



Darlington Refurbishment Update

February | 2020



CANATOM
POWER GROUP



BWXT
BWXT Canada Ltd.



ONTARIO POWER
GENERATION

Darlington Refurbishment & Cont'd Operations

DARLINGTON NUCLEAR REFURBISHMENT PROJECT

30 MORE YEARS OF CLEAN ELECTRICITY
NUCLEAR ENERGY PLAYS A FUNDAMENTAL ROLE IN ONTARIO'S CLEAN-ENERGY EQUATION

THE REFURBISHED
DARLINGTON STATION
WILL REDUCE GREENHOUSE GAS
EMISSIONS BY AN ESTIMATED

297
MILLION TONNES

THAT'S THE EQUIVALENT
OF REMOVING

2 MILLION
Cars per
YEAR

FROM ONTARIO'S ROADS



1 IN 5

HOMES AND BUSINESSES
ARE POWERED BY DARLINGTON -
WITH VIRTUALLY
NO GREENHOUSE GASES



20%

OF ONTARIO'S POWER IS
SUPPLIED BY DARLINGTON -
ENOUGH TO SERVE A CITY OF
2 MILLION PEOPLE



60%

OF ONTARIO'S DAILY
ELECTRICITY NEEDS ARE
SUPPLIED BY THIS PROVINCE'S
NUCLEAR FLEET



8¢ kWh

30 YEARS OF POWER
BELOW AVERAGE COSTS

ONTARIOPOWER
GENERATION

\$12.8 BILLION
project investment

\$89.9 BILLION
boost to Ontario's GDP

704,112
person-years of
increased employment

8¢/kWh
30 years of power
below average costs



Average number
of jobs per year
14,200



Government
revenues
\$9.3 billion



Corporate profits
before tax
\$7 billion

Darlington – Creating jobs for Ontario

Darlington Nuclear Refurbishment PROJECT PARTNERS ACROSS ONTARIO



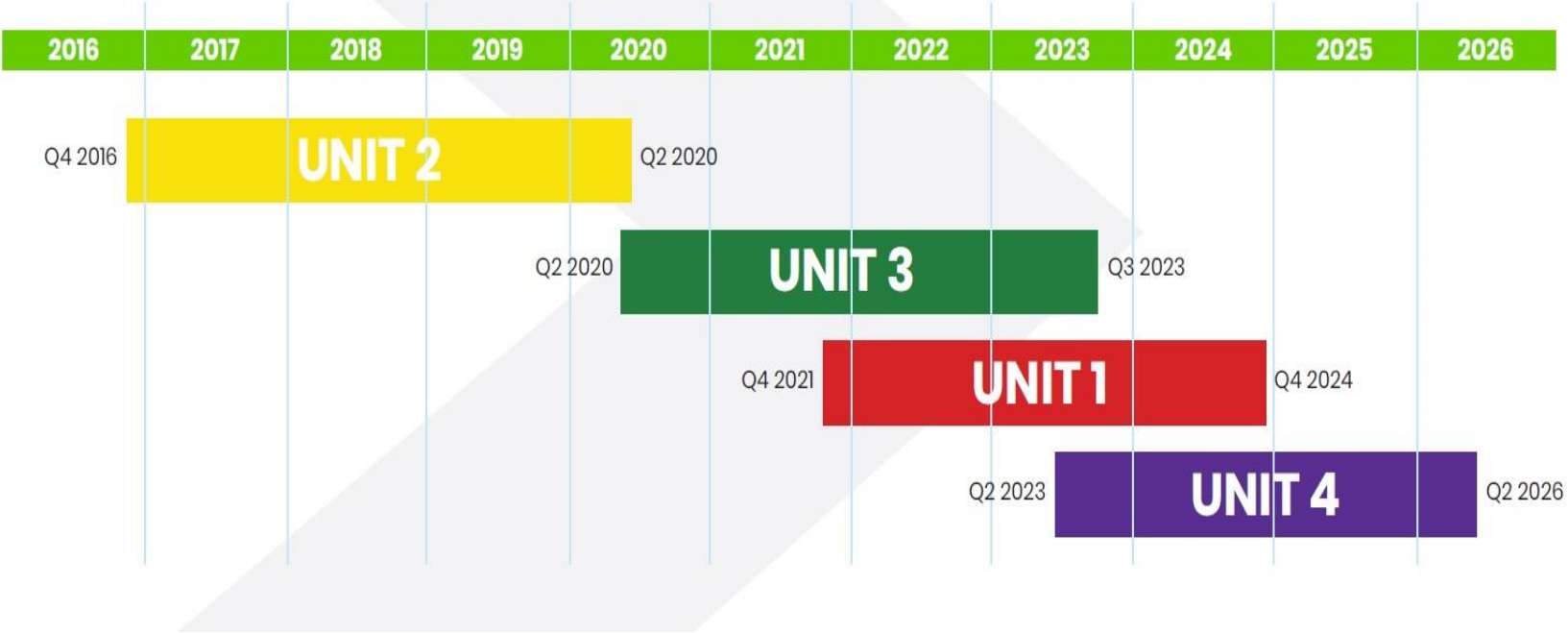
Meeting Canada's Climate Change Goals

One of Canada's largest infrastructure and clean energy projects.

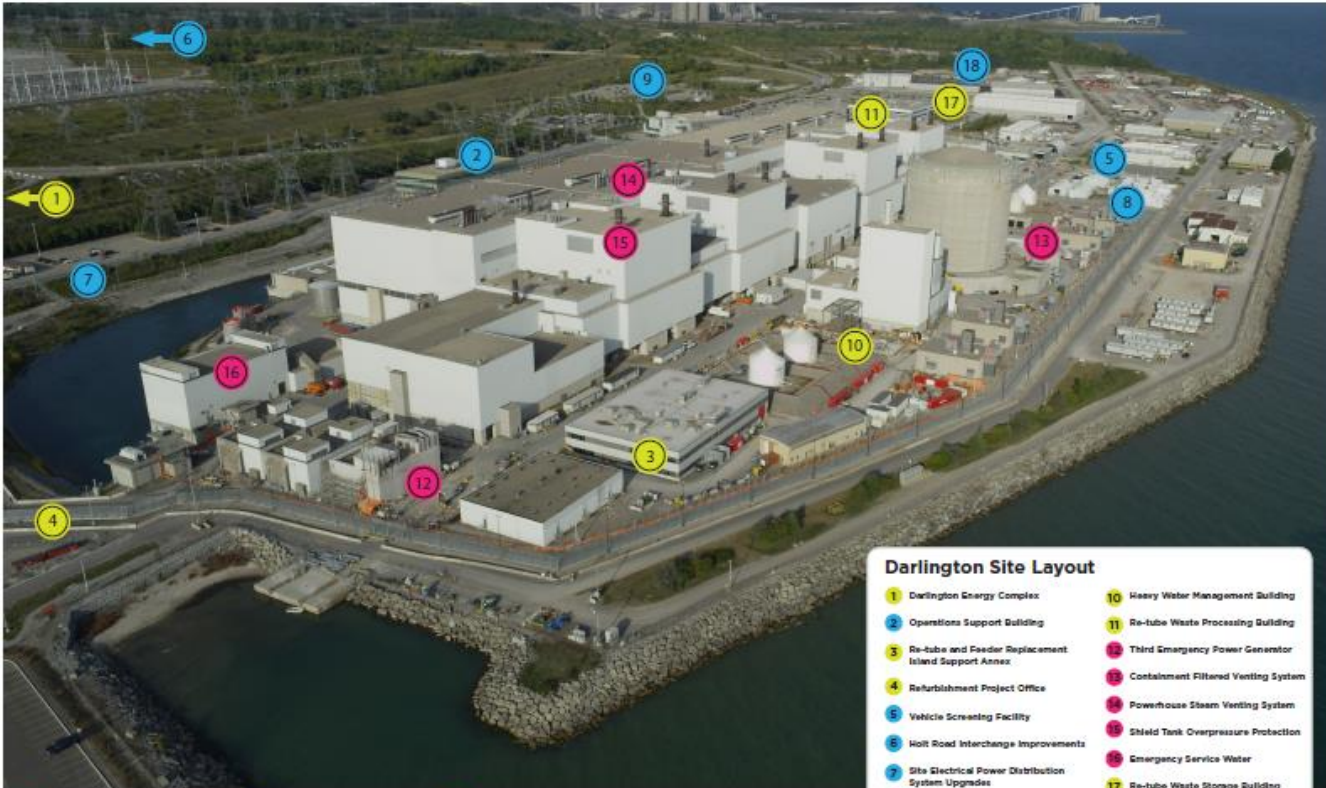




Darlington Refurbishment Schedule



Infrastructure and Safety Projects



ALL 18
projects
complete

● Safety Improvement Projects
 ● Refurbishment Projects
 ● Site Infrastructure Projects

Darlington Site Layout

- | | |
|---|---|
| 1 Darlington Energy Complex | 10 Heavy Water Management Building |
| 2 Operations Support Building | 11 Re-tube Waste Processing Building |
| 3 Re-tube and Feeder Replacement Island Support Annex | 12 Third Emergency Power Generator |
| 4 Refurbishment Project Office | 13 Containment Filtered Venting System |
| 5 Vehicle Screening Facility | 14 Powerhouse Steam Venting System |
| 6 Holt Road Interchange Improvements | 15 Shield Tank Overpressure Protection |
| 7 Site Electrical Power Distribution System Upgrades | 16 Emergency Service Water |
| 8 Auxiliary Heating Steam Facility | 17 Re-tube Waste Storage Building |
| 9 Water and Sewer | 18 Darlington Waste Management Facility |

Heavy Water (D2O) Storage Facility – Construction Complete



- Fit for purpose end of November –ahead of Unit 3 need date
- 32 systems completed
- Receive and store heavy water for overlap units in the province
- Water will be upgraded by Tritium Removal Facility

Unit 2 Progress

Segment 1: Defuel Reactor and Isolate from the Station



SHUT DOWN REACTOR
OCT 15, 2016
BREAKER OPEN

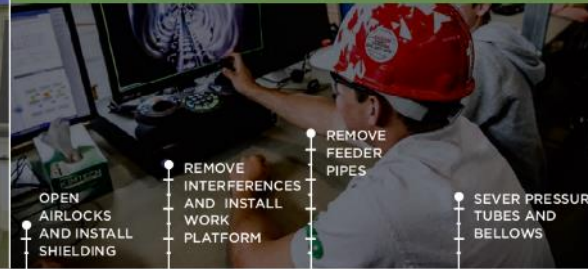
DEFUEL REACTOR

INSTALL BARRIERS TO ISOLATE UNIT 2 FROM STATION

CONTAINMENT PRESSURE TEST

PROGRESS AS AT MARCH 31, 2017
19 DAYS AHEAD OF SCHEDULE

Segment 2A: Prepare for Reactor Component Removal



OPEN AIRLOCKS AND INSTALL SHIELDING

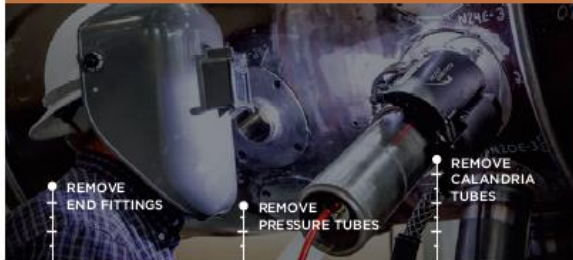
REMOVE INTERFERENCES AND INSTALL WORK PLATFORM

REMOVE FEEDER PIPES

SEVER PRESSURE TUBES AND BELLOWS

SEGMENT 2A
APRIL 27, 2017

Segment 2B: Remove Reactor Components



REMOVE END FITTINGS

REMOVE PRESSURE TUBES

REMOVE CALANDRIA TUBES

SEGMENT 2B

Segment 3: Install Reactor Components



INSPECT AND INSTALL CALANDRIA TUBES

INSPECT AND INSTALL FUEL CHANNELS

INSTALL FEEDER PIPES

SEGMENT 3

Segment 4: Load Fuel, Test and Restart Reactor



LOAD FUEL AND REMOVE EQUIPMENT

HEAT UP AND LOW POWER TESTING

HIGH POWER TESTS AND CONNECTION TO THE GRID

SEGMENT 4

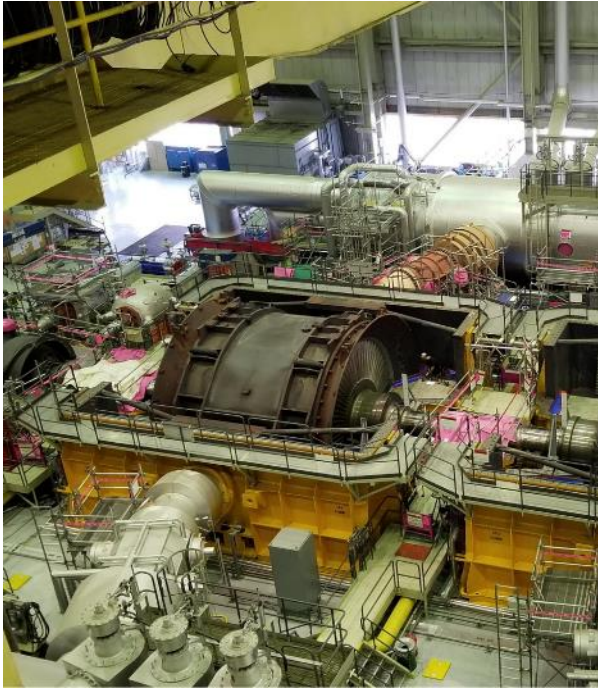
PROJECT COMPLETE



Steam Generator Work - Complete



Turbine Generator Major Overhaul - Complete



The Lower Pressure 2 Steam Inlet Casing installed



Re-installation of Lower Pressure 3 spindle



The Generator rotor being installed.

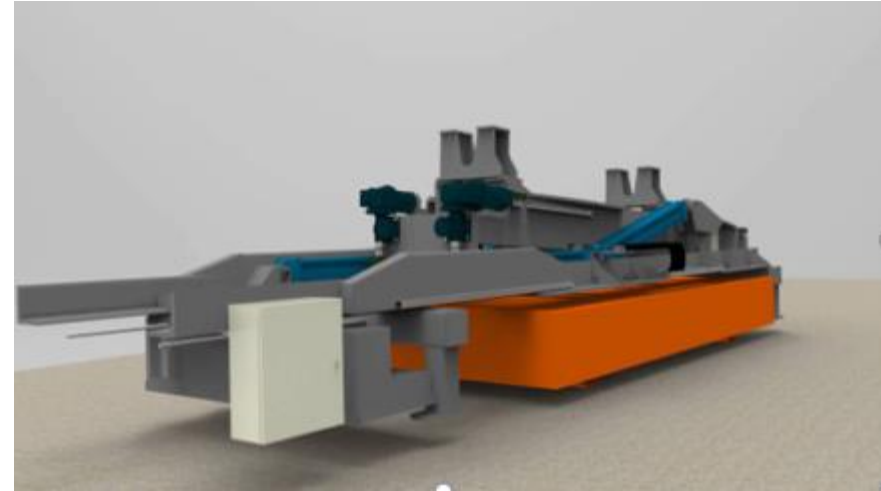
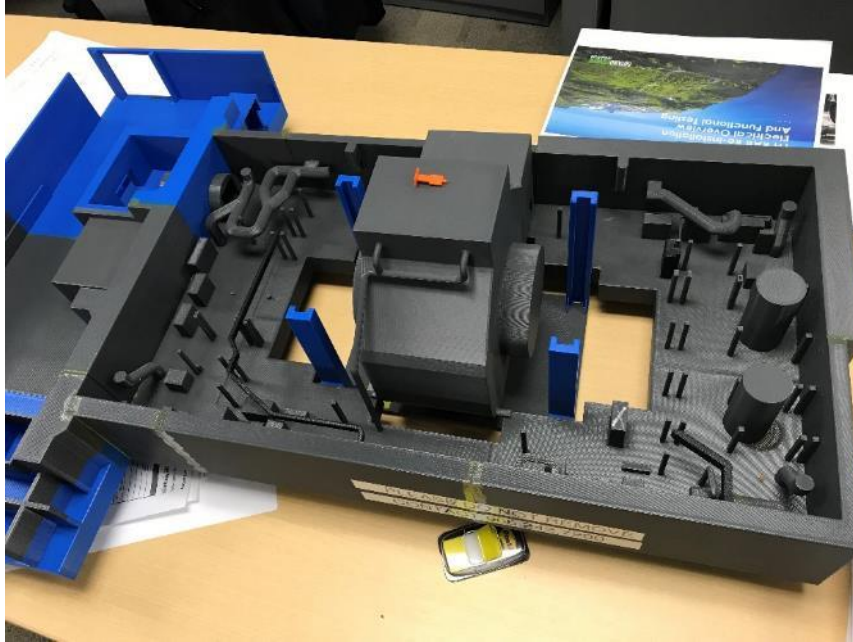
Feeder Campaign Complete



New Fuel Load - complete



VAULT RESTORATION – road to operations control





Safety Performance

- 22 million hours worked with only one lost time accident
- Since June 2019 there have been no High Maximum Reasonable Potential for Harm events
- As Unit 2 progresses through Vault Restoration, Safe Work Plans are being reviewed to identify and mitigate safety hazards from:
 - working at heights
 - material handling
- Radiological safety continues to report no unplanned events.

Performance



- Unit 2 on **budget**

- Unit 2 on **schedule** for revised commitment of end of June 2020

- Overall, four unit project remains on budget and schedule



- **Environment** – no reportable events

- **Quality** – Lower feeder weld failure rates higher than expected during early feeder installation



Unit 2 Performance Summary

- All non-critical path work is 96% complete
- Unit 2 on target for June 25th, 2020
- Regulatory requirements are on track

Remaining Work:

- Vault Restoration
 - Re-tube Tooling Platform removal - **complete**
 - Installation of Fuel Handling equipment – **nearing completion**
 - Removal of Bulkheads to reconnect Unit 2 to station
- Unit Start Up – 52 days
 - Warm up and condition the reactor
 - Conduct operational testing of reactor, safety systems
 - Synchronize to electricity grid & high power testing

93%

Complete

42/58

Systems in
Service

Journey of Excellence

ROAD TO RESTART

ONE TEAM WINS

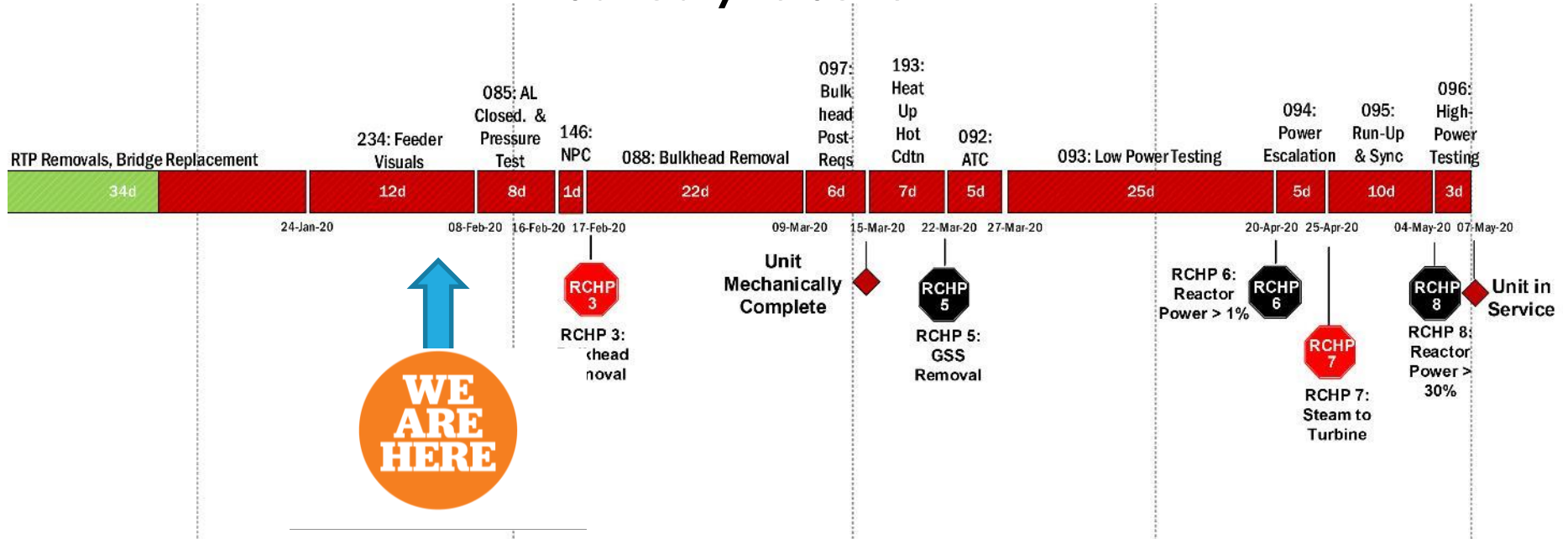
Darlington Nuclear
for the future



ONTARIOPOWER
GENERATION

Road to Restart Unit 2

January to June



Vault Restoration



We are Nuclear Professionals

- I understand how my tasks impact the core, my peers and our community. I care to take actions to protect them.
- Understand the **why, what and how** of being a nuclear professional.
- **Five key attributes:**
 - Understand and manage risks
 - Anticipate Effects of your actions
 - Understand and apply event prevention tools
 - Procedural Use and Adherence. Can't? Stop and ask for help
 - Practice Good Housekeeping and control work areas



Unit 3 Planning Readiness

98%

Engineering Design

Engineering design is 98% complete (EV) with no risk to Execution.

70%

Documentation

70% of Segment 1 CWP's are complete

55% of all Comprehensive Work Packages (CWPs) have been prepared.

91%

Procurement (Segment 1)

91% of known Materials on site
4% Scheduled for delivery 90 days prior to execution

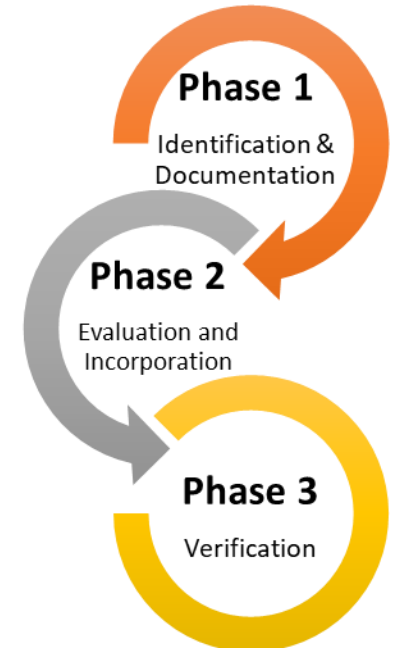
Breaker Open
April 3
44 days and counting!



Lessons Learned Process



- OPG and its Contractors are focused on achieving continuous improvement as the Program proceeds through the refurbishment
- Both OPG and its Contractors have developed Lessons Learned processes to capture and implement the knowledge and experience gained in planning and executing the work.
- The majority of Technical issues incurred on Unit 2 have been resolved.
- **More than 3,500 Lessons Learned have been documented, dispositioned and or implemented, including:**
 1. Tooling changes/upgrades
 2. Critical task training
 3. LEAN/Kaizan process improvements
 4. Workstream organization/approach



Strategic Initiatives for DNRU314

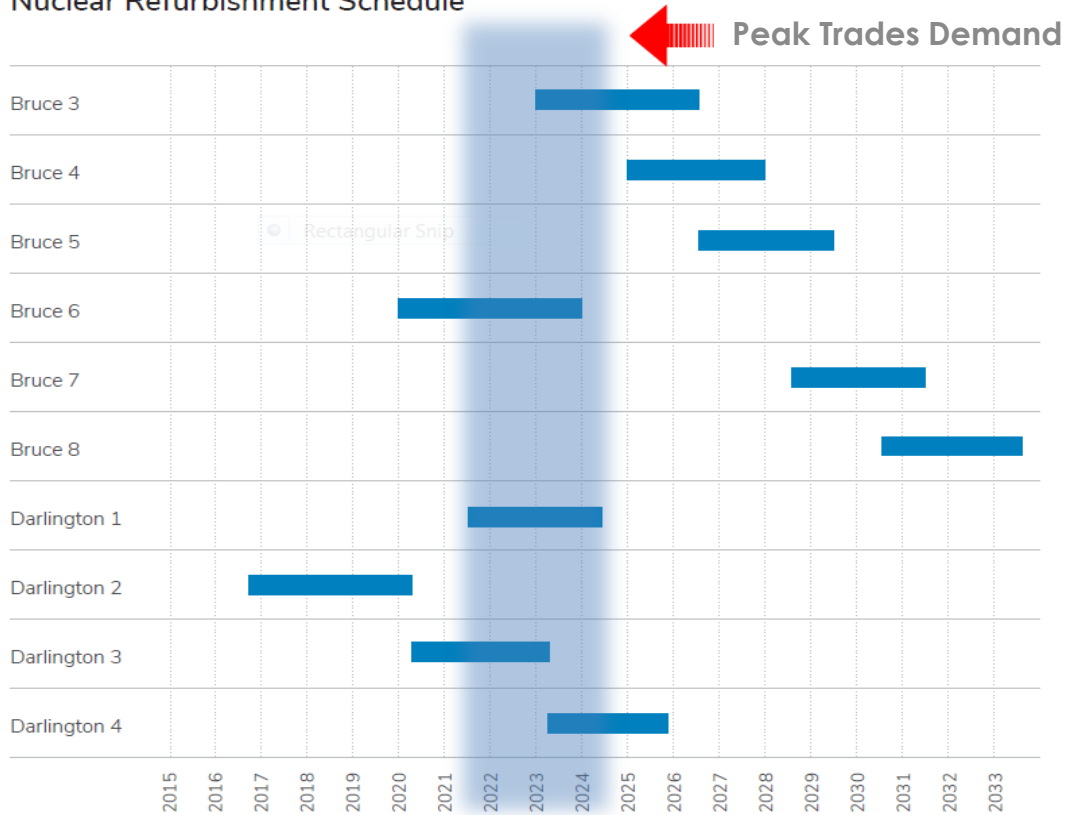
- One Team
- Radiation Protection
- 24x5 schedule
- Supervisory Leadership
- Feeder Strategy
- Digitization/Documentation/CWP Improvements



Provincial Nuclear Refurbishment Schedule

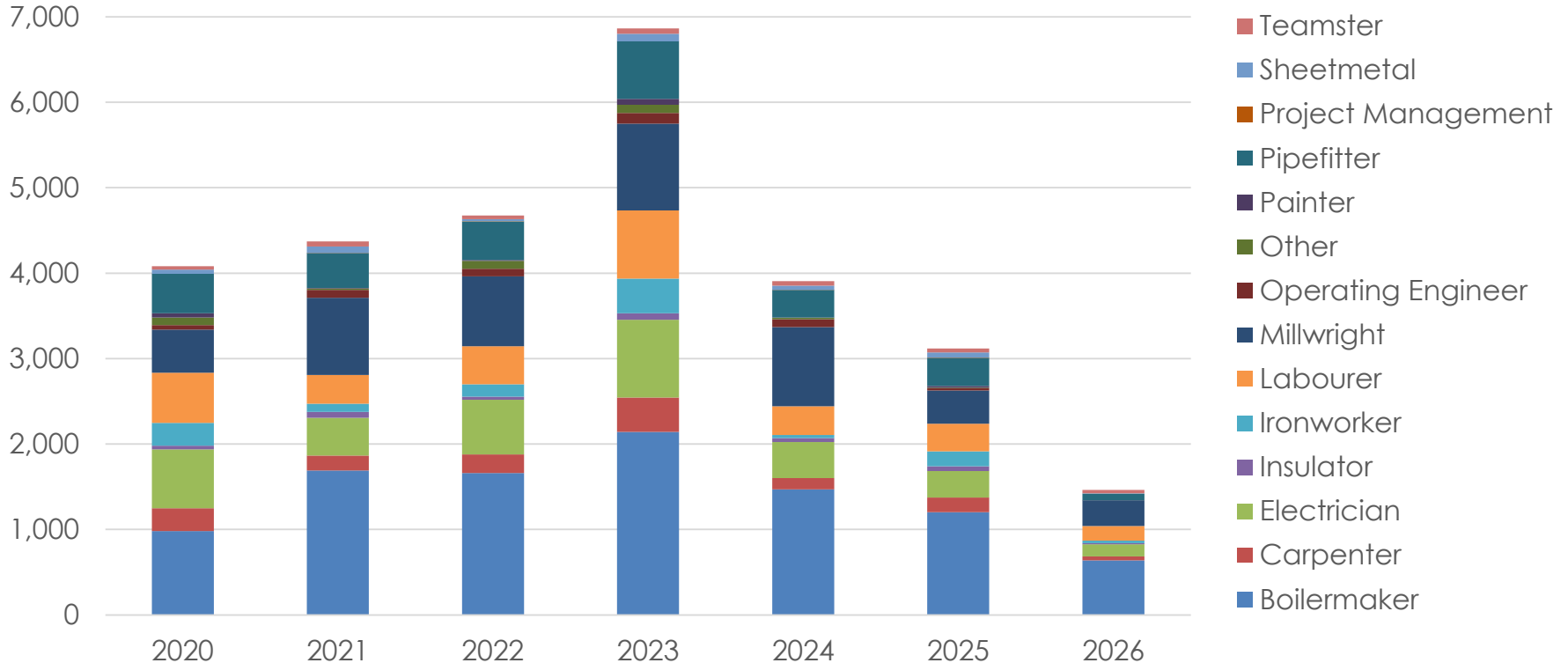


Nuclear Refurbishment Schedule



OPG & Bruce Power Trades Demand Profile

Total Demand for Trades for OPG and Bruce Power Refurbishments*





OPG/Bruce Power Collaboration

To maximize efficiencies for Ontario and deliver the projects safely, with quality on time and on budget. By taking a pro-active approach in applying lessons learned to date we are aligned around:

- Investing in our people: to build strong project managers and develop strong leadership capabilities.
- Owner oversight and involvement with our project partners and contractors to ensure commercial commitments are met.
- Maintaining a “Project-Centric” approach with clear lines of accountability and authority.
- Rigorous layered oversight at all levels of our organizations to ensure transparent and accurate information flows and resolution of issues and learnings shared.
- Build trusting collaborate relationships to drive for efficiencies and to maximize on opportunities.

Job Ready Dispatch (JRD, Jan 2020)

- allow the transfer of training credits for Business Trades Union (BTU) staff between OPG and BP; avoid retraining as well as decrease the time required to get BTU staff working at site

Powering Ontario Together

2018 Report on Nuclear Collaboration



Bruce Power
Innovation at work

ONTARIO POWER
GENERATION

Updated Nov 2019

We are part of something special

Darlington

Leading

The World



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Thank You!



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