



A REPORT ON CANADA'S LARGEST CLEAN POWER PROJECT

DARLINGTON REFURBISHMENT

AUGUST 2016

ONTARIO **POWER**
GENERATION

READY TO EXECUTE

The Darlington Nuclear Generating Station has been safely and reliably producing almost 20 per cent of the province's electricity since the early 1990s. After six years of detailed planning and preparations, OPG is now ready to refurbish the station's four nuclear reactors, extending their lifetime for another 30 years of clean power.

This October, OPG will take the Unit 2 nuclear reactor offline to execute Darlington Refurbishment. This three-year (40 month) project will be the first of four such outages as we refurbish the plant's four units over the next 10 years. During this period, OPG will remove, replace and repair critical components in each reactor. With less than two months to go, all necessary materials required to start Refurbishment has been delivered to site; training of workers has begun at our mock-up facility; and the detailed execution plan has been finalized. While there is still a lot of work to be done, there are no major obstacles in our way to start this project as committed, mid-October.

We call this step "Breaker-Open," because we will officially disconnect from Ontario's power grid to start the work.



FOUR PILLARS TO REFURBISHMENT SUCCESS

The project pillars measure our success in maintaining high standards when it comes to safety, quality of work done right the first time, ability to stay on schedule, and adherence to the overall project cost estimate. Here is an overview of our current performance since our last report.

SAFETY



Safety performance has been excellent. The project team has safely worked 2,372 days without a lost-time accident. OPG, with its vendor partners, continues to be rigorous to reduce low level events that, if unmanaged, can lead to lost-time accidents.

QUALITY



There have been no new significant quality events on the Refurbishment project.

SCHEDULE



There are schedule challenges with certain pre-requisite* projects, however, none are expected to impact Breaker-Open. The project remains on track to begin refurbishment of Unit 2 in October.

COST



Cost performance is excellent and has improved since the last reporting period. The work to date is being performed efficiently across many aspects of the project. OPG remains within its \$12.8 billion project estimate, with \$2.6 billion spent to date.

■ Excellent □ Good ■ Moderate ■ Poor

* **Pre-requisite projects** are numerous critical activities that must be completed in order to execute refurbishment.

A NUMBER OF MOVING PARTS

Darlington Refurbishment comprises over 500 projects, across four refurbishment units and five work bundles or *parts*, operating together toward success.

Re-tube and feeder replacement is core to a successful refurbishment. It involves removing and replacing the fuel channels, calandria tubes and feeders inside each reactor.



No safety issues or quality events have been identified. While some materials are delayed, all are expected to be in place in spring of 2017 following removal of fuel, draining of heavy water and isolation of Unit 2 from the other three operating units at the Darlington Station. Use of the mock-up reactor has shifted from testing to training of staff on tools and procedures. As a result, efficiencies and safety improvements continue to be realized well in advance of the project start date.

The **turbine generators** work bundle consists of inspections and repairs on the four turbine generator sets and replacement of analog control systems with new digital control systems.



No safety issues or quality events have been identified and schedule performance has improved. All of the specialized Original Equipment Manufacturer parts required to refurbish the turbine generator for Unit 2 were delivered on time.

Defueling of the Reactor involves removing used fuel from the reactor and refurbishing the fuel handling equipment.



No safety issues or quality events have been identified. All materials required for execution have been delivered and are ready for staging. All equipment and tooling modifications are complete and on-reactor rehearsals were conducted successfully to defuel 18 fuel channels. The results of these tests were positive and provide confidence that OPG can defuel the reactor within the planned duration.



One Team Approach

Crucial to the success of this project is our One Team approach. OPG's dedicated employees, construction partners and industry partners from across Ontario are working together to get a quality job done safely, on time and on budget.

The **steam generators** work bundle includes mechanical cleaning, water lancing, inspection and maintenance work.



No safety issues or quality events have been identified. The project is ready to proceed. A number of efficiencies have been realized between OPG and vendor project management.

Balance of plant covers a number of smaller projects to replace or repair components on both the nuclear side (such as heavy water and cooling systems) and on the non-nuclear side (such as electrical system, piping and valve work).



No safety issues or quality events have been identified. Two pre-requisite projects - the shutdown cooling heat exchanger replacement project and the adjuster rod shim project - are both on track to be in-service prior to breaker open. Some non-critical pre-requisite projects are delayed but pose no risk to the overall schedule.



POWERED UP FOR REFURBISHMENT

Over the past six years, OPG has been involved in a number of facilities and infrastructure projects and safety improvement opportunities at the station.

FACILITIES AND INFRASTRUCTURE PROJECTS

1. Darlington Energy Complex
2. Operations Support Building Refurbishment
3. Re-tube and Feeder Replacement Island Support Annex
4. Refurbishment Project Office
5. Vehicle Screening Facility
6. Holt Road Interchange Improvements
7. Site Electrical Power Distribution
8. Auxiliary Heating System
9. Domestic Water and Sewer
10. Heavy Water (D2O) Storage and Drum Handling Facility
11. Re-tube Waste Processing Building

SAFETY IMPROVEMENT OPPORTUNITIES AND OTHER PROJECTS

12. Additional (3rd) Emergency Power Generator
13. Containment Filtered Venting System
14. Power House Steam Venting System
15. Shield Tank Overpressure Protection
16. Emergency Service Water Projects

WASTE MANAGEMENT FACILITIES

17. Re-tube Waste Storage Building
18. Used Fuel Dry Storage

■ In-progress and on track □ Completed



DARLINGTON REFURBISHMENT

PROJECT READINESS AT A GLANCE

Darlington Refurbishment is a **\$12.8 billion** initiative, the largest clean energy project in Canada.

It is expected to generate **\$14.9 billion** in economic benefits to Ontario, and will create **8,800 jobs** per year over the course of the project and **11,800 jobs** at its peak. Scheduled for completion by 2026, OPG is now ready to execute a plan that will enable the plant to continue providing safe and reliable energy to the province for the next 30 years.



SAFETY

2,372

DAYS WITHOUT A
LOST-TIME ACCIDENT

ALL FILTERS ARE IN PLACE FOR THE
CONTAINMENT FILTERED VENTING
SYSTEM.

ALL REGULATORY **APPROVALS
TO COMMENCE REFURBISHMENT**
HAVE BEEN **RECEIVED** FROM THE
CANADIAN NUCLEAR SAFETY
COMMISSION (CNSC).



QUALITY

722

COMPREHENSIVE

WORK PACKAGES HAVE
BEEN DEVELOPED AND
OVER **75,000** TASKS
HAVE BEEN SCHEDULED

51 INTEGRATED IMPLEMENTATION PLAN
TASKS FOR THE CNSC (SCHEDULED FOR
COMPLETION IN 2016) ARE ON TRACK.

30,000: THE NUMBER OF HOURS TRADES
HAVE PRACTISED USING TOOLS AT THE
MOCK-UP AND TRAINING FACILITY



SCHEDULE

OVER 22,000

CUBIC METRES OF CONCRETE
DELIVERED TO DATE - ENOUGH TO PAVE A
SIDEWALK FOR **46 KM**

DELIVERED ON TIME:

- PRODUCTION TOOLS REQUIRED
TO PERFORM THE REMOVAL AND
REPLACEMENT OF FUEL CHANNEL
ASSEMBLIES AND FEEDER TUBES IN
EACH REACTOR.



COST

\$2.6 BILLION

SPENT TO DATE

**PROJECT IS CURRENTLY
ON BUDGET.**

- SIGNIFICANT IMPACT TO THE
LOCAL ECONOMY

The Containment Filtered Venting System under construction at the Darlington Nuclear Generating Station.



Ontario Power Generation produces almost half of the electricity that Ontario homes, schools, hospitals and businesses rely on each day. We are committed to ensuring our energy production is reliable, safe, clean and sustainable for Ontarians today and for the future.