not be permitted. At the completion of drilling, each grout hole and drain hole shall be thoroughly flushed with water under pressure as determined by the Engineer prior to removing the drill rods and bit from the hole.

b. Drilling Core Holes. Core hole diameters shall be not less than NX-size and shall be drilled to varying depths up to a depth of 300 feet. Maximum core recovery will be required. The Contractor shall supply approved wooden core boxes securely nailed and with wooden dividers for the required core size. The core shall be removed from the holes immediately if blocking of the bit or grinding of the core is indicated by the drill behavior regardless of the length of run which has been made.

Cores shall be placed in the boxes in the proper sequence as removed from the barrel and designated accurately by small labelled wooden blocks according to the measured distances in the holes. Where no core is recovered, wooden blocks of a length equal to the length of core loss shall be placed in the core box. No box shall contain cores from more than one hole. Designated marks, hole numbers and elevations shall be placed on the boxes and along the line of cores. Covers shall be securely fastened to the core boxes with wood screws to protect the core. The boxes shall be delivered to a location designated by the Engineer within the work areas.

c. Drilling Grout Holes. Grout hole diameters shall be AX-size or larger. In general, grout holes will be drilled in a direction that is perpendicular to the general surface slope, however, the Contractor may be required to drill grout holes at any angle between the vertical and horizontal. Grout holes shall also be drilled from tunnels, shafts and galleries as shown on the drawings and as established during the progress of the work.

Drilling may be required by the stage grouting method or holes may be required to be drilled to full depth and packer grouting utilized. The grout so placed, which remains within the hole shall be removed from the hole by washing or other approved methods. Redrilling of a grout hole, which as determined by the Engineer, is required as a result of Contractor's failure to remove the grout therefrom, shall be performed by and at the expense of the Contractor. Care shall be taken to avoid obstructing or clogging grout holes. Any grout hole that becomes obstructed or clogged shall be cleaned to the satisfaction of the Engineer or redrilled, or a new hole drilled at the expense of the Contractor.

d. Drilling Drain Holes. Drain holes shall be NX-size (3-inch) and shall be drilled to varying depths up to a depth of 100 feet. Drain holes shall not be drilled until all grouting within 300 feet has been completed. If, due to lack of care or negligence on the part of the Contractor, the drain holes should become filled with grout or any other material or otherwise plugged so as to impair their usefulness, the Contractor shall redrill or drill a new hole at his own expense to secure satisfactory drainage.

5. GROUT AND DRAIN PIPES

Grout pipes shall be placed at the ground surface end of each grout hole, except that where approved by the Engineer, the Contractor will be permitted to use an expansion-type plug for making connections to grout holes. Pipes for grouting shall also be set over springs, crevices in the rock or other foundation defects as uncovered during construction progress. Grout pipes set in rock shall extend a minimum distance in rock to permit a firm anchorage without excessive use of pipe. Grout pipes and drain pipes set in concrete shall end not less than 3 inches inside the finished surface of the concrete. A standard coupling and wrapped nipple to facilitate removal shall be attached to the grout and drain pipe and shall extend beyond the finished surface of the concrete as shown on the drawings.

The holes left after removal of wrapped nipples shall be filled immediately and completely with drypack in accordance with the provisions of Section 9B, par. 17. The spaces between grout pipes and the rock or concrete into which they are inserted shall be carefully sealed with grout to secure firm anchorage and prevent entry of concrete or other materials prior to grouting. All pipe and fittings to be embedded in rock or concrete shall be in correct alignment and shall be cleaned thoroughly of all dirt, grease, grout and mortar immediately before being embedded. The pipe and fittings shall be carefully assembled and

placed with all fittings tight and shall be held firmly in position and protected from damage while the concrete is being deposited.

6. WASHING AND PRESSURE TESTING

During or after the drilling of exploratory and grout holes and during the grouting program, it will be required that all holes be thoroughly washed and pressure tested to the extent determined necessary by the Engineer. It also may be necessary upon the completion of drilling any exploratory hole that it be pressure tested using special double-seal packers. All rock seams and crevices intersected by grout holes and containing clay or other washable materials, shall be washed with water under pressure to remove as many of these materials as possible. When required, such materials shall be ejected from one or more grout holes by introducing water under pressure into an adjacent hole. All holes shall be washed for a sufficient period of time during which the fractured filling is being removed, as determined by the escape of water containing solids through surface openings or other grout holes. Such washing and pressure testing will normally not exceed 15 minutes for each stage of each hole. However, when the Contractor is required to conduct water tests on any stage of any foundation hole for periods exceeding 15 minutes, he will be paid therefore as defined in Paragraph 20e of this section.

7. EXPLORATORY CORE HOLES

The Contractor shall, as required, perform exploratory core drilling for the purpose of investigating rock conditions under the dam and other structures, defining grouting requirements, or determining the effectiveness of grouting operations. Exploratory drilling shall be performed from the diversion tunnel, exploratory tunnel and other places as required. The extent of such exploratory drilling is uncertain at this stage and can only be determined in the course of the work.

8. CONSOLIDATION GROUTING

Low pressure shallow grouting shall be performed to consolidate the near surface rock of the dam and spillway foundations and the rock surrounding the penstock excavations. The low-pressure grout holes, which are designated as "B" holes on the drawings, will range up to 30 feet into rock. The "B" hole grouting shall be completed in such areas as the Engineer may direct before any concrete is placed in the structure. The "B" hole grouting shall proceed ahead of concrete placement to the extent deemed necessary by the Engineer to obtain the proper consolidation of the foundation. The number, spacing, and depths of the "B" holes, and the pressures and grout mixes to be used for injections will depend upon the nature of the rock, as disclosed by the foundation excavation, the results of water pressure or other tests, and the results of the actual grouting operations.

9. CURTAIN GROUTING

a. General. Curtain grouting, which consists of high pressure grouting shall be performed from the ground surface, the surface of the foundations for the dam, underground from tunnels and shafts, and in galleries in the dam as shown on the drawings. The extent of curtain grouting is uncertain and the number and depths of holes and pressures applied will be determined by the Engineer as the work proceeds. In the dam and spillway area, the curtain grout holes are designated "A" holes. No curtain grouting under structures shall be done until concrete within 100 feet has been placed to a height of 50 feet, except as approved by the Engineer. Following completion of a stage of grouting, no grout hole shall be deepened until the grout in the rock surrounding the hole has been permitted to set for 16 hours unless otherwise directed. Curtain grout holes shall be initially spaced widely (30 foot centers) and shall be drilled and grouted before intermediate holes are drilled and grouted, and in this manner, the drilling and grouting of all holes shall be completed with such final spacing of holes as the results of previous grouting show to be necessary.

b. Procedures. The water-cement ratio by volume will be varied to meet the characteristics of each hole as revealed by the grouting operation; however, grout mixes, in general, will range from a 0.6:1 water-cement ratio by volume to as thin as 10:1. Sand or other approved admixtures may be required during the grouting program. Where sanded grout is used, it will not contain more than three (3) parts of sand to one (1) part of cement by weight. If an open hole condition exists grouting will be started with a thick mix. If pressure tests indicate a relatively tight hole, grouting will be started with a thin mix. If, due to the size and continuity of openings intersected by the drill hole, it is impossible to develop pressure after pumping a reasonable volume of grout at the minimum workable water-cement-sand ratio, the speed of pumping may be reduced or grouting of the hole may be temporarily discontinued.

Pressures as high as practicable up to a maximum of 300 psi may be required; however only such pressures shall be applied which, as determined by experience, are safe against rock or concrete displacement or injection of excessive quantities of grout into areas not requiring grouting. If during the grouting of any hole, grout is found to flow from adjacent grout holes or connections so as to interfere seriously with the grouting operation or to cause appreciable loss of grout, such holes and connections shall be temporarily valved off and periodically vented to prevent grout setting up and plugging the holes. All holes from which grout returns are noted shall be connected to a grout pump and grouting of each such hole completed at the pressures specified for grouting. After the grouting of any stage of a hole is completed, the pressure shall be maintained by means of a valve until the grout has set to the extent that it will be retained in the hole.

The grouting of any hole in which a water-cement mixture of 3:1 or thicker is being used, shall not be considered complete until the hole or connection refuses grout at 75 percent of the maximum pressure established for

that stage of that hole. The grouting of any hole in which a water-cement mixture thinner than 3:1 is being used shall not be considered complete until the hole or connection takes grout at the rate of less than 2 cubic feet of the grout mixture in 15 minutes if pressures between 0 psi and 100 psi are being used, and in 5 minutes if pressures in excess of 100 psi are being used. All grout leaks shall be caulked whenever determined necessary by the Engineer.

c. Regrouting. As the construction work progresses, the development of leakage or the condition of the surrounding foundations may indicate that all or parts of the foundation or other work already grouted require additional work. In such event, the equipment shall be returned and additional holes shall be drilled and/or grouted. No additional allowance above the applicable contract unit prices will be made for any such drilling and grouting or for the expense of moving equipment to other areas of work and returning to previously drilled or grouted areas.

10. GROUTING OF KEYED CONTRACTION JOINTS

a. Tubing for Grouting Keyed Contraction Joints. Systems of thin wall steel tubing, fittings and grout outlets, similar to electrical conduit, fittings and outlets, as approved by the Engineer, shall be placed in the keyed contraction joints in the dam. All tubing, fittings and grout outlets shall be galvanized and shall have water-tight connections tested with water and air prior to and following embedment of systems in concrete. All nails, tie wire, wooden plugs, asphalt emulsion for sealing purposes, and temporary supports required for proper installation of the grouting systems shall be furnished by and shall be cut to length and formed by the Contractor.

Where grout tubing terminates at a concrete surface exposed to the action of flowing water, the tubing shall terminate inside a recess constructed in the surface of the concrete to be dry-packed at the completion of grouting operations. Where grout tubing terminates at other exposed surfaces, the tubing shall be fitted with a wrapped nipple to facilitate removal and filling with drypack at the completion of grouting operations.

b. Hookups to Contraction Joint Grouting Systems. Each keyed contraction joint in the dam is divided into a number of separate grout lifts. Each lift contains its own seals, supply and vent pipes. Hookups to the keyed contraction joint grouting systems in the dam, will be required to wash out and test the joints and grout systems prior to grouting, to grout the various joints, and, if necessary, to rehook the systems during or after the grout operations.

c. Pressure Grouting Keyed Contraction Joints. Pressure grouting of the keyed contraction joints in a grout lift shall be commenced after the concrete adjacent to this lift has reached a temperature of 45°F or less. However, no grouting shall be performed, if the concrete adjacent to the joint has a temperature of 34°F or less. The temperatures will be determined by means of thermocouples embedded in the concrete. Cool water shall be used in the

grout mixture to prevent quick setting of the grout, and water having temperatures above 70°F shall not be used. All grout shall be pumped unless otherwise permitted. The program of grouting, the time when each lift of a contraction joint shall be grouted, the grout mixture used, the pressure applied, and all other details of the grouting operations shall be in accordance with these specifications and as directed by the Engineer.

The Contractor shall provide all required access and facilities such as catwalks, ladders and platforms to each and every joint and joint lift. The Contractor shall supply all labor, tools and materials required in setting dial gages or other devices with which to measure movement of the joints during the washing, testing and grouting operation. Before any lift of a joint is grouted, the joint lift shall be washed thoroughly with water under pressure and be allowed to remain filled with water for a period of 24 hours. Immediately prior to being grouted, the water shall be drained from the joint lifts to be grouted. All leaks discovered prior to grouting and leaks occurring during the grouting operations shall be caulked or otherwise stopped. The adjacent joint lifts at the same elevation as the one being grouted, shall be kept filled with water under pressure during grouting, and water shall be kept circulating in the grout lift directly above, as directed. The grout shall be held in each contraction joint or joint system until it has taken its initial set. Water and thin grout shall be vented and pressure applied as many times as determined necessary by the Engineer.

11. GROUTING OF GRAVEL FILLED CONTRACTION JOINTS

All applicable provisions relating to materials, equipment, methods, temperature and procedures as specified in this section for grouting of keyed contraction joints in the dam apply also for grouting of gravel filled contraction joints, except as follows.

Grouting of the aggregate in the wells of the contraction joints shall be deferred until all monoliths have been built to full height and temperature conditions as specified in Paragraph 10c above have been established. Intrusion of cement mortar shall be a continuous operation of each contraction joint well until the well is filled completely; but the rate of filling shall not exceed 20 feet vertically within the time required for the mortar to attain its initial set.

Standard 2-inch steel pipe for grout connections shall be set in the face of the dam at each contraction joint in the locations shown on the drawings. A standard coupling and wrapped nipple shall be attached to the grout pipe and shall extend beyond the finished surface of the concrete to facilitate removal and patching of holes. Care shall be taken to avoid clogging or obstructing the pipe before being grouted.

Apparatus and equipment for mixing and placing intrusion mortar shall be capable of effectively mixing, agitating, and pumping mortar and forcing it into the aggregate placed in each contraction joint well in a continuous uninterrupted flow at sufficient pressure to cause the mortar to rise at a uniform rate not to exceed 20 feet within the time required for the mortar to attain its initial set. Standby apparatus and equipment shall be provided so that, in case of failure of any part of them, the continuous process of pumping intrusion mortar into the prepacked aggregate in each contraction joint will not be interrupted for more than 30 consecutive minutes before pumping is resumed.

Immediately prior to injection of mortar into the contraction joint well, clean water shall be introduced through the lowest available grout pipe until the water level in the well is 20 feet above that pipe. Thereafter, during the process of intrusion grouting the water level in the well shall be maintained at least five feet above the highest level of the intruded mortar. The standout pipes along each side of the contraction joints shall be used to control such water levels.

The intrusion of mortar into the prepacked aggregate in each contraction joint well shall start at the lowest level. The intrusion of mortar through pipes at higher levels shall not begin until the intruded mortar has filled the aggregate at least five feet above this second, or subsequent, point of introduction of mortar.

The intent of the sequence of operations described above is to insure that all entrained air will be displaced by the rising water and that all entrained water will be displaced by the mortar introduced, thereby insuring that the intruded mortar will fill completely all voids in the aggregate from the bottom to the top of each contraction joint well.

12. GROUTING OF COOLING SYSTEM

After the cooling pipe systems have served their purpose and immediately before their grouting is commenced, each cooling pipe shall be cleaned out with water and air under pressure.

Immediately before the grouting is commenced, the water in the embedded cooling coils shall be thoroughly blown out with air. The grout shall be held in the cooling coils by means of valves on each end of the coils until it has taken its initial set.

All applicable provisions relating to materials, methods and procedures specified in this section for grouting of contraction joints apply for grouting of the cooling system in the dam.

13. BACKFILL GROUTING

Backfill grouting consists of low pressure grouting which shall be performed to fill all voids between concrete tunnel linings and the rock surface and to fill all voids between mass concrete and rock surface at the tunnel plugs and in the erosion cavity backfill in the left abutment of the dam. Backfill grouting shall be performed either through holes drilled through the concrete lining or through grout pipes terminating in a gravel pocket placed between the forms and rock surface prior to concreting and in a manner approved by the Engineer.

14. CONTACT GROUTING

a. General. Contact grouting shall be performed to fill all voids between the steel liner and the concrete lining in the penstocks, below the draft tube liners and sluice liners, and below the stay ring at the turbine spiral cases.

b. Penstocks. In the concrete lined portion of the penstocks, the Contractor shall embed grout pipes in the concrete as shown on the drawings. In the steel lined portion tapped holes and plugs will be provided in the penstock steel. The Contractor shall drill through these holes into the concrete lining up to the rock surface and grout under controlled pressure the gap between steel and concrete and between concrete and rock. After all grouting through the initially provided holes in the penstock steel is completed, the Engineer will determine the areas where additional contact grouting is required. In these areas the Contractor shall then drill additional holes through the steel liner and concrete to complete contact grouting of the penstocks as directed. All holes through the steel liner shall be plugged, welded tight and ground smooth after completion of the grouting operations. Holes in concrete shall be filled with dry pack as specified in Section 9B, paragraph 17.

c. Draft Tube Liners and Sluice Liners. Holes will be provided in the invert of the draft tube liners and sluice liners through which the Contractor shall grout under low pressure to fill all gaps between concrete and liner to the satisfaction of the Engineer. If required, additional holes shall be drilled and grouted. All holes through the liners shall be plugged, welded tight and ground smooth after completion of grouting operations.

d. Turbine Stay Ring. The space underneath the stay ring shall be completely filled with grout after the spiral case has been embedded in concrete. Grout and vent holes will be provided in the lower section of the stay ring for this purpose.

The Contractor shall install 20 pipes extending into the space underneath the stay ring where entrapped air might prevent this space being filled with concrete. Each grout pipe shall be extended upward into the turbine pit by a standpipe for a height of 12 feet above the grout outlet at the stay ring. The grout and standpiping shall be one inch diameter, standard weight black steel pipe with malleable iron screwed fittings.

After all concrete has been placed around the spiral case, the voids under the stay ring shall be grouted. The Engineer will determine the point under the stay ring that has the maximum volume of voids. The grout pipe closest to this point shall be the grout inlet pipe. This pipe shall be extended by a standpipe 23 feet high, measured above the grout outlet. The grout shall be pumped or poured into this inlet pipe at a slow rate to permit complete filling of all the voids. As each 12-foot standpipe around the circumference of the runner removal gallery overflows, that pipe shall be capped. When all pipes, except the inlet pipe, have been capped, the inlet pipe shall be filled to the 23-foot height and kept filled until the grout attains its initial set. If an obstruction is encountered during grouting in an area between the inlet pipe and any of the successive standpipes, the original inlet pipe shall be capped at the 12-foot height and a new inlet location determined and the same procedure followed as outlined above. The grouting system shall remain in position after the completion of the grouting operations until the grout has set. After removal of the grouting system, the Contractor shall dry-pack all voids and grind flush to the concrete surface all exposed portions of the grout and vent lines.

15. ANCHOR BARS

The Contractor will be required to drill for and grout anchor bars in place as shown on the drawings and as directed by the Engineer. Holes for anchor bars may be drilled with any type drill that produces a satisfactory hole. The diameter of each anchor bar hole shall not be less than 1-1/2 times the diameter of the anchor bar. The anchor bars shall be No. 8 or No. 11 reinforcement steel as directed. The bars shall be of lengths shown or as required to suit the variations in actual excavation lines and thickness of concrete to be attached. The maximum length of the bars shall not exceed 30 feet. The locations and depths of the anchor bar holes shall be as shown on the drawings or as directed by the Engineer.

Holes for anchor bars shall be cleaned thoroughly with air and water and shall be completely filled with grout mixed in the proportions and to the consistency directed by the Engineer. To prevent too rapid absorption of the water from the grout, the holes shall be filled with water some time in advance of placing grout. The holes shall then be cleared of water by an air jet and the grout introduced. The anchor bars shall then be forced by slow twisting and/or slight churning into the grout to the bottom of the hole or as necessary to properly position the protruding ends of the bars. Before the grout takes its initial set, if so directed, the bars shall be gently vibrated or rapped to insure

that the entire surface of the embedded portion of the bar is in intimate contact with the grout and all air expelled. Special care shall be taken to insure against any subsequent movement of the bars and against freezing of the grout until the grout has set firmly.

16. ROCK BOLTS

a. General. The Contractor shall furnish, install and maintain rock reinforcement. Rock reinforcement will consist of ungrouted or grouted rock bolts and rock bolt accessories. For the purposes of these specifications ungrouted rock bolts are rock bolts without accessories for grouting. Grouted rock bolts are bolts with accessories for grouting, and which are grouted in place after the bolts are tensioned. Rock bolts required for subsequent installation of structural steel and metalwork shall be installed to closer tolerances than allowed for rock reinforcement in general.

b. Tests by the City. Prior to purchase of rock bolts, the Contractor shall submit a detailed description of them to the Engineer for his review and exceptions, if any. On request, the Contractor shall furnish to the Engineer for testing purposes, five (5) bolts from the first shipment of bolts to be installed in the work; provided, that a minimum of one (1) bolt may be required from each consignment delivered to the work. These test bolts shall be furnished as soon as practicable after arrival of each consignment. The City will perform tests including tension tests, on any number of rock bolts furnished by the Contractor.

c. Drilling of Holes. The holes for rock bolt installation may be drilled with either percussion or rotary drills. The type, diameter and length of the holes drilled in rock for the installation of rock bolts shall be such that for the type of anchor and length of bolt used, the effective strength of the bolt as demonstrated by pullout tests, can be developed. Each hole shall be cleaned of all drill cuttings, sludge and debris by air and water before a rock bolt is inserted in the hole.

d. Insertion of Bolt. After the hole is cleaned, the bolt shall be inserted in the hole and the anchorage firmly seated and tightened. The installation procedure shall cause no damage to the thread on the projecting end of the rock bolt.

e. Installation of Accessories. The bearing plate shall be placed over the projecting end of the bolt. Beveled washers shall then be placed as necessary to insure that the succeeding flat washer is at right angles to the axis of the bolt. A flat, hard steel washer shall be placed over the beveled washers, where used, and shall immediately precede the nut.

f. Greasing. Before installation, the threads of the rock bolts, the nuts and the washers shall be coated with an approved plastic grease of the type used for bilge protection and containing rust inhibiting compounds.

g. Torque. The nut shall then be placed on the projecting end of the bolt. It shall be free running on the threads of the bolt and shall be tightened by a controlled torque impact wrench to a torque of 350 foot pounds, unless a lesser torque value is directed by the Engineer. The Contractor shall test the torque wrenches weekly or as requested by the Engineer, to guarantee the accuracy of the applied torques.

h. Testing.

(1) Torque Test. After initial installation, the Contractor shall insure that the rock bolts continue to act effectively by torque testing them and retightening, if necessary, to the specified torque. Such testing shall be performed at least once every 14 days during the first three months after installation of the bolts and shall be performed on bolts selected by the Engineer. However, all bolts, including rock bolts installed by others during early phases of construction work on the project, within 30 feet of a blasting operation shall be torque tested within four hours after each blast and retightened, if necessary, to the approved torque. If it is found that any bolt will not take the required torque without anchorage slip, the adjacent bolts shall be tested also and a number of new bolts equal to the number of the unsatisfactory ones shall be installed in the immediate vicinity of the unsatisfactory bolts. A final torque test shall be made immediately prior to placement of any lining or before grouting of the bolt.

(2) Pullout Test. The Contractor shall make a pullout test of one bolt selected by the Engineer from each 100 bolts installed. The purpose of a pullout test is to determine the anchorage capability of a bolt. The Contractor shall provide two sets of an approved pullout test equipment for use in making these tests. Each set shall include a suitable hydraulic jack, means for attaching the jack to the end of the bolt, a hydraulic pump, measuring devices for pull and movements at the bolt end, and all other required accessories. All pullout tests shall be made before the bolts are grouted. A pullout test result will be acceptable which indicates that the anchorage will take a tension equal to 90 percent of yield strength of the rock bolt shank as determined by tests by the City as described in Paragraph 16b above without significant anchorage slip. Significant anchorage slip will be deemed to occur, when the measuring device attached to the outer end of the bolt indicates an outward movement of the bolt and continues to indicate such a movement under the following conditions:

(a) If no increase in loading from the hydraulic jack occurs, or

(b) If a decrease in loading from the hydraulic jack is being introduced.

16. ROCK BOLTS - Continued

A movement of the outer bolt end indicating anchorage slip during initial tensioning of the rock bolt will not be considered to indicate a significant anchorage slip as defined above. If the result of a pullout test on the selected bolt is not acceptable in the opinion of the Engineer, five other bolts selected by the Engineer from the last 100 bolts installed shall be subjected to a pullout test. If the average of these five tests is less than 90 percent of the yield strength a pullout test shall be made on the remainder of the 100 bolts, then all 100 bolts shall be retightened to the required torque, and the pullout testing program repeated. If still unsatisfactory, all such bolts shall be rejected and replaced by additional bolts installed in intermediate positions between the rejected bolts.

i. Grouting of Rock Bolts.

(1) Preparations for Grouting. Where grouted rock bolts are required for rock reinforcement, the Contractor shall supply all accessories required to grout the rock bolts in place after installation. All necessary preparations of a bolt for grouting shall be made during the initial installation of the bolt. After the bolt has been tensioned the tension shall not be relaxed for grouting or any other purpose.

(2) Time of Grouting. All grouted rock bolts shall be grouted in place within twenty-one days of installation of the bolt; no blasting may take place within fifty feet of a grouted bolt until seven days after grouting of that bolt.

(3) Grout Mixture. The grout mixture shall consist of cement and water, conforming to the requirements of this section, mixed in the proportion of 4.5 gallons of water to 1 sack of cement. Commercial grade aluminum powder shall be added to the grout in the proportion of 0.005 percent by weight of cement (about a level teaspoon of powder per bag of cement). The powder shall first be very carefully blended with cement in the proportions of one part powder to 50 parts dry cement by weight. The blend shall then be added to the batch in the mixer at the rate of four ounces of blend to each sack of cement and the batch mixed for a minimum of three minutes by means of a high-speed mechanical stirrer. After mixing, the grout shall be sieved through a U. S. Standard 16 mesh screen. The grout shall be used as soon as possible after thoroughly mixing all ingredients, but in any event within thirty minutes after addition of aluminum powder blend to the batch.

(4) Grouting Pressure. The grouting pressure shall be no more than sufficient to fill the drill hole adequately; however, the Contractor shall ensure that grout completely fills the space around the rock bolt from the bearing plate up to and including the anchorage

of the bolt and that all air is vented out of the drill hole. If, during the grouting of any bolt, grout is found to flow from points in the rock surface adjacent to the bolt, such leaks shall be plugged or caulked, so that no further grout leakage takes place.

17. CONTROL OF WATER AND DRILLING OF DRAIN HOLES

If inflow of drain water occurs into the underground excavation, the Contractor may be required to drill holes and grout the vicinity of the area of seepage. The Contractor may also be required to drill drain holes after this grouting is completed and to set drain pipes into these holes for the control of the flow. Drain pipes shall also be set in holes drilled into the machine hall roof to control seepage and in crevices and over springs emanating from the rock surfaces. The amount of this work cannot be determined at this time and the various items of work required may vary considerably from the quantities shown in the Proposal.

18. ACCESSORIES

The furnishing and use of accessories temporarily required shall include miscellaneous pipe, fittings, pipe caps, valves, gauges, gauge savers, packers of all types, caulking materials, supports, related equipment and materials, communication systems, and similar items necessary to the satisfactory completion of all drilling and grouting work. These accessories shall not be measured for direct payment but will be considered as subsidiary obligations of the Contractor and all costs in connection therewith shall be included for payment with the applicable items of work.

19. RECORDS

The Engineer will keep records of all pressure, rate of pumping, amount of cement for each change in water-cement ratio, and such other data as may be deemed necessary by him. The Contractor shall furnish all necessary assistance and cooperation to this end. No grouting shall be performed except in the presence of a representative of the Engineer.

20. MEASUREMENT AND PAYMENT

a. General. The unit prices bid for the items listed below shall constitute full payment for all items of drilling and grouting and related work as described and covered by this section of the specification. No payment will be made for grout lost due to: improper anchorage of grout pipes and accessories, or defective connections; defective pipe, fittings and equipment; Contractor's negligence or failure to promptly caulk or plug leaks; grout remaining in mixer more than 4 hours after mixing; or grout remaining in mixer and agitator tanks after completion of any part of the grouting operation except grout remaining in lines and pumps; all as determined by the Engineer. The cost of handling sand, mineral fillers and fluidifiers, if required, shall be included in

the unit prices bid for grouting. When grout is permitted to set without washing in any stage of any grout hole prior to drilling the next deeper stage at the direction of the Engineer, the re-drilling or reaming of grout will be paid for at 30 percent of the unit price bid.

b. Drilling Exploratory Drill Holes. Drilling of exploratory core holes shall include all holes for which core recovery is required by the Engineer. Measurement for payment will be the number of linear feet of core recovered in the work determined to the nearest one linear foot. Payment will be made at the unit price per linear foot bid for "Exploratory Drilling".

c. Drilling Holes with Rotary Drills. Drilling of holes with rotary drills shall include drain and grout holes for which no core recovery is required. Measurement for payment will be the number of linear feet of such holes satisfactorily drilled as shown on the drawings and as directed by the Engineer measured to the nearest one linear foot from the surface of the material being drilled to the bottom of each hole. Payment will be made at the unit price per linear foot bid for "Drilling Holes with Rotary Drills".

d. Drilling Holes with Percussion Drills. Drilling of holes with percussion drills will be measured for payment as the number of linear feet of such holes satisfactorily drilled in the work measured to the nearest one linear foot from the surface of the material being drilled to the bottom of each hole. Payment will be made at the unit price per linear foot bid for "Drilling Holes with Percussion Drills", which shall constitute full compensation for furnishing all labor, supervision, materials, equipment and the performance of all operations and incidentals necessary to drill such holes.

e. Washing and Pressure Testing. Washing and pressure testing that does not exceed 15 minutes for any one stage of any exploratory core hole or grout hole will not be measured for direct payment and shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included for payment with the applicable items for drilling or grouting. Measurement for payment of washing and pressure testing of any one stage of any one exploratory core hole and foundation grout hole that exceeds 15 minutes, when approved by the Engineer, will be based on the number of required hours measured to the nearest one-quarter (1/4) hour determined from the time the pump starts to inject water into a hole until the time the pump ceases to inject water into a hole as directed with due deduction of the initial 15 minutes. Payment will be made at the unit price per hour bid for "Water Testing".

f. Pipe and Fittings for Grout and Drain Holes. Measurement for payment for this item includes all pipe and fittings for consolidation grouting, for curtain grouting, for grouting the gravel filled contraction joints in the dam, for backfill grouting at tunnel plugs, for drain holes and control of water. Measurement will be the number of pounds of grout pipe and drainage pipe and fittings satisfactorily furnished and installed and left in place measured to the nearest one pound. Payment will be made at the unit price per pound bid for "Furnishing

20. MEASUREMENT AND PAYMENT (Continued)

and Installing Grout and Drainage Pipe and Fittings". No payment will be made for grout pipe and fittings required for contact grouting as defined in this section.

g. Connections to Grout Holes. Connections to consolidation and curtain grout holes and for contact grouting will be measured for payment as the number of grouting connections satisfactorily made in the work including connections to holes drilled and water tested but not required to be grouted. Connections for backfill grouting behind tunnel lining will not be measured for payment. Payment will be made at the unit price per connection bid for "Hookup to Grout Holes". Payment will be made only once for each time the hole is connected for pressure testing and grouting after completion of the stage depth of drilling. Payment for foundation holes in which packers are required to be used will be paid for at 35 percent (35%) of the unit price bid in the Proposal for "Hookup to Grout Holes", each time a satisfactory packer setting or connection is made.

h. Pressure Grouting Foundations. Payment for this item includes all grouting performed for consolidation grouting and curtain grouting. Pressure grouting foundations will be measured for payment on the basis of the number of cubic feet of cement actually forced into the holes or grout connections at the direction of the Engineer, measured to the nearest cubic foot. In measuring grout for payment, the volume of one sack of cement will be considered as one cubic foot and payment will be made at the unit price per cubic foot bid for "Pressure Grouting Foundations". No separate payment will be made for water, sand, or communication systems; however, cement will be paid for separately as specified in Section 9B.

i. Tubing for Keyed Contraction Joints. The thin wall steel tubing, fittings and grout outlets for the keyed contraction joints, for the tunnel plugs and for the backfill concrete in the erosion cavity will be measured for payment as the number of pounds of these items satisfactorily installed and left in place measured to the nearest one pound. Payment will be made at the unit price per pound bid for "Furnishing and Installing Metal Tubing for Keyed Contraction Joints". The computed weight for payment will not include the weight of nails, tie wire, temporary supports or other materials necessary for the satisfactory installation and performance of contraction joint grout pipe system.

j. Pressure Grouting Contraction Joints and Systems. Measurement for payment will be made on the basis of the number of sacks (94 pounds) of cement used in the grout and satisfactorily injected into the joints or systems or required to fill permanent pipes. Measurement under this item will be made on the basis of all cement used for grouting the keyed contraction joints, the gravel filled contraction joints, the cooling water systems and the drain line at the diversion tunnel plug. Payment will be made at the unit price per sack for "Pressure Grouting Contraction Joints and Systems". It shall also include all cost to the Contractor for hookup, furnishing and handling special cement for

20. MEASUREMENT AND PAYMENT (Continued)

grouting contraction joints in the dam and for hookups and communication systems required for grouting under this item of the schedule.

k. Backfill Grouting. Backfill grouting will not be measured for payment and the cost to the Contractor for all work pertaining to backfill grouting behind tunnel linings, tunnel plugs and backfill concrete in the erosion cavity will be considered as a subsidiary obligation of the Contractor. All cost in connection therewith shall be included in the bid price for the respective concrete item, except that all tubing, piping, and fittings required to be installed in tunnel plugs and the erosion cavity concrete shall be paid at the unit price per pound bid for "Furnishing and Installing Metal Tubing for Keyed Contraction Joints".

l. Contact Grouting. Measurement for payment of contact grouting includes all grout injected to fill the voids between the steel liner and concrete in the penstocks. It shall not include grouting performed at the draft tube liners, sluice liners and below the turbine stay rings, but the cost for this operation shall be included in the cost of installing the respective item. Measurement will be on the basis of the number of cubic feet of cement used in the grout and satisfactorily injected. In measuring grout for payment the volume of one sack of cement will be considered as one cubic foot. Payment will be made at the unit price per cubic foot bid for "Contact Grouting".

m. Anchor Bars. Holes for anchor bars shall be measured for payment as the actual linear feet of holes drilled up to the length as shown on the drawings or as directed by the Engineer. Payment for the holes for anchor bars will be made at the unit price per linear foot bid for "Drilling Holes for Anchor Bars and Grouting Bars in Place", which unit price shall include the cost of all labor, materials, plant and operation required for drilling the holes and grouting bars in place, except that the actual weight of bar furnished and placed will be paid for at the unit price per pound bid for "Furnishing and Placing Reinforcement Steel". No separate payment will be made for sand and cement used in the grout.

n. Rock Bolts. Measurement for payment of rock reinforcement will be the total number of linear feet of rock bolts installed, as directed by the Engineer, provided that each bolt less than 6 feet in length will be paid for as a bolt six feet in length. Any bolt or anchor which will not withstand the required torque or is rejected after testing as described above, will not be measured for payment. Material used for temporary supports, for the Contractor's convenience, and material installed in excess of that directed or not in compliance with these specifications will not be measured for payment. Payment will be made at the unit price per linear foot bid to "Furnishing and Installing Ungrouted Rock Bolts" and "Furnishing and Installing Grouted Rock Bolts", respectively. Such payment shall be full compensation for furnishing all labor, equipment and materials, and performing all operations to complete the installation in compliance with these specifications, including drilling the holes, furnishing, installing and grouting rock bolts in place, complete with bearing plates, washers and nuts, torque testing and retightening of bolts, and performing pullout tests.

SECTION 9A

CONCRETE - GENERAL

1. GENERAL

This section of the specifications sets forth the general requirements governing the manufacture and placement of all concrete and performance of related work required by these specifications. The special requirements governing the erection of concrete structures for the various features of the project are covered in Section 9B following this section.

The Contractor shall furnish all labor, plant and equipment, and all materials and supplies required for the manufacture and placement of all concrete required by this specification. He shall perform all work and incidental operations involved in the manufacture and placement of concrete including reinforcement and gunite as specified in Section 9B. All such labor, plant and equipment, and all materials and supplies shall strictly conform with all applicable provisions of this specification.

2. PLANT AND EQUIPMENT

Prior to the construction and installation of the Contractor's plant and equipment for processing, handling, transporting, storing, and proportioning concrete ingredients, and for mixing, transporting, and placing concrete, the Contractor shall submit drawings for review and exceptions, if any, by the Engineer showing proposed plant arrangement, together with descriptions of the equipment he proposes to use in sufficient detail so that an adequate review can be accomplished. The minimum size of each mixer shall be two (2) cubic yards, and the total capacity of the plant shall be at least 150 cubic yards per hour. The total [illegible] of the storage bins shall be at least 300 tons. All information shall be [illegible]ithin sixty (60) days after award of contract. The Contractor shall also subm[illegible] at this time detailed information of his proposed method and equipment for protection of concrete as specified in Paragraph 17 below. After completion of installation, the operation of the plants and equipment shall be subject to the approval of the Engineer. Where these specifications require specific types of equipment to be used or specific procedures to be followed, such requirements are not to be construed as prohibiting use by the Contractor of alternative types of equipment or procedures if it can be demonstrated to the satisfaction of the Engineer that equal results will be obtained by the use of such alternatives. Approval of plants and equipment or their operation, or of any construction procedure shall not operate to waive or modify any provisions or requirements contained in these specifications governing the quality of the materials or of the finished work. It shall be the responsibility of the Contractor to provide adequate usable storage facilities for concrete aggregates at the job site during winter months and other adverse conditions to insure against shutdowns of concrete production due to lack of aggregate.

3. COMPOSITION

a. General. Concrete shall be composed of cement, sand, coarse aggregate, water, air-entraining agent, and admixtures, if required, all so proportioned and well mixed as to produce, as determined by the Engineer, a plastic, workable mixture, suitable to the conditions of placement which will be encountered in the construction work covered by these specifications.

b. Maximum Size of Aggregate. The maximum size of coarse aggregate in concrete for any part of the work shall be the largest of the specified size, practicable for satisfactory consolidation of the concrete by vibration.

Except where it is determined by the Engineer that due to closely spaced reinforcement or other reasons the use of a smaller maximum size aggregate is necessary to obtain satisfactory placement of the concrete, the maximum size aggregate shall be as follows:

(1) Six-inch maximum size aggregate shall, in general, be used in mass or semi-mass concrete for the dam, spillways, in backfill concrete and elsewhere in other equally massive portions of structures where concrete containing 6-inch maximum size aggregate can be properly placed.

(2) Three-inch maximum size aggregate shall be used in concrete for walls that are 15 inches or more in thickness and in slabs that are 8 inches or more in thickness, such as in massive floors and walls or other massive portions of the powerplant structure, and elsewhere, where concrete containing 6-inch maximum size aggregate cannot be placed. However, 1 and 1/2-inch maximum size aggregate may be used in work requiring pumping.

(3) One and 1/2-inch maximum size aggregate shall be used in reinforced sections, as directed by the Engineer.

(4) Three quarter-inch maximum size aggregate shall be used in heavily reinforced sections where concrete containing 1-1/2 inch maximum size aggregate cannot be satisfactorily placed, as determined by the Engineer.

c. Mix Proportions. The Engineer will determine, and furnish the Contractor with the proportions of mixes necessary to fulfill the requirements of strength, durability, impermeability and soundness of all authorized concrete works. The Engineer may vary the mix proportions from time to time as necessary according to existing conditions. The mix proportions shall not be altered except with written consent of the Engineer.

Except where provided otherwise by these specifications, all sampling and testing of materials will be done in accordance with applicable ASTM Speci-

fications. The various materials proposed for use shall be selected by the Contractor well in advance of the time when they will be required in the work, and suitable samples, as they are to be used in the concrete, shall be delivered to the Engineer at least sixty (60) days in advance of the time when the placing of the concrete is expected to begin. These samples shall be sufficient in quantity to permit the making of such test specimens as may be required for determining the suitability and proportions of the materials.

The concrete mixes will vary in strength requirement. The mix for backfill concrete, where strength is not governing, will be designed for a minimum of 2,000 pounds per square inch compressive strength at 28 days. The mix for backfill around penstock steel liners will be designed for a minimum compressive strength of 2,500 pounds per square inch at 28 days. The mix for the concrete at sluice openings and other selected portions of the arch dam will be designed for a minimum compressive strength of 4,000 pounds per square inch at 28 days. Prestressed concrete shall develop a strength of 5000 pounds per square inch at 28 days. The mix for all other concrete will be designed for a minimum compressive strength of 3,000 pounds per square inch at 28 days.

Tests of the aggregate and the resulting concrete will be made during the progress of the work, and the mix proportions will be changed whenever necessary as determined by the Engineer for the purpose of securing the most satisfactory concrete with reference to economy, workability, density, impermeability, durability, and strength, and the Contractor shall not be entitled to any additional compensation because of such changes.

d. Consistency. The amount of water used in the concrete shall be changed as required to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregates as they enter the mixer. Addition of water to compensate for stiffening of the concrete resulting from excessive overmixing or objectionable drying before placing will not be permitted.

e. Measurement of Water. Uniformity in concrete consistency from batch to batch will be required, and the Contractor shall equip each mixer with a consistency meter satisfactory to the Engineer, that will provide a reliable, continuous indication of concrete consistency and record it on the combined autographic recorder chart hereinafter described. The sensitivity of the consistency meters shall be such that the effect of a change in slump of 1/2-inch shall be readily discernible to the operator, and the range of the meters shall be sufficient to include a slump of as little as 1 inch. The design and construction of the consistency meters shall be such as to eliminate appreciable errors in indicated consistency that would result from friction in the mixer operation and from variations in power input.

f. Maximum Slumps. For mass concrete, the slump shall not exceed 2-1/2 inches; and for ordinary reinforced walls, beams, linings, and slabs, the slump shall not exceed 4 inches. These slumps are the maximum slumps of the

concrete at the mixing plant. However, the Engineer reserves the right to require lesser slumps whenever in his judgment such lesser slumps are practicable and will result in concrete of better quality or greater economy. All concrete will be placed at the lowest slump possible consistent with good placement.

g. Tests. The compressive strength of the concrete will be determined by the City of Seattle through the medium of tests of 6-inch diameter by 12-inch cylinders, made and tested in accordance with Designation 29 to 33, inclusive, of the Bureau of Reclamation Concrete Manual, except that, for all concrete samples from which cylinders are to be cast, the pieces of coarse aggregate larger than 1-1/2 inches will be removed by wet screening or handpicking.

Slump tests will be made by the City in accordance with Designation 22 of the Bureau of Reclamation Concrete Manual. The Contractor shall provide such facilities as may be necessary for procuring and handling representative test samples of aggregates and concrete at the batching and mixing plant. The tests will be made at the expense of the City, and the Contractor shall furnish concrete and aggregate for testing purposes at no cost to the City.

4. CEMENT

a. General. Cement of the type and quality herein specified or directed by the Engineer for all concrete, gunite, mortar, and grout to be used on the work covered by these specifications shall be furnished by the Contractor. Cement for concrete shall be delivered to the project in bulk or in sacks, with the approval of the Engineer. All empty cement sacks shall be burned. Cement for all grouting, including grouting of foundations, contraction-joint grouting system, and concrete-cooling system, dowels, anchor bars, bolts, and door and window frames; and, if required by the Engineer, cement for isolated minor items of concrete work, shall be delivered in 5-ply waterproof sacks.

The cement to be furnished under these specifications shall conform in all respects with the Specifications for Portland Cement of the American Society of Testing Materials, Designation C 150 as applying to Type II cement, except fineness, and that the percentage of sodium oxide (NaO) plus 0.658 x the percentage of potassium oxide (K_2O) in the cement shall not exceed six-tenths (6/10) of one (1) percent. The cement shall conform with the requirements for false set in accordance with Federal Specification SS-C-192.

The average specific surface of the cement in a bin sampled shall be not less than 1800 square centimeters per gram, and the specific surface of cement in any individual test sampled shall not be less than 1600 square centimeters per gram.

b. Inspection and Testing. Cement shall be stored at the manufacturing plant in bins set aside for City Light use. The Contractor shall furnish the Engineer with the results of the chemical and physical tests made on each filling of a bin prior to shipment from the bin.

The Contractor shall furnish the City with each shipment, a copy of the manufacturer's certification stating compliance with project specifications and recording the number of sacks or barrels in each shipment. The Engineer shall have access to the manufacturing plant during the filling of each bin to procure samples for his own testing.

Tests for false set may be made on cement after delivery to the job site at which time the cement may be rejected if it fails to meet the false set limitation. The Contractor shall inform the Engineer in writing, at least 30 days before first shipments are required, concerning the mill or mills from which the cement is to be shipped; and the purchase order number, contract number, or other designation that will identify the cement to be used by the Contractor and shall furnish a copy of each invoice containing the weight of each shipment.

Permission to ship cement either before completion of tests or from untested stock shall in no way relieve the Contractor of the responsibility for furnishing cement meeting the requirements of these specifications, and may be revoked if test results indicate failure of the cement to conform with the requirements.

c. Storage Facilities. Weathertight storage space for sacked cement and bins for the storage of bulk cement shall be provided by the Contractor, subject to the approval of the Engineer. The bins shall be emptied completely and cleaned by the Contractor at intervals of 4 months, or more frequently if necessary to prevent deterioration of the cement, as determined and directed by the Engineer.

In order that ample cement shall always be available for the work, ample storage facilities, subject to the approval of the Engineer shall be provided by the Contractor. If cement is supplied from more than one mill, the different cements shall be blended and used in the concrete mixes for various features or lifts of the work in proportion to the quantities supplied from each mill, if such procedure is considered necessary and is directed by the Engineer.

In order that cement may not become unduly aged after delivery, the Contractor shall use cement in the chronological order in which it was delivered on the job. Each shipment of sacked cement shall be stored so that it may readily be distinguished from other shipments. All cement shall be free from lumps and shall be otherwise undamaged when used in concrete, grout or mortar.

d. Cement for Contraction-Joint Grouting. Cement for contraction-joint grouting shall be of such fineness that 100 percent of the cement will pass a No. 100 United States standard screen, and 98 percent will pass a No. 200 United States Standard Screen.

5. ADMIXTURES

a. General. The Contractor shall use an air-entraining agent in all concrete. Accelerators and retarders may be used in certain portions of the work with the approval of the Engineer. Air-entraining agents, accelerators and retarders used shall be furnished by the Contractor, and the cost of the materials and all costs incidental to their use shall be included in the unit price bid in the schedule for concrete in which the materials are used.

b. Air-Entraining Agents. The Contractor shall use an air-entraining agent in all concrete. The air-entraining agent used shall conform to the requirements of ASTM Designation C 260 and shall be of uniform consistency and quality within each container and from shipment to shipment. Agents will be accepted on manufacturer's certification of conformance with specifications, but permission to ship on certification shall in no way relieve the Contractor of responsibility for furnishing an agent meeting specification requirements. Agents shall be subject to sampling and testing. The Contractor shall furnish samples of the air-entraining agent 60 days prior to its use in concrete.

The amount of air-entraining agent to be used in each concrete mix shall be such as will effect the entrainment of four to six percent of air in the concrete as discharged from the mixer, as directed by the Engineer.

The agent in solution shall be added automatically to the batch in a portion of the mixing water. This solution shall be batched by means of a mechanical batcher capable of accurate measurement. When calcium chloride is being used in the concrete, it shall be introduced into the mixer in solution and the portion of the mixing water containing the air-entraining agent shall be introduced separately into the mixer.

c. Accelerator. An accelerator for increasing the strength of concrete at early ages may be used upon written approval covering the type, amount, and location of use. The amount of accelerator used shall be no more than that necessary to produce the desired result. Calcium chloride shall not be used in excess of two percent, by weight, of the cement. The accelerator shall be measured accurately and shall be introduced into the mixer in solution in the mixing water. Use of an accelerator in the concrete shall in no way relieve the Contractor of responsibility for compliance with the requirements of this specification governing protection and curing of the concrete.

d. Retarders. In special cases the use of a retarding densifier in the concrete may be required by the Engineer.

The retarding densifier may be in liquid or powder form and shall be added at the mixer. The proportion shall be according to mix temperature or air temperature, whichever is higher, the exact amount to be as directed by the Engineer.

The densifier shall be free of calcium chloride, foaming or air-entraining agents. Concrete containing the densifier in the proportion of one pound powder to four fluid ounces liquid per bag of cement shall show the following improvements compared to reference concrete:

1. For equal water-cement ratio: Increase slump from four inches to at least six inches and 28-day compressive strength at least 8%.

2. For reduced water-cement ratio: Maintain slump and increase 28-day compressive strength at least 16%.

3. For equal or reduced water-cement ratio: Delay the setting time at least 30% and increase the unit weight of concrete.

The densifier shall alter bleeding characteristics of the concrete so that the rate of clear water bleeding is increased and laitance reduced.

Plastiment, powder or liquid, manufactured by Sika Chemical Corporation, Passaic, New Jersey, is considered to comply with specification requirements for retarding densifier.

6. WATER

The water to be used in concrete, mortar, and grout shall be furnished by the Contractor. All water used in concrete, mortar, and grout shall be subject to the approval of the Engineer and shall be free from objectionable quantities of silt, organic matter, alkali, salts, and other impurities, which in the opinion of the Engineer might reduce the strength, durability or quality of the concrete, gunite, mortar or grout.

7. SAND

a. General. The term sand is used to designate aggregate in which the maximum size of particles is 3/16 of an inch. Sand for concrete, mortar, and grout shall be natural sand or a mixture of natural sand and crushed rock produced as specified in Paragraph 8f below. The sand, as delivered to the batching plant, shall have a reasonable uniform and stable moisture content not exceeding 10%.

Sand for all concrete, mortar, and grout shall be furnished by the Contractor. The sand may be obtained by the Contractor from the source described in Paragraph 8e. below or from such other source as the Contractor may elect, subject to the written approval of the Engineer.

b. Quality. All sand for concrete, mortar, and grout shall consist of hard, dense, durable, uncoated rock fragments and shall be free from injurious amounts of dust, lumps, soft or flaky particles, shale, organic matter, alkali, loam, mica, roots, and other deleterious substances. The percentage of material passing a No. 200 screen shall not exceed three percent, by weight. The sum of the percentages of all deleterious substances shall not exceed one percent, by weight. Soundness of the sand shall conform to the requirements of ASTM Designation C-33.

c. Grading. The sand, as batched, shall be well-graded and when tested by means of standard screens shall conform to the following limits:

Screen No.	Individual percent, by weight, retained on screen
4	0 to 5
8	5 to 20
16	10 to 24
30	10 to 30
50	15 to 35
100	12 to 20
Pan	3 to 7

The modulus of fineness shall be not less than 2.70 nor greater than 3.10. The quality of the sand shall be such that 2 - by 4-inch cylinders of 1 to 3 mortar, when made and tested in accordance with the tests for compressive strength of Portland cement mortar of the ASTM Serial Designation C 87 shall develop a compressive strength not less than that of mortar cylinders made with a standard Ottawa sand.

d. Tests. The Engineer will test the sand. The Contractor shall provide such facilities as necessary for procuring representative samples for testing. At least 30 days before any sand is required for use on the construction work, the Contractor shall deliver to the Engineer for preliminary tests prior to approval, as many representative samples of the sand proposed for use as may be required by the Engineer. These tests will be made at the expense of the City.

8. COARSE AGGREGATE

a. General. The term "coarse aggregate" is used to designate aggregate ranging in size of particles from 3/16 inch to 6 inches or any size or range of

sizes within such limits. Coarse aggregate for concrete shall consist of natural gravel or a mixture of natural gravel and crushed rock, produced as provided in Paragraph 8f. below.

Coarse aggregate for all concrete shall be furnished by the Contractor. The Contractor may obtain coarse aggregate from the source as provided in Paragraph 8e. below, or from such other source or sources as he may elect, subject to the approval of the Engineer.

b. Quality. Coarse aggregate shall consist of hard, dense, durable, uncoated rock fragments and shall be free from injurious amounts of soft, friable, thin, elongated, or laminated pieces, alkali, organic matter, or other deleterious substances. The percentage of material passing a No. 200 screen shall not exceed one percent. The sum of the percentages of all roots and other deleterious substances in any size, as delivered to the mixer, shall not exceed one percent, by weight. Roots in objectionable quantity in the finished aggregate, as determined by the Engineer, shall be removed by floatation, hand picking or other suitable method.

Coarse aggregate may be rejected if it fails to meet the following test requirements:

(1) Los Angeles rattler test (Designation 21). If the loss, using grading A, exceeds 10 percent, by weight, at 100 revolutions or 40 percent, by weight, at 500 revolutions.

(2) Sodium-sulfate test for soundness (Designation 19). If the weighted average loss, after five cycles, is more than 10 percent, by weight.

(3) Specific gravity (Designation 10). If the specific gravity (saturated surface-dry basis), is less than 2.60.

The designations in parentheses refer to methods of test described in the Appendix of the Bureau of Reclamation Concrete Manual.

c. Separation. The coarse aggregate shall be separated into nominal sizes as follows:

Designation:	Nominal Size:	Indicated Screen:	Min. % Ret:	Max % Ret:
3/4"	3/16" to 3/4"	3/8"	50%	65%
1 1/2"	3/4" to 1 1/2"	1 1/4"	25%	40%
3"	1 1/2" to 3"	2 1/2"	25%	40%
6"	3" to 6"	5"	25%	40%

8. Coarse Aggregate - Continued

Separation of the coarse aggregate into specified sizes shall be such that when the aggregate is tested by screening on the screens designated in the following tabulation, the material passing the undersize test screen (significant undersize) shall not exceed two percent, by weight, as batched; and all material shall pass the oversize test screen:

Size:	For Undersize Test:	For Oversize Test:
3/4-inch aggregate	No. 5 mesh *	7/8 inch
1 1/2 - inch aggregate	5/8 inch	1 3/4 inches
3 - inch aggregate	1 1/4 inches	3 1/2 inches
6 - inch aggregate	2 1/2 inches	8 inches

* United States Standard Screen

Screens used in making the test for undersize and oversize shall conform to the requirements of ASTM Designation E 11, with respect to permissible variations in average openings.

Not more than fifty (50) percent of each nominal designated size of the coarse aggregate shall consist of broken rock. The suitability of broken rock, if used, will be determined by the Engineer. The coarse aggregate shall be so graded that concrete of the required workability, density, impermeability, and strength can be made without the use of an excess quantity of sand, water, or cement, as determined by the Engineer. If broken rock is used, crushers for producing it shall be furnished, installed, and operated by the Contractor at his own expense.

The different sizes of coarse aggregate shall be stored separately according to size. Stockpiling or storing shall be done in such manner as to avoid segregation, and the manner of piling or storing shall be approved by the Engineer. Effective rock ladders shall be constructed for the stockpiling of the coarse aggregates when the distance through which the aggregates would fall is so great that objectionable breakage would occur. The location, sequence, and method of screening, washing, and storing operations shall be such as to insure that each of the various sizes of aggregate shall have a reasonably uniform and stable moisture content when delivered at the mixing plant. No trucks or equipment will be allowed on screened aggregate.

The relative amounts of each size of coarse aggregate to be used in each mix of concrete for the various features of the work will be determined by the Engineer, and will be based on the production of concrete having the optimum workability, density, impermeability, strength, and economy.

d. Tests. The Engineer will test the coarse aggregate, and the Contractor, at least 30 days before the aggregate is required for use, shall provide such facilities as may be necessary for procuring representative samples of the coarse aggregate proposed for use. The cost of this test will be at the expense of the City.

8. Coarse Aggregate - Continued

e. Sources of Sand and Coarse Aggregate. The City-owned Metaline Bar deposit located approximately 13 miles upstream of the project site, at the location and within the boundaries shown on the drawings will be made available to the Contractor for his use in producing aggregates for the work to be performed under this specification.

The City has excavated several test pits in the area and logs of material found are available to the Bidders. The Contractor will be required to make his own investigations to ascertain the quantity of suitable aggregate available and the amount of processing necessary to produce aggregate conforming to the requirements of this specification. The Contractor will be required to take material from locations approved by the Engineer within the established boundaries.

It is expected that the material in the bar is deficient in fine sand. If additional fine sand is required it shall be obtained from other sources or manufactured by the crushing of coarse aggregate. The Contractor shall furnish all necessary power for operation of the plant.

No charge will be made to the Contractor for aggregate materials obtained from the Metaline Bar deposit on the work covered by this specification. During the period of the Contractor's operation the Contractor shall be responsible for the material in the deposit and no material shall be furnished or made available by the Contractor to any person or agency without the written direction of the Engineer. However, the City reserves the right to permit removal of materials from this deposit by others at any time.

The accessibility of the Metaline Bar deposit is dependent upon the river discharges. The Contractor shall schedule his operations for providing the aggregates in such a manner that aggregate is available at all times when the construction program requires the manufacture of concrete. Supplemental information for Bidders includes a rating curve for the Pend Oreille River at Metaline Bar, a description of a reference bench mark, logs of test pit materials and results of various tests performed by the City.

The Contractor shall comply with the provisions for stream polution as specified in Section 1C and shall secure the necessary permits from the appropriate agencies of the State of Washington.

The Contractor shall oil all roads over which aggregate is hauled that are not already blacktopped and shall oil these roads as often thereafter as required to effectively suppress dust.

f. Production of Sand and Coarse Aggregate. The Contractor shall carefully clear the area of any deposits, from which aggregates are to be produced, of trees, roots, brush topsoil, clay, unsuitable sand and gravel, and other objectional matter. Unprocessed materials that are taken from any deposit and not used shall be disposed of at the side of the deposit and in a

manner approved or directed by the Engineer. The Contractor shall develop and maintain the deposit in a suitable condition for the excavation and removal of the required material, in a manner satisfactory to the Engineer. Processing of the raw materials shall include screening and washing as necessary to produce sand and coarse aggregate meeting the requirements of this specification. Processing shall also include removal of roots and twigs. Processing of sand and coarse aggregate may be performed at the Metaline Bar or the Project Site. However, final screening to remove undersize materials from the 6" to 3", 3" to 1-1/2" and 1-1/2" to 3/4" aggregates, shall be accomplished as the coarse aggregates enter the mixing plant storage bins. Water for washing aggregates may be taken from Pend Oreille River and shall be free from objectionable quantities of silt, organic matter, alkali, salts, and other impurities. The location of the processing plant or plants shall be subject to the approval of the Engineer. In order to meet the specified grading for sand, the Contractor may add manufactured sand to the extent necessary to make up deficiencies in the natural sand grading. If crushed aggregate is mixed with natural material, the crushed aggregate shall be blended uniformly with the uncrushed aggregate. Crushing and blending operations shall at all times be subject to approval by the Engineer. Excess processed material which is normally wasted shall be stockpiled at a convenient location and turned over to the City for its use without charge. All manufactured sand or coarse aggregate remaining at the completion of the work in stockpiles at the gravel deposit or the work site shall become the property of the City without cost. At the completion of the work, the plant and equipment shall be removed, and the area cleaned up and left in an orderly condition.

9. BATCHING

a. General. The Contractor shall provide such means and equipment as are required to determine accurately and to control the prescribed quantities of the various materials, including water, cement, admixtures, sand, and each individual size of coarse aggregate entering the concrete, and such means and the equipment and its operation shall at all times be subject to approval by the Engineer.

The quantities of bulk cement, sand, and each individual size of coarse aggregate entering each batch of concrete shall be automatically weighed separately, and each material shall be in separate container, and the quantities of water and admixture shall be determined by direct weighing or volumetric measurement.

Batch bins shall be constructed so as to be self-cleaning during draw-down and the bins shall be drawn down until they are practically empty at least once each week. Materials shall be deposited in the batch bins directly over the discharge gates.

Each mixer shall have a capacity of not less than two cubic yards and the concrete plant shall be capable of producing a minimum of 150 cubic yards of concrete per hour. The plant shall be rated at a minimum of 300 tons.

Coarse aggregate shall be deposited in the batch bins through effective rock ladders when the distance through which the aggregates would fall is so great that objectionable breakage would occur.

Equipment for conveying batched materials from the batch hoppers to and into the mixer shall be so constructed, maintained, and operated that there will be no spillage of the batched materials or overlap of batches. Equipment that fails to conform to these requirements shall be effectively repaired or satisfactorily replaced.

b. Equipment. The weighing and measuring equipment shall conform to the following requirements:

(1) Construction and accuracy. -- The construction and accuracy of the weighing equipment shall conform to the applicable requirements of Federal Specification AAA-S-121 for such equipment, subject to the provisions of the following subparagraph (5).

(2) Scale-load indicator. -- Each weighing unit shall include a visible springless dial which will register the scale load at any stage of the weighing operation from zero to full capacity.

(3) Autographic recorder. -- The batching equipment shall include an accurate recorder for making a continuous visible combined record on a single chart of the measurement of each separate concrete ingredient, including all mixing water, and admixture, and of the consistency of the concrete during the mixing process. A portion of the recorder chart equivalent to at least 30 minutes of plant operation shall be visible after recording. This portion of the chart shall be supported over its entire width on a smooth, firm backing so that notes can be made without puncturing the paper. Each unit for recording the weight of a concrete ingredient or for recording the consistency of concrete during the mixing process shall be equipped with a readily adjustable guide pen or other equally suitable device for making a continuous visible indication on the chart of the correct weight of the ingredient or of the desired consistency of the concrete. Suitable means shall be provided to insure proper alignment, uniform rate of travel, and tautness of the paper without wrinkling. The recording equipment shall include facilities for automatically registering on the chart the time of day at intervals of not more than 15 minutes, and shall be designed for simplicity in operation and maintenance.

9. Batching - Continued

(4) Weight adjustment. -- The equipment shall be capable of ready adjustment for compensating for the varying moisture content in the aggregate and for changing the mix proportions.

(5) Delivery control. -- The equipment shall be capable of controlling the delivery of material for weighing so that the combined inaccuracies in feeding and measuring during normal operation will not exceed 1 percent for water, or weighed cement; 3 percent for admixtures; 2 percent for sand, 3/4-inch coarse aggregate, and 1-1/2-inch coarse aggregate; and 3 percent for 3-inch coarse aggregate and 6-inch coarse aggregate.

(6) Sampling facilities. -- Convenient facilities shall be provided for readily obtaining representative samples of cement, admixture, sand, and each size of coarse aggregate from the discharge streams between bins and the batch hoppers or between the batch hoppers and the mixers.

(7) Water-measuring device. -- The operating mechanism in the water-measuring device shall be such that leakage will not occur when the valves are closed and that small increments of water may be discharged, when required, for final tempering of the concrete in the mixer. The water-measuring device shall be constructed so that the water will be discharged quickly and freely into the mixer without objectionable dribble from the end of the discharge pipe.

(8) Protection and visibility. -- The recorder and the operating controls shall be installed in a room that is sufficiently tight to exclude objectionable dust. The room walls shall have sufficient glass-covered openings to permit a general view, by the plant operator and plant inspector of the batching equipment. The recorder shall be constructed so that the City inspector can view the recorder chart and make notes on the chart without interfering with the plant operators. The recorder shall be located within the room so as to be easily accessible for maintenance. Each scale dial shall be in full view of the plant operator, if possible.

(9) Observation and control facilities. -- The mixing plant shall be arranged so that the mixing action in at least one of the mixers can be conveniently observed from the control station. When practicable, this mixer shall be used for mixing concrete in which the maximum size of aggregate is 1-1/2-inches or less. Provisions shall be made so that the mixing action of each of the other mixers can be observed from a safe location which can be easily reached from the control station. Provision shall also be made so that the operator can observe the concrete in the receiving hopper or buckets after being dumped from the mixers.

(10) Ownership of charts. -- All graphic charts pertaining to batching operations made by the equipment mentioned in sub-paragraphs (b) (1) to (b) (9) shall, after recordation, become the property of the City of Seattle.

(11) Moisture content indicator. -- A suitable instrument for determining the moisture content shall be installed in the weigh hopper for the sand. The dial of the indicator shall be visible to the operator.

c. Check Tests of Equipment. The Contractor shall provide test weights at least equivalent to the maximum working load used on the most heavily loaded scale and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device, and shall make periodic tests for accuracy of measurement over the full-capacity range of each scale or measuring device.

The tests shall be made in the presence of a City inspector, and the test procedures shall be subject to approval by the Engineer. Unless otherwise directed, tests of equipment in operation shall be made at least once every two weeks in the case of equipment for measuring water, cement, and admixture; and at least once every month in the case of equipment for measuring sand and coarse aggregate. In addition, check tests shall be made at other times when deemed necessary by the Engineer.

The Contractor, shall, if required, furnish the Engineer with copies of the complete results of all check tests made; and shall make such adjustments, repairs, or replacements as the Engineer may consider necessary to secure satisfactory performance. All such tests shall be at the expense of the Contractor.

q d. Telephone Communication. The Contractor shall furnish and install at his expense adequate direct telephone communication between the mixing plant and the point of concrete placement and between the City field laboratory and the mixing plant and shall furnish all necessary equipment.

10. MIXING

a. General. The concrete ingredients shall be mixed thoroughly in batch mixers of an approved type and size, and so designed as to positively insure uniform distribution of all of the component materials throughout the mass at the end of the mixing period. All concrete shall be uniform in composition and consistency from batch to batch, except where changes in composition or consistency are required. Water shall be added prior to, during, and following the mixer-charging operations. Excessive overmixing requiring the addition of water to preserve the required concrete consistency will not be permitted. Mixing shall be done only in the presence of a City inspector.

b. Adequacy of Mixing. The adequacy of mixing will be determined by the method of "Variability of Mortar in Concrete," Designation 26 of the current edition of the Bureau of Reclamation Concrete Manual. For any one mix, the variability of the air-free un weights (range between maximum and minimum air-free weights) of three samples,one each taken from the front, center, and back of a batch of concrete in the mixer, shall not exceed the following maximum limits:

For 1 batch	2.3 pound per cubic foot.
Average for 3 batches	1.6 pound per cubic foot.
Average for 20 batches	1.2 pound per cubic foot.
Average for 90 batches.	0.9 pound per cubic foot.

c. Mixing Time. Unless otherwise directed or approved by the Engineer, the mixing of each batch shall continue for not less than the number of minutes stated in the following tabulation after all materials, except the full quantity of water, are in the mixer:

Capacity of Mixer	Time of Mixing
2 cubic yards	1-1/2 minutes
3 cubic yards	2 minutes
4 cubic yards	2-1/2 minutes

The minimum mixing periods specified are predicated on proper control of the speed of rotation of the mixer, and on prompt and approved practice in loading of materials, including water, into the mixer. The City reserves the right to increase the mixing time if the charging and mixing operations fail to produce concrete that conforms with the foregoing requirements with respect to adequacy of mixing.

Any mixer that at any time produces unsatisfactory results shall be repaired promptly and effectively or shall be replaced. Mixers shall not be loaded in excess of their rated capacity unless specifically authorized. Each mixer shall be equipped with a mechanically or electrically operated timing and signaling (and locking) and metering device which will indicate and assure the completion of the required mixing period and which will count the batches. Mixers shall be completely discharged before recharging. All double batches shall be wasted.

11. FORMS

a. General. Formwork shall be used wherever necessary to receive and form all concrete work, conforming to the shapes, lines and dimensions of the members as shown on the drawings or to prevent contamination of the concrete during placement, by materials caving or sloughing from adjacent surfaces left by excavation. Forms shall be adequately strong, rigid and durable to withstand all stresses imposed thereon and to permit all operations incidental to placing and compacting concrete without any deformation which will impair the surface finish or quality of the concrete work; shall be sufficiently tight to prevent leakage of mortar or liquid; and shall be accurately placed and rigidly maintained in correct position during placement and set of concrete so that all structural elements shall be within the tolerances specified in Paragraph 14 and the concrete surfaces shall be within the limits specified in Paragraph 15.

Wood sheathing or lining shall be of such kind and quality or shall be so treated or coated that there will be no chemical deterioration or discoloration of the formed concrete surfaces. Chamfers shall be provided for all exterior and interior corners.

b. Type of Forms. The following types of forms shall be used for various structures as specified.

(1) Type 1 - Board Sheathing. Sheathing shall be fir, select merchantable (or better), T&G, S4S, of 6-inch nominal width for plane surfaces and 4-inch nominal width (or less if necessary for curved surfaces), with wood or structural-steel framing or supports. The lumber furnished shall be in accordance with the current Standard Grading and Dressing Rules of the West Coast Lumbermen's Association.

(2) Type 2 - Steel Sheathing. Sheathing shall be plate-steel sheets with structural-steel or wood framing.

(3) Type 3 - Plywood Sheathing or Lining. Plywood sheathing shall have a minimum thickness of 5/8-inch and shall be supported by studs.close enough to prevent a rippling effect in the concrete surface. Plywood lined sheathing shall be sheathing of select merchantable fir shiplap (or better) of 6-inch nominal width for plane surfaces or 4-inch nominal width or less for curved surfaces with a plywood lining of not less than 3/8-inch. Plywood sheathing and lining shall conform to U. S. Commercial Standards (C.S. 45-60) for Douglas Fir, Grade B-B Plyform. Forms may be constructed on wood or structural-steel framing.

Insofar as practicable, the plywood sheets shall be of uniform width and length. The joints between sheets shall be smooth and as nearly perfect as practicable, and no major patching of the plywood will be permitted. Minor imperfections shall be corrected by the use of an

11. Forms - Continued

approved patching compound and sandpapered smooth after it has hardened thoroughly. The use of sheet metal to correct imperfections will not be permitted.

c. Application. Forms for concrete in the arch dam (except for surfaces exposed to water at high to medium velocities) and forms for concrete in other structures that are exposed to weathering, public view and inspection, may be type (1), (2) or (3), as approved by the Engineer.

Forms for concrete surfaces exposed to water at high to medium velocities, (such as for the spillway, intake tunnels, penstocks and draft tubes) shall be type (3), except that type (1) shall be used for curves of small radii.

Forms for all concrete surfaces that will be covered by backfill, at the option of the Contractor, may be any grade lumber S4S, S1S2E, plywood or steel sheathing with wood or structural-steel framing.

Forms for concrete exposed to public view in the dam access gallery, the visitors access gallery, the service bay above elevation 1754 and the machine hall shall be type (3).

Forms for portal structures and the parapet wall along the dam crest, the retaining wall in the forebay and the trashrack structure shall be of a type to produce a textured finish as shown on the drawings.

Forms for concrete surfaces that will be permanently exposed to weathering, to flow of water or exposed to public view shall be smooth and free from dents, sags, holes, and all other defects to the extent required to form concrete surfaces in accordance with Paragraph 15 of this section.

d. Construction of Formwork. For surfaces permanently exposed to view, the sheathing or lining shall be placed horizontally, unless otherwise directed, so that the joint marks on the concrete surface will be in general alignment both horizontally and vertically, so that all horizontal form marks are continuous across the entire surface, and so that for forms constructed of plywood, plywood lining or of panels of tongue-and-groove sheathing, the vertical form marks are continuous across the entire surface. If forms of tongue-and groove sheathing are constructed into panels, the sheathing shall be cut square, the panels shall be composed of single lengths of sheathing across the width of the panel and the vertical form marks shall be symmetrical in relation to the form grooves of vertical control joints. If forms of tongue-and-groove sheathing are not constructed into panels, the sheathing shall be cut square and the vertical joints in the sheathing shall be staggered and shall be made only at studs.

Where directed by the Engineer, the sheathing for certain surfaces shall be placed vertically and of uniform sectional heights with continuous 3/4-inch "V"-grooved horizontal joints. Before constructing forms of plywood, plywood lining or panels of tongue-and-groove sheathing, the Contractor shall submit drawings of his proposed arrangement of the plywood or of the panels to the Engineer for approval.

11. Forms - Continued

Forms used for successive lifts shall be adequately lapped and firmly fitted against completed lifts, and rigidly anchored in correct position so as to maintain accurate alignment of surfaces and prevent leakage of mortar. Form ties shall be used as necessary to insure against spreading of the reset forms under pressure of the subsequently placed concrete and consequent offset from the previously formed face.

Forms for beams and girders shall be constructed so that the sides may be removed without disturbing bottom of form or its supports. Forms shall be so constructed that they can be removed readily without hammering or prying against the concrete. All exposed edges or corners shall be beveled or rounded by the use of moulding strips or suitable edging tools, unless otherwise indicated on the drawings or directed by the Engineer. Temporary openings, sufficient in size and number, properly located, and each with satisfactory means of closure, shall be provided in forms for tunnel lining, column and wall forms or where needed to facilitate cleaning, inspection and concrete operations. Forms exposed to extreme temperature or weather changes shall be so constructed and protected as to prevent excessive shrinkage, warping or bulging. For such conditions strips should be left open in slab forms midway between supporting beams or columns until concrete is to be poured.

When forms are to be re-used, the surface in contact with the concrete shall be thoroughly cleaned of all encrustations before the subsequent pour is made. If the form is demolished and the sheathing is to be re-used, all nails should be withdrawn and the surfaces in contact with the concrete shall be thoroughly cleaned before re-use.

e. Surfaces of Water Passages. Particular care shall be taken in the spillways, wingwalls, piers, intakes, tunnels, draft tubes and other concrete surfaces subject to the action of rapidly flowing water so as to give very smooth finishes, free from offsets and other irregularities which might cause cavitation. Forms for all waterways shall be modeled to the exact outlines and shapes shown on the drawings. The dimensions and alignments shown on the drawings for gate settings, outlet and inlet passages shall be held within the specified tolerances. Where necessary to meet requirements for curvature, the form sheathing shall be built of laminated splines cut to make tight, smooth form surfaces. The forms shall be so constructed that the joint marks on the concrete surfaces shall follow the line of water flow. After the forms have been constructed, all surface imperfections shall be corrected, all nails shall be hidden, and any roughness and all angles on the surfaces of the forms caused by matching the form material shall be dressed to the required curvatures.

f. Formwork for Embedded Metal. Recesses or blockouts for subsequent installation of metalwork shall be formed to shape and dimensions shown on drawings. Extra bracing and stiffening will be required for heavy embedded metal structures in order to prevent unnecessary strain or displacement. Anchor bolts and tie rods for structural steel members and other metal work, or for installing equipment shall be accurately positioned as required for proper installation of the work. Where gate guides or sealing strips are to be attached to the forms, every precaution shall be taken to prevent buckling or distortion of the metal due to the heat of the concrete or to pressure thereof.

g. Form Ties. Embedded metal rods used for holding forms shall remain embedded and shall terminate not less than 1-1/4 inches away from the formed faces of concrete wherein the maximum size of aggregate is 1-1/2 inches or less, and not less than 2 inches away from the formed faces of concrete wherein the maximum size of aggregate is 3 inches or larger. Embedded fasteners on the ends of rods shall be such that their removal will leave holes of regular shape. Embedded wire ties for holding forms will not be permitted in concrete walls to be subjected to water pressure or where the wall surfaces will be permanently exposed. Wire ties, where permitted in isolated areas, shall be cut off flush with the surface of the concrete after the forms have been removed. Types of form ties used shall be approved by the Engineer.

h. Cleaning and Oiling of Forms. At the time concrete is placed in the forms, the surfaces of the forms shall be free from encrustations of mortar, grout, or other foreign material that would contaminate the concrete or interfere with the fulfillment of the specification requirements pertaining to the finish of formed surfaces. Subsequent to all cleanup operations and before concrete is placed, the surfaces of the forms shall be oiled with a commercial form oil that will effectively prevent sticking and will not stain the concrete surfaces. After oiling, surplus oil on form surfaces and any oil on the reinforcing steel or other surfaces requiring bond with the concrete shall be removed. For wood forms, form oil shall consist of straight, refined, pale, paraffin mineral oil. For steel forms, form oil shall consist of refined mineral oil suitably compounded with one or more ingredients which are appropriate for the purpose, as directed by the Engineer. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

i. Removal of Forms. Forms shall be left in place until their removal is authorized by the Engineer, and shall be removed with care so as to avoid damage to the concrete. Form removal will be authorized, and forms shall be removed as soon as practicable, in order to avoid delay in water curing, also to enable the earliest practicable repair of surface imperfections as hereinafter provided. In order to avoid excessive stresses in the concrete that might result from swelling of the forms, wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete. Forms for the openings shall be constructed so as to facilitate such loosening. Tunnel-lining and gallery forms shall not be removed until the strength of the concrete is such that form removal will not result in perceptible cracking, spalling, or breaking of edges or surfaces, or other damage to the concrete.

12. PREPARATION FOR PLACING

a. General. No concrete shall be placed until all formwork, installation of parts to be embedded, and preparation of surfaces involved in the placing have been inspected and approved by the Engineer or an authorized representative. Such approval, however, shall in no way relieve the Contractor of his responsibility to conform with all provisions of these specifications.

No concrete shall be placed in water except with the written permission of the Engineer, and the method of depositing the concrete shall be subject to his approval. Concrete shall not be placed in running water and shall not be subjected to the action of running water until after the concrete has hardened and has gained sufficient strength to withstand the action of the water. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed.

b. Final Cleanup of Surfaces. Immediately before placing concrete, all surfaces upon or against which concrete is to be placed shall be free from standing water, mud, debris, and objectionable matter of every kind. Except as otherwise specified, all surfaces of rock upon or against which concrete is to be placed shall, in addition to the foregoing requirements, be clean, solid, and free from oil, objectionable coatings, and loose, semi-detached, or unsound rock fragments, and shall be sufficiently rough, as determined by the Engineer to assure satisfactory bond with the concrete. The final cleaning and roughening of the surfaces of rock shall be performed by the use of high-velocity air-water jets, wet sandblasting, stiff brooms, picks, or other effective means satisfactory to the Engineer. All surfaces upon which or against which concrete is to be placed shall be moistened thoroughly so that moisture will not be drawn from the freshly-placed layer of bonding mortar to be applied, as specified in Paragraph 13c, immediately before the placement of concrete upon or against any surface.

c. Surfaces of Construction Joints. Concrete surfaces upon or against which concrete is to be placed and to which new concrete is to adhere, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surface of construction joints shall be clean and damp when covered with fresh concrete or mortar, and shall be entirely free from any pools of water. Cleaning shall consist of the removal of all laitance, loose or defective concrete, coatings, and foreign material. Cleaning of the surfaces of construction joints shall be accomplished by wet sandblasting, followed by thorough washing.

The construction joints in mass concrete, and where practicable in other concrete, shall be cleaned and washed immediately before the layer of bonding mortar, as described in Paragraph 13c, and the concrete in the next lift is placed. Where it is not practicable, to clean the joints after forms are set, the joints shall be wet sandblasted and washed at the last opportunity prior to setting the forms, and shall be washed thoroughly again with air-water jets and thoroughly cleaned of all objectionable matter immediately prior to placement of adjoining bonding mortar and concrete. The pour shall be made as soon as possible after the form has been set.

d. Surfaces of Contraction Joints. The surfaces of all contraction joints shall be cleaned thoroughly of accretions of concrete or other foreign material by scraping, chipping, or other means satisfactory to the Engineer before the abutting concrete is placed.

13. PLACEMENT OF CONCRETE

a. General. No concrete shall be placed except in the presence of a duly authorized inspector representing the Engineer. Concrete, when placed in the forms, shall be of such consistency and composition that it can be worked readily into the corners and angles of forms and around all reinforcement and embedded items without segregation of the materials or collection of free water on the concrete surfaces. Concrete shall be deposited as nearly as possible in its final position in the forms so that flow within the mass and consequent segregation will be reduced to a minimum.

Concrete will not be permitted to fall freely from a height of more than 6 feet or at too great an angle from the vertical, or to strike the forms or embedded materials. Where such separation would otherwise occur, the Contractor shall provide suitable drop chutes spaced not more than 10 feet apart and with a length of not over 20 feet, or other means satisfactory to the Engineer.

b. Transportation and Handling. The methods and equipment used for conveying concrete shall be such that concrete having the required composition and consistency will be delivered into the work, without objectionable segregation or loss of slump. Conveyance of concrete by means of chutes, belt conveyors, or other similar equipment whereby the concrete is exposed in a long, thin, continuous flow will not be permitted unless approved in writing by the Engineer for very limited isolated sections of the work.

Concrete may be transported by bucket if no noticeable separation or bleeding due to settlement occurs, or if a loss in slump greater than one inch does not occur, by pumping or by use of agitator bodies mounted on trucks, provided no means of adding water to the mixed concrete is attached to the truck. All concrete used under these specifications shall be initially mixed in the Contractor's main batching plant.

The full capacity of a bucket may be deposited in one operation where this has no objectionable effect on the placing of the concrete, but near forms and in and around embedded metalwork and elsewhere, as directed by the Engineer, the contents of the bucket shall be discharged in such quantities as required for satisfactory placement.

The design of buckets used for concrete placement shall be subject to the approval of the Engineer and shall be such as to permit close regulation of the amount of concrete to be deposited at each dumping operation.

After the completion of a pour, no traffic or activity will be allowed for 24 hours. If foot traffic must cross over blocks poured less than 24 hours previously, bridges or catwalks must be provided and shall be installed immediately after concreting operations have ended. Any necessary work shall be done on "snowshoes" with the minimum amount of walking while the concrete is in its plastic stage.

c. Placement of Bonding Mortar. After the surfaces that are to receive concrete have been prepared satisfactorily, as specified in the preceding paragraph, all surfaces of rock and construction joints of such contour that they can be covered by mortar shall be covered with a layer of mortar approximately one-half of an inch thick. The mortar shall have the same proportions of cement and sand as the regular concrete mixture being placed, unless otherwise directed by the Engineer. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in the manner hereinafter specified.

The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface with a broom. Concrete shall be placed immediately upon the fresh mortar. Before placing concrete against formed construction joints, the surfaces of the joints, where accessible, shall be coated thoroughly with mortar immediately before they are covered with concrete, by scrubbing with wire brooms dipped in the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to insure that the new concrete is brought into intimate contact with the surfaces of the joint, by careful puddling and spading with suitable tools.

d. Temperature of Concrete. Concrete when placed during hot weather shall have a temperature of not more than 65° F. when deposited in the forms. If necessary to keep the temperature of the concrete from exceeding these limits, the Contractor shall at his expense employ effective means and measures for reducing the temperature of the concrete, subject to the approval of the Engineer such as (1) cooling the mixing water; (2) cooling the aggregate; (3) shading materials and facilities from direct sunlight; (4) insulating water-supply pipelines and tanks, or other satisfactory means.

Concrete when placed during cold weather shall have a temperature when deposited in the forms, of not less than 40° F. in mass concrete and 50° F. in walls and slabs in freezing weather; and the temperature of the concrete shall be maintained at 50° F. or more for not less than 72 hours after placement, and thereafter the concrete shall be protected against freezing until the end of the prescribed moist-curing period.

The above specified limits for placing temperatures may be relaxed by the Engineer for concrete in underground structures.

Before placement of concrete in cold weather, the foundation materials upon or against which the concrete is to be placed, also the forms, reinforcing steel, and embedded parts shall be thoroughly cleaned of all ice, snow, frost, preferably with steam, and heated to a degree satisfactory to the Engineer.

Equipment and methods for heating mixing water and aggregates, and the extent or degree of heating shall all be subject to the approval of the Engineer. Mixing water shall not be heated to a temperature in excess of 150° F. unless

13. Placement of Concrete - Continued

authorized in writing by the Engineer. If satisfactory measures are not adequately provided by the Contractor, as determined by the Engineer, concrete-placement operations shall be discontinued.

Concrete-placement operations shall also be discontinued, during rain storms of such severity that water collects in pools of water on the surfaces, unless adequate protective measures are made available by the Contractor, as determined by the Engineer. If water does collect in pools on the surface of newly placed concrete prior to placement of any subsequent lift of that pour, these pools shall be removed by siphoning, bailing or other suitable means. Mortar shall be piled at toe of pour and be spread immediately prior to placement of each bucket during rain storms. A minimum amount (as little as 1/4 cubic yard) of mortar shall be ordered during rain storms.

e. Time Interval Between Mixing and Placing. Concrete shall be placed before its initial set has occurred and, unless otherwise authorized by the Engineer, before it has contained its water content for more than 30 minutes, except that under weather conditions not conducive to a high rate of evaporation, this time limit may be extended by the Engineer in accordance with the circumstances. Any concrete that becomes so stiff before placement that proper placement cannot be assured, as determined by the Engineer or his authorized representative, shall be wasted. No payment will be made to the Contractor for any cement or other materials furnished by the Contractor and contained in any concrete thus wasted.

f. Placement at Construction Joints. Construction joints shall be approximately horizontal unless otherwise shown on the drawings or prescribed by the Engineer, and shall be given the prescribed shape by the use of forms, where required, or other means that will insure suitable joining with subsequent work. Unless otherwise shown on the drawings, keyways will not be required at construction joints. The surfaces of horizontal construction joints between succeeding lifts in the monolithic blocks of the dam shall, wherever necessary, be provided with such surface contour as necessary, including shallow sumps, to facilitate the removal of cleanup waste.

All intersections of construction joints with concrete surfaces which will be exposed to view shall be made straight and level or plumb.

g. Concrete Placement in Layers. All formed concrete, except mass concrete placed in lifts in the dam as described in subparagraph h., shall, insofar as practicable and possible, be placed in continuous approximately horizontal layers, the depths of which generally shall not exceed 20 inches, unless layers of less depth are necessary, as determined by the Engineer in order to place concrete in accordance with other requirements of these specifications; and the concreting shall be carried on as a continuous operation, insofar as practicable, until the placing of the unit is completed. The thickness of the horizontal layers and the rate of placing shall be so adjusted and regulated that each layer of concrete placed will be in a plastic unset condition when covered by the next layer.

13. Placement of Concrete - Continued

h. Placement of Mass Concrete in Lifts. In placing concrete in each lift of the monolithic blocks of the dam or other structure, the Contractor, unless otherwise authorized by the Engineer, shall maintain the exposed area of fresh concrete at the practicable minimum, by first building up the concrete in successive approximately horizontal layers to the full width of the block and to the full height of the lift over a restricted area at the downstream end of the block, and then continuing upstream in similar progressive stages to the full area of the block. The slope formed by the unconfined upstream edges of the successive layers of concrete shall be regulated to minimize segregation and secure adequate compaction without unnecessarily enlarging the area of exposure of the fresh concrete.

i. Placement in Tunnel Linings. In limited spaces, such as linings of tunnels, and backfilling of recesses and other similar features, concrete shall be placed preferably by pumping. Any other suitable method may also be used except that pneumatic equipment method will not be permitted. The equipment used in placing the concrete and the method of its operation shall be such as will permit introduction of the concrete into the forms without high velocity discharge and resultant separation.

In placing concrete by pumping, the slope placement method shall be used wherever possible. The end of the discharge line shall be buried in the concrete insofar as practicable. The space beneath forms and liners shall be completely filled by placing concrete from one side before concrete for the side walls are placed. The concrete shall be brought up on the side walls uniformly on both sides as the pour progresses. Placing equipment shall be operated by experienced operators only. Cold joints shall be avoided where practicable. Where cold joints are unavoidable the concrete at the surface of such joints shall be clean and damp, and roughened if necessary, as directed by the Engineer, before being covered with fresh mortar and concrete.

j. Placement Near Wall Openings. In order to avoid corner cracks as a result of settlement of fresh concrete at the sides of wall openings, placement of wall concrete shall be discontinued at the tops of wall openings having vertical dimensions greater than two feet for as long a period as practicable, but where construction joints at tops of openings are not required, placement shall be resumed before the concrete has attained initial set, in order to avoid cold joints. If the concrete in the top slabs of square or rectangular sections is placed monolithically with concrete in the side and interior walls, the following instructions shall be strictly observed:

(1) Concrete in the top two feet or more of each wall shall be placed with as low a slump as practicable, and special care shall be exercised to obtain consolidated concrete at the tops of the walls.

(2) Concrete in the walls shall be allowed to settle for not less than one hour and not more than three hours, but in no case shall placing of the top fillets and slab be delayed so long that the vibrating unit

13. Placement of Concrete - Continued

will not readily penetrate the wall concrete under the pressure of its own weight. When consolidating the concrete in the top fillets and slabs over the walls, the vibrating unit shall penetrate and revibrate the concrete in the tops of the walls, before additional concrete is placed.

k. Compaction. All concrete, as it is being placed, shall be compacted by mechanical vibrating equipment, supplemented by handspading and tamping wherever necessary to obtain satisfactory results, as determined and directed by the Engineer. Each layer of concrete shall be compacted to the maximum practicable density, so that the concrete is free from pockets of coarse aggregate and closes snugly against all surfaces of forms and embedded materials. In compacting each layer of concrete the vibrating head shall be caused to penetrate and revibrate the concrete in the upper portion of the underlying freshly-placed concrete. Layers of concrete shall not be placed until the underlying layers of fresh concrete previously placed have been thoroughly worked and compacted as specified or as directed by the Engineer.

The vibrating equipment shall consist of electric or pneumatic, power driven, immersion-type vibrators, operating at speeds of at least 7,000 rpm while immersed in the concrete. For placement of mass concrete and for placement of concrete where use of a six-inch diameter vibrator is practicable, immersion type pneumatic vibrators, six inches in diameter, with rpm in excess of 7,000 revolutions per minute when immersed in concrete, as manufactured by Malan Vibrator Company, 10156 Rush Street, South El Monte, California, or approved equal, shall be used. Form vibrators of approved type rigidly attached to the forms may also be used where approved by the Engineer. The size of vibrators, the number of vibrators used, the length of time operated in any one spot, the distance which they are moved from one vibrator spot to another, and all operations connected with their use shall be such as to insure the proper compaction of the concrete.

Where smooth, dense surfaces are required, concrete shall be vibrated, tamped and spaded along the forms to release the air and force the coarse aggregate back from the forms, then revibrated at such distance from the forms as necessary to produce concrete and concrete surfaces of the density and smoothness required.

For concrete placed in stationary forms in tunnel lining, the use of immersion-type vibrators may be supplemented by the use of form vibrators of approved type, rigidly attached to the forms. However, form vibration shall be held to a minimum unless otherwise authorized by the Engineer. Care shall be exercised to avoid contact of the vibrating head with surfaces of the forms. Excessive vibration causing segregation and laitance or tending to bring an excessive amount of water to the surface shall be avoided. In compacting the surface of a concrete lift, the coarser particles of aggregate on the surface shall be embedded while the concrete is being vibrated.

14. TOLERANCES

a. General. Permissible surface irregularities for the various classes of concrete surface finish are specified in Paragraph 15 below, and are to be distinguished from tolerances as described herein. These tolerances define deviations from the established lines, grades, and dimensions which will be permitted in the work, except that the City reserves the right to diminish the tolerances if they impair the structural action or operational function of a structure. Where tolerances are not stated for any individual structure or feature permissible deviations will be interpreted in conformance with the provisions of this paragraph. Rejected work shall be remedied or removed and replaced at the expense of and by the Contractor.

b. Tolerances in Arch Dam, Spillway and Other Mass or Semi-Mass Concrete:

Variations in straight and curved, horizontal lines.	In 20 feet	1/2 inch
	In 40 feet	3/4 inch
	In 80 feet or more .	1-1/4 inch
Variations in straight and curved, vertical or inclined lines.	In 10 feet	1/2 inch
	In 20 feet	3/4 inch
	In 40 feet or more .	1-1/4 inch

c. Tolerances in Reinforced Concrete Structures:

(1) Variation from the plumb.	In 10 feet	1/4 inch
	In any story or 20 feet maximum .	3/8 inch
	In 40 feet or more .	3/4 inch
(2) Variation from the level or from the grades indicated on the drawings.	In 10 feet	1/4 inch
	In any bay or 20 feet maximum .	3/8 inch
	In 40 feet or more .	3/4 inch
(3) Variation of the lineal building lines from established position in plan and related position of columns, walls and partitions.	In any bay or 20 feet maximum .	1/2 inch
	In 40 feet or more .	1 inch
(4) Variation in the sizes and locations of sleeves, floor openings, and wall openings.	. . . . .	1/4 inch

(5) Variation in cross-sectional dimensions or columns and beams and in the thickness of slabs and walls	Minus	1/4 inch
	Plus	1/2 inch
(6) Variation in steps:		
a. In a flight of stairs	Rise	1/8 inch
	Tread	1/4 inch
b. In consecutive steps	Rise	1/16 inch
	Tread	1/8 inch

d. Tolerances for Placing Reinforcement Steel:

(1) Variation for protective covering or effective depth in bending	With 2-inch cover . .	1/4 inch
	With 3-inch cover . .	1/2 inch
(2) Variation from indicated spacing	. . . . .	1 inch

e. Tolerances for Tunnel and Shaft Lining:

(1) Departure from established alignment or grade	. . . . .	1/2 inch
(2) Variation in thickness at any point	. . . . .	minus 0
(3) Variation from inside dimensions	. . . . .	1/2 of 1 percent

f. Tolerances in Buried Structures: In general, they are twice the amount stated for non-buried structures.

15. FINISHING

a. General. Allowable deviations from the perpendicular or the horizontal; and from alignment, profile grades and dimensions shown on the drawings, which are specified in Paragraph 14 above, and designated "Tolerances", are to be distinguished from conditions requiring finishing as herein described.

All operations required in finishing concrete surfaces shall be performed only by skilled craftsmen and in the presence of an inspector representing the Engineer. All concrete surfaces will be inspected, and checked if and as necessary, to determine whether surface irregularities are within the limits herein specified, using for this purpose, in addition to an ordinary foot-rule, a 5-foot straightedge for formed surfaces, a 10-foot straightedge for unformed plane surfaces; and an accurately-constructed template or other satisfactory means for curved surfaces. Surface irregularities, consisting of depressions or bulges, are of two kinds; (1) abrupt or conspicuous irregularities such as those caused by displaced or misplaced forms or by loose knots or other

defects in form lumber, which will be tested by direct measurement; and (2) gradual or almost imperceptible irregularities that frequently are observable only when checked with a straightedge or template as above indicated. The Contractor shall furnish templates and straightedges.

The Contractor shall take necessary precautions, to the satisfaction of the Engineer, to prevent too rapid drying of the concrete during finishing operations and protect the concrete from the elements, including direct rays of the sun and shall cover portions of the area immediately following concrete placement to finished grade during finishing operations. Before final acceptance of the work, the Contractor shall take precaution to prevent unsightly encrustations and stains on all exposed surfaces of concrete, and if such does occur, before final acceptance of the work, the Contractor shall remove all stains and encrustations by cleaning the exposed surfaces to the satisfaction of the Engineer.

b. Types of Finishes for Formed Surfaces. The formed surfaces of the various features of the dam and appurtenant structures shall be finished as hereinafter specified:

(1) Type 1 finish. -- No treatment will be required other than correction of defective concrete, correction of surface depressions exceeding 1" and dry packing form bolt holes. This finish, in general, covers formed concrete surfaces against which backfill is to be placed.

(2) Type 2 finish. -- Neat removal of fins and correction of defective concrete, correction of bulges or abrupt irregularities by bush-hammering and sack-rubbing bushed area within 24-hour period or by bushhammering and grinding and dry packing of form bolt holes will be required. No other sack-rubbing will be necessary. Abrupt irregularities must be less than one-quarter inch. This finish, in general, covers formed surfaces not exposed to close view or flowing water at high or medium velocities.

(3) Type 3 finish. -- Neat removal of fins, correction of defective concrete, dry packing of form bolt holes, correction of bulges or abrupt irregularities, matching adjacent texture and sack-rubbing entire surface will be required. Abrupt irregularities shall be less than one-eighth (1/8) inch. This finish, in general, covers formed concrete surfaces exposed to close view.

(4) Type 4 finish. -- Correction of defective concrete, dry packing of form bolt holes, sack-rubbing of entire surface, grinding of fins and correction of bulges and abrupt irregularities by grinding to a 20 to 1 slope when concrete has sufficiently hardened to prevent tearing the surface will be required. This finish, in general, covers formed concrete surfaces subject to action of flowing water at high or medium velocities.

15. Finishing - Continued

c. Finishing Unformed Surfaces.

(1) General. Surfaces in the interior of a structure shall be sloped for drainage where shown on the drawings or directed. Surfaces exposed to the weather and underground concrete surfaces exposed to moisture from adjacent rock surfaces, and which would normally be level, shall be sloped for drainage. Unless the use of other slopes or level surfaces is indicated on the drawings or directed, narrow surfaces, such as tops of walls and curbs, shall be sloped approximately 3/8 of an inch per foot of width; broader surfaces, such as walks, roadways, platforms, and decks shall be sloped approximately 1/4 of an inch per foot. The unformed surfaces of the various features of the dam and appurtenances shall be finished in conformity with the following requirements or as directed by the Engineer.

(2) Screeded Finish. Unformed surfaces that will be covered by fill material or concrete shall be leveled and screeded sufficiently to produce even uniform surfaces. Surface irregularities, measured as indicated in subparagraph a. shall not exceed 1/4 of an inch.

(3) Float Finish. After the concrete has been struck off to line or grade as shown on the drawing, the concrete shall be allowed to lose its moisture film or shine before starting to float. No finishing tools shall be used until the surface water has evaporated or is removed by draining, mopping, etc. No drier shall be used for this purpose. At the correct time, the concrete shall be hand floated with wooden floats for the first floating. Hand or power floating will be acceptable for the second floating. Floating of the surface shall be the minimum necessary to produce the desired finish. The surface shall be checked with straight edges or templates before the second floating and all correction shall be made prior to the second floating. Irregularities shall be less than 1/4" in 10 feet. Bull floating may be necessary, and if necessary, it should be accomplished at the proper time. Corners of exposed edges should be edged with proper tools as directed or shown on the drawings. This finish applies to gutters, top of spillway piers, top of training and retaining walls, sump floors.

(4) Trowel Finish. Surfaces to be troweled should have a small amount of mortar brought to the surface by the prior two float finishes in order to permit effective troweling. The troweling should start when the floated finish has hardened sufficiently to prevent an excess of fine material being brought to the surface. Troweling should be the minimum necessary to produce the desired finish and should be applied with firm pressure that will flatten and smooth the sandy surface left by the floating. Two trowelings at the proper time, and made to satisfaction of the Engineer will be sufficient for light trowel finish. For a hard trowel finish, at least four trowelings will be required. The hard troweling should produce a hard, dense, glossy

surface, free of blemishes, ripples and trowel marks, Irregularities shall be less than 1/4" in 10 feet.

Light trowel finish applies to unformed surfaces which will be covered with water proofing, roofing or a cover slab, top of parapets, log chute bottom, lower floors in machine hall and floors which receive floor tiles. Hard trowel finish applies to all unformed surfaces subject to action of flowing water such as invert of intake tunnels, draft tubes and spillway crests and chutes.

(5) Brush Finish. Brushing shall be done immediately after second trowel, with suitable brush as directed by the Engineer. Irregularities shall be less than 1/4" in 10 feet. This finish applies to exterior stair treads and exterior stairway landings.

(6) Broom Finish. Brooming shall be done at the proper time after the second floating, with a broom suitable for the purpose. Care should be exercised to prevent excessive tearing of the surface with the broom. Irregularities shall be less than 1/4" in 10 feet. This finish applies to roadway slabs and bridge deck on the dam, on trashrack structure and access tunnels.

(7) Other Surfaces. Surfaces which are not specifically covered in the above paragraph shall be finished as directed by the Engineer.

16. CURING

All concrete shall be cured by means of water unless otherwise permitted or directed by the Engineer. Surfaces of the concrete shall be kept wet for at least 14 days immediately following placement of the concrete. Curing shall be accomplished by covering with water-saturated material or by a system of perforated pipes, mechanical sprinklers, or porous hose, or by any other method approved by the Engineer, which will keep all surfaces to be cured continuously (not periodically) wet. The Contractor shall have all equipment and materials required for curing on hand and ready to install before concrete is placed. Water used for curing shall meet the requirements of these specifications for water used for mixing concrete.

All horizontal construction joints shall be kept continuously moist, regardless of time, until they are covered with concrete, unless otherwise directed by the Engineer for surfaces exposed for a long period of time.

The Contractor will be permitted to use transparent surface membrane type curing compound for curing of isolated areas, if specifically authorized in writing by the Engineer. Curing compounds shall meet the requirements of ASTM C156-55 T. The curing compound used and the manner of curing shall be subject to the approval of the Engineer.

17. PROTECTION

The Contractor shall protect all concrete against damage until final acceptance. Special care shall be taken to prevent spalling of exposed corners and edges, and spillage of petroleum products on the concrete. All permanently exposed surfaces of concrete shall be protected from the direct rays of the sun for 72 hours following completion of concrete placement. Such protection shall be made effective during concrete finishing operations if so requested by the Engineer, and in all other cases protection shall be made effective as soon as practicable after placement of unformed concrete or after the removal of forms from formed concrete.

All openings in structures around which concrete is poured, such as the dam sluice gate openings, galleries, etc., shall be closed off effectively and completely at each end to prevent uneven cooling of the concrete immediately subsequent to placement of concrete. The enclosure shall remain in place until its removal is authorized by the Engineer.

If required by the conditions described below, the concrete shall be protected against freezing by insulation of forms, covering and artificial heat, flooding, steam curing or other means as approved by the Engineer. When artificial heat is employed, special care shall be taken to prevent the concrete from drying. The use of unvented heaters will not be permitted. Immediately after removal of forms from concrete less than 14 days old during freezing temperatures, adequate protection, subject to the approval of the Engineer, shall be given to the concrete to prevent damage due to an excessive temperature differential.

The following conditions require protection of the concrete against freezing:

Immediately following the first frost in the fall, the Contractor shall be prepared to protect all newly placed concrete against freezing. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40°F for more than one day, the concrete shall be protected against freezing temperatures for not less than 48 hours after it is placed. After the mean daily temperature in the vicinity of the worksite falls below 40°F for more than one day, the surface of mass concrete shall be maintained at a temperature not lower than 40°F for at least 96 hours after it is placed, and the surface of all other concrete shall be maintained at a temperature not lower than 50°F for at least 72 hours after it is placed.

Mass concrete cured by water curing shall be protected against freezing temperatures for three days immediately following the 96 hours of protection at 40°F. All other concrete cured by water curing shall be protected against freezing temperatures for three days immediately following the 72 hours of protection at 50°F.

Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40°F in 24 hours. After March 15, when the mean daily temperature rises above 40°F for more than three successive days, the specified 96-hour protection at a temperature not lower than 40°F for mass concrete, and the specified 72-hour protection at a temperature not lower than 50°F for all

other concrete, may be discontinued for as long as the mean daily temperature remains above 40° F, provided that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

18. REPAIR OF CONCRETE

a. General. All operations required in repairing concrete shall be performed by skilled workmen in the presence of an inspector representing the Engineer. All work shall be completed as soon as practicable after removal of forms, preferably within 12 to 24 hours after forms are removed. Concrete that is damaged from any cause, or that is honeycombed, fractured, or otherwise defective, and concrete which, because of surface imperfections, including bulges or depressions, must be excavated and built-up to bring the surface to the prescribed lines and surfaces, shall be removed and replaced with dry-pack, mortar, or concrete as herein specified.

Defective concrete shall be excavated to sound concrete to satisfaction of the Engineer. All excavation lines shall be horizontal or vertical and edges shall be sharp and slightly undercut, except top edge of area to be filled with concrete, which shall be sloped to allow for the escape of air. Spalled edges will not be permitted. Repair work in areas to be sack-rubbed, shall be sawn one inch deep before chipping is started. Care shall be exercised to prevent damaging the sawn edges. After chipping, all loose particles shall be removed by wet sand-blasting or washing with an air-water jet at high pressures. Inspection and approval of excavated areas must be obtained before filling the void.

The existing concrete shall be kept thoroughly wet for 8 hours before repair concrete, dry pack or mortar is placed or sack-rubbing is started. The surface shall be damp but free of surface water and coated with a thin coat of neat cement grout containing an approved bonding agent immediately prior to placement of concrete. Excessive grout must be removed prior to placement of concrete or mortar. If a form is used, it shall be stripped and the concrete finished to match the adjacent texture within twenty-four hours.

All repairs shall be protected from the direct rays of the sun for 72 hours and shall be continuously cured for seven days.

When bulges or other surface irregularities protrude outside the limits specified in the following paragraph for formed surfaces, except surfaces to be covered by backfill, the protrusions shall be reduced by bushhammering followed by grinding so that the surfaces are within the specified limits. Drypack filling shall be used for holes having at least one surface dimension equal approximately to the depth of hole; for holes left by the removal of fasteners from ends of form tie rods; for grout pipe and cooling pipe recesses; and for narrow slots made for repair of cracks. Filling of holes left by the removal of fasteners from the ends of tie rods on surfaces that will be covered by backfill will also be required.

Drypack shall not be used for filling behind reinforcement, or for filling holes that extend completely through a concrete section. Mortar filling, placed under impact by use of a mortar gun, shall be used for holes too wide for dry-pack filling and too shallow for concrete filling and no deeper than the far side of the reinforcement that is nearest the surface. Concrete filling shall be used for holes extending entirely through concrete sections; for holes which are greater in area than one square foot and deeper than four inches; and for holes in reinforced concrete which are greater in area than one-half of one square foot and which extend beyond the reinforcement.

All fillings shall be bonded tightly to the surface of the surrounding concrete, and shall be sound and free from shrinkage cracks and drummy areas after the fillings have been cured and have dried. All fillings in surfaces that will be permanently exposed to view shall contain sufficient white Portland cement to produce the same color as that of the adjoining concrete, as determined by samples produced by the Contractor.

b. Mix for Drypack. Drypack shall be one part cement to two parts of concrete sand by volume, with just enough water so that the mortar as used will stick together on being molded into a ball by slight pressure of the hands and will not exude free water when so pressed but will leave the hands damp.

c. Mix for Sack-Rubbing. Mix for sack-rubbing shall be one part cement to two parts of minus 16 screen sand by volume, with an approved bonding agent. Application of sack-rub shall comply with U. S. B. R. Manual.

19. WATER STOPS, SEALS AND CORKBOARD JOINT FILLERS

a. Waterstops and Seals. All waterstops and seals shall be installed so as to form a continuous watertight diaphragm at each joint as shown on the drawings. Adequate provision shall be made to support and completely protect the waterstops and seals during the progress of the work. The Contractor shall replace and repair at his own expense, any waterstops or seals punctured or otherwise damaged before final acceptance of the work. Steel seals shall be 8-inch wide by 1/8 inch, or 8-inch wide No. 11 ga., conforming to ASTM Designation B 152, 12 inches wide, .032 inches thick, Type Commercial Quality Steel Stripping. Copper seals shall conform to ASTM Designation B 152, or 12 inches wide, 24 ounce, Type ETP, light cold-rolled temper. Rubber waterstops shall consist of a durable, elastic, cured rubber compound capable of effectively sealing the construction joint between the penstock encasement and the upstream wall of the powerhouse. The rubber waterstops shall be as manufactured by Servicised Products Corporation or an approved equal. Plastic waterstops shall be made from virgin polyvinylchloride compound as manufactured by Tecon Products Inc., or approved equal.

b. Corkboard Joint Filler. Where joint filler is required, it shall be corkboard conforming to ASTM Designation D 544, Type II. Damp proofing for the edges of cork board joint filler shall be "Para-Plastic" sealing compound

as manufactured by Servicised Products Corporation, or approved equal.

c. Cork Membrane Sheets. Where cork membrane sheets are required, it shall be sheet cork conforming to ASTM Designation D 544, Type I. Adhesives for placement of the cork membrane sheets shall be M3 Cement as manufactured by Minneapolis Mining Company or an approved equal.

20. TEST SPECIMENS OF CONCRETE

Test specimens of concrete for determining whether the compressive strength and other properties are in accordance with those specified will be taken at frequent intervals, as determined by the Engineer. Specimens will be taken at the mixing plant and in accordance with the most recent methods recommended by the ASTM Designation C 31. Concrete cylinders may also be cast at the place of placement. The specimens will be taken and tested by and at the expense of the City. The Contractor shall assist in handling and transporting concrete and concrete cylinders, if required, at no cost to the City.

SECTION 9B

CONCRETE STRUCTURES

1. CONCRETE CONSTRUCTION - GENERAL

a. Lines, Grades and Dimensions. All concrete construction shall conform to Section 9A and to the detail requirements of the following paragraphs. Concrete finishes shall conform to Section 9A-15 and shall be as noted on the drawings.

All structures shall be built to the prescribed lines, grades, and dimensions. Construction joints shall be located and constructed as shown on the drawings or approved by the Engineer. The Contractor shall place and attach to each structure all timber, metal, or other accessories necessary for its completion as shown on the drawings. The cost of such work, for which specific unit prices are not provided in the schedule, shall be included in the unit prices bid in the schedule for the work to which they are appurtenant. The dimensions of each structure shown on the drawings will be subject to such reasonable changes as may be found necessary by the Engineer to adapt the structures to the conditions disclosed by the excavation.

b. Concrete Lining in Tunnels.

(1) Forms. In addition to the applicable provisions of Section 9A the following requirements apply to the forms for concrete in tunnel linings. Tunnel lining forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in position. Openings shall be provided along each side wall and in the arch. The openings shall be spaced at not more than 8 feet center longitudinally in each side wall and in the crown, and shall be located at mid height of the tunnel in side walls and, in the crown, alternately on each side of the tunnel center line. The openings shall have means for quick closing, and close securely and flush with the concrete contact surface.

(2) Construction Joints. Bulkheads will be required at the ends of successive pours of concrete tunnel lining.

(3) Cleanup of Tunnel Floors. Before placing concrete or gunite thereon, cleanup of the tunnel floors shall be performed as specified in Sec. 5-10.

However, no such cleanup will be required in the machine hall access tunnel, including the wye-section, the dam access gallery, the visitors access gallery and the intake gate gallery. In these tunnels, loose rock and tunnel muck below grade which is considered suitable foundation material for a concrete road slab may be left in place. All such material shall be compacted and graded as required, before concrete is placed thereon. When such material is considered to be unsuitable foundation, it shall be removed as directed by the Engineer and replaced with concrete or other acceptable backfill material. Such excavation and

backfill will be considered as extra work and an equitable adjustment will be made in accordance with the applicable provisions in this specification.

2. CONCRETE IN DAM

a. General. The item "Arch Concrete in Dam" includes the following:

(1) All concrete placed for the foundation plug.

(2) All concrete between El. 1660 and 1930 in the arches between the structural arch outlines as shown on the drawings or as established by the Engineer during excavation, including the downstream fillets, but excluding any upstream fillet.

(3) All concrete above El. 1930 in the arches between the abutment lines as determined by the riverside surfaces of the riverside spillway piers.

(4) All concrete in sluice piers, projections, steps and similar features which are placed monolithically with the concrete in the dam under (1), (2), and (3) above.

All concrete to backfill prescribed excavations outside the structural arch outlines of the dam, all concrete to backfill the erosion cavity outside the limits for structural concrete in the access elevator and all concrete in the face wall between the erosion cavity and the arch dam abutment will be included in the item "Concrete in Arch Abutment".

All concrete, except precast and prestressed concrete, in projections, steps, columns, beams and slabs which are not placed monolithically with the concrete in the dam shall be included in "Structural Concrete on Dam".

All precast concrete on the dam shall be included in the item - "Precast Concrete".

All prestressed concrete on the dam shall be included in the item - "Prestressed Concrete".

b. Placement. No concrete shall be placed in the dam until all blasting for the excavation of the dam is completed. Construction of the dam shall be, in general, in horizontal lifts. The height of each lift shall be 5 feet between El. 1760 and 1850. In other portions of the dam lift heights of 5, 7.5 or 10 feet will be permitted, however, the Engineer may limit the height of lift placed on rock foundation to a maximum of 5 feet. Forms for surfaces between adjacent blocks may be removed as soon as the concrete has hardened sufficiently to prevent surface damage. The placing of concrete in the dam between El. 1845 and El. 2000 shall be regulated such that the maximum differential between adjacent blocks shall not exceed 30 feet and the highest block in the dam shall be not more than 50 feet above the lowest block in the dam. All lifts at the same elevation in the dam will be of uniform height. An interval of 72 hours will be required between the end of pouring one lift of concrete and the start of pouring of the succeeding lift, unless otherwise approved by the Engineer in writing.

The Contractor shall submit within (90) ninety days after receipt of notice to proceed with surface work at the site to the Engineer for his review and exceptions, if any, his plan for placing concrete in the dam, designating the sequence of placing the lifts in the various blocks.

c. Preparation for Overtopping. At the approach of the period of high river discharges in 1966, the Contractor shall have completed the dam up to El. 1765 and shall have performed all foundation and contraction joint grouting below this elevation. The blocks adjacent to each abutment shall be constructed to minimum El. 1770 to form a temporary overflow section confined to the 4 middle blocks. The Contractor shall suitably protect exposed grout outlets and seals from damage due to action of the water. The Contractor will not be permitted to place concrete, during the runoff, in the blocks outside of the temporary overflow section.

d. Cleanup after Overtopping. In addition to the treatment of construction joints as specified in Section 9A-12d, the Contractor shall perform the following work to the surfaces of the partly finished dam after the period of high runoffs in 1966. All concrete affected by running water or damaged otherwise shall be removed and/or repaired. All foreign materials deposited on the construction joints and collected in the expansion joints shall be removed. If required by the Engineer, the Contractor shall drill holes into the concrete and install thermometers in these holes to determine the concrete temperature. The Contractor shall circulate water at a temperature of 120°F. through the top two cooling water systems in the respective blocks until the temperature in the concrete at a point 4 feet below the exposed construction joint reaches 70°F. Circulation of the hot water for each block shall continue until all concrete in the successive lift is placed.

If a horizontal construction joint is left exposed during cold weather for a period of ten days or longer, the Engineer may direct the Contractor to warm up the previously placed concrete as described above, except that the prescribed temperature of circulated water shall be 100°F. The water shall be circulated until the concrete reaches 50°F, all as described above.

e. Cooling Concrete in Dam. Under normal temperature conditions and a construction progress as shown on the schedule on Drawing No. B-5506, cooling of concrete in the dam will be required between elevation 1660 and 1765, and of only a portion of the concrete above 1765. Cooling shall be by pumping river water through pipes embedded in the concrete. However, extreme weather conditions or a different construction progress may require the Contractor to cool a bigger portion or all of the concrete in the dam. The Contractor may be permitted to use natural river water when its temperature is cool enough to achieve the required rate of cooling. Records of water temperature are plotted on Drawing No. D-19018. However, the Contractor may be required to use refrigerated river water for this purpose. The times when cooling is to be performed, the order in which the various portions shall be cooled, the rate of temperature drops and the maximum temperature of the cooling water shall be directed by the Engineer.

Cooling shall be performed in two distinct operations. The initial cooling shall be commenced immediately prceding the placement of concrete over the cooling coil and shall continue as directed (generally 14 days) in order to reduce the heat rise due to hydration of the cement. The final cooling shall reduce the average concrete temperature in the region of a grout lift to the required grouting temperature.

Except as provided in this specification or directed by the Engineer, the amount of cooling water circulated in each cooling coil shall be, in general, 6 gallons per minute and the temperature drop in concrete shall be as authorized by the Engineer. Satisfactory means of measurement of flow of cooling water at the outlet in each block shall be provided by the Contractor. Cooling coil water flow may be shut off and restarted at a later date, if necessary, in the opinion of the Engineer. Provision shall be made in the layout of the pipe connections for reversing the direction of flow of water through the imbedded coils, and the direction of the flow shall be reversed once each 24-hour period.

The Contractor shall provide catwalks, ladders and platforms as specified in Section 25 and all other necessary facilities to enable the Engineer to move from block to block and observe the cooling operations. Unless otherwise ordered or approved in writing by the Engineer, these facilities shall be left in place for use by the Engineer until all contraction joint grouting operations have been completed, and shall then be removed by the Contractor. All bolts and anchors in the faces of the dam shall be removed and all holes left after the removal of the bolts and anchors shall be filled immediately and completely with dry pack as provided in Paragraph 17 of this section.

f. Refrigeration Equipment. The Contractor shall furnish, install and operate all equipment required for mechanical refrigeration of the water for cooling of the concrete. The refrigeration equipment and layout will be subject to approval. The refrigeration plant shall be composed of 40- to 60-ton refrigeration units so that a breakdown of one unit will not immobilize the entire plant. The combined capacity of the refrigeration plant shall be not less than 200 tons per day. All cooling water lines exposed to atmospheric conditions shall be satisfactorily insulated and the Contractor shall maintain the plant and equipment and furnish all labor, materials, power, and parts for its operation. The plant shall be operated only by competent personnel trained in the operation of refrigeration equipment. For the control of cooling operations, temperatures of the concrete shall be determined by means of thermocouples embedded in concrete.

g. Embedded Piping for Cooling Systems. Where 5-foot lifts of concrete are used, the cooling coils shall be placed on the top of each lift. Where 10-foot lifts are used, the Contractor shall place one coil on top of the preceding lift and shall place another coil when the lift reaches the 5-foot mark. This coil shall be pre-assembled so that no interruption is caused to the placing operation. If the Contractor is permitted to use 7-1/2 foot lifts, he shall notify the Engineer of this lift height well in advance so that a revised layout of the cooling system can be provided.

The pipe or tubing and fittings required for the cooling systems to be embedded in the concrete shall be furnished by the Contractor, and shall be cut, bent, fabricated, and coupled by the Contractor. The cooling pipe or tubing shall be 1-inch outside diameter, metal pipe or tubing with a wall thickness of not less

than 0.058 inch. The lengths of pipe or tubing may be joined together with expansion-type couplings similar to those shown on Drawing No. D-23102, or by any other method or type of coupling as may be approved by the Engineer. Pipe caps shall be Type II and pipe couplings shall be Type I, all in accordance with Federal Specification WW-P-521b. Pipe nipples shall be Type A, wrought iron or steel, in accordance with Federal Specification WW-N-351. Pipe nipples used for surface connections shall be galvanized. All pipe or tubing shall be clean and free from scale, inside and outside, and shall be so maintained by the Contractor until it is embedded in the concrete. The Contractor has the option to submit alternate cooling piping details for acceptance by the Engineer.

The pipe or tubing shall also be placed on the rock foundation and shall conform as closely as practicable, as determined by the Engineer, to the contours of the foundation. Where required, pipe or tubing shall be supported and securely held in place by metal ties in a manner approved by the Engineer. All materials required to support and secure the cooling systems in place shall be furnished by the Contractor.

All cooling systems shall be washed clean and shall be tested for leakage, in the presence of the Engineer's representative, at a pressure of 50 pounds per square inch, and shall be watertight at that pressure before being embedded in concrete. The Contractor shall protect the cooling systems from displacement or damage during the placing of concrete and other work following the placing and testing of the cooling systems. Removable nipples shall be placed where the inlet and outlet ends of the cooling coils extend through the formed surfaces of the concrete. The Contractor shall cap and otherwise suitably protect the inlet and outlet ends from damage until the cooling operations are completed.

After the cooling coils have served their purpose, as determined by the Engineer, the embedded cooling coils shall be filled with grout as provided in Section 8-12 after which the Contractor shall remove the nipples in the surfaces of the concrete. All holes left after the removal of the nipples shall be filled immediately and completely with drypack in accordance with the provisions of Paragraph 17 of this section.

h. Thermocouples. Control of concrete cooling and contraction joint grouting operations in the dam will be accomplished by obtaining temperatures from thermocouples embedded in the concrete. These thermocouples shall be embedded approximately every 25 feet in elevation in each block, and elsewhere where directed by the Engineer.

The City will furnish made-up thermocouples, together with switches and thermocouple extension wire cut to required length, ready for installation. The Contractor shall furnish all other materials. The Contractor shall prepare the thermocouples for placement. This will require the determination and cutting of the proper lengths of wire to reach from the points of temperature measurement to the downstream face, with an additional 6 feet of wire extending outside the face of the dam. Each length of wire shall have the ends bared at one end, and the two dissimilar metal wires shall be twisted together

and then silver-soldered to form the thermocouple junction. Each junction shall then be dipped twice in glyptol or cable compound to waterproof the junction. A number of thermocouples shall be prepared in advance, checked against a calibrated mercury thermometer while submerged in water, and tagged for location. Prior to embedment, the thermocouples shall again be checked to assure correct operation of the junction point.

Each thermocouple junction shall be placed in the fresh concrete at the center of the placement lift. The thermocouple junction shall be supported at the midpoint elevation, between cooling water pipes in the fresh concrete in such a manner as to prevent displacement of the junction in a vertical direction and damage to the junction and extension wire from placing or vibrating equipment. Thermocouple extension wire laid on the top of the previously placed lift shall be placed alongside cooling tubing as far as practicable to protect the wire from damage prior to being embedded and during concrete placing operations. No splices will be permitted in the wire embedded in concrete. Where splices are necessary outside the face of the dam, the similar metal wires shall be twisted together, soldered, and then wrapped individually to prevent shorting between wires.

3. SPILLWAYS AND RETAINING WALLS

a. General. The item "Concrete in Spillways and Retaining Walls" shall include all concrete in the spillways outside the limits for arch concrete in dam including piers, discharge channel, bridge slabs, walls, parapets; all concrete in the access elevator above El. 1922; and all concrete in the retaining wall between the left abutment spillway and trashrack structure.

b. Placement. The elements of the spillway which act also as arch dam abutments, consisting of all spillway piers, overflor sections, bridge beams and end abutments shall be constructed well in advance of the arch dam above El. 1930, so that most of the shrinkage in these structures has occurred when the adjacent concrete in the dam is being placed. No vertical construction joints will be permitted between the overflow section for the radial gates and the adjacent spillway piers.

4. TRASHRACK STRUCTURE

All concrete for the trashrack structure, including foundations, piers, parapet, roadway slab, trashrack air compressor room but excluding prestressed and/or precast members shall be included in the item "Concrete in Trashrack Structure". All prestressed members for the trashrack support beams shall be included in the item "Prestressed Concrete". If the Contractor elects to precast the struts (at El. 1965) between the piers, these members shall be included in the item "Precast Concrete".

5. INTAKES AND PENSTOCKS

a. Intake Tunnels. The walls and roof of the intake tunnels upstream of the gate structure up to and including the roundings at the portals shall be gunite lined. The Contractor shall install wire mesh to reinforce the gunite. The Contractor may be required to place gunite for structural support as described in Paragraph 16 b. before applying the gunite lining. The floor of the intake tunnels upstream of the gate structure shall also be gunite lined; however, the Engineer may determine that a concrete slab, reinforced with wire fabric be constructed instead, if ground conditions require it.

The gunite lining in the intake tunnels shall be smooth enough to provide good, hydraulic conditions. Isolated rock points will be permitted to protrude from the gunite, however, protruding sharp points shall be rounded as directed . The thickness shall be as directed to prevent unstable material from becoming dislodged during operation of the project.

Any concrete in the intake tunnel floors shall be included in the item "Concrete in Tunnel Floors" and all gunite in the intake tunnels shall be included in the item "Gunite".

b. Intake Gate Structures. All concrete in the intake tunnels between the gunite lined portion and the vertical construction joint downstream of the gate slot; in the intake gate shafts; in the intake gate chambers for Units 51 through 55; in the hoist support structures; and in the gate house for unit No. 56 shall be included in the item "Concrete in Intake Gate Structures".

c. Penstocks. All concrete between the vertical construction joints downstream of the gate slots and a horizontal plane through the upper end of the penstock steel liners shall be included in the item "Concrete Lining in Penstocks". All concrete between a horizontal plane through the upper end of the penstock steel liners and the vertical construction joint close to and upstream of the machine hall upstream wall shall be included in the item "Backfill Concrete Behind Penstock Steel".

6. MACHINE HALL

a. Concrete Lifts. The placement of concrete in the machine hall shall be carried on at such a rate that the formation of cold joints will be prevented. Slabs shall be placed in one lift unless otherwise authorized or directed. Machine hall concrete shall be placed in lifts as shown on the construction joint layout drawings. If the Contractor desires to place the concrete in lifts different from those shown on the drawings, the Engineer may permit him to do so, in writing, provided that the cost to the City is not increased. Each lift of the concrete shall be a monolithic (continuous) lift. Placement shall begin at one end of a lift and progress in layers (20-inch maximum) toward the other end of the lift each layer being placed so that the full depth of the lift is developed as the concreting progresses toward the ends of the lift.

b. Foundations for Crane Runway. Before erecting the structural steel for the crane runway, the Contractor shall construct the foundation beams and pads for the steel columns. The volume of concrete required therefore, may vary considerably from that shown on the drawings and the Contractor shall not be entitled to any payment above the unit prices bid, if the shape of the foundation excavation necessitates an increased quantity of concrete, reinforcement steel and anchor bars to be installed for the crane runway foundations. All concrete required to be placed for this purpose shall be included in the item "Concrete in Crane Runway Foundations".

c. Substructure. The concrete for supporting and encasing turbine parts in the structure shall be placed in stages, places, and sequence as the erection procedure requires and as shown on the drawings. Delays in concrete placewill be necessary at times to permit checking, adjusting and grouting operations to insure proper installation of the draft tube liners and spiral cases. Concrete piers shall be constructed for the support and adjustment of the draft tube liners and spiral cases. The Contractor shall provide adequate internal bracing for the equipment to prevent distortion during installation and placement of concrete. All bracing tie downs shall be secured by welding prior to placement of concrete. The cost for this bracing shall be included in the unit price bid for the concrete. After the entire assembly has been checked for concentricity and alignment, the concrete shall be placed.

In placing the concrete, approved methods such as elephant trunks shall be used to prevent the concrete from falling more than 5 feet, or building up out of level, or from exerting unbalanced pressures upon the liners and spiral cases. In the placement of this and all other concrete about the steel liners and spiral cases, mechanical vibrators shall be used with great care in proximity of the installed equipment or appurtenances. Hand rodding and spading shall be used where directed. The rate of placing and maximum depth of lifts shall at all times be subject to approval of the Engineer. Evidence of displacement or threatened displacement of equipment which has been set in proper position shall be considered sufficient cause for the Engineer to require corrective measures. This may include, but not be limited to, change in depth, sequence, and time required between lifts.

Should any equipment be damaged or displaced, from such cause as too rapid or careless placement or concrete, or nonconformity with these specifications or the instructions of the Engineer, or other fault of the Contractor, it shall be the sole responsibility of the Contractor to correct same at his own expense. Should displacement occur during placing of concrete, necessitating the removal of concrete in contact with the draft tube liners, the spiral cases and related parts, the Contractor shall be fully responsible for all necessary corrective work, including repairs to the liners, spiral cases and valves, and cost of corrections.

All concrete below El. 1725, between the vertical construction joints in the penstocks close to and upstream of the upstream machine hall wall and the vertical construction joints in the draft tubes close to and downstream of

the downstream machine hall wall, except concrete in crane runway foundations and concrete paving in unit bay Nos. 55 and 56, shall be included in the item "Concrete in Machine Hall Substructure". This item includes also the concrete piers constructed to support spiral case and draft tube liner before they are encased in concrete.

d. Intermediate Structure. After the concrete has been placed around the spiral cases to the floor at El. 1725, a delay in concrete placing operations shall be made of sufficient duration for checking of alignment and shrinkage. Placing of concrete in the generator pedestal shall be performed in conformity with these specifications for concrete in general. All anchor bolts, inserts, and other embedded items, shown or necessary for the complete installation, shall be accurately positioned and securely held in place to the required tolerances. Any displacement thereof during concreting shall be corrected by and at the expense of the Contractor. All concrete in the unit bays and the service bay between El. 1725 and 1759 and between the upstream and downstream machine hall walls, shall be included in the item "Concrete in Machine Hall Intermediate Structure".

e. Superstructure. All concrete in the unit bays and service bay above El. 1759, and between the upstream and downstream machine hall walls, shall be included in the item "Concrete in Machine Hall Superstructure". Concrete in tunnels leading to the machine hall, which is placed outside of the excavation lines for the machine hall, shall not be included in the items for concrete in the machine hall, but shall be included in the appropriate items for concrete in these tunnels.

f. Hatchcovers. All concrete in hatchcovers shall be included in the item "Precast Concrete".

7. DRAFT TUBES AND DRAFT TUBE GATE SHAFTS

All concrete in the draft tubes between the vertical construction joints close to and downstream of the machine hall excavation and the vertical construction joint upstream of the draft tube gate slots shall be included in the item "Concrete in Draft Tubes". All concrete in the draft tube floors and lining downstream of construction joints located upstream of the gate slots and within the limits for structural concrete, all concrete in the draft tube piers, and all concrete in draft tube gate shafts and draft tube gate maintenance chambers below El. 1790 shall be included in the item "Concrete in Draft Tube Gate Shafts". All concrete in the lower mucking tunnel placed adjacent to the draft tubes outside the limits for structural concrete shall be included in the item "Backfill Concrete at Structures".

8. GENERATOR BUS GALLERIES

All concrete in the generator bus galleries between a vertical plane through the downstream limit for machine hall excavation and a vertical plane through the upstream limit for draft tube gate maintenance chamber excavation shall be included in the item "Concrete in Generator Bus Galleries". All concrete in the

generator bus galleries downstream of the vertical plane through the upstream limit for draft tube gate maintenance chamber excavation and below El. 1790 shall be included in the item "Concrete in Draft Gate Shaft".

9. TRANSFORMER BAYS

All concrete on the floor of the transformer bays downstream of the limits for the concrete in the draft tube gate shafts shall be included in "Concrete in Tunnel Floors". All concrete in transformer bays placed against the sidewalls and roof, and all concrete in the canopies over the transmission line anchor beams shall be included in the item "Concrete in Tunnel Lining". All concrete in the removable curtain walls between transformer bays and dam access gallery and all concrete in the transmission line anchor beams to be installed at the downstream end of the transformer bays shall be included in the item "Precast Concrete".

10. VISITORS ACCESS GALLERY

All concrete in the visitors access gallery outside of the excavation limits for machine hall and dam access gallery shall be included in the item "Concrete in Visitors Access Gallery".

11. CONCRETE IN TUNNELS

a. Tunnel Floors. All concrete on tunnel floors for roadway slab and curbs in the machine hall access tunnel including access tunnel wye, in the intake gate gallery, and in the dam access gallery, and all concrete in the floor of the transformer bays and engine generator gallery shall be included in the item "Concrete in Tunnel Floors". The limits for concrete on the tunnel floor above the draft tube gate shafts is a horizontal plane at El. 1790 and the limit at the southeast end of the tunnel is the point where the reference grade at the centerline of the tunnel floor intersects with the erosion cavity or with the actual rock surface created by overbreak due to the proximity of the erosion cavity.

b. Tunnel Lining. All concrete in the lining of tunnel sidewalls and tunnel roofs for the machine hall access tunnel including the access tunnel wye, the intake gate gallery, the dam access gallery, the transformer bays, the engine generator gallery, and any concrete lining required in the diversion tunnel and mucking tunnels shall be included in the item "Concrete in Tunnel Lining".

c. Tunnel Portals. All concrete in the portal structures for the machine hall access tunnel, for the exploratory tunnel, for the northwest portal of the dam access gallery, for the intake gate gallery, and all concrete in the diversion tunnel intake structure, shall be included in the item "Concrete in Tunnel Portals".

d. Tunnel Plugs. All concrete placed for the plug in the diversion tunnel, for the plug in the lower mucking tunnel and the plug in the muck removal gallery shall be included in the item "Concrete in Tunnel Plugs".

12. ACCESS ELEVATORS

All concrete in the elevator shaft below El. 1922 and all structural concrete at the lower two landings shall be included in the item "Concrete in Access Elevator".

13. BACKFILL CONCRETE

a. Backfill Concrete at Structures. This item of work shall include:

(1) All concrete placed outside the limits for structural concrete against excavations performed by others.

(2) All concrete for the cutoff at the West Side Access Road.

(3) All concrete placed in the lower mucking tunnel adjacent to the draft tubes and outside the limits for structural concrete.

"Structural Concrete" shall be as defined in Subparagraph 27a. below.

b. Backfill Concrete Behind Penstock Steel. This item of work shall include all concrete as defined in Paragraph 5c. above.

14. PRECAST CONCRETE

This item of work includes the following precast members:

a. Concrete in transmission line anchor beams.
b. Concrete slabs for the road bridge on the dam.
c. Concrete in hatchcovers.
d. Concrete in removable curtain walls at transformer bays and engine generator gallery.
e. Concrete in trashrack pier struts, if Contractor elects to precast these members.

15. PRESTRESSED CONCRETE

This item of work includes the following members which shall be precast and prestressed before installation:

a. Concrete beams for the road bridge on the dam.
b. Concrete beams for the road bridge on the trashrack structure.
c. Concrete in trashrack support beams.

The drawings show the requirements for the prestressed concrete members which are designed utilizing standard AASHO sections. The Contractor will be permitted to use different sections, provided that their capacity is equal to the loading assumed for the sections shown and further provided that the cost to the City is not increased by using them. The design, materials, fabrication and erection of all prestressed concrete members shall be in accordance with "Tentative Recommendations for Prestressed Concrete" by

ACI-ASCE Joint Committee 323. Thirty days before fabrication of the prestressed concrete members, the Contractor shall submit to the Engineer the name of the subcontractors, if any, and sufficient details of the members he proposes to use to enable the Engineer to verify compliance with this specification.

16. GUNITE

a. General. For the purposes of this Contract, when the name gunite is used on drawings and in the specifications, it means "pneumatically applied mortar" or "shotcrete" as described in "Recommended Practice for the Application of Mortar by Pneumatic Pressure", as published by the American Concrete Institute.

The Contractor shall furnish all equipment and material and place gunite to stabilize excavated surfaces, for structural support, to complete lining the diversion tunnel, to line the intake tunnels, to line other rock surfaces which show a tendency to disintegrate after excavation, to control water flows from seams and crevices, and for other purposes as shown on the drawings or as directed by the Engineer. Only experienced personnel shall be employed for placing gunite and satisfactory written evidence of such experience shall be furnished to the Engineer, if required.

Cement and water for gunite shall conform to the requirements of Section 9A. Sand to be used for gunite may be natural sand or crushed sand. Before procuring sand for guniting a quantity sufficient for testing purposes shall be furnished to the Engineer for his review and exception, if any. The minimum mixing time for each batch of gunite shall be 1-1/2 minutes. Except for the provisions contained in these specifications, materials, equipment, mix proportions, mixing, preparation of surfaces, drainage provisions, placing procedure, sequence of application, time between coats, construction joints, curing, and tests for gunite shall be in accordance with "Recommended Practice for the Application of Mortar by Pneumatic Pressure" as published by the American Concrete Institute.

b. Gunite for Structural Supports. The Contractor may be required to use gunite for constructing structural support for excavated surfaces where seams and fractured zones are encountered. The method for constructing these structural supports shall be as follows.

After reinforcing the vicinity of such seams or zones with rock bolts, the Contractor shall locally clean the seam or zone to a depth satisfactory to the Engineer. Welded wire fabric or chain wire mesh shall be installed by attaching it to rock bolts. Reinforcement steel may also be required to be installed. The Contractor shall fill the area of local excavation with successive layers of gunite until a structural member consisting of reinforced gunite is built up. Typical details for structural gunite treatment are shown on the drawings.

17. DRY-PACK

Dry-pack shall be used for repair of concrete imperfections, for filling the holes left by the removal of form ties and for equipment installation as directed by the Engineer. The mix for dry-pack shall be one part cement to two parts concrete sand by volume, together with an approved bonding agent in an approved amount and sufficient white Portland cement to match the color of the surrounding concrete surface, if that surface is exposed to view. Only enough water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water. Dry-pack shall be placed by solidly compacting it in thin layers over its entire surface by use of hand or pneumatic tamping equipment.

18. MORTAR FOR STRUCTURAL STEEL AND EQUIPMENT INSTALLATION

Mortar for structural steel and equipment installation shall be special sand-cement mortar for use in seating structural steel members and machinery on foundations. This mortar shall be practically a non-settling mortar. It shall, unless otherwise directed by the Engineer, be prepared by the Contractor either by prolonged or delayed mixing of ordinary mortar; by addition of aluminum powder to ordinary mortar; or by the use of special cement; and the use of specially selected clean, hard sand containing approximately 25 percent of material that will pass a No. 50 screen. The mortar shall be prepared in accordance with the current edition of the Concrete Manual of the U. S. Bureau of Reclamation. Embecco may also be used with prior approval of the Engineer.

19. BLOCKOUTS

Blockouts will, in general, be shown on the concrete outline drawings. However, blockouts for equipment furnished by the Contractor, such as elevators and air conditioning equipment, shall be coordinated with the vendors' shop drawings.

The concrete surfaces of the blockouts shall be roughened before concrete is placed in the blockouts. The roughening shall be performed by sandblasting, chipping or other methods approved by the Engineer, and in such a manner as not to loosen, crack, or shatter any part of the concrete beyond the roughened surface. After being roughened, the surfaces of the blockouts shall be cleaned thoroughly of all loose fragments, dirt, lime, and other objectionable substances by wet sandblasting immediately before placement of readily installed forms. The surfaces of the blockouts shall be sound and hard and in such condition as to assure good mechanical bond between the existing and new concrete. All concrete which is not hard, dense, and durable, as determined by the Engineer, shall be removed to the depth required to secure satisfactory surfaces. Surfaces of the blockout shall be damp when covered with fresh concrete or mortar. Special care shall be taken in placing the concrete in blockouts to assume satisfactory bond with the existing concrete and complete contact with the metalwork to be embedded in the blockout concrete.

20. CONCRETE PAVING IN UNIT BAY NOS. 55 AND 56

The Contractor shall construct a 4-inch nominal thickness concrete paving on the backfill in unit bay Nos. 55 and 56. The paving shall be reinforced with wire fabric and constructed in slabs not exceeding 8 feet in width or length separated by 2 x 4-inch timber. No special sub-base material will be required, but the Contractor shall adequately wet the base and/or use building paper to prevent loss of moisture while placing the concrete. The concrete shall be given a light trowel finish.

21. CONCRETE AT BATCH PLANT

The Contractor shall furnish at the batch plant concrete for which the exact location of placement or the use cannot be predicted, for which the quantity cannot be approximated and which is not otherwise covered by a unit bid price. The mix for this concrete shall be as directed by the Engineer for the purpose intended.

22. MISCELLANEOUS CONCRETE

This item of work includes the following:

a. All concrete in the exploratory tunnel between the machine hall and the elevator sump and concrete adjacent to the erosion cavity.

b. All concrete for the duct banks in the upper parking area.

c. All concrete for the manhole at the south end of the trashrack structure.

d. All concrete for the bulkhead wall in the lower mucking tunnel near the access tunnel wye.

e. All concrete for drainage catch bains.

f. Other concrete of similar nature as directed by the Engineer.

23. VERMICULITE LINING

The Contractor shall line the transformer bays and the engine generator room with a fire resistant lining, consisting of vermiculite mortar, reinforced with wire mesh, which is fastened to existing rock bolts. The applicable provisions of Paragraph 16 above for "Gunite" shall apply for the vermiculite lining, except as specified below. The mixture for this lining shall consist of one sack of Portland cement to four cubic feet of vermiculite concrete aggregate, Zonolite brand or approved equal, with stabilizer, mixed with approximately 12 to 13 gallons of water. The mix shall be applied with a plaster machine or other suitable plant until a minimum thickness of four inches is built up over the whole area to be coated.

24. FLOOR HARDENERS

a. General. The Contractor shall apply floor hardener to all floors in the machine hall, except where tiles or other floor covering will be installed or the Engineer directs the Contractor to omit the application.

b. Materials. Fluosilicate crystals shall be used for floor hardener and shall be magnesium fluosilicate or zinc fluosilicate or a combination of both.

c. Application. Two coats of liquid floor hardener shall be applied to the concrete floors in a manner approved by the Engineer. After the concrete floors have been cured thoroughly and at such time as directed by the Engineer, the surface shall be cleaned thoroughly of all dirt, grease, laitance, or other foreign matter and shall be allowed to dry, immediately after which the floor hardener shall be applied. The Contractor shall prepare the hardener solution by dissolving fluosilicate crystals in the proportion of one-half pound of crystals per gallon of water for the first coat and 2 pounds of crystals per gallon of water for the second coat. The hardener solution shall be applied at a maximum coverage of 100-square-feet-per-gallon per coat. The solution shall be applied liberally by means of floor mops. Each coat shall be spread uniformly, and the presence of pools of the hardener solution shall be avoided. The first coat shall be allowed to dry thoroughly before the second coat is applied. After the second coat has dried, the floors shall be brushed and washed with water to remove any crystals which may have formed on the surface.

25. REINFORCEMENT STEEL, WIRE FABRIC AND WIRE MESH

a. General. All reinforcement bars, in general, shall conform to the requirements of ASTM Designation A 15 for intermediate grade bars, or to ASTM Designation A 432, where specified. The deformations on the bars shall conform to ASTM Designation A 305. Welded wire fabric shall conform to ASTM Designation A 185. The chain wire mesh shall be No. 9 gauge, 2-inch mesh fabric, Class I coating, conforming to ASTM Designation A 392.

b. Fabricating and Placing. Steel reinforcement may be fabricated in the shop or in the field. The drawings in general show only typical details for reinforcement steel, wire mesh and wire fabric. Further detailed information required will be supplied by additional drawings, sketches or written instructions from the Engineer, as he deems necessary. From these drawings and specifications the Contractor shall prepare all reinforcement steel details. All detailing shall be done in accordance with ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures", and shall be prepared by or under the direction of a registered professional civil engineer. The Contractor shall be fully and solely responsible for detailing, furnishing, bending and placing of all reinforcement steel and shall submit to the Engineer for approval copies in triplicate of all bar lists, bending and placing diagrams. This information shall be submitted to the Engineer at least twenty (20) days before fabricating steel. The City reserves the right to require the Contractor to furnish, cut, bend and place a reasonable amount of miscellaneous reinforcement steel, as may be

found necessary, in order to complete the structures as shown on the drawings or as ordered by the Engineer.

The Contractor shall submit to the Engineer his method for placing concrete in the cantilevering portions of the dam, such as sluice gate piers and bridge piers, so that additional reinforcement steel can be incorporated in the design to provide for tension in these members during construction.

Before placing, the surface of reinforcement steel, wire fabric, wire mesh, and surfaces of any metal bar supports shall be cleaned of heavy flaked rust, loose mill scale, dirt, grease, or other foreign substances which, as determined by the Engineer, are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap or equivalent treatment is considered objectionable. After placing, the reinforcement bars shall be kept in a clean condition until they are entirely embedded in the concrete.

Reinforcement bars shall be accurately placed and secured in position so that they will not be displaced during the placement of the concrete, and special care shall be exercised to prevent any disturbance of the reinforcement bars in concrete that has already been placed. Wherever necessary or so ordered, metal chairs, metal hangers, metal spacers, or other approved supports shall be furnished and used by the Contractor for supporting reinforcement bars. Wherever necessary, as determined by the Engineer, to prevent future damage to the concrete or unsightly rust stains on exposed concrete surfaces, all such supports for reinforcement bars shall be made of non-corrosive metal.

All splices of reinforcement bars shall be made by lapping the bars at least 24 diameters of the smaller bar unless otherwise shown or authorized. Field splices other than those shown on the approved drawings and bar lists shall be subject to the approval of the Engineer. In general, straightening and rebending improperly bent bars, will not be allowed, except upon specific approval of the Engineer. Unless otherwise shown on the drawings or directed by the Engineer, and except for hooks and clearances, measurements for bending and placing the bars shall be to the centerline of the bars.

Wire fabric and wire mesh shall be cut to size as required. When it is installed on vertical or overhanging surfaces, it shall be fastened to adjacent rock bolts, or by the use of Ramsets, spikes or similar means, or by a combination thereof.

Wire mesh or fabric shall be attached to the previously installed rock bolts by use of an additional steel plate and/or nut which have received the same coating as those used on the rock bolt. Immediately prior to attaching wire mesh or fabric to any previously installed rock bolt, the bolt shall be checked for the required torque value as specified in Section 8, paragraph 16, "Rock Bolts". Subsequent torque testing will not be required. In areas where no rock bolts are available for fastening of the fabric or mesh, the Contractor shall install Ramsets, spikes or similar anchors at a nominal spacing of five feet. Where required, additional support for wire mesh or fabric shall be provided

as directed by the Engineer. Lapping of fabric or mesh shall be at least six inches.

26. POST TENSION CABLES

The Contractor shall, in addition to reinforcement steel, install post tension cables and shall post tension the piers of the sluice gates in the dam and the piers of the radial gates in the spillways.

The post tension cables shall contain Super-Tens stress-relieved wire as fabricated by American Steel and Wire, a division of U.S. Steel, or approved equal. The individual wires in the assemblies shall have a nominal diameter of 0.25 inch and a minimum breaking strength of 11,780 pounds. The wire assemblies in the spillway piers shall consist of 24 wires, and in the sluice gate piers of 20 wires. They shall be supplied by the manufacturer complete with flexible tubing, bearing plates, stressing washers and shims. The jacking ends shall be provided with grout pipe attachment. The bearing plates shall be designed for anchorage in concrete with a 28-day strength of 3,000 psi in the spillway piers and 4,000 psi in the sluice gate piers.

After the concrete surrounding the post tension cables has gained sufficient strength, the Engineer will issue permission to the Contractor to tension the cables. The jacking force for each cable is shown on the drawings. After satisfactory tensioning, the space between the wire strands and the flexible tubing shall be grouted. Prior to installing the post tension cable assemblies, the Contractor shall submit to the Engineer for his review, details of the installation and grouting procedures he proposes to use.

27. MEASUREMENT AND PAYMENT

a. Structural Concrete. The definition "structural concrete" means the outline of a concrete structure as designed to perform its functions and to be structurally adequate. It is defined by the minimum excavation lines, the concrete outlines and items of equipment embedded in it. Minimum excavation lines for excavation performed by others are shown on the drawings or will be defined by the Engineer.

b. Measurement of Concrete. Measurement for payment of concrete required to be placed directly against surfaces excavated by others will be made on the basis of concrete actually placed as measured at the mixer in accordance with the "Standard Method of Tests for Weight per Cubic Foot, Yield and Air Content (gravimetric) of Concrete", ASTM Designation C 133. Except for concrete behind penstock steel and in tunnel plugs, the quantity of structural concrete for the respective part of the work will be deducted from the total amount of concrete placed and the remaining concrete will be included in the item "Backfill Concrete at Structures".

Measurement for payment of structural concrete will be to the lines and grades and excavation lines as shown on the drawings or defined by the Engineer.

Measurement for payment of concrete required to be placed directly against surfaces excavated under this Contract will be made to the lines and grades to which payment of excavation is made.

In measuring concrete for payment, the volume of any opening, recess, duct, embedded pipe, woodwork and metalwork, which is larger than 100 square inches in cross section will be deducted. No payment will be made for concrete, or materials therein, which have been wasted due to over ordering, rejected or used as follows: in finishing operations; in grouting rock bolts, anchor bars, anchor bolts, mortar underneath equipment or the like; in replacement of damaged or defective concrete; extra concrete required as a result of careless or needless excavation; concrete placed by the Contractor in enlargement of structures or elsewhere for the purpose of enabling or facilitating his operations; or other unrequired uses as determined by the Engineer. All concrete waste, to the nearest 1/4 cubic yard, shall be agreed upon immediately or at the conclusion of a pour or shift, whichever occurs first, by the concrete placement foreman and the City's inspector.

Measurement for payment of dry pack and concrete in blockouts will be included in the measurement for payment of the respective concrete where these items are located.

c. Payment of Concrete. The payment of concrete as described herein will constitute full compensation to the Contractor for all materials used, except cement and reinforcement, for batching, mixing, forming, preparations for placing, consolidating, finishing, curing, repairing and for furnishing and installing wall stops, seals, corkboard and other joint fillers. Payment for the various concrete items will be made at the applicable unit price per cubic yard in the Proposal. No payment will be made for concrete not repaired, patched or finished as directed.

All cost to the Contractor for preparatory work before and cleanup work after overtopping of the dam in 1966 will be paid for as extra work. Work in connection with the preparation of horizontal construction joints in the dam left exposed during cold weather for a prolonged period, including heating of old concrete, will not be paid separately, but the cost thereof shall be included in the unit price for concrete in the dam.

Payment for furnishing concrete at the batch plant will be made at the unit price bid per cubic yard which price shall include all plant, equipment, labor, sand, gravel and other materials (except cement) necessary to manufacture the concrete ready for transportation to the site of its use. Payment for transporting and placing the concrete will be paid for at an agreed price or as extra work at the option of the Engineer.

d. Cement. Measurement for payment of sacked cement will be on the basis of the number of sacks of cement used at the mixer. Measurement for

payment of bulk cement will be on the basis of batch weights at the batching plants. One barrel shall be considered as 4 sacks of sacked cement or 376 pounds of bulk cement. Payment will be made at the unit price per barrel bid for "Furnishing and Handling Cement".

Payment under this item will be made for all cement used in concrete for which payment is made except prestressed concrete. Payment will be made under this item for cement used for pressure grouting foundations, contact grouting, grouting of contraction joints in dam, curtain grouting, and grouting of cooling systems. No payment will be made for cement used in finishing; cement used in wasted concrete; cement used in the replacement of damaged or defective concrete; cement used in extra concrete required as a result of careless excavation; cement used in concrete placed by the Contractor in excavation intentionally performed by the Contractor to facilitate his operations; and cement used for grouting rock bolts, anchor bars, anchor bolts, and mortar underneath equipment or the like and for contact grouting. No separate payment will be made for cement used in gunite.

e. Cooling.

(1) Refrigeration Equipment. Payment for furnishing, maintaining and removing of the refrigeration equipment will be made at the lump sum price bid in the Proposal for "Furnishing and Installing Refrigeration Plant". Operation of the refrigeration plant will be paid for on an 8-hour shift basis. The unit price per shift shall include all cost to the Contractor for starting up, running, and closing down the plant. A portion of a shift will be considered as a full shift for payment purposes.

(2) Pipe and Tubing. Measurement for payment for furnishing and placing metal pipe or tubing and fittings for concrete cooling systems will be made along the centerlines of the pipe or tubing, from end to end of the pipe or tubing in place, and only for that pipe or tubing which is permanently embedded in the concrete as directed by the Engineer. Payment will be made at the unit price per linear foot bid for "Furnishing and Installing Pipe and Tubing for Concrete Cooling Systems", which unit price shall include the entire cost of furnishing all labor, equipment, and materials as described in this paragraph; of loading, hauling, unloading, storing, handling, and placing the pipe or tubing and fittings; or protecting the pipe or tubing from injury and clogging; of testing the cooling systems under pressure; and of furnishing all temporary fittings for surface connections and removing the nipples in the surface of the concrete and filling, with dry pack, the holes left by the removal of the nipples. All nipples used as surface connections and removed by the Contractor as provided herein shall remain the property of the Contractor.

(3) Thermocouples. Measurement for payment for installing thermocouples will be the lengths of extension wire embedded in concrete plus six (6) feet, as directed by the Engineer. Additional lengths outside the face of the dam or in the galleries will be installed on a force account basis. Payment for embedded thermocouple wire plus six feet will be made at the unit price per linear foot bid for "Installing Thermocouples", which unit price shall include the cost of performing all work described herein.

(4) Cooling Concrete. Measurement for payment for cooling concrete will include all concrete in the respective concrete lift within each block which the Engineer directed to be cooled and which was actually cooled by circulating water through embedded pipes. Payment for cooling concrete will be made at the unit price per cubic yard bid therefor in the Proposal. Payment for cooling concrete will be made only once regardless of the requirement for subsequent cooling as specified in this section. The unit price for "Cooling Concrete" will be deemed to reimburse the Contractor for all cost of cooling the respective portion of the dam, including furnishing, installing, insulating and removing the cooling water headers, distribution lines and temporary facilities, but excluding the cost for furnishing, installing, operation, and removal of the refrigeration plant, furnishing and installing the permanent pipe and tubing and installing the thermocouples.

f. Gunite and Vermiculite Lining.

(1) Gunite Plant. Payment for furnishing, maintaining and removing the gunite plant from the site will be made at the lump sum price bid in the Proposal for "Furnishing and Maintaining Gunite Plant".

(2) Gunite and Vermiculite Lining. Gunite or vermiculite lining will be measured for payment on the basis of the number of bags of cement (94 pounds) actually incorporated in gunite or vermiculite lining. One bag of cement will be considered, for payment purposes only, to be equivalent to one cubic foot of gunite or vermiculite lining. Payment will be made at the unit price per cubic foot bid. This payment will include the cost of furnishing all material and labor for preparing and cleaning surfaces, placing and curing the gunite or vermiculite lining including the cost of furnishing, storing, and handling sand, aggregate and cement.

g. Floor Hardeners. Measurement for payment for furnishing and applying two coat concrete floor hardener will be the number of square yards of concrete floors on which two coats of liquid floor hardener is applied. Payment will be made at the unit price per square yard bid for "Furnishing and Applying Floor Hardener".

h. Reinforcement Steel, Wire Fabric and Wire Mesh. The amount of reinforcement steel bars to be paid for will be computed on the basis of the nominal weights of the various sizes placed, as shown on the drawings or as directed.

The amount of welded wire fabric to be paid for will be computed on the basis of the nominal weight per square foot of fabric. The weight of supports, spacers, ties, anchors, waste due to cutting, and material placed and splices made for the Contractor's convenience will not be included.

The amount of chain wire mesh to be paid for will be the surface area actually covered by chain wire mesh.

Payment for reinforcement steel and welded wire fabric will be made at the unit price per pound bid for "Furnishing and Installing Reinforcement Steel and Welded Wire Fabric". Payment for chain wire mesh will be made at the unit price per square foot bid for "Furnishing and Installing Chain Wire Mesh", which will constitute full compensation to the Contractor for all labor, material and equipment required to install the chain wire mesh, including additional steel plates and nuts on rock bolts, Ramsets and spikes.

i. Post Tension Cables. Measurement for payment of post tension cables will be the length of cables, measured from end to end, including sockets, installed in the works as specified. Payment will be made at the unit price per linear foot bid for "Furnishing and Installing Post Tension Cables".

SECTION 10

METALWORK

1. GENERAL

The work covered by this section of the specifications consists of furnishing all plant, labor, equipment and material required to furnish and install, or install only, the following:

a. Steel liners for the sluice openings in the dam.

b. Closure gate for the diversion tunnel.

c. Trashracks and guides for the forebay.

d. Penstock steel liners.

e. Corrugated arch ceiling in machine hall.

f. Crane runway structural steel in machine hall.

g. Expansion anchors.

h. Metal inserts, pipe hangers and supports.

i. Rails for trash rake, draft tube gantry and sluice maintenance gate operator.

j. Miscellaneous metalwork, such as hatch covers, gratings, handrails, ladders, stairs, platforms and monorails.

Erection in the field will be by bolting and arc welding, or by any approved combination of these, and the Contractor shall be prepared to perform both classes of work. The items furnished by the Contractor shall be complete, with all parts of good materials and accurate workmanship, skillfully fitted, and properly connected and assembled. All work, materials, and services not expressly called for in the specifications or shown on the drawings, but which are necessary for proper erection, shall be performed and furnished by the Contractor at no increase in cost to the City. All parts of all material shall be assembled accurately and erected as shown on the drawings or as directed, and all match-marks of the manufacturer shall be followed carefully. Members shall not be overstressed during erection, and hammering that will injure or distort the members will not be permitted. Cutting of members with a cutting torch will not be permitted unless approved.

Bearing surfaces and surfaces to be in permanent contact shall be cleaned thoroughly before the members are assembled or erected. In bolted connections,

the bolts shall be drawn tight and where required, the threads shall be burred so that nuts cannot become loosened, or the nuts shall be tackwelded to the bolts.

Except as otherwise provided herein, the design, fabrication and erection shall be in accordance with the applicable provisions of the latest edition of "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.

Materials incorporated into the work shall be new and of the most suitable grade of their respective kinds for the purpose used and shall be furnished in accordance with the current edition of the applicable ASTM Designation.

2. MATERIAL

Except as specified in the following paragraphs of this Section, all materials shall conform to the following specifications:

a. Penstock Steel. Plate steel for the penstock shall be ASTM, A 201, grade B, (modified). The steel shall also meet the following additional requirements:

(1) The steel shall be fully killed and made to fine grain melting practice.

(2) The steel shall be furnished in the normalized or normalized and tempered heat treated condition.

Mill certificates showing the results of chemical analysis and physical tests are required for all plate steel supplied under these specifications and shall be furnished to the Engineer in quadruplicate before any fabrication work on the plates is done.

b. Structural Steel. Steel plates, shapes and bars for welded structural parts shall conform to the requirements of ASTM Designation A-36. Mill certificates showing results of chemical analysis and physical tests for plate steel to be supplied for the sluice liners in the dam shall be furnished in quadruplicate to the Engineer for approval prior to beginning fabrication.

c. Track Rails shall conform to the requirements of ASTM Designation A1.

d. Bolts. High strength structural bolts shall conform to the requirements of ASTM Designation A 325 and standard bolts to the requirements of ASTM Designation A 307, Grade A.

e. Pipe. Except as otherwise specified herein, pipe for structural use shall be standard weight, black steel pipe conforming to the requirements of

ASTM Designation A53 or A139, Grade A.

f. Floor gratings shall be of the type and sizes shown on the drawings and shall comply with the standard design procedures and specifications of the Metal Grating Institute, Pittsburgh, Pa.

3. FABRICATION

Plate steel fabrication of the penstocks and sluice liners shall conform to the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, "Rules for Construction of Unfired Pressure Vessels" current edition, except that in case of any conflict between the code provisions and these specifications or approved drawings, the specifications shall govern. However, the Contractor will not be required to stamp any part of this work with the official code symbol.

Structural steel fabrication other than for the penstocks shall conform to the requirements of the current edition, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

The Contractor shall be responsible for the proper detail dimensions affecting fabrication. All dimensions not specifically shown on the drawings or called for elsewhere in these specifications shall be at the option of the Contractor, subject to the approval of the Engineer.

4. WELDING, GENERAL

a. Welding Processes. All welding shall be performed by the shielded metal-arc process with coated electrodes for manual welding or the submerged arc process for automatic welding.

b. Manual Welding. All low hydrogen electrodes shall be purchased in sealed containers and shall be thoroughly dry when used. Electrodes taken from sealed containers shall be used within four (4) hours. Electrodes not used within this time limit shall be stored in electrode storage ovens equipped with temperature controls. Electrode storage oven temperatures shall be in accordance with the electrode manufacturer's recommendations. Electrodes that have wet or damaged coatings shall not be used.

c. Automatic Welding. All submerged arc welding of longitudinal seams shall be made using starting and stopping tabs.

Individual submerged arc weld beads shall not exceed 3/8 inch in thickness for joining materials less than 1-1/4 inches thick and shall not exceed 1/2 inch in thickness for joining materials 1-1/4 inches and greater in thickness.

d. Preheat and Interpass Temperature. A preheat and interpass temperature of 150°F. minimum shall be used when any one of the following conditions exist:

(1) When the ambient temperature is below 40°F.

(2) When the base metal thickness to be welded exceeds one inch.

(3) When the specified minimum tensile strength of the material to be welded is 65,000 psi or greater.

(4) When the specified minimum carbon content of the material to be welded exceeds 0.30 percent.

(5) When the surfaces to be welded contain moisture.

e. Workmanship and Visual Quality Requirements. In addition to conformance with the procedural and quality requirements set forth in the applicable code and/or the specifications, all manual welding shall meet the following requirements for workmanship and visual quality:

(1) Each weld shall be uniform in width and size throughout its full length and each layer of welding shall be smooth, free of slag, cracks, pinholes and undercut, and shall be completely fused to the adjacent weld beads and base metal. In addition, the cover pass shall be free of coarse ripples, irregular surface, non-uniform head pattern, high crown, deep ridges or valleys between beads, and shall blend smoothly and gradually into the surface of the base metal.

(2) Butt welds shall be slightly convex of uniform height, and shall have full penetration.

(3) Fillet welds shall be of specified size, with full throat and with legs of uniform length.

(4) Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

f. Repairs. All unacceptable weld defects shall be removed by chipping, grinding, arc or flame gouging following which the area shall be properly prepared for welding and repaired by a qualified welding procedure approved by the Engineer. The Contractor shall establish the cause of all defects and show that the situation has been corrected before further welding will be permitted. No additional payment shall be made for making any repairs.

g. Peening. The Contractor shall not be allowed to peen welds without the prior approval of the Engineer.

h. Electrodes. Unless otherwise approved by the Engineer electrodes for manual welding shall not exceed 5/32" diameter for out-of-position (other than the flat, 1G position), and shall not exceed 3/16" diameter for work in the flat, 1G position. Furthermore, the maximum width of any bead of welding, other than a cover pass, shall not exceed three times the diameter of the electrode being used.

i. Edge Preparation. The surfaces to be welded shall be free from rust, grease, paint and other foreign matter for a distance of at least six inches back from the edge of the weld.

j. Grinding Wheels. Grinding wheels which leave a deposit detrimental to subsequent welding shall not be permitted. The Engineer reserves the right to disapprove the use of any grinding wheels which in his opinion are detrimental to welding.

5. WELDING OF PENSTOCK AND SLUICE LINERS

a. General. When welding the penstock and sluice liner, the Contractor shall perform such welding as possible in the shop. For the purpose of this specification the Contractor's shop will be defined as a permanent shop at the manufacturer's plant or a temporary shop with the respective equipment erected at the project site.

The penstock steel liner sections shall be partially shop fabricated at the Contractor's permanent shop facilities. Completion of fabrication of the individual penstock liner sections shall be made at the Contractor's temporary jobsite fabrication facilities. All longitudinal welds shall be made outside of the tunnel prior to final installation. Wherever possible, the individual penstock liner sections shall be joined outside of the tunnel into the longest lengths compatible with installation requirements. All girth welds completed outside of the tunnel, and wherever possible girth welds made inside the tunnel shall be welded from both sides without the use of backing strips. Backing strips are not permitted for longitudinal welds. Backing strips, where required for girth welds made inside the tunnel, shall be as specified on the drawings.

Alignment of the penstocks during installation must be maintained within the tolerances shown on the drawings or stated in the specifications. In this regard particular care shall be taken during welding of the girth joints, to avoid undue distortion and unless otherwise approved by the Engineer no more than two girth joints shall be welded at any one time. Furthermore, welding of each girth joint shall be done in such a manner as to balance welding stresses and equalize distortion by employing four welders, one working in each quadrant, to weld each girth joint, unless otherwise approved by the Engineer.

All welding for penstock and sluice liners shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, except as modified by these specifications. The Contractor shall be held responsible for the design and

5. Welding of Penstock and Sluice Liners - Continued

quality of the work performed by his welding organization and shall conduct tests of the welding procedures to determine the suitability of a given procedure; and the ability of each welder and welding operator to properly apply the procedure and otherwise perform in a manner that assures finished work of specified or desired quality.

b. Welding Processes and Procedures. All welding shall be performed by the shielded metal-arc process using low-hydrogen type electrodes for manual welding or the submerged-arc process for automatic welding.

c. Qualification of Welding Procedure. All welding procedures used in fabrication and installation of the penstocks and sluice liners shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. The procedure qualification shall contain full information on all the factors set forth in the Recommended Form O-1 of Appendix II, Section IX of the ASME Boiler and Pressure Vessel Code.

In addition to the ASME Code requirements for welding procedures the Contractor shall be required to submit a detailed procedure of the proposed sequence of welding the girth joints in the penstocks and sluice liners.

Six copies of the Qualification of Welding Procedures and welding sequence procedures shall be submitted to the Engineer for approval. The Engineer shall have the right to require any changes he deems necessary to make the Contractor's welding procedure conform with the requirements and intent of these specifications without additional cost to the City. No welding shall be done prior to approval of the Contractor's welding procedure.

d. Qualification of Welders. All welders shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code following the same procedure established in the welding procedure qualification. Regardless of what prior qualifications a welder may have, qualification in the presence of the Engineer or his authorized representative is required for welders who perform work under this specification. All welder qualification test coupons shall become the property of the City. The Engineer reserves the right to require the requalification, at the Contractor's expense, of any welder whose work appears questionable.

e. Radiographic Examinations. All longitudinal and girth welds in the penstock shall be 100% radiographically examined.

Radiographic examination shall comply with Section VIII of the ASME Boiler and Pressure Vessel Code and shall meet the technique and acceptance standards of Paragraph UW-51 of Section VIII of the ASME Code and the following additional requirements:

(1) The radiographic film shall be a fine-grain high-contrast type equivalent to Eastman Kodak AA.

(2) Weld surfaces shall be ground, when required, so that surface irregularities will not interfere with radiographic interpretation.

(3) Exposure density over the interpretable length of the film shall be within the range of 1.75 to 2.50 as determined either by film density specimen or by densitometer.

(4) All radiography shall be performed with lead screens.

(5) All radiography shall be performed by an experienced radiographic technician fully capable of meeting the requirements of this specification.

(6) The Contractor shall furnish complete facilities for processing, viewing and storing of film.

(7) Unless otherwise approved by the Engineer, the Contractor shall not be permitted to weld more than 2 girth welds prior to radiographing preceding welded joints.

(8) Unless otherwise approved by the Engineer, the Contractor shall not be permitted to weld more than 5 joints prior to repairing and re-radiographing preceding weld joints with defects disclosed by radiography.

The Engineer reserves the right to make the final interpretation of the radiographs. All unacceptable defects disclosed by radiography shall be repaired in accordance with the requirements of this specification and re-radiographed. All radiography shall be at the Contractor's expense.

All radiographs, and 5 copies of a diagramatic sketch showing radiograph locations shall be delivered to the City and shall become the City's permanent property.

f. Thermal Stress Relieving. Stress relieving of welded joints is not required.

g. Additional Tests and Examinations. Additional tests and examinations may be required at the discretion of the Engineer where there is doubt as to the adequacy of a part. The City will pay for the additional examination if the part is found to be adequate; however, the Contractor shall pay for the additional examinations and required repairs, if the part is inadequate.

6. WELDING OF STRUCTURAL STEEL AND METALWORK

a. General. All welding of structural steel shall be in conformance with AWS D2.0-63, "Standard Specification for Welded Highway and Railway Bridges", except as modified by the special requirements of Paragraph 4 and the general

requirements listed below:

(1) Materials to be welded shall be as specified on the drawings.

(2) Low-hydrogen electrodes shall be used for full penetration groove welds in plate thickness over one inch.

(3) Members of structural steel and metalwork which are to be jointed by welding, shall be cut accurately to size, and where required, shall be rolled or pressed to the proper curvature in accordance with dimensions shown on the drawings. The edges of these members shall be sheared, flame-cut or machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal free from laminations, surface defects caused by shearing or flame-cutting operations, or other injurious defects.

(4) The surfaces of plates to be welded shall be free from rust, grease, and other foreign matter for a distance of at least six inches back from the edge of the weld.

b. Qualification of Welders and Welding Operators. All welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified in Appendix D of AWS D2.0-63. If, as determined by the Engineer, the work of any welder appears questionable, such welder will be required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Such additional qualification tests for welders and the physical tests of the welded specimens shall be made in the presence of the Engineer. If required, the Contractor shall furnish to the Engineer a certified copy of reports of the results of physical tests of specimens welded in the qualification tests. All expense in connection with making the qualification tests for welders and welding operators shall be borne by the Contractor.

7. PROTECTIVE COATINGS

a. Shop Painting. Unless otherwise specified, all structural steel and miscellaneous metalwork, except surfaces in contact with or embedded in concrete, shall be shop coated with red lead primer, applied thoroughly and evenly to dry surfaces which have been cleaned by flame or wire brush of loose mill scale, dirt, rust, grease, weld slag and other foreign matter. Metal primer shall be applied by brush or spray and shall be applied the same day that the surfaces are cleaned. The dry film thickness of the metal primer shall be at least 1.5 mils. Surfaces subject to field welding shall be left unpainted for six inches on either side of the joint. Red lead primer shall conform to Federal Specification TT-P-86, Type II or approved equal.

b. Galvanizing. Metalwork specified to be galvanized shall be thoroughly cleaned by effective means of all loose mill scale, rust spatter, slag and flux

deposit, oil, dirt and other foreign matter. It shall be zinc coated after fabrication by the hot-dip galvanizing process in conformance with ASTM Designation A 123 and coating shall not be lighter than 2.0 ounces per square foot of surface, except as otherwise specified, provided that all nuts, bolts, washers and miscellaneous items shall be galvanized in accordance with ASTM Designation A 153. All threads and holes shall be free from excess spelter after galvanizing. Cold bending of any section or member after galvanizing will not be permitted.

All Shop welds on material to be galvanized shall be sandblasted or acid treated prior to galvanizing. All handrails and pipe sleeves exposed to weather shall be galvanized after fabrication in accordance with ASTM Designation A 386.

c. Field Painting. All field painting shall be as specified in Section 20.

8. SLUICE LINERS

All items shown on Drawings Nos. D-23097 and D-23098 shall be included in the item "Furnishing and Installing Sluice Liners". The Contractor shall install the liners in the dam with the aid of piers, jacks and anchors similar to the procedure as shown on the drawings for the draft tube liners and spiral cases. The requirement for penstock steel liners under Paragraph 11 for machine work and finishing, shop inspection, marking and installation shall also apply for the sluice liners. After the concrete around the sluice liners has hardened sufficiently the Contractor shall grout behind the liners as described in Section 8.

9. DIVERSION CLOSURE GATE

All items shown on Drawing No. D-23132 including anchor bolts, guides and other embedded metalwork shall be included in the item "Furnishing and Installing Diversion Closure Gate". After fabrication, the gate shall receive one coat of red lead primer.

10. TRASHRACKS AND GUIDES

The City will contract to have the trashrack panels, guides and appurtenances furnished and delivered to the project site. The Contractor shall install the trashrack guides and trashrack panels as shown on the drawings and shall furnish and install all other metalwork required to be installed in the trashrack structure. The items to be included in "Installing Trashracks and Guides" are shown on Drawing No. D-23141.

11. PENSTOCK STEEL LINERS

a. General. All items shown on Drawing No. D-23148 shall be included in "Furnishing and Installing Penstock Steel Liners."

b. Machine Work and Finishing. The machine tools used by the Contractor for performing the various machine operations shall be of the proper type and of ample capacity for the work to be done, and shall be capable of producing such accuracy that specified tolerances are observed at all times. The use of inadequate or inaccurate equipment and tools shall not be permitted. Machine finishing shall be done in accordance with the best modern shop practice. The quality of the finish, where not specified, shall be the most suitable for the part to which it applies.

c. Fits and Tolerances.

(1) Except as otherwise noted, all fits and tolerances shall conform to the American Standard Tolerances, Allowances and Gauges for Metal Fits (ASA Standard B 4.1).

(2) In general, out-of-roundness or ovaling as measured by the difference between the maximum and minimum diameters shall not exceed 1-1/2 inches. The inside circumference of the steel liner shall not be more than 3/16 inch larger nor 3/16 inch smaller than the circumference computed from the specified inside diameter. The out-of-roundness shall have the form of a smooth oval that can be field corrected.

(3) The steel liner circumference for a distance of 18 inches from the end of the steel liner length adjacent to the spiral case, where a coupling is required shall not be more than 1/4 of an inch larger or 1/16 of an inch smaller than the computed circumference based on the specified outside diameter. The outside surface of the steel liner shall be free from defects that would prevent a tight joint with the rubber gasket and all out-of-roundness shall have the form of a smooth oval that can be field corrected. The maximum out-of-roundness as determined by the difference between the maximum and the minimum diameter shall not exceed 3/16 of an inch.

(4) Measured dimensions shall be corrected to 70°F for comparison with specified tolerances.

(5) The edges of the longitudinal joints of adjoining plates within each course shall be in continuity on the inside surface within a maximum permissible offset of 1/16 inch.

(6) The edges of girth joints of adjoining courses shall be in continuity on the inside surface of the plates within a maximum permissible offset of 1/16 inch.

(7) Longitudinal welds of adjacent plate courses and at field joints shall be staggered a minimum of 45 degrees.

(8) Ends of adjacent sections shall be in a common plane normal to a vertical plane through the penstock centerline.

(9) Welds on the inside of the steel liner shall have a reasonably uniform crown not to exceed 1/16 inch. Welds on external surfaces of the steel liner may project a maximum of 3/32 inch, except near the coupling where they are to be ground smooth for a distance of 18 inches from the end of the steel liner section.

d. Shop Inspection. All shop and field work shall be subject to inspection by the Engineer. Acceptance of the work or the waiving of the inspection shall in no way relieve the Contractor of his responsibility of meeting the requirements of these specifications.

e. Marking. Each part designated on the drawings shall be legibly and durably marked in a conspicuous place with an appropriate number of mark as approved. The vertical and horizontal centerlines shall be marked on the inside of each end of each steel liner section. The direction of flow shall be clearly marked on each steel liner section. The Contractor shall supply the Engineer with an erection diagram.

f. Installation.

(1) Program. The Contractor shall submit to the Engineer for approval within sixty (60) calendar days after notice to proceed, a fabrication program and installation procedure for the steel liner in accordance with the conditions for the overall construction program as specified in Paragraph 1A-7 and with the conditions specified hereunder. Approval of the Contractor's installation procedure shall in no way relieve the Contractor of his responsibility for the safety and adequacy of his procedures, however, the Engineer shall have the right to make any changes he deems necessary to make the Contractor's procedure and installation sequence conform with the requirements and intent of these specifications without additional cost to the City.

(2) Installation Aids. The Contractor shall furnish all materials and equipment required for the installation of the steel liners such as rails, spiders, hoists, lugs, scaffolding and details of such equipment shall be included in the installation procedure to be submitted.

(3) Lifting Lugs and Attachments. Welding of lifting lugs, dogs, fit-up clips and other attachments for the Contractor's convenience in handling, transporting and fit-up of the penstock and sluice liner sections shall be welded in accordance with a qualified and approved welding procedure as required in Paragraph 5c. These attachments shall not be removed without prior approval by the Engineer.

When required by the Engineer, attachments shall be removed by carbon-arc or oxyacetylene cutting. Breaking off of attachments is prohibited. Any gouging of the base metal when removing attachments shall be repaired in accordance with Paragraph 4f and the surface finish of the plates shall be restored by grinding to its original condition.

(4) Temporary Supports. The Contractor shall furnish and install all temporary supports, jacks and shims where required to adequately support and position the steel liner sections during erection and concreting. Temporary supports shall be designed to resist all forces resulting from installation and concreting and shall maintain the sections in circularity within the tolerances for out-of-roundness. Timber supports shall not be used where they will be embedded in concrete. All temporary supports not embedded in concrete shall be removed after the steel liner and penstock installation has been completed.

g. Inspection Car. The Contractor shall design and furnish a vehicle which he may use for welding the sections of the steel liner, for grouting behind the penstock lining and for applying the protective coatings, which the Engineer will use for inspection of the completed penstock installation including checking of the effectiveness of grouting operations and for future maintenance work.

This car shall be equipped with rubber tired wheels, so that the protective coating on the interior of the penstock steel is not damaged. The car shall be operated by a portable winch located on the tunnel invert in vicinity and downstream of the intake gate slots. Adjustable platforms shall be provided on the inspection car so that all parts of the concrete and steel lining of the penstock between the vent shaft at the gate slot and the spiral case inlet are within reach of an inspector standing on a platform. The car shall be designed so that it can be disassembled in the space downstream of the intake gate slot and be removed through the vent shaft downstream of the gate slot. The car shall be designed to safely support equipment for manual welding, grouting and interior coating of the steel liner in place.

The Contractor shall also design, fabricate and install adequate permanent anchorages for the winch and the inspection car and shall also supply a hoist suitable for operating the car under load for the total length of the penstock between vent shaft and spiral case inlet.

Before commencing fabrication the Contractor shall submit to the Engineer for his review and exceptions, if any, drawings showing the car, winch and appurtenances.

After the completion of all work for the penstocks, the inspection car and winch shall become the property of the City. The Contractor shall disassemble the car and store it at a place in the vicinity of the works as directed by the Engineer.

h. Hydrostatic Test. The Engineer may perform a hydrostatic test on the completed steel liner within twelve months after installation has been completed. The installation will be subjected to the maximum design pressures. The Contractor may witness the test if he so desires. If the hydrostatic test discloses that any work performed by the Contractor is defective, the defective work shall be immediately corrected by and at the expense of the Contractor.

12. CORRUGATED ARCH CEILING

a. General. The item of the Proposal for furnishing and installing the corrugated arch ceiling includes furnishing and installing all items shown on Drawings No. D-23224 through No. D-23228, except as modified by subparagraph 17b below.

b. Materials.

(1) Metal Ceiling. The metal ceiling shall be corrugated and curved galvanized steel panels of not lighter than No. 12 United States Standard gage sheet steel and shall be equal to Wonder Building arch panels as developed by Wonder Building Corporation of America, 30 North LaSalle Street, Chicago 2, Illinois. Panels shall be hot-dip galvanized and the zinc coating shall be not less than 2.50 ounces per square foot in accordance with ASTM Designation A 446. Arch curvature dimensions and properties of the panel cross section shall be in accordance with the drawings.

(2) Washers. All beveled washers shall be malleable iron or steel washers. Washers for high-strength bearing bolts and high-strength bolts shall be in accordance with ASTM Designation A 325-61T. All other washers shall be standard steel or wrought iron washers.

(3) Studbolts. Studbolts shall be of standard commercial quality and shall be flux filled for end welding with automatic end-welding guns.

(4) Galvanized Sheet Steel. Galvanized sheet steel shall be in accordance with ASTM Designation A 446, Grade A.

(5) Calking Compound. Calking compound shall have a light skin when applied, shall not sag or slip under heat or vibration, shall have low shrinkage, shall not dry out, and shall be suitable for application at temperatures as low as 28°F. Calking compound shall be equal to JS-745 calking compound as manufactured by Tremco Manufacturing Company, 10701 Shaker Boulevard, Cleveland, Ohio.

c. Fabrication and Erection. Fabrication of the supporting structural steel shall be in accordance with the applicable provisions of Paragraph 3 of this section. All supporting structural steel work shall be galvanized in accordance with Paragraph 7.b. Fabrication of the metal ceiling shall be equal to the best modern practice in the manufacture and fabrication of the type of materials covered by the drawings and these specifications. Fabrication of the metal ceiling shall be in accordance with the approved drawings submitted for approval prior to starting of fabrication, and the applicable provisions of the "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction. All side joints shall be interlocked and all end joints shall be lapped. All joints shall be watertight. Calking materials, closures, or gaskets shall be shown on the erection drawings and shall be subject to approval by the Engineer. Adequate provisions shall be made by the Contractor to insure watertightness at all openings in the metal ceiling. Bolts for fastening panels together shall be not less than 1/2 inch in diameter, shall have hexagonal heads and nuts, and shall have two metal backed neoprene washers. All bolts shall be installed with heads on the underside of the arch ceiling. Sheet metal gutters, closure panels, downspouts, hangers, and supports shall be fabricated and installed as shown on the drawings in a substantial, workmanlike and neat manner.

Where rockbolts installed under other items of these specifications are utilized for erecting supporting steel, the Contractor may remove bearing plates and washers as required and shall erect steel as shown on the drawings. Where the existing rock face at the location of the arch ceiling support is over-excavated more than three inches beyond payline, gunite, properly reinforced and anchored to the rock face, shall be applied to provide a uniform base for attachment of the ceiling support brackets.

The Contractor shall furnish and install temporary supports as required to permit erection of the corrugated arch ceiling prior to the construction of concrete structures in the machine hall and adjacent tunnels. These temporary supports shall be of steel where they will be embedded in concrete during erection of structures. All other temporary supports shall be removed when no longer required. An existing walkway has been installed by others as shown on Drawing D-23185. The Contractor shall modify the existing walkway, and shall furnish and install the access ramp and the ladder to the existing walkway as part of the work for furnishing and installing the arch ceiling.

d. Erection Procedure. Within sixty days after receipt of notice to proceed, the Contractor shall submit to the Engineer for his review and exceptions, detail drawings and erection procedures for the corrugated arch ceiling.

12. Corrugated Arch Ceiling - Continued

e. Protective Coating. The upper side of the ceiling shall receive additional protective coating as specified in Section 20.

f. Monorail. The monorail installed at the arched rock of the roof by others shall be removed by the Contractor and the rockbolts shall be cut off where required for proper installation of the corrugated arch ceiling. The monorail and other salvaged material shall be stored in the vicinity of the works as directed by the Engineer.

13. CRANE RUNWAY

The City will furnish the structural steel framing and accessories for the crane runway in the machine hall. The structural steel consists of base plates, columns, crane girders, bridge crane rails, resilient fabric pad and washers, and miscellaneous items as shown on Drawings Nos. D-23229 and D-23230. The Contractor shall furnish and install anchor bars and rockbolts, and shall erect the framing as shown on the drawings. Corrections of minor misfits and a reasonable amount of reaming and cutting of excess material shall be considered a legitimate part of erection. All field-welded connections shall develop the full strength of the member.

14. EXPANSION ANCHORS, METAL INSERTS, AND PIPE HANGERS

The Contractor shall furnish and install expansion anchors and slotted metal inserts as shown on the drawings or as directed by the Engineer. Unless otherwise specified on the drawings, expansion anchors shall consist of lead and metal-alloy units and shall be equal to expansion anchors manufactured by the National Lead Company, the Star Expansion Bolt Company or the Arro Expansion Bolt Company.

Unless otherwise shown on the drawings, slotted metal inserts shall be made of black pressed steel suitable for 3/4 inch square head bolts and shall be capable of carrying 3,000 pounds per linear foot in 2,500 pound concrete. They shall be provided with end caps at each end and rigidly attached anchors spaced at about 6-inch centers and of sufficient length to extend about 4 inches into the concrete from the back face of the inserts. Provisions for inserting bolts into the slot shall be made at one end.

All pipe hangers, pipe supports, and pipe inserts, including anchors, bolts and nuts, shall be furnished and installed by the Contractor in the location indicated on the drawings or as directed by the Engineer. Additional supports or hangers that are not shown on the drawings shall be furnished and installed whenever necessary to adequately support the piping.

15. RAILS

The Contractor shall furnish and install the rails for the trash rake, the rails for the draft tube gate gantry and the rails for the maintenance gate operator in the dam, including splice bars, and anchor bolts. The rails for the bridge crane

15. RAILS - Continued

in the machine hall will be furnished by the City and shall be installed by the Contractor together with the crane runway steel. The Contractor shall take special care to insure that the gauge is maintained accurately and that the rails are level, at the correct elevation, and are anchored firmly in place before and during placement of concrete.

16. MISCELLANEOUS METALWORK

a. Installation of Miscellaneous Metalwork. The City will furnish to the Contractor various items of embedded metalwork which shall be installed by the Contractor. This metalwork consists of generator anchor bolts; rotor pedestal plate and anchor bolts; and anchor bolts, embedded frames and leveling devices for auxiliary electrical and mechanical equipment to be installed by others.

b. Furnishing and Installing Miscellaneous Metalwork. This item of work will comprise metalwork involving only minor fabrication, such as scroll case jacking plates (40 required), draft tube jacking plates (96 required), transformer leveling beams (8 required), parapet beams - main floor in machine hall, stair safety treads, as well as items involving more fabrication. This item of work will include the following:

(1) All items shown on Drawing Nos. D-23231, D-23232, D-23233 (except for draft tube gate hoist rails and accessories, and trashrack structure hoist rails and accessories), D-23234, D-23235, D-23236, D-23237, D-23113, D-23114, and D-23099. Typical details are shown in the above drawings for hatch covers, ladders, handrail and similar items. The Contractor will be required to furnish several such items to suit the individual requirements.

(2) All metalwork items shown on Drawing Nos. D-23100 and D-23101, and cover plates for contraction joints on Drawing No. D-23102.

(3) The following items shown on general arrangement and other general drawings:

(a) Perforated flow plate in diversion tunnel.

(b) Dished head, frame and anchor bolts at mucking tunnel plug.

(c) Roof hatch in valve house at dam.

(d) Grating platforms in pipe ducts, sumps and gate chambers.

(e) Rotor erection plate.

(f) Drainage gallery gratings at future units.

(g) Spiral stair and ladder in Access to exploratory tunnel and ceiling.

(h) Sliding bearing plates for prestressed dam access bridge.

(i) Drainage sump frames and gratings.

(j) Frames and covers for recesses and blockouts through walls and floors.

(k) Sheet metal form for cable duct in wall at unit 51.

(l) Lead bearing plates for trashrack structure prestressed bridge beams.

(m) Hook eyes, she-bolts, and similar items for erection and servicing of equipment.

(4) Items of metalwork similar to items under (1), (2), and (3), above, not called for or shown on the drawings but required for the completion of work under this Contract.

The Contractor will be furnished with drawings similar to those listed in (1) above, showing details of all metalwork to be furnished and installed. Any additional details or shop drawings required for the fabrication of these items will be the sole responsibility of the Contractor and the cost of this work shall be included in the unit price per pound bid for "Furnishing and Installing Miscellaneous Metalwork".

c. Installation of Embedded Metalwork - General. Metalwork to be embedded in concrete shall be installed prior to placement of concrete; except that where shown on the drawings or as directed by the Engineer, recesses or blockouts shall be provided in the concrete and the metalwork shall be subsequently grouted or concreted therein. Anchor bolts shall be in position when the concrete is placed, unless otherwise directed. When it is impractical to place anchor bolts required for the installation of ladders, handrails, louvers or other comparatively light metal accessories, holes shall be drilled in the concrete after the concrete has attained design strength, and expansion bolts or unit-type lead and iron expansion anchors shall be set. Expansion anchors and installation procedure details shall be submitted for approval by the Engineer prior to installation. Metalwork to be embedded in concrete shall be placed accurately and shall be held in the correct position while the concrete is being placed. The surfaces of all metalwork to be in contact with concrete shall be cleaned thoroughly of all rust, dirt, grease, loose scale, grout, mortar and other foreign substances before the concrete is placed.

17. MEASUREMENT AND PAYMENT

a. Measurement. When payment is made at the unit price per pound bid for any item of the Proposal, the actual weight of each part or item will be determined by the Engineer in the most practicable manner, using scale weights if possible, shipping weights, manufacturer's weights, catalog weights and estimated weights based on actual dimensions without deduction of holes or addition of weld metal. The weight of all tare, packing and blocking will be deducted, using only net weights for payment quantities. The weight of all supports, hangers, anchors, blocking or bracing not shown on the drawings, but used to hold the miscellaneous items in position will not be included in the weight for payment.

Anchors, jacks, internal bracings, temporary supports and other erection aids required for the proper installation will not be measured for payment.

b. Payment. Payment for the various items of metalwork to be installed or furnished and installed except as specified hereinafter, will be made at the applicable lump sum or unit price bid in the Proposal.

All cost to the Contractor for furnishing and erecting the A-frames to support the diversion closure gate during lowering, the lowering device including the water tank, sheaves and cables shall be included in the item "Closure of River Diversion".

The cost to the Contractor for furnishing the penstock inspection car with winch and appurtenances shall be considered to be included in the lump sum price bid for "Furnishing Penstock Inspection Car".

Grouting between penstock steel liner and concrete will be paid as specified in Section 8. No separate payment will be made for grouting underneath sluice liners but the cost therefor will be considered to be included in the unit price per pound bid for "Furnishing and Installing Sluice Liners".

Furnishing and installing rockbolts, gunite and grouting if required, drain piping, pipe hangers, air conditioning duct and protective coating for the Corrugated Arch Ceiling will be paid under the applicable items of the Proposal. All other costs to the Contractor for furnishing and installing the complete arch ceiling including supports, brackets, frames, walkways, ladder, gutters, pipe enclosure, modifications to existing walkways, removal of the existing monorails and transporting to storage, shall be included in the lump sum price bid for "Furnishing and Installing Corrugated Arch Ceiling".

The installation of rockbolts and anchor bars, the construction of the concrete footings, and the application of gunite, if any, for the crane runway erection, will be paid under the applicable items in the Proposal. All other cost to the Contractor to complete the erection of the crane runway including installation of crane rail shall be included in the unit price per pound bid for "Installing Crane Runway Structural Steel".

Expansion anchors to be furnished and installed by the Contractor shall not be measured for payment but the cost for furnishing and installing the expansion anchors shall be included in the unit or lump sum price bid for furnishing and/or installing the respective item of metalwork or equipment.

Furnishing and installing metal inserts, pipe hangers and supports will be made at the applicable price per pound bid in the Proposal.

SECTION 11

METAL PIPE, VALVES AND FITTINGS

1. GENERAL

a. Scope. The work covered by this section of the specifications consists of furnishing all plant, labor, equipment and materials and performing all operations required in connection with installing, or furnishing and installing the piping as herein specified and/or shown on the drawings; but, does not include piping or special valves furnished by the City which are included for payment with special apparatus and machinery. Except as otherwise specified herein or shown on the drawings, the Contractor shall furnish all materials and accessories required for complete installation of the piping covered by this section of the specifications. The piping included in this section is both embedded and exposed piping, the installation of which is related to the construction of the dam, power plant and appurtenant structures. Where piping is identified with a piping system, the piping required may be a complete system or portions of a system as shown on the drawings.

b. Included Work. The work covered by this section of the specifications shall include, but not be limited to, the following:

(1) Dam Site.

Lines for Level Sensing Devices

Drain pipe and valves in inspection gallery

Drainage of roadway and bridges

Embedded grout piping

Embedded drain piping

Cooling piping

Piping for seal inflation

Piping for bubbler system

(2) Spillways

Drain pipe under spillway slabs

Piping for bubbler system

(3) Access Elevator at Dam

Drain pipe at sump

Drain pipe from El. 1815

(4) Sluice Gate Control Center

Drain pipe at dam access gallery portal

Vent pipe at control center

(5) Exploratory Tunnel

Drain pipe from cavity in side drift

(6) Forebay

Lines for Level Sensing Device

Drain pipe at foundation of trashrack structure

(7) Intakes & Penstocks

Drain pipe in access gallery

(8) Machine Hall

Penstock drains

Penstock Fill Line

Draft tube dewatering and balancing line with valves

Building drains into drainage gallery

Pipes and valves between lower sumps

Overflow from higher sump

Discharge lines from drainage pumps along draft tubes

Discharge lines from drainage pumps along bus ducts

Drain line from elevator pit

Drain line from sewage treatment system

Drain line from heating and ventilating equipment

Embedded piping to and from turbines

Embedded piping to and from generators

Embedded domestic water supply system piping

Embedded compressed air system piping

Embedded CO_2 system piping

Embedded plumbing lines

Embedded piezometer lines

Turbine vent lines

Sanitary vent lines

Sump vent lines

Pipe sleeves

Drain pipes from arched ceiling
Oil fill and drain lines for generator thrust and guide bearing, turbine bearing and governor actuator sump and servomotors.

(9) Draft Tubes & Transformer Bays

Drain lines from tunnel floors

Lines for Level Sensing Device

(10) Miscellaneous

Piping and valves at diversion tunnel plugs

Piping and valves through muck removal tunnel

Piping and valves into draft tube drainage gallery

c. Materials. The following standards and specifications form a part of these specifications:

American Society of Testing Materials

American Water Works Association

American Standard Association

American Welding Society

Any materials required which are not covered by detailed specifications herewith or elsewhere in these specifications and/or the drawings, shall conform to the applicable provisions of the above listed specifications. In cases where material is covered by two or more of the above listed specification groups, the highest grade or requirements of any of said specifications shall apply. In cases of conflict between any of the above listed specifications, the Engineer shall decide said conflict. In cases where material is not covered by one of the above listed specifications, the Contractor shall furnish the highest grade material or product available.

d. Welding. All welding shall be performed by the electric-arc method in accordance with the procedures as established by the ASA Piping Code B31.1 and all welding operators shall be duly qualified in accordance with said Code.

e. Embedded Piping. All embedded pipe lines shall be installed accurately in position, in accordance with the dimensions given on the drawings and shall be securely held in place while concrete is placed. All open ends and branch connections shall be furnished with pipe plugs, pipe caps or flange protectors. All such protective devices shall remain in place after completion of the work.

f. Testing.

(1) General. Whenever specified hereinafter, the parts of the piping systems shall be flushed and hydrostatically tested by the Contractor after installation to determine the tightness of joints and possible installation defects, and approved by the Engineer before such piping will be accepted. Joints and connections in piping shall be water, air or oil tight, as applicable. Any defects or leaks disclosed by tests shall be satisfactorily repaired by the Contractor. All equipment and devices required for conducting the tests shall be supplied by the Contractor. The Contractor shall notify the Engineer in sufficient time before starting any test to permit witnessing of the test by the Engineer. Unless otherwise specified herein the piping of each system shall be tested at a pressure not less than 150 percent of the normal working pressure. The pressure shall be held for a length of time sufficient to determine tightness, but in no case less than 15 minutes. Underground piping or piping to be encased in concrete shall be tested and approved before concrete is placed.

(2) Compressed Air Lines. Compressed air lines (except governor oil air systems) shall be tested in accordance with the ASA Code for Pressure Piping B31.1. The working pressure for the station air system is 125 psig.

(3) Cooling and Service Water Piping. Cooling and service water piping shall be tested with water under a pressure of not less than 150 percent of its maximum operating pressure but not less than 200 psi. Tests on the fire water lines shall be made in accordance with NBFU Pamphlet No. 14.

(4) Gauge and Piezometer Piping. Gauge and piezometer piping shall be tested with water under a pressure of 150 psi. Instrument air lines shall be tested at 150 percent of maximum operating pressure.

(5) Domestic Water System. Upon the completion of the roughing-in of the domestic water system, the entire hot and cold water piping systems shall be tested at a hydrostatic pressure of not less than 100 psi, and proved tight at this pressure for not less than thirty (30) minutes. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in the manner described for the entire system.

(6) Drainage and Vent System. The piping of the drainage and venting systems shall be tested with water or air. The water or air test shall be in accordance with Section 318, paragraph 2d of the Western Plumbing Officials Uniform Plumbing Code.

(7) Bubbler Systems. The piping for the bubbler systems shall be tested with air at 150 percent of maximum operating pressure.

(8) Lubricating Oil System. The piping for filling and draining the entire lubricating system for each unit shall be tested under a pressure of 150 psi for not less than one (1) hour.

(9) Level Sensing Device Lines. Shall be blown out with air and then tested under 100 psi for not less than one (1) hour.

2. WATER SYSTEMS

The Contractor shall furnish, install and test embedded portions of the cooling water supply, service water, fire and domestic water, penstock fill and drain lines, cooling water discharge and dewatering pump discharge lines as specified herein and as shown on the drawings.

a. Penstock Fill Line.

(1) General. The penstock fill line will extend from the upstream face

of the dam, as shown on Drawing D-23078, and D-23094, and will be entrenched and encased in concrete in the exploratory tunnel, as shown on Drawing D-23111. At the power plant as shown on Drawings D-23159 and D-23163, the line follows the excavation entering the power plant as shown on Drawing D-23154. Within the power plant, as shown on Drawing D-23329, the branch lines from the penstocks and the connecting lines from the main header for Units 51, 52, 53, and 54 will be daylighted within the draft tube access area, as shown on Drawings D-23323 and D-23324. The branch lines and connecting lines for the future units 55 and 56 will terminate with dished heads. A total of five mechanical type couplings shall be furnished and installed with the fill line. Location of the couplings shall be as directed by the Engineer.

(2) Material. The penstock fill line and all branch lines shall be fabricated from ASTM A-155 Grade C55-Firebox Quality Class 1, material with a minimum wall thickness of 3/8-inch.

(3) Welding. All welding of the penstock fill line and branch lines shall be in accordance with Section 10, Paragraphs 4 and 5 of this specification.

b. Spiral Case Drain Lines. The 14-inch diameter spiral case drain lines shall be installed as shown on Drawings D-23323, D-23324 and D-23329.

c. Make-Up Header. The 8-inch diameter service water make-up header will branch off the 36-inch penstock fill line at Unit 51, as shown on Drawings D-23323, D-23324, and D-23329. Provide blind flange at El. 1725.

d. Cooling Water Discharge. The cooling water discharge line will be embedded in the generator pedestal and the downstream power plant wall and will include exposed piping and valves between the pedestal and the discharge into the draft tube tunnel as shown on the drawings.

3. TAILRACE AND SUMP CONNECTING AND BALANCING LINES

The Contractor shall furnish and install the pipe, valves and fittings for connections from the draft tubes to the dewatering sump. All valves shall be complete with extension stems and watertight floor boxes.

4. VENT LINES

The Contractor shall furnish and install the following vent piping, fittings and appurtenances:

a. Turbine and Air Vents, comprising portions of the air vent lines to the draft tube gate shaft for the turbine, complete as specified and shown on the drawings.

b. Sanitary Vents, comprising portions of all vents required in the sanitary system and from the battery room and machine shop sinks.

c. Sump Vents, comprising embedded vent lines to the draft tube gate shaft, complete with flap valves as specified and shown on the drawings.

5. DRAIN SYSTEMS

The Contractor shall furnish and install the embedded portions of the following drain systems:

a. Drain Lines at Dam, comprising embedded and exposed pipe, pipe fittings and valves for the roadway and bridges, inspection gallery in dam, gate operating gallery in dam, the spillway slab and for the dam access gallery portal.

b. Drain Lines at Trashrack Structure and Intake, comprising embedded and exposed pipe, pipe fittings and valves for the roadway and bridges, drain pipe at foundation of the trashrack structure and drain pipes in the intake gate gallery.

c. Building Drain Lines, comprising the floor drains, pipe and pipe fittings for the power plant drains and the discharge lines from the drainage and dewatering sump pumps including slide type gate, discharge lines from drainage pumps below the bus ducts, the ceiling drain piping including the lines through the exploratory tunnel, draft tube drain lines and valves, drain line from the elevator pit, pipe and valves between the lower sumps, and overflow line from upper sump.

d. Battery Room Drain Lines, comprising acid resistant floor drains, pipe and pipe fittings.

e. Penstock Drain Line, comprising the valves, mechanical couplings,

pipe and fittings from the lower end of the penstock pipe.

6. LUBRICATING OIL, AIR AND SERVICE WATER SYSTEMS

The Contractor shall furnish, install and test embedded portions of the lube oil, air and service water piping as specified herein and as shown on the drawings.

7. VENTILATION PIPE AND/OR DUCTS

The Contractor shall furnish and install embedded ventilation pipe and/or ducts as shown and specified on the drawings.

8. PLUMBING AND SEWAGE DISCHARGE PIPING

The Contractor shall furnish and install all pipe, fittings and appurtenances required to rough in the sanitary plumbing system as specified and shown on the drawings. The required system shall include the embedded soil pipe for waste lines from the various plumbing fixtures together with all necessary and customary fittings, cleanouts and other items required for a first class installation. Plumbing fixtures and exposed waste and vent lines will be furnished and installed by others.

The Contractor shall also furnish and install the embedded sewage discharge piping as shown on the drawings, and sewage plant foundation drainage line.

9. PIPING FOR SLUICE GATE

The Contractor shall furnish, install and test the pressure piping for the sluice gate seals as specified herein and as shown on the drawings.

10. PIPING FOR BUBBLER SYSTEMS

The Contractor shall furnish, install and test the bubbler system piping for the spillway gates, skimmer gate, sluice gates and the trashrack structure including all pipe, valves and fittings as specified herein and as shown on the drawings. The air compressors for the bubbler system are not a part of this item and shall be installed as specified under Section 5.

11. OIL PIPING

The Contractor shall furnish and install the oil piping in the Machine Hall as specified herein and as shown on the drawings.

The Contractor shall furnish and install one (1) Style MX-16 Boss Male Hose Coupling with I.P.T. - size 4-inch, bolt clamp, cadmium-plated, rustproof and capable of operation under 50 pounds per square inch pressure for the oil drain line discharge as shown on Drawing D-23352, and four (4) Style MX-16 Boss Male Hose Coupling with I.P.T. - size 2-inch, bolt clamp, cadmium-plated, rustproof; one per oil fill line as shown on Drawing D-23329.

The interior of all oil piping installed under these specifications shall be cleaned by the Contractor as specified below. Piping shall be cleaned after it has been assembled and erected in place, but before the piping has been pressure tested. If the pressure test discloses defects that require dismantling of the piping, the dismantled sections shall be recleaned. The Contractor shall furnish all materials, supplies, labor, and equipment for cleaning the oil piping. In enclosed spaces, where danger of vapor accumulation exists, the solvent used for cleaning shall be of a nonexplosive type such as Stoddard solvent. In open, nonhazardous locations, clean mineral spirits, xylol, or white gasoline may be used. Sand or grit blast shall not be used for cleaning the interior of any part of the oil lines. No direct payment will be made for cleaning oil piping. The cost of cleaning oil piping shall be included in the applicable prices bid in the Proposal for furnishing and installing the various sizes and systems of metal pipe, fittings, and valves, and for installing equipment where such equipment includes the installation of oil piping furnished by the City. The cost of cleaning oil reservoirs, oil drip tank, and pressure tanks, including furnishing of flushing oils, shall be included in the applicable prices bid in the Proposal for installing the equipment of which they are a part.

After the oil piping has been erected, it shall be dismantled in convenient sections for cleaning, and each section shall then be cleaned in accordance with the following procedure:

Step 1. Clean with a power-driven rotary wire brush drawn through the pipe.

Step 2. Blow out with compressed air, using a nozzle on the end of an air hose that will create turbulence and can be drawn through the pipe.

Step 3. Swab with a cloth, thoroughly impregnated with solvent (but not dripping) drawn through the pipe.

Step 4. Swab with a dry cloth drawn through the pipe.

12. LINES FOR LEVEL SENSING DEVICES

a. General. The Contractor shall furnish and install and test all necessary lines between the sensing devices and the discharge point as stated herein or shown on the drawings. The copper tubing and manually operated valves connecting the nitrogen cylinders for each system to the bubble discharge points shall be furnished and installed by the Contractor.

b. Reservoir and Forebay Level Sensing Device. The servomanometer will be furnished and installed by others under a later contract, in the location as shown on the drawings. The copper tubing and valving to be installed under this Contract shall be located as shown on Drawings D-23395, D-23169, D-23188 and D-23190 and covered herein. The manual operated valves located in the housing for the skimmer gate and air compressors shall be of the Robbins

metering and shutoff valve, Line type, series 375B for 3/8" Dia. tubing, capable of operating under the feet of head as indicated and in the location as shown on D-23395.

c. Tailrace Level Sensing Device. As shown on Drawings No. D-23190, D-23188, and D-23169, the two (2) - 3/8-inch diameter copper tubings shall be furnished and installed along with one (1) manual operated valve for each line as described in 12b above.

13. PIEZOMETER AND GAUGE PIPING

The Contractor shall install or furnish and install embedded piezometer lines at the turbine spiral case and embedded gauge and meter piping elsewhere as shown on the drawings or as directed by the Engineer.

14. PIPE SLEEVES

The Contractor shall furnish and install pipe sleeves where shown on the drawings and where required to provide openings for the passage of pipe, valve extension stems, pump columns, etc., through concrete within the power plant. The pipe sleeves shall be of the type and size shown on the drawings including welded attachments such as waterstops, flanges, etc. Attention is called to the necessity for the Contractor to locate and place the pipe sleeves accurately in order that piping systems subsequently installed may be erected in accordance with the drawings.

15. MANHOLES AND FLOOR BOXES

The Contractor shall furnish and install the following:

a. Manholes. Cast iron manhole frames and covers complete with bolts and gaskets, if required, as specified and shown on the drawings.

b. Floor Boxes. Cast iron floor boxes complete with covers, packing gland, studs and nuts as manufactured by The Chapman Valve Mfg. Co. The floor box assembly must be watertight and withstand 30 psi water pressure.

One ratchet wrench with removable extension piece and socket shall be furnished. The wrench shall be reversible ratchet wrench, female drive with 1-1/8 inch square opening, Lowell Wrench Co. Series 40, or equivalent. The extension piece and socket shall be as shown on the drawings.

16. PAINTING

Unless otherwise specified, painting of metal pipe, valves and fittings shall be in accordance with the requirements stipulated in Section 20, "Painting Steel Metalwork," in the Coating Schedule included therein.

17. MEASUREMENT AND PAYMENT

a. General. No separate payment will be made for testing of piping systems and painting of piping, valves and fittings; and, the cost thereof shall be included in the applicable item of the Proposal.

b. Measurement by Weight. Measurement of the quantity of pipe, pipe fittings, valves, sleeves, hangers, inserts, supports and other items to be paid for on a pound-price basis will be determined by the Engineer by the actual weight to the nearest one (1) pound of said items installed in place. Weight will be determined in the most practicable manner, using scale weights, if possible, catalog weights and/or shipping weights. The weight of all packing, boxing, temporary bracing and blocking, rejected items, cutting waste and items which are not actually installed in the work will not be included.

c. Payment on Weight Basis. The prices bid per pound for supplying and installing pipe, pipe fittings, valves, sleeves, hangers, inserts, supports and like items shall include unloading, handling, transporting, storing, fabricating, placing and testing. There shall be no separate allowance for flange bolts, gaskets, welds, flashing, lead, joint compound and other such items which shall be considered incidental to and included in the appropriate item of the Proposal.

d. Payment on Lump Sum Basis. The prices on all items in the Proposal, which are lump sum items, shall constitute the full compensation for each lump sum item described in the Specifications and as shown on the drawings. These lump sum prices include all materials except such equipment to be City supplied, all labor, transportation, providing the necessary construction equipment, supervision and the performance of all necessary operations and incidentals to complete the work, including testing, all in accordance with these Specifications.

SECTION 12

GATES AND HOISTS

1. GENERAL

a. Scope. The work covered by this section of the specifications consists of performing all operations in connection with the installation of the City-furnished gates with embedded parts, hoists, operators, controls and appurtenances.

b. Intent. It is the intent of the specifications that the work of the Contractor and/or his subcontractors under this Section shall include all work required to install the equipment in a satisfactory, neat and workmanlike manner, tested and ready for use and service for commercial operation.

All equipment will be shop assembled by the manufacturer and tested for fit and alignment and, before being disassembled for shipment, will be matchmarked and/or otherwise marked for correct assembly and alignment of all parts in the field.

The Contractor will be required to assemble and install the gates and gate frames so as to maintain in the field the tolerances shown on the drawings and shall familiarize himself with the problems involved and with the fact that certain assembly operations will require accuracy beyond that required in ordinary practices.

All temporary erection materials, platforms, scaffolding, models or templates required for erecting and adjusting the equipment shall be furnished by the Contractor at no additional cost to the City.

c. Welding. All welding under this Section of the specification shall be in accordance with Section 10, paragraphs 4 and 5 of these specifications. Alignment of the gates during installation must be maintained within the tolerances shown on the drawings and stated in the specifications. In this regard, particular care shall be taken during welding of the field splices to control the sequence of welding so as to avoid undue distortion. In addition to the requirements for approval of welding procedures, the Contractor shall also be required to submit a proposed procedure for welding sequences to be employed in making the field splices for the draft tube and intake gates.

2. INSTALLATION OF GATE FRAMES GUIDES AND RAILS

The gate frames and guides, complete with anchor bolts and permanent erection bolts shall be assembled and installed by the Contractor as shown on the drawings

or as directed by the Engineer. The structural steel and metalwork for the frames and guides will be furnished completely fabricated in sections convenient for shipment and will have been assembled in the shop, and when so assembled, open holes for field bolts and dowels will have been reamed and all parts will have been marked and matchmarked to facilitate assembly in the field. Field assembly will be by bolting or welding or a combination of these methods.

Suitable recess or blockouts shall be constructed in the concrete of the structure to provide for installation of the frames and guides. Anchor bolts shall be located accurately and shall be held rigidly in position while the concrete in the structure is being placed.

Care shall be taken to insure that all frames and guides are installed so that the gate sealing surface of each frame is even and lies in a true plane and that the bearing surface of the tracks or gate guides of each frame lie in the same plane, so that when the gates are installed the gate wheels or gate seats will bear evenly to assure no leakage between the gate seals and the seal seating surfaces. After the frames and guides have been placed accurately, adjusted, and cleaned thoroughly of all rust, dirt, and other foreign material, the recesses or blockouts shall be filled with concrete. Unless otherwise specified herein, no blockout concrete shall be placed until the gates have been installed and final adjustments have been made to the satisfaction of the Engineer. After these recesses or blockouts have been filled with concrete, the exposed surfaces of the embedded metal shall be cleaned and painted in accordance with Section 20.

3. INSTALLATION OF GATES

All gates will be delivered to the dam site in pieces convenient for shipment. They shall be assembled by the Contractor as shown on the manufacturer's drawings. Field splices shall be made by a combination of bolting and welding. Special precautions shall be taken in making field welds in order to maintain the alignment of sealing surfaces, bearing surfaces and wheels. The rubber seals for the gates shall be attached by the Contractor as shown on the drawings, or as directed by the Engineer. The Contractor shall carefully spot and accurately drill the holes in the seals with rubber plug drills. Field painting of gates shall be in accordance with Section 20.

4. INSTALLATION OF GATE OPERATING EQUIPMENT

All gate operating equipment will be supplied complete with anchor bolts, motors, limit switches, controls and accessories. The equipment shall be assembled, serviced and installed by the Contractor in the correct position with respect to the gate which it will operate. After each piece of equipment is installed, it shall be connected to the gate and given an operating test. All required adjustments shall be made until the operation of each operating unit and its gate is satisfactory to the Engineer. Where gate controls are furnished having provisions or equipment for remote or automatic control which involves equipment not furnished or installed under this Contract, the Contractor shall be required

to add temporary jumpers or make wiring modifications as necessary and as instructed by the Engineer, to enable the gate hoist control equipment furnished with the gates to be utilized to demonstrate the safe, satifactory, and intended operation of the gates. Field painting of the equipment shall be in accordance with Section 20.

5. SLUICE GATES AND HOISTS

The sluice gates shall be placed in the "maintenance position" above the gate slots for assembling. When the field splices are complete, the seals installed and the hoisting ropes attached, each gate shall be lowered into the gate slot and the guide angles located and welded to the embedded metal to suit the gate. All anchor bolt nuts in the gate frames and rails shall be adjusted, if required, so that the rails, seal plates, guides, base plates, etc. are located, with respect to the gates, within the tolerances shown on the drawings and to the satisfaction of the Engineer.

The seal pressurizing system and gate frame heaters shall be connected and tested to the satisfaction of the Engineer before the seal frames are welded to the sluice liner plates. After all adjustments are made, blockout concrete shall be placed around the gate frame members as shown on the drawings.

Controls for the sluice gate hoists shall be installed as shown on the drawings. Control of the gate seal heaters and seal pressurizing systems will be interlocked with the gate hoist controls in order to prevent damage to the gate seals and hoist mechanisms. A single remote control panel for all seven sluice gates will be located in the sluice gate control center as shown on the drawings. All control equipment necessary for control of the heater and seal pressurizing systems, with the exception of any solenoid operated valves associated with the seal pressurizing systems, will be furnished as part of the gate hoist control equipment.

6. SLUICE MAINTENANCE GATE, OPERATOR AND HOIST

The equipment to be installed under this paragraph shall include the sluice maintenance gate, all horizontal and vertical rails and guides, the hoist and lifting beam to be used for hoisting the gate for maintenance, the operator and operating shafts for moving the gate horizontally and all accessories required for a complete installation.

The gate hoist will have a capacity based on the buoyant weight of the gate. Therefore, hoisting equipment required for installation and testing of the gate shall be furnished by the Contractor.

After the rails, guides and bearing surfaces have been aligned to the satisfaction of the Engineer, the main load carrying members and other members, if directed by the Engineer, shall be embedded in blockout concrete.

The gate shall be assembled on the rails and all field connections shall be welded or bolted as shown on the manufacturer's drawings. After assembly, the gate shall be moved, by its operating shafts, to each sluice opening and all required adjustments shall be made. The Contractor shall demonstrate that the gate moves freely from opening to opening with the wheel springs decompressed and that the sealing surfaces are in intimate contact when the gate is in front of each opening with the wheel springs compressed.

Testing and adjusting of the gate, operator and rails shall continue until the Engineer is satisfied with the installation. The remaining blockouts shall be filled with concrete when all tests are completed.

7. SPILLWAY RADIAL GATES AND HOISTS

The radial gates shall be assembled in the spillways and field connected as shown on the manufacturer's drawings. The side seals shall be adjusted to the out-to-out dimensions shown on the drawings. Special care shall be taken in adjusting the seals at the bottom corners of the gate to prevent leakage at these points.

Anchorage girders will be furnished with the gates and shall be embedded in the spillway piers as shown on the drawings. The location and alignment of the anchorage girders shall be approved by the Engineer before embedment. Provisions shall be made to hold the girders rigidly in place so that no movement will take place during placement of the concrete.

The trunnion bearings shall each be adjusted by the means provided to locate the gate leaf accurately in position and molten zinc fill shall be poured between the trunnion base and the anchorage. Zinc will be furnished with the gates.

After the hoist is installed and [illegible]isting ropes are connected, the gate shall be raised and lowered and the [illegible]eal plates and gate sill shall be adjusted if required. Before placing b[illegible]ckout concrete, the seal heaters shall be tested.

Controls for the radial gate hoists shall be installed as shown on the drawings. Control of the gate seal heaters will be interlocked with the gate hoist controls, and the necessary control equipment for control of the heaters will be furnished with the gate hoist control equipment. The hoist control equipment furnished with the gates will include equipment and provisions for both remote manual and local automatic control of the position of the gates. The remote manual and local automatic control equipment will not be furnished or installed under this Contract, and the Contractor shall add temporary jumpers or make minor wiring modifications as necessary and as instructed by the Engineer, to enable the gate hoist control equipment furnished with the gates to be operated utilizing the local manual controls provided. All limit switches, feedback slidewires, position transmitters, and other electrical equipment forming part of the gate control or position indication systems shall be installed and wired to terminal blocks provided in the control cabinets even though the devices may not be required or utilized in the local manual control system. All equipment installed shall be operated to the satisfaction of the Engineer.

8. SKIMMER GATE AND OPERATOR

The Bascule Type Skimmer Gate and its operator and embedded metal shall be installed as shown on the drawings. Rubber seals for the sides and bottom of the gate will be attached to the embedded metal as shown on the manufacturer's drawings and the gate shall be mounted on bearings which are bolted to the concrete.

The electric operator and its supporting bracket shall be installed and the complete assembly adjusted to the Engineer's satisfaction.

The control equipment for the gate operator will be furnished with the gate and shall be installed where shown on the drawings.

9. INTAKE GATES AND HOISTS

The sections of intake gates shall be placed in the "maintenance position" for assembling. When the field splices are complete the seals shall be installed as shown on the manufacturer's drawings. After the hoist has been installed and hoisting ropes attached, the gate shall be lowered into the gate slots and the guides, rails and seal plates shall be adjusted to the tolerances shown on the drawings. After all adjustments have been made to the satisfaction of the Engineer, blockout concrete shall be placed around the frame members as shown on the drawings. The damper on the load brake fan shall be adjusted so that the gate will close without power at a predetermined velocity.

Controls for the intake gate hoists shall be installed as shown on the drawings. The hoist control equipment furnished with the gates will include equipment and provisions for both remote manual raising and lowering, and remote emergency tripping of the gates from the powerhouse. The remote control equipment will not be furnished or installed under this Contract, and the Contractor shall add temporary jumpers or make minor wiring modifications as necessary and as directed by the Engineer, to enable the gate hoist control equipment furnished with the gates to be operated utilizing the local manual controls, provided, all limit switches or other electrical devices forming part of the gate control systems shall be installed and wired to terminal blocks provided in the control cabinets even though the limit switches or other devices may not be required or utilized in the local manual control systems. All equipment installed shall be operated to the satisfaction of the Engineer.

10. DRAFT TUBE GATES, GANTRY AND LIFTING BEAM

The gantry crane to be used for operating the draft tube gates, shall be assembled on the Contractor-furnished rails in the dam access gallery. The gates shall be assembled in the "maintenance position" above the gate slots.

After the gates are assembled and the crane has been serviced, each gate shall be lowered with the lifting beam to its closed position and the gate frames, guides

and guide shoes shall be adjusted to the tolerances shown on the manufacturer's drawings.

Payment for supplying and installing the gantry crane runway rails and accessories will be paid to the Contractor under the bid item for "Furnishing and Installing Rails".

11. CLEANING, SERVICING AND TESTING

a. General. During the progress of the work and upon completion, the Contractor shall conduct such tests as the Engineer may deem necessary to insure that all equipment is in a condition for proper and satisfactory service. Methods of conducting tests shall be in accordance with the applicable code, or with other regulations having jurisdiction.

b. Cleaning and Servicing. After each complete unit of equipment has been installed, and necessary electrical connections have been made, it shall be serviced and tested. The servicing shall consist of lubricating, adjusting and cleaning all parts of the machinery. The Contractor shall clean the equipment of dirt, mortar, concrete, or other materials which have been misplaced, spilled or allowed to mar the finish of structures or equipment. All debris, temporary piping, supports, etc., shall be removed from the site and dumped or disposed of as directed by the Engineer. The Contractor shall flush thoroughly all bearings, except as designated by the Engineer, reservoirs, gear housings, etc., with solvent before the same are filled with oil. All solvent for flushing, and all lubricating oil, hydraulic oil and grease shall be furnished by the Contractor. Mechanical equipment and motors shall be checked to see that moving parts move freely, glands shall be properly packed, connections shall be checked for tightness, etc. Adjustments shall be made by the Contractor at the direction of the Engineer. Any changes or adjustments found to be necessary shall be made by and at the expense of the Contractor. Where these specifications require that operation is a part of the installation work, the Contractor shall supply temporary power and the equipment shall be turned over to the City in operating condition.

c. Tests. The Engineer will not approve and the City shall not be deemed to have accepted the work or any part thereof until the Contractor has made sufficient tests to enable the Engineer to determine that the work meets all of the requirements of the drawings and specifications. The Engineer shall be notified in ample time so that he may be represented at all tests that may be made. If inspection or tests show the work, or any part thereof, not to be as represented and/or contracted for; if any portion of the work fails to operate to the satisfaction of the Engineer the Contractor shall make good any or such defective portions of the work. The repair of damage which is due to the operations of the Contractor and the correction of minor defects, errors, and inaccuracies in the machinery, equipment, and other metal-work furnished by the City which may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer shall be made by and at

the expense of the Contractor. The repair of damage in the machinery, equipment, and other metalwork furnished by the City which is due to no fault of the Contractor for and the correction of defects, errors, and inaccuracies in the machinery, equipment, and other metalwork furnished by the City which are ordered to be corrected by the Engineer and which are over and above what may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer, will be paid for as extra work under the applicable provisions of the contract.

12 PAINTING

After completion of the work, including all tests and inspections, the mechanical work covered by this section shall be painted by the Contractor. Painting and coatings shall be done in accordance with the requirements of Section 20.

13. MEASUREMENT AND PAYMENT

a. General. Measurement and payment shall be made in accordance with this paragraph and with the prices bid in the proposal for installing the gates, hoists, cranes, embedded metals and appurtenant materials, and/or supplying and installing miscellaneous materials, as described hereinafter, in other parts of the specification, and on the drawings. The installation of the equipment shall include, but not be limited to: erection, placing the equipment in its operating location, connection of all power supplies, limit switches and other required electrical apparatus, cleaning, servicing, adjusting and testing. The equipment shall be maintained in proper operating condition until final acceptance by the Engineer. The prices bid for the various items shall include the cost of making such minor changes and correcting such minor errors and inaccuracies in the various parts as may be expected to occur in the ordinary commercial grade or shop work and manufacture of such materials and equipment, including minor wiring changes and additions to control equipment as noted elsewhere in this section of the specifications.

The cost for loading and transporting the equipment from the dam site storage area to the place of installation shall also be included in the prices bid in the Proposal for supplying and/or installing the various items of equipment.

The City will assume the cost for unloading and placement in stored location at the dam site of City-furnished equipment and materials described in this section of the specification.

b. Measurement. When payment is made at the unit price per pound bid for any item of the Proposal, the actual weight of each part or item will be determined by the Engineer in the most practicable manner, using scale weights, whenever possible, shipping weights, manufacturer's weights, catalog weights and estimated weights based on actual dimensions without deduction of holes or the addition of weld metal. The weight of all tare, packing and blocking will be deducted,

using only net weights for payment quantities. The weight of all supports, hangers, anchors, blocking or bracing not shown on the drawings, but used to hold the miscellaneous items in position will not be included in the weight for payment.

Anchors, jacks, internal bracings, temporary supports and other erection aids required for the proper installation will not be measured for payment.

c. Payment on Unit Price Basis. The unit prices bid in the Proposal for installing or for supplying and installing the items shall include unloading (except City-furnished equipment), handling, transporting, storing, assembling, placing, erecting, installing and testing. No separate allowance will be made for installing metalwork, anchor bolts, motors, limit switches, valves, piping, companion flanges, controls, gauges, instruments and like accessories furnished with the units or which are incident to their proper and complete installation.

d. Payment on Lump Sum Price Basis. The lump sum prices bid for items in the Proposal shall constitute the full compensation for each lump sum item described in the specifications and as shown on the drawings. These lump sum prices include all materials except such equipment to be furnished by the City, all labor, transportation, providing the necessary construction equipment, supervision and the performance of all necessary operations and incidentals to complete the work, including testing, all in accordance with these specifications.

SECTION 13

AIR CONDITIONING

1. SCOPE

The work to be performed under this section shall consist of the following work in connection with the air conditioning equipment for the machine hall:

a. Checking of the design.

b. Furnishing and installing equipment.

c. Balancing, testing and adjusting the systems.

2. DESIGN

a. Assumptions. The systems have been designed based upon the following conditions:

	Winter		Summer	
	Outside	Inside	Outside	Inside
A/C Unit No. 2 for Service Bay Lobby, Offices, and Control Room	-15°DB	70°DB	93°DB; 71.8°WB	70°DB; 40%RH
A/C Unit No. 1 for Unit Bays, Service Bay and Tunnels	-15°DB	70°-65°DB	93°DB; 71.8°WB	70°DB; 40%RH

b. Basis of Bid Price. The Contractor shall base his bid price on the equipment and layout as described in these specifications. He shall include in this bid his cost of checking the design and of balancing, testing and adjusting the systems.

c. Checking of Design and Departures. Prior to fabricating or purchasing any materials or equipment, the Contractor shall assure himself that he can balance the systems as designed under the design conditions. He may propose modifications to the Engineer. If the Engineer determines that such modifications are necessary or desired, he will issue a change order and will notify the Contractor of adjustments to the bid price, if any.

Approval by the Engineer of any departures from the layout as shown herein shall not relieve the Contractor of the responsibility of satisfactory performance

and acceptability of the equipment, materials and systems.

3. INSTALLATION - GENERAL

a. Materials and Equipment. All materials and equipment shall conform to that shown on the drawings and to the following specifications. Following each item of equipment specified herein is a list of approved manufacturers of the particular item. These are listed in order of preference, and the first manufacturer listed is the one upon whose equipment the design has been based, and the one upon whose equipment the bids shall be based. Bidders shall quote on the basis of furnishing the equipment specified herein.

After award of contract, the Contractor may offer substitute equipment and/or materials of equal design, quality, capacity, durability, and efficiency. The substitute equipment and materials will be given fair and equitable consideration, provided no basic design changes are involved.

Approval by the Engineer of such substitutions will not relieve the Contractor of the responsibility of satisfactory performance, nor of the responsibility for providing adequate and acceptable clearances for entry, servicing, and maintenance of the equipment.

b. Items of Equipment. The items of equipment to be furnished and installed shall include, but not be limited to, the following:

(1) Air conditioning units.

(2) Unit heaters.

(3) Supply fans.

(4) Exhaust fans.

(5) Air filters.

(6) Chilled water coils.

(7) Hot water coils.

(8) Preheat and reheat coils.

(9) Packaged liquid chillers.

(10) Circulating pumps.

(11) Carbon monoxide detectors.

(12) Duct work.

(13) Piping.

(14) Control systems.

(15) Motors and motor controllers.

(16) Equipment supports.

(17) Instrument air compressor.

c. Clearances. The dimensions of the spaces available for equipment and the location of equipment, penetrations, etc., are indicated on the drawings. Equipment, duct work, piping arrangement, etc., shall be provided with adequate and acceptable clearances for entry, servicing, and maintenance unless otherwise noted on drawings.

d. Interference. The Contractor shall be responsible for assuring that the duct work, piping, etc., can be installed without interference with lights, structural members, downspouts, etc. If any such interferences exist or occur, the Contractor shall make the necessary adjustments to permit satisfactory installation without additional cost to the City.

e. Codes and Standards. The work, equipment, and materials shall conform to the requirements of the following codes and standards:

(1) American Society of Heating, Refrigeration and Air Conditioning Engineers Guide, latest edition (ASHRAE).

(2) Air Moving and Conditioning Association, Inc., standards definitions, terms, and test codes for Centrifugal, Axial, and Propeller Fans (AMCA).

(3) National Board of Fire Underwriters pamphlet No. 90 "Air Conditioning, Warm Air Heating, Air Cooling Ventilating Systems," latest edition.

(4) Local and/or State of Washington Codes and requirements as applicable.

4. AIR CONDITIONING UNITS

a. Central Station Air Conditioning Units.

(1) The Central Station Air Conditioning unit hereafter designated as A/C unit No. 1, for the Unit Bay, Service Bay below El. 1759 and Tunnels shall be a packaged unit complete with fans, fan section, coil sections, mixing box, V-belt drives, belt guard, fan stabilizer, and drain pans as shown on the drawings. The unit shall be installed in strick accordance with the manufacturer's recommendations.

(2) The unit shall be capable of delivering the quantity of air required, at the static pressure required, as shown on the drawings.

(3) The housing shall be of heavy gauge steel suitably reinforced with a substantial formed steel frame.

(4) Fan section structure shall not be lighter than 10 gauge and fan section access panels not lighter than 16 gauge metal.

(5) The exterior of the unit shall present a smooth surface without protruding angles, braces, stiffeners, etc.

(6) The interior of the housing shall be insulated with 1/2" thick fiberglas fire-resistant insulation. It shall be applied with an asphalt base fire-resistant mastic to bond the insulation to the panel and frame members.

(7) Drain pans shall have 1" insulation applied with mastic between the inner and outer pans. All drain pans shall be furnished with side drain connections.

(8) The fans shall be centrifugal type, full width, Class I, double inlet, double width, manufactured by the unit manufacturer. They shall be of the backwardly curved, non-overloading type.

(9) The fan bearings shall be ball bearings of the self-aligning, grease lubricated type, with grease fittings mounted externally on the unit.

(10) The fan shaft shall be cold finish, turned, ground and polished to insure trouble-free operation and tolerances within the recommendations of bearing manufacturers.

(11) The fans shall be accurately balanced both statically and dynamically, and be free from objectionable vibration and noise.

(12) The fan motors shall be rubber grommet mounted on an adjustable pivot base located external to the unit as shown on the drawings.

(13) The fan belt guards shall be easily removable, and made of coiled steel band with expanded metal.

(14) Acceptable manufacturers are:

(a) Kennard/Nelson Company
(b) Acme Industries, Incorporated
(c) American Blower Company

b. Dual Duct Air Conditioning Unit.

(1) The Dual Duct Air Conditioning Unit, hereafter designated as

A/C Unit No. 2, for the Service Bay Lobby, Offices and Control Room shall be a package high pressure unit complete with fan, fan section, coil sections, mixing box, motor, V-belt drives, belt guard, and drain pans as shown on the drawings.

(2) The unit shall be capable of delivering the quantity of air required, at the static pressure required as shown on the drawings.

(3) The high pressure unit shall have heavier than usual frame and panel construction to provide vibration free and air tight unit under all operating pressures and fan speeds.

(4) The exterior of the unit shall present a smooth surface without protruding angles, stiffeners, braces, etc.

(5) The interior of the housing shall be insulated and the insulation shall be bonded to the housing as specified for A/C Unit No. 1.

(6) Drain pans shall have 1/2-inch insulation applied with mastic between the inner and outer pans. All drain pans shall be furnished with side drain connections.

(7) The fans shall be designed for the higher system pressures with heavier shafting, bearing, and peripherally reinforced Class II fan wheels.

(8) The fans shall be centrifugal type, full width, double inlet, double width, and with forwardly curved blades.

(9) Acceptable manufacturers are:

(a) Kennard/Nelson Company
(b) Acme Industries, Incorporated
(c) American Blower Company

5. UNIT HEATERS

a. Electric unit heaters shall be of the suspended-propeller type with adjustable louvers and horizontal discharge as indicated on the drawings, and of the capacities indicated on the drawings. They shall be rated in accordance with the code adopted jointly by the IUHA and ASHRAE.

b. The heating elements shall be longitudinal fin type wherein the fin is an integral part of the element sheath.

c. Element sheaths shall be of aluminized steel and shall employ the highest quality helically-coiled resistance wire, embedded in densely packed magnesium oxide.

d. The individual elements shall be mounted in a heavy steel frame designed for easy removal from the unit and shall be protected from over-heating by automatic reset, snap-action, high limit cut-outs.

e. Cabinet construction shall be of heavy gauge steel. Finish shall be of hard-baked enamel pre-phosphatized to prevent corrosion.

f. Fans shall be propeller type with evenly balanced blades driven by heavy duty, life-time lubricated sealed bearing, enclosed motors and shall circulate air evenly over heating elements.

g. Both fans and motors shall be mounted entirely within cabinet enclosure.

h. Contactors, when specified as integral to unit heaters, shall be mounted within unit heater enclosures or in cabinet extensions of enclosures to insure smooth and attractive continuity of cabinet design.

i. Acceptable manufacturers are:

(1) Wesix Electric Heater Company
(2) ILG Electric Ventilating Company
(3) Electromode, Division of Commercial Controls Corporation

6. SUPPLY FANS

a. The warm air transfer fan shall be of the "Buffalo" Volume Fan type complete with flanged wheels, self aligning pillow block ball bearings, heat slinger, V-belt drives, adjustable motor bases, and belt guards.

b. The fan shall be capable of delivering the quantity of air required, at the static pressure required as shown on the drawings.

c. The housing shall be of a one-piece grey iron casting construction.

d. Motor starter shall be furnished and shall be 3-phase with necessary control transformer. The starter will be wall mounted.

e. Acceptable manufacturers are:

(1) Buffalo Forge Company
(2) American Blower Company
(3) Clarage Fan Company

7. EXHAUST FANS

a. Welding, Battery Room and CO Exhaust Fans.

(1) The battery room exhaust fan, shop area welding fume exhaust fan, draft tube welding fume exhaust fan, and carbon monoxide exhaust

fan shall be of the "Buffalo" Volume Fan type complete with standard flanged wheels, one-piece grey iron casting housing, shaft seal consisting of an asbestos ring, heat slinger, and standard slip inlet and outlet connections.

(2) The fans shall be capable of exhausting the quantity of air required, at the static pressure required as shown on the drawings.

(3) Acceptable manufacturers are:

(a) Buffalo Forge Company
(b) American Blower Company
(c) Clarage Fan Company

b. Plant Exhaust Fan.

(1) The plant exhaust fan shall be of the "Buffalo" Industrial Exhauster type complete, with type MW wheel, heavy gauge fabricated steel housing and heat slinger.

(2) The fan shall be capable of exhausting the quantity of air required, at the static pressure required as shown on the drawings.

(3) Acceptable manufacturers are:

(a) Buffalo Forge Company
(b) American Blower Company
(c) Clarage Fan Company

8. AIR FILTERS

a. Automatic air filters shall be of the Roll-O-Matic media type using glass fiber filtering media in rolls. Each shall be complete with motor drive, timer, media runout signal, and initial filling of filtering media.

b. The filtering media shall be of progressive density both in number and diameter of the fibers.

c. The adhesive used in the filtering media shall be capable of operation in air temperature ranging from 5°F to 115°F.

d. Air velocity through the filtering media shall not exceed 500 feet per minute over the net face area. At this rating the resistance through the clean filtering media shall not exceed 0.16" w.g. The dust removal efficiency under these conditions shall not be less than 80 percent as established under the Air Filter Institute Code, Section 1.

e. The drive shall be mounted outside of the filter casing for ease of maintenance and servicing. It shall be housed to protect it from damage.

f. The filter casing shall be constructed of heavy gauge galvanized steel.

g. Acceptable manufacturer:

(1) American Air Filter Company

9. CHILLED WATER COILS

a. The Water Cooling Coils shall be of the cleanable tube type and constructed of 5/8" OD seamless copper tubing arranged in staggered pattern with respect to direction of air flow. Fins shall be copper, continuous plate type spaced 8 fins per inch and bonded to tubes by hydraulic expansion for maximum contact and heat transfer.

b. Dimensions and number of rows for coils shall be as shown on drawings.

c. Each coil shall have flanged galvanized steel casing. End tube sheets shall be constructed of heavy gauge metal with tube holes drawn into a smooth collar.

d. Coils shall be installed with the tubes in a horizontal position with water flow through the coils in upward direction to facilitate self-purging.

e. Intermediate center support members shall be provided in all coils exceeding 53" long.

f. All coils shall be tested with 300 lbs. pneumatic pressure under water.

g. Removable plugs shall be installed on header end only.

h. Acceptable manufacturers are:

(1) Kennard/Nelson Company

(2) Aerofin Corporation

(3) American Blower Company

10. HOT WATER COILS

a. The Hot Water Coils shall be of the cleanable tube type and constructed of 5/8" OD seamless copper tubing arranged in staggered pattern with respect to direction of air flow. Fins shall be copper, continuous plate type spaced 8 fins per inch and bonded to copper tubes by hydraulic expansion for maximum contact and heat transfer.

b. Dimensions and number of rows for coils shall be as shown on drawings.

c. Coils shall have flanged 14-16 gauge galvanized steel casing. End tube plates shall be constructed from 16 gauge galvanized steel.

d. Intermediate center supports shall be provided in all coils exceeding 53" in length.

e. Coils shall be tested with 300 lbs. pneumatic pressure under water.

f. Removable plugs shall be installed on header end only.

g. Acceptable manufacturers are:

(1) Kennard/Nelson Company

(2) Aerofin Corporation

(3) American Blower Company

11. PREHEAT AND REHEAT COILS

a. Preheat and Reheat Coils shall consist of electric heating elements of longitudinal fin construction, totally enclosed in aluminum steel sheaths, with not less than 3/4" spacings between adjacent fins to prevent accumulation of dirt and dust.

b. Elements shall be individually removable from heater enclosure without removal of duct section from duct to facilitate maintenance or replacement.

c. Heaters shall have integral high-limit thermostats for element protection in the event of blower failure.

d. Wiring compartment shall be sealed from air stream to prevent dirt and moisture accumulation and shall operate at temperatures allowing supply wires rated for 167°F.

e. Heater coils shall be factory connected. Terminal blocks shall be provided for the connection of external wiring.

f. Heater size, rating, and capacity shall be as shown on drawings.

g. Acceptable manufacturers are:

(1) Wesix Electric Heater Company

(2) Edwin L. Wiegand Company

(3) Industrial Engineering and Equipment Company

12. PACKAGED LIQUID CHILLERS

a. A/C Unit No. 1

(1) The Packaged Liquid Chiller shall consist of cooler, condensers,

12. Packaged Liquid Chillers - Continued

interconnecting piping, open type dual compressors, dual control panel, and rigid steel frame consisting of structural steel, channels, angles, and plates.

(2) The unit shall meet the required capacity and ratings of tonnage, quantity of cooling water and temperature ranges, quantity of condenser water and temperature ranges, and shall not exceed the pressure drops through the cooler and condensers as noted on the drawings.

(3) The compressors shall be accessible open type motor-compressor units with all moving parts statically and dynamically balanced. The compressors shall have the ability to vary capacity in response to cooling load requirements by means of a built-in suction pressure actuated automatic capacity control system.

(4) The cooler shall be a thru-tube direct expansion type with refrigerant in the tubes and water to be cooled in the shell. The cooler is to be factory-insulated with 3" of rock cork protected with a steel jacket and is to be constructed and tested in accordance with ASME code requirements.

(5) The condensers shall be cleanable thru-tube type with steel shell and integral finned, rolled-in copper tubes and complete with relief and purge valves. These are to be constructed and tested in accordance with ASME requirements.

(6) Each refrigerant circuit shall be complete with muffler, heat exchanger, solenoid valve, pilot-operated thermal expansion valve, charging valve, filter-drier, liquid line shutoff valve, sight glass and moisture indicator. Each circuit shall function independently of each other.

(7) The electrical controls and compressor motor starters shall be mounted in a totally enclosed metal cabinet and factory-wired to the control terminal strip. All controls and enclosures are to conform to applicable codes. The unit shall include a two-step water temperature controller and an operating switch. Each circuit shall include compressor starters, high and low pressure controllers, freeze-up protection control, oil pressure differential switch, and non-cycling pump down relay. Suction pressure, discharge pressure and oil pressure gauges, and signal indicator lights to warn of open limit switches on high pressure, low pressure, oil pressure, or freezestat shall be an integral part of the control panel. A compressor body thermostat shall be included with each compressor and wired to the control panel.

(8) The unit shall be a standard production factory-assembled model and shall be given a complete factory control sequence test.

(9) Acceptable manufacturers are:

(a) Acme Industries, Incorporated
(b) Worthington Corporation
(c) Carrier Corporation

12. PACKAGED LIQUID CHILLERS - Continued

b. A/C Unit No. 2

(1) The Packaged Liquid Chiller shall consist of cooler, condensers, inter-connecting piping, dual compressors, control panel, and rigid steel structural frame members and supporting base.

(2) The unit shall meet the required capacity and ratings of tonnage, quantity cooling water and temperature ranges, quantity condenser water and temperature ranges, and shall not exceed the pressure drops through the cooler and condenser as noted on the drawings.

(3) The compressors shall be accessible hermetic motor compressor unit with rotating parts statically and dynamically balanced, full pressure lubrication, suction and oil strainers, and sight glass for visual oil level check.

(4) The cooler shall be thru-tube direct expansion type with refrigerant in the tubes and water to be cooled within the shell. The cooler is to be factory insulated with closed-cell foamed plastic and is to be constructed and tested in accordance with Underwriter's Laboratory or ASME code requirements.

(5) The condensers shall be cleanable thru-tube type with steel shell and integral finned copper tubes. The condensers are to be complete with relief and purge valves. They are to be constructed and tested in accordance with Underwriter's Laboratory or ASME code requirements.

(6) The control panel box shall be single compartment steel enclosure mounted on the unit containing all electrical controls. All controls and starters shall be completely factory-wired and adjusted in accordance with applicable code requirements.

(7) The refrigerant circuit shall be complete with thermostatic expansion valve, liquid line solenoid valve, sight glass and moisture indicator, filter-drier, relief valve, purge valve, charging and liquid line shutoff valve, discharge gas muffler, heat exchanger and suction and discharge pressure gauges for each circuit.

(8) The chilled water pump shall be centrifugal type pump of close-coupled, bronze-fitted construction with drip-proof motor, enclosed impeller and mechanical seal and shall be factory-mounted complete with insulated pump discharge to cooler inlet piping. Pump shall have the capacity as noted in the drawings.

(9) The unit shall be a standard production factory-assembled model and shall be given a complete factory operating and control sequence tests under full load conditions and shall be shipped with an operating

refrigerant and oil charge.

(10) Acceptable manufacturers are:

(a) Acme Industries, Incorporated

(b) Worthington Corporation

(c) Carrier Corporation

13. CIRCULATING PUMPS

a. The Chilled Water Circulating Pump and the Condenser Circulating Pump shall be especially designed for quiet operation and guaranteed by the manufacturer for the intended application.

b. The pumps shall have the capacity, head and horsepower characteristics as noted on the drawings.

c. Pumps shall be base-mounted and of horizontal or vertical split case design as noted on the drawings. Pump volute shall be supported by the pump base and shall be equipped with venting petcock at its high point. Tapped gauge openings at suction and discharge nozzles shall also be provided.

d. All operating parts shall be accessible without disturbing piping or motor connections.

e. Pump motors shall be specially constructed for quiet operation and shall not exceed 1750 RPM.

f. Motors shall be flexibly connected to pump. Pumps shall be equipped with watertight mechanical seals.

g. Pump and motor shall have oil-lubricated sleeve bearings and suitable oil level indicator shall be provided on the pump.

h. Pumps shall be installed, aligned and started in accordance with the manufacturer's recommendations.

i. Acceptable manufacturers are:

(1) Bell and Gossett Company

(2) Buffalo Forge Company

(3) Chicago Pump Company

14. CARBON MONOXIDE DETECTORS

a. The CO detectors shall be a completely self-contained unit in a weatherproof case and equipped with brackets for easy wall mounting.

b. The detector shall be of the continuous type instrument with a sensitrol meter relay which can be adjusted to between .01% and .04% concentration of CO during predetermined settings.

c. The detector shall be of the ventilating control type with automatic timer and connections to a set of relay contacts for operating an external circuit.

d. Acceptable manufacturer:

(1) Mine Safety Appliances Company

15. DUCT WORK

a. General. Duct work for the air conditioning systems, unless otherwise noted on the drawings or herein, shall be fabricated of commercial quality galvanized steel sheets. The gauges of metal, construction details, stiffeners and bracing shall be, as a minimum requirement, in accordance with the recommendations in the Guide of the ASHRAE.

(1) All access doors and other openings into ducts or plenum chambers shall have sponge rubber gaskets attached to them to prevent air leakage.

(2) Flat surfaces having shortest dimension 18 inches or over shall be cross broken for stiffening.

(3) All duct joints shall be hammered smooth and snug to make them airtight. All exposed edges shall be turned for strength and appearance, and the sheet metal shall be fitted closely and neatly together and be furnished with all necessary ribs, cleats, stiffeners, and other reinforcements required to make all sections rigid and substantial.

(4) The high pressure system shall have round factory fabricated spiral wound ducts and fittings unless otherwise noted on drawings.

(5) All exhaust duct systems shall be as airtight as possible in construction with welded or brazed joints.

(6) Turns in ducts shall be made with a minimum radius equal to 1-1/2 times the width of the duct, except as otherwise shown on the drawings. All mitered turns 45 degrees and greater shall be made

with turning vanes.

(7) Where possible all branches from main or branch ducts shall be of radius bend take off type.

(8) Duct turning vanes shall be installed in all square turns and as otherwise indicated on the drawings. The turning vanes shall consist of curved tubular metal blades, arranged to permit the air to make abrupt turns without appreciable turbulence. They shall be of the manufacturers' standard products, and shall be quiet and free from vibration when the system is operating.

b. Insulation. All supply air duct work exterior to the room or area it is serving, shall be insulated from its point of beginning at the air conditioning units, and shall be continuous up to the point where the ducts are delivering the air at diffusers, registers, and grilles.

(1) All return air duct work from air conditioned rooms and areas shall be insulated where it passes through rooms or areas that are not air conditioned.

(2) Exhaust air duct work shall not be insulated.

(3) Insulation shall be as follows:

(a) All exposed supply air and return air duct work, plenums, etc., to and from air conditioned rooms and areas shall be insulated with 3/4" thick Fiberglass Vapor-Seal insulation Type FF. The insulation shall be attached to the exterior of the duct work with metal clips secured with adhesive, or pronged finger straps, attached to the duct surfaces in accordance with the manufacturer's recommendations. Plasterer's corner bead shall be applied over corners of the insulation. Asbestos cement shall then be neatly finished over the entire surface of the insulation. Six ounce canvas shall then be pasted on over the entire surface with a heavy brush coating of the same adhesive.

(b) Where two or more supply and/or return air ducts run side by side, or one above the other, and the space between them does not exceed one inch, two 1/2 inch thickness of insulation may be placed between them, and the finish shall be applied as though the two ducts were one.

c. Flexible Connections. Flexible connections shall be installed at the inlet and outlet of all fans or equipment containing rotating parts unless otherwise noted on drawings. Flexible connections on the outlet side of heating equipment shall be of the high temperature resistant type. All other flexible connections shall be eight oz. canvas. Flexible connections shall be securely

15. DUCT WORK - Continued

fastened to the duct and the equipment with easily removable steel bands or equivalent which shall be held in place with metal screws or bolts. A minimum two inch clearance shall be maintained between ducts and fans or equipment where flexible connections are used.

d. Supports and Hangers. Proper duct supports and hangers shall be provided and spaced at intervals sufficient to prevent any sag in duct work and duct work joints. All duct work, diffusers, registers, controls, etc., shall be supported from the building walls, ceilings, or from concrete floors with carefully installed expansion bolts or equivalent. Wire shall not be used for supports and any wire used for temporary supports shall be removed prior to acceptance of the installation.

e. Flexible Hose. Flexible hose shall be continuous vinyl coated spring steel wire helix covered with a vinyl impregnated fabric. The helix and cover shall be permanently fused together, to result in an uninterrupted continuous inner and outer surface.

(1) The flexible hose shall be flame-retardant, waterproof and impervious to moisture, rust, and mildew.

(2) The flexible hose shall meet Underwriter's specification (NBFU Pamphlet 90A, Paragraph 113).

(3) Acceptable manufacturers are:

(a) Flexaust Company
(b) Carnes Corporation
(c) Wiremold Company

f. Access Openings. Suitable access openings with covers shall be installed in the duct work at all control devices, balancing dampers, etc., that are not otherwise accessible.

g. Attenuators. The High Velocity Valve Attenuators shall be fabricated from 20 gauge galvanized steel and completely lined with 5/8" to 1" thick sound attenuating fiber glass material coated with an erosion resistant finish. A removable access door is to be provided in the casing for inspection or removal of the Pneumavalve units. All seams that are not spot welded are to have gaskets or a sealer so that air leakage downstream of the valves will not exceed 5% with 1-inch static and the outlet sealed.

(1) All attenuator bearings shall be brass or nylon.

(2) Each attenuator shall be provided with two dampers, one for each duct. Dampers shall be helical spring, neoprene covered type and shall shut with no more than 2% leakage at rated CFM.

(3) All units shall be provided with static pressure taps for air delivery measurement. Balancing must be achieved by a single adjustment.

15. DUCT WORK (Continued)

(4) Total air volume shall be set by a single manual adjustment. Air temperature shall be modulated by a thermostat actuating an internally mounted air motor.

(5) Constant air delivery shall be maintained within ± 5% by a single pressure regulator actuating one internally mounted pneumatic motor.

(6) Acceptable manufacturers are:

(a) Conner Engineering Corporation
(b) Buensod-Stacey, Incorporated
(c) Barber-Colman Company

h. Diffusers. Air supply diffusers shall be of the rectangular, square or round type as indicated on the drawings.

(1) All supply and return air diffusers shall be of the sizes indicated on the drawings. They shall be equipped with built-in, positive, full closing, air volume dampers, so calibrated that they can be set directly for any desired percentage of full open air delivery.

(2) The air volume controls shall be completely independent and adjustable from the diffuser face after it is installed.

(3) The entire inner elements of the diffuser shall be quickly and easily removable for cleaning or inspection and replacement without tools and without disturbing their adjustment.

(4) Finish shall be manufacturers' standard.

(5) Acceptable manufacturers are:

(a) Conner Engineering Corporation
(b) Anemostat Corporation
(c) Barber-Coleman Company

i. Supply Air Registers. Supply air registers shall be of the double deflection type and sized as shown on the drawings.

(1) Face louvers shall be streamlined contour for minimum resistance.

(2) The register frame shall be constructed of 18 gauge steel and a sponge rubber gasket shall be attached to the rear frame to prevent leakage.

(3) The damper shall be of the opposed blade type easily operated through the face of the register by a removable key.

15. DUCT WORK (Continued)

(4) Each register shall be equipped with an air extractor for mounting in the duct take-off to the register.

(5) Acceptable manufacturers are:

(a) Conner Engineering Corporation
(b) Air Distribution Products
(c) Carnes Corporation

j. Return Air Registers. Return air registers shall be of the non-adjustable louver type with horizontal or vertical blades and sized as shown on the drawings.

(1) Louvers shall be factory set in a straight flow position, streamlined for minimum resistance.

(2) The register frame shall be constructed of 18 gauge steel and a sponge rubber gasket shall be attached to the back of the frame to prevent air leakage unless otherwise noted on the drawings.

(3) The damper shall be of the opposed blade type and easily operated through the face of the register with a removable key.

(4) Acceptable manufacturers are:

(a) Conner Engineering Corporation
(b) Air Distribution Products
(c) Carnes Corporation

k. Multi-Louver Dampers. Multi-louver dampers for use in connection with the air intake louvers shall be of the opposed blade design, motor operated, and actuated by the CO detectors as shown on the drawings.

(1) Blades shall be precision formed with overlapping fit and weather stop to assure minimum air leakage. Blades shall be balanced and aligned to assure smooth uniform action. Blades shall not exceed 48 inches in width. Where dampers wider than 48 inches are required, they shall be made up of equal width sections.

(2) Blades shall be made of not less than 16 gauge (0.0598") steel or No. 12 gauge (0.081") aluminum, with cemented on foam rubber edging. Aluminum blades if used shall have stiffener ribs incorporated in them to assure strength and rigidity.

(3) Damper bearings shall be oilite.

(4) Damper frames shall be constructed of not less than No. 14 (0.0747") hot rolled, galvanized steel, or 12 gauge (0.081") aluminum

channels. Frames shall have corner braces for additional rigidity where dampers are 36 inches or more in width.

(5) An operating arm and linkage connecting to all damper blades with suitable oilite bearings, shall form a part of all dampers. Where dampers of two or more sections wide are required, an operating arm and linkage shall be furnished for each section.

(6) Damper blades shall be welded to the damper shafts or set screws holding the blades to the shafts shall be tack welded to prevent their working loose and allowing the blades to twist on the shafts.

(7) Acceptable manufacturers are:

(a) Minneapolis Honeywell Regulator Company
(b) American Foundry and Furnace Company
(c) The Airolite Company

16. PIPING

a. Design Rating. Design rating for chilled water and condenser water piping, unless otherwise noted on drawings, shall be as follows:

Design pressure:	100 psig
Design temperature	100° F

b. Materials. The following piping materials shall be used:

(1) Pipe. Seamless or welded carbon steel, ASTM A 53 Grade A

(2) Pipe Joints.

2-1/2" and over:	Schedule 40, Beveled Ends
2" and under:	Schedule 40, Screwed

(3) Fittings.

2-1/2" and over:	Butt welding, std. wt. carbon steel, ASTM A 234 Grade WPA or WPA-W
2" and under:	150# std. screwed, malleable iron, ASTM A 197

(4) Flanges.

2-1/2" and over:	150# std. welding neck or slip-on, forged carbon steel, ASTM A 181 Grade 1, F & D, FF

(5) Unions.

2" and under:	150# malleable iron, bronze to iron, ground joint

(6) Gaskets. 1/16" thick, full face, compressed asbestos fiber

(7) Bolting. Sq. hd. machine bolts conforming to ASTM A 307, Grade B, with nex. nuts

(8) Gate Valves.

2-1/2" and over:	125# flanged, F & D iron body, bronze mounted, single disc wedge OS & Y, ASA, FF
2" and under:	150# screwed, bronze, single disc wedge, rising stem

(9) Globe Valves.

2-1/2" and over:	125# flanged, bolted bonnet, OS & Y, bronze seat, ring seat disc and stem
2" and under:	150# screwed, bronze, full plug type disc

(10) Check Valves.

2-1/2" and over:	125# flanged, bronze, balanced type swing disc
2" and under:	150# screwed, bronze trim, swing type

c. Installation. Install pipe hangers and supports to allow for expansion and contraction of piping. Hangers and supports shall be placed to prevent pipes from sagging or undue vibration. They shall be placed close to fittings wherever possible. Provide anchors as required, and provide saddles to protect pipe insulation from damage.

d. Insulation. Cold insulation shall be applied to the chilled water pipes from chiller discharge nozzle to chilled water coil inlets. Proper precaution shall be taken in supporting the cold lines to prevent damage to pipe insulation. The condenser water piping shall be insulated as designated in the drawings.

17. CONTROL SYSTEMS

a. Temperature Control System.

(1) Temperature control systems for the heating, ventilating, and air conditioning systems shall be of the pneumatic type. Installation of the systems shall be under the direct supervision of the control manufacturer. The control systems shall be furnished complete including all necessary thermostats, temperature controllers, humidistats, motors, linkages, valves, pressure and temperature switches, thermometers, and accessories as required for the complete systems.

(2) Piping and conduit shall be run in a neat and workmanlike manner with suitable clamps or guides to preclude interference with other devices and operations in connection with testing or replacement.

(3) Control systems shall be guaranteed against defects in material and workmanship for a period of one year after date of certificate of final acceptance and shall be serviced for that period without additional cost to the Owner. Framed control diagrams and sequence of operation shall be hung in the heating, ventilation, and air conditioning mechanical rooms, or left with the Owner.

b. Thermometers.

(1) Thermometers shall be located at all fresh air intakes to heating, ventilating and air conditioning units, in the mixed air chambers of all units, and in the duct work leading away from the units.

(2) Thermometers shall be of the dial type with black numerals and black pointer or a silver plated dial. The dial case shall be adjustable to an angle of 90, 135 or 180 degrees for easy reading. Remote bulb thermometers shall be furnished with a mounting flange and screws for direct mounting on duct work. Dials shall be mounted outside of duct work, plenums, etc., so they may be read from without.

(3) Thermometers for fresh air intakes shall be of the remote bulb type, range 0^{o} to 160^{o} F, and the bulb shall be mounted directly at the downstream side of the fresh air louvers or dampers.

(4) Thermometers for measuring mixed air temperatures in plenums shall be of the remote bulb type, range 0° to 160° F, and the bulb shall be mounted directly downstream of the air filters.

(5) Thermometers for measuring air temperatures in the ducts downstream of the units and/or fans, shall be of the rigid bulb type, range 50° to 250° F. These shall be equipped with 1/2" NPT pressure fitting for mounting in 1/2" NPT couplings welded to the duct work.

(6) Acceptable manufacturers are:

(a) Minneapolis Honeywell Regulator Company
(b) Weston Company

c. Control Panel

(1) The control panel shall be of the surface mounted unitized cabinet type. The cabinet assembly shall consist of a fixed one-third panel with a two-third door, subpanel, and cabinet.

(2) The panel shall be furnished and shall contain all controls as indicated on the drawings.

(3) The panel shall be pre-wired at the factory and terminals for field connections shall be provided.

(4) All devices on panels shall have engraved nameplates.

(5) Acceptable manufacturer:

(a) Minneapolis-Honeywell Regulator Company

18. MOTORS

The Contractor shall refer to the drawings, Electric Motor Data Specifications, and Electrical Specifications for motor sizes and ratings.

19. MOTOR CONTROL

a. Motor controllers shall consist of air circuit breaker combination magnetic starters with manually reset thermal overload protection for full voltage, nonreversing across-the-line service. Each motor controller shall have an enclosure suitable for its area of use, i.e. general purpose, weather-tight, etc. A suitable access from the front shall be provided for field wiring.

b. Starters shall be internally wired for maximum horsepower rating of size specified. Control wires shall be No. 12 minimum size switchboard wire. Breakers shall be wired for maximum ampere rating of frame.

Solderless lugs shall be provided on load side of all motor controllers. Each controller shall include a front mounted pushbutton station and provision to extend a control circuit to a remote pushbutton station or selector switch. A control circuit fuse shall be provided for separate control circuits.

c. The main power supply shall be 440 V 3-phase, 60-cycle, control power shall be 120 V a-c single-phase, 60-cycle. Each door shall be mechanically interlocked with its circuit breaker so that the door cannot be opened with equipment energized. Each operating handle shall be furnished with locking device and indicator to show position of breaker. Each controller shall have two extra auxiliary contacts (exclusive of latch-in), one normally opened and one normally closed. Each motor controller shall have three overload devices with overload heaters sized for motors with 40° C rise, unless otherwise specified.

d. Motor controllers and parts therewith shall be of standard design and completely interchangeable by NEMA size with other controllers and/or breakers of like manufacture.

e. The following motor controllers shall be furnished and shall be wall mounted.

(1) Motor controller for A/C Unit No. 1 chilled water pump.

(2) Motor controller for A/C Unit No. 1 condenser circulating pump.

(3) Motor controller for transfer fan.

20. POWER SUPPLY

The motor control center, 480 volt power distribution panel and 120 volt power distribution panel shall be as specified in Section 17.

21. INSTRUMENT AIR COMPRESSOR

a. The air compressor unit shall be a packaged unit complete with a 30 gallon capacity tank, constructed and stamped in accordance with the ASME Boiler and Pressure Vessel Code Section VIII, width tank relief valve, pressure reducing valve, pressure switch, intake air filter, check valve, and belt guard as shown on the drawings.

b. The unit shall have a corrosion resistant water-cooled condenser with trap for moisture removal.

c. The unit shall be of the size and capacity as shown on the drawings.

d. Acceptable manufacturer:

(1) Minneapolis-Honeywell Regulator Company.

22. EQUIPMENT SUPPORTS

Equipment, unless furnished with its own structural support base or otherwise noted on drawings, shall be furnished with suitable supports or hangers.

23. GROUTING

All equipment bases resting on concrete pads as shown on the drawings shall be grouted, one inch minimum thickness. Equipment shall be properly aligned.

24. PAINTING

The manufacturer's standard finish will be acceptable for equipment supplied hereunder, unless otherwise noted herein and on the drawings. Painting of inner surfaces of concrete air supply shafts and ducts shall be as specified in Section 20.

25. BALANCING, TESTING AND ADJUSTING

a. Balancing, testing and adjusting of the Systems shall be witnessed and supervised by a representative of the Engineer. The Contractor shall notify the Engineer in sufficient time prior to the beginning of such balancing, adjusting, and testing to allow the Engineer time to make his representative available for the witnessing.

b. The Contractor shall furnish all labor, tools and instruments required to properly accomplish the balancing, testing and adjusting.

c. Prior to any testing, the Contractor shall accomplish the following:

(1) Air intake dampers should be in the full open position.

(2) Set and lock splitter dampers in the position indicated on the drawings.

(3) Set all balancing dampers in the full open position.

(4) Set all diffuser dampers, supply and exhaust register dampers, and return air register dampers in the full open position.

(5) Assure that all fans and motors are properly lubricated, and fan belts are at proper tension.

(6) Assure that all automatic air filters have sufficient clean filtering material in them to serve during the balancing period.

(7) Assure that branch exhaust duct stubs located in Draft Tube Gallery are blanked-off.

(8) Have a service man from the manufacturer of the temperature controls available.

(9) Have a recently calibrated anemotherm, anemometer, and tachometer available.

(10) Have a psychrometer and psychrometric chart available.

26. ACCEPTANCE

a. Any portion of the work which fails to function to the satisfaction of the Engineer or any defects which are disclosed shall be remedied by the Contractor at his own expense and the work shall be again tested.

b. A complete record of all tests and their results shall be provided by the Contractor.

c. After completion of the balancing, adjusting and testing to the full satisfaction of the Engineer, the work will be accepted by the City, subject to the guarantees which are in force after completion.

27. GUARANTEES

In addition to the guarantees as specified in Section 1B, paragraph 39, the Contractor shall also guarantee the performance of the air conditioning systems for two years after acceptance. He shall promptly adjust, repair, or replace all parts of the systems adjudged by the Engineer to be below the prescribed standards. The entire cost of this remedial work shall be borne by the Contractor.

28. MEASUREMENT AND PAYMENT

The item "Furnishing and Installing Air Conditioning Systems" shall include all work described under Section 13, including checking of the design, furnishing and installing the equipment complete, balancing, testing and adjusting the systems. Payment will be made at the lump sum price bid therefor in the Proposal.

SECTION 14

ELEVATORS

1. GENERAL

a. Scope. The work covered by this section of the specifications consists of performing all operations in connection with the furnishing and installing of the power plant and dam access elevators and their appurtenances.

b. Intent. It is the intent of the specifications that the work of the Contractor and/or his subcontractors under this Section shall include all work ordinarily done by an elevator contractor, to install the elevators and appurtenant equipment in a satisfactory, neat and workmanlike manner, tested and ready for use and service for commercial operation.

c. Work Included. The work to be performed shall include the furnishing of all labor, plant, materials, tools and construction equipment etc., required for a complete installation of the power plant and dam access elevator equipment including materials, accessories, appurtenances, instruments, gauges, etc., and all interconnecting wiring, etc., as indicated or required for the complete and successful operation of the equipment.

d. Standards. All equipment and appurtenances specified herein or otherwise required for a complete installation shall be in compliance with the requirements of the National Electrical Code, American Standard Safety Code for Elevators and any local codes or ordinances that may be applicable to this installation, including all applicable revisions which are current on the date of award of Contract.

e. Local and State Inspection. The Contractor shall obtain and pay for all necessary local and State inspection and permits required and to make such tests as are called for by the regulations of such authorities. These tests shall be made in the presence of the authorized representatives of such authorities, and signed records of such tests and approvals must be submitted to the Engineer.

f. Welding. All welding shall be in accordance with the requirements of Section 10, paras. 4 & 6, and the following requirements for radiographic inspection. Whenever possible welds in critical members shall be designed so that, in addition to visual inspection, 100 percent of such welds may be inspected radiographically in accordance with Section VIII of the ASME Code, Paragraph UW-51 thereof. Where welds in critical members cannot be radiographically inspected, they shall be subjected to magnetic particle inspection.

2. DESCRIPTION OF ELEVATORS

a. General. The Contractor shall furnish and install automatic selective collective passenger elevators, of the worm gear traction type, complete with

2. DESCRIPTION OF ELEVATORS - Continued

car platform, counterweight, buffers, elevator machine, hoistway doors and trim, structural parts and anchor bolts, and all appurtenances specified herein or otherwise required for a complete installation.

b. Power Plant Elevator.

Type	Geared traction
Capacity	5,000 pounds, exclusive of car, cables and ropes
Speed	200 feet per minute
Platform, approximately	7'-4" wide and 7'-11" front to back
Hoistway	Wall to wall dimensions of hoistway approximately 9'-4" wide x 9'-0" front to back
Home Floor	Provisions shall be made in controls for selecting a Home Floor at option of the City
Travel, approximately	60 feet
Number of landings and openings in line	Six (6)
Control	Selective collective without attendant, rheostatic and self-leveling
Number of pushbutton risers	One (1)
Guide Rails	Planed steel
Buffers	Spring
Car Doors	5'-4" x 7'-0", 2-speed, side opening
Hoistway Doors	6'-0" x 7'-0", 2-speed, side opening
Door operation	Automatic, with closers
Signals	Car position indicator with direction arrows - in use lights
Machine location	Overhead
Interior Height of Car	8'-0"

2. DESCRIPTION OF ELEVATORS - Continued

Power Supply	440 volt, 3-phase, 60-cycle, a-c
Lighting Supply	115 volt, 60-cycle, a-c

c. Dam Access Elevator.

Type	Geared traction
Capacity	2000 pounds, exclusive of car, cables and ropes
Speed	300 feet per minute
Platform, approximately	6'-4" wide x 4'-5" front to back
Hoistway	Wall to wall dimensions of hoistway approximately 8'-6" wide x 7'-2" front to back (circular in shape)
Home Floor	Provision shall be made in controls for selecting a Home Floor at option of the Owner
Travel, approximately	210 feet
Number of landings and openings in line	Three (3)
Control	Selective collective without attendant, rheostatic and self-leveling
Number of pushbutton risers	One (1)
Guide rails	Planed steel
Buffers	Spring
Car doors	4'-0" x 7'-0", 2-speed, side opening
Hoistway doors	4'-7" x 7'-0", 2-speed. side opening
Door operation	Automatic, with closers
Signals	Car position indicator with direction arrows - in use lights
Machine location	Overhead
Interior Height of Car	8'-0"

Power Supply	440 volt, 3-phase, 60-cycle, a-c
Lighting Supply	115 volt, 60-cycle, a-c

3. ELEVATOR MACHINE AND MOTORS

a. Location. The elevator machine shall be placed directly over the hoistway, mounted on structural steel beams or channels furnished and installed, with any necessary bearing plates. These beams shall be securely fastened to suitable supports which shall be furnished complete with anchor bolts and parts for embedding in concrete.

b. Sound Reducing. Necessary sound reducing materials, preferably rubber pads of proper density, shall be provided to effectively isolate the machine from the machine beams of flooring.

c. Machine. The machine shall be of the single worm-geared traction type, with motor, brake, gearing and driving sheave mounted in proper alignment on a cast iron or steel bedplate. The worm shall be of steel, integral with the worm shaft and shall be provided with a ball bearing thrust with self-aligning blocks, designed to take the end thrust of the worm in both directions. The thrust bearings shall be removable without dismantling the machine. The worm gear shall be hobbed from a bronze rim which will be accurately fitted and bolted to the gear spider. Roller bearings shall be provided and they shall be equipped with suitable means of lubrication. The brake shall be spring applied, electrically released, and designed to be instantly and automatically applied in the event of interruption of power supply from any cause.

Sufficient deflector and overhead sheaves shall be provided to obtain proper lead on the ropes to car and counterweight. Sheaves shall be cast iron, accurately machined and grooved for the diameter of ropes used and supported by steel beams or channels.

d. Motor-Generator Set. To obtain the most desirable speed control of the elevator, the elevator motor shall be of the d-c type. A motor-generator set shall be supplied with the elevator as a means of converting the available alternating current to direct-current for the elevator motor use. The motor-generator set shall be of compact design. Bearings shall be of ample size with automatic lubrication and properly designed seals to prevent oil leakage. The set shall be designed to comply with the IEEE Standards for Class A insulation and for continuous operation under full load with 50-degree Centigrade temperature rise. If a d-c exciter is required it may be mounted on the motor-generator set or provided as a separate unit. The motor-generator set shall be mounted on a cast iron or steel bedplate or may be of the unit type, and shall be properly aligned and balanced to eliminate vibration. The motor-generator set shall be located in the machine room and isolated from the floor by rubber isolation pads. Appropriate switches and protective devices shall be included for the control of the motor-generator set. The controller shall be so arranged

that after a pre-determined period of elevator inactivity, the motor-generator set automatically shuts down. It shall restart after pressing of a hall button or a car button.

e. Hoisting Motor. The hoisting motor shall be of the direct-current reversible type, specifically designed for elevator service, with high starting torque and low starting current, designed to withstand the severe loads encountered in elevator service and shall have sufficient capacity to operate with the contract load and speed without overheating. The motor shall be rated for 50-degree Centigrade temperature rise based on a 30-minute operation period. The motor shall be of drip proof construction, with anti-friction bearings, Alemite pin type grease fittings and spring type grease relief fittings and shall conform to the requirements of NEMA Standards for Motors and Generators for Integral Horsepower Direct-Current Elevator Motors.

4. GUIDES RAILS AND BUFFERS

a. General. Guides for car and counterweight shall consist of planed steel tees, erected plumb with an 1/8 inch tolerance, and securely fastened to the concrete by anchors and to the brackets by bolts. Guide rails for the car shall have a section weighing not less than 16 pounds per lineal foot; and those for the counterweight shall be of a section weighing not less than 8 pounds per lineal foot and shall comply with the requirements of the American Standard Safety Code for Elevators. The ends of all guides shall be tongued and grooved, forming matched joints and connected with steel plates. All necessary clamps and brackets for the car and counterweight guide rails, including drilling of supports, shall be furnished and installed by the Contractor.

b. Guide Rail Lubricators. Guide rail lubricators shall be installed on the top of the car and counterweight. These lubricators shall distribute oil evenly to the guides rails. The rate of feed shall be adjustable by means of regulating screws. Suitable containers shall be provided to catch the oil at the bottom of the guides.

c. Roller Guide Shoes. Roller guide shoes shall be furnished, securely bolted to the car and counterweight frames at top and bottom. Each roller guide shall consist of a set of three sound-reducing wheels to run on the three finished rail surfaces. The wheels shall be mounted in precision type ball bearings and held in contact with the rail surfaces by means of adjustable cushioning devices. Roller guides shall run on dry unlubricated guide rails.

d. Buffers. Substantial spring buffers shall be installed under the car and counterweight. Buffers in the pit shall be mounted on continuous steel channels which are fastened to the guide rails. Pipe struts for buffers shall be provided, if required.

5. COUNTERWEIGHTS

The elevator shall be suitably counterbalanced for smooth and economical operation. Cast iron weights shall be contained in a structural steel frame properly guided with suitable guide shoes. The counterweight shall be equal to the weight of the complete elevator car plus about 40% of the specified capacity load.

A substantial metal counterweight screen of required length shall be installed at the top and bottom of the hoistway.

6. ROPES

Suitable traction steel hoist ropes of sufficient size and number shall be installed to insure proper wearing qualities. As a minimum, the number of ropes shall comply with the factor of safety requirements of the American Standard Safety Code for Elevators.

Hoist and governor ropes shall be especially designed for elevator service and shall comply with the minimum requirements of the ASE Code.

The main ropes as well as the governor ropes shall be supplied with wind troughs. All ropes shall consist of at least eight (8) strands of steel wound about a hemp core center.

7. CAR FRAME AND PLATFORM

a. Car Frame. The car frame shall consist of structural steel channels and angles which are securely riveted or bolted and substantially reinforced and braced as to relieve the car enclosures of undue strains.

b. Car Construction. Panels and canopy shall be no lighter than No. 14 U. S. gauge furniture steel, smooth and free from defects. Wainscot panels shall be in one (1) piece vertically from floor to canopy. All plates shall be welded. Drawn steel shapes shall be no lighter than No. 16 U. S. gauge. No visible fastening for moldings or ornamentation shall be used. The car shall be entirely free from squeaks and rattles and all joints shall be light proof.

c. Car Platform. The car platform shall consist of structural steel frame filled with two layers of wood flooring and a top floor covering. The wood flooring shall consist of T. & G yellow pine. The top floor covering shall be a resilient tile floor (Armstrong #1009 custom vinyl teak cork or approved equal.) The underside of the car platform shall be covered with sheet steel of not less than .016 inch thickness. The platform shall be equipped with a bronze threshold plate, and be mounted on rubber pads supported on an auxiliary steel frame fastened to the car frame. This arrangement shall form an isolating cushion between the car and steel car frame. A manufacturers standard of comparable design will be acceptable.

d. Electrical Features. The following electrical features shall be furnished and installed on the elevator car:

(1) An indirect fluorescent trough fixture of adequate intensity shall be provided for lighting.

(2) A concentric ring ceiling type ventilating grill approximately 14-inches in diameter, with exhaust fan shall be provided.

(3) Conveniences outlets shall be provided on top of the car and underneath the platform for use when servicing the elevator.

(4) A stainless steel telephone cabinet complete with telephone and traveling cable shall be provided in each car for emergency use.

(5) The dam access elevator shall be furnished with thermostatic controlled heaters to maintain a car temperature of 65°F with an outside temperature of 10°F ambient. The heaters shall be rated at 440-volt, 3-phase, 60 cycle, A.C.

8. CAR ENCLOSURE

a. Car Doors. The car entrance shall be protected by automatically operated two-speed side opening doors of the size shown on the drawings. Doors shall be of flush construction, with each door panel not less than 1-1/4" thick and made of not less than No. 16 gauge furniture steel substantially reinforced with continuous vertical members and containing effective sound deadening material. Each door panel shall be reinforced as required for hangers, interlocks, door closer and keyways. Panel rigidity shall be obtained by suitable steel reinforcement. Each door panel shall have a removable non-metallic guide which shall ride in a suitable groove placed in the door sill.

The car door shall have four (4) sheave type two-point suspension hangers and tracks complete. Sheaves shall be steel with a flanged groove in which a solid rubber tire shall be securely vulcanized. Sheaves shall include ball bearings sealed to retain grease lubrication and shall be mounted on steel housings arranged for attaching to the door. Hangers shall be provided with ball bearing adjustable rollers to take the up-thrust of the doors. Tracks shall be cold drawn steel with surfaces shaped to conform to the tread of the hanger sheaves and rollers.

b. Door Contact. The car doors shall be equipped with a contact which will prevent operation of the car unless the gate is closed. The contact shall be of an approved type and shall be tested as required by ASE Code.

9. HOISTWAY ENTRANCE

a. General. Each entrance shall be designed for finished walls and shall include hoistway door unlocking devices and service keys to meet local code requirements.

b. Door Frames. The openings in the concrete structure shall be formed to act as the finished door frame.

9. HOISTWAY ENTRANCE - Continued

All hoistways landing doors shall be equipped with metal non-vision closure at all sides and finished to match the doors. They shall be installed in a manner to reduce to a minimum the clearance between the doors of the hoistway and car beyond the door openings.

c. Doors. Doors shall be automatically operated two-speed side opening doors of the size shown on the drawings. Doors shall be of flush construction, with each door panel not less than 1-1/4" thick and made of not less than No. 16 gauge furniture steel substantially reinforced with continuous vertical members and containing effective sound deadening material. Each door panel shall be reinforced as required for hangers, interlock, door closer, keyways, and with hoistway door unlocking devices and service keys as required to conform to code requirements. Each door panel shall have a removable non-metallic (laminated phenolic, or equal) guide which shall ride in a suitable groove placed in the door sill.

d. Sills. Each sill shall be of extruded aluminum. The grooves for the door guides shall be accurately formed to provide minimum clearance. Each sill shall be supported on steel anchors securely fastened to the floor construction and located in proper relationship to the elevator car guides. Anchors and fasteners shall be provided.

e. Fascia Plates. Fascia plates shall be of No. 14 U. S. gauge steel reinforced to insure a flat even surface throughout and shall be securely fastened to hanger housings and concrete walls.

f. Toe Guards. Toe guards, made of No. 14 U. S. gauge steel, shall be supplied for the lowest landing and they shall be gradually beveled to the wall.

g. Headers. Headers shall be constructed of sufficient size and thickness to provide support for the frame and hangers and shall be securely bolted to the strut angles or closer support angles.

h. Steel Angles. Steel angles shall be furnished of sufficient size to accommodate the door closers. Angles shall be continuous and securely bolted to the sills and concrete walls above or bracketed from a point above the header to the guide rails.

i. Hanger Cover Plates. Hanger cover plates shall be made of No. 14 U. S. gauge steel, shall be of the removable type, and shall be arranged to assure hanger accessibility from within the car.

j. Miscellaneous. Sills, struts, hanger supports, hanger covers, and unit frames shall be erected after the erection of rough walls and set in proper relation to the elevator car guides. Doors, fascias and toe guards shall be installed after the walls are finished. Unit frames shall have a protective covering for finished surfaces.

Each entrance door shall have the necessary hangers and tracks complete. Hangers shall be of sheave type arranged for two-point suspension of the doors. Hanger brackets shall be integral with the door, or applied. Sheaves and rollers shall be of steel and shall include ball bearings properly sealed to retain grease lubrication. Adjustment ball bearing rollers shall be provided to take the up-thrust of the doors. Tracks shall be cold drawn or cold rolled steel of smooth surface and the working section shall be cleaned and oiled with wick type lubricators.

10. CAR AND HOISTWAY DOOR OPERATORS

a. General. Doors on the car and at each hoistway landing shall be operated quietly and smoothly by an electric operator driven by a direct current motor which shall open the car door and hoistway door simultaneously.

The operator shall fully open the door in a maximum time of 2.9 seconds, and shall fully close the doors in a maximum time of 3.9 seconds. Door movement shall be cushioned or checked at both limits of travel

An electro-mechanical interlock shall be provided at each opening to prevent the operation of the elevator unless all doors are closed and locked.

An electric contact shall be provided on the car door which shall prevent elevator movement away from the landing unless the doors are in the closed position and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing as defined in the American Standard Safety Code for Elevators. The pressing of a car button once the doors are fully open, shall cause the doors to close.

b. Interlock. Each hoistway door shall be equipped with a positive electro-mechanical interlock and auxiliary door closing device so that the elevator can be operated only after the interlock circuit is established. The interlock operation shall comply with the American Standard Safety Code for Elevators.

c. Manual Operation. The door operator shall be arranged so that in case of interruption or failure of electric power from any cause, the doors can be readily operated by hand from within the car. Devices and keys for opening the doors from the landing shall be provided as required by governing code.

d. Protective Device. The car doors shall be provided with a protective device extending the full height and projecting beyond the front edge of the door

while the door is closing. The device shall retract as the door opens. Should this device touch a person or object in its path, while the car doors are closing, both car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a predetermined time interval and then close automatically.

e. Operator. The doors shall open automatically as the elevator is leveling and close either after expiration of a time interval or the moment a car button call is registered. If desired, it shall be possible to stop or reverse the doors. In case of power interruption or failure of the operator, it shall be possible to open the doors manually from within the car.

11. HOISTWAY ACCESS AND TOP OF CAR INSPECTION

a. General. There shall be provided a hoistway door unlocking device and top of car inspection device in accordance with the requirements of the 1955 Edition of the American Standard Safety Code, including 1957 Revisions for elevators. Also there shall be provided a cable inspection door unlocking device and an additional inspection device for the dam access elevator.

b. Equipment. The following equipment shall be furnished:

(1) A key operated inspection switch with two positions, normal and inspection, located in the car.

(2) Hoistway door unlocking devices conforming to the requirements of the ASE Code shall be provided to permit authorized persons to gain access to hoistway when the elevator car is away from the landing. In addition, a cable inspection door unlocking device to permit authorized persons to gain access to the dam elevator hoisting cable supports from within the elevator car.

(3) An operating box on top of each car located between car crosshead and hoistway doors and an operating box outside the cable inspection door of dam elevator car, each complete with an emergency stop switch and selection switch, safety button and "Up" and "Down" operation buttons.

(4) An emergency stop switch in the pit.

c. Operation. To gain access to the top of the car, the car shall be run to a point below the top terminal landing by means of the regular operating device. The inspection switch in the car is turned to the inspection position which modifies the operation as follows:

(1) Normal operating car and landing devices made ineffective.

(2) Top of car operating device made effective.

(3) Power door operation cut out.

(4) Automatic leveling cut out.

d. Miscellaneous. The top door shall be opened by means of a special key inserted in the hoistway unlocking device in the door. The top of car is selection swtich when operated shall make the top of car operating device effective. To operate the top of car operating devices, a selection switch shall be turned from "Manual" to "Top of Car".

In addition to the top of car operating device, there shall be an operating device located outside the cable inspection door exterior of the dam access elevator car. The inspection door shall be opened by means of a special key inserted in the unlocking device in or near the door. The cable inspection selection switch when operated shall make the top of the car operating device ineffective and the cable inspection operating device effective. To operate the cable inspection operating device, a selection switch shall be turned from "Manual" to "Cable Inspection".

Movement of the car shall be by simultaneous, continuous pressure of the appropriate direction button and the safety button. Operation from top of car or inside a car shall not be permissible unless all electric door contacts are closed.

A hoistway door unlocking device shall be provided at the bottom floor permitting this door to be opened by means of a special key regardless of the position in the car.

To gain access to the pit, the car is run above the lowest floor. The inspection switch in the car is operated, making normal operating devices ineffective. The pit door is then opened by inserting the special key in the unlocking device, making access to the pit available.

e. Elevator Inspection Platform. Steel platform shall be provided on top of the elevator car as shown on the drawing for inspection and maintenance of the hoistway.

The platform shall be floored with non-slip steel plates and provided with toe plates at all open edges.

12. GOVERNOR AND SAFETY

A mechanical safety device shall be mounted under the car platform and securely bolted to the frames. It shall be actuated by a centrifugal governor mounted in the machinery room and connected to the safety tripping mechanism by a continuous governor cable attached to the car frame, passing over the governor sheave and a weighted tension sheave in the pit.

The governor jaws shall grip the cable in a minimum time after the governor

reached tripping speed and shall be held in engagement with the cables by springs and the tension of the governor rope. The governor jaws shall be so designed that the governor rope may slide through them after the safety has set without damage to the rope.

The operation of the governor on overspeed shall open a switch disconnecting the power from the elevator, and shall trip the safety mechanism. The safety mechanism when tripped shall engage the rails with sufficient force to stop the car from governor tripping speed with full load in the car. The pressure of the two pairs of jaws on the rails shall be equalized.

The mechanism shall gradually and smoothly bring the car to a top from governor tripping speed, with an average rate of retardation within the limits given in the ASE Code for various loads.

The governor shall be accurately adjusted and sealed with the tripping speed specified in the ASE Code.

In the event of parting of hoist cables, the safety mechanism shall apply instantly and independently of the speed action of the governor.

13. OPERATOR CONTROLS AND SIGNALS

a. Operation. The operation shall be selective collective automatic control with a flush-mounted operating device in the car which shall include a bank of buttons numbered to correspond to the landing served, a switch for the car light, a switch for vent fan, and alarm button connected to an alarm bell outside the hoistway, which serves as an emergency signal, an emergency stop switch, and such auxiliary switches as may be required. Single pushbuttons shall be mounted at each terminal landing and "Up" and "Down" buttons at each intermediate landing.

The operation shall be such that momentary pressure on one or more car or landing buttons, other than those for the landing at which the car is standing, shall start the car. However, in this case, interlock circuits must be established, and cause the car to stop at the first landing for which a car or landing button is pressed corresponding to the direction in which the car is traveling. The car shall stop at all landings for which calls are registered and these stops shall be made in the order in which the landings are reached, irrespective of the sequence in which the buttons are pressed. Thereby the buttons for a given landing must have been pressed sufficiently in advance of the arrival of the car at that landing to permit the stop to be made.

Car buttons shall have preference over landing buttons and shall make the landing buttons inoperative until the response to the car buttons has been completed. The system shall be so arranged that the floor buttons are inoperative while the car is in motion and for a predetermined time after the car stops at a landing.

If no car buttons are pressed and the car starts up in response to several "Down" calls, the car shall proceed first to the highest "Down" call and then reverse to collect the other "Down" calls. "Up" calls shall be collected similarly when the car starts down in response to such calls. If the car stops for a landing call and a car button is pressed within a predetermined interval after the stop for a landing corresponding to the direction the car was traveling, the car shall proceed in the same direction regardless of other landing calls registered.

If "Down" landing buttons are pressed while the car is traveling up, the car shall not stop at these landings, but these calls shall remain registered. After the highest car and landing calls have been answered and the door interlock circuit is established, the car shall reverse automatically and response to "Down" car and landing calls. When traveling down, the car shall not respond to "Up" landing calls, but these calls shall remain registered and be answered on the next up trip.

A time delay relay shall hold the car for a few seconds at the landings at which stops are made to enable passengers to enter or leave the car. Pressure of a car button for another landing before this time elapses shall cause the car to start provided the car door and hoistway door are closed. When the car has answered the farthest call, this interval shall permit a car button to be registered to establish the direction of car travel even though a landing button call may already be registered for the opposite direction of travel.

The emergency stop switch shall interrupt the power supply and apply the brake independently of the regular operating device. Opening the emergency stop switch shall not cancel registered calls and, after the switch is closed, the car shall continue to answer these calls.

A key-operated "parking" switch shall be furnished in the car. When this switch is in the "on" position, normal operation of the elevator shall occur, in the "off" position the elevator shall be shut down. In addition, "Hold Open" button for door closure shall be provided in the car controls.

b. Controls and Signals. The controller shall be of the electro-magnetic type and designed to provide the operation described above. The controller shall control starting, stopping and the speed of the elevator motor and also apply the brake if any of the safety devices function, or if the power fails from any cause. The controller shall include a reverse phase relay.

A safety mechanism shall be mounted on the button members of the car frame and shall be operated by a centrifugal speed governor located over the hoistway. The safety mechanism shall be arranged to stop the car whenever excessive descending speed is attained and means shall be provided to cut off power from the motor and apply the brake prior to application of the safety. If the car should be released from the hoist ropes, the safety mechanism shall apply instantly and independently the speed action of the governor.

The elevator shall be equipped with an automatic stopping device, arranged to bring the car to a stop at the terminal landings independent of the regular operating device in the car. Final limit switches shall be provided in the hoistway, operated by the car and arranged to stop the car and prevent normal operation, should it travel beyond the zone of the normal stopping device.

The elevator controller shall be equipped with an overload relay arranged to shut off power and protect the motor from damage in the event that the elevator is overloaded.

The elevator shall be provided with a self-leveling feature that will automatically bring the car to the floor landings. This self-leveling shall, within its zone, be entirely automatic and independent of the operating device and shall correct for over-travel or under-travel and rope stretch. The car shall also be maintained approximately level with the landing irrespective of the load.

c. Alarm Bell. An emergency alarm bell with necessary wiring and transformer shall be provided and located outside the hoistway adjacent to the upper landing and connected to a plainly marked pushbutton located in the car's operating panel. The alarm circuit shall include independent contact for the annunciator system of the power plant.

d. Position Indicators. An electric position indicator shall be provided in the elevator car and at each landing. The indicator shall consist of a finished faceplate with glass numerals, behind each of which will be a small shielded light bulb, so arranged that as the car travels through the hoistway, its position shall be indicated by the illumination of the numeral corresponding to the landing at which the car is stopped or passing. Direction arrows shall be included.

Each landing button fixture shall be similar to a Westinghouse Type E corridor pushbutton station, and include a suitable direction light for each button. Whenever a landing call is registered, the corresponding "Up" or "Down" light shall become illuminated and effect visible registration of the landing call until answered.

14. ELECTRICAL WIRING AND PROTECTION

a. General. The Contractor shall furnish and install all necessary insulated wiring conductors, conduits, tubing, fittings, boxes and inter-connecting trailing cable for all parts of the elevator machinery, cars, signals and telephones complete and ready for installation.

b. Wiring. Insulated wiring shall have a flame retarding and moisture resisting outer cover and shall be run in rigid steel conduit or wire ducts. Traveling cables between car and hoistway shall have flame retarding and moisutre resisting outer covers. They shall be flexible and suitably suspended to relieve strains in the individual conductors.

c. Conductors and Conduits. All insulated conductors and conduit, as well as fittings including metal boxes, shall comply with the requirements of the code for "Electrical wiring, pipes and ducts in power elevators, dumbwaiter hoistways, and machine rooms" issued by the ASME American Standard Safety Code for Elevators, Dumbwaiters, and Escalators; A17.1.

d. Indicators. Car and hall button indicators shall be provided with gaskets for moisture resistance. Limit switches the top of car operating device and car door contacts shall be moisture proof. Interlocks, stopping switch and door operator shall be covered and shielded against moisture. Conduit shall be rigid with water-tight connectors. Gasketed unilets and junction boxes shall be provided.

e. Controllers. The controllers will be located in an unheated room. Insulation shall be treated for damp and fungus (tropical type) in such a way that the equipment will operate either continuously or intermittently. Metal parts, hardware, and bearings shall be given special attention for corrosion resistance. Cubicle heaters shall be provided to maintain moisture-sensitive equipment above the dew point. Sensitive equipment shall also be dust-protected to the extent that normal operation will not be affected by conditions during initial and future construction periods.

f. General Protection. All material in the hoistway shall be moisture resistant and all safety mechanism parts shall be cadmium plated.

15. WRENCHES, TOOLS, AND SPECIAL EQUIPMENT

a. The Contractor shall furnish one complete set (total for two elevators) of case-hardened special wrenches and any special tools, slings, and other equipment that may be necessary for convenient assembly or dismantling of any part of the elevator equipment.

b. All tools and equipment shall become and remain the property of the City. The wrenches and tools shall be provided with a steel box, with means for ready identification.

16. SPARE PARTS

a. The following spare parts shall be supplied by the Contractor for each elevator and the cost of furnishing these parts shall be included in the price bid for furnishing the equipment required.

(1) One spare operating coil for each type of main and motor contactor.

(2) One spare, renewable contact for each type of controller.

(3) One spare relay for each type relay used.

b. All spare parts furnished shall be interchangeable with and shall be of the same material and workmanship as the corresponding original parts.

17. TESTING

In order to insure the safe operation of the elevators the Contractor shall, upon their completion and before being placed in service, subject the elevators and all related equipment to an acceptance inspection and tests in the presence of the Engineer's inspecting representative. These tests shall determine that all parts of the installation conform to the applicable code requirements and that all safety equipment has been properly installed and functions as required under all sections pertaining to Elevators in Part IX of The American Standard Safety Code for Elevators, A17.1-1960. In the event of any major alterations, a similar inspection and test shall be made.

The Contractor shall be responsible for any damage to any work covered by this Specification, before acceptance of the work, and upon completion and acceptance of the work the Contractor shall furnish to the City a complete and "as built" wiring diagram of the entire installation.

18. MAINTENANCE SERVICE

The Contractor shall supply maintenance on the entire elevator systems for a period of twelve (12) months after acceptance. The maintenance work shall be done only by competent personnel under the supervision of and in the direct employ of the Contractor or his subcontractor. This maintenance shall include the following:

a. Emergency call-back service during the regular working hours of the Contractor or subcontractor.

b. Systematic examination, adjustment and lubrication of all elevator equipment as recommended by the manufacturer's standard maintenance and instruction manual.

c. Prompt replacement or repair without cost to the City, of electrical and mechanical parts of the elevator equipment whenever required for proper operation during the maintenance period. The Contractor shall use only standard parts produced by the manufacturer of the equipment concerned.

d. All wire ropes shall be replaced as often as necessary to maintain an adequate factor of safety.

Renewals or repairs necessitated by reason of any cause beyond the control of the Contractor shall not be at the expense of the Contractor.

19. PAINTING AND PROTECTIVE COATINGS

a. General. All unfinished surfaces of the elevators, except those surfaces which will be embedded in concrete, shall be thoroughly cleaned, and painted by the Contractor at the factory with a suitable priming paint, satisfactory to the Engineer. Flaws in the exterior surfaces shall be filled by electric welding or metalizing and ground smooth before being given the prime coat. All metal finished surfaces shall be protected from corrosion by a readily removable rust preventative compound. Steel shall be factory painted with one coat of zinc-chromate paint except for the wearing surfaces of the guide rails. Any exterior surfaces requiring welding during assembly shall be ground smooth and given a prime coat. Final painting of the elevators installations, except the Contractor's standard finishes, will be done by the City after erection is completed.

b. Surface Preparation. Steel surfaces shall be prepared in accordance with the Steel Structures Painting Council Surface Preparation Specification.

c. Painting.

(1) General. All metal work except finished or working surfaces shall be properly painted, generally in accordance with the manufacturer's standards. Before applying any protective coatings, the metal for the car, doors, trim, frames and other related accessories shall be thoroughly cleaned of oil and grease and have all rust removed. Except as otherwise provided herein, they shall be coated immediately after cleaning with the manufacturer's standard rust inhibitive paint. Following the initial priming coat, a sufficient number of filler or surfacing coats shall be applied to all surfaces which will be exposed after installation to provide a smooth, even finish, each coat being based and sanded as necessary. After surfacing, no less than four finishing coats of enamel shall be applied, each coat being baked and the final coat rubbed to a smooth eggshell gloss. The color of the finishing coats will be determined by the Engineer to be compatible with the architectural treatment of the power plant.

(2) Closures and Doors. Closures, doors, fascias, and other exposed parts shall be thoroughly cleaned of oil, grease and other foreign substances in preparation for finishing. Materials shall then receive a rust-preventing treatment such as "Bonderizing" or the equal followed by a baked-on primer coat.

All exposed surfaces of the doors and closures shall receive application of mineral filler with each application baked and sanded to insure a smooth surface. This shall be followed by a heavy coat of baked enamel primer or surfacer which is sanded and rubbed smooth.

Three additional coats of enamel in the color as selected by the

Engineer shall be applied each of which shall be baked on separately and made smooth and clean.

(3) Car. Before the finish is applied, the panels shall be thoroughly "Bonderized" after which the car interior shall be cleaned and then sprayed with not less than three (3) coats of pigmented lacquer, the color as selected by the Engineer. The car side surface of the door shall be baked enamel to match the car interior.

The exterior shall be finished with one (1) shop coat of lead and oil paint.

(4) Structural Members and Elevator Platform. All structural members and the elevator platform shall receive a shop coat of black paint.

20. PAYMENT

Payment for all items of work performed under this section will be made at the lump sum price bid in the Proposal for "Furnishing and Installing Dam Elevator and Appurtenant Equipment" and "Furnishing and Installing Power Plant Elevator and Appurtenant Equipment".

SECTION 15

TURBINES, MACHINE HALL CRANES AND TRAVELING TRASH RAKE AND HOIST

1. GENERAL

a. Scope. The work covered by this section of the specifications consists of performing all operations in connection with the installing of the mechanical equipment and their appurtenances as hereinafter described.

b. Intent. It is the intent of the specifications that the work of the Contractor and/or his subcontractors under this section shall include all work ordinarily done by a mechanical contractor, to install mechanical equipment and appurtenances in a satisfactory, neat and workmanlike manner, tested and ready for use and service for commercial operation.

All equipment will be shop assembled by the manufacturer and tested for fit and alignment and, before being disassembled for shipment, will be matchmarked and/or otherwise marked for correct assembly and alignment of all parts in the field.

c. Work Included. The work to be performed shall include the furnishing of all labor, plant, materials, tools and construction equipment etc., required to complete the installation of all mechanical equipment including materials, accessories, appurtenances, instruments, gauges, etc., and all interconnecting piping, valves, etc., as indicated or required for the complete and successful operation of the equipment.

d. Erecting Supervisors. The City will furnish, without cost to the Contractor, the services of competent and qualified Erecting Supervisors for certain specified City-furnished equipment, who will represent the manufacturer and act in an advisory capacity.

The Erecting Supervisor will be provided for such reasonable time, as determined by the Engineer, as will be necessary for the complete installation of the particular equipment, including the correct procedures and methods to be used in setting, erecting, aligning and otherwise assembling and installing the equipment.

The Contractor shall give the Engineer a 30-day notice of the time when Erecting Supervisors will be required at the site. The Contractor, his employees and subcontractors shall cooperate fully with said Erecting Supervisors and shall perform all installation and erection work under his guidance and technical direction. In the event of differences of opinion between the Contractor and the Erecting Supervisors regarding the work to be done the decisions of the Engineer shall be final and conclusive. The presence of the Erecting Supervisors shall not relieve the Contractor from responsibility for obtaining proper installation as required.

2. INSTALLATION AND ERECTION REQUIREMENTS

a. All installation and erection methods and procedures shall conform with accepted best engineering practice, and the requirements of accepted codes and regulations where applicable. All equipment shall be erected in accordance with the respective manufacturer's recommendations for installation, and shall be located, piped, tubed, connected and otherwise erected and installed in strict accordance with the specifications, as shown on the drawings, or as directed by the Engineer.

b. Some items of equipment will be supplied by manufacturers disassembled as necessary to comply with shipping and unloading limitations. The Contractor shall reassemble and install the equipment complete with all accessories and auxiliaries, including such accessories as are supplied by the manufacturer and shipped separately, such as gages, valves, interconnecting piping, instruments, etc. The Contractor shall uncrate, clean and inspect all equipment and material, and shall remove any temporary plugs, blanks, braces, etc., which may have been installed for shipment by the manufacturer. Rust inhibitors, slushing compounds, wrapping or other protective material shall be removed and the equipment shall be inspected and cleaned of any foreign matter which may have accumulated during shipment. Immediately upon receipt, all equipment shall be thoroughly inspected by the Contractor who shall report any damaged equipment to the Engineer as soon as same is observed.

c. Equipment shall be placed, aligned and bolted down prior to making external connections. In making external connections, such as piping, care shall be exercised to insure that no strain or thrust will be placed on the equipment, and provisions for relief of expansion of piping and equipment shall be checked. After the external connections are made, the level and alignment shall be rechecked and the bolts tightened. Mortar mixtures or dry-pack of the proper proportions and consistency as prescribed in Section 9B, to produce a firm continuous support for the equipment, shall be poured or placed. Exposed edges of the mortar shall be smoothly finished. All rotating machinery shall be checked for proper shaft rotation and alignment after piping connections and mortaring have been completed, and any necessary re-alignment shall be done.

d. The Engineer will initially establish a coordinate grid system and benchmark for datum. Thereafter, the Contractor shall be responsible for the elevations and proper positioning of all equipment to the required and approved tolerances, subject to checking by the Engineer at all times. The Contractor shall maintain or renew, if damaged, these original benchmarks and shall extend survey control as required or as directed by the Engineer. All equipment shall be correctly aligned by approved methods of sufficient accuracy to insure proper functioning of the completed work. Alignment tolerances, where called for in the specifications, shown on the drawings or subsequently issued on erection drawings, or as required by the equipment manufacturers, shall be rigidly adhered to. Misalignment of any piece of equipment shall be corrected by realigning the misaligned parts; and, where any necessary mortar has been placed,

the Contractor shall remove and replace such mortar as directed at his own expense.

e. The installation of each item of mechanical equipment shall include, where applicable, the installation of electrical components including those of power and control. No installation of mechanical equipment or electrical equipment shall be made until concrete finishing, patching and repair, which may cause dust and debris, has been completed in adjacent areas. The Contractor shall install conduit, wire terminals and indentification tags, and shall make all external electrical connections required to place the equipment in operation. All electrical conduit, wiring, junction boxes and other such accessories required to deliver power to the point of service for the equipment and covered under Section 18.

3. INSTALLATION OF HYDRAULIC TURBINES

a. General. The City has contracted with Nydqvist & Holm Aktiebolag, Trollhattan, Sweden, to furnish and deliver at Metaline Falls, Washington, the hydraulic turbine equipment. The Contractor shall install the embedded parts for four (4) Francis type hydraulic turbines, supplied by the City, complete with their auxiliary equipment. Great care and accuracy will be required in placing the equipment. The proper grades and centerlines to which equipment is to be set shall be established by the Contractor.

All installation work and adjustments shall be done under the supervision of erection engineers representing the turbine manufacturer. In the course of erection, repeated careful checks of alignment, levels, concentricity and trueness shall be made. The Contractor shall keep records of all alignment checks; such records shall be signed by the manufacturer's field representative and copies shall be submitted to the Engineer for approval.

The work shall be performed in general accordance with the procedures, methods and precautions outlined in the NEMA publication "Hydraulic Turbine and Governor Field Erection Information" (Authorized Engineering Information 9-29-1954).

b. Equipment and Materials. The embedded parts for the four (4) turgines consist of spiral case, stay ring with discharge ring, draft tube liner, pit liner, and anchorages. The turbine manufacturer will supply all screw jacks, anchor straps, tie rods and turnbuckles required for the erection of the equipment by the Contractor. Anchor bars of reinforcing steel to which tie-rods for the various embedded parts will be attached shall be supplied and installed by the Contractor. The jacking base plates shall be supplied and installed by the Contractor as specified in Section 10.

Blocking and shoring which is considered necessary for transporting, assembling and installing the various turbine components will be furnished with the turbine parts. However, the Contractor shall provide and install such

additional blocking during assembly as required, and any additional shoring and bracing necessary during concreting operations.

c. Spiral Case. The spiral case for each unit will be furnished in approximately 52 sections and shall be welded to the stay ring assembly. The spiral case plate sections vary in thickness from 1-5/8 inches to 1 inch. The lineal length of field welded joints will be approximately 1200 feet per unit.

Plates may be jacked into position and heated if necessary. Erection of each ring section shall start at the bottom and progress upward. Each ring section shall be supported and braced so that the horizontal spring line marked on the inside of the plates is maintained at a true elevation and the dimensions of the Inspection Check Sheet are satisfied. Make-up sections shall be fitted and cut to suit after the main portion of the spiral case has been completely welded.

If anchor bolts are displaced from drawing location, it may be necessary to refit the brackets provided for permanent anchorage before welding to the case. Baffle plates shall be welded only after all other welding is completed and approved.

More detailed instructions and the sequence in which the various parts of the spiral case shall be welded will be shown on installation drawings available for inspection by the bidders as specified in Section 1C-12.

d. Stay Ring with Discharge Ring. The stay ring with bottom ring for each unit will be delivered in four sections complete with bolts for field assembly. The stay ring with discharge ring will be joined to the spiral case by welding.

The stay ring shall have its upper and lower crowns braced, if necessary, using suitable spiders furnished by the Contractor. This bracing is necessary in order to hold round the openings in which the head cover and bottom ring fit.

Stay ring shall then be set to grade, leveled, top and bottom bores made concentric and secured in position. Constant checks and necessary adjustment shall be made to maintain grade, level and concentricity during the process of erection of the spiral case and continued during and after concrete is poured.

e. Draft Tube Liner. The draft tube liners will be delivered in sections determined by shipping limitations. The various components shall be joined by welding and anchor straps shall be attached during assembly of the liner.

f. Pit Liner. Each pit liner will be furnished in three sections. They shall be joined by welding, and anchor straps and the servomotor anchorages shall be attached during assembly.

g. Placing Concrete and Grouting. All metal surfaces that are to be embedded in concrete shall be free from rust, loose scale, oil or any other foreign matter. If necessary, sandblasting may be required. All holes and grooves for

lubrication shall be examined and cleaned where necessary. Care shall be taken to protect any finished parts liable to damage during handling and concreting.

After the Engineer has given his approval, concrete shall be placed in accordance with the provisions in Section 9B and grouting shall be performed as specified in Section 8.

h. Hydrostatic Test. The spiral case of each turbine shall be properly assembled and all alignments carefully and accurately checked. When the casing is ready for embedding in concrete, with the temporary bulkheads installed, the casing shall be filled with water at a temperature of not less than 40° F. The spiral case shall be vented during filling to prevent the formation of air pockets. After the case and the water have reached approximately the same temperature, the case shall be pressure tested at an internal hydrostatic pressure of 236 psig. This test pressure shall be held for a minimum of 2 hours, after any leaks disclosed have been eliminated to the satisfaction of the Engineer. The pressure shall then be rediced to 118 psig. At this pressure, the assembly shall be carefully rechecked for alignment and elevation. Then the concrete shall be placed over and around the apiral case as specified in Section 9B. While 118 psig pressure is maintained in the spiral case, a sufficient quantity of cooling water shall be circulated through the spiral case to maintain the water temperature in the spiral case within 5° F. above that determined at the beginning of the concreting operation. This 118 psig pressure and 5° temperature differential shall be maintained for 72 hours after concrete placement over and around the case has been completed. After this 72-hour period the pressure may be relieved, but circulation of cooling water shall continue until heat of hydration in the concrete around the case has been sufficiently dissipated. The time when the circulation of cooling water is to be discontinued will be determined by the Engineer.

Water for the hydrostatic tests and cooling shall be supplied by gravity or by centrifugal pumps having non-overloading characteristics. Reciprocating pumps shall not be used. Two pressure gages shall be used during the test and each gage shall be calibrated immediately prior to the test by means of a deadweight gage tested or other acceptable standards. A positive type of relief valve having a capacity equal to that of the supply main shall be installed in an appropriate location in the system. Prior to the test the relief valve shall be tested and set to relieve at 5 percent above the maximum test pressure. Two thermometers shall also be installed to determine the temperature of the water in the spiral case during the curing of the concrete over and around the spiral case. A connection has been provided in the bulkhead for the turbine inlet and a similar connection has been provided in the test barrel which will be installed in the center of the stay ring. The test barrel shall be installed with the piping connection located opposite the smaller section of the spiral case and these connections used to circulate cooling water through the turbine casing.

The Contractor shall submit to the Engineer for approval drawings and procedures indicating the cooling water arrangement and methods for attaining the required pressures. The drawings shall be complete in detail indicating

location of relief valves, pressure gages and temperature controls. The City will furnish suitable bulkheads complete with beveled edges for field welding required to close off the turbine spiral case openings. All other material, labor and equipment required for the pressure tests and the cooling system, including piping, pumps, fittings, and the relief valves and thermometers shall be furnished by the Contractor. After having served their purpose, the Contractor shall return to the City's warehouse at the job site the temporary turbine stay ring bulkhead complete and in usable condition. The two dished heads on the turbine inlets shall be welded to the ends of the penstocks for the future units.

4. WELDING OF TURBINE SPIRAL CASE AND STAY RING

a. General. All welding of the spiral case plates and stay ring shall be performed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, except as modified by these specifications. The Contractor shall be held responsible for the quality of the welds and shall conduct tests of the welding procedure to determine the suitability of a given procedure, and tests of the welders and welding operators to determine their ability to properly apply the welding procedure. No welding shall be permitted on any equipment that has been stress-relieved.

b. Welding Processes and Procedures.

(1) General. All welding shall be performed by the shielded metal arc process using low hydrogen type electrodes.

(2) Low Hydrogen Electrodes. All low hydrogen electrodes shall be purchased in sealed containers and shall be thoroughly dry when used. Electrodes taken from sealed containers shall be used within four hours. Electrodes not used within this time limit shall be stored in electrode storage ovens equipped with temperature controls. Electrode storage oven temperatures shall be in accordance with the electrode manufacturer's recommendations. Electrodes that have wet or damaged coatings shall not be used.

(3) Peening. The Contractor shall not be allowed to peen welds without the prior approval of the Engineer.

(4) Electrodes. Unless otherwise approved by the Engineer electrodes for manual welding shall not exceed 5/32" diameter for out of position (other than the flat, 1G position), and shall not exceed 3/16" diameter for work in the flat, 1G position. Furthermore, the maximum width of any bead of welding, other than a cover pass, shall not exceed three (3) times the diameter of the electrode being used.

(5) Grinding Wheels. Grinding wheels which leave a deposit detrimental to subsequent welding shall not be permitted. The Engineer

reserves the right to disapprove the use of any grinding wheel which in his opinion are detrimental to welding.

(6) Edge Preparation. The surfaces to be welded shall be free from rust, grease, paint and other foreign matter for a distance of at least six inches back from the edge of the weld.

c. Qualification of Welding Procedure. All welding procedures for welds in the spiral case plates and stay ring shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code and the modifications set forth in this specification. The procedure qualification shall contain full information on all the factors set forth in the Recommended Form Q-1 of Appendix II, Section IX of the ASME Boiler and Pressure Vessel Code.

Six copies of the Qualification of Welding Procedures shall be submitted to the Engineer for approval. The Engineer shall have the right to require any changes he deems necessary to make the Contractor's welding procedure conform with the requirements and intent of these specifications without additional cost to the City. No field welding shall be done prior to approval of the Contractor's welding procedure.

d. Qualification of Welders. All welders shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code following the same procedure established in the welding procedure qualification. Regardless of what prior qualifications a welder may have, qualification in the presence of the Engineer or his authorized representative is required for welders who perform work under this specification. All welder qualification test coupons shall become the property of the City. The Engineer reserves the right to require the requalification, at the Contractor's expense, of any welder whose work appears questionable.

e. Preheat and Interpass Temperature. A preheat and interpass temperature of 150°F. minimum shall be used when anyone of the following conditions exist:

(1) When the ambient temperature is below 40°F.

(2) When the base metal thickness to be welded exceeds one inch.

(3) When the specified minimum tensile strength of the material to be welded is 65,000 psi or greater.

(4) When the specified minimum carbon content of the material to be welded exceeds 0.30 percent.

(5) When the surfaces to be welded contain moisture.

f. Workmanship and Visual Quality Requirements. In addition to conformance with the procedural and quality requirements set forth in the applicable code and/or the specifications, all manual welding shall meet the following requirements for workmanship and visual quality:

4. WELDING OF TURBINE SPIRAL CASE AND STAY RING - Continued

(1) Each weld shall be uniform in width and size throughout its full length and each layer of welding shall be smooth, free of slag, cracks, pinholes and undercut, and shall be completely fused to the adjacent weld beads and base metal. In addition, the cover pass shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads, and shall blend smoothly and gradually into the surface of the base metal.

(2) Butt welds shall be slightly convex of uniform height, and shall have full penetration.

(3) Fillet welds shall be of specified size, with full throat and with legs of equal length.

(4) Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

g. Repairs. All unacceptable weld defects in the spiral case plates and stay ring shall be removed by chipping, grinding, arc or flame gouging following which the area shall be properly prepared for welding and repaired by a qualified welding procedure approved by the Engineer. The Contractor shall establish the cause of all defects and show that the situation has been corrected before further welding will be permitted. No additional payment shall be made for making any repairs.

h. Radiographic Examinations. All full penetration welds in the spiral case plates and stay ring shall be 100% radiographically examined. Radiographic examination shall comply with Section VIII of the ASME Boiler and Pressure Vessel Code and shall meet the technique and acceptance standards of Paragraph UW-51 of Section VIII of the ASME Code and the following additional requirements:

(1) The radiographic film shall be a fine grain, high contrast type equivalent to Eastman Kodak AA.

(2) Weld surfaces shall be ground, when required, so that surface irregularities will not interfere with radiographic interpretation.

(3) Exposure density over the interpretable length of the film shall be within the range of 1.75 to 2.50 as determined either by film density specimen or by densitometer.

(4) All radiography shall be performed with lead screens.

(5) All radiography shall be performed by an experienced radiographic technician fully capable of meeting the requirements of this specification.

(6) The Contractor shall furnish complete facilities for processing, viewing and storing of film.

(7) Unless otherwise approved by the Engineer, the Contractor shall not be permitted to weld more than 2 girth welds prior to radiographing preceding welded joints.

(8) Unless otherwise approved by the Engineer, the Contractor shall not be permitted to weld more than 5 joints prior to repairing and re-radiographing preceding weld joints with defects disclosed by radiography.

The Engineer reserves the right to make the final interpretation of the radiographs. All unacceptable defects disclosed by radiography shall be required in accordance with the requirements of this specification and re-radiographed. All radiography shall be at the Contractor's expense.

All radiographs, and five copies of a diagramatic sketch showing radiograph locations, shall be delivered to the City and shall become the City's permanent property.

i. Additional Tests and Examinations. Additional tests and examinations may be required at the discretion of the Engineer where there is doubt as to the adequacy of a part. The City will pay for the additional examinations if the part is found to be adequate; however, the Contractor shall pay for the additional examinations and required repairs if the part is inadequate.

j. Thermal Stress Relieving. Stress relieving of field welded joints is not required.

5. ERECTION EQUIPMENT AND AIDS

a. Bridge Cranes. Upon completion of the installation and testing of the bridge cranes by the Contractor and acceptance has been made thereof by the Engineer, the cranes will be available to the Contractor for his requirements. Operation and use of the cranes shall at all times be subject to the approval of the Engineer. The Contractor shall keep records of all time the cranes are operated. The Contractor shall provide qualified operators and shall assume the responsibility of operation of the cranes. The Contractor shall provide all maintenance personnel and all maintenance material for the operation of the cranes. The Contractor shall be liable for all claims of injury or damage from his operation of the cranes. Any damage to the cranes resulting from the Contractor's operation thereof, shall be repaired or replaced by the Contractor to the satisfaction of the Engineer and without cost to the City. Upon completion of the work, the cranes shall be reconditioned and restored by the Contractor to the satisfaction of the Engineer.

The travelling speeds and maximum height of vertical lifts are as follows:

(1) Main hoist speed, feet per minute 3.9

(2) Auxiliary hoist speed with rated load, feet per minute . . . 29

(3) Auxiliary hoist speed with no load, feet per minute 75

(4) Bridge travel speed, limited to loads on auxiliary hook only, feet per minute 200

(5) Bridge travel speed, rated maximum load, feet per minute 100

(6) Trolley travel speed, feet per minute 50

(7) Maximum vertical lift height, main hoist, feet 73

(8) Maximum vertical lift height, auxiliary hoist, feet 118

The capacity of each auxiliary hoist will be 25 tons. The capacity of each main hoist will be limited to 30 tons until 28 days have elapsed since completion of all concrete construction in the machine hall below El. 1759. After this period the total capacity of 200 tons for each main hoist can be utilized. The Contractor may be restricted in the use of the cranes during interim periods in order to prevent damage to freshly placed concrete in vicinity of the crane runway structural steel.

b. Other Equipment and Aids. The Contractor may use any special equipment, appliances, and tools which are furnished with the equipment for erection purposes, but shall not use tools furnished with the equipment cifically for maintenance purposes, unless permitted by the Engineer. Any damage to such special equipment, appliances and tools used by the Contractor shall be repaired or replaced by the Contractor to the satisfaction of the Engineer, without cost to the City. Slings used for erection purposes will not be required for later use.

6. ERECTION AND TESTING OF BRIDGE CRANE AND LIFTING BEAM

a. General. The two (2) 200-ton power plant bridge cranes, complete with crane rails, conductors and lifting beam will be furnished by the City for erection and installation by the Contractor. The Contractor shall install the rails and accessories in accordance with Section 10 "Metalwork", and the drawings. The services of the crane manufacturer's erection engineer will be provided as required by the Engineer to technically direct the field erection and testing of the cranes and all equipment supplied under the crane contact.

b. Delivery. The crane will be delivered to the job site match-marked during shop-assembly such that the field joints may be realigned and bolted by the Contractor. The manufacturer will supply the required bolts, including fitting-up bolts to complete these field connections. Electrical components such

as hoists, controls and drives will be shop-assembled and electrically test operated. The cranes will be internally wired as far as practicable.

c. Erection and Servicing. Before crane assembly, the Contractor shall confirm that the crane rail alignment and elevation meet the manufacturer's specified tolerances.

The Contractor shall erect the cranes on the crane rails, the bridge stops on the rails, and install the conductor supports and brackets as shown on the drawings. Initially the crane stops at the service bay end of the power plant will be located adjacent to the rock. Prior to completion of the concrete work in the service bay the bridge stops shall be moved to their permanent location.

d. Field Tests. The cranes shall be operated by the Contractor for at least eight (8) hours under light loads to run in the gearing and to insure that lubrication is thorough and complete.

The Contractor shall at his expense, perform the following field tests under supervision of the Engineer:

(1) The trolleys and hoists shall be operated without load in each direction to the full limits of their motion or travel.

(2) The equipment shall be examined for misalignment, improper adjustment, overheating and other possible defects.

(3) The above tests shall be repeated with the cranes loaded to 30 tons per crane.

(4) The cranes shall perform the operations of raising, lowering, holding in any position, and transporting the test loads at rated speeds throughout the full available length of crane and power plant runways.

(5) With the hoists loaded as under (3) above, they shall be operated to determine whether the hook or lifting beam motions can be controlled within the specified fraction of an inch.

(6) When all concrete work is finished below El. 1759 or by February 1, 1966, whichever date is later, the cranes shall be operated with a test load of one hundred twenty-five (125) percent of the rated capacity of each hook being tested to demonstrate that the cranes can raise, lower, hold in any position, and transport at the specified speed and conditions without damage or undue deflections of the crane parts. The test shall be repeated with each hook, in turn, carrying the test load.

(7) All travel distances shall be overrun to check the operation of all limit switches.

The temporary wiring shall be installed in such a manner as to provide all necessary a-c power from the construction power source and shall be removed to facilitate the installation of permanent wiring.

The Contractor shall furnish all test load materials and all equipment required for making the tests. After completion of load testing, the Contractor shall satisfa ctorily dispose of the test load.

7. ERECTION AND TESTING OF TRASHRACK RAKE AND TRAVELING HOIST

a. General. The Contractor shall install on the trashrack structure the City-furnished traveling trashrake and hoist, which is used to remove debris from the trashracks. The equipment will be disassembled as necessary to facilitate shipping.

The traveling hoist car will be furnished complete with starter, overload protection, limit switches, pushbuttons, and electric power cable and reel with industrial type plug.

b. Trashrack Rake Erection.

(1) The trashrack rake is lowered to the bottom of the trashracks by means of an electric hoist. Upon reversal of motion, the raking element assumes a position in which it can remove trash from the upstream face of the racks. As the rake is hoisted to the end of rack level where it engages an apron on the traveling hoist car which retains the trash until the upper limit of travel is reached, the trash will automatically dump into a container located under the hoist car.

(2) The trashrack rake and the traveling hoist car appurtenant parts will be inspected by the Engineer and shall also be inspected by the Contractor after receipt at the job site. All mechanical parts, until assembly, shall be stored ain a clean dry place, and covered by the Contractor to exclude dust and dirt.

(3) Immediately preceding erection of the traveling trash rake and hoist all parts shall be carefully unpacked, thoroughly cleaned and inspected. Report of parts found defective shall be made promptly in writing to the Engineer. Rust inhibitors, temporary oil fillings and preservative compounds shall be removed.

The hoist drums, motors and drive mechanisms shall be assembled on the structural frame of the traveling hoist car by workmen skilled in the assembly of machinery. This operation shall be performed under favorable weather conditions. Wire rope installation shall proceed with care to avoid injury to same.

Before connection to power all moving parts shall be lubricated in accordance with the manufacturer's recommendations.

(4) The erection of the trashrack rake and traveling hoist car shall include the proper installation of each item of electrical equipment including those of power and control. The Contractor shall install conduit, wire terminals, limit switches and shall make all connections required to place the equipment in operating condition. All electrical conduit, wiring, junction boxes and other such accessories required to deliver power to the points of service for the trashrack rake are covered under Section 18.

Instructions from the trashrack rake and traveling hoist car manufacturer concerning assembly and operation shall be carefully followed.

(5) The structural portions of the traveling hoist car and trashrack rake shall be assembled in the manner indicated on the drawings. Assembly will generally be by bolting, using turned bolts. The manufacturer will supply the required bolts, including fitting-up bolts to complete these field connections.

c. Field Testing. After the complete structure (trash rake and traveling hoist car) has been erected, adjusted, lubricated and connected to power, it shall be field tested as described below:

(1) The raking element shall be operated through its full range of vertical motion across the entire trashrack structure in the presence of the Engineer to insure proper function without fouling.

(2) The hoist car travel mechanism shall be tested by operating the hoist car a number of times in either direction on the runway tracks with the raking element in the dump position.

8. CLEANING, SERVICING AND TESTING

a. General. During the progress of the work and upon completion, the Contractor shall conduct such tests as the Engineer may deem necessary to insure that all equipment is in a condition for proper and satisfactory service. Methods of conducting tests shall be in accordance with the applicable code, or with other regulations having jurisdiction.

b. Mechanical Equipment. After each complete unit of mechanical equipment has been installed, and necessary electrical connections have been made, it shall be serviced and tested. The servicing shall consist of lubricating, adjusting and cleaning all parts of the machinery. The Contractor shall clean all equipment of dirt, mortar, concrete, or other materials which have been misplaced, spilled or allowed to mar the finish of structures or equipment. All debris, temporary piping, supports, etc., shall be removed from the site and disposed of as specified in Section 7. The Contractor shall flush thoroughly all

bearings, except as designated by the Engineer, reservoirs, gear housings, etc., with solvent before the same are filled with oil. All solvent for flushing, and all lubricating oil, wire rope coatings, hydraulic oil and grease shall be furnished by the Contractor. Mechanical equipment and motors shall be checked to see that moving parts move freely, glands shall be properly packed, connections shall be checked for tightness, etc. Adjustments shall be made by the Contractor at the direction of the Engineer. Any changes or adjustments found to be necessary shall be made by and at the expense of the Contractor. Where these specifications require that operation is a part of the installation work, the Contractor shall supply temporary power and the equipment shall be turned over to the City in operating condition.

c. Tests. The Engineer will not approve and the City shall not be deemed to have accepted the work or any part thereof until the Contractor has made sufficient tests to enable the Engineer to determine that the work meets all of the requirements of the drawings and specifications. The Engineer shall be notified in ample time so that he may be represented at all tests that may be made. If inspection or tests show the work, or any part thereof, not to be as represented and/or contracted for; if any portion of the work fails to operate to the satisfaction of the Engineer, the Contractor shall make good any of such defective portions of the work.

The repair of damage which is due to the operations of the Contractor and the correction of minor defects, errors, and inaccuracies in the machinery, equipment, and other metalwork furnished by the City which may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer shall be made by and at the expense of the Contractor. The repair of damage in the machinery, equipment, and other metalwork furnished by the City which is due to no fault of the Contractor and the correction of defects, errors, and inaccuracies in the machinery, equipment, and other metalwork furnished by the City which are ordered to be corrected by the Engineer and which are over and above what may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer will be paid for as extra work under the applicable provisions of the contract.

9. PAINTING

After completion of the work, including all tests and inspections, the mechanical work covered by this section shall be painted by the Contractor. Finish field painting and coatings shall be done in accordance with the requirements of Section 20.

10/ MEASUREMENT AND PAYMENT

a. General. It shall be understood that payment for testing shall be included in the prices bid for installing or for supplying and installing the vari-

ous items of mechanical equipment, piping, metalwork, etc. The installation shall include motors and controls, limit switches, small valves and piping instruments, controls which are a definite part of the mechanisms, the making of mechanical connections, servicing, testing, adjusting, cleaning of all metalwork, pipe and equipment and the maintenance of the same in position and proper operating condition until final acceptance by the Engineer. The prices bid for the various items shall include the cost of making such minor changes and correcting such minor errors and inaccuracies in the various parts as may be expected to occur in the ordinary commercial grade of shop work and equipment.

The cost of loading and transporting the equipment from the warehouse at the damsite shall also be included in the prices bid in the proposal for installing the various items of mechanical equipment.

b. Payment. The lump sum prices shall constitute the full compensation for each lump sum item described or as shown on the drawings. These lump sum prices include all materials except such equipment to be furnished by the City, all labor, transportation, providing the necessary construction equipment, supervision and the performance of all necessary operations and incidentals to complete the work, including testing, all in accordance with these specifications.

The cost of all labor, material, and equipment for prestressing and pressure testing the spiral cases, for circulating cooling water, and for returning the temporary pressure bulkheads shall be included in the lump sum price bid.

SECTION 16

MECHANICAL EQUIPMENT

1. GENERAL

a. Scope. The work covered by this section of the specifications consists of performing all operations in connection with the following Contractor furnished and installed mechanical equipment and their appurtenances:

(1) Sewage treatment plant.

(2) Air Compressors for ice prevention systems.

(3) Penstock fill valve.

(4) Emergency generator fuel storage, intake and exhaust system.

(5) Sump discharge slide gate.

b. Intent. It is the intent of the specifications that the work of the Contractor and/or his subcontractors under this section shall include all work ordinarily done by a mechanical contractor, to install mechanical equipment and appurtenances in a satisfactory, neat and workmanlike manner, tested and ready for use and service for commercial operation.

c. Work Included. The work to be performed shall include the furnishing of all labor, plant, materials, tools and construction equipment etc., required to complete the installation of all Contractor - furnished mechanical equipment including materials, accessories, appurtenances, instruments, controls, gauges, etc., and all interconnecting piping, valves, etc., as indicated or required for the complete and successful operation of the equipment.

. Erecting Supervisors. The Contractor shall furnish, without cost to the City, the services of competent and qualified Erecting Supervisors for all equipment specified herein when deemed necessary by the Contractor and/or requested by the Engineer. The Erection Supervisor shall represent the manufacturer and act in an advisory capacity.

The Erecting Supervisors shall be provided for such reasonable time, as determined by the Engineer, as will be necessary for the complete installation of the particular equipment, including the correct procedures and methods to be used in setting, erecting, aligning and otherwise assembling and installing the equipment.

2. INSTALLATION AND ERECTION REQUIREMENTS

a. All installation and erection methods and procedures shall conform with accepted best engineering practice, and the requirements of accepted codes

and regulations where applicable. All equipment shall be erected in accordance with the respective manufacturer's recommendations for installation, and shall be located, piped, tubed, connected and otherwise erected and installed in strict accordance with the specifications, as shown on the drawings, and as directed by the Engineer.

b. The Contractor shall install the equipment complete with all accessories and auxiliaries, including such accessories as are supplied by the manufacturer and shipped separately, such as gages, valves, interconnecting piping, instruments, etc. The Contractor shall uncrate, clean and inspect all equipment and material, and shall remove any temporary plugs, blanks, braces, etc., which may have been installed for shipment by the manufacturer. Rust inhibitors, slushing compounds, wrapping or other protective material shall be removed and the equipment shall be inspected and cleaned for any foreign matter which may have accumulated during shipment.

c. Equipment shall be placed, aligned and bolted down prior to making external connections. In making external connections such as piping, care shall be exercised to insure that no strain or thrust will be placed on the equipment, and provisions for relief of expansion of piping and equipment shall be checked. After the external connections are made, the level and alignment shall be rechecked and the bolts tightened. Mortar mixtures or dry-pack of the proper proportions and consistency as prescribed in Section 9A, to produce a firm continuous support for the equipment shall be poured or placed. Exposed edges of the mortar shall be smoothly finished. All rotating machinery shall be checked for proper rotating and shaft alignment after piping connections and mortaring have been completed, and any necessary re-alignment shall be done.

d. The Contractor shall be responsible for the proper positioning of all equipment to the approved tolerances, subject to checking by the Engineer at all times. All equipment shall be correctly aligned by approved methods of sufficient accuracy to insure proper functioning of the completed work. Alignment tolerances, where called for in the specifications, shown on the drawings or subsequently issued on erection drawings, or as required by the equipment manufacturers, shall be rigidly adhered to. Misalignment of any piece of equipment shall be corrected by re-aligning the misaligned parts.

e. The installation of each item of mechanical equipment shall include, where applicable, the installation of electrical components including those for power and control. No installation of mechanical equipment or electrical components shall be made until concrete finishing, patching and repair, which may cause dust and debris, has been completed in adjacent areas. The Contractor shall install conduit, wire terminals and identification tags, and shall make all external electrical connections required to place the equipment in operation. All electrical conduit, wiring, junction boxes and other such accessories required to deliver power to the point of service for the equipment are covered under Section 18.

3. SEWAGE TREATMENT PLANT

a. General. The Contractor shall furnish and install, as shown on Drawing No. D-23355, a completely cylindrical steel tank diffused air sewage treatment plant. It shall be Rated Aeration SS Hydroshear Aerating Tank as manufactured by Chicago Pump, Hydrodynam Division, Food Machine and Chemical Corporation, or approved equal, designed for 3000 gallons per day of domestic sewage.

The unit shall satisfactorily perform the purification of the sewage by the aerobic digestion process. The unit shall comminute the sewage solids, continuously aerate the activated sludge-sewage mixture in the aeration compartment, and continuously clarify the aerated sewage in the settling compartment. The settled activated sludge in the settling compartment shall be continuously returned to the aeration compartment by a lift pump capable of delivering four cubic feet per minute of air with a blower of positive displacement rated to deliver seventeen cubic feet per minute of free air at 4.6 pounds per square inch, V-belt driven by a 1-1/4 horsepower motor, 440 volts, three-phase, 60 cycle a-c. The comminutor shall be 115 volts, single phase, 60 cycle a-c. All motor starters and required control equipment shall be included with the treatment plant.

b. Piping. All sewage piping shall be furnished and installed by the Contractor as shown on the drawings and/or covered in Section 11.

4. ICE-PREVENTION SYSTEM AIR COMPRESSORS

a. General. The ice prevention systems shall comprise the following equipment and shall be located as stated herein or as shown on the drawings. The Contractor shall be responsible for furnishing and installing all equipment and appurtenances necessary to place in operation each of the described systems.

b. Spillway Ice Prevention System - Right Abutment. The right abutment spillway ice preventative system shall consist of the following equipment and appurtenances.

Two (2) Ingersoll Rand type 244D3 compressors with an 80 gallon horizontal receiver, or approved equal, capable of delivering at least 20 cubic feet per minute of free air each at 40 pounds per square inch with minimum discharge pulsations. They shall be located as shown on Drawing No. D-23398. The appurtenant equipment shall be as specified below.

A control system shall be furnished which will alternate compressor operation in eight (8) hour intervals throughout the winter months of the year or anytime the ambient temperature decreases sufficiently to cause the still water in the immediate vicinity of the spillway gate to freeze. Compressor operation shall be manually initiated or stopped by the placing of a maintained position transfer switch in the "Auto" or "Off" positions respectively. Should one compressor

4. ICE-PREVENTION SYSTEM AIR COMPRESSORS - Continued

fail to start or malfunction within its scheduled eight (8) hour period of operation, the remaining compressor shall automatically start and thereafter run continuously. Upon the malfunction or failure of a unit to start within a predetermined time, a suitable electrically independent alarm contact will close and remain closed. This alarm contact shall be wired by others to remote alarm indication equipment. The alarm shall be automatically reset upon operation of the transfer switch to the "Off" position. The entire control system to be furnished shall have the prior approval of the Engineer both as to the equipment furnished and the electrical circuitry employed.

The compressors shall be equipped with an unloader which takes the air pressure off the cylinders and intercoolers every time a compressor stops. All necessary valving and piping between the compressors to perform the described operation, and the piping connecting the compressors and the discharge points in the spillway crest shall be furnished and installed as covered in Section 11 and as shown on the drawings.

c. Spillway Ice Prevention System - Left Abutment. The left abutment spillway and disposal channel ice preventative system shall consist of the same equipment and appurtenances as outlined under (b) above; except that air shall also be supplied to the upstream side of the skimmer gate as shown on Drawing No. D-23398. The location of the compressors shall be in the room provided for the skimmer gate operator as shown on Drawing No. D-23398.

The piping connecting the compressors and the discharge points in the spillway crest and disposal channel crest shall be furnished and installed as covered in Section 11 and as shown on the drawings.

d. Trashrack Ice Prevention System. The ice preventative system for the trashrack will comprise two (2) Ingersoll Rand type 15S3E9, 120 gallon horizontally mounted receivers, or approved equal, capable of delivering at least 65 cubic feet per minute of free air at 80 pounts per square inch, and shall be located in the station service supply and compressor room as shown on Drawing No. D-23138. The controls shall be similar to those under Paragraphs 4. b and c above for the spillways and shall be subject to the same approval condition.

The piping and valving necessary to complete the system shall be furnished and installed as covered in Section 11.

The dual line system leading from the compressor room to the discharge pipes located on the upstream face of the trash racks shall contain manually operated valves to enable the selection of the correct discharge line which shall be determined by the elevation of the water surface. If the water surface is between El. 1966.0 and above, the line designated as "First" shall be selected. If the water surface decreases below El. 1966.0, the air supply from the compressors

4. ICE-PREVENTION SYSTEM AIR COMPRESSORS - Continued.

should be switched from line "First" to line "Second" by means of valves. They shall be manually operated 125-pound screwed ends, bronze discs, Crane globe valves, or approved equal.

5. PENSTOCK FILL VALVE

a. General. The valve shall be a 36-inch, 150-pound, cast steel, electric motor operated, spherical valve with seal heaters as manufactured by Allis-Chalmers Company, or approved equal, with appurtenant equipment as specified herein. The operating mechanism shall be equipped with a handwheel to permit manual operation of the valve. The valve shall be supported and located as shown on the drawings and will be accessible by ladder from the dam access roadway at El. 1832. All required tubing, fittings, electrical appurtenances, and connections shall be supplied to complete the installation.

b. Operating Mechanism. The motor operating mechanism and its associated control equipment shall be arranged for the following operations.

(1) Operation through a complete opening or closing stroke in one minute.

(2) Local and remote opening and closing control shall be provided by means of pushbutton stations having provisions for stopping and reversing at any position between full open and full closed or vice versa. The local station may be incorporated in the enclosure specified under subparagraph c. (3) below. The remote station shall be provided with position indication lamps.

(3) Automatic stopping of the valve motor operator by torque limit control when the plug is tightly seated in the closed position or in the event an obstruction lodges in the valve opening during closure.

(4) Automatic stopping, by limit switch, of the valve motor operator when the plug reaches the full open position.

(5) Limit switch to make the "close" control ineffective after the plug is seated in the closed position.

(6) The handwheel shall be mechanically and/or electrically interlocked with the motor operator so that the valve cannot be operated by electrical control when prepared for manual operation or vice versa.

(7) The effort required on the handwheel to operate the valve shall not exceed forty pounds.

(8) The valve shall be equipped with velocity sensing equipment or devices having an accuracy of plus or minus 1.0 feet per second velocity in the pipe. All required tubing, fittings or other required electrical or mechanical appurtenances shall be supplied to complete the installation. Upon attainment of a preset and adjustable velocity setting, the equipment shall act to close a contact to initiate automatic electrical closure of the valve by means of the motor operator. A normally open electrically independent alarm contact shall also be furnished and wired out to an approved molded terminal block, which shall close upon operation of the velocity sensing device. This contact will be wired to remote annunciation equipment by others under a later contract.

c. Electrical Equipment. The electrical equipment and components shall meet the following minimum requirements:

(1) The horsepower rating of the motor shall be sufficient to operate the valve through an opening or closing stroke under the most adverse operating conditions which may be imposed upon it without overloading the motor.

(2) The motor shall be of the totally-enclosed type with moisture resistant insulation, rated at 55°C continuous duty over a 40°C ambient, and designed for operation on a 480-volt, 3-phase, 60-cycle power supply. The motor shall be equipped with ball bearings.

(3) The starting and reversing switches, relays, limit switches, push-button station or any other electrical equipment required shall be enclosed in NEMA Type 3 enclosures. As many as possible of the electrical control components, commensurate with the manufacturer's control and operating scheme, shall be enclosed in a single enclosure arranged for separate wall mounting, or alternatingly be enclosed by, or attached to, the motor operating mechanism. The remote push-button station and position indicating lamps shall be provided in a NEMA Type 4 enclosure.

(4) The reversing motor starter shall be of the combination circuit breaker type with overload protection in all 3 phases.

6. EMERGENCY GENERATOR FUEL STORAGE, INTAKE AND EXHAUST SYSTEM

The item "Furnishing and Installing Emergency Generator Fuel Storage Tank" shall include the fuel storage tank with all connecting piping and necessary valving and shall be installed by the Contractor in accordance with Drawing No. D-23191 and shall meet the operating requirements of the engine generator supplier. The tank shall be five feet inside diameter by eight feet high with a standard base.

The item "Furnishing and Installing Intake and Exhaust System for the Emergency Generator" shall include the following:

a. Intake louver in partition at dam access gallery.

b. Exhaust louver in closure wall at tailrace.

c. Exhaust duct between generator and exhaust louver.

d. Exhaust piping from generator through closure wall at tailrace.

The items under a. through d. above shall be as recommended by the emergency generator manufacturer for the type and size generator described in this specification. All tests required by the State of Washington and applicable codes shall be performed at the expense of the Contractor.

7. SUMP DISCHARGE SLIDE GATE

a. General. The 24-inch slide gate shown on Drawing No. D-23366 complete with gate, embedded guides, anchors, operator, operating item, stem guides and appurtenant equipment shall be included in the item "Furnishing and Installing Sump Discharge Slide Gate".

Gate operator, and accessories shall be of a size, type and construction to suit the installation. The gate to be supplied hereunder shall be made by a manufacturer regularly engaged in such work. The Engineer reserves the right to approve or disapprove the adequacy of the gate and all connections to related appurtenant parts proposed under these items. The gate and accessories shall operate properly, with a practical degree of watertightness under an unbalanced head of approximately 75 feet.

b. Gate. The gate shall be of close-grained gray cast iron with horizontal and vertical ribs of sufficient section to withstand the specified maximum heads, both seating and unseating, without excessive distortion. Seating surfaces shall be of bronze seating faces firmly attached to the cast iron gate. Seating faces shall be machined to a plane and smooth finish. A cast groove shall be provided at each side of the gate to receive the guide angle. A square pocket, well ribbed and cast integrally with the slide, shall be provided to take the opening and closing thrust of the stem block nut.

c. Gate Frame. The frame shall be of cast iron and of sufficient section to resist distortion. Seat facings shall be of the same material and applied in the same manner as stated under "Gate". Faces for mounting guide bars shall be fully machined.

d. Gate Guides. Guide bars for the slide gate shall be of close-grained, gray cast iron. The groove to match the tongue of the slide and the mounting pads for side wedges shall be fully machined. The length of the guides must be

sufficient to extend at least one-half the height of the slide when it is fully open.

e. Gate Stem. The gate stem shall be solid and made of stainless steel of a diameter to safely withstand the opening and closing thrusts encountered in operation of the gate under the specified head and shall be supplied in reasonable lengths to permit easy installation and removal. Sufficient modified Acme threads shall be provided on one end to allow for full gate opening. Bolted stainless steel couplings shall be provided when necessary to join sections of the stem. Stop nuts with set screw are to be provided to prevent over-travel in closing the gate.

f. Stem Guides. The stem guides shall be cast iron, adjustable in two directions to provide full adjustment for proper alignment with the stem and shall be bronze bushed. They are to be provided in sufficient quantity that the slenderness or L/r ratio of the stem does not exceed 200, except when splices interfere.

In addition to the embedded pipe sleeve required through mass concrete for the gate stem, a stainless steel pipe complete with couplings incorporating stem guides shall be provided. The stainless steel pipe shall be furnished with external spacers to provide close tolerance within the embedded pipe sleeve. The stainless steel pipe and stem shall be designed for removal from above.

g. Gate Operator. A hand crank operated geared operator shall be furnished, and shall be of the removable crank type, one or two speeds, depending on the capacity required, and fully enclosed. Sufficient grease fittings shall be provided to permit lubrication of all bearings, gears, and other moving parts. Roller bearings shall be provided above and below the flange on the operator nut to take the thrust developed by opening and closing of the gate under the maximum operating heads specified. Sleeve bearings shall be bronze. An arrow with the words "Up" and "Down" shall be located in a prominent location, readily visible, indicating the correct rotation of the crank to raise or lower the gate. Hand cranks shall have revolving sleeves, a 15-inch radius and require 25 pounds pull or less to operate the gate at the maximum operating heads given. All gears, spur pinions, bevel gears and bevel pinions shall have cut teeth. Lift nuts shall be of cast manganese bronze. All cast iron lift parts must have smooth exterior faces. Stem cover and indicator shall be provided for the operator. Stem covers are to be steel and indicators of the counter type showing position of gate. A brass plate shall be attached to the operator housing to show counter reading with gate in fully closed position at each of the six openings and the fully open position.

8. CLEANING, SERVICING AND TESTING

a. General. During the progress of the work and upon completion, the Contractor shall conduct such tests as the Engineer may deem necessary to insure that all equipment is in a condition for proper and satisfactory service. Methods of conducting tests shall be in accordance with the applicable code, or with other regulations having jurisdiction.

b. Mechanical Equipment. After each complete unit of mechanical equipment has been installed, and necessary electrical connections have been made, it shall be serviced and tested. The servicing shall consist of lubricating, adjusting and cleaning all parts of the machinery. The Contractor shall clean all equipment of dirt, mortar, concrete, or other materials which have been misplaced, spilled or allowed to mar the finish of structures or equipment. All debris, temporary piping, supports, etc., shall be removed from the site and disposed of as specified in Section 7. The Contractor shall flush thoroughly all bearings, except as designated by the Engineer, reservoirs, gear hoisings, etc., with solvent before the same are filled with oil. All solvent for flushing, and all lubricating oil, hydraulic oil and grease shall be furnished by the Contractor. Mechanical equipment and motors shall be checked to see that moving parts move freely, glands shall be properly packed, connections shall be checked for tightness, etc. Adjustments shall be made by the Contractor at the direction of the Engineer. Any changes or adjustments found to be necessary shall be made by and at the expense of the Contractor. Where these specifications require that operation is a part of the installation work, the Contractor shall supply temporary power and the equipment shall be turned over to the City in operating condition.

c. Tests. The Engineer will not approve and the City shall not be deemed to have accepted the work or any part thereof until the Contractor has made sufficient tests to enable the Engineer to determine that the work meets all of the requirements of the drawings and specifications. The Engineer shall be notified in ample time so that he may be represented at all tests that may be made. If inspection or tests show the work, or any part thereof, not to be as represented and/or contracted for; if any portion of the work fails to operate to the satisfaction of the Engineer, the Contractor shall make good any of such defective portions of the work.

The repair of damage which is due to the operations of the Contractor and the correction of minor defects, errors, and inaccuracies in the machinery, equipment, and other metalwork furnished by the City which may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer shall be made by and at the expense of the Contractor. The repair of damage in the machinery, equipment, and other metalwork furnished by the City which is due to no fault of the Contractor and the correction of defects, errors, and inaccuracies in the machinery, equipment, and other metalwork furnished by the City which are ordered to be corrected by the Engineer and which are over and above what may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer will be paid for as extra work under the applicable provisions of the contract.

9. PAINTING

After completion of the work, including all tests and inspections, the mechanical work covered by this section shall be painted by the Contractor. Finish

field painting and coatings shall be done in accordance with the requirements of Section 20.

10. MEASUREMENT AND PAYMENT

a. General. It shall be understood that payment for testing shall be included in the prices bid for installing or for supplying and installing the various items of mechanical equipment, piping, metalwork, etc. The installation shall include motors and controls, limit switches, small valves and piping, instruments, controls which are a definite part of the mechanisms, the making of mechanical connections, servicing, testing, adjusting, cleaning of all metalwork, pipe and equipment and the maintenance of the same in position and proper operating condition until final acceptance by the Engineer. The prices bid for the various items shall include the cost of making such minor changes and correcting such minor errors and inaccuracies in the various parts as may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials and equipment.

b. Measurement of Unit. Measurement of the quantity of items of mechanical equipment and accessories required in the work will be determined by the Engineer by actual count of units of said equipment and fixtures installed in place. Said units shall include motors, limit switches, valves and piping, controls, gauges, instruments and like accessories which are furnished with the units or which are incidental to their proper installation. In order to be considered complete, each unit must have all appurtenances attached and connecting piping and wiring completed and be in proper working condition.

c. Payment on Unit Price Basis. The prices bid in the Proposal for installing or for furnishing and installing the items shall include unloading, handling, transporting, storing, assembling, placing, erecting, installing and testing, No separate allowance will be made for installing metalwork, anchor bolts, motors, limit switches, valves, piping, companion flanges, controls, gauges, instruments and like accessories furnished with the units or which are incident to their proper and complete installation.

d. Payment on Lump Sum Price Basis. The prices on all items in the Proposal, which are lump sum items, shall constitute the full compensation for each lump sum item described in the Specifications and as shown on the drawings. These lump sum prices include all materials, all labor, transportation, providing the necessary construction equipment, supervision and the performance of all necessary operations and incidentals to complete the work, including testing, all in accordance with these Specifications.

e. Piping. All piping to connect the sewage treatment plant, all piping to connect the air compressors and complete the ice-prevention systems including the orifice plugs, and all piping and couplings upstream and downstream of the penstock fill valve will be paid as specified in Section 11. The cost to the Contractor for furnishing and installing all connecting piping and necessary valving for the generator fuel storage tank shall be included in the item for furnishing and installing this tank. All cost to the Contractor for piping, flexible hoses with connections and the cable reel required to complete the installation of the grout gallery drainage pump shall be included in the item for furnishing and installing this pump.

SECTION 17

INSTALLATION OF ELECTRICAL POWER SUPPLY, DISTRIBUTION AND CONTROL EQUIPMENT

1. SCOPE

The work under this section consists of installing, connecting, testing and placing into service the power supply, power distribution and power control equipment, and power supply cable furnished by the City, in accordance with these specifications and as shown on the drawings. The Contractor shall furnish all necessary devices and materials necessary for complete installation of the equipment, which is specifically set forth under Paragraphs 5 through 14 below. The connection of power supplies, limit switches, pressure switches, thermostats, pushbuttons, or any other required electrical equipment necessary to place the mechanical equipment detailed under Sections 12, 13, 14, 15 and 16 of these specifications into operation, including the furnishing of all necessary fittings, hardware and small materials as set forth under Paragraph 3A of this section of the specifications, is included as part of the work covered by Sections 12, 13, 14, 15 and 16 of these specifications.

2. EQUIPMENT AND MATERIAL FURNISHED BY CITY

The items of electrical power equipment to be furnished by the City for installation under this section consist of the following:

a. 13,800-480Y/277-volt Main Station Service Switchgear Sections.

b. 480-volt, 480Y/277-volt, and 208Y/120-volt Power Distribution and Lighting Distribution Panels.

c. 480-volt Motor Control Centers.

d. 480-208Y/120-volt Transformers for A.C. Lighting, A.C. Emergency Lighting, and A.C. Auxiliary Services.

e. 480-volt A.C. Lighting Voltage Regulators.

f. 208Y/120-volt A.C. and 125-volt D.C. Emergency Lighting Distribution Panels.

g. 208Y/120-volt A.C. and 125-volt D.C. Emergency Lighting Transfer Panel.

h. 480Y/277-volt A.C. Diesel Engine Generator Set and Appurtenant Equipment.

i. 13,800-480Y/277-volt, 150 kva Padmounted Transformer and Appurtenant Equipment.

j. 15 kv Main Station Service Power Cables.

The handling of City-furnished material and equipment shall be as specified in Section 1C, paragraph 3d. Packing and crating material shall not be removed until the equipment is to be actually installed. Instrument and relay blocking shall not be removed by the Contractor

3. MATERIAL FURNISHED BY CONTRACTOR

a. Materials. Unless otherwise specified, the Contractor shall furnish all fittings, anchor bolts, metal inserts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compounds and other electrical accessories, hardware or materials required to satisfactorily install and place into service the equipment and material. Unless otherwise approved in writing by the Engineer, all devices, materials and accessories furnished by the Contractor shall be as specified herein, or as shown on the drawings. The devices and material shall be new and shall conform to the latest applicable standards of IEEE, ASTM, ASA, NEMA, NEC, U/L, IPCEA and of the Division of Safety of the State of Washington. In general, the internal wiring for the equipment furnished by the City will be brought out to terminal blocks for connecting to the external cables or wires. Wire terminals shall be of the solderless pressure type, AMP #32544 or approved equal.

b. Approval. The Contractor shall submit for the approval of the Engineer a list of materials, devices and accessories to be furnished by the Contractor. Approval shall be obtained prior to purchase of any major item of material, device or accessory. This approval shall not relieve the Contractor from responsibility for the proper performance of the materials, devices or accessories as required by the specifications.

4. INSTALLATION OF ELECTRICAL EQUIPMENT

a. General. All electrical installations shall be in accordance with the applicable standards of IEEE, NEMA, NEC, and the Division of Safety of the State of Washington, unless otherwise specified. The Contractor shall install concrete inserts; set, level and secure equipment in position; connect together all equipment which required dismantling or which was received dismantled, including bus and internal wire connections; properly connect all incoming wires and cables, and adjust and place into service the electrical equipment and material required by these specifications. All work shall be done in an orderly, thorough and workmanlike manner, shall present a neat appearing installation when complete, and shall conform to the best modern practice for the class of work, notwithstanding any omissions in the drawings and specifications. The furnishing and installation of wire and cable, with the exception of the 15 KV power cables, and temporary power feed, shall be in accordance with Section 18 of these specifications.

All equipment shall be installed in accordance with the drawings and the manu-

facturer's recommendations and shall operate to the satisfaction of the Engineer. Necessary tests to demonstrate that the mechanical and electrical operation of the equipment is satisfactory, safe, or as intended, and meets the requirements of these specifications, shall be made by the Contractor at no additional cost to the City. The Contractor shall be responsible for, and shall correct by repair or replacement at his own expense, all damage to, or failure of, any part of any of the items of the equipment which, in the opinion of the Engineer, has been caused by faulty mechanical or electrical assembly by the Contractor, except such damage or failure as may be attributed to defective parts furnished by the City, as determined by the Engineer.

No equipment shall be installed until all required patching and finishing in the area has been completed. All installed equipment shall be adequately protected and covered at the discretion of the Engineer after installation.

b. Interconnections. The Contractor shall connect all power supply wiring, and that portion of the metering, relaying, control power, and general control wiring required to exhibit the safe, satisfactory, and intended operation of the equipment. The Contractor shall terminate all wires forming interconnections among and between the main station service switchgear sections, emergency generator, distribution panels, motor control centers, lighting regulators, auxiliary transformers, and other equipment as listed in these specifications. The Contractor shall not terminate wires which connect equipment not scheduled for installation under this Contract.

5. MAIN STATION SERVICE SWITCHGEAR SECTIONS

The two main sections of station service switchgear shall be located in the powerhouse. Each section will consist of an incoming line section with disconnect switch, key interlocked with the transformer secondary breaker; a transformer section containing a 3-phase, 13,800 delta-480Y/277-volt, 2000KVA ventilated dry type power transformer with provisions for the addition of future forced air cooling equipment and arranged with a section of insulated neutral bus; and low voltage switchgear sections containing a transformer secondary breaker, metering, relaying and switching equipment, and feeder, transfer, and tie breakers as shown on the drawings.

The Contractor shall furnish and install a 500 MCM, 600-volt, THW insulated cable for connection between the insulated neutral buses of the two switchgear sections. The Contractor shall connect the transformers to the proper tap to match the 12,470-volt temporary service

The incoming 15 KV power cable to each line section will be A.W.G. #1, stranded, 3-conductor, shielded and jacketed, and will be furnished by the City. The Contractor shall be required to install stress relief cones for these cables in accordance with the cable manufacturers recommendations before termination.

6. A.C. POWER DISTRIBUTION AND A.C. LIGHTING DISTRIBUTION PANELS

The number, type and location of the A.C. power and lighting distribution panels is as follows:

Ten - 480-volt power distribution panels located in the powerhouse.

Two - 480-volt power distribution panels, one located in each of the spillway left and right abutment compressor rooms in the vicinity of the dam.

One - 480-volt power distribution panel located in the trashrack compressor room.

Four - 480Y / 277-volt split bus lighting distribution panels located in the powerhouse.

One - 480Y / 277-volt lighting distribution panel located in the sluice gate operating room in the vicinity of the dam.

One - 480Y / 277-volt lighting distribution panel located in the trashrack compressor room.

Two - 208Y / 120-volt power distribution panels located in the powerhouse.

One - 208Y / 120-volt lighting distribution panel located in the trashrack compressor room.

One - 208Y / 120-volt lighting distribution panel located in the spillway right abutment compressor room.

7. A.C. MOTOR CONTROL CENTERS

The number, type and location of the motor control centers is as follows:

Three - Type "B" 480-volt sump pump motor control centers located in the powerhouse.

One - Type "B" 480-volt heating and ventilating motor control center located in the powerhouse.

All of the equipment shall be installed, wired, and tested, but only the 480-volt heating and ventilating motor control center will be placed into service under this contract.

8. A.C. AUXILIARY SERVICES, A.C. LIGHTING AND A.C. EMERGENCY LIGHTING TRANSFORMERS

The number, type and location of the transformers is as follows:

One - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type 15 KVA auxiliary services transformer located in the powerhouse.

Four - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type, auxiliary lighting transformers located in the powerhouse, two at 15 KVA and two at 20 KVA.

One - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type, 15 KVA emergency lighting transformer located in the powerhouse.

One - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type, 9 KVA auxiliary lighting transformer located in the sluice gate operating room in the vicinity of the dam.

One - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type, 3 KVA auxiliary lighting transformer located in the spillway right abutment compressor room.

One - 480-208Y/120-volt, 3-phase, 60 cycle, ventilated, dry type, 9 KVA auxiliary lighting transformer located in the trashrack compressor room.

9. A.C. LIGHTING AND A.C. EMERGENCY LIGHTING VOLTAGE REGULATORS

The number, type and location of the voltage regulators is as follows:

Two - 480-volt ± 20%, 3-phase, 60 cycle, 28.8 regulated KVA automatic lighting voltage regulators, each furnished with an integrally mounted 480Y/277-volt A.C. distribution panel containing eight 3-pole branch circuit breakers, located in the powerhouse.

One - 480-volt ± 20%, 3-phase, 60 cycle, 3 regulated KVA automatic emergency lighting voltage regulator, located in the powerhouse.

One - 480-volt ± 20%, 3-phase, 60 cycle 15 regulated KVA automatic lighting voltage regulator, located in the trashrack compressor room.

10. A.C. AND D.C. EMERGENCY LIGHTING DISTRIBUTION PANELS

The number, type and location of the A.C. and D.C. emergency lighting distribution panels is as follows:

Three - 208Y/120-volt A.C. and 125-volt D.C. emergency lighting distribution panels located in the powerhouse.

One - 208Y/120-volt A.C. and 125-volt D.C. emergency lighting distribution panel located in the sluice gate operating room in the vicinity of the dam.

11. A.C. AND D.C. EMERGENCY LIGHTING AUTOMATIC TRANSFER PANEL

The emergency lighting transfer panel will consist of termination facilities for four 120-volt A.C. branch circuits, fourteen 2-pole 240-volt circuit breakers, four A.C. to D.C. transfer switches, termination facilities for six 125-volt D.C. emergency lighting circuits, and outgoing termination facilities for four combination A.C. or D.C. feeder circuits supplying the emergency lighting distribution panels detailed under Paragraph 10 above. The entire equipment will be furnished in a single enclosure, which will contain all undervoltage or other required auxiliary control relays. The total emergency lighting load will be approximately 15 KW.

The Contractor shall make all tests to demonstrate that the equipment is ready to be placed into service. The D.C. circuits will not be available under this contract.

12. A.C. DIESEL ENGINE GENERATOR SET AND APPURTENANT EQUIPMENT

A 480Y/277-volt, 750 KW, 0.8 P.F., 720 R.P.M. diesel engine generator shall be located in the emergency generator room, and will be furnished complete with all appurtenant equipment required for governing and voltage regulation; cranking equipment (including 120-volt, 170 ampere-hour battery and trickle charger); metering, protective relaying and alarm systems; automatic custom starting equipment; exerciser for periodic operation of the unit; all pressure, temperature and flow devices required for operation and protection of the diesel engine; 120-volt A.C. fractional horsepower cooling water circulation pump and two 2500-watt thermostatically controlled cooling water heaters to maintain unit at proper temperature during periods of shutdown; and a 120-volt A.C. fractional horsepower fuel transfer pump for pumping fuel from the storage tank to the dayuse tank provided with the diesel. A 480-volt switchgear section will be furnished with the unit which will house the generator breaker and one feeder breaker, and all electrical equipment noted above with the exception of the circulation and transfer pumps, the cranking battery and the 2500-watt heaters. Furnishing of the fuel supply lines; diesel exhaust system; cooling system intake and exhaust air metalwork, dampers or other related equipment; and the fuel storage tank are covered under the mechanical sections of this specification and their supply and/or installation does not comprise part of the electrical installation of City-furnished equipment

13. A.C. PAD MOUNTED DISTRIBUTION TRANSFORMER AND APPURTENANT EQUIPMENT

One 150 KVA 3-phase, 13,800-480Y/277-volt pad mounted transformer shall

located in the trashrack compressor room, and will be furnished complete with a 3-pole double throw manually interlocked 15 KV oil insulated transfer switch with two integrally mounted 3-phase compound filled cable heads, secondary metering equipment, and a 480-volt secondary breaker.

The Contractor shall connect the transformer to the proper tap to match the 12,470-volt temporary service.

The two incoming 15 KV power cable taps from the main 15 KV power cables will be A.W.G. #1, stranded, 3-conductor, shielded and jacketed, and will be furnished by the City. The Contractor shall install stress relief cones for these cables in accordance with the cable manufacturers' recommendations and terminate them at the oil insulated transfer switch, and shall perform all dismantling, reassembling, and oil and compound handling operations required to connect the cables and place the transfer switch into service. An initial quantity of insulating oil for the switch and compound for the cable heads will be furnished with the equipment, sufficient for one complete installation.

14. 15 KV MAIN STATION SERVICE POWER CABLES AND TEMPORARY POWER FEED

a. Scope. The work covered by this subparagraph consists of the following:

Installing two 15 KV power cables between the main station service switchgear sections in the powerhouse and sectionalizing boxes in the trashrack compressor room.

Installing two 15 KV power cables between the sectionalizing boxes and the oil insulated transfer switch on the 150 KVA padmounted transformer in the trashrack compressor room.

Installing a temporary power feed consisting of two 15 KV power cables from the sectionalizing boxes mentioned above to a terminal pole located just outside the trashrack compressor room, and constructing a three-phase 12,470-volt overhead line to the construction power feeder located on the West Side Access Road, a distance of approximately 1000 feet.

Installing two 15 KV link sectionalizing boxes, and terminating in each the three 15 KV power cables as called for in the paragraphs immediately above.

Covered under a future contract will be the removal of the temporary power feed and the installation of permanent 15 KV cables from the BPA switchyard. The 150 KVA padmounted transformer and the main station service switchgear transformers will have taps in the primary winding to match the 12,470-volt temporary service and the 13,800-volt permanent service.

b. Installation.

(1) Cable. The cable will be 15 KV, ungrounded neutral, 3-conductor, AWG #1, shielded, PVC jacketed cable having an outside diameter of approximately 2.1 inches. This cable will be furnished by the City in sufficient length for the required connections.

The Contractor shall install, support, and place the 15 KV power cables in galvanized steel cable trays and ladders and non-metallic conduit between the main station service switchgear sections and the link boxes. The Contractor shall pull the 15 KV power cable taps into rigid galvanized steel conduit between the pad mounted transformer and the link boxes, and between the link boxes and the terminal pole. Sufficient length shall be left at the ends of the cable to make connections conveniently to the equipment and link boxes. The cable shall not be pulled into any conduit until the conduit runs have been cleaned and are free from obstructions and sharp corners. The cable shall be installed so that no cuts or abrasions in the insulation or protective covering, or kinks in the conductors occur. Cable splices will be permitted only where approved by the Engineer. All splices shall be made in accordance with the recommendations of the cable manufacturer.

Lubricants used as an aid during the pulling operation shall be soapstone or other material not injurious to the cable jacket. Pulling stresses in excess of Manufacturer's specifications will not be permitted. Any cable damaged during installation shall be removed and replaced with cable of the same type and manufacture, at the Contractor's expense. Cable supports shall be installed whenever a cable leaves a cable tray or conduit, and where necessary at the discretion of the Engineer, to relieve any stress due to the weight of the cable. Where the cables run in cable ladders, cable clamps shall be installed approximately every 4 feet, or as shown on the drawings.

(2) Temporary Power Feed. The Contractor shall furnish all material for and construct a three-phase, four-wire wood pole line from the construction power feeder to a terminal pole just outside the trashrack compressor room. The terminal pole shall be furnished by the Contractor complete with disconnection and termination facilities for the two 15 KV cables. The cables shall be run in rigid steel conduit underground from the pole to the wall of the room, and then be run exposed on the ceiling and wall of the room to the link sectionalizing boxes as shown on Drawing No. D-23837. The wood pole line shall be constructed in accordance with the requirements of Section 1C, paragraph 8, of these specifications.

(3) Link Sectionalizing Boxes. Two 15 KV, oil-filled, 3-way, 250-amp. capacity link sectionalizing boxes equipped with compound filled cables heads shall be installed on the wall of the trashrack compressor room.

The link boxes and insulating oil and cable head compound in sufficient quantity for one complete installation will be furnished by the City. The Contractor shall install stress relief cones and terminate the cables in accordance with the recommendations of the cable manufacturer.

c. Tests. In addition to general operational tests, the entire cable system shall be subjected to high potential and resistance tests in accordance with the applicable requirements of IPCEA Standards Publication S-19-81. The tests shall be conducted by and at the expense of the Contractor and in the presence of the Engineer. If any failure is detected, the Contractor shall assist the Engineer in determining the trouble. The Contractor shall replace the faulty section of cable if, in the opinion of the Engineer, the failure was due to any damage sustained during installation or after receipt of the cable by the Contractor.

15. PAYMENT

a. Installation of Electrical Equipment. Payment for installing the various items of electrical equipment specified in this section will be made at the respective lump sum price bid in the Proposal for installation of each item which price shall cover all costs for installing the equipment complete in accordance with the requirement of this section.

b. 15 KV Main Station Service Power Cables and Temporary Power Feed. Measurement for payment will be based on the total length of cable satisfactorily installed. Payment will be made at the unit price per linear foot bid in the Proposal for "Installing and Placing into Service 15 KV Main Station Service Power Cables and Temporary Power Feed". The cost of terminating the cables in the link boxes and at the 150 KVA transformer, and the cost of furnishing and installing the temporary wood pole line and associated equipment, installing the link boxes, and making of the required tests shall be included in the unit price bid for installing the cable.

SECTION 18

CONDUIT, WIRE AND CABLE, GROUNDING, AND TRAYS

1. SCOPE

The work covered by this section of the specifications consists of furnishing all labor and material required for the complete installation of all conduit, wire and cable, grounding, trays, special boxes, and 440-volt receptacles, unless otherwise noted on the drawings or elsewhere in these specifications. Excluded from this section is the lighting system, which is covered under Section 19.

2. MATERIALS - GENERAL

Unless otherwise approved in writing by the Engineer, all materials to be furnished by the Contractor shall be as specified herein, or as shown on the drawings. The use of manufacturer's names and catalog numbers does not preclude the use of an approved equal. This equipment or material shall be new, and shall conform to the latest applicable standards of IEEE, ASTM, ASA, NEMA, NEC, IPCEA and the Division of Safety of the State of Washington. Materials and equipment used shall bear the label of the Underwriters Laboratories and shall be listed by U/L in their list of electrical materials unless the materials and/or equipment is of a type for which the U/L does not list or provide label service. Where no specific make of material is specified, any first class product of a reputable manufacturer may be used provided it conforms to the requirements of these specifications and meets with the approval of the Engineer. Unless otherwise specified, the Contractor shall furnish all conduit, cable trays, wire and cable, outlet boxes, 440-volt receptacles, junction boxes, fittings, anchor bolts, concrete inserts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compounds, and other electrical accessories, hardware or materials required to satisfactorily install and place the equipment and materials into service.

3. INSTALLATION - GENERAL

All electrical installations shall be in accordance with the applicable standards of IEEE, NEMA, NEC, and the Division of Safety of the State of Washington, unless otherwise specified. The Contractor shall install conduit, cable trays, wire and cable, outlet boxes, 440-volt receptacles, junction boxes, fittings, anchor bolts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compounds, concrete inserts, and other electrical accessories. All work shall be done in an orderly, thorough and workmanlike manner, shall present a neat appearing installation when completed, and shall conform to the best modern practice for the class of work, notwithstanding any omissions in the drawings and specifications.

All material shall be installed in accordance with the drawings and the recommendations of the manufacturer. The Contractor shall, at no additional cost to the City, perform such tests as may be required to demonstrate that the

installation is mechanically secure, circuit continuity correct, and insulation intact and undamaged. The Contractor shall be responsible for, and shall correct by repair or replacement at his own expense, all damage to, or failure of, any part of any of the items of the equipment which, in the opinion of the Engineer, has been caused by faulty mechanical or electrical assembly by the Contractor.

4. ELECTRICAL CONDUIT AND FITTINGS

a. Materials. Materials for the conduit system shall conform to the following:

(1) Rigid Steel Conduit. Rigid steel conduit and fittings shall be in accordance with ASA Standard C80.1, zinc coated. Conduit sizes shall not be less than 3/4 inch unless otherwise noted on the drawings.

(2) Rigid PVC Conduit. Rigid PVC conduit and fittings shall be installed in the machine hall access tunnel; dam access gallery; transformer bays; intake gate gallery; exploratory tunnels or in other locations where the moisture from the overhead rock may drip on the electrical conduit and fittings. If these areas are required to be concrete lined, rigid steel conduit and fittings as called for in these specifications may be used upon prior approval of the Engineer. Rigid PVC conduit shall also be used where non-metallic conduit is called for on the drawings, unless otherwise specified. Rigid PVC conduit shall have U/L approval for rigid non-metallic conduit and shall be similar and equal to that which is manufactured by Kraloy/Chemtrol Co. All conduit fittings which are attached to and required for the non-metallic conduit system shall be of the same manufacturer. Copper-free aluminum fittings having a maximum copper content of 0.3 of 1 percent may be used where non-standard fittings are required for the non-metallic conduit system.

(3) Flexible Conduit. Flexible steel conduit shall be galvanized steel core with a copper bonding conductor between the spiral segments and have an extruded synthetic jacket over-all to insure a liquidtight conduit. The conduit shall be American Brass Sealtight Flexible conduit. Flexible conduit fittings shall be of the grounding type and of a design approved for this type of flexible conduit.

(4) Conduit Boxes. Outlet boxes, junction boxes and pull boxes for rigid steel conduit shall be sheet steel or cast as called for on the drawings, shall be of standard approved weight and size, and shall be galvanized in accordance with applicable standards. The

minimum size outlet box shall be 4 inches square by 1-1/2 inches deep. Condulets shall be Crouse-Hinds and the minimum size used shall be equivalent to the Mark 9 series. Junction and pull boxes for rigid PVC conduit shall conform with the requirements of Paragraph 4. a. (2) of this section of the specifications.

(5) Conduit Bushings. Conduit bushings shall be OZ Electric Manufacturing Co., type IGB.

(6) Expansion Fittings. Expansion fittings for rigid steel conduit 1-inch and below shall be Crouse-Hinds condulet expansion unions. Expansion fittings for rigid steel conduit 1-1/4-inch and above shall be OZ Manufacturing Co. type DX. Expansion fittings for rigid PVC conduit shall conform with the requirements of Paragraph 4, a. (2) of this section of the specifications.

(7) Lay-in Duct and Fittings. Lay-in duct with screw type cover shall be embedded in the service bay shop area where shown on the drawings, complete with necessary connectors, elbows, and knockouts. The duct shall measure 6 inches by 6 inches in section, and shall be of Square D manufacture.

b. Installation. The Contractor shall furnish and install conduits, conduit boxes, and fittings complete and in an approved manner. All embedded conduits, conduit boxes and fittings shall be held securely in position while the concrete is being placed. Wall mounted controllers, boxes, etc., shall be spaced from the concrete wall by 1/4-inch spacers unless otherwise noted on the drawings. Conduits or couplings stubbed flush with floors or walls shall be aligned and held in place prior to and while pouring concrete with a 3-foot or longer conduit extension to insure that the conduit or coupling will extend perpendicular to the surface, be properly spaced, and be properly aligned. After the concrete forms have been removed, a mandrel approximating the diameter of the conduit shall be pulled through all conduits to loosen any burrs and to check for obstructions. A wire brush and swab shall then be pulled through the conduits to clean out any remaining foreign matter. Thereafter, the conduit shall be sealed in an approved manner to prevent the entrance of concrete or other foreign material and to protect exposed threads until the conduit is readied for wire pulling. After the concrete forms have been removed, all concrete shall be cleaned from the inside of the conduit boxes. A metal tag with the conduit number on it shall be attached to each conduit at all junctions. All steel conduit bent in the field shall have standard or long-radius bends as directed or as shown on the drawings; shall be free from kinks, indentations or flattened surfaces; and shall be bent cold to prevent damage to the protective

coating. Burrs and sharp corners at the end of each conduit shall be removed with a tapered reamer.

Conduit shall be installed so that there will be no traps to collect condensation. The threads of all embedded conduit joints shall be covered with red lead and shall be tightened securely to prevent the entrance of moisture, concrete, and other foreign material. Where embedded conduits cross expansion or contraction joints in concrete, expansion fittings shall be installed. All exposed rigid steel conduits shall be tightened securely at the joints and supported rigidly in place at intervals of not more than six feet or as directed by the Engineer. Rigid PVC conduits shall be supported in accordance with the manufacturer's recommendations and within three feet of each box or other conduit termination.

Double locknuts, bushings, and grounding bushings as shown on the drawings shall be installed at boxes and cabinets to provide continuous ground circuits and also to protect wires and cables from abrasion. Flexible conduit may be used only where called for on the drawings or approved by the Engineer.

All spare conduits stubbed flush with the floor shall be terminated with couplings and plugged with a pipe plug.

5. WIRE AND CABLE

a. General. The Contractor shall furnish and install all of the wire and cable required to complete the installation of equipment as specified in Section 17 and as shown on the drawings or as directed by the Engineer.

b. Material.

(1) Power Wire. The power wire shall be single conductor, No. 12 AWG minimum, of the filled cross-linked polyethylene insulation type, rated 600 volts and 90°C. General Electric Vulkene Insulated Power Cable SI-58063 or equivalent is acceptable. Wire size AWG No. 12 shall be solid, unless otherwise noted, and wire size AWG No. 10 and larger shall be stranded.

(2) Control Wire and Cable. All control wiring, except as noted below, shall be stranded No. 12 AWG minimum, of the filled cross-linked polyethylene insulation type, rated 600 volts and 90°C with neoprene jacket. General Electric Vulkene Industrial Control Cable SI-58145 or equivalent is acceptable. Control wiring for pushbutton controls from motor control centers to remote pushbuttons may be solid and shall conform to the requirements of Paragraph 5. b. (1) of this section of the specifications.

ready to be tested and the Contractor shall conduct the tests as instructed. If any failure is detected; the Contractor shall locate and determine the trouble and shall make any corrections to the installation without additional cost to the City. Connection of the wiring to the respective equipment or device terminal blocks, etc., and furnishing and installing all conductor identification tags at the terminals shall be work included as part of the installation of the respective items of equipment.

(2) Cable Supports. Whenever a cable leaves a trench, tray or conduit, a cable support shall be furnished and installed to relieve any stress placed on the terminals to which the cable is connected which is due to the weight of the cable. Unless otherwise specified, the method proposed by the Contractor shall be subject to the approval of the Engineer.

6. SPECIAL BOXES

a. General. The Contractor shall furnish and install all special boxes as specified herein and as required. All sheet metal or cast boxes with an inside volume of more than 150 cubic inches shall be considered as special boxes. Boxes with a volume of 150 cubic inches or less shall be considered as part of the conduit installation.

b. Installation. The Contractor shall install the special boxes, including terminal blocks, as shown on the drawings or as required. The Contractor shall furnish and install all concrete anchors and bolts and any other material and equipment required to install the metal boxes. The boxes shall be hot dipped galvanized after fabrication unless otherwise approved by the Engineer.

7. 440-VOLT RECEPTACLES

a. General. The Contractor shall supply and install all 440-volt power receptacles as indicated on the drawings. The receptacles shall be Crouse-Hinds Weather Resistant "Arktite" type with threaded cap. All power receptacles shall be 3-wire, 4-pole with current rating as required.

b. Installation. The Contractor shall mount all receptacles, make all electrical connections, and supply all material and equipment necessary to complete the installation as shown on the drawings or as directed by the Engineer.

8. CABLE TRAYS AND CABLE LADDERS

a. General. The Contractor shall supply and install the cable trays and cable ladders as shown on the drawings. The Contractor shall

(3) PVC Conduit Continuity Ground Wire. Continuity ground wire within rigid PVC conduit shall be green colored thermoplastic, rated 600 volts, 75°C, NEC type THW.

c. Installation.

(1) Wire and Cable. The Contractor shall pull the wire and/or cable into the conduit and trays with sufficient length left at the ends to make connections conveniently to all equipment or devices. The Contractor shall furnish and install all wire connectors used for connecting conductors to the terminal blocks and they shall be solderless pressure type, AMP, No. 32544 lugs. No spade type lugs will be permitted.

The wire shall not be pulled into the conduit until the conduit runs have been cleaned. The wire shall be installed so that no cuts and abrasions in the insulation or protective covering, or kinks in the conductors occur. No splices shall be made in conductors except at boxes, outlets or cabinets. Splices will not be permitted in condulets except as approved by the Engineer. All splices shall be subject to the approval of the Engineer and no splices shall be installed if it is at all possible to pull the wire continuously from the source to the load. Where a lubricant is needed as an aid in pulling wire or cable, only soapstone or other material not injurious to the sheath or insulation shall be used. Excessive pulling stresses will not be permitted.

Any wire or cable damaged during installation shall be removed and replaced with equivalent wire or cable at the Contractor's expense. Wire connectors used for joining conductors shall be approved solderless pressure-type connectors. They shall be furnished and installed by the Contractor as required for all splices, joints, and connections to render the connections mechanically and electrically secure and shall be covered with an insulating material equal to that of the conductor insulation. Each conductor shall be tagged at splices, devices, terminal blocks and panels with Natvar Corporation No. 400 black extruded tubing and designations deeply embedded using Kingsley white stamping foil.

The Contractor shall make insulation and continuity tests before connection to terminal points at junction boxes or equipment. Insulation tests shall consist of applying a 1,000-volt test for each insulated wire. Each individual conductor shall be tested to ground with all other conductors in the circuit tied together and grounded. Resistance readings for the insulation tests shall not be less than those required by Article 110, Paragraph 110-19 of the 1962 National Electrical Code. The Contractor shall be responsible for notifying the Engineer when the wire or cable is

furnish and install all mounting brackets, concrete inserts and miscellaneous fittings as required to complete the cable tray and cable ladder installation.

b. Installation. The cable trays shall be fastened to the mounting brackets located and as shown on the drawings. The bolts shall be as recommended by the tray manufacturer and shall be free of sharp edges that may cut the cables. The trays shall be installed level, straight and free of any undue stresses. Joints in trays shall be covered with standard coupler plates to eliminate all sharp or protruding edges that may injure the cables. The cable tray installation shall include all supporting steel, supporting brackets, hardware, fittings, elbows, tees and dropouts.

9. GROUNDING

a. General. The Contractor shall furnish and install the ground system, including all fittings, connectors and all material and equipment required to complete the installation, as specified herein, as shown on the drawings, or as directed by the Engineer.

b. Material. The material shall conform to the following:

(1) All ground cables shall be annealed, concentric stranded, bare copper cable of the size shown on the drawings and in accordance with ASTM Designation B8.

(2) All cable connectors shall be of the compression type, Burndy type YYT and shall have a current carrying capacity equal to that of the copper cable with which they are used.

(3) Ground rods shall be copper coated steel rods 3/4-inch in diameter and ten feet long.

c. Installation. The Contractor shall install the embedded ground system and all exposed grounding for the initial equipment which is being installed under this Contract, as provided for and shown on the drawings. The Contractor shall place the ground rods and drive to full depth. The Contractor shall extend embedded ground cable stub-outs to the equipment to be connected under this Contract and make necessary connections to the equipment ground bus or point, including furnishing and installing all cables and connectors required. Connections to equipment shall be made with Burndy bolted connectors as shown on the drawings. The Contractor shall extend ground wire or cable to all conduit ground bushings, handrails, ladders, water and air lines, as directed by the Engineer, whether shown on the drawings or not. The ground system shall be tied into the existing ground mat where shown on Drawing No. D-23760-Rev. 2,

by means of one 500 MCM ground cable from the manhole at the trash-rack structure. A second 500 MCM ground cable shown terminated in the manhole will be tied to the existing ground mat by others under a later contract.

All paint, scale and enamel shall be removed from points of contact on metal surfaces before the ground connections are made, and all bolts shall be drawn up tight to insure a secure connection, but not tight enough to damage the bolt or cable. All exposed ground cable shall be run parallel to building walls, floors and ceilings, and shall be supported every three (3) feet with one-hole clamps and clamp-back type supports.

10. MEASUREMENT AND PAYMENT

a. General. The payment for each part of the electrical installation as itemized in the Proposal, will be made at the applicable lump sum or unit price bid in the Proposal, which price shall constitute full compensation for the respective installation complete, including outlet boxes, junction boxes, fittings, anchor bolts, concrete inserts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compounds, and other electrical accessories, hardware or materials required to properly install and make all electrical and mechanical connections, in accordance with the specifications and drawings or as directed by the Engineer.

b. Measurement. Measurement of material and equipment for payment will be based on exact amounts satisfactorily installed and will not include any material or equipment that has been wasted or replaced due to damage or unsatisfactory installation by the Contractor.

c. Payment

(1) Conduit. Payment will be made at the applicable unit price bid in the Proposal for furnishing and installing the respective electrical conduit, which payment shall constitute full compensation for furnishing and installing the conduit, including all fittings, outlet boxes, and junction boxes as specified herein or as directed by the Engineer. The conduit shall be measured by the linear foot for payment for each size installed. No direct payment will be made for fittings, supports, outlet boxes, condulets, or boxes with an inside volume of 150 cubic inches or less. Concrete for encasement of the duct bank and pull boxes in the exploratory tunnel, the duct banks in the upper parking area, and the man hole at the south end of the trashrack structure will be included for payment under Miscellaneous Concrete.

(2) Wire and Cable. Payment will be made at the applicable unit price bid in the Proposal for furnishing and installing the respective wire and cable, which payment shall constitute full compensation for the accepted installation of all the wire and cable for power and control circuits. If sizes or types of wire or

cable not listed in the Proposal are required, payment will be made at the unit price bid for the next larger wire or cable listed which will have the same voltage characteristics. The wire and cable will be measured for payment by the linear foot of each respective size installed.

(3) Special Boxes. Payment will be made at the unit price per pound bid for "Furnishing and Installing Special Boxes," which payment shall constitute full compensation for furnishing and installing the special boxes as specified herein or shown on the drawings. Measurement for payment will be by the weight of all metal boxes furnished and installed including all concrete anchors and mounting bolts.

No separate payment will be made for installing and furnishing terminal blocks mounted in the special boxes when required, but the cost thereof shall be included in the unit price per pound bid for "Furnishing and Installing Special Boxes."

(4) 440-volt Receptacles. Payment will be made at the applicable unit price bid in the Proposal for "Furnishing and Installing 440-volt Receptacles," which payment shall constitute full compensation for furnishing and installing the respective receptacles and making all electrical connections thereto.

The cost of conduits, wires, boxes, and grounds required for the receptacles shall not be included in the unit price bid in the Proposal for "Furnishing and Installing 440-volt Receptacles." Payment for these items will be made at the applicable unit price bid for furnishing and installing the respective items.

(5) Cable Trays and Cable Ladders. Payment will be made at the applicable unit price bid in the Proposal for furnishing and installing the respective cable trays and cable ladders, which payment shall constitute full compensation, except as noted below, for furnishing and installing the cable trays and cable ladders.

The concrete inserts for the cable trays and cable ladders will be paid for under the unit price bid in the Proposal for "Furnishing and Installing Concrete Inserts."

The miscellaneous metal supports within the elevator shaft, and elsewhere if required, will be paid for under the unit price bid in the Proposal for "Furnishing and Installing Miscellaneous Metalwork."

(6) Ground System. Payment will be made at the applicable unit price bid in the Proposal for furnishing and installing the respective ground cable which payment shall constitute full compensation for

furnishing and installing the cable, ground rods, connectors, copper ground inserts, cable clamps and cable supports. The ground cable shall be measured by the pound for payment for each size installed. No separate payment will be made for connectors, ground rods, cable clamps and cable supports, couplings, Burndy connectors, etc., but will be measured for payment by the applicable unit price for ground cable installed.

SECTION 19

LIGHTING SYSTEM

1. SCOPE

The work covered by this section of the specifications consists of furnishing all labor and material required for the complete installation of the lighting system, unless otherwise noted on the drawings or elsewhere in these specifications.

The machine hall lighting fixtures below the powerhouse crane rails for El. 1759 between units No. 51 and No. 56 will not be installed under this Contract. Conduit only shall be installed as shown on the drawings.

Lighting panels shall be installed in accordance with Section 17 of these specifications. All temporary feeders required for lighting of the excavation under this Contract will be furnished and installed under Section 10, paragraph 8. The Contractor shall make all electrical connections required to complete and test the lighting system.

2. EQUIPMENT AND MATERIALS - GENERAL

Unless otherwise approved in writing by the Engineer, all equipment and materials to be furnished by the Contractor shall be as specified herein, or as shown on the drawings. The use of manufacturer's names and catalog numbers does not preclude the use of an approved equal. All equipment or material shall be new, and shall conform to the latest applicable standards of IEEE, ASTM, ASA, NEMA, NEC, IPCEA and the Division of Safety of the State of Washington. Materials and equipment used shall bear the label of the Underwriters Laboratories and shall be listed by U/L in their list of electrical materials unless materials and/or equipment is of a type for which the U/L does not list or provide label service. Where no specific make of material is specified, only first class product of a reputable manufacturer may be used provided it conforms to the requirements of these specifications and meets with the approval of the Engineer. Unless otherwise specified, the Contractor shall furnish all fixtures, lamps, receptacles, switches, conduit, wire, outlet boxes, junction boxes, fittings, anchor bolts, concrete inserts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compounds, and other electrical accessories, hardware or materials required to satisfactorily install and place the lighting system into service.

3. INSTALLATION - GENERAL

All electrical installations shall be in accordance with the applicable standards of IEEE, NEMA, NEC, and the Division of Safety of the State of Washington, unless otherwise specified. The Contractor shall install fixtures, lamps, receptacles, switches, conduit, wire, outlet boxes, junction boxes, fittings, anchor bolts, mounting brackets, cable supports, wire terminals, solderless lugs, connectors, identification tags, tape, insulating compound, concrete

inserts, and other electrical accessories; set and level fixtures in position; connect together all equipment which required dismantling or which was received dismantled; connect all incoming wires properly; and adjust and make ready for service the electrical lighting system required by these specifications and drawings. All work shall be done in an orderly, thorough and workmanlike manner, present a neat appearing installation when completed, and shall conform to the best modern practice for the class of work, notwithstanding any omissions in the drawings and specifications.

All equipment shall be installed in accordance with the drawings and the manufacturer's recommendations and shall operate to the satisfaction of the Engineer. Necessary tests to demonstrate that the mechanical and electrical operation of the equipment is satisfactory and meets the requirements of these specifications shall be made by the Contractor at no additional cost to the City. The Contractor shall be responsible for, and shall correct by repair or replacement at his own expense, all damage to, or failure of, any part of any of the items of the equipment which, in the opinion of the Engineer, has been caused by faulty mechanical or electrical assembly by the Contractor.

No equipment shall be installed until all required patching and finishing in the area has been completed. All installed equipment shall be adequately protected and covered at the discretion of the Engineer after installation.

4. FIXTURES

a. General. The fixtures shall be as called for in the fixture schedule, or an approved equal.

The fluorescent fixture ballasts shall be CBM certified, HPF, and shall be individually protected either by fuse or thermal protection. The ballast protector shall be located inside of the wiring channel and not be accessible from the outside of the fixture. Fixtures shall be designed to keep the operating temperature as low as possible and the maximum temperature of the hot spot on the ballast case shall not exceed 90°C during normal operation.

The mercury ballasts shall be of the constant wattage HPF type and shall regulate lamp wattage within plus or minus 2 percent when the line voltage is plus or minus 13 percent from nominal.

Ballasts which are located outdoors; on the dam; in the machine hall access tunnel; dam access gallery; transformer bays; intake gate gallery; which are 100 feet or less from the access portals, shall be equipped with -20°F ballasts. Ballasts in the machine hall access tunnel; dam access gallery; intake gate gallery; located 101 feet or more from tunnel portals shall be equipped with 0°F ballasts. Cold weather ballasts are not required elsewhere on the project unless otherwise noted on the drawings.

Fixtures which are pendant mounted shall be equipped with earthquake proof

hangers.

b. Installation. The Contractor shall install the fixtures in accordance with the drawings and manufacturer's recommendations. Prior to acceptance by the City, the Contractor shall thoroughly clean all fixtures and fixture supports and replace any lamp which was used for a period equivalent to 50 percent or more of its rated life at his own expense.

c. Lamps. Lamps shall be the type as called for in the fixture schedule.

5. SWITCHES AND RECEPTACLES

The lighting switches and receptacles shall be the type as shown on the drawings or an approved equal. Cover plates for flush mounted wiring devices shall be made of stainless steel, 0.040 inches thick with satin finish. Cover plates for wiring devices in surface-mounted boxes shall be as shown on the drawings or an approved equal.

6. GROUNDING

Grounding of fixtures, receptacles, switches and miscellaneous equipment for the lighting system shall be via the rigid steel conduit system. Where rigid PVC conduit is used, an additional green colored grounding wire, as shown on the drawings, shall be installed in the conduit system for grounding continuity.

7. ELECTRICAL CONDUIT AND FITTINGS

a. Materials. Materials for the conduit system shall conform to the following:

(1) Rigid Steel Conduit. Rigid steel conduit and fittings shall be in accordance with ASA Standard C80.1, zinc coated. Conduit sizes shall not be less than 3/4 inch unless otherwise noted on the drawings.

(2) Rigid PVC Conduit. Rigid PVC conduit and fittings shall be installed in the machine hall access tunnel; dam access gallery; transformer bays; intake gate gallery; exploratory tunnels or in other locations where the moisture from the overhead rock may drip on the electrical conduit and fittings. If these areas are required to be concrete lined, rigid steel conduit and fittings as called for in these specifications may be used upon prior approval of the Engineer. Rigid PVC conduit shall have U/L approval for rigid non-metallic conduit and shall be similar and equal to that which is manufactured by Kraloy/Chemtrol Co. All conduit fittings which are attached to and required for the non-metallic conduit system shall be of the same manufacturer. Copper-free aluminum fittings having a maximum copper content of 0.3 of 1 percent may be used where non-standard

fittings are required for the non-metallic conduit system.

(3) Flexible Conduit. Flexible steel conduit shall be galvanized steel core with a copper bonding conductor between the spiral segments and have an extruded synthetic jacket over-all to insure a liquid-tight conduit. The conduit shall be American Brass Sealtight Flexible conduit or an approved equal. Flexible conduit fittings shall be of the grounding type and of a design approved for this type of flexible conduit.

(4) Conduit Boxes. Switch and receptacle outlet boxes, lighting outlet boxes with fixture studs, junction boxes and pull boxes for rigid steel conduit, sheet steel or cast as called for on the drawings, shall be of standard approved weight and size and shall be galvanized in accordance with applicable standards. Junction and pull boxes for rigid PVC conduit shall conform to the requirements of Paragraph 7. a. (2) of this section of the specifications.

The minimum size outlet box shall be four inches square by 1-1/2 inches deep, except for those outlet boxes located in the partitions in the service bay, where reduced sizes are necessary because of space requirements. Condulets shall be Crouse-Hinds or equal and the minimum size used shall be equivalent to the Mark 9 series.

(5) Conduit Bushings. Conduit bushings shall be OZ Electric Manufacturing Co., type IGB or an approved equal.

(6) Expansion Fittings. Expansion fittings for rigid steel conduit 1-inch and below shall be Crouse-Hinds condulet expansion unions, or an approved equal. Expansion fittings for rigid steel conduit 1-1/4-inch and above shall be OZ Manufacturing Co., type DX, or an approved equal. Expansion fittings for rigid PVC conduit shall conform to the requirements of Paragraph 7. a. (2) of this section of the specifications.

b. Installation. The Contractor shall furnish and install conduits, conduit boxes, and fittings complete and in an approved manner. All embedded conduits, conduit boxes, and fittings shall be held securely in position while the concrete is being placed. Conduits or couplings stubbed flush with floors or walls shall be aligned and held in place prior to and while pouring concrete with a 3-foot or longer conduit extension to insure that the conduit or coupling will extend perpendicular to the surface, be properly spaced, and be properly aligned. After the concrete forms have been removed, a mandrel approximating the diameter of the conduit shall be pulled through all conduits to loosen any burrs and to check for obstructions. A wire brush and swab shall then be pulled through the conduits to clean out any remaining foreign matter. Thereafter, the conduit shall be sealed in an approved manner to prevent the entrance of concrete or other foreign material and to protect exposed threads

until the conduit is readied for wire pulling. After the concrete forms have been removed, all concrete shall be cleaned from the inside of the conduit boxes. A metal tag with the conduit numbers on it shall be attached to each conduit at all junctions. All steel conduit bent in the field shall have standard or long-radius bends as directed or as shown on the drawings; shall be free from kinks, indentations or flattened surfaces; and shall be bent cold to prevent damage to the protective coating. Burrs and sharp corners at the end of each conduit shall be removed with a tapered reamer.

Conduit shall be installed so that there will be no traps to collect condensation. The threads of all embedded conduit joints shall be covered with read lead and shall be tightened securely to prevent the entrance of moisture, concrete, and other foreign material. Where embedded conduits cross expansion or contraction joints in concrete, expansion fittings shall be installed. All exposed rigid steel conduits shall be tightened securely at the joints and supported rigidly in place at intervals of not more than six feet or as directed by the Engineer. Rigid PVC conduits shall be supported in accordance with the manufacturer's recommendations and within 3 feet of each box or other conduit termination.

Double locknuts, bushings, and grounding bushings as shown on the drawings shall be installed at boxes and cabinets to provide continuous ground circuits and also to protect wires and cables from abrasion. Flexible conduits may be used only where called for on the drawings or approved by the Engineer.

All spare conduits stubbed flush with the floor shall be terminated with couplings and plugged with a pipe plug.

8. WIRE

a. General. The Contractor shall furnish and install all of the lighting wire as specified herein and as shown on the drawings or as directed by the Engineer. Wire size AWG No. 12 shall be solid, unless otherwise noted, and wire size AWG No. 10 and larger shall be stranded. No. 12 AWG shall be the minimum size wire for lighting and receptacles. No. 14 AWG shall be the minimum size wire for pendant fixture wire.

b. Material.

(1) Wiring to the lighting fixtures, unless otherwise specified, shall be of the filled cross-linked polyethylene insulation type, rated 600 volts and 90°C. General Electric Vulkene Insulated Power Cable SI-58063 or equivalent is acceptable.

(2) Pendant fixture wire shall be silicone insulated, stranded, rated 600 volts, and 150°C, NEC type SFF-2. General Electric Silicone Rubber, Appliance, and Fixture Wire SI-53916 or equivalent is acceptable.

(3) Continuity ground wire within rigid PVC conduit shall be green colored thermoplastic, rated 600 volts, 75°C, NEC type THW.

c. Installation. The Contractor shall pull the wire into the conduit with sufficient length left at the ends of the wire to make connections conveniently to all equipment or devices. The wire shall not be pulled into the conduit until the conduit runs have been cleaned. The wire shall be installed so that no cuts and abrasions in the insulation or protective covering or kinks in the conductors occur. No splices shall be made in conductors except at boxes, outlets or cabinets. Splices will not be permitted in condulets except as approved by the Engineer. Where a lubricant is needed as an aid in pulling the wire, only soapstone or other material not injurious to the wire sheath or insulation shall be used. Excessive pulling stresses will not be permitted.

Any wire damaged during installation shall be removed and replaced with equivalent wire at the Contractor's expense. Wire connectors used for joining conductors shall be "Scotch Lock" preinsulated spring connectors, or an approved equal. They shall be furnished and installed by the Contractor as required for all splices, joints, and connections, to render the connections mechanically and electrically secure. Each wire shall be tagged at the panels with Natvar Corporation No. 400 black extruded tubing or an approved equal and designations deeply embedded using Kingsley white stamping foil.

The Contractor shall make insulation and continuity tests before installation of fixtures and fixture wires. Insulation tests shall consist of applying a 1,000-volt test for each insulated wire. Each individual conductor shall be tested to ground with all other conductors in the circuit tied together and grounded. Resistance readings for the insulation tests shall not be less than those required by Article 110, Paragraph 110-19 of the 1962 National Electrical Code. The Contractor shall be responsible for notifying the Engineer when the wire is ready to be tested and the Contractor shall conduct the tests as instructed. If any failure is detected, the Contractor shall locate and determine the trouble and shall make any corrections to the installation without additional cost to the City. Connection of the wiring to the panels, and furnishing and installing all conductor identification tags at the terminals, shall be work included.

9. MEASUREMENT AND PAYMENT

Payment will be made at the lump sum price bid for "Furnishing and Installing Lighting System," which price shall constitute full compensation for the lighting system installation complete, including fixtures, lamps, receptacles, switches, conduit, wire, outlet boxes, junction boxes, fittings, anchor bolts, mounting brackets, cable supports, solderless lugs, identification tags, wire terminals and connectors, tape and other electrical accessories, ground connectors and any other hardware and material required to properly install and make all electrical and mechanical connections, in accordance with these specifications and drawings or as directed by the Engineer.

SECTION 20

PAINTING STEEL METALWORK

Part I - General

1. GENERAL

This Section stipulates the requirements for the painting of steel metal work. The Contractor shall furnish, prepare and apply all materials for cleaning, painting or coating the metalwork as stipulated in this Section.

The Section consists of three parts, as follows:

Part I - A general description of the painting work coming under this contract; and specifications and other information generally common to Parts II and III.

Part II - Covers painting work coming under Classification A.

Part III - Covers painting work coming under Classification B.

2. COATING SCHEDULES

Part II of this Section includes a tabulated schedule of coating detail for Classification A items; and, Part III of this section includes a similar schedule for Classification B items.

3. WORK NOT INCLUDED

Painting of the following items is not included, except as otherwise specified:

a. Accoustical tile.

b. Concrete surfaces.

c. Masonry surfaces.

d. Items furnished with the finish painting included (except for touch-up).

e. Non-ferrous metals.

f. Nameplates and instruction plates.

g. Galvanized surfaces, unless otherwise specified.

h. Surface portions of items that are to be in contact with concrete or embedded in concrete. (These surfaces, however, shall be cleaned as necessary to provide satisfactory bond with the concrete.)

Part I - Continued.

4. DEFINITIONS

Wherever these words occur in this Specification, they shall have the following meanings:

a. "Indoors" - Those surfaces completely enclosed by floors, walls, and ceilings.

b. "Outdoors" - Those surfaces of buildings, equipment, structural steel, etc., not completely enclosed.

c. "Exterior" - Outer or exposed surfaces of an item.

d. "Interior" - Inner surfaces of an item, such as the lining of a tank.

e. "Paint" - The term "paint", as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, catalysts, thinners, and other organic or inorganic paint products and protective coatings, whether used as prime, intermediate or finish coats.

5. ABBREVIATIONS

The following abbreviations when used in this specification shall have the following meanings:

BR - Bureau of Reclamation

FS - Federal Specification

MS - Military Specification

SSPC - Steel Structures Painting Council

6. PAINT PACKAGING AND STORAGE

a. Packaging. Paints shall be delivered to the job in unbroken containers upon which are indicated the designated name, formula or specification number, and color of the paint; the manufacturer's name and directions and the date of packaging, all of which shall be clearly legible at the time of use. The size and strength of the paint containers shall be suitable for transporting, storage and handling on the job. The containers shall be made of materials which do not react with or are otherwise detrimental to the quality of the paint materials content.

Part I - Continued.

b. Storage. All paint shall be stored in an area that is well ventilated and free from excessive heat, sparks, flame, or the direct rays of the sun. Paints susceptible to damage from freezing shall be kept in a heated storage space when necessary.

All containers of paint shall remain unopened until ready for use. The oldest of each kind of paint shall be used first. Containers which have been opened shall be used first.

Paint which has livered, gelled, or otherwise deteriorated during storage shall not be used.

7. PAINT COLORS

Paint colors are specified in the Coating Schedule for the equipment to be painted. Should the Engineer decide to specify a different color, it will be a color similar to those listed below. All tinting shall be done by the manufacturer.

a. Light Gray. Light Gray shall match American Standards Association Gray No. 61.

b. Pearl Gray. Pearl Gray shall match Amercoat Corporation Standard Color Card B.

c. Dark Gray. Dark Gray shall match American Standards Association Gray No. 24.

d. Medium Gray. Medium Gray shall match Amercoat Corporation Standard Color Card B.

e. Haze Green. Haze Green shall match Amercoat Corporation Standard Color Card B.

f. Medium Green. Medium Green shall match Amercoat Corporation Standard Color Card B.

g. Horizon Blue. Horizon Blue shall match Amercoat Corporation Standard Color Card B.

h. Bright Red. Bright Red shall match Amercoat Corporation Standard Color Card B.

i. Beige. Beige shall match Amercoat Corporation Standard Color Card B.

The colors to be used for code marking, safety striping and other miscellaneous

Part I - Continued

painting not specified above, such as black, white, blue, red and orange shall be the manufacturer's standard colors for such applications subject to approval.

8. SAMPLES

The Contractor shall submit color chit samples matching the colors noted in the Coating Schedule together with the type of paint and the manufacturer's specification for the Engineer's approval.

An area of ten (10) square feet shall be painted for the approval of the Engineer.

9. PAINT CERTIFICATION AND TESTING

a. Each container of paint delivered to the job shall have the manufacturer's certification attached to the container stating that the material conforms to the particular specification given herein.

b. The City reserves the right to take one-quart samples from any of the containers of paint for testing purposes. There shall be no charge for these samples but the total amount taken for such purposes shall not exceed four gallons. Testing will be done at the City's expense.

c. Any paint found not in conformance with the specifications shall be removed from the job and from the structure, if already applied, at the Contractor's expense. The Contractor shall then furnish new material without charge to the City which does conform to the specified requirements. Any such new paint furnished may also be sampled and tested. If re-application to a formerly coated surface is required, it shall be treated as if it had never been coated insofar as these specifications are concerned.

d. The City may require the Contractor to furnish the following data prior to approval of paints:

Certified copy of test data by an independent laboratory, if available, to verify conformance of the paint system to the specified tests;

An experience record of bidder's materials presently in use on similar projects;

Copies of descriptive brochures, application instructions, and technical data of the paint system, and

Coverage data (square feet per gallon of paint per mil of dry film thickness, etc.).

Part I - Continued

10. APPLICATION OF PAINT AND PROTECTIVE COATINGS

a. General. Painting shall be done only by experienced workmen. The application of paint and protective coatings shall be in strict accordance with the manufacturers instructions except as otherwise specified or directed by the Engineer.

Finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks and other blemishes. Paint shall be applied so as to produce an even coating of dry film thickness not less than that specified in the Coating Schedule. Edges, corners, crevices, welds, bolts and rivets shall receive special attention to ensure their receiving a coating of the required thickness.

Surfaces of items subject to field welding after painting shall be left unpainted for six inches adjacent to joints, and painting completed after welding.

b. Mixing of Paint. Paint shall be thoroughly mixed and kept at a uniform consistency during application. Coatings which require a catalyst shall be mixed and discarded in accordance with the manufacturer's directions. Where necessary to suit conditions of surface, temperature, weather and method of application, the packaged paint may be thinned immediately prior to application but strictly in accordance with the manufacturer's directions.

c. Method of Application. Primers on bare metal shall be brush applied, except zinc silicate coatings which shall be spray applied. Coats other than the primers may be applied with approved spray equipment. Areas inaccessible to spraying shall be coated by brushing or other suitable method. All coats shall be unscarred and completely integral at the time of application of each succeeding coat. Whenever possible each coat shall differ slightly in color from the preceding coat to differentiate them during application. Sufficient time shall be allowed between coats to ensure proper drying.

11. SPRAY EQUIPMENT AND USE

The spray equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application. The Contractor shall furnish the City with a copy of the manufacturer's instructions for the type of equipment being used.

Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and shall be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

Paint ingredients shall be kept properly mixed in the spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

Part I - Continued

The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or loss by overspray.

Spray equipment shall be kept clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted. Spray equipment shall be completely cleaned at the end of each day's operation.

Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly. During application the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet film of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke and overspray at the end of the pass avoided. A cross spray coat shall be applied if necessary to secure a uniform coat of the proper thickness.

All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.

Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used. Brushes shall be used to work paint into cracks, crevices, and blind spots which are not adequately painted by spray.

Engineer's approval may be requested for the use of airless spray equipment for those coating materials which will result in a coating as good or better than if applied with air spray equipment.

12. ADVERSE PAINTING CONDITIONS

No coating work shall be done under unfavorable weather conditions, unless the work is well protected from such conditions, and then only with the specific approval of the Engineer.

Paint shall not be applied when the surrounding air temperature is below 40° F. or when the temperature is expected to drop to 32° F before the paint has dried; to wet or damp surfaces, or in rain, snow, fog, mist, or when the relative humidity exceeds 85 percent, or when any of these conditions are imminent; when the steel temperature is at a temperature above 125° F or at a temperature which will cause blistering or porosity; or under any other condition which will be detrimental to the lift of the paint.

Paint exposed to freezing, excess humidity, rain, snow or condensation during application and/or before drying properly shall be permitted to dry. Damaged areas of paint shall then be removed and the surface blasted to white metal and repainted with the same number of coats of paint as the same kind of undamaged areas.

13. INSPECTION

a. General. Inspection, to determine conformance of the work with this Specification, will be done by the Engineer without cost to Contractor. The Contractor shall furnish appropriate equipment for holiday detection and the measuring of dry film thicknesses. Work found to be defective shall be repaired to the satisfaction of the Engineer, by and at the expense of Contractor. Repaired areas will be reinspected.

b. Surface Preparation. The Engineer will inspect for approval all Classification A surface preparation work, and reserves the right to make similar inspections on Classification B work, prior to application of the base or primer coating by the Contractor. Each coating shall be inspected for approval prior to application of the next coating.

c. Dry Film Thickness. The dry film thickness on steel will be measured above the peaks of the blast pattern or other surface irregularities by means of a magnetic thickness gauge such as the General Electric Thickness Gage, Type B;

d. Holiday Detection. Holiday detection on steel will be done by means of a low-voltage, non-destructive, wet-sponge flaw detector, such as the Tinker and Rasor M-1 flaw detector.

e. Use of Contractor's Facilities. The Contractor shall make available for use by the City during the progress of the work, scaffolds, ladders, staging or other such equipment used or installed by him to perform the required work. The City will use these facilities to inspect the work as it is being done and to make the necessary paint thickness determinations.

The use of the facilities by the City will ordinarily be at such times as will not unduly interfere with the Contractor's work; but, the Contractor shall suspend his work in any area to permit inspections and determinations of the paint thickness whenever it is necessary.

The Contractor shall provide a bosun's chair or similar workman's hoist for use by City for inspection of areas in which stationary scaffolding is not installed and otherwise not readily accessible by other means.

Part I - Continued

14. WORKING CONDITIONS

The Contractor must provide adequate ventilation while painting and blasting. The ventilation shall be adequate to remove fumes, preventing injury to workmen or the possibility of accumulating volatile gases.

Cloths and cotton waste material which might constitute a fire hazard shall be placed in closed metal containers or be destroyed at the end of each days work.

All safety precautions, as specified by the coating manufacturer, as well as the State of Washington Safety Code shall be adhered to.

15. PROTECTION AND REPAIR OF COATINGS

a. Protection. The Contractor shall provide protection for items while being painted, and after painting is completed. Items which have been painted shall not be handled, worked or otherwise disturbed until the paint coat is completely dry and hard.

All metal work that has been painted or coated shall be handled with care so as to preserve the coating in its best condition.

Adjacent floors, equipment and other surfaces shall be protected from paint splatter or spray by covering with drop cloths or other suitable material or masking as required.

b. Repair. Before proceeding with the regular painting or coating operations, the Contractor shall clean and repair all areas of shop coat which are defective or damaged. Shop-coated or field-coated areas that are loose, weakly bonded, blistered, abraded, rusted, or otherwise defective, shall be removed to clean metal by scraping, shipping, wire brushing, or other effective means. Areas thus prepared shall be cleaned of all dust, dirt and other contamination, usring clean rags and clean solvent. These surfaces shall then be repainted in accordance with the painting schedule.

Part II - Classification A

1. GENERAL

This part of Section 20 stipulates the requirements for painting the items of steel metalwork designated as Classification A.

The work covered consists of furnishing all labor and supervision, material and equipment, and the performance of all operations and incidentals necessary to accomplish the painting as specified herein or shown on the drawings or in the Coating Schedule for Classification A work.

Classification A items are the major heavy steel metalwork units of the Project in size, importance of function, cost, severity of exposure and difficulty of maintenance. Application of the most durable protective coating systems ob tainable are desired and intended; and, the specification requirements for surface preparation, materials, application, measurement, and other aspects of the work are strictly directed to this purpose; accordingly, only those modifications, changes or substitutions will be considered which, in the judgment of the Engineer, advance this purpose.

Those items, and parts, appurtenances and accessories thereof, which are continuously submerged in water shall be protected by a 5-coat, 10-mil dry film thickness, vinyl system, Code Designation VX. The exceptions to this rule are the trashrack panels, supports and guides which, because of difficulties of application due to the forms and shapes of the metal, shall be protected by a coating system composed of a base coat of self-curing type zinc silicate, a vinyl type tie coat and a heavy body coat of vinyl type mastic paint. The coating system for the trashracks is Code Designation ZS-VT-VM.

Those items, and parts, appurtenances and accessories thereof, which are intermittently immersed in water, but not exposed to public view shall be protected with a single coat of inorganic zinc silicate, of the separate cure type. This coating is Code Designation ZG.

Those items, and parts, appurtenances and accessories thereof, which are only intermittently immersed in water, or not at all, but which are exposed to public view shall be protected by a coating system composed of a base coat, Designation ZG; and a finish coating of high solids, vinyl type paint of the selected color, Designation VF. System coating Designation is ZG-VF.

The surface preparation for all Classification A items shall be by dry-blasting to white metal in the field in place; accordingly, these items shall be delivered to the job without a shop coat of paint.

Part II - Continued

2. MATERIALS

The products listed herein below are approved for application to items as indicated in the Specifications and the Coating Schedule for Classification A.

Code	Type of Paint	Specification Manufacturer - Product
VX	Vinyl Special	Amercoat No. 23 Amercoat Corporation
VF	Vinyl Finish	Amercoat No. 99 - Semi Gloss Amercoat Corporation
ZG	Zinc Silicate	Amercoat-Dimetcote No. 3 Amercoat Corporation
ZS	Zinc Silicate	Amercoat-Dimetcote No. 4 Amercoat Corporation
VT	Vinyl Tie Coat	Amercoat No. 86 Tie Coat Amercoat Corporation
VM	Vinyl Mastic	Amercoat No. 87 Amercoat Corporation

The paint materials listed above are specified by reference to a proprietary brand. However, the Contractor may submit for approval paints of the same generic types but of a different manufacturer or specification, which offer the same degree of quality as those specified above, and which have had a minimum of 15 years of satisfactory field service under exposure conditions comparable to those existing on this project; provided, that the paints proposed shall be compatible, and the products of one manufacturer. The most durable protective coating system obtainable is desired; and, in evaluating durability the field experience record of the coatings will be given major consideration. Laboratory tests alone, simulating field conditions, will not be accepted in lieu of successful experience in actual field applications; accordingly, products unproven by extensive and satisfactory field experience will not be considered. The City reserves the right to select, for application by the Contractor, the products which, in the Engineer's judgment, will best provide the protective coatings required by the environments; and, which best meets the requirements of this specification. The written decision of the Engineer as to the acceptance of any substitute paint proposed by the Contractor shall be final and binding.

Part II - Continued

3. SURFACE PREPARATION

a. General. Prior to application of the specified protective coatings, all surfaces of the item and appurtenances and accessories thereof, to be painted shall be dry blasted to "white" metal in accordance with the provisions of the Steel Structures Painting Council Specifications, SSPC-SPS-52T.

Blasting of the surfaces shall be accomplished with the items fabricated and in place. This procedure may be modified, with the Engineer's approval, where access to certain surfaces would otherwise be inadequate for proper execution of the work.

All weld splatter shall have been removed and all welds, burrs and ragged edges ground smooth prior to commencement of blasting operations.

Heavy deposits of oil or grease shall be removed by solvent cleaning hereinafter specified, before sandblasting is begun. Small quantities of oil and grease may be removed by the blast cleaning operation. If oil and grease are removed by blast cleaning, the abrasive shall not be reused if such reuse is detrimental to the surface.

Cleaning operations shall not be conducted on surfaces that will be wet after blasting and before painting, or when the surfaces are less than 5 degress Fahrenheit above the dew point, or when the relative humidity of the air is greater than 85 percent.

Blast cleaning operations shall be done in such a manner that no damage is done to partially or entirely completed portions of the work.

b. Method. Blast cleaning surfaces to "white" metal, shall be accomplished by dry blasting using compressed air blast nozzles and dry sand, metallic slag or other suitable materials which will produce the results required.

The compressed air used for blasting shall be free from detrimental amounts of condensed water or oil. Adequate separators and traps shall be provided. Air shall be maintained at pressures giving effective blasting at all times. Nozzles shall be discarded when the orifice is worn 50 percent greater in diameter than its original size.

After blasting, all surfaces shall be brushed with clean brushes made of hair, bristle, or fiber, blown off with compressed air (from which detrimental oil and water have been removed), or cleaned by vacuum for the purpose of removing any traces of blast products from the surface and from pockets and corners.

c. Anchor Pattern. The roughness character of the prepared surface shall be such as to provide the proper anchor pattern for the paint, as recommended by the paint manufacturer. The Engineer may test the anchor pattern,

Part II - Continued

to determine whether the pattern is correct for application of the paint system and reserves the right to direct modification of blasting material, or other factors, if necessary, to secure the required anchor pattern.

d. Solvent Cleaning. Where solvent cleaning is required it shall be accomplished by wiping the surface with rags or brushes wetted with solvent. The final wiping shall be done with clean solvent and clean rags or brushes. No detrimental residue shall be left on the surface.

Fire and explosion hazards are inherent in solvent cleaning operations, and no work shall proceed until safe conditions have been established.

Safety solvents shall be used for cleaning. Flammable safety solvent, suitable for use, must have a minimum flash point of 100° F. Xyol, Tuluol, and chlorinated hydrocarbon solvents may be used where adquate ventilation is provided to keep their vapor content in the air below minimum toxic or flammable concentrations. Gasoline or benzene shall not be used.

e. Safety Precautions. Proper safety precautions shall be taken before any work is done.

Nozzle blast operators exposed to blast dust shall wear a U. S. Bureau of Mines approved helmet connected to a source of clean, compressed air.

Filter type respirators shall be worn by all others who are exposed to blast dust environment. Adequate protection for personnel from flying particles shall also be provided in any blasting operation.

Safety goggles shall be worn by all peraons near any blasting operation.

Blast hose shall be grounded to dissipate static charges.

4. CODE DESIGNATION - VX

a. General. Code Designation VX protection coating required a polyvinyl chloride system consisting of three distinct but compatible component paints for primer, body and seal coats. A total of five (5) coats of the paints shall be applied to a minimum dry film thickness of 10 mils, as follows: one primer coat (approximately 1.0 mil thick); two body coats at 3.0 mils each; and, two seal coats at 1.5 mils each. The combined thickness of the primer and the two body coats shall be not less than 7.0 mils; and, the combined thickness of the two seal coats shall not be less than 3.0 mils.

b. Application.

(1) General. The paint coatings shall be applied in accordance with

Part II - Continued

Paragraph 3, "Surface Preparation". Each cost of paint shall be applied as a continuous film of uniform thickness free of holidays, sage or runs. All visible thin spots or areas missed in application shall be repainted and permitted to dry before the next coat of paint is applied. Each coat of paint shall be in a proper state of cure or dryness before the application of the succeeding coat. Paint shall be considered dry for recoating after it has dried not less than the minimum drying time, and not until the succeeding coat can be applied without causing development of any detrimental film irregularities such as lifting or loss of adhesion of the undercoat. and without damage from scaffolds, rigging or other operations involved in application of the additional coats.

(2) Primer Coat. The primer coat shall be applied to the blasted "white" metal surface on the same day the surface is prepared; and, the freshly blasted steel shall not be allowed to stand over night between blasting and application of the primer coat. In the event that rusting occurs after completion of the surface preparation, the surfaces shall be again cleaned in accordance with the specified method.

The paint shall be stirred thoroughly before and during application to ensure suspension of all pigments. The metal surface shall be dusted thoroughly ahead of the priming operation.

The primer shall be applied by brush; thoroughly brushing it into the metal surface, to form a smooth, even, wet coat, with no bare areas or holidays. Special attention shall be given to applying the required coverage and coating thicknesses over all welds, seams, bolt ends, edges and corners, and rough spots. Any loose hairs from the brush shall be removed from the primer coat before application of the first body coat.

(3) Body coats and seal coats shall be applied by approved spray equipment. The paints shall be thoroughly mixed before use, and frequently during application. Paints shall not be thinned unless necessary for workability, and using only the thinner recommended by the paint manufacturer. Special attention shall be given to applying the required coverage and coating thicknesses over all welds, seams, bolt ends, edges, and corners, and rough spots. Overspray conditions shall be corrected before proceeding with the next coat, and shall also be corrected on the final seal coat, all in accordance with the paint manufacturer's recommended methods.

c. Coating Checks and Measurement. The total dry film thickness of the primer and body coats shall measure not less than 7.0 mils. The total dry film thickness of the two seal coats shall measure not less than 3.0 mils. The total dry film thickness of the completed coating shall measure not less than 10.0 mils.

Part II - Continued

The Engineer will measure the dry film thickness of the coatings, at the three stages tipulated above, with a General Electric Thickness Gage, Type B, or other means equally accurate.

The thickness of the coatings applied to the structure will be determined from measurements made at numerous locations on the various surfaces after the paint has been applied and allowed to dry. The number of measurements taken, their spacing and location shall be determined by the Engineer and shall be such as to ensure that all surfaces of the structure have received the required thickness of paint, and will be based upon the particular surface to be measured. Should measurements indicate that the thickness at any location is less than the specified minimum, the Contractor shall apply the necessary additional paint to an area surrounding the low reading as directed. This area may extend to the locations surrounding the low reading where the measurements taken at the same time indicate that the required minimum thickness has been met.

The completed coating shall provide a surface free of pinholes, holidays and runs. A Tinker and Rasor or other low voltage (under 100 volts) holiday detector shall be used to determine acceptability.

The Contractor shall have a representative present when the measurements are being made, to establish mutual agreement to the measurements. Should the Contractor fail to provide a representative he shall abide by the results.

d. General Requirements of Paint.

(1) Colors. The prime coat shall be dark gray to contrast with the light color of sandblasted steel. Each body coat and seal coat shall be of different color to differentiate them during application. All tinting shall be done by the manufacturer.

(2) Storageability. The materials shall show no settling or separation which cannot be readily eliminated and the solutions restored to smooth, homogeneous mixtures by manual stirring within 6 months after delivery.

(3) Application properties. When applied as specified the materials shall have acceptable brushing and spraying properties and shall level to a smooth, uniform coating free from runs and sags and other surface irregularities as applied singly or in combination.

(4) Drying properties. The material shall be of the air drying type and each coat of material shall dry sufficiently within (3) hours at 73^{o}+ 2^{o} F. and 50 percent relative humidity to permit recoating without producing surface irregularities.

Part II - Continued

5. CODE DESIGNATION ZG

a. General. Code Designation ZG protective coating requires a single coating of zinc silicate with separate cure especially designed for the protection of metal surfaces from rust and corrosion. The coating shall bond chemically as well as mechanically to the metal surface and resist undercutting and water penetration. The coating material shall be 100 percent inorganic zinc silicate with a minimum of 23 pounds of metallic powder to the gallon, requiring a minimum of 24 hours of cure.

b. Application. The coating shall be applied to the blasted "white" metal surface prepared in accordance with Paragraph 3, "Surface Preparation". The coating manufacturer's mixing, application and curing instructions shall be strictly complied with at all times.

The coating shall be applied to the steel on the same day the surface is prepared; and the freshly blasted steel shall not be allowed to stand overnight between blasting and application of the coating. In event rusting occurs before completion of the surface preparation, the surfaces shall again be cleaned in accordance with the specified method.

The powder and liquid shall be mixed by a mechanical agitator and used within the recommended pot life. Thinner or solvent shall not be added. Special attention shall be given to applying the required coverage and coating thicknesses over all weld seams, bolt ends, edges and corners, and rought spots.

The coating shall be applied to a minimum dry film thickness of 3.0 mils and the curing solution applied, using approved spray equipment. Where the film thickness is greater than 3.0 mils so that curing is not properly effected, an additional application of curing solution shall be made. The curing solution shall be allowed to remain on the surface at least 24 hours protected from moisture in any form.

c. Coating Checks and Measurements. The dry film thickness of the completed coating shall measure not less than 3.0 mils.

Test and check procedures shall be as stipulated for Code Designation VX, except as indicated above.

6. CODE DESIGNATION ZG-VF

a. General. Code Designation ZG-VF protective system requires a VF coating applied over the base coating, ZG.

b. Base Coating - ZG. This coating shall be as specified in Part II, para. 5, "Code Designation ZG", except that after curing is accepted as completed, the residue of the curing solution shall be removed as soon as possible by flushing the surface with fresh water or by steaming; and, to facilitate removal

Part II - Continued

of heavy deposits, scrubbing with stiff bristle brushes. The surface shall finally be thoroughly flushed with fresh water and allow to dry before applying the VF coating.

The coating shall be applied to a dry blasted white metal surface.

c. Finish Coating - VF. This coating shall be a high solid, vinyl coating, compatible with the ZG base coating, and resistant to all atmospheric exposures.

The coating shall be spray applied at package consistency onto the base coat after the base coat has been cured, cleaned and accepted. Immediately prior to application of VF, the surface to be coated shall be dusted with brush or clean cloth to remove any accumulation of dust. Surfaces must be completely dry. The minimum dry film thickness of the applied VF coating shall be 3.0 mils.

The coating manufacturer's mixing, application and drying instructions shall be strictly complied with at all times.

d. Coating Checks and Measurements. The dry film thickness of the ZG coating shall measure not less than 3.0 mils.

The dry film thickness of the completed coating shall measure not less than 6.0 mils.

Test and check procedures shall be as stipulated for Code Designation VX, except as indicated above.

7. CODE DESIGNATION - ZS - VT - VM

a. General. Code Designation ZS-VT-VM protective system requires a base coat of ZS, a tie coat of VT and a finish coat of VM.

b. Base Coat - ZS. This coating shall be as specified in Part II, para. 6 "Code Designation ZG-VF"; except, that the coating material shall be a self-curing type not requiring the separate application of a curing solution; the coat shall be applied to a minimum dry film thickness of 4.0 mils; the 100 percent inorganic zinc silicate material shall contain a minimum of 25 pounds of metallic powder to the gallon.

The coating shall be applied to a dry blasted white metal surface.

c. Tie Coat - VT. This coating shall be a vinyl resin type specifically designed to serve as a tie coat between the ZS base and the overlying VM finish coat. It shall be compatible with both base and finish coat materials.

Part II - Continued

This coating shall be brush applied at package consistency, over the base coat, after the base coat has been accepted as completed. Immediately prior to application of VT, the surface to be coated shall be dusted with brush or clean cloth to remove any accumulation of dust. The minimum dry film thickness of the VT coating shall be 1.0 mils.

d. Finish Coat - VM. This coating shall be a high solids, heavy bodied mastic type material based on vinyl resins, compatible with the underlying VT tie coat. Immediately prior to application of the VM, the surface to be coated shall be dusted with brush or clean cloth to remove any accumulation of dust. Surfaces must be completely dry. The material shall be spray applied at package consistency onto the tie coat to a minimum dry film thickness of 10.0 mils.

e. Application Instructions. The coating manufacturer's mixing, application and drying instructions shall be strictly complied with at all times.

f. Coating Checks and Measurements. The dry film thickness of the ZS coating shall measure not less than 4.0 mils. The total dry film thickness of the completed coating shall measure not less than 15.0 mils.

Test and check procedures shall be as stipulated for Code Designation VX, except as indicated above.

8. PAYMENT

No separate payment shall be made for painting but all costs of furnishing all labor and supervision, material and equipment, and the performance of all operations and incidentals necessary to accomplish the painting as specified herein shall be included in the applicable prices bid in the Proposal for furnishing and installing, or installing, the metalwork items.

9. COATING SCHEDULE FOR CLASSIFICATION A

The coating schedule for Classification A items is found on the following three pages.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION A

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
VX	Draft Tube Gates	4	SP-5						VX		10.0
ZG	Draft Tube Gates	8	SP-5		ZG						3.0
VX	Draft Tube Gate Frames	12	SP-5						VX		10.0
VX	Draft Tube Gate Guides	12	SP-5						VX		10.0
VX	Draft Tube Gate Rails	12	SP-5						VX		10.0
VX	Draft Tube Gate Dogging Device	12	SP-5						VX		10.0
VX	Draft Tube Gate Lifting Beam	12	SP-5						VX		10.0
VX	Intake Gates	6	SP-5						VX		10.0
VX	Intake Gate Frames	6	SP-5						VX		10.0
VX	Intake Gate Guides	6	SP-5						VX		10.0
VX	Intake Gate Dogging Device	6	SP-5						VX		10.0
VX	Intake Gate Rails	6	SP-5						VX		10.0
VX	Penstock Liners	6	SP-5						VX		10.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

SHEET NO. 1 OF 3 SHEETS

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1702 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION A

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES MILS
VX	Skimmer Gate - Upstream side	1	SP-5						VX		10.0
ZG-VF	Skimmer Gate - Downstream side	1	SP-5		ZG	VF					3.0 3.0
VX	Sluice Gate - Upstream Side	7	SP-5						VX		10.0
ZG-VF	Sluice Gate - Downstream side	7	SP-5		ZG	VF					3.0 3.0
VX	Sluice Gate - Frames	7	SP-5						VX		10.0
VX	Sluice Gate - Guides	7	SP-5						VX		10.0
VX	Sluice Gate - Rails	7	SP-5						VX		10.0
VX	Sluice Liners	7	SP-5						VX		10.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION A

SHEET NO. 3 OF 3 SHEETS

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
VX	Sluice Maintenance Gate	1	SP-5						VX		10.0
VX	Sluice Maintenance Gate Frame	1	SP-5						VX		10.0
VX	Sluice Maintenance Gate Guide Rails	1	SP-5						VX		10.0
VX	Sluice Maintenance Gate Lifting Guide	1	SP-5						VX		10.0
VX	Sluice Maintenance Gate Lifting Frame	1	SP-5						VX		10.0
VX	Spillway Gates - Upstream side	2	SP-5						VX		10.0
ZG-VF	Spillway Gates - Downstream side	2	SP-5		ZG	VF					3.0 3.0
ZS-VT-VM	Trash Rack Supports		SP-5		ZS	VT	VM				4.0-1.0 10.0
ZS-VT-VM	Trash Rack Guides		SP-5		ZS	VT	VM				4.0-1.0 10.0
ZS-VT-VM	Trash Rack Panels		SP-5		ZS	VT	VM				4.0-1.0 10.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

Part III - Classification B

1. GENERAL

This part of Section 20 stipulates the requirements for painting the items of steel metalwork designated as Classification B, and consists of all items to be painted under this Contract, other than those items under Classification A.

The work covered by this section of the specification consists of furnishing all labor and supervision, material and equipment, and the performance of all operations and incidentals necessary to complete the painting as specified herein or shown on the drawings and the Coating Schedule for Classification B work.

2. MATERIALS

The products listed herein below are approved for application to items as indicated in the Specifications and the Coating Schedule for Classification B. Materials are designated herein by reference to a Standard Specification or to a proprietary brand. However, the Bidder may base his Proposal on, and submit for approval, paints of different manufacture or specification which offer the same degree of quality as those specified and that have had a minimum of five years' satisfactory field service under exposure conditions comparable to those existing on this project at the location of use. Laboratory tests simulating field conditions will not be accepted in lieu of experience with actual field applications. The decision of the Engineer in writing as to the acceptability of the substitute paint will be final. Paints of the same type shall be the products of one manufacturer.

Code	Type of Paint	Specification - Manufacturer - Product
AP	Aluminum Paint	FS TT-A-468a, Type II, Class B. Mixing Varnish for aluminum paint FS TT-V-119, Pittsburgh #17-15 surface conditioner, or approved equal shall be mixed into the paint in the amount of 1 gallon of conditioner to every 15 gallons of paste and varnish mixture.
CE	Coal Tar Emulsion	For touch-up of acid-resistant coating use paint to equipment manufacturer's standard
CX	Coal Tar Finish	Amercoat Corporation Protective Coating No. 78

Part III - Continued

EG	Exterior Gloss Finish	FS TT-E-489, Class A or approved equal as specified for exterior and interior gloss
GP	Galvanized Primer	FS TT-P-6416, Type II
IE	Interior Eggshell Primer	FS TT-E-489, Class A
IF	Interior Flat	Sherwin-Williams Co. "Multi-Color"
IP	Interior Primer	Sherwin-Williams Co. "Quali-Kote"
SP	Steel Primer - Glyptol	Alkyd-resin type as manufactured by General Electric Company, GE Glyptol #1272-Red
SS	Steel Primer, Slow Dry	
SX	Steel Primer	FS TT-P-86, Type II, or approved equal
VC	Vinyl Conditioner	MS MIL-P-15328B
VF	Vinyl Finish	Amercoat No. 99 - Semi Gloss Amercoat Corporation
VP	Vinyl Primer	Amercoat No. 86 Amercoat Corporation
VS	Vinyl Sealer	Amercoat No. 87 Amercoat Corporation
VX	Vinyl Special	Amercoat No. 23 Amercoat Corporation
WR	Silicone Water Repellent	Dehydratine No. 22, A.C. Horn Co.
ZC	Zinc Coating	Subox "Galvanox" Sealube - 2 RO
ZG	Zinc Galvanize	Amercoat - Dimetcoat No. 3 Amercoat Corporation

Part III - Continued

ZS	Zinc Silicate	Amercoat - Dimetcoat No. 4 Amercoat Corporation
ZT	Zinc Treatment	Amercoat No. 59 Amercoat Corporation

3. SURFACE PREPARATION AND APPLICATION

a. General. Finish hardware except hinges, hardware accessories and similar items in place prior to painting, shall be taped or removed during painting operations and repositioned upon completion of painting. Surfaces to be painted shall be clean, smooth, dry and free from dust, grit, moisture and frost.

Application of the paint and protective coatings shall be in strict accordance with the manufacturer's instructions except as otherwise specified or directed by the Engineer. Reference is made to Paragraph 12 of Part I.

b. Bare Metal. Bare metal surfaces shall be prepared in accordance with Steel Structures Painting Council Surface Preparation Specification cited in the Coating Schedule for Classification B items.

c. Galvanized Surfaces. Galvanized surfaces to be painted shall be solvent-cleaned and treated with metal conditioner.

d. Coal Tar Epoxy. The instructions, directions and recommended procedures of the coating manufacturer regarding mixing, catalyzing, surface preparation and application of the epoxy, the solvents to be used for cleanup, and the directions regarding disposal of unused catalyzed material shall be followed by the Contractor in strict detail. The metal areas to be coated shall be thoroughly cleaned to bare metal. Primer shall be applied and allowed to dry according to the manufacturer's instructions. Epoxy shall be applied without thinning and shall be 16 mils or more in total dry film thickness applied in two or more coats to obtain the specified thickness. The finished coating shall overlap the main body of coating to form a continuous coating free from pinholes and holidays. Touch-up and final coats of shop coated areas shall be done using the same type and manufacture of protective coating material as was originally applied.

e. Red Lead Primer. Areas to be primed shall be thoroughly cleaned to base metal and edges of adjacent paint shall be feathered. Red lead primer shall be applied by brush or spray the same day the surfaces are cleaned. The dry film thickness of the applied paint shall be at least 1-1/2 mils.

f. Vinyls and Zinc Silicate Paints. Surface preparation and application shall be as stipulated in Part II for Classification A work.

Part III - Continued

4. REPAIR OF GALVANIZING AND DAMAGED PAINT SURFACES

a. General. Some items of machinery, equipment, and other metalwork furnished by the City may be furnished completely painted, may have a coat of prime paint, or may be galvanized. Machinery, equipment and metalwork furnished by the City will be inspected by the Engineer at the time of delivery to the Contractor and damaged areas of paint or galvanizing which are found to be defective or damaged at the time of delivery, as determined by the Engineer, shall be cleaned and repaired by the Contractor and payment therefor will be made as extra work.

The repair of damaged areas of paint or galvanizing on machinery, equipment, and other metalwork furnished by either the City or the Contractor which is due to the operations of the Contractor shall be made by and at the expense of the Contractor in a manner satisfactory to the Engineer.

b. Galvanized Surfaces. Damaged galvanizing shall be repaired by Galvanox, applied at least as thick as the shop applied galvanizing.

c. Primed Surfaces. Abraded surfaces shall be cleaned and touched up by using the same type and thickness of material as was used for the original prime coat. Such surfaces shall be prepared in accordance with the applicable SSPC Surface Preparation Specification as determined by the Engineer.

d. Finished Surfaces. Damage to paint finished surfaces shall be repaired by surface preparation in accordance with applicable SSPC Surface Preparation Specification as determined by the Engineer; and, recoating using the same types and thicknesses of materials as were used in the original coatings.

5. PAYMENT

No separate payment will be made for painting but all costs of furnishing all labor and supervision, material and equipment, and the performance of all operations and incidentals necessary to accomplish the painting as specified herein shall be included in the applicable prices bid in the Proposal for furnishing and installing, or installing, the metalwork items.

6. COATING SCHEDULE FOR CLASSIFICATION B

The coating schedule for Classification B items is found on the following seven pages.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES MILS
	Aluminum			No Paint							
	Brass, Bronze & Copper, Except as noted			No Paint							
	Bronze Cranes										
	Hooks and Blocks		SP-3	SX	EG	EG				Black & Yel. Safety Stripes	4.0
	Cabinets, Miscellaneous										
	Except as noted		SP-3	SX	EG	EG					4.0
	Cable Trays and Supports		SP-2	S-1, ZC						Galvanized	
	Cable Ladders		SP-2	S-1, ZC						Galvanized	
	Cable Ducts		SP-2	S-1, ZC						Galvanized	

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Checkered Plate - Outdoor, topside		SP-5						VX		10.0
	Checkered Plate - Outdoor, underside		SP-5						VX		10.0
	Checkered Plate - Outdoor, underside, exposed		SP-5						VX		10.0
	Conduit - Electrical			No Paint							
	Doors & Frames, Exterior, Outside face		SP-3	SX	SX	EG	EG				4.0
	Doors & Frames, Exterior, Inside face		SP-3	SX	SX	EG	EG				4.0
	Embedded Metal, Pipe, Bolts, etc.			No Paint							
	Equipment Supports		SP-3	SX	SX	EG	EG			Same as Equipment	4.0
	Fence, Including Gates		SP-2	S-1, ZC						Galvanized	

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Draft Tube Gate - Gantry	1	SP-3	S-1, ZS	VF					Medium Green	5.0
	Intake Gate Hoists	6	SP-3	S-1, ZS	VF					Medium Green	5.0
	Skimmer Gate Operator	1	SP-3	S-1, ZS	VF					Medium Green	5.0
	Sluice Gate Hoists	7	SP-3	S-1, ZS	VF					Medium Green	5.0
	Sluice Maintenance Gate Hoist	1	SP-3	S-1, ZS	VF					Medium Green	5.0
	Sluice Maintenance Gate Operator	1	SP-3	S-1, ZS	VF					Medium Green	5.0
	Spillway Gate Hoists	2	SP-3	S-1, ZS	VF					Medium Green	5.0
	Hand Rails, Indoors		SP-3	SX	S	EG	EG			Surf Green	4.0
	Hand Rails - Indoors, Galvanized		SP-3		VC	EG	EG			Surf Green	4.0
	Hand Rails - Outdoors		SP-3		VC	EG	EG			Light Green	4.0
	Hand Rails - Outdoors		SP-3		VC	EG	EG			Dark Gray	4.0

AP	ALUMINUM PAINT	VF	VINYL FINISH
CE	COAL TAR EMULSION	VM	VINYL MASTIC
CX	COAL TAR, SPECIAL	VP	VINYL PRIMER
EG	EXTERIOR GLOSS	VS	VINYL SEALER
GP	GALVANIZED PRIMER	VT	VINYL TIE COAT
IE	INTERIOR EGGSHELL	VX	VINYL, SPECIAL
IF	INTERIOR FLAT	WR	SILICONE WATER REPELLANT
SP	STEEL PRIMER-GLYPTOL	ZC	ZINC COATING
SS	STEEL PRIMER, SLOW DRY	ZG	ZINC SILICATE, SEP. CURE
SX	STEEL PRIMER, SPECIAL	ZS	ZINC SILICATE, SELF CURE
VC	VINYL METAL CONDITIONER	ZT	ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SHEET NO. 4 OF 7 SHEETS

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Hand Wheels		SP-3		EG	EG					4.0
	Hatches and Frames		SP-3	SX	SX	EG	EG			Light Gray	4.0
	Ladders, Inside		SP-3	SX	EG	EG				Mermaid Green	4.0
	Ladders, Inside - galvanized		SP-3		VC	EG	EG			Mermaid Green	4.0
	Ladders, Outside		SP-3	SX	EG	EG				Light Gray	4.0
	Ladders, Outside - galvanized		SP-3	SX	VC	EG	EG			Light Gray	4.0
	Metal Overhead Doors - Inside face		SP-3	SS	EG	EG				Mermaid Green	4.0
	Metal Overhead Doors - Outside Face		SP-3	SS	EG	EG				Ocean Green	4.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE. BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Miscellaneous Metalwork, Indoors, Including Stairs		SP-3	SX	SX	EG	EG			Light Gray	4.0
	Miscellaneous Metalwork, Outdoors, Including Stairs		SP-3	SX	SX	EG	EG			Light Gray	4.0
	Miscellaneous Sheet Steel Enclosures, Indoors		SP-2	SX	EG	EG				Light Gray	4.0
	Miscellaneous Sheet Steel Enclosures, Outdoors		SP-2	SX	EG	EG				Dark Gray	4.0
	Pipe, Valves, Fittings - galvanized		SP-2		VC	EG	EG			Light Gray	4.0
	Pipe, Valves, Fittings - Others		SP-3	SX	SX	EG	EG			Light Gray	4.0
	Pipe Valves, Fitting - Submerged		SP-3		CX	CX				Black	16.0
	Structural Steel										
	Outdoor - Unprimed		SP-3		SX	SX	EG	EG		Light Gray	8.0
	Outdoor - Primed		SP-3	SX	SX	EG	EG			Light Gray	8.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
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ZG ZINC SILICATE, SEP. CURE
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SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

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EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Trashrack Rake Travelling Hoist										
	Cab Interior		SP-3	SX	SX	EG	EG			Light Gray	4.0
	Handrails		SP-5						VX	Gray	10.0
	Walkways		SP-5						VX	Gray	10.0
	Exposed Surfaces		SP-5						VX	Gray	10.0
	Hoist		SP-3	S-1, ZS	VF					Medium Green	5.0
	Valve Floor Stands		SP-3	SX	SX	EG	EG			Surf Green	4.0
	Window Frames - Interior		SP-3	SX	SX	EG	EG			Light Gray	4.0

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

BOUNDARY PROJECT - DAM AND POWERPLANT
SPECIFICATION NO. 1782 - SECTION 20 - PAINTING STEEL METAL WORK
COATING SCHEDULE - CLASSIFICATION B

SUPPLEMENTARY AND GENERAL INSTRUCTIONS ON PRECEDING PAGES AND ON APPROVED MATERIAL LISTS SHALL APPLY TO WORK SPECIFIED AS THOUGH PRINTED IN FULL ON THIS SHEET.

CODE DESIGNATION	DESCRIPTION	UNITS	SURFACE PREPARATION	TOUCH-UP COAT	MINIMUM DRY FILM THICKNESS MEASURED ABOVE BLAST PATTERN PEAKS OR OTHER PROMINENCES: FULL FIELD COATS 1	2	3	4	5	FINISH COLOR	MILS
	Penstock Fill Line - (*)										
	Exterior surface, touch-up		SP-3	S-1, ZS							3.0
	Exterior surface at welds		SP-5		ZG						3.0
	Interior surface, touch-up		SP-3	S-1, VX							10.0
	Interior surface, at welds		SP-5						VX		10.0
	Valves, touch-up		SP-3	S-1, ZG	VF						5.0
	(*) In addition to the above field painting,										
	the items shall be shop coated as stipulated										
	in Section 11, paragraph 2,a.										

AP ALUMINUM PAINT
CE COAL TAR EMULSION
CX COAL TAR, SPECIAL
EG EXTERIOR GLOSS
GP GALVANIZED PRIMER
IE INTERIOR EGGSHELL
IF INTERIOR FLAT
SP STEEL PRIMER-GLYPTOL
SS STEEL PRIMER, SLOW DRY
SX STEEL PRIMER, SPECIAL
VC VINYL METAL CONDITIONER
VF VINYL FINISH
VM VINYL MASTIC
VP VINYL PRIMER
VS VINYL SEALER
VT VINYL TIE COAT
VX VINYL, SPECIAL
WR SILICONE WATER REPELLANT
ZC ZINC COATING
ZG ZINC SILICATE, SEP. CURE
ZS ZINC SILICATE, SELF CURE
ZT ZINC TREATMENT

SURFACE PREPARATION STANDARDS OF THE STEEL STRUCTURES PAINTING COUNCIL

SP 2 HAND TOOL CLEANING
SP 3 POWER TOOL CLEANING
SP 5 WHITE METAL BLAST CLEANING

SPECIAL NOTES APPLYING TO WORK ABOVE

S-1

EACH AREA REQUIRING TOUCH-UP TO BE GIVEN A TWO COAT TOUCH-UP. THE SURFACE PREPARATION REQUIRED PRIOR TO TOUCH-UP APPLIES TO THE DEFECTIVE OR DAMAGED AREAS ONLY.

SHEET NO. 7 OF 7 SHEETS

SECTION 21

CONCRETE BLOCK MASONRY

1. GENERAL

Concrete block work shall include the furnishing of all labor supervision, material and equipment, and performance of all operations and incidentals necessary for the furnishing, deliverying and erection of the concrete block masonry as specified herein or shown on the drawings.

2. MATERIALS

Materials shall conform to the specifications as listed below:

a. Concrete Blocks. ASTM Designation C 90, with linear shrinkage limited to 0.05 percent, size as shown on the drawings.

b. Ground Face Concrete Blocks. Concrete blocks as above, but with 1/16 inch ground off the exposed surfaces will be provided for the following areas:

Service Bay, El. 1780'-0", over rolling doors (grind two faces)

Service Bay, El. 1759'-0", veneer at duct opening (grind one face)

Control Room Kitchen, El. 1759'-0", (grind jambs and two faces)

Control Room Toilet, El. 1759'-0", (grind jamb and one face)

c. Reinforcing Bars. ASTM Designation A 15, intermediate grade, deformed in accordance with ASTM A 305.

d. Joint Reinforcement. Standard "Tye-Bloc" manufactured by Gateway Engineering Company or approved equal.

e. Masonry Anchors. "Bee-Hive" Dovetail Anchor Slot and "Bee-Hive" Cavity Wall Dovetail Anchors CWA-G 16 manufactured by Gateway Engineering Company or approved equal.

d. Mortar. ASTM Designation C 270, Type S with 1800 psi compressive strength at 28 days.

e. Grout. Proportioned to produce a grout with 2500 psi compressive strength at 28 days.

f. Lime. ASTM Designation C 207, Type N.

g. Aggregates, Cement and Water shall be as specified in Section 9A.

3. ERECTION

Concrete block masonry walls shall be true to line, level, plumb and built to dimensions shown on drawings. Wall pattern shall be common bond with vertical joints, aligned over the center of each lower block unit. Vertical and horizontal mortar joints shall be tooled to a 3/8" concave face. Concrete blocks shall be laid dry. Mortar protruding at joints shall be cut clean. Cells containing reinforcement shall be solidly filled with grout in lifts not to exceed eight feet. Reinforcing bar splices shall lap 30 bar diameters. Bond beam lintels over masonry openings shall extend two feet beyond rough opening. Blocks adjacent to metal door jambs shall be cut, ground round and filled with grout to close the opening caused by the cut. Concrete block veneer shall be vertically anchored at 2'-0" on centers and horizontally anchored at every fourth course.

4. MEASUREMENT AND PAYMENT

Measurement for payment for concrete block masonry work will be the actual area of concrete block walls and veneer satisfactorily constructed, measured along centerline of the walls or veneer, without deduction for openings one square foot or smaller in area. Payment will be made at the unit price per square foot bid for "Furnishing and Erecting Concrete Block Masonry". No additional payment will be made for furnishing and placing mortar, grout, reinforcement steel, anchors, corkboard joint fillers, for fitting around piping and duct works, for cutting concrete blocks, or other work incidental to the work of furnishing and erecting concrete block masonry.

SECTION 22

MOVABLE PARTITIONS

1. GENERAL

Movable partition work includes the furnishing of all labor, supervision, material and equipment, and performance of all operations and incidentals necessary for the furnishing, delivery and erection of movable partitions as specified herein or shown on the drawings.

Movable partitions include glazed partitions, paneled partitions, glass walls with vertical mullion supports, and glazed aluminum doors and hardware.

2. MATERIALS

a. Movable partition frames shall be manufactured by National Gypsum Company, 850 South Van Ness Avenue, San Francisco, California, or an approved equal. Movable partition frames include "D" plates at vertical mullions, "A" plates at mullions and head, black plastic sills, door sections set for 1-3/4" thick doors, pressed-in aluminum stops at glazed sections, gaskets, posts, floor tracks, and fasteners.

b. Panels set into the movable partitions shall be "Alply" panels manufactured by Aluminum Company of America or approved equal, with a polystyrene core, 1/8" thick sanded cement-asbestos back-up boards, .024 inch thick plain No. 32 Alumilite facing on both sides, and bounded integrally with a waterproof adhesive into a 1-9/16" thick panel.

c. Aluminum doors and hardware components shall be manufactured by Kawneer Company, 600 Parr Boulevard, Richmond, California, or approved equal, including Narrow Stile "190" doors, No. 6300 single-acting 105° opening hold-open device (for single doors and for active leaf of double doors), door floor closers, No. 37-936 top offset pivots, No. 37-227 round face concealed flush bolts (inactive leaf of double door), No. H-1 push-pull bars applied on both sides of each door leaf, No. 37-164 RH and No. 37-165 LH dead bolt locks with strikes (Control Room entrance doors only) and 1-5/32" key cylinders with two keys per cylinder.

d. Glass shall be regular polished plate glass, glazing quality and 1/4 inch thick, manufactured by Pittsburgh Plate Glass Company or approved equal.

e. Caulking shall be Hornflex Caulking compound manufactured by A. C. Horn Companies, Division of Sun Chemical Corporation or approved equal.

3. ERECTION

a. Movable partitions, doors and hardware shall be installed according to the manufacturer's instructions. Recessed door floor closers shall be cast in concrete floor slabs for offset pivoting. Vertical mullions shall be neatly coped as required to receive light switch boxes. Glass shall be set on shims in the concrete chases of window walls and caulked flush. Vertical mullions in glass walls shall be securely anchored to concrete without interferring with the glass. Panels shall be cut square and true to fully seat in movable partition frames. Movable partition frames shall be erected in plane, plumb and square. Keying shall be coordinated with the Engineer. Care shall be exercised to protect the movable partitions before, during and after erection to prevent damage to the finish. The Contractor shall be required to apply a protective covering of heavy paper or plastic sheet over the erected partitions, especially in the area adjacent to the elevator. Any damaged partitions that cannot be repaired to a "like new" finish and condition shall be replaced by the Contractor at his own expense.

4. MEASUREMENT AND PAYMENT

Payment for furnishing and installing movable partitions complete with metal panels, glazed doors, all necessary hardware, door operating mechanism, thresholds and all other material and equipment necessary to complete the installation of the movable partitions will be the lump sum price bid for "Furnishing and Installing Movable Partitions".

SECTION 23

HOLLOW METAL DOORS

1. GENERAL

The work includes the furnishing of all labor, supervision, material and equipment, and performance of all operations and incidentals necessary for the furnishing, delivery and erection of hollow metal doors, frames and door hardware as specified herein and as shown on Drawing No. B-5507.

2. MATERIALS

a. Metal Doors. Metal doors shall be flush type of the size and design shown and shall be fabricated from two sheets of not less than No. 18 gauge steel, separated by vertical steel reinforcements spaced not more than 6 inches on centers, extending the full height of the doors, and welded to the cover sheets. The top and bottom edges of the doors shall be seal welded and reinforced by a steel channel member extending the full width of the doors and be welded in place. Both side edges of the doors shall be reinforced the full height with a continuous strip of steel of sufficient gauge to support the required hardware and to provide adequate rigidity. The doors shall be sound deadened in an approved manner and shall be free from metallic ring. A continuous astragal shall be connected to the mortise leaf of double doors. Reinforcements and mortises for the specified hardware shall be provided. Hardware reinforcements shall be steel of sufficient gauge to support the hardware. Exposed surfaces of the doors shall be thoroughly cleaned using solvent, wire brush or other effective means. After cleaning, the surfaces to be painted shall be so filled with mineral filler and sanded as to present a smooth surface. The doors shall then be given two baked-on coats of rust inhibitive primer.

b. Frames. Metal door frames shall be fabricated from not less than No. 16 gauge steel for 1-3/4" doors with 2" face and 5-3/4" width and shall be of welded construction with angles, returns and mitres neatly welded. Integral door jamb stops shall receive three (3) dimples per jamb stop for receiving a 5/16" diameter flat head machine bolt. Frames shall be equipped with cadmium plated 5/16" diameter flat head machine bolts, bolt sleeves and expansion shields. Hardware reinforcements shall be steel of sufficient gauge to support the hardware. Exposed surfaces of the frames shall be cleaned, filled and painted as specified herein for the metal doors.

c. Hinges. Hinges shall be as manufactured by C. Hager & Sons Hinge Manufacturing Company, St. Louis 4, Mo. (or other approved similar products) and shall be No. 55BB 1199 x US32D, AMS, 4-1/2 x 4-1/2, 1-1/2 pair per door.

d. Locks and Closers. Locks and closers shall be as manufactured by The American Hardware Corporation, Russell & Irwin Division, New Britain, Conn., or approved equal, and shall include the following:

No. P625 lockset, Bristol, stainless steel US 32D

No. P610 latchset, Bristol, stainless steel US 32D

No. 3963 1/2 escutcheon, stainless steel US 32D

No. A 605 strike, stainless steel US 32D

No. A 606 strike, stainless steel US 32D

No. P400 MH 4 door closer

No. 400 M-23 bracket for parallel arm closers

No. 210 1/2 polished aluminum stop

e. Thresholds. Thresholds shall be as manufactured by Wooster Products Inc., Wooster, Ohio, or approved equal, and shall be Type 115-S in 5" widths, plain surface.

3. ERECTION

Hollow metal doors, frames and hardware shall be installed according to the manufacturer's instructions. Regular or reverse bevels on lockset and/or latchset fronts shall be determined from the door hand-swing as noted in the Door Schedule. Locksets and latchsets shall be for 1-3/4" thick hollow metal doors. Screws, bolts and other fastenings shall be of the type and size best suited for the intended purpose and shall be of a composition that will not support galvanic action. Keys and keying shall be coordinated as directed by the Engineer.

4. MEASUREMENT AND PAYMENT

Payment for furnishing and installing the hollow metal doors shown on Drawing No. B-5507, complete with hollow metal door frame, thresholds and hardware will be made at the lump sum price bid in the Proposal for "Furnishing and Installing Hollow Metal Doors".

SECTION 24

CORRUGATED METAL PIPE CULVERTS

1. GENERAL

The Contractor shall furnish and install new culverts as shown on the drawings or as directed by the Engineer.

2. MATERIAL

All culverts to be furnished and installed shall be standard U. S. manufactured galvanized corrugated metal pipe, perforated where required, with connecting bands. The gauges to be used shall be as listed below:

36-inch diameter - 12 gauge

24, 18 & 12-inch diameter - 14 gauge

3. INSTALLATION

The sizes of culvert pipe, culvert locations and lengths will be determined in the field by the Engineer. Each pipe culvert shall be laid so that the minimum distance from the finished surface of the roadway to the top of the pipe shall be not less than one-half the diameter of the pipe and in no event less than one foot.

The trenches in which the pipe is to be laid shall be excavated carefully to the lines and grades established by the Engineer so that the pipe will be fully supported at all points by the unexcavated ground or compacted backfill under the bottom quarter of the circumference; provided, that where rock is encountered in the bottom of the trenches, the trenches shall be excavated to a depth of 6 inches below the grade established for the bottom of the pipe, and this additional excavation shall be backfilled with material approved by the Engineer, which material shall be compacted by an approved mechanical tamper before the pipe is laid. The backfill material in the bottom of trenches, where additional excavation has been required, shall be carefully shaped to bet the curvature of the pipe under the bottom quarter of its circumference.

The pipe shall be handled at all times in such a manner as to avoid damaging the spelter coating. Any damage to the coating shall be repaired entirely at the expense of and by the Contractor, by the application of bituminous coating in a manner approved by the Engineer. No damaged pipe shall be placed except as directed by the Engineer. The pipe shall be laid to the lines and grades established by the Engineer, with the separate sections joined firmly together by means of coupling bands designed for the purpose, with the outside laps of circumferential joints pointing upgrade, and with the longitudinal joints at the sides.

As each unit of pipe is laid, sufficient soil or sand and gravel shall be tamped

about the pipe to hold it rigidly in place until the joints are completed. After the joints have been completed, the backfilling shall be completed around structures to the lines shown on the drawings or as directed by the Engineer. The material used for the backfill, the amount thereof, and the manner of depositing the material shall be subject to the approval of the Engineer. Insofar as practicable, backfill material shall be obtained from material removed in excavating for structures, but when sufficient suitable material is not available from this source or from adjacent roadway excavation, additional material shall be obtained from sources approved by the Engineer.

The Contractor shall compact backfill to depths and top widths shown on the drawings or prescribed by the Engineer, and within planes sloping at a slope 1 to 1 from the edges of such top widths to intersections with the natural ground surface or to intersections with the surfaces of the excavation for the culverts. The material to be compacted shall be deposited in approximately horizontal layers not more than 6 inches in thickness when compacted and shall be moistened to have the best practicable moisture content required for compaction. When each layer of material has been conditioned to have the best practicable moisture content, it shall be thoroughly compacted to the satisfaction of the Engineer by the use of tamping machines or other suitable compacting equipment.

The material for backfill placed over the pipe from the top of the compacted backfill to at least 1 foot over the top of the pipe shall be free from rocks larger than 3 inches in diameter and shall be placed in such manner that damage to the pipe will not result. Travel over the culverts will not be permitted until backfill has been placed to a depth of at least 1 foot over the top of the pipe.

The Contractor shall place riprap around the intake end of all culverts as directed by the Engineer except that concrete catch basins shall be constructed where specifically designated on the drawings. The rock used for riprap shall be clean, hard, dense and durable. The largest rock in the riprap shall be not more than one-tenth of a cubic yard in volume, and the rock shall grade uniformly from the maximum size down to rock or spalls not less than one-tenth of a cubic foot in volume. The inclusion of rock spalls or gravel in the mass in an amount not in excess of that required to fill the voids in the material specified above, as determined by the Engineer, will be permitted. The rock in riprap need not be compacted but shall be dumped and graded off in such a manner as to insure that the larger rocks are uniformly spaced and the smaller rock fragments and spalls serve to fill the spaces between the larger rock and in such a manner as will result in a reasonable smooth surface and a uniform layer of riprap 24 inches thick. Hand placing will be required only to the extent necessary to secure the results specified above.

4. MEASUREMENT AND PAYMENT

Measurement and payment for CMP culverts will be the number of linear feet of corrugated metal pipe actually installed in the location designated by the Engineer, measured along the centerline of the pipe. Payment will be made at the

unit price per linear foot bid for the respective items of Furnishing and Installing CMP. No separate payment will be made for required excavation, for trenches, backfill and compaction, riprap and other work incidental to the installation of the CMP culverts, but the cost thereof shall be included in the unit prices bid for "Furnishing and Installing CMP". Except concrete required for culvert catch basin inlets will be paid as miscellaneous concrete and catch basin inlet gratings will be paid as miscellaneous metalwork as specified elsewhere.

SECTION 25

CATWALKS FOR DAM CONSTRUCTION AND TIMBER BULKHEAD

1. GENERAL

The Contractor shall furnish all labor, supervision, material and equipment and perform all operations necessary to furnish and install the temporary catwalks, ladders and platforms on the dam and the timber bulkhead required to close the opening for the spiral case access gallery between Unit 54 and future Unit 55, as shown on the drawings.

2. MATERIALS

a. Structural Timber. Structural timber shall be Douglas fir Coast Region, dense select structural grade in conformance with W. C. L. A. Rules No. 15.

. Plywood. Plywood shall be exterior C-C, or Ply Form Ext-DFPA-B-B Douglas Fir, in conformance with U.S. Commercial Standard CS45-60.

c. Building Paper. Building paper shall be asphalt-saturated felt, free from holes and breaks, weighing not less than 14 pounds per one hundred square feet, or other waterproof paper or plastic approved by the Engineer.

d. Miscellaneous Metal. Bolts, washers, nuts and other miscellaneous metal shall be as specified in Section 10.

e. Cables. Cables shall be 1/2 inch 6 x 19 class rope, improved plow steel, independent wire rope core or approved equal.

3. CATWALKS FOR DAM CONSTRUCTION

The Contractor shall construct the temporary catwalks, ladders and platforms on the dam as shown on Drawing No. D-23115. He may be required to modify the details shown on the drawing to suit the configuration of the dam. Nothing contained in this specification shall be construed to prevent the Contractor from providing safety measures required by the applicable rules and regulations and installing additional means of access, including other catwalks, ladders, platforms or ramps to facilitate construction of the dam and installation of equipment.

After completion of all grouting and incidental work, the catwalks, ladders and platforms shall be removed by the Contractor. All removed material shall be disposed as specified in Section 7.

4. TIMBER BULKHEAD

The timber bulkhead shall be installed in a metal frame as shown on Drawing No. D-23232. The building paper shall be applied weather board fashion, lapped not less than two inches at horizontal joints, not less than six inches at vertical joints, and carried around the ends of the timber in such a way as to prevent leakage around the timber or through the joint between timber and frame.

5. MEASUREMENT AND PAYMENT

All cost to the Contractor for furnishing, installing, removal and disposal of the catwalks, ladders and platforms as shown on Drawing No. D-23115 shall be included in the lump sum price bid for "Temporary Catwalks on Dam." The cost for additional access facilities and similar work not shown on this drawing shall be included in the prices for the applicable items in the Proposal.

Payment for the metal frame and anchorage for the timber bulkhead will be made at the applicable unit prices bid for "Furnishing and Installing Miscellaneous Metalwork." Payment for furnishing and installing all other material required to complete the bulkhead will be at the lump sum price bid for "Furnishing and Installing Timber Bulkhead."

SECTION 26

ALUMINUM RAILINGS

1. GENERAL

This work includes the furnishing of all labor, supervision, material and equipment, and performance of all operations and incidentals necessary for the furnishing, delivery and erection of aluminum railings at the Visitor's Access Gallery as specified herein or as shown on the drawings.

2. MATERIALS

Extruded tubes and sections shall be as manufactured by the Aluminum Company of America, or approved equal products and shall be fabricated from aluminum alloys 6063-T6 for railing and 6063-T5 for posts with 215-A1 finish; welding alloy shall be 5554. After etching and sealing and prior to shipment, the surfaces shall be given two sprayed coats of clear, colorless, methacrylic lacquer having a total minimum thickness of 0.0005 inches. Aluminum surfaces in contact with the steel post supports shall be painted with a heavy brush coat of zinc chromate primer conforming to Federal Specifications TT-P-645 and two coats of aluminum paint over a heavy brush coat of alkali-resistant bituminous paint conforming to Military Specifications MIL-P-6883. Connections shall be made with oval head recessed Philips machine screws of 300 series stainless steel.

3. INSTALLATION

Railings shall be erected level and/or parallel to slope. Posts shall be erected square and plumb. Welding shall be electrically flash welded with surplus metal removed and ground smooth. Work shall be coordinated with the Electrical work to facilitate installation of electric light fixtures and conduits. Openings for wiring shall be drilled or coped at points hidden from sight and without weakening the post supports. Light fixtures integral with the aluminum railing shall be attached with tamper-proof connections and without damage to the aluminum finishes.

4. MEASUREMENT AND PAYMENT

Payment for furnishing and installing aluminum railings complete with posts, railings and all other material and equipment necessary to complete the installation of the aluminum railings will be the lump sum price bid for "Furnishing and Installing Aluminum Railings".

SECTION 27

ROOF VENTILATORS

1. GENERAL

The work includes the furnishing of all labor, supervision, materials and equipment, and performance of all operations and incidentals necessary for the furnishing, delivery and erection of roof ventilators at the Access Elevator roof as specified herein or as shown on the drawings.

2. MATERIALS

Roof ventilators shall be as manufactured by American Cyanamid Co., 5 Bay State Rd., Cambridge 38, Mass., or approved equal and shall be "Ventdome" model HV 4242, white domes W-10.

3. ERECTION

Roof ventilators shall be connected to the wood nailers on the concrete curbs with stainless steel wood screws and sealing washers, four per side, and shall have an aluminum angle seal welded to aluminum curb of roof ventilators.

4. MEASUREMENT AND PAYMENT

Payment for furnishing and installing roof ventilators complete with all curb angles, anchor bolts, wood nails and all other material and equipment necessary to complete the installation of the access elevator roof ventilators will be made at the lump sum price bid for "Furnishing and Installing Roof Ventilators".

SECTION 28

INSTRUMENTATION OF DAM

1. GENERAL

Instrumentation of Dam shall include the furnishing of all labor, supervision, material and equipment and performance of all operations and incidental necessary for permanent installation of measuring devices and instruments in the dam as specified herein or shown on Drawing No. D-23086.

2. DESCRIPTION

Resistance thermometers for measuring the temperature of the concrete, strain meters for measuring the conditions of strain in the concrete, deformation meters for measuring the deformation of the foundation and abutment rock and flat jacks for indicating pressure on the surface of the foundation rock shall be installed by the Contractor as shown on the drawings or as directed by the Engineer. The strain meters and thermometers will consist of small electrical resistance coil units sealed in suitable protective casings of metal and rubber tubing and will weigh only a few pounds each. The type A deformeters will be free relaxation type deformeters consisting of a steel rod anchored into a hole drilled in the foundation rock as shown on the drawings to indicate rock deformation measured by a dial strain gage at the surface. Type B is as type A, except with a linear variable differential transformer (L.V.D.T.) attached. The flat jacks will be steel pressure cells grouted into slots cut in the foundation rock and pressured hydraulically through a steel tube. The thermometers, strain meters, type B deformeters with sockets and the necessary length of electrical leads attached for connecting the instruments to terminal boards located in the gallery, the type A deformeters, and the flat jacks complete with steel tubing and valve for attaching to terminal boards located in the gallery, will be furnished by the City. The terminal boards with terminal boxes will also be furnished by the City. The terminal boxes shall be installed in the sidewalls of the gallery and shall be mounted flush with the walls. Each terminal box or group of terminal boxes shall be grounded to nearest available ground with No. 4 AWG, bare, stranded copper cable. The No. 4 AWG, bare, stranded copper cable shall be furnished by the Contractor. At the points of entrance of instrument cables to terminal boxes, conduits or conduit nipples and suitable locknuts shall be provided by the Contractor. The ends of all conduits or conduit nipples shall be provided with bushings. All adjoining terminal boxes shall be interconnected by conduit not less than 2 and 1/2 inches in diameter. The lead for all meters will be furnished by the City and will be specially fabbricated, rubber-insulated, rubber-sheathed, electrical cable designed to minimize the possibility of mechanical injury and to insure long life when embedded in concrete. Field splices, where required in the cables, will be made by the City, but in general it is desired to avoid splicing, and splices will be made only where absolutely necessary. The resistance thermometers will be equipped with 3-conductor cable having an approximate

overall diameter of 1/2 inch, and the strain meters and deformation meters will be equipped with 4-conductor cable having an approximate overall diameter of 9/16 of an inch. The 3-conductor cable and the 4-conductor cable will be equipped with a search wire fabricated integrally with the cables.

Each group of meters and each single meter shall be grounded with No. 14 AWG, bare, stranded copper cable. The No. 14 AWG, bare, stranded copper cable shall be furnished by the Contractor and shall extend between the locations of groups of meters and single meters and the terminal boxes.

3. INSTALLATION

The Contractor shall provide suitable recesses in the fresh concrete before it has attained final set, and the resistance thermometers and strain meters shall be placed in these recesses and shall be embedded properly in the fresh concrete as directed by the Engineer. Immediately prior to embedment, each group of strain meters arranged as a cluster will be assembled by the City to a holding fixture or spider, designed to insure accurate alignment during concrete placing operations. The holding fixtures (spiders) will be furnished by the City. The type B deformation meters shall be embedded in fresh concrete so that the deformation meters, after being finally covered, will be bisected by the plane of contact between the foundation rock and the concrete of the plug and between the plug and arch concrete. Type A deformeters shall be anchored properly at top and bottom with the top projecting approximately three inches from the surface of the concrete with caps or protective covers installed to protect the projecting deformeter tops against damage or burial. The flat jacks shall be properly grouted into slots drilled into the foundation rock and embedded in grout. The anchors of the deformeters will be furnished by the City and shall be grouted prior to concrete placing, as directed by the Engineer, into holes drilled into the foundation and abutment rock to such depths as shown by the drawings or as directed by the Engineer. Where required, such holes shall be cased to the depths directed. The casing shall be flush-joint casing and shall be furnished by the Contractor. The cable and tubes from all instruments in the dam shall be embedded in the concrete in trenches suitably formed in the concrete before final set has been attained and shall be covered with not less than 6 inches of fresh concretebetween the instruments and the nearest pull box. From there they shall be placed in rigid electrical conduits embedded in the concrete as directed by the Engineer. Electrical conduit, conduit nipples and fittings as required shall be furnished by the Contractor.

Temporary protective covering shall be provided by the Contractor at each instrument location and each cable location shown on the drawing to cover instruments and cable immediately after embedment and shall not be removed until the concrete has hardened sufficiently to prevent damage to the instruments and cables from traffic. Thereafter, and until the next higher lift of concrete has been placed, the locations of instruments and cables shall be clearly marked to avoid damage from any of the Contractor's operations.

4. MEASUREMENT AND PAYMENT

The NX holes drilled in the foundation of the dam for installation of deformation meters will be made at the applicable unit price bid in the Proposal for "Drilling Holes with Rotary Drills". Payment for furnishing and installing BX flush-joint casing for deformation meters will be made at the applicable unit price bid for "Furnishing and Installing Grout and Drainage Pipe and Fittings". Payment for furnishing grounding wires, electrical conduit and fittings will be made at the unit price bid in the Proposal. All other cost to the Contractor for a complete instrumentation of the dam as shown on Drawing No. D-23086, including installing permanent measuring devices with all conductors, conduits, tubing, terminal boxes and all other material and equipment will be made at the lump sum price bid for "Installing Instruments in Dam".

SECTION 29

GATE CONTROL CENTER WINDOW

1. GENERAL

This work includes the furnishing of all labor, supervision, materials and equipment and performance of all operations and incidentals necessary for furnishing, delivery and installing the window for the sluice gate control center.

2. MATERIALS

a. Laminated glass shall be "Herculite," three layers of 1/4-inch thick plate, with polyvinyl butyral between layers, manufactured by Pittsburg Plate Glass Company, or approved equal.

b. Glazing gaskets shall be Neoprene Compound 8312 (ASTM Designation SC-720), continuous extrusion with corner injection moulded into one piece, manufactured by Standard Products Company, Port Clinton, Ohio, or approved equal.

c. Sealant shall be Hornflex modified polysulfide primer and Hornflex modified polysufide synthetic rubber sealant, Thiokol LP-32. manufactured by A. C. Horn Company, or approved equal.

d. Materials for steel frames and concrete fasteners shall be in accordance with Section 10.

3. ERECTION

The window shall be installed as shown on Drawing No. D-23099. The steel which the sealant will contact shall be acid etched and free from oil, dust and all other foreign material to insure a perfect sealing bond. The glass and gasket shall be assembled prior to installation in the frame. The inside angle frame shall be installed after the glass, gasket and sealant have been placed and shall be adjusted and secured to insure compression and uniform full bearing between gasket and steel frames sufficient to insure a watertight installation.

4. MEASUREMENT AND PAYMENT

Payment for furnishing and installing the window for the sluice gate control center complete with all frames, anchors, glass, gaskets, sealant and all other material and equipment necessary to complete the installation will be made at the lump sum price bid for "Furnishing and Installing Window for Sluice Gate Control Center."