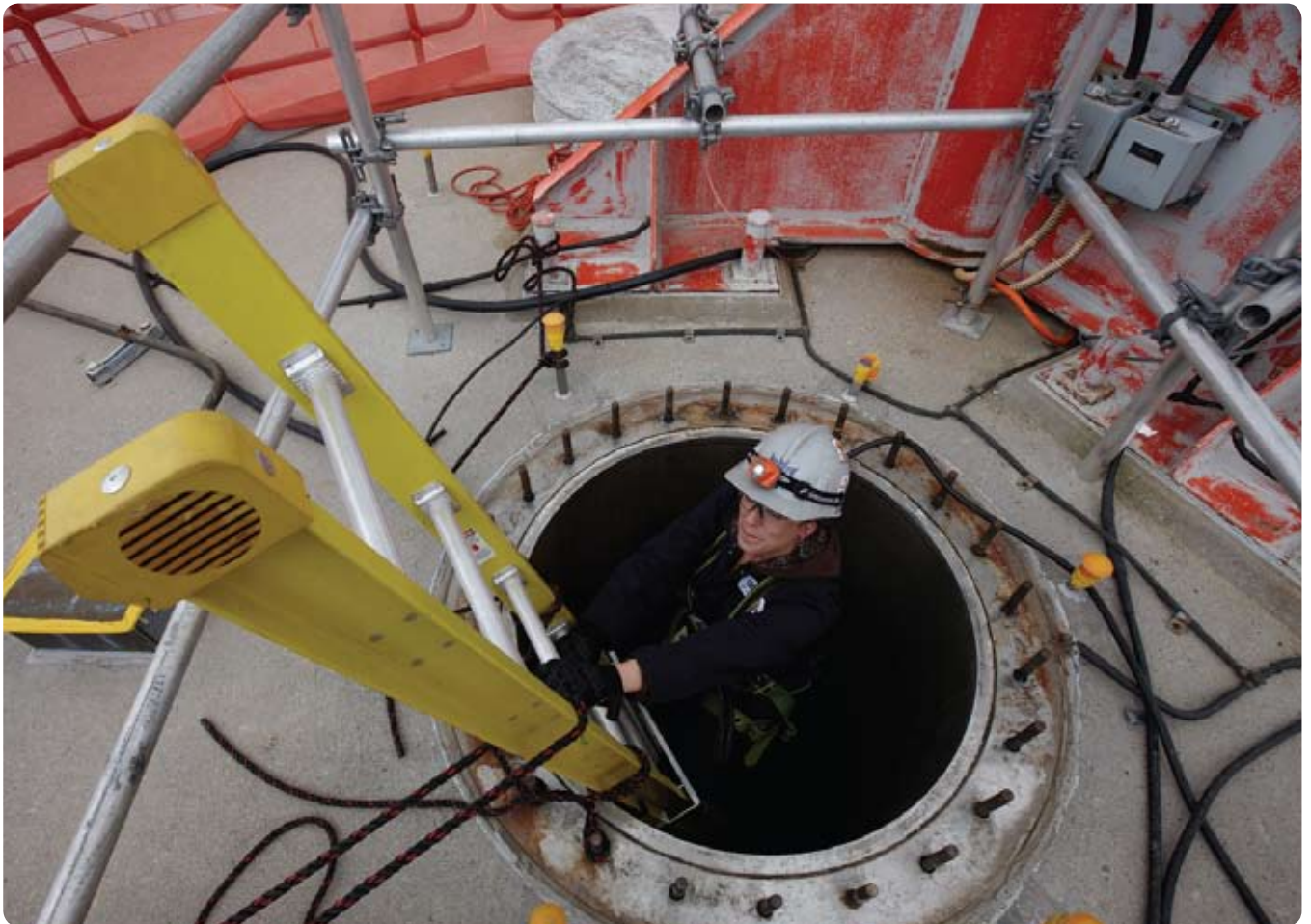


Generating 70% of Ontario's Electricity

It's All About Performance

THE DARLINGTON VACUUM BUILDING OUTAGE

April 15 – May 25, 2009



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OPG's biggest nuclear project in 2009

Darlington's VBO is a major success



Outage staff on top of the Vacuum Building: To prepare for the outage, hoisting and rigging equipment were brought in, and a temporary elevator was erected to allow crews to access the roof.

“Being accountable for our work is the trait of a highly functioning team. It is about how we can all rely on each other living up to our responsibilities...”

Wayne Robbins,
Senior Vice-President, Darlington

A very big outage

On May 25, employees at the Darlington nuclear generating station successfully completed its largest and most complex project for the year – the Darlington Vacuum Building Outage (VBO).

Occurring every 12 years, the Darlington VBO was launched on April 15 following more than two years of preparation. Throughout the planning process, numerous permits and approvals were obtained from relevant government agencies to ensure all regulatory requirements were met. The outage lasted 40 days and involved over 4,000 OPG staff and contractors.

The VBO required OPG to shut down all four of Darlington's nuclear reactors to

allow for the inspection and maintenance of the station's vacuum building structure to ensure its continued availability. The fact that the project was completed safely and in a timely manner is a tribute to sound planning, effective coordination, and near flawless execution on the part of OPG's outage staff.

The first Darlington reactor – Unit 4 – was brought back on line on May 20. This was quickly followed by Unit 1 on May 21 and Unit 2 on May 25. Darlington Unit 3 will remain off line until early July as part of a scheduled outage. The 3,600 MW Darlington station generates more than



VBO by the numbers

- 25,000 tasks completed
 - including 7,000 prerequisites and 2,000 contingency tasks
- Over 500 tasks completed on average per day
- 629 tasks completed on May 1 – an all-time high
- Excellent safety performance
 - no “near miss” events that could have caused serious injury
 - no Lost-Time Accidents,
- 9,500 different parts and pieces of equipment purchased
- 82,000 meters of wire and cable issued
- 14,500 feet of pipe, hose and tubing issued
- 1,300 valves issued

17 per cent of the electricity consumed in Ontario. The timely completion of the VBO ensures that the station will continue its significant contribution to the Province's energy needs.

What is a vacuum building?

A critical part of Darlington's safety system, the vacuum building is a 75 metre tall structure made from reinforced concrete. The interior is kept at a near perfect vacuum. In the unlikely event of a rupture in the piping in any of Darlington's four reactors, steam from the break would be automatically sucked into the vacuum building and condensed into water – preventing any

damage due to steam pressure build-up.

The structure has never had to be used.

The interior of the vacuum building houses 11 million litres of water in a massive storage tank high above the structure's floor. If steam should escape from a reactor, the water condenses it thereby reducing pressure.

A safe and well-executed project

VBO's success reflects strong project management

Meticulous planning

OPG started planning for the VBO in 2007. Leading up to the outage, more than 7,000 pre-requisite tasks were completed to help ensure a smooth launch. Extensive communications and briefings were conducted to enable all staff to fully understand their role in making the outage a success. An Outage Control Centre (OCC) was established to facilitate, coordinate and manage the thousands of tasks associated with the project.

Precise coordination

Every day during the outage, a dedicated oversight team would meet at 7AM to review progress from the night before and go over plans for the upcoming day's work. A second meeting was held in the afternoon, followed by a conference call in the evening to plan ahead for the next day. Daily meetings were also held to ensure the outage adhered to its critical path and that tasks were performed on schedule. Every task in the outage was planned in advance and dependent for its success on the tasks that preceded it. Like a fine watch, all the pieces had to fit together.

Before any task was performed, workers themselves would meet with their supervisor for a pre-job briefing to determine the best approach to take and identify any potential barriers to its safe completion.

During the course of performing an outage task, if an issue or problem could not be resolved within 30 minutes, supervisors would notify the OCC for support. Flexible OCC teams would then move into action to quickly provide solutions and facilitate the work.

Solid execution

In executing the VBO, OPG staff successfully achieved the following milestones

- safe shutdown of four nuclear reactors;
- ensuring that the reactors' backup shutdown cooling systems were functioning;
- removing the huge vacuum building from service and pressurizing it to atmosphere;
- inspecting, testing and performing maintenance on the vacuum building – including the emergency service water system;
- restarting three of Darlington's units; and
- readying a fourth unit – Unit 3 – for a 42-day planned outage.



Remote monitoring of radiation levels and staff safety to ensure they are well within acceptable limits is an important part of any outage. During the VBO, OPG met or bettered its radiological targets.



The discovery of new issues and challenges is a normal part of any outage. During the VBO, cross-functional Significant Issues Resolution teams, like this one, were quickly assembled to work through and resolve issues in order to keep the outage moving.



The Outage Control Centre in action. The OCC helps ensure that the outage stays on track. When an issue is encountered while working, outage staff immediately contacted the OCC for support. OCC staff worked 24/7 to help resolve problems and minimize their impact on outage work.

Five-phase approach a key success driver

To manage the huge outage effectively, OPG broke it down into five phases. Transition periods between one phase and the next allowed OPG to independently verify that all critical tasks were completed safely prior to starting the next phase.

Phase 1 – Preparation (Jan. 2007– April 15, 2009)

Phase 2 – All Darlington Units are shut down (launched April 15)

Phase 3 – Vacuum Building taken out of service and inspected (launched April 26)

Phase 4 – Vacuum Building Inspection and Maintenance (launched May 3)

Phase 5 – Start-up of Units 4, 1 and 2 (launched May 13)

Outage staff made VBO a success

Showed excellent teamwork and support

“The VBO was successful because our outage staff worked safely, communicated effectively, and followed procedures. The level of teamwork throughout the project was outstanding.”

Dave Hunter,
Director of Work Management, Darlington



Members of Darlington’s field engineering staff in front of the Vacuum Building. The Field Engineering department oversees field work done by contractors at the station. These employees are one of the many groups that helped make the VBO a success.

Collective effort

Over 4,000 people participated in the VBO. They included Darlington employees, contractors, OPG’s nuclear support staff, and employees from OPG’s Pickering nuclear station. OPG’s fossil and hydroelectric business units also contributed by maintaining superb performance, reliability and availability throughout the outage period. This was truly a team effort involving a wide range of skills, groups and individuals all working toward a common goal.



A member of the VBO’s “ice plug” crew freezes a portion of pipe. Pipe freezing enables maintenance and repair work on systems without the need to cut piping.

Key results

- **Strong Safety performance:** Throughout the VBO, safety was OPG’s paramount consideration. At the end of the outage, OPG met or bettered all of its safety targets – including all nuclear, radiological, employee and environmental targets.
- **VBO structure passed inspection:** Inspections and tests of the vacuum building indicated that its overall condition is very good. OPG put the structure back into service confident that it will remain sound until its next scheduled inspection in 2021.
- **Emergency service water (ESW) system work completed:** The ESW is an important safety system which supplies cooling water to essential safety-related areas of the station when normal water-supplies are unavailable. During the VBO, employees replaced or overhauled 61 valves; replaced water lines; and inspected the entire ESW system. This included underwater inspection and maintenance.



A diver prepares to enter the water to inspect a part of the ESW system. During the outage, zebra mussels were found to be impeding water flow in the cooling water supply lines. Divers helped remove over 520 tonnes of zebra mussels, restoring flow well above requirements.



Mixed Sources

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