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**Presentation from Ontario
Power Generation**

**Présentation d'Ontario Power
Generation**

In the Matter of

À l'égard de

**Darlington Nuclear Generation
Station: Update on Process for the
Return to Service Darlington Unit 2**

**Centrale nucléaire de Darlington :
Mise à jour sur le processus pour la
remise en service de la tranche 2 de
Darlington**

Commission Meeting

Réunion de la Commission

February 20, 2019

Le 20 février 2019

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Darlington Refurbishment

Presentation to the
Canadian Nuclear Safety Commission

February 20, 2019





Agenda

Darlington Station

- Nuclear Operational Focus
- Safety: Our First Priority
- Benefits of Refurbishment
- Roles and Accountabilities

Darlington Refurbishment: Overview

- Project Management Excellence
- Site Safety and Infrastructure Projects

Project Performance

- Project Scope
- Safety and Performance
- Project Phases and Execution Schedule
- Innovation

Unit 2 Return to Service

- Journey of Excellence
- Reactor Control Hold-points

Closing



Darlington Station

Safe, Reliable Operations

- In-service 1993, providing safe, clean, reliable power
 - 4 units, 3,524 MW net output
 - 20% of Ontario's demand
 - Power for two million homes
- Recognized internationally for excellent performance
- Strong community support for refurbishment and ongoing operations



Public and Employee Safety: Our First Priority

- Nuclear Safety
- Conventional Safety
- Radiological Safety
- Environmental Safety
- Public Safety



Commitment to Community

- Communicate openly and transparently
 - Nuclear Public Information and Transparency Protocol
 - Frequent notifications and updates
 - Indigenous engagement
- Corporate Citizenship Program
 - Over 300 community initiatives
- OPG Employees: public ambassadors



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

297

MILLION TONNES

\$89.9

BILLION
boost to
Ontario's GDP

704,112

person-years of
increased employment

Darlington Continued safe, reliable operations

- Refurbishment Project
- Life Cycle Management Plan
- Operating & Maintenance Programs
- 30 more years of clean, safe, reliable energy



Path to Success

Nuclear Excellence

- Station operations and Refurbishment project executed under a single site licence
- Clear roles, responsibilities and accountabilities:
 - To ensure safe operation of the running units at all times
 - To provide clear focus on refurbishment
 - To enable strong integration and collaboration between organizations



Refurbishment Project Overview

Canada's largest clean energy project



Darlington Refurbishment

- Multi-year project:
 - *Started in January 2010 – Finish in 2026*
 - *Each Unit will undergo Refurbishment outage of 35-40 Months*
 - *Overlapping Refurbishment of Units 3, 1 & 4*
- \$12.8B investment
- Replace major reactor components and upgrade key plant systems
- Substantial safety and equipment investments



Phased Project Management



Initiation

- Technical Assessments
- Condition Assessments
- Economic Feasibility
- Contracting strategy
- Board and shareholder approvals

2007-2010



Definition

- Regulatory Approvals
- Integrated Safety Review
- Integrated Implementation Plan
- Cost and schedule
- Infrastructure upgrades
- Awarding of contracts
- Mobilize and train

2010-2015



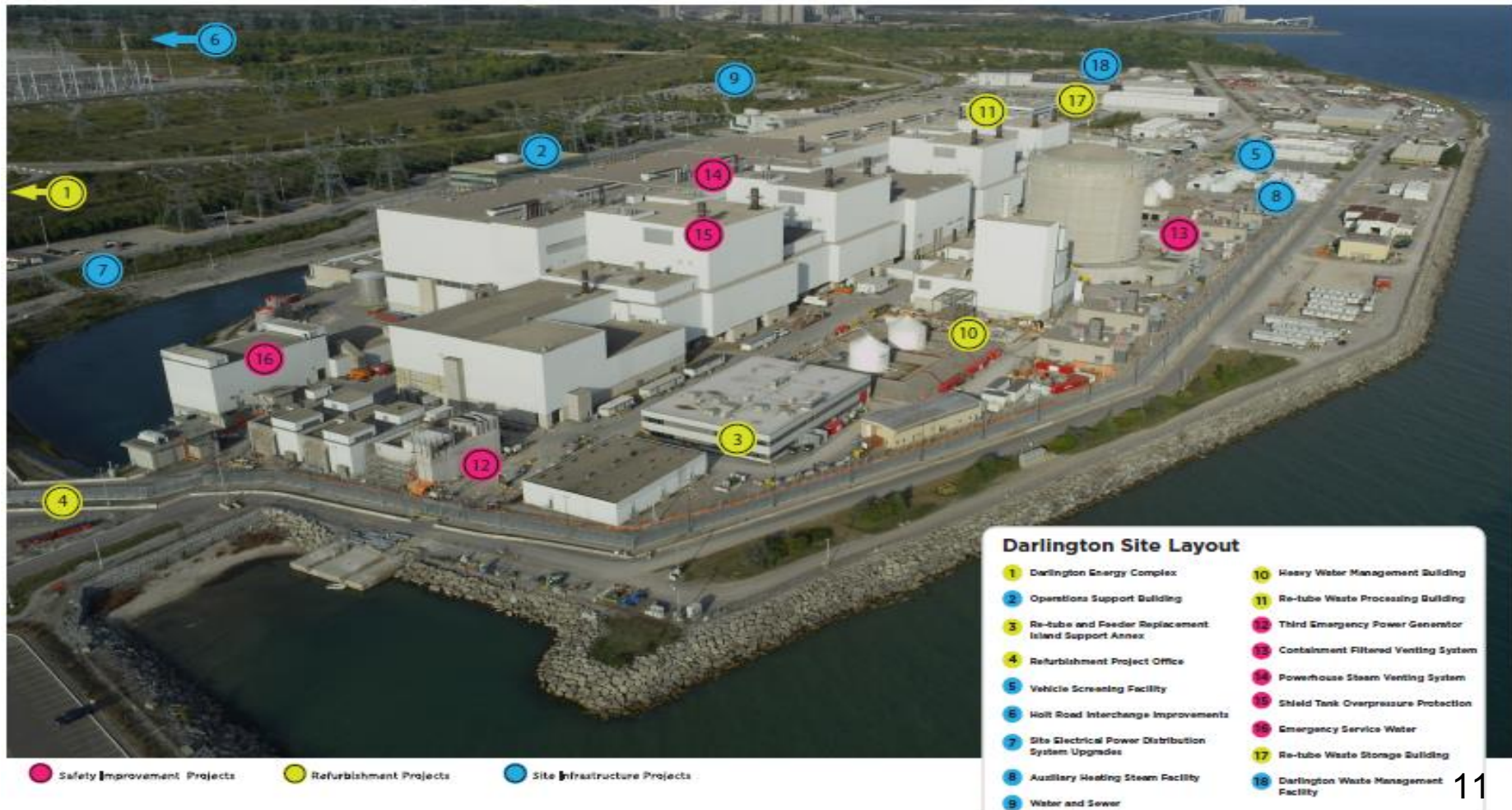
Execution

- Shut-down, defuel and dewater
- Isolate unit from station
- Component Removal
- Waste reduction and storage
- Installation of components
- Load fuel
- Return to Service

2016-2026



Safety and Infrastructure Investments





Project Scope and Performance



Execution Scope



Defueling and Fuel Handling Reliability

- Reliability investments prior to defuel
- Maintaining and upgrading fuel handling systems

Re-tube and Feeder Replacement

- Remove/replace fuel channels and feeders.





Execution Scope



Steam Generator

- Not being replaced
- Clean and inspect primary and secondary side
- Installation of access ports

Turbine Generator

- Inspect and overhaul turbines, generator and auxiliaries
- Upgrade turbine generator control systems





Execution Scope

Balance of Plant

- New Auxiliary Shutdown Cooling
- Shut Down Cooling Heat Exchangers
- Stainless steel piping replacing original copper
- Vault Coolers
- Adjuster Rods
- Replacement/refurbishment of major valves
- In-core Flux Detectors
- Shutdown System computers
- Low Pressure Service Water
- Fire Protection System upgrades
- Electrical Refurbishment
- Primary Heat Transport Pump Motors





Integrated Implementation Plan (IIPs)

- 162 IIP Commitments
- 100% completion to date from 2015-18
- 72 IIP commitments for U2 restart.
- All IIPs are tracked and progressing to completion



3rd Emergency Power Generator

IIPs also include:

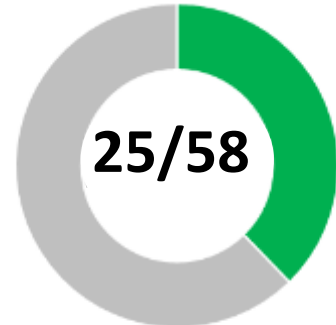
- Shield Tank Overpressure Protection
- Containment Filtered Venting System
- Powerhouse Steam Venting System
- Emergency Service Water
- Emergency Power Generator 3



Unit 2 Project Performance



Safety

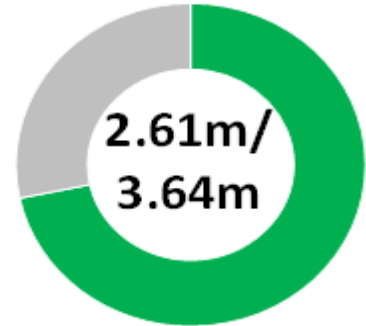


Quality

Systems Available



Schedule



Cost

Hours Completed



Industrial Safety

- 10 years without Lost Time Accident
- 13 million hours safely worked
- Strong Safety Performance
 - No lost-time accidents since 2010
 - 10x better Ont. Construction Industry
- Extensive mock-up training
- New to nuclear training
- OPG and Contractor safety plans
- Field oversight



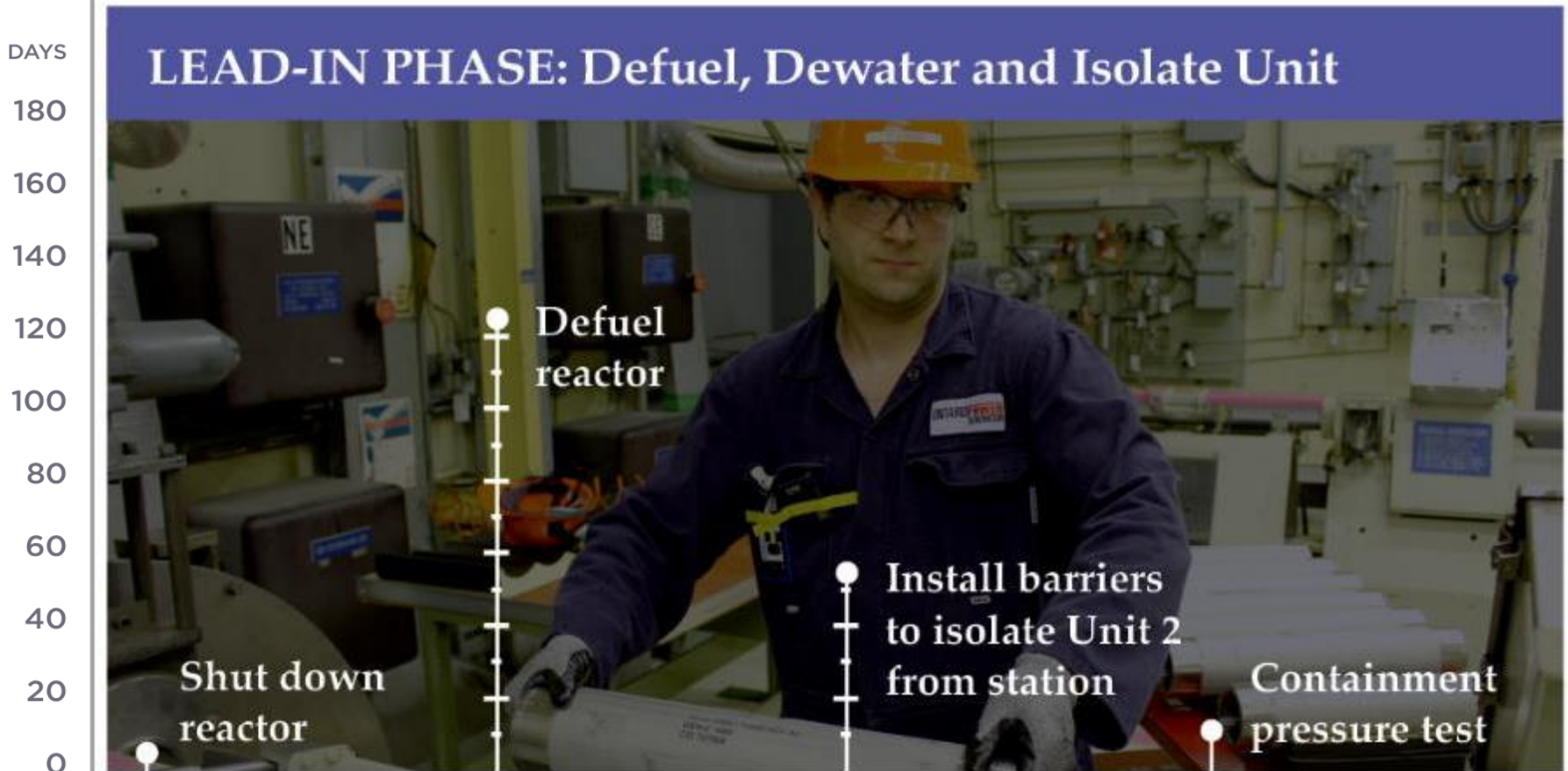


Radiological Safety

- OPG aggressive targets – strong performance
- Significant investments in workers and technology
- Workers protected (2018 data)
 - 23,500 smears
 - Over 8,000 air samples
 - 40,000 Whole Body Counts
- Waste volume reduction/storage
 - Environmental stewardship
 - 5,000 kg magnetite removed
 - 700,000 kg materials safely removed

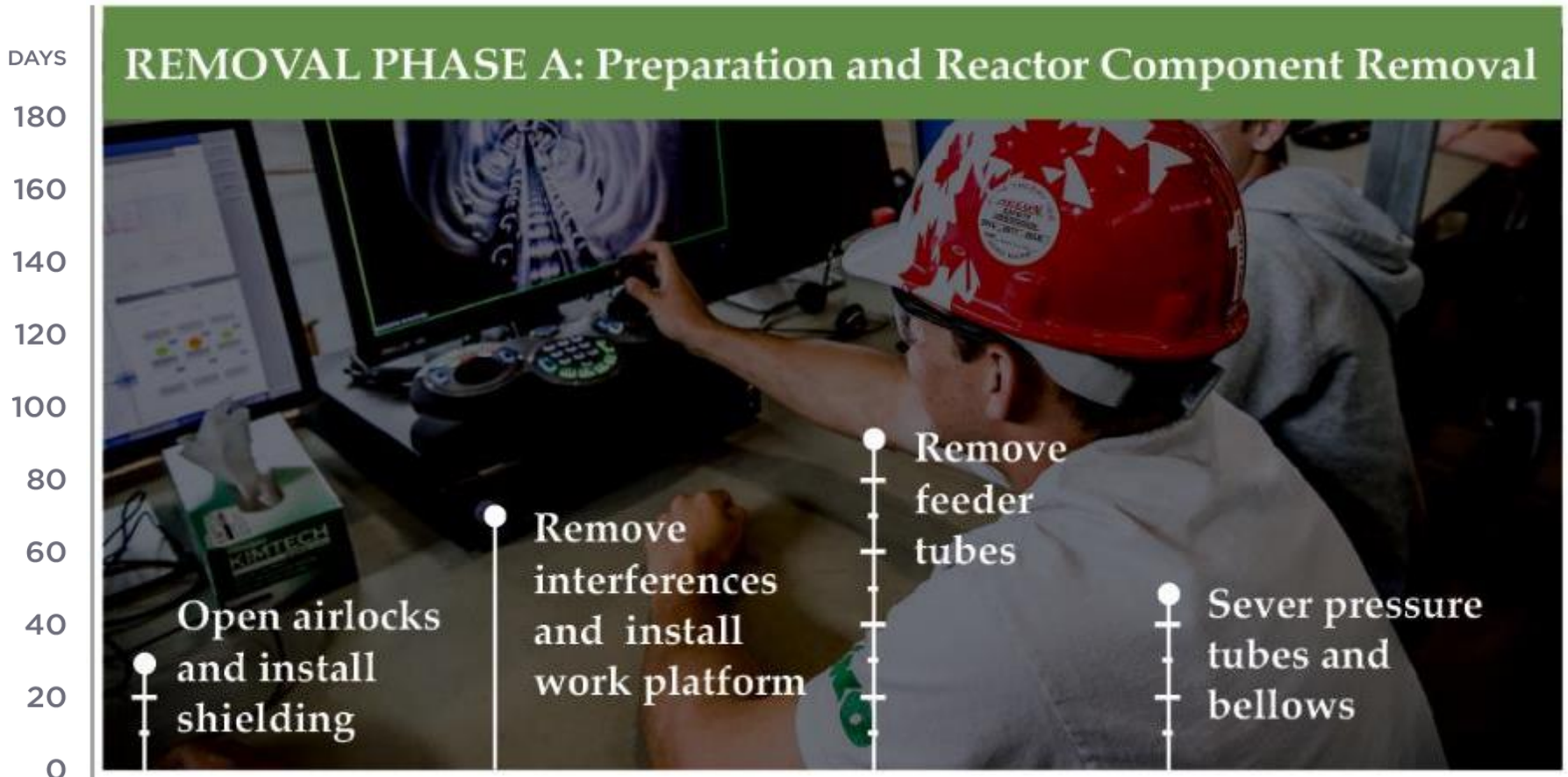
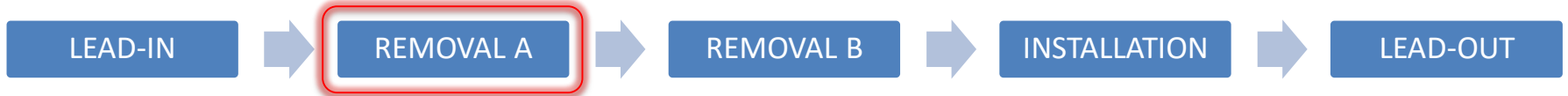


Unit 2 Execution Phases and Schedule



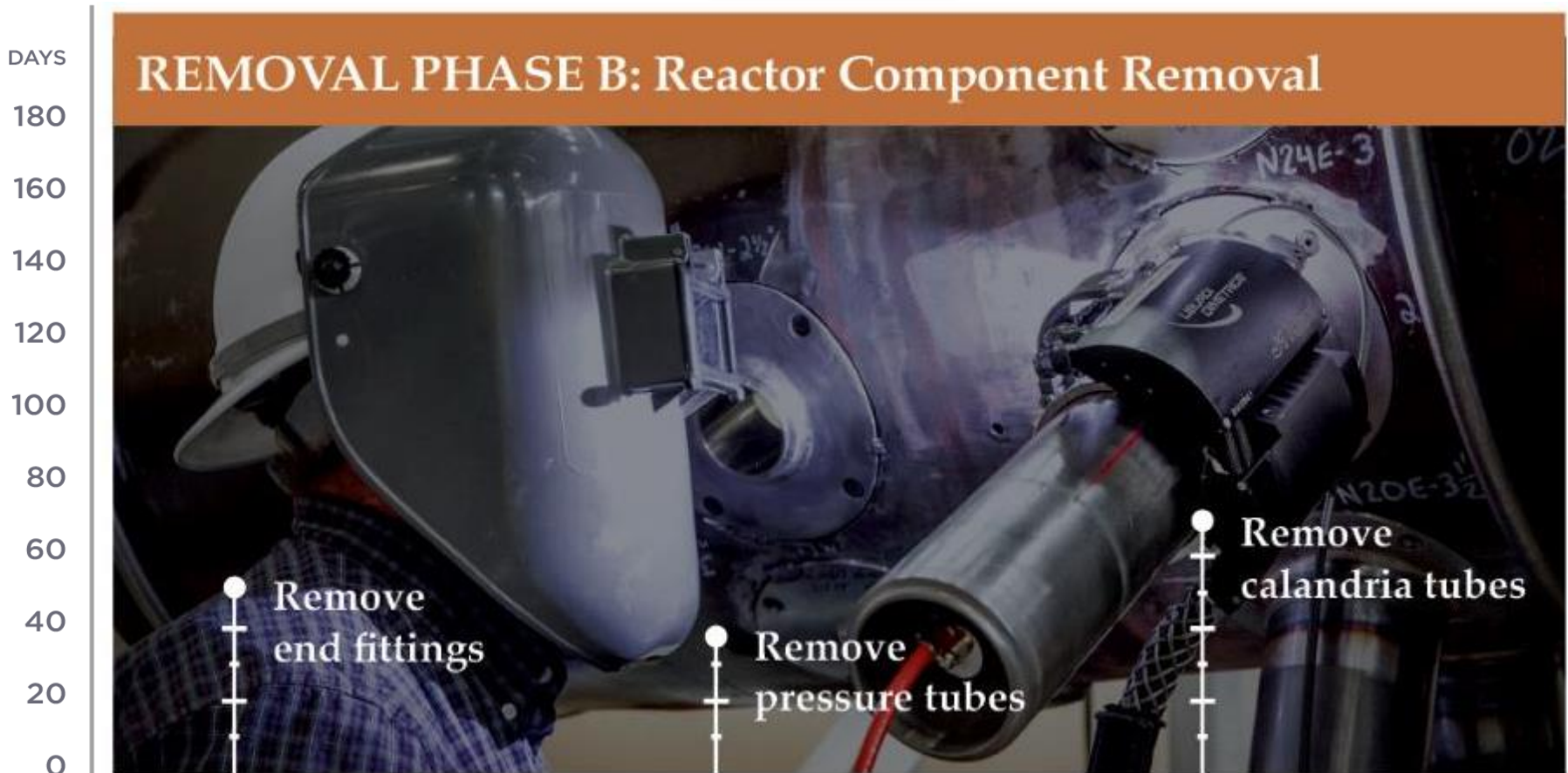


Unit 2 Execution Phases and Schedule



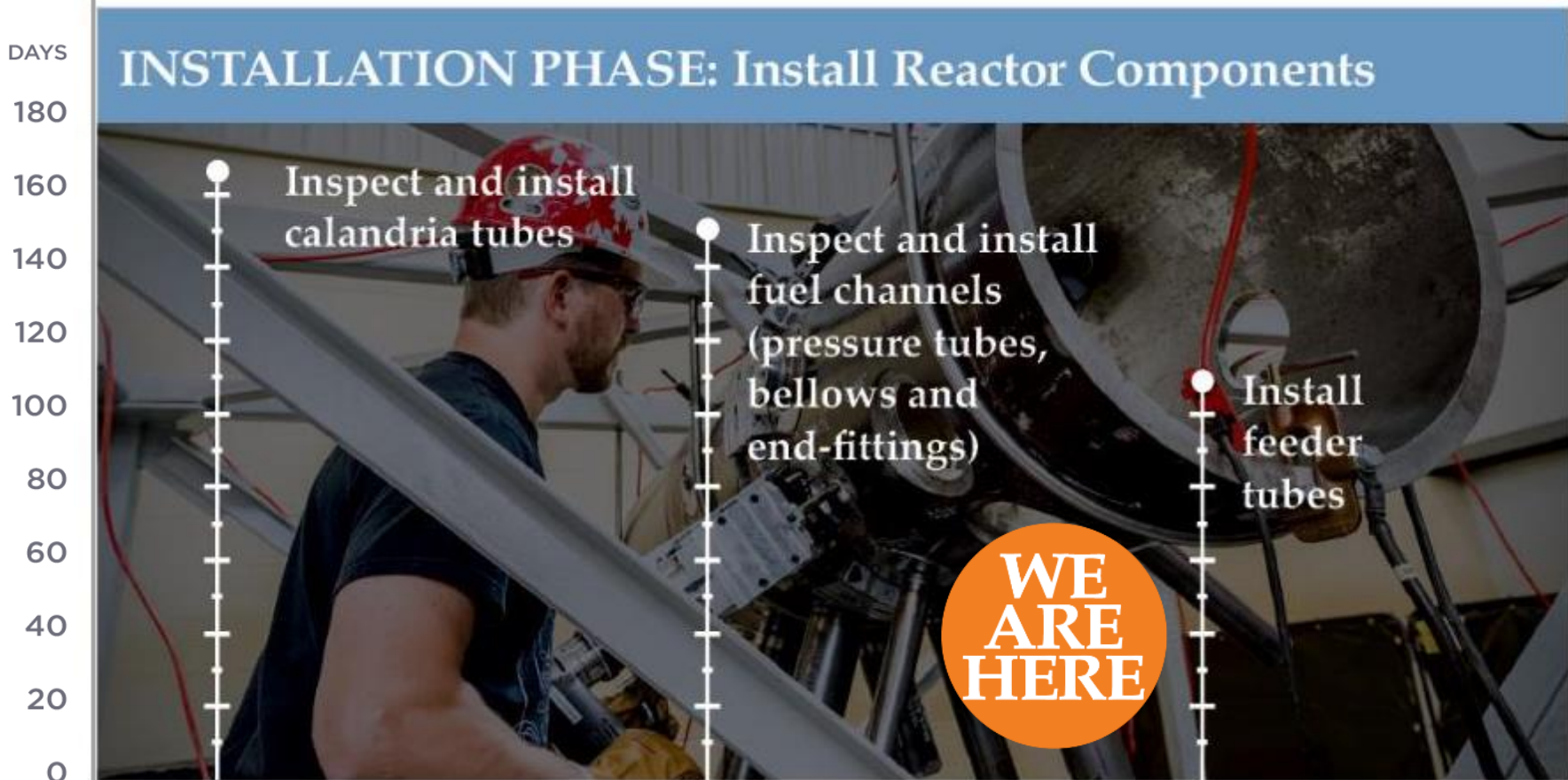


Unit 2 Execution Phases and Schedule



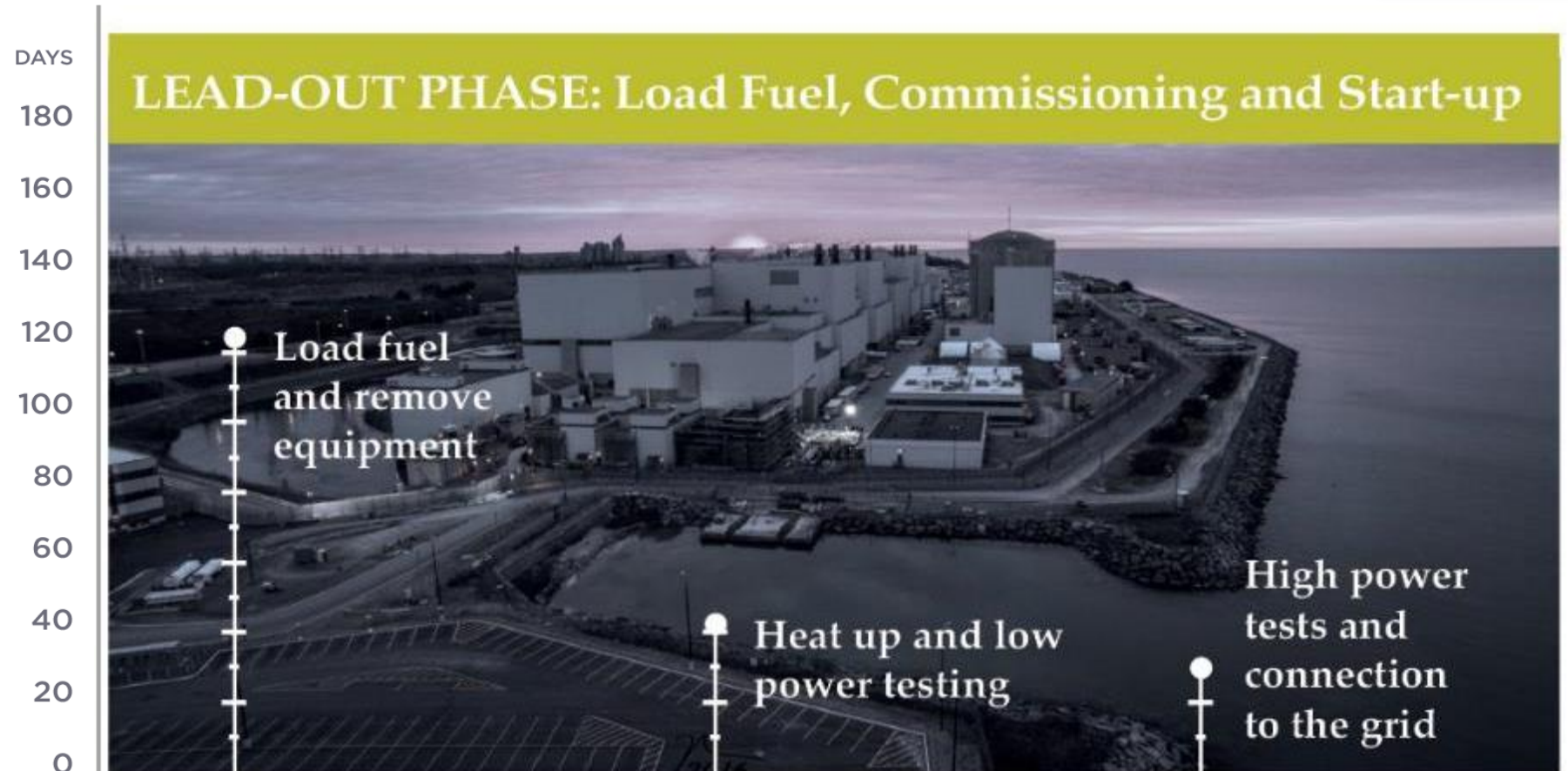


Unit 2 Execution Phases and Schedule





Unit 2 Execution Phases and Schedule





Innovation and Continuous Learning



- Radiological Protection
- Retube Control Centre
- Mock-up training facility
- Robotic Tooling
- Virtual Reality Training
- Lessons Learned





Return to Service Program



Integration and Collaboration





Restart Control Hold Points (RCHP)



9 Restart Control Hold Points including CNSC Regulatory Hold Points (RHP):

- Completion Assurance Documents (CADs) produced for each of nine RCHPs.
- 4 CADs Submitted to CNSC for RHPs

**Moderator
Fill**

Fuel Load

**Bulkhead
Removal**

**Heat
Transport
System Fill**

**GSS
Surrender**

**Reactor
Power > 1%**

**Steam to
Generator**

**Reactor
Power > 30%**

**Prior to
35% Power**





Closing Remarks

- Safe, reliable operations
- Strong project performance – Safety and Quality
- Single Site Licence: Clear roles and accountabilities
- Significant investments to increase plant safety margins
- 30 or more years of safe, clean, reliable power generation





Thank you

ONTARIOPOWER
GENERATION