Workers at Ontario Power Generation's (OPG) Pickering Nuclear during a planned maintenance outage. *Image: OPG*

Building a better outage

COG's Reduced Outages Program is working with members and suppliers to explore how new technologies can reduce the time and frequency of maintenance outages while increasing their effectiveness and safety

Across the CANDU fleet, strong, efficient and continuous performance, with less frequent and shorter outages, has become increasingly common even as many reactors have reached several decades of lifetime operation.

Case in point, in February, Ontario Power Generation's (OPG) Darlington Nuclear Plant Unit 1 reached 1,106 continuous days of operation or just more than three years, since going online Jan. 26, 2018.

This was the longest period any nuclear power reactor in the world had been in continuous operation by nearly 150 days. The record-breaking achievement in uninterrupted power generation was possible thanks in part to innovations and developments in inspection and maintenance outage technologies and processes.

Many CANDU stations are making progress towards longer lengths of time between maintenance outages with similar advancements.

Through CANDU Owners Group's (COG) Reduced Outages Program, COG member utilities are collaborating with Canadian Nuclear Laboratories (CNL), COG supplier participants like MDA, Alithya and Kinectrics, and University Network of Excellence in Nuclear Engineering (UNENE) to develop and employ advanced technologies and methods to achieve significant reductions in planned outage maintenance work, outage duration, cost and worker dose.

The goal of this area of Strategic R&D (SRD) is reducing costs and returning plants online faster, resulting in greater earnings from increased generation and better overall performance.

Opportunities to apply some of the latest technologies are being explored as part of the reduced outage effort including machine learning, robotics, digitalization, automation, online monitoring, new and improved sensors, probes and advanced analytics. Coupled with initiatives in human performance and process improvements such as the on-going advancements in condition-based maintenance, CANDU stations are expecting to see stronger performance results with less time offline.

"The recent record-breaking performance by Darlington's Unit 1 demonstrates the outstanding performance capabilities

"The impetus for this new and higher level of COG collaborative research, which reduces risks and shares costs and benefits, has never been stronger."

CANDU OWNERS GROUP

of a well-managed CANDU reactor," says John de Grosbois, COG SRD Reduced Outages Program Lead.

"In the near term, there is a wave of new technologies upon us, such as augmented and virtual reality, among others," he says. "Collectively, these so called 'disruptive' technologies are creating significant and impactful innovation opportunities," he says.

The Reduced Outages program actively engages site specialists as an active part of the COG R&D team, with suppliers and university researchers, to identify, prototype and deliver new transformational solutions.

The use of technology to reduce maintenance effort during outages was identified as a strategic focus area and a top priority by COG member CNOs when the SRD program first launched in 2016. The goal was to minimize work associated with inspection and monitoring during outages and to develop strategies to avoid or shorten them all together.

As well, the program seeks to find ways to improve outage-related planning, logistics and training along with tools and delivery systems.

"We are actively pursuing information exchange and cooperation with EPRI's Plant Modernization Program and other partners, like Halden and INL (Idaho National Lab), to leverage their excellent research and technology capabilities into our research and development initiatives," says de Grosbois.

"The impetus for this new and higher level of COG collaborative research, which reduces risks and shares costs and benefits, has never been stronger."

Highlights of COG's Reduced Outages program

COG's Reduced Outages program is exploring application of a number of different technologies to reduce maintenance effort during outages and reduce time offline for CANDU plants.

Online monitoring and condition-based maintenance

Supplier participant: MDA

This work area focuses on improved and proactive monitoring and maintenance of equipment, components and systems.

Automated analysis and data analytics

COG member: CNL

This area looks at using artificial intelligence and advanced analytics to process outage inspection data faster and more accurately.

Advanced sensors, probes and scanning technologies

COG member and supplier participant: CNL and Kinectrics

This work focuses on development of improved inspection technologies, such as ultrasonic and electromagnetic sensors, focusing on faster, more accurate scans of steam generators, feeders and fuel channels.

Improved fuel channel inspection

Supplier participant: MDA

This research focuses on tooling to enable transition toward inspections outside of traditional outage windows and in the longer term, possibly some fuel channel inspections and monitoring online.

Digitalization and modernization

Supplier participant: Alithya

This work focuses on use of a range of new technologies including mobile computing and semantic information technology to improve data collection and integration to make maintenance work more efficient and coordinated with other plant activities.

Robotics and automated tooling

Supplier participant: MDA

This research area investigates use of autonomous or remotely-controlled robots for use in hazardous or physically-constrained environments or in key outage systems like feeders. The goal of this work is reduce worker time and dose and improve inspection quality.

Advanced manufacturing

COG member: CNL

This work looks at use of additive manufacturing and high-strength as well as radiation-tolerant materials to improve component reliability and performance or replace obsolete and difficult to manufacture parts.

Augmented and virtual reality

Supplier participant: Alithya

This area focuses on advanced visualization and simulation technologies and their applications to inspections and maintenance. These tools can strengthen training as well as maintenance work planning processes.