OPG's Inspection and Reactor Innovation

ONTARIO POWER GENERATION

About Us

Who we are

Inspection and Reactor Innovation (IRI) is a division of Ontario Power Generation (OPG) that provides inspection, maintenance, and innovative services for the energy sector worldwide. Our clients include nuclear, hydroelectric and thermal/geothermal electric utilities.

Why we're here

To work alongside entrepreneurs, innovators, and start-ups to drive improvements to safety, efficiency, and the effectiveness of inspections and maintenance in the energy sector.

OPG is hosting a pitch competition in collaboration with Spark Centre's Ignite program to foster innovation and creative ideas for the inspection and maintenance of energy utilities – **apply between August 21 and September 29, 2017**, and visit ignitedurham.ca/OPG for more details!

What we bring to the table

Engineering and technology development, project management, testing resources and capabilities, regulatory experience, and more!

Technologies

We deploy a range of technologies across land, sea, and air to ensure safe and reliable operation of the power generating stations we serve.

LAND

The bulk of work is conducted through remote operation of specialized tooling within hydroelectric and nuclear stations.

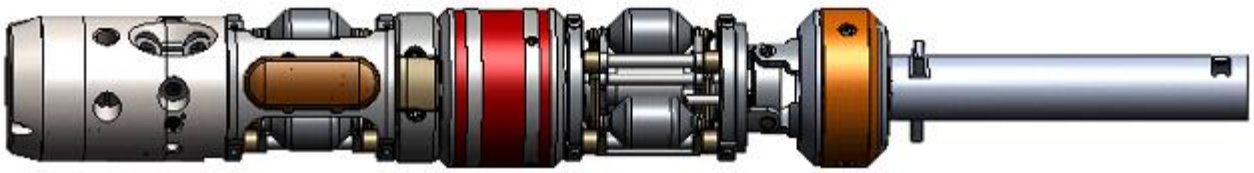
SEA

Our Diving Operations Team provides safe, secure, high-quality, and low-cost underwater inspection and maintenance services to power generating stations.

AIR

The use of drone technology provides significant safety and cost benefits by simplifying inspections in locations that would be difficult for humans to reach.

NDE (Non-destructive Examination)



- Ultrasonic testing uses high-frequency sound energy and ultrasonic waves, which can help identify tube-wall thickness, detect fractures or corrosion in the material, and measure the flow rate of the water running inside a pipe.

- Eddy-Current testing uses specialized probes to detect defects such as erosion, cracking or even loose parts.

- Laser technology is used to map the profile of complex structures, such as the reactor face, to accurately predict operating lifespan.

What improvements can we make to existing NDE technologies to provide our clients with the best solutions?

NDE (Non-destructive Examination)

Steam Generators

- Inspection and Monitoring of boiler tubes and nozzle thickness:
  - Bobbin Probe Eddy Current, specialized ET (x-probe) and UT
  - Tube Removal and plugging
  - Metallurgical Examination
  - Foreign material retrieval tool
- Utilizes robotic systems that can reduce dose the technicians are exposed to by 75%

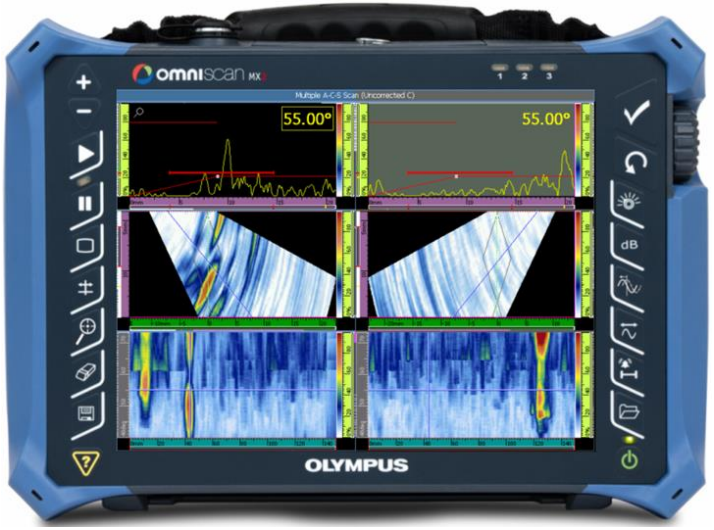
Feeders

- Used to measure the feeder pipe wall thickness in specific areas using ultrasonics
- Wall thickness measurement: METAR (axial) and 6-probe tool (circumferential)
- UT thinning (PAUT) and cracking
- Visual inspection for fretting and vibration induced failures
- Feeder Replacement
- Measure wall thickness downstream of large radius bends beyond the elbow section

NDE (Non-destructive Examination)

Phased Array UT (PAUT) Turbine Blade Scanner System

- Emits an ultrasonic signal through the turbine blade root to check for defects.
- Turning the wheel drives the scanner arm along the blade.
- Defects will show up on the screen similar to a heat-map (more amplitude = more red).



Balance of Plant Heat Exchanger Inspection

- Uses Non-Destructive Examination (NDE) to inspect heat exchangers
- Includes leading edge heat exchanger tubular ultrasonic testing inspection technology, including Internal Rotary Inspection System (IRIS) and Tiny Rotating Ultrasonic Tube Inspection Equipment (TRUSTIE)

Laser Scanning and Mapping

3D Laser mapping Creaform Scanner

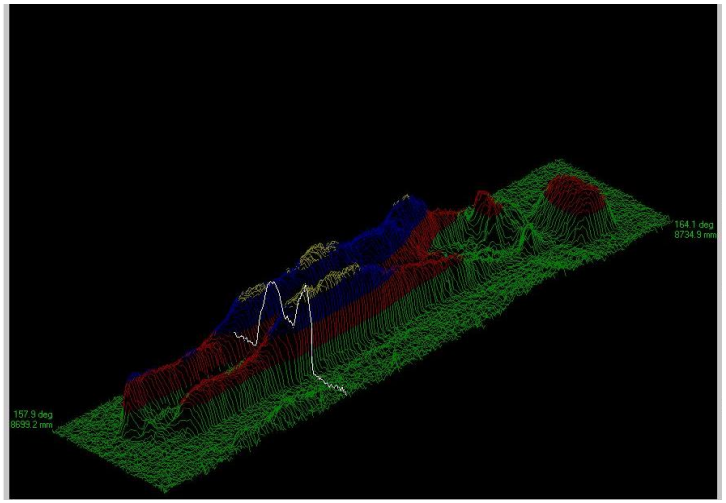
- Uses laser triangulation to determine position of reflected light and turns that into a point cloud.
- Two lasers emitted from the scanner & one positioning target create the triangle.
- Does this 100,000s of times and creates the image which can be used to compliment visual inspections or as a reverse engineering tool.
- Scan is then exported to another program for further processing.

STEM tool

- The utilization of a laser-scanning system to map the reactor face.
- Determines the elongation of the fuel channels in the reactor over time.

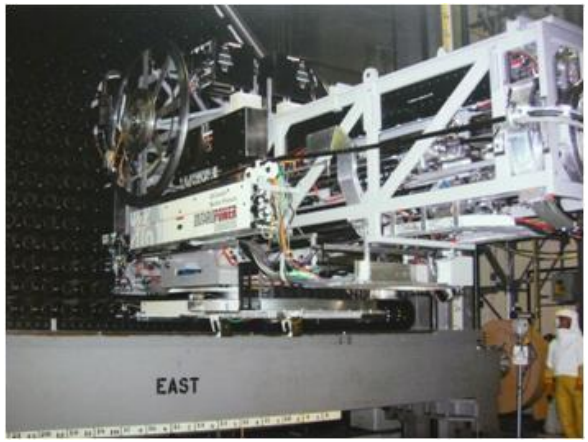
Fret Replica Inspection Laser Scanner (FRILS)

- FRILS analyzes replicas that are taken of a fret within the fuel channel.
- Using cameras, laser profiling and a scanning electron microscope, the flaw length, width depth and root radius are found.
- Performs analysis on the replica sample once it is retrieved from the replication technique.



Automation and Robotics

We employ automation and robotics to achieve faster, cheaper, and safer inspections. Robotics are used to lessen the dose received by our technicians while performing nuclear inspections.

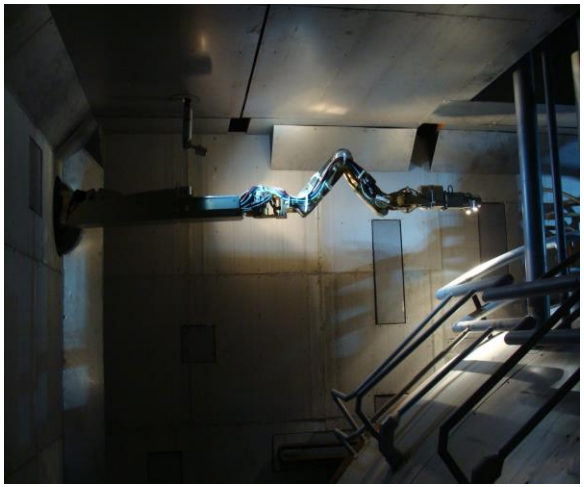


Universal Delivery Machine (UDM)

- Mechanism used to deliver fuel inspection and other critical equipment to the reactor face

Channel Inspection Gauging Apparatus for Reactors (CIGAR)

- Performs full volumetric inspections of the fuel channel, including gap, sag, replica, and visual camera inspection.



Spacer Location and Repositioning (SLAR)

- Used to locate and reposition garter springs to prevent pressure tube to calandria tube contact (PT-CT contact) and subsequent blister cracking.

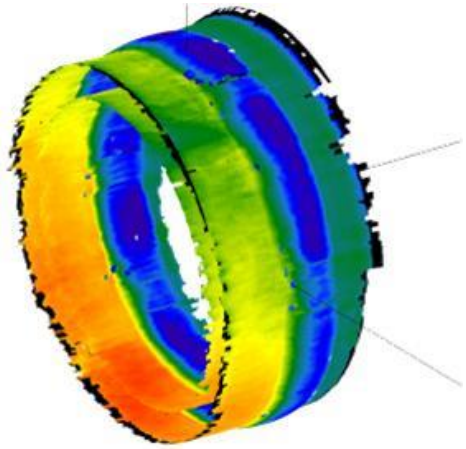
Advanced Non-Destructive Examination (ANDE)

- Uses cutting-edge technology to obtain ultrasonic, eddy current, gap, and sag data to characterize the condition of pressure tubes.

Calandria Vault Inspection (CVI)

- 11-degree-of-freedom robotic arm used to inspect Pickering A calandria vault.

Automation and Robotics



Matrix Inspection Technique (MIT)

- Full circumferential inspection of feeder pipe welds, representing a worldwide first and breaking new ground in ultrasound technology

Heat Transfer Equipment Department (HTED)

- Uses robotic NDT technology to perform inspections on heat exchangers and steam generators.

How can we use automation to streamline the process of line checking across multiple conductors simultaneously?

Concrete/Rebar Inspections

GPR (Ground Penetrating Radar)

- Searches for voids, cracks, delaminations, and thickness.

Impact Echo

- Steel ball creates an impact with concrete and a transducer measures the pressure wave to determine integrity of material.

UPV (Ultrasonic Pulse Velocity)

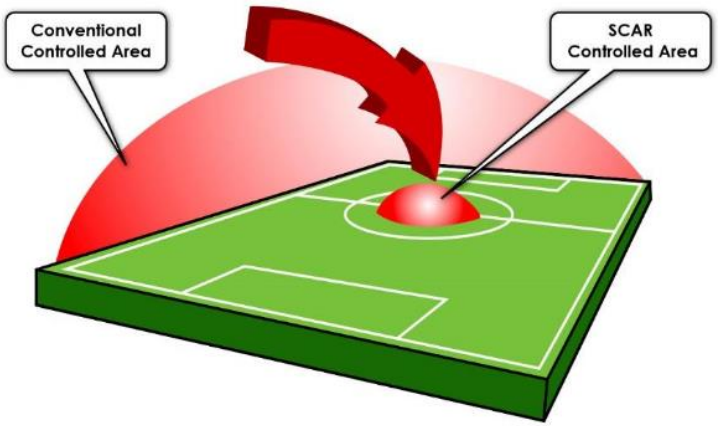
- Measures the time of travel of an ultrasonic wave to measure quality and strength of concrete.

What disruptive technology can be introduced to help automate the inspection process and provide faster, cheaper, and safer inspection and maintenance services?

Radiography / X-ray

Quality Control (QC)

- Challenges are brought on by MIC (Microbiological Corrosion) and FAC (Flow Assisted Corrosion).
- Digital radiography is an invaluable engineering tool for diagnosing required repair or replacement areas in piping systems.
- New technologies such as Pulsed X-Ray (PXR) and Small Controlled Radiography (SCAR) allow for a much smaller exclusion zone, increasing the margin of safety and efficiency of the system.



In what ways can we use artificial intelligence to help automate the dose management process?

Underwater Inspections (Diving)

- Recognized as a safety leader by the Ministry of Labour for commercial diving within the province of Ontario.
- Inspections are carried out using video technology, vacuum systems, remotely operated vehicles (ROVs), and hydraulically driven tools.
- Our divers have the capability to field three working diving crews, and have expanded our technical capabilities to include mechanical, welding, cutting and maintenance activities.
- Services also include environmental monitoring, fish impingement barriers, and security booms and barriers

Where can we realize new and innovative applications of technology in underwater environments?

UAVs – Unmanned Aerial Vehicles

- First used to inspect Darlington's vacuum building, and now continues to inspect OPG's nuclear sites and hydroelectric stations (e.g. ice booms on Niagara River).

- Our fleet of UAVs has since grown from 1 drone to 11, equipped with sensitive sensors and cameras capable of HD imagery, thermo-graphing capabilities, and high-resolution 3D maps.

- We have several Special Flight Operations Certificates that allow our 7 trained pilots to fly the drones in certain airspaces.

Aeryon Skyranger Drone

- Rugged drone for outdoor visual inspections, can be equipped with different payloads (i.e. cameras)
- 5km range, we operate with 100m height & 800m radius guidelines
- ½ hr flying time rated for 50 minutes in the air
- Equipped with 20MP camera w/ 30x zoom

Elios Drone

- Drone in a ball, used for indoor inspections
- Designed for contact; drone drives into a wall, and uses that to drive itself to the inspection location along a surface

How can we use drones for data collection and inspection across energy utilities?

What type payloads can we use in tandem with drones to make our inspections safer and more effective?

Our Future

Training

How can we use VR/AR as a medium for training and assisting technicians in field work?

Process Management

What software solutions could we use to better track critical assets and personnel?

3D Mapping and Visualization

What technologies can we use to map and visualize objects with a complex geometry?

Wearables

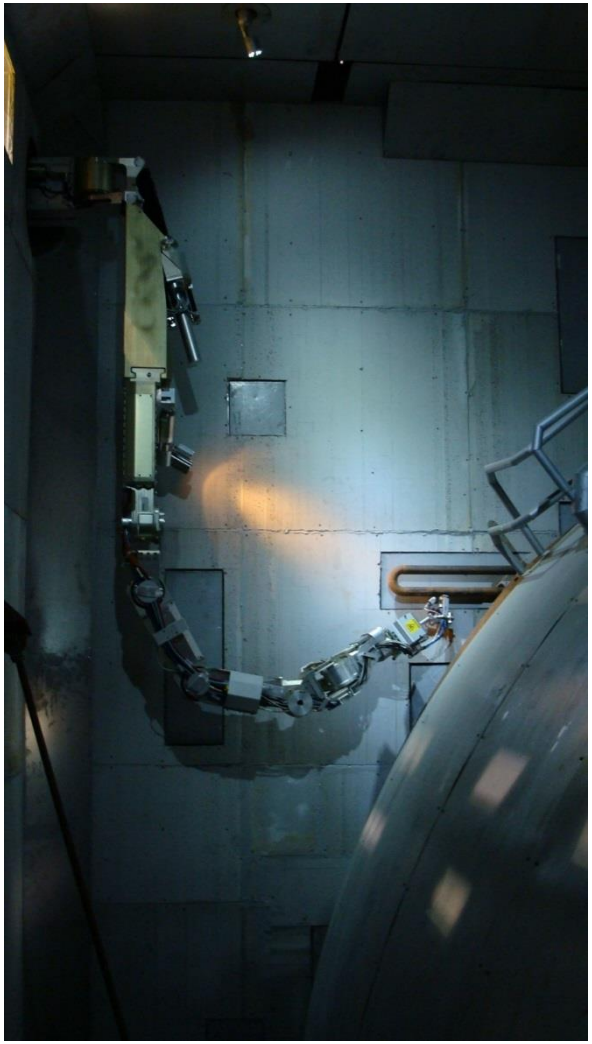
How can we use smart Personal Protective Equipment in the collection of real time crucial data to improve safety for the worker?

IoT

How can we implement IoT to allow for better connectivity and communication between equipment and the user?

Data Management

How can we streamline and simplify our systems so they can perform more reliably and efficiently?



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