



**PICKERING NUCLEAR
GENERATING STATION**

Part I Hearing
Licence Renewal

April 4, 2018

Randy Lockwood, Senior Vice President
CMD 18-H6.1A





Presentation Outline

- Opening Remarks
- Performance Highlights
- Our Request and Pickering's Commitments
- Extended Commercial Operation
- End of Commercial Operation
- Summary and Conclusions



Opening Remarks

Glenn Jager, Chief Nuclear Officer

PICKERING NUCLEAR CONTINUED OPERATIONS TO 2024

GREENHOUSE GAS-FREE BASE LOAD CAPACITY NEEDED FROM 2018-2024
NUCLEAR ENERGY PLAYS A FUNDAMENTAL ROLE IN ONTARIO'S CLEAN-ENERGY EQUATION

CONTINUED OPERATIONS AT THE PICKERING STATION WILL REDUCE GREENHOUSE GAS EMISSIONS BY AN ESTIMATED

17 MILLION TONNES

THAT'S THE EQUIVALENT OF REMOVING

3.4 MILLION Cars per YEAR

FROM ONTARIO'S ROADS

CONTINUED OPERATIONS WILL SAVE ONTARIO ELECTRICITY CONSUMERS



\$600 MILLION

\$1.54 BILLION TO ONTARIO'S GDP PER YEAR

7,590 FULL-TIME EQUIVALENT JOBS PER YEAR

\$290 MILLION IN GOVERNMENT TAXATION REVENUES

1 IN **7** 7 house icons, with the first one being larger and more prominent.

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

BEST PERFORMANCE YEAR IN 2016 FOR



SAFETY

AND OPERATIONAL PERFORMANCE

14% OF ONTARIO'S POWER IS SUPPLIED BY PICKERING - ENOUGH TO SERVE A CITY OF

1.5 MILLION PEOPLE





Our last years will be our best

Pickering Nuclear Generating Station

- Best performance in the history of the plant
- Fit for service through to 2024
- Significant investments that make Pickering even safer and more reliable



Performance Highlights

- ✓ Pickering All Injury Rate was 0.06 – industry best
- ✓ Collective Radiation Exposure better than target
- ✓ Equipment Reliability Index the highest in station history
- ✓ Two of six operating units achieved record operating runs in 2017
- ✓ Best ever Forced Loss Rate performance
- ✓ Fish Authorization issued for Pickering NGS

Securing Ontario's Clean Power Future

Investment for Improvement

2013-2017

- **Emergency Mitigating Equipment (EME) – Phases 1 and 2**
- Supply of emergency makeup water to refill the emergency coolant injection storage tank, for gravity feed into the Pickering NGS units' heat transport systems
- **Passive autocatalytic recombiners** for enhanced hydrogen mitigation in containment
- Installation of removable flood barriers, to provide additional protection following an external flood
- Shutdown Cooling Heat Exchangers
- Procedural updates to enhance **containment filtered venting capability** through the FADS in situations without electrical power
- **Standby Power Upgrades:** new Emergency Power Generator (EPG) engines, Standby Generator and EPG protective relays, and on-line refueling of the Auxiliary Power System
- **Fire Protection upgrades**
- Stack monitors
- **Real-Time Perimeter Radiation Detectors**
- **New emergency personnel accounting system within the Pickering NGS protected area**
- On-site Emergency Provisions to support sequestered staff (i.e., food, water, etc.)

Safety Enhancements – Phase 1 & 2 EME

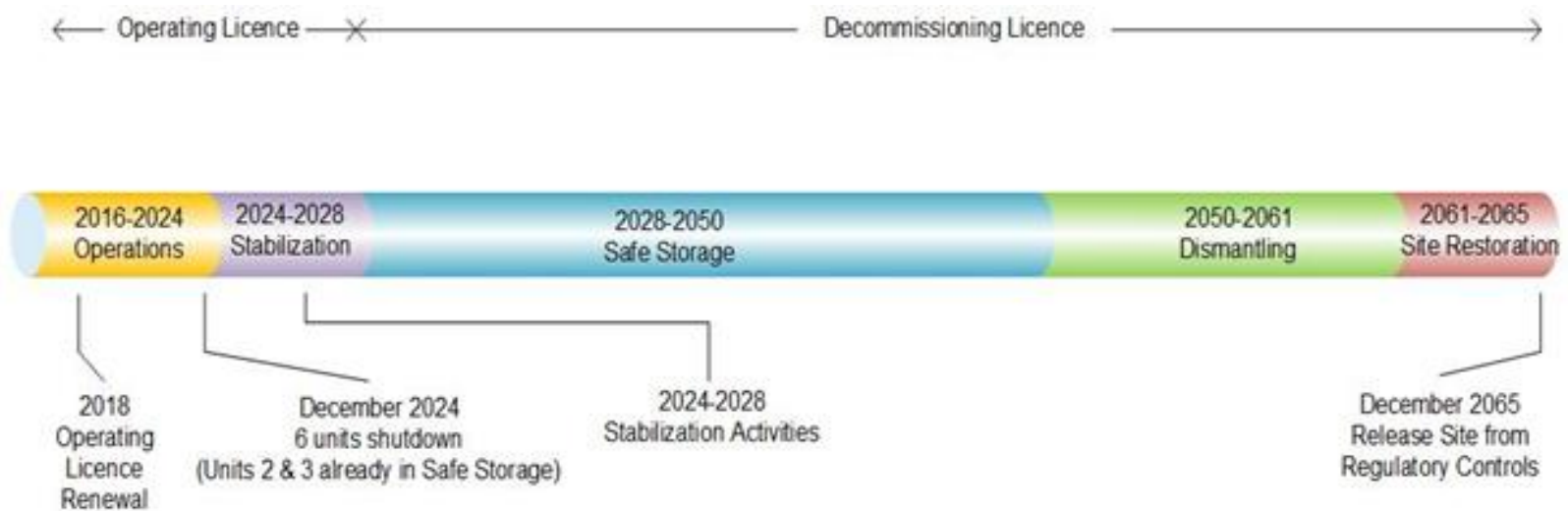


Invested to protect the public, workers and environment



Request for Licence Renewal

- OPG is seeking a 10-year licence renewal (September 1, 2018 to August 31, 2028):
 - Continued commercial operation to end of 2024 (295,000 Effective Full Power Hours for lead unit)
 - Stabilization period (fuel and water removed from reactors)
 - Start of safe storage by 2028





Pickering's Commitments

- Uphold **nuclear safety**
- Assure **fitness for service**
- Maintain an **engaged workforce**
- Maintain **low impacts of operation**
- Support **transparency and engagement** with the public
- Continue to **invest**



Extended Commercial Operations

Steve Gregoris, Deputy Site Vice President



Nuclear Safety

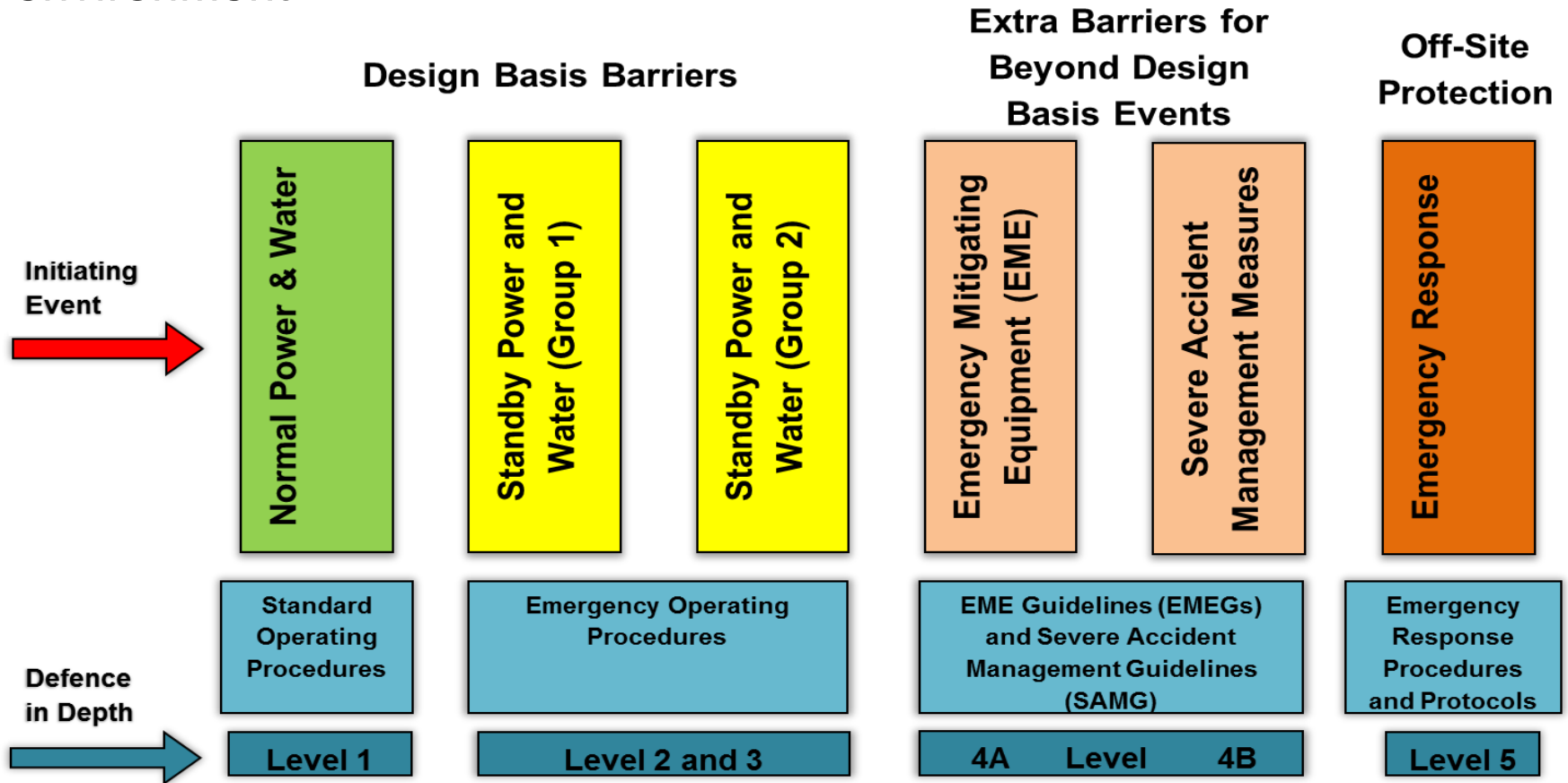
Nuclear safety will be assured such that plant personnel, the public and the environment are protected.

- Defence in Depth
- Periodic Safety Review
- Safety Analysis
 - whole-site risk
- Emergency Preparedness

Committed to Nuclear Safety

Defence in Depth

Pickering has many robust barriers to protect the public and the environment.

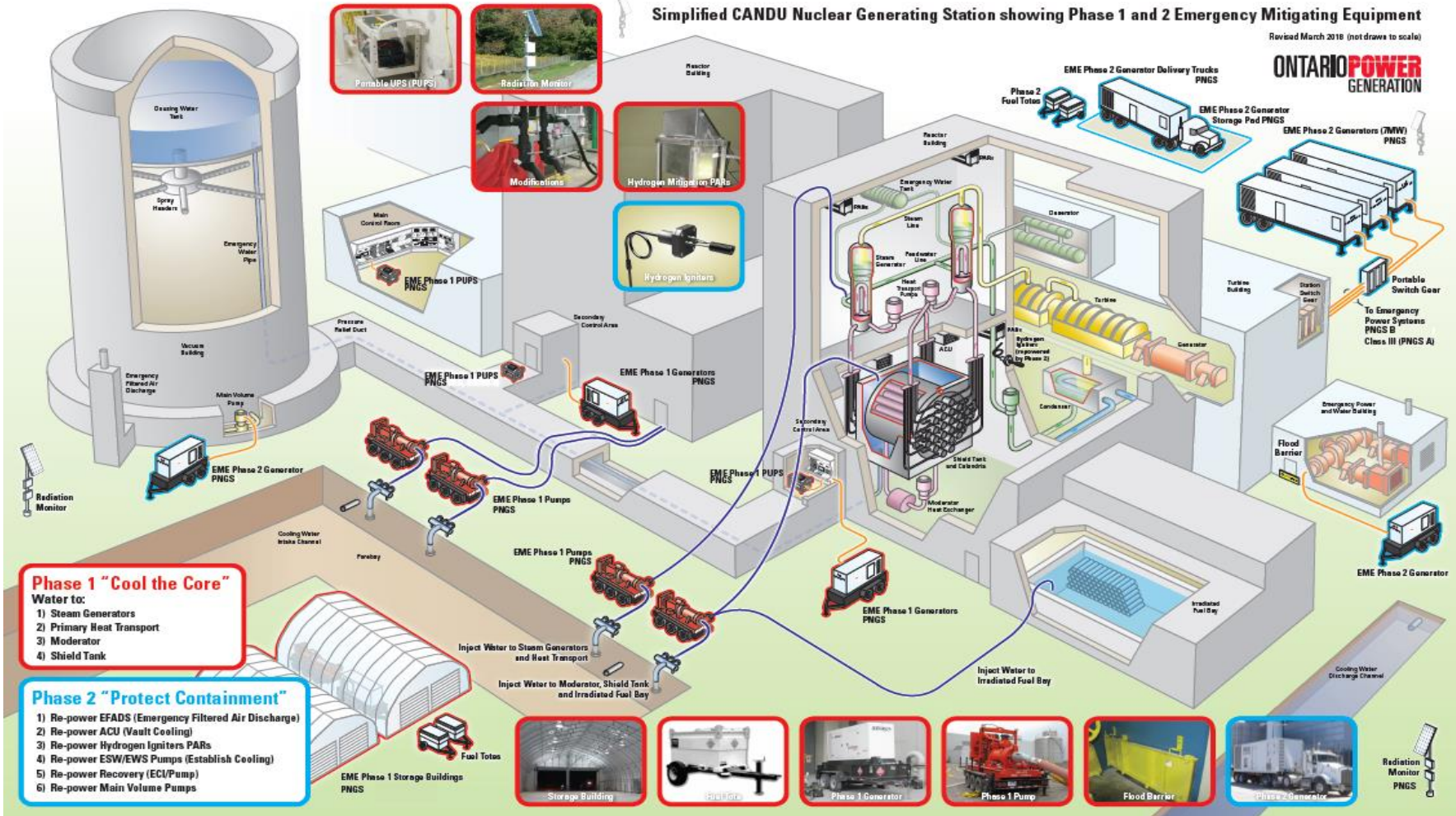


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Flexible Deployment of EME

Simplified CANDU Nuclear Generating Station showing Phase 1 and 2 Emergency Mitigating Equipment

Revised March 2018 (not drawn to scale)



- Phase 1 "Cool the Core"**
Water to:
- 1) Steam Generators
 - 2) Primary Heat Transport
 - 3) Moderator
 - 4) Shield Tank

- Phase 2 "Protect Containment"**
- 1) Re-power EFADS (Emergency Filtered Air Discharge)
 - 2) Re-power ACU (Vault Cooling)
 - 3) Re-power Hydrogen Igniters PARs
 - 4) Re-power ESW/EWS Pumps (Establish Cooling)
 - 5) Re-power Recovery (ECI/Pump)
 - 6) Re-power Main Volume Pumps

Committed to Nuclear Safety





Safe Today, Safer Tomorrow

Periodic Safety Review (PSR)

Overall Conclusion:

- Confirmed current plant operation is safe
- Confirmed the plant can be safely operated through to 2024

Conduct of PSR:

- Per CNSC requirements and international practice
- Covers all aspects important to continued safe operation
- Identifies additional safety enhancements in the Integrated Implementation Plan (IIP), accepted by CNSC

PSR Safety Enhancements

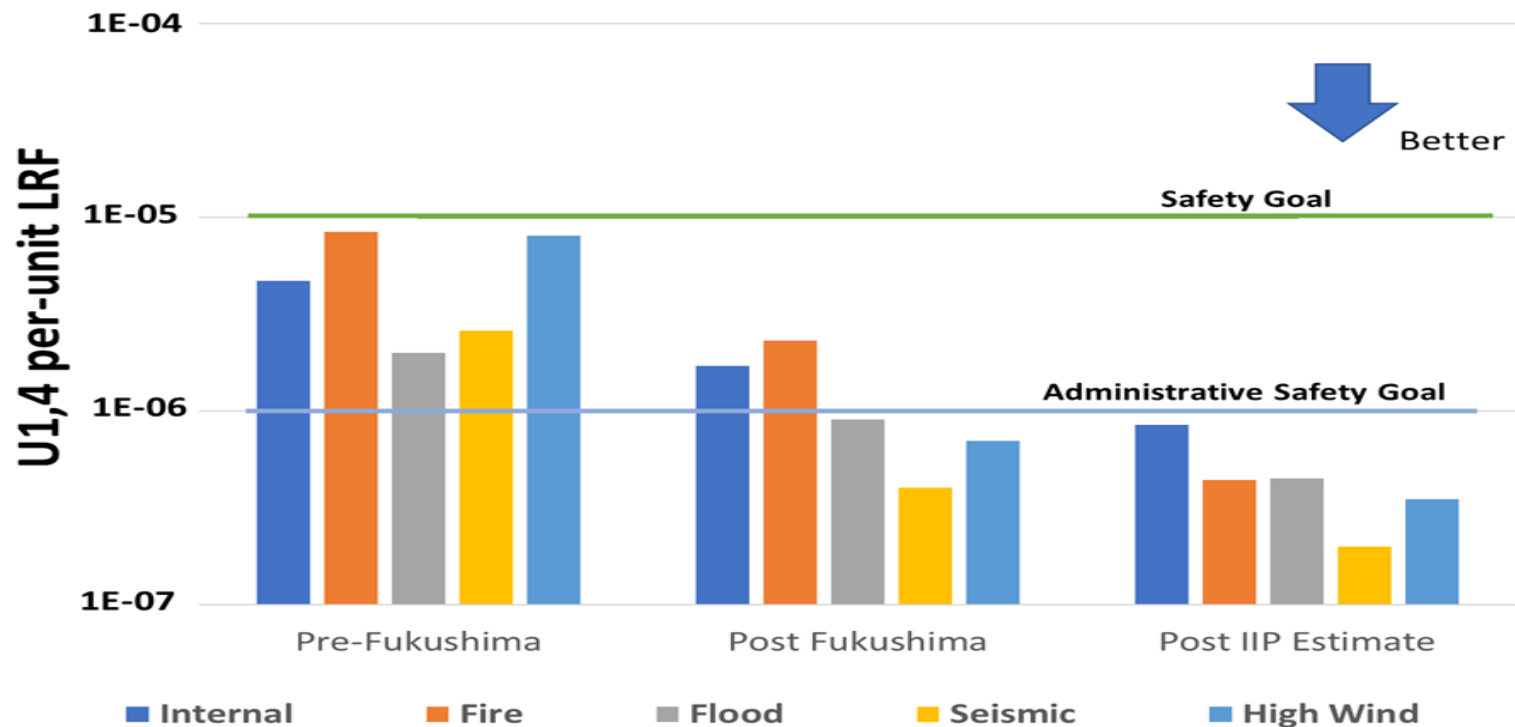
- Enhanced station fire protection: firewater from Units 1,4 diesel driven firewater pumps as an additional diverse supply for Units 5-8 through station interconnection
- Firewater modifications to provide an additional source of make-up water to Units 1,4 Heat Transport Systems, Steam Generators, and Calandria Vessels - for fuel cooling



Committed to Nuclear Safety

Integrated Implementation Plan (IIP)

- Pickering will be even safer via the IIP
- 63 IIP actions to be completed by 2020
- Includes physical plant modifications to significantly enhance nuclear safety



Committed to Nuclear Safety

Pickering Containment Integrity

- Pickering has a very robust containment design, including the existing means for containment filtered venting without power
 - Large off-site releases are very unlikely
- Phase 1 EME and PSR firewater modifications provide extra defence-in-depth for fuel cooling
 - Large off-site releases are even less likely
- Phase 2 EME strengthens containment defence-in-depth
 - Restores power to containment coolers and hydrogen ignitors, to protect containment integrity
 - Enables additional, diverse means of filtered venting





Safety Analysis

- Comprehensive deterministic and probabilistic analyses
- PSA safety goals are met for each reactor unit and hazard
- Pickering whole-site PSA:
 - At the forefront of international PSA developments
 - Supports that whole-site risk is low

Total site LRF (all units/all hazards)
0.82 per 100,000 years



per-unit LRF safety goal (per hazard)
1 per 100,000 years

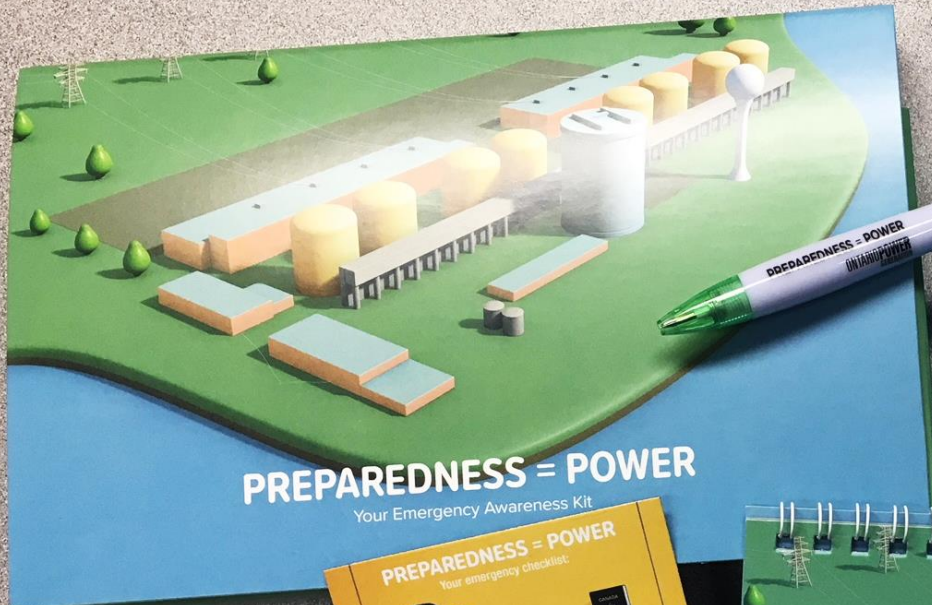
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Emergency Preparedness

- Robust EP plans and continuous improvement
 - OPG will enhance plans for Pickering NGS based on the updated Provincial Nuclear Emergency Response Plan (PNERP)
- Public emergency alerting via multiple different methods (sirens, radio, television, social media, and cell phones)
- Pre-distribution of potassium iodide pills (KI pills)
- Polling results support that the public knows what to do in the unlikely event of a nuclear emergency

Committed to Nuclear Safety



PREPAREDNESS = POWER
Your Emergency Awareness Kit



Prepare to be safe.



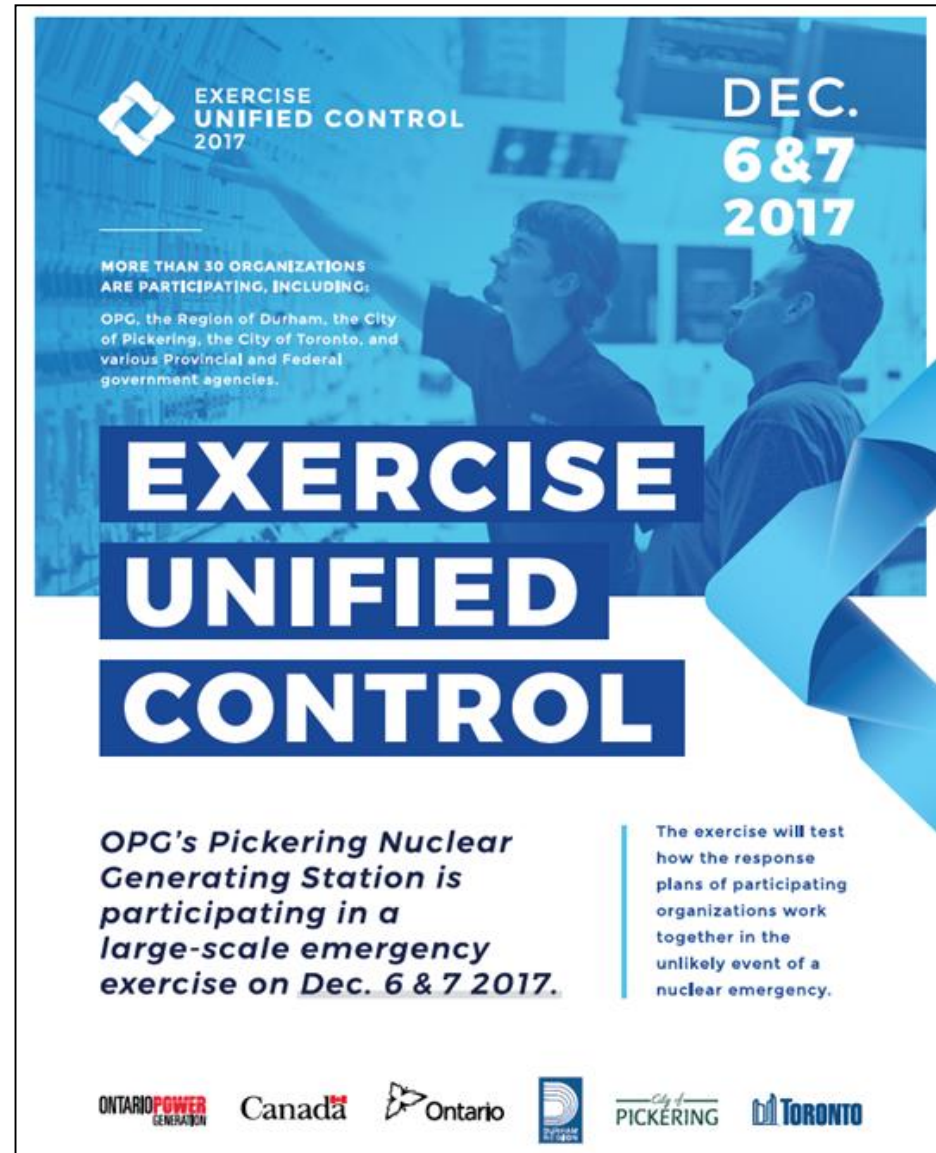
PREPAREDNESS = POWER
Everything you need to know about nuclear safety



Committed to Nuclear Safety

Emergency Preparedness

- Exercise Unified Control
 - Large-scale exercise with over 800 off-site partners from over 30 agencies
 - Severe accident scenario
 - Successfully demonstrated the robustness of both on-site and off-site EP, and the viability of recent innovations
 - Strengthened relationships with OPG and agencies



EXERCISE UNIFIED CONTROL 2017

DEC. 6 & 7 2017

MORE THAN 30 ORGANIZATIONS ARE PARTICIPATING, INCLUDING:
OPG, the Region of Durham, the City of Pickering, the City of Toronto, and various Provincial and Federal government agencies.

EXERCISE UNIFIED CONTROL

OPG's Pickering Nuclear Generating Station is participating in a large-scale emergency exercise on Dec. 6 & 7 2017.

The exercise will test how the response plans of participating organizations work together in the unlikely event of a nuclear emergency.

ONTARIO POWER GENERATION Canada Ontario PICKERING TORONTO

Committed to Nuclear Safety

ONTARIO POWER GENERATION



EXERCISE
**UNIFIED
CONTROL
2017**

Committed to Nuclear Safety



Fitness for Service

Stephanie Smith, Director of Operations and Maintenance



Fitness for Service (FFS)

Systems, structures and components at the plant are fit to continue commercial operation to the end of 2024, and inspection programs will ensure fitness-for-service during the next licence period.

- Aging Management
- Fuel Channels



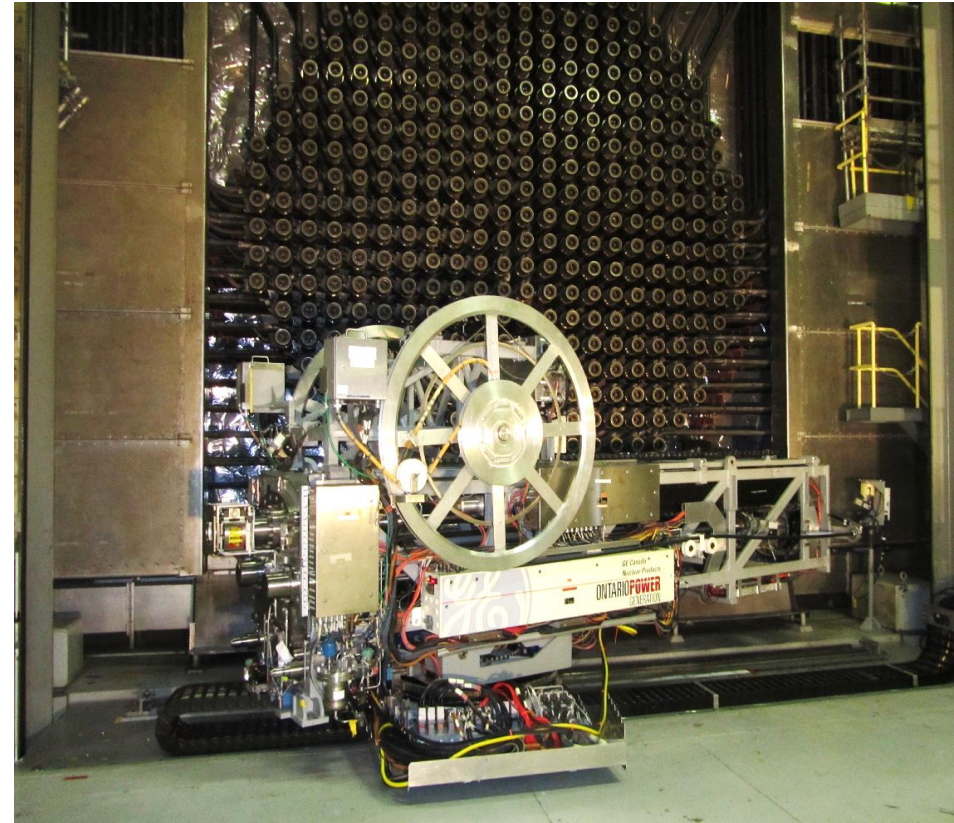
Committed to Fitness for Service

ONTARIO **POWER**
GENERATION

Aging Management

FFS is rigorously demonstrated and re-assessed regularly through testing, maintenance, and periodic inspections, in accordance with:

- CNSC requirements and CSA Standards
- OPG's Integrated Aging Management Program
- Life Cycle Management Plans



Committed to Fitness for Service

Fuel Channel FFS

OPG assures fuel channel FFS for all units, with margin to the end of 2024

- Sound technical reviews
 - supported by R&D, in concert with industry
- Established programmatic controls
- Availability of mitigating measures
- Associated IIP actions to enable safe operation to 2024

Pickering Unit	Projected Unit EFPH as of Dec. 31, 2024
Unit 1	192,000
Unit 4	167,500
Unit 5	287,500
Unit 6	295,000
Unit 7	287,000
Unit 8	274,000

Hydrogen Equivalent [Heq] levels projected to be < 120 ppm and well within validated range of fracture toughness models per CSA Standard, for all units.

Fuel Channel Aging is understood and well managed



Engaged Workforce

Staff are qualified and competent to operate the plant, and this will be maintained through the next licence period, including sufficient staffing numbers.

- Qualified workforce
- Safety culture
- Staffing management



Engaged Workforce

- An extensive training program ensures that staff have the necessary skills and knowledge to conduct their work
- The safety culture at Pickering NGS is healthy and regularly monitored
- Succession Planning and hiring strategies support the continuity of critical roles

Committed to an Engaged Workforce



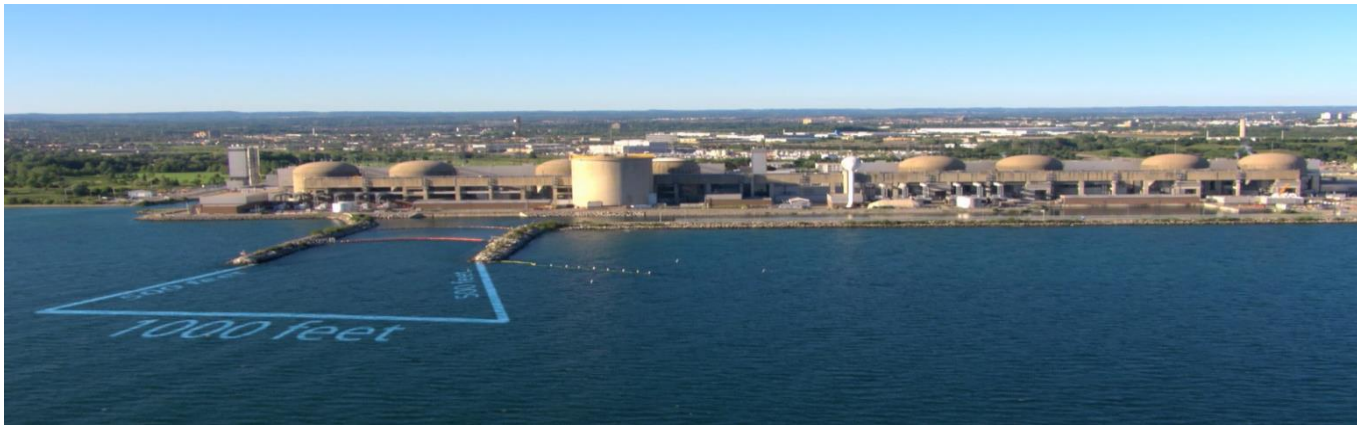
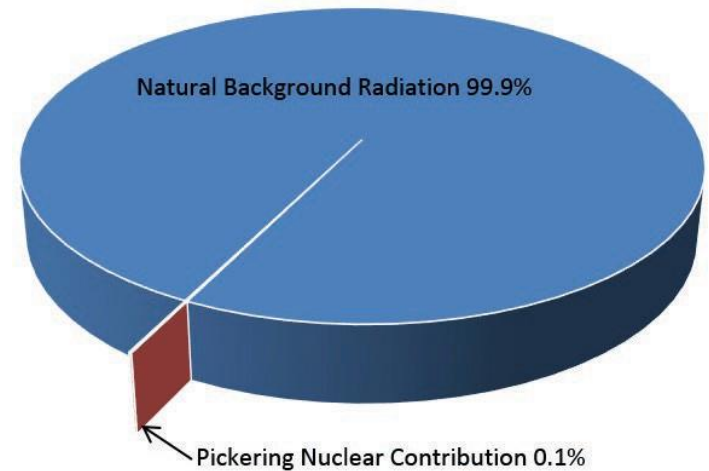
Low Impacts of Operation

Impacts of plant operation to the public, workers, and the environment will continue to be of low-risk and adequately mitigated, while continuing to provide the various societal and environmental benefits of plant operation.

- Radiation Protection
- Conventional Health and Safety
- Environmental Protection
- Waste Management

Protecting the Public and Environment

- Radiological releases into air and water are far below regulatory limits
- OPG regularly samples water, air, and soil to ensure radiological and non-radiological emissions remain at safe levels
- Various forms of waste are effectively managed
- Fish Authorization issued for Pickering



Committed to Low Operational Impacts

Protecting Workers

- Workplace safety is a core value
 - Conventional health and safety
 - Radiation protection
- Workers are well protected through use of advanced technology



Committed to Low Operational Impacts

A photograph of two young women, one white and one Black, smiling and holding saplings in a field. They are wearing white gloves and holding the plants in large, dark, cylindrical containers. The background shows a green field, trees, and a tall tower under a clear blue sky.

Transparency and Engagement

Randy Lockwood, Senior Vice President

Transparency and Engagement

Transparency and appropriate public and Indigenous engagements will continue.

- OPG maintains strong relationships with Indigenous and local communities
- OPG shares information on facility operations and performance, and licence renewal (www.opg.com)



Committed to Transparency and Engagement



Committed to Transparency and Engagement

Continuing to Invest

OPG will continue to invest in Pickering to support the above objectives, including to improve equipment reliability, to assure fitness for service until the end of commercial operations, and to further enhance nuclear safety.

- To enhance nuclear safety and reliability
- Inspections and maintenance
- Improved environmental protection
- In our people and industry leading use of innovation and technology



Committed to Continued Investment

INVESTING IN INNOVATION X-LAB

Committed to Continued Investment

Continued Investment

2018-2021 Plan

- Safety improvement modifications
- Equipment reliability
- Increased inspections
- Equipment upgrades
- Environmental Protection



Committed to Continued Investment

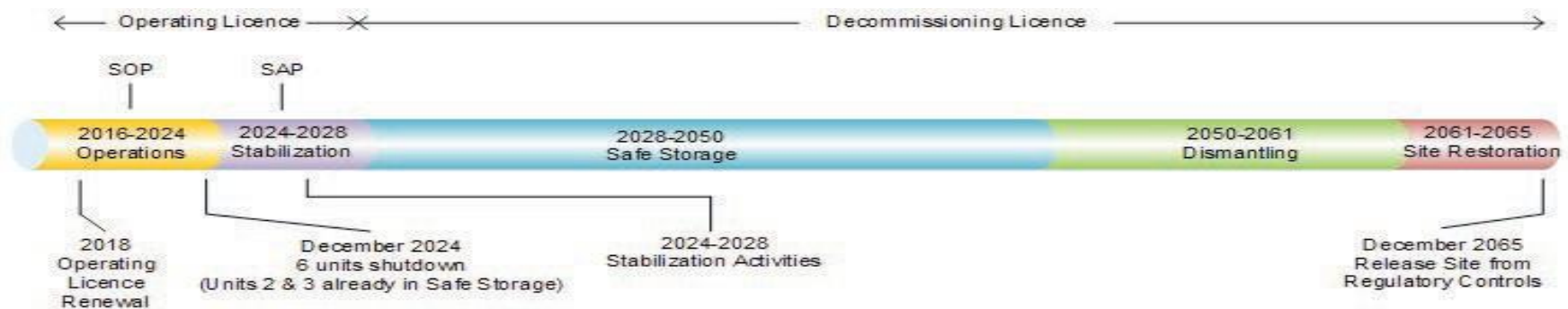


End of Commercial Operation

- Sustainable operations
- Stabilization activities

Sustainable Operations Plan (SOP) & Stabilization Activities Plan (SAP)

- SOP is pro-actively developed to plan for the transition to End of Commercial Operation
 - OPG understands the actions and supplemental measures needed
- SAP documents the activities to safely transition from commercial operation to a Safe Storage State
 - Informed by Darlington refurbishment and Pickering Units 2,3 Safe Storage experience
 - Predictive Effects Assessment: low risk to human health and the environment
- SOP and SAP consider all 14 CNSC Safety and Control Areas



End of Commercial Operation



PICKERING NUCLEAR

is one of the top-performing stations in Canada



Summary

- Pickering plays an important role in providing clean, safe, reliable, low cost electricity
 - Protecting the public, workers, and the environment
 - Fostering open and respectful relationships with communities
- Long history of safe operation at OPG nuclear facilities
 - Engaged, experienced and motivated staff will keep Pickering operating well
 - Increasingly high levels of plant performance, some are best ever
- Through continued investments, the Pickering design has advanced to be safer than ever before
- Through the IIP, Pickering will be even safer

Safe Today, Safer Tomorrow

Conclusions

- OPG is qualified to continue commercial operation of Pickering NGS through to the end of 2024 and transition the station to safe storage by 2028
- OPG will continue to make adequate provisions to protect the health, safety, and security of persons, and the environment, and will maintain national security and international obligations

Our last years will be our best

