

# Performance Report for the Darlington Refurbishment Project

Ontario Power Generation is the general contractor and project manager for all aspects of the Darlington Refurbishment. In this role, OPG has direct oversight of all vendors performing work on any of the many projects within the refurbishment. This is the same model that was key to success at the Wolsong (South Korea) CANDU nuclear refurbishment.

The Ontario Ministry of Energy has requested that OPG provide regular public updates on the progress of refurbishment. This Performance Report is the first of ongoing semi-annual updates that will communicate major milestones and outline progress against timelines and budgets.

OPG’s project management approach aims to – among other things – minimize risk to OPG, to the Government and to the ratepayers of Ontario. OPG is building on the lessons learned from other refurbishments and large scale, complex projects. OPG is planning the work well ahead of the scheduled first unit refurbishment; doing in-depth plant condition assessments and inspections; completing all engineering, establishing the facilities and infrastructure needed to support the work; completing the mock-up facility; securing all regulatory approvals; and building a schedule that is realistic and an estimate that is achievable.

OPG will commit to a final cost and schedule in fall, 2015 before entering the execution phase of the project. Execution of the first unit will begin in 2016. Final commitments on subsequent units will take into account the performance of the initial refurbishment. If approved, refurbishment of all four units would be completed in 2025.

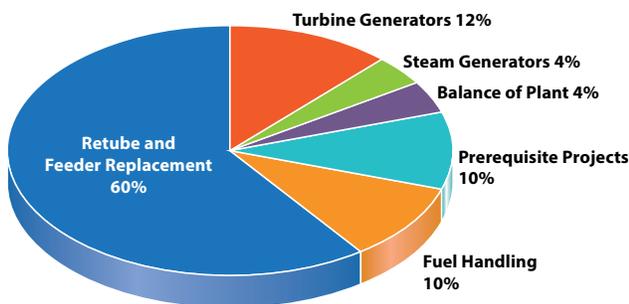


Chart shows work programs comprising refurbishment: Each area is made up of several projects.



The Darlington Energy Complex

## Major Work Packages

Darlington Refurbishment is made up of many individual projects of various scales and size. Six major project work packages are:

- **Retube and Feeder Replacement (“RFR”):** This work includes the removal and replacement of pressure tubes, calandria tubes and feeders in each reactor. This is the largest work package and is the core to the success of refurbishment. It represents the majority of the refurbishment critical path schedule.
- **Turbine Generators:** This package consists of inspections and repairs of the four turbine generator sets and the replacement of analog control systems with new digital control systems.
- **Fuel Handling:** This project involves the defueling of the reactor and refurbishment of the fuel handling equipment.
- **Facility and Infrastructure Projects:** These are required to execute refurbishment and/or extend Darlington station life. There are more than 20 smaller scale projects such as Water and Sewer, Heavy Water Storage, Auxiliary Heating System, Electrical Power Distribution System, and Refurbishment Project Office.

- **Balance of Plant:** This work consists of a number of smaller projects to replace or repair components on the reactor side of the unit (such as heavy water and cooling systems) and on the conventional side of the unit (such as electrical system, piping and valve work).
- **Steam Generators:** This includes mechanical cleaning, water lancing, inspection and maintenance work of the generators.

## Key Milestone Achieved

A significant milestone was reached on March 31, 2014. The Darlington Energy Complex Reactor Mockup Training Facility was declared ready for service.

This milestone was achieved two months ahead of schedule and under budget. The results demonstrate that the ‘Engineer, Procure and Construct’ model and project management approach used for Darlington’s refurbishment can achieve significant business value.

Starting in 2015, the mockups will be used for tool testing and to train the trainers, trades, and management to prepare for execution on the first unit scheduled for refurbishment (Unit 2).

For more information, go to [www.opg.com/darlingtonrefurb](http://www.opg.com/darlingtonrefurb)

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## Overall Program Health



**Darlington Refurbishment is currently in the definition and preparation phase ahead of first unit execution starting in October 2016. The overall program health is good.**

### Cost



**Cost** - The total cost of the Definition Phase work, which began in 2010 and ends in early 2016, is forecast to be \$2.5 to \$2.7 Billion. To date, actual costs are \$1.1 Billion. This is slightly below plan mainly due to schedule delays of some pre-requisite projects and retube and feeder replacement tooling. OPG's current estimate is that the total project will be less than \$10B in 2013 dollars, excluding interest and inflation. Our planning to date gives us high confidence the project will be completed within that budget. This estimate will be confirmed by fall, 2015.

### Schedule



**Schedule** - The program remains on track to begin the first unit refurbishment in October 2016. The reactor mock-up was completed ahead of schedule March 31. Turbine/steam generators, retube and feeder replacement planning, and the defueling projects all remain on track. The retube and feeder replacement tooling procurement project is currently behind its original schedule, however, tracking to full recovery by September 2014 mitigating any downstream schedule impacts. Challenges in completing the engineering for prerequisite projects, particularly heavy water storage and the auxiliary heating system have led OPG to establish a new collaborative approach with vendors to ensure these projects are recovered to ensure that the refurbishment date is not impacted.

### Safety



**Safety** - We use two measures, Injury Rate and Accident Severity. The All Injury Rate measures the number of workplace injuries per 200,000 hours worked. For the year to date, Darlington Refurbishment recorded 0 injuries per 200,000 hours worked. The Accident Severity Rate measures the number of lost days to employee injuries per 200,000 hours worked. In Q1, the Darlington Refurbishment team has recorded 0 days lost per 200,000 hours worked. Since 2008 Darlington Refurbishment has worked over a million hours without a lost time accident.

### Project Status

Retube and Feeder Replacement (RFR) (60% of project)



The 2014 work program includes completing the reactor mock up, developing a revised cost estimate and project schedule, and delivery of all tooling by year end. The reactor mock up was completed two months ahead of schedule and under budget. The next iteration cost estimate and schedule was completed in June. The final cost estimate and schedule will be released in mid 2015. The schedule to receive tooling is behind schedule. Recovery plans were put in place in December 2013 and the project is on track to fully recover the schedule by September allowing for delivery of all tools by year end.

#### Legend

	Excellent
	Good
	Marginal
	Poor

Steam/Turbine Generators (16% of project)



The focus in 2014 is progression of detailed design and the start of procurement of materials. All of these activities are on track.

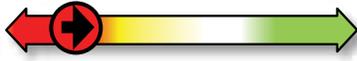
Fuel Handling (10% of project)



Defueling work includes delivery of dummy fuel bundles and flow reduction orifice bundles as well as progression of detailed design. Due to a revised scope for the fuel handling work, contract issuance occurred mid 2014 but activities are on track. Upon award, engineering will begin.

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**Prerequisite Projects**  
(10% of project)



A number of prerequisite projects are underway to support the execution of the refurbishment and to support the extended life of Darlington. The following table provides a list of the major projects and their statuses. Management actions have been taken to ensure recovery and delivery of the Heavy Water Storage and Auxiliary Heating System projects which comprise about four per cent of the entire refurbishment project to ensure that they are ready in advance of the first unit refurbishment in 2016.

**Facility and Infrastructure Projects:**

- Darlington Energy Complex – in service ahead of schedule and under budget ●
- Operations Support Building Refurbishment – on plan ●
- Re-tube & Feeder Replacement Island Support Annex – on plan ●
- Refurbishment Project Office – on plan ●
- Vehicle Screening Facility – on plan ●
- Holt Road Interchange Improvements – on plan ●
- Electrical Power Distribution – on plan ○
- Auxiliary Heating System – on schedule but over budget ●
- Water and Sewer – behind schedule and over budget ●
- Heavy Water Storage – behind schedule and over budget ●

**Safety Improvement and Other Projects:**

- 3rd Emergency Power Generator – on plan ●
- Containment Filtered Venting System – on plan ○
- Power House Steam Venting System – on plan ●
- Shield Tank Overpressure Protection – on plan ●
- Fire Water and Emergency Cooling – on plan ●
- Islanding Modifications – on plan ●

**Balance of Plant Work**  
(4% of project)



The balance of plant work program, which includes a number of smaller projects, is behind schedule due to contract award delays. A revised contracting approach is now in place, contracts are being awarded, and collaborative front end planning is underway to streamline workflow and to meet refurbishment program targets.