



GENERATOR REWIND PROGRAM

SEATTLE CITY LIGHT

Power Supply & Environmental Affairs

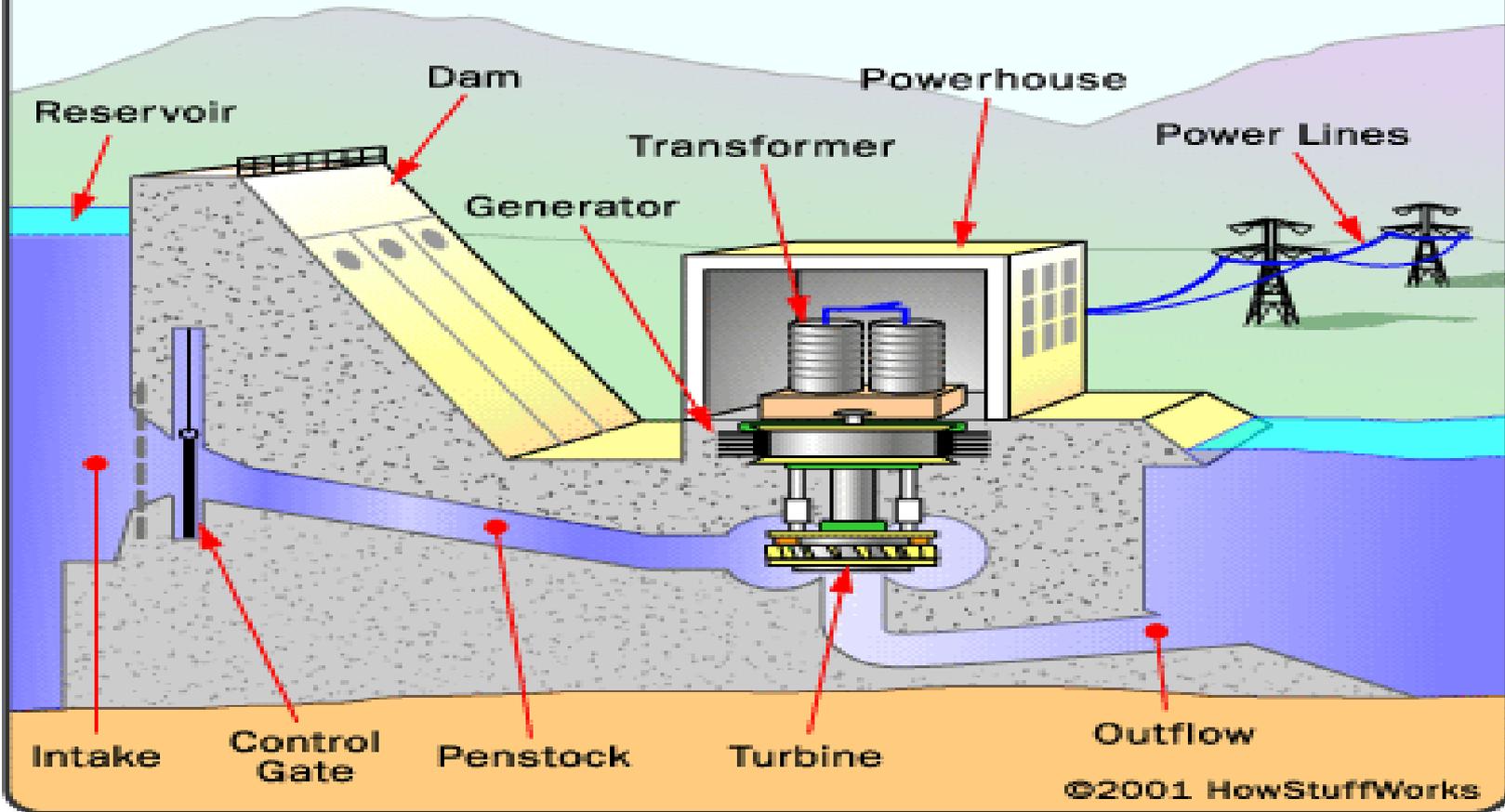
www.seattle.gov/light

Purpose

SCL is half-way through a multi-year program to “rewind” twelve of our generating units. We want to present the status of our program highlighting our successes, our challenges, and what we are working on for the future.

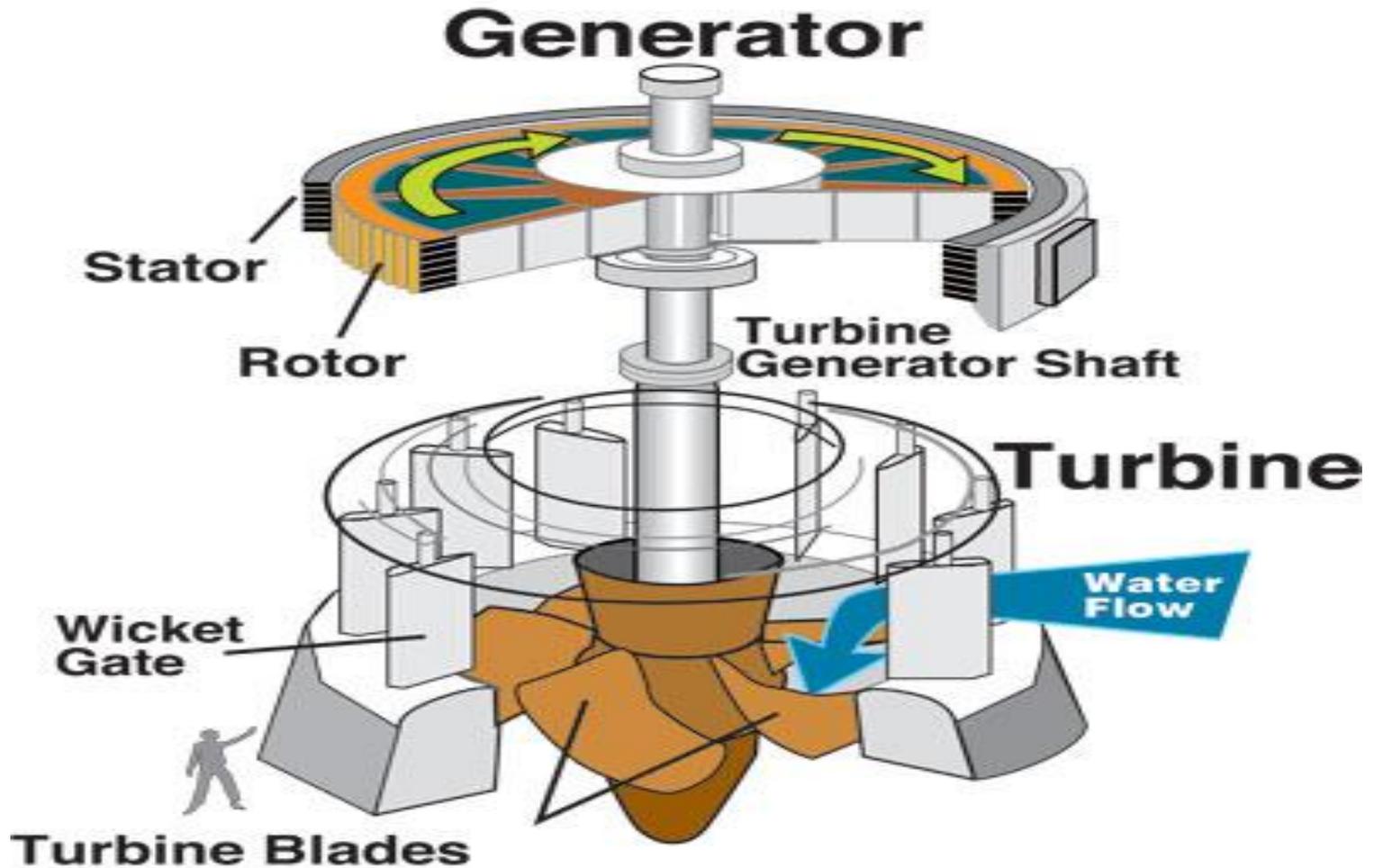
Quick Overview of Hydro- Electric Power Plants

Inside a Hydropower Plant





Boundary Dam



Cutaway View of a Turbine/Generator Assembly

SCL Generator Rewind Program

What is a Generator Rewind?

- Generators have insulated copper bars or cables (windings) in both the stationary and rotating portions of the generator.
- Windings are supported by a stack of thin layers of steel.
- During a rewind, the old copper windings and steel are removed and replaced.

Generator During Rewind



Workers preparing copper bars for installation into stator



Rotor with new poles being lowered into stator

Why Rewind Generators

- Generator windings have a life expectancy of 30 – 35 years.
- Insulation degradation and mechanical fatigue cause the windings to deteriorate over time.
- We've exceeded normal life expectancy on many of our generators.
- Unplanned outages can cost millions of dollars of lost revenue over the cost of a planned outage.

Why Rewind Generators

- Each machine overhaul project takes about 24-30 months to budget/procure, plan, design, manufacture, deliver, and finally reassemble and commission.
- Out of service time for a planned outage is approximately 6-9 months.
- Unplanned outages are down for the entire procurement through commissioning period.

Generator Rewind Program

- Seattle City Light owns and operates 22 hydro generators in 7 plants located in:
 - Pend Oreille County (Boundary)
 - Whatcom County (Skagit)
 - King County (Cedar Falls & Tolt)

| Powerhouse | Generator No. | Last Rewind Date | Years since last rewind | Upcoming Rewind Date |
|-------------|---------------|------------------|-------------------------|----------------------|
| Boundary | 51 | 1967 | 47 | 2018 |
| Boundary | 52 | 1982 | 32 | 2019 |
| Boundary | 53 | 1983 | 31 | 2014 |
| Boundary | 54 | 1968 | 46 | 2018 |
| Boundary | 55 | 2013 | 1 | |
| Boundary | 56 | 1986 | 28 | 2015 |
| Diablo | 31 | 1962 | 52 | 2016 |
| Diablo | 32 | 1962 | 52 | 2017 |
| Diablo | 35 | na | 78 | 2021 |
| Diablo | 36 | na | 78 | 2022 |
| Newhalem | 20 | 1970 | 44 | 2020 |
| Gorge | 21 | 1982 | 32 | 2023 |
| Gorge | 22 | 1982 | 32 | 2024 |
| Gorge | 23 | 1983 | 31 | |
| Gorge | 24 | 1990 | 24 | |
| Ross | 41 | 2009 | 5 | |
| Ross | 42 | 2005 | 9 | |
| Ross | 43 | 2006 | 8 | |
| Ross | 44 | 2007 | 7 | |
| Cedar Falls | 5 | 1993 | 21 | |
| Cedar Falls | 6 | 1994 | 20 | |
| South Tolt | 81 | 1995 | 19 | |

 Rewind planned in next 6 years

 Rewound within the last 10 years

Program Status

- The program was originally planned to be completed in 10 years at a cost of about \$85 million.
- Now, in year 10, we are half way complete and now expect the program to cost about twice the original budget.
- All costs have been factored into the Power Production capital budget as detailed in the Strategic Plan.

Successes

- Increased the life span of each unit for at least another 30 years.
- Transition to Asset Management
 - Historically units were run to failure
- SCL has retained nationally recognized experts in generator design and construction to support us as “owners representatives”, which has provided training for our in-house staff.

Successes

- Provided increased capacity where available.
 - Boundary 55 has been increased by about 20 MW.
- Improved machine monitoring which helps us predict maintenance needs, resulting in fewer and shorter outages.
- More responsive power management capabilities by installing automation and remote control systems with associated cyber security features.

Challenges

- Staffing has not allowed us to accommodate more than one rewind per year.
- Building out electrical infrastructure to support new technology for cyber security, machine monitoring and automation has required more budget and staff than was planned for the original rewind program.
- Rewinds require SCL crews and contractor crews to share the same construction space creating potential logistic issues.

Challenges

- Finding the optimal contracting mechanism.
 - Ross units contracted as Furnish/Install purchase contracts. Worked well but had limited protections for the City.
 - Boundary Unit 55/56 contracted as a Design/Build Public Works contract. Shifts liability to the contractor, but has resulted in delays, higher costs, and contract disputes.
 - In the future, we will review lessons learned to optimize our contracting decisions

Future

- Potential contract disputes with Toshiba on the Boundary 55/56 design/build contract.
 - Non-compliance with contract requirements
 - Damages associated with project delays
 - Working to avoid litigation, but we may be forced to pursue it.
- Scoping next group of rewinds taking into consideration the lessons learned from completed units.

Future

- Prioritizing remaining rewind schedule to accommodate the additional resource requirements associated with the cyber security, machine monitoring and automation infrastructure work while maintaining our current budget.
- Committed to remaining within our Capital Program budgets as defined in the strategic plan.

Questions?