



# Radiation Protection and ALARA Program Highlights at Ontario Power Generation

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**ONTARIO****POWER**  
GENERATION



# Ontario Power Generation

- 10 Operating Nuclear Stations at 2 sites
- 2 Shut Down Nuclear Stations in Safe Storage
- 3 Dry Fuel Storage Sites
- 1 Nuclear Waste Facility
- 65 Hydroelectric Stations
- 3 Thermal Generating Stations
- 2 Wind Power Turbines
- Generating Capacity >16,000 MW







# OPG Nuclear

- Pickering Nuclear Generating Station
- Darlington Nuclear Generating Station
- Health Physics Laboratories
- Western Waste Management Facility

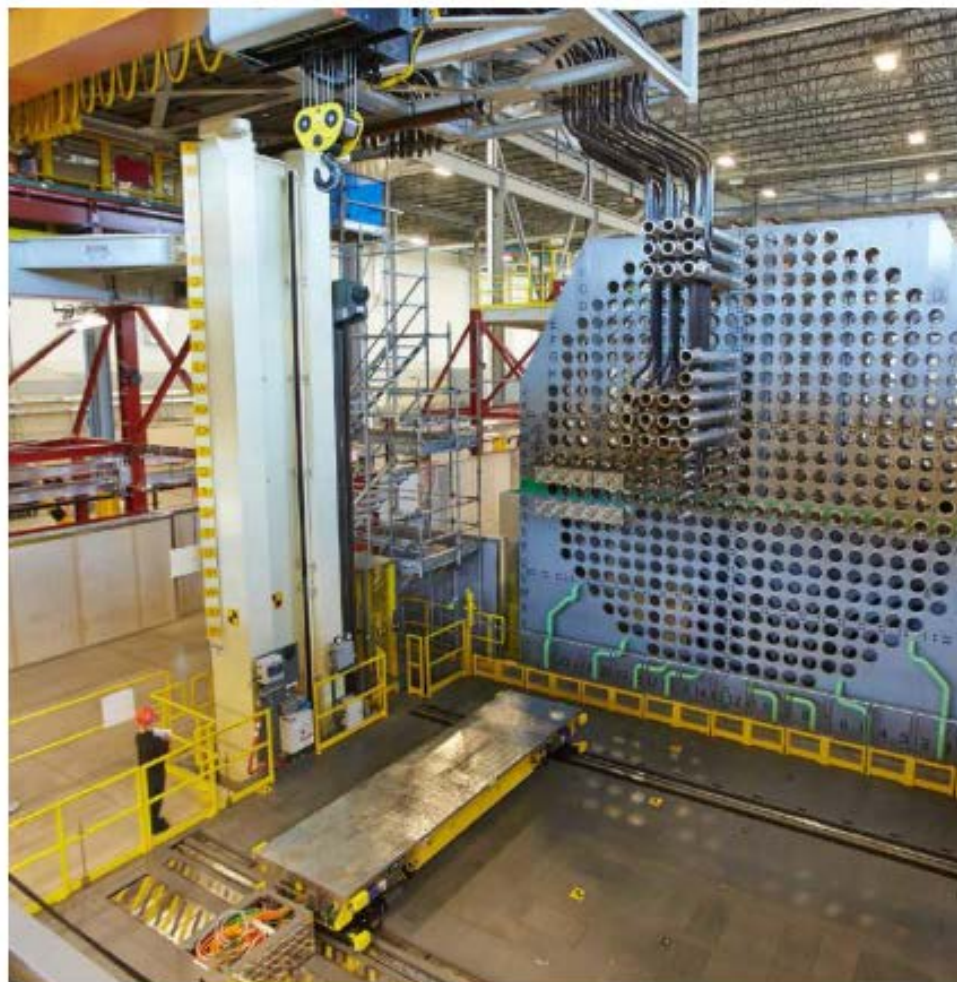


- Darlington Refurbishment
- Pickering Extension of Commercial Operations
- Safe Storage & Decommissioning Planning
- Deep Geological Repository



# Darlington Refurbishment

- Operating since early 1990s, producing ~20% of Ontario's power
- Replacement of core reactor components to allow for another 30 years of operation
- Expected to generate \$14.9 B in economic benefits in Ontario
- At peak will create 11,700 jobs per a year







# We Are All RP

- Self Protection and Service Protection Model





# We Are All RP







## Dose Goal's



- WANO – Area for Improvement
  - Qualified Workers sometimes do not apply appropriate work practices to control and reduce crew and individual dose. RP staff and managers are not reinforcing focus on minimizing crew and individual doses.
- Needed a practical and automated solution



# Dose Goal's



## ■ What Does Excellence Look Like?

- Staff understand station, department, crew, and individual dose goals
- Staff discuss and set a challenging dose goal each day, prior to conducting radiological work
- Real time external dose status displayed in the station
- Dose is reported and discussed with staff
- Methods and initiatives to reduce dose are documented and tracked by departments





# Dose Goal's



## ■ Significant Change Management:

- Dose Goal integrated into EPD issuance software
- Dynamic Learning Activity developed
- Face to face presentations with crews
- Whole Body Monitor messaging
- RPTV campaign
- Pins / stickers / magnets
- Tools for supervisors to see how their crew is performing
- Real-time department dose status boards at EPD issuing stations and primary entrances to reactor buildings
- Weekly updates at station alignment meetings on progress
- “We Are All RP” Parking spot





# Dose Goal's



OPG CONFIDENTIAL

## REP Worker List

REP Number: 32100-23 (APPROVED)  
Date Printed: 2016-01-21 15:52

Route To:  
Site Records

### Job Information:

Unit: 018  
Job Description: IOP - Minor Maintenance, Routines, Walkdowns and Inspections  
High Hazard: No

### Workers List:

#	Name	DISN	NEW Status	Removal	RP Qual	Whole Body CYD	Trit. Com.	Est. Gamma + Neutron Dose	Est. Int. H3	Est. WB CYD	WB CAL ECL	WB 5Year ECL	Current Skin CYD	Est. Skin Dose	Est. Skin CYD	Current Extremity CYD	Est. Extremity Dose	Est. Extremity CYD	Dose Goal
1		404814	YES		G	1	0	60	12.5	73.5	1000	5000	1	72.5	73.5	1	500	501	11

☐ Indirectly Protected Qualified Personnel

Green Person:

DISN:

### Approval Required:

☒ None

☐ Shift Manager

Signature

☐ RP / Shift Manager

Signature

Approval Notes:

### Other Information

eg: Anticipated Jump Time, Work order, jump order, contact information for WorkGroup Supervisor





## Dose Goal's



- Annually, more than 100,000 entries into the Reactor Buildings
- Significant potential for dose savings if every individual saved a mrem.





# Remote Monitoring

## ■ Remote Monitoring Set-Up (PNGS)

- 8 Control Consoles
- 5 Server Cabinets
- Stand Alone Fiber Network
- I.T. Controlled Connection to Network
- Real-Time Hazard Display
- PoE Compliant Network Components
- Archived Hazard Information
- 600+ Teledosimeters (iPAM/PAM TRX)
- 500+ Transmitting Devices

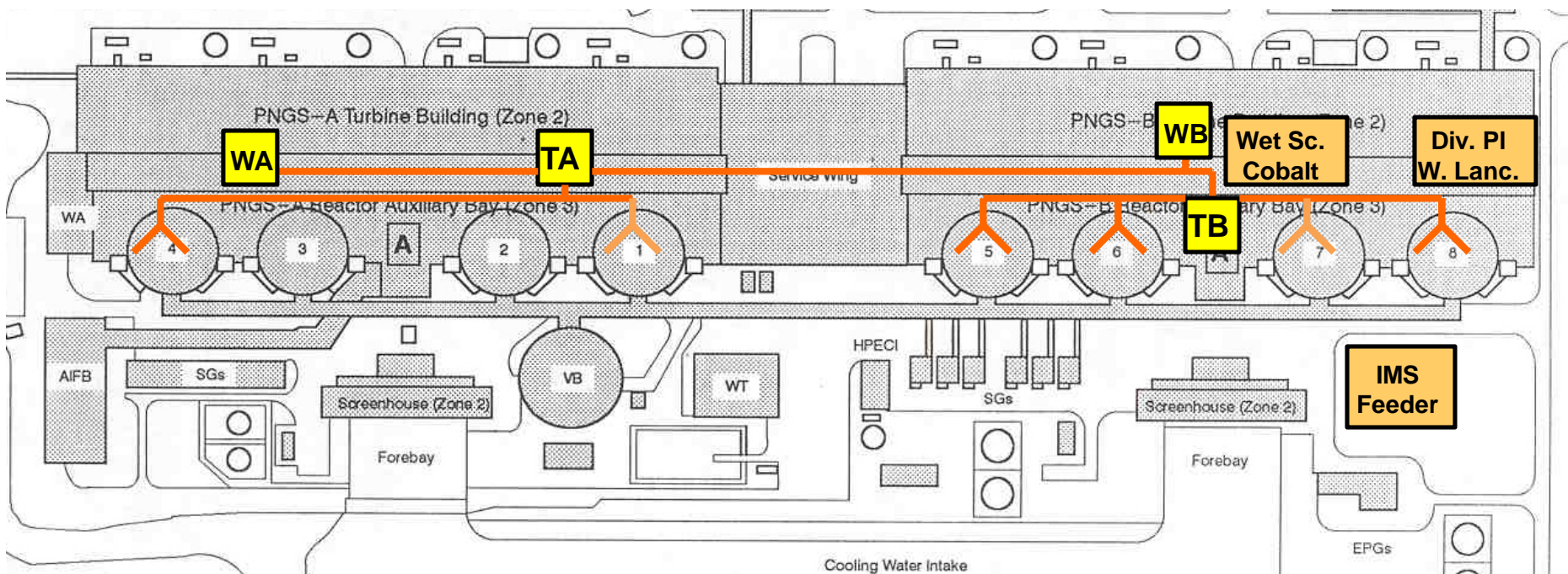




# Remote Monitoring

## ■ Network

- Fiber
- LAN
- Zinwave Distributed Antenna System





## Challenge from the Management Team

- Routine radiation surveys to be fully automated
- Ability to perform non-routine radiological surveys remotely
- Limit the requirement for Radiation Technicians to be in radiologically controlled areas

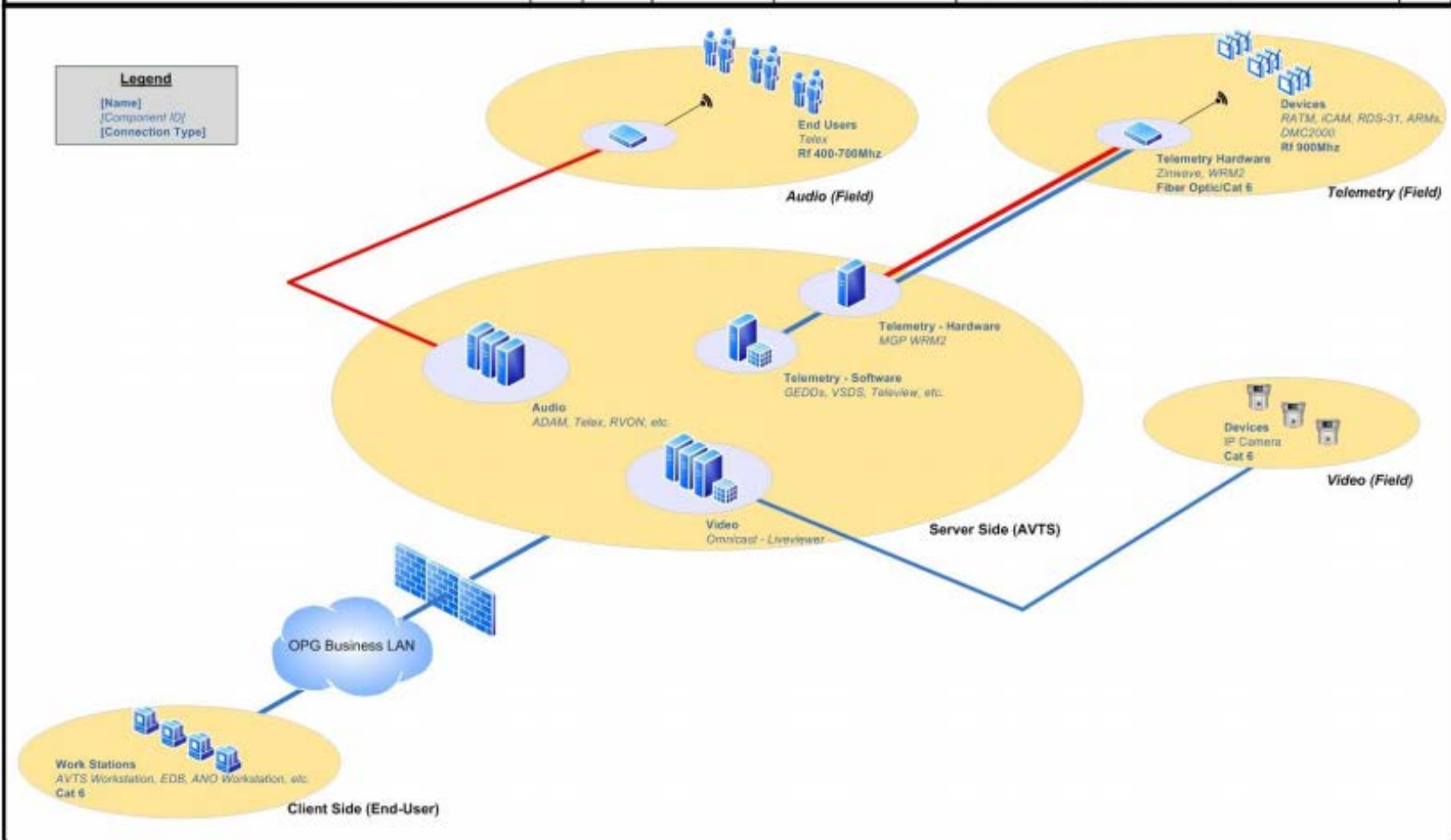




# Remote Monitoring System Overview

Created For: Ontario Power Generation, Remote Monitoring Group - Fleet  
 Prepared By: Matthew Lai, Health Physicist, Health Physics Department  
 Reviewed By: Scott Whitmarsh, RM FLMa, RP Remote Monitoring  
 Approved By: Josip Zic, Section Manager, RP Programs & Field Support

REV.	DATE	LAST UPDATE	DESCRIPTION	TITLE	LOC.
1.0	JAN/9/2016	FEB/9/2016	AVTS Functional Diagram by Components	Audio-Visual Teledosimetry System (AVTS) High Level Functional Diagram	CORP





## Quick Wins

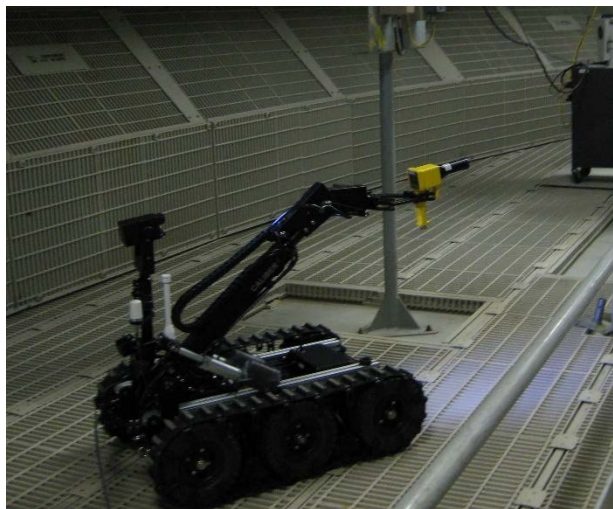
- Real-Time Routine Surveys
  - Gamma, tritium, beta airborne, alpha airborne, radioiodine
- Emergency Preparedness
  - Source Term / Near Boundary
  - Assembly Areas
- Non-Radiological Monitoring
  - iCAM filter head counter
  - HEPA vacuum on/off
  - Temperature
  - Humidity
  - Drum level monitor
  - Video for Operations / Fire Protection / OCC





# Robotics

- Perform radiological surveys
- Visual / thermal inspections
- Leak searches
- Perform tasks in high radiation areas
- Remove High Activity debris







# Darlington Unit 1 Leakage



# Darlington Unit 1 Leakage

- Increased leakage to collection from the Unit 1 Moderator Heat Exchanger.
- Required closure of drain valve within the Moderator Heat Exchanger Room.
- On-Power Entry into Access Controlled Area (gamma dose rates of 23 rem/h).
- Estimated gamma and neutron dose for worker to perform work:
  - Whole Body External = 1.5 rem
  - Extremity = 30 rem



# Darlington Unit 1 Leakage

## ■ Solution

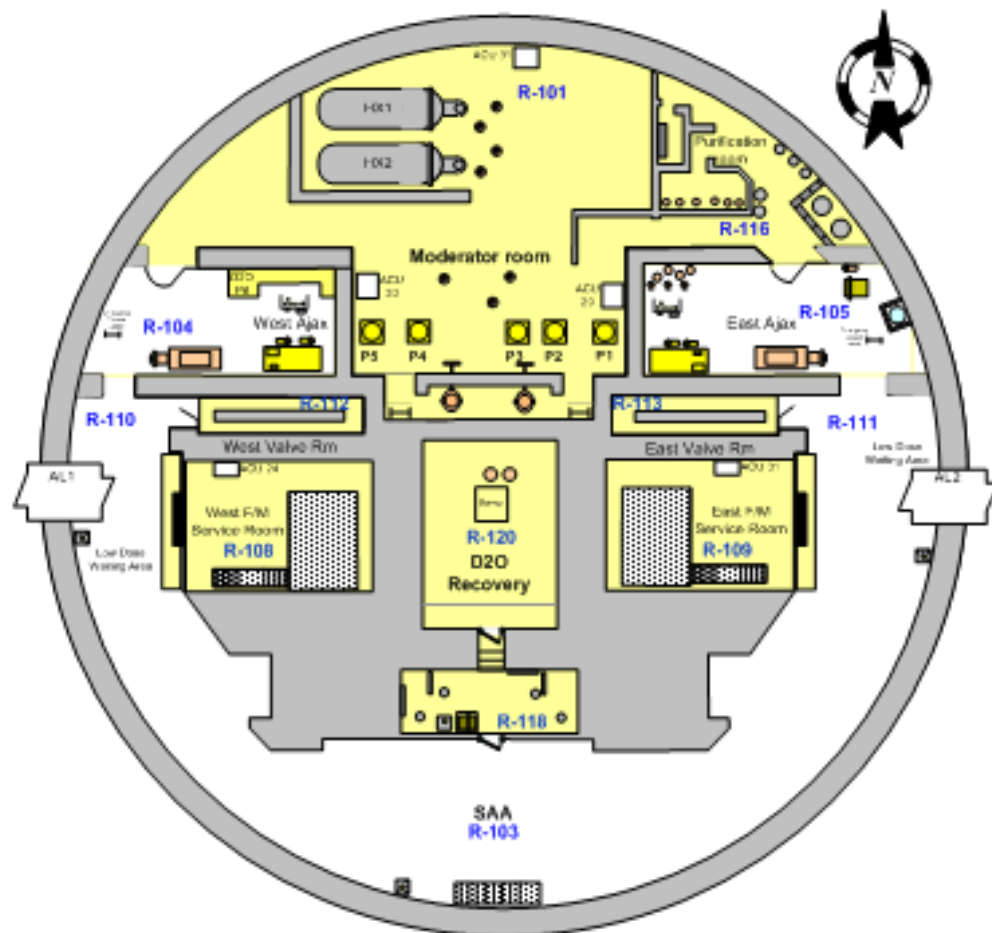
- Performed work with Reactor Maintenance Robot, fitted with tool for turning valve.
- Execution time = 1 hour and 22 minutes





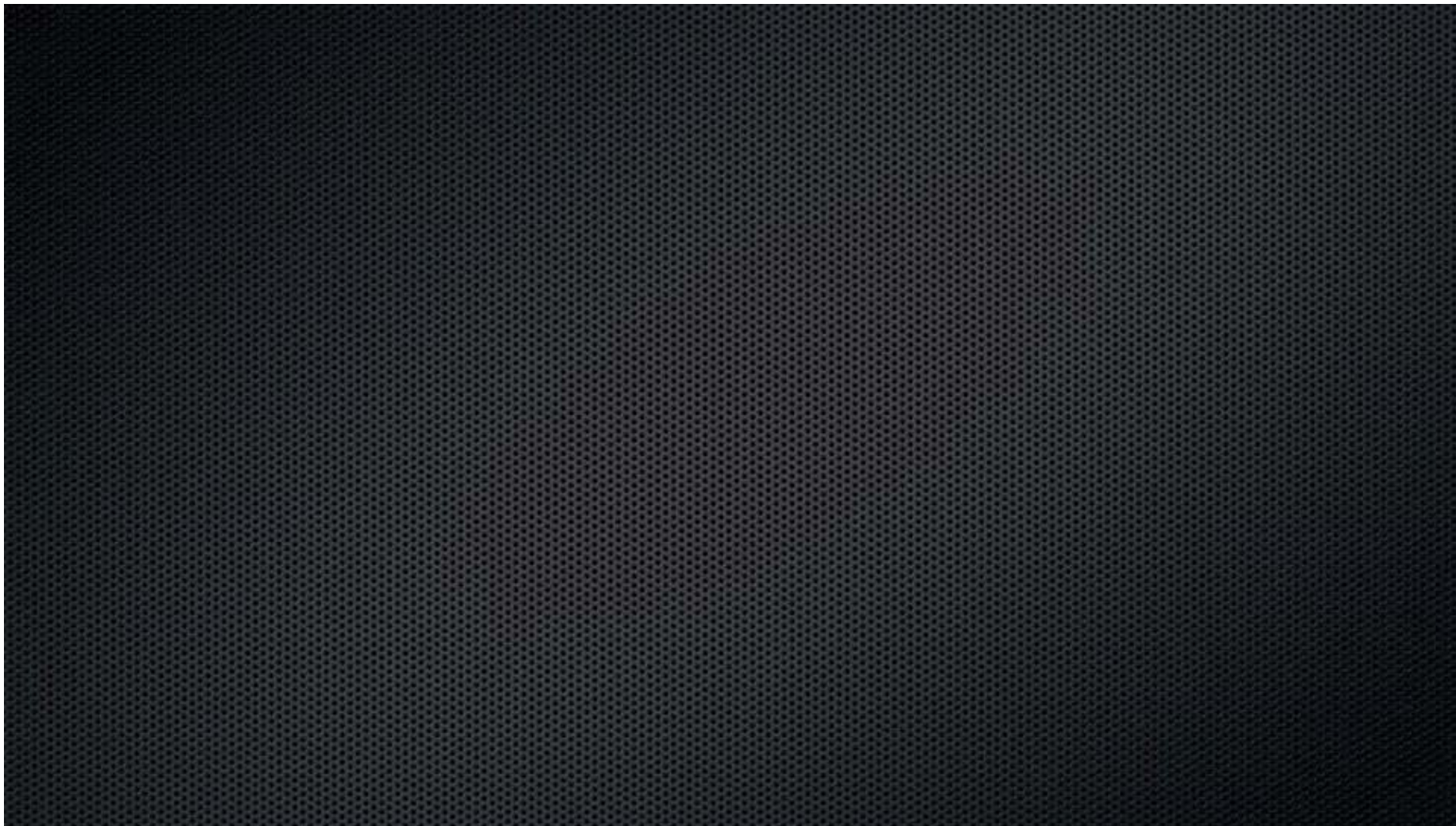
# Stuck Radiography Source

- October 19, 2015, radiography at Pickering Unit 6, room 118.
- Two radiography shots were performed.
- When the second was done, radiographer noticed source would not retract to exposure device.
- Se-75 Radiography Camera, with 70 Ci source
- Dose rate at 5' was 7 rem/h, kink in guide tube was 2' away





# Stuck Radiography Source





# Stuck Radiography Source

- Dose Summary
  - Peak personnel rate: 84 mrem/h, received when employee installed shielding tunnel.
  - Highest dose for one worker per jump: 4 mrem.
  - Collective dose over two days on this job: 22 mrem.
  
- Exclusion zone was maintained for two days.





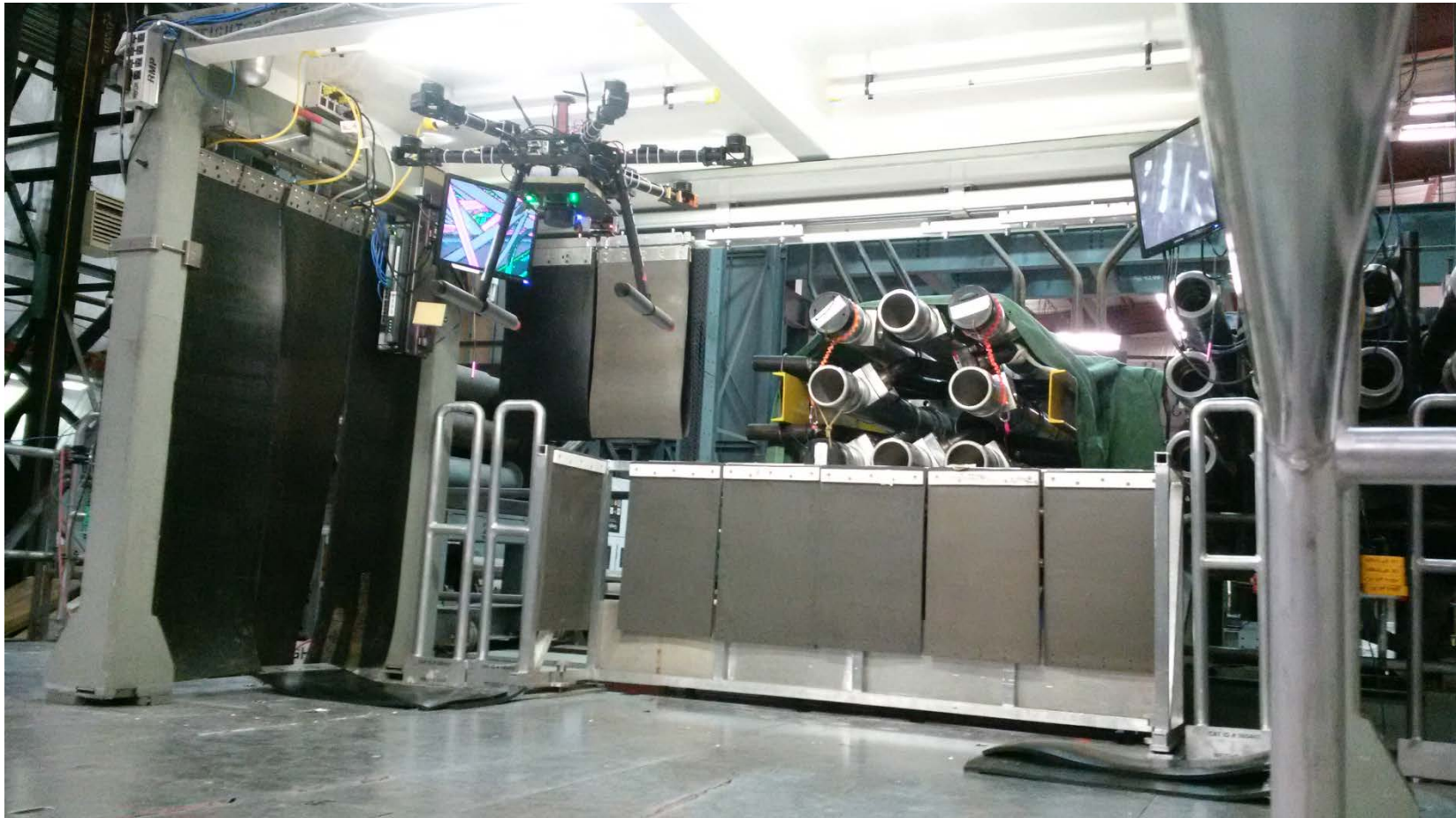
# Automated Reactor Face Survey Initiative

## ■ Current Method:

- Remote monitors on F/M Bridge
- 2-3 hours of critical path

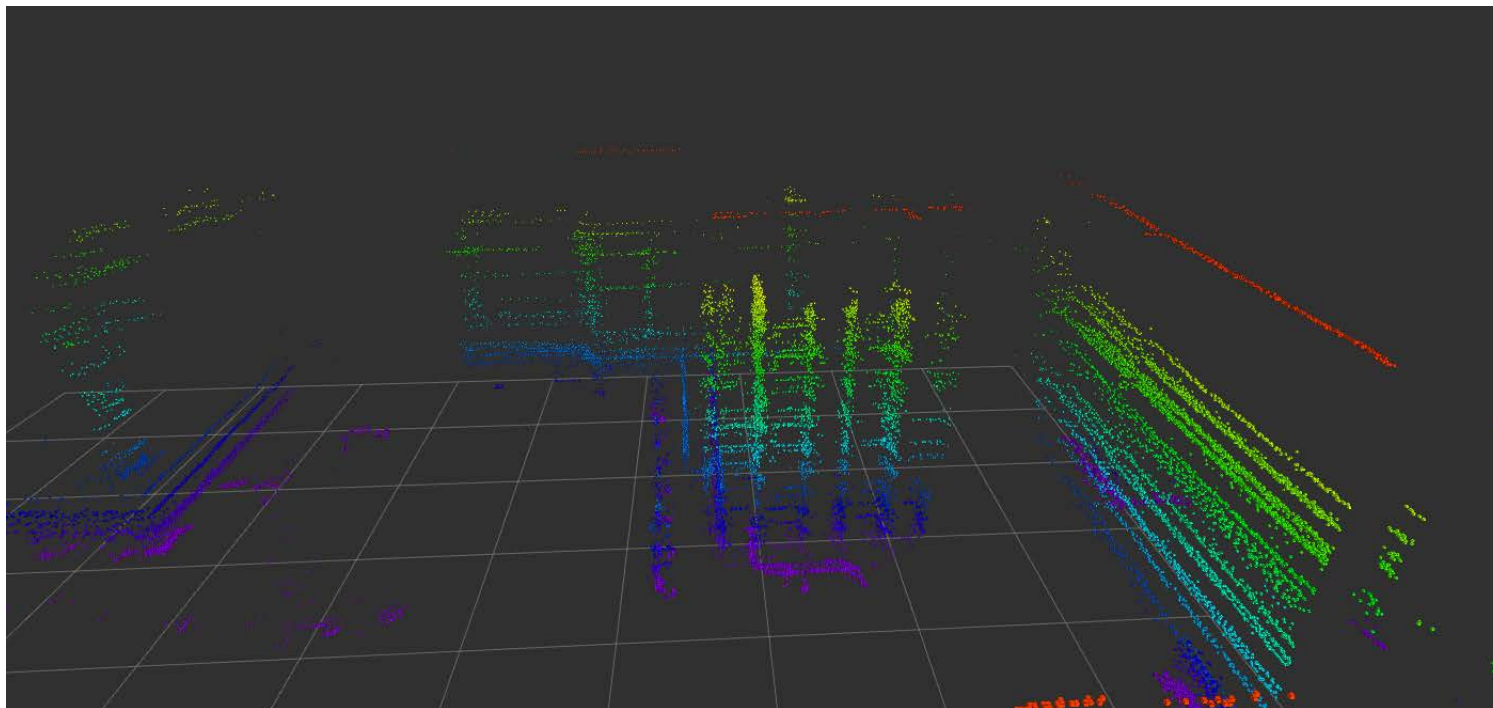
## Proposed Method:

- Automated drones
- Off critical path





# Automated Reactor Face Survey Initiative



## ■ Challenges

- Time required to measure up to 390 channels, with current battery limitations of drones
- Positioning of drone without GPS
- Additional weight of gamma detector and transmitter



# Questions?

