

Rezoning for Bruce Power CANDU Reactors



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Purpose

- Share with the nuclear industry the development strategy and implementation of a major project devoted to further improving contamination control at Bruce Power.

About Bruce Power

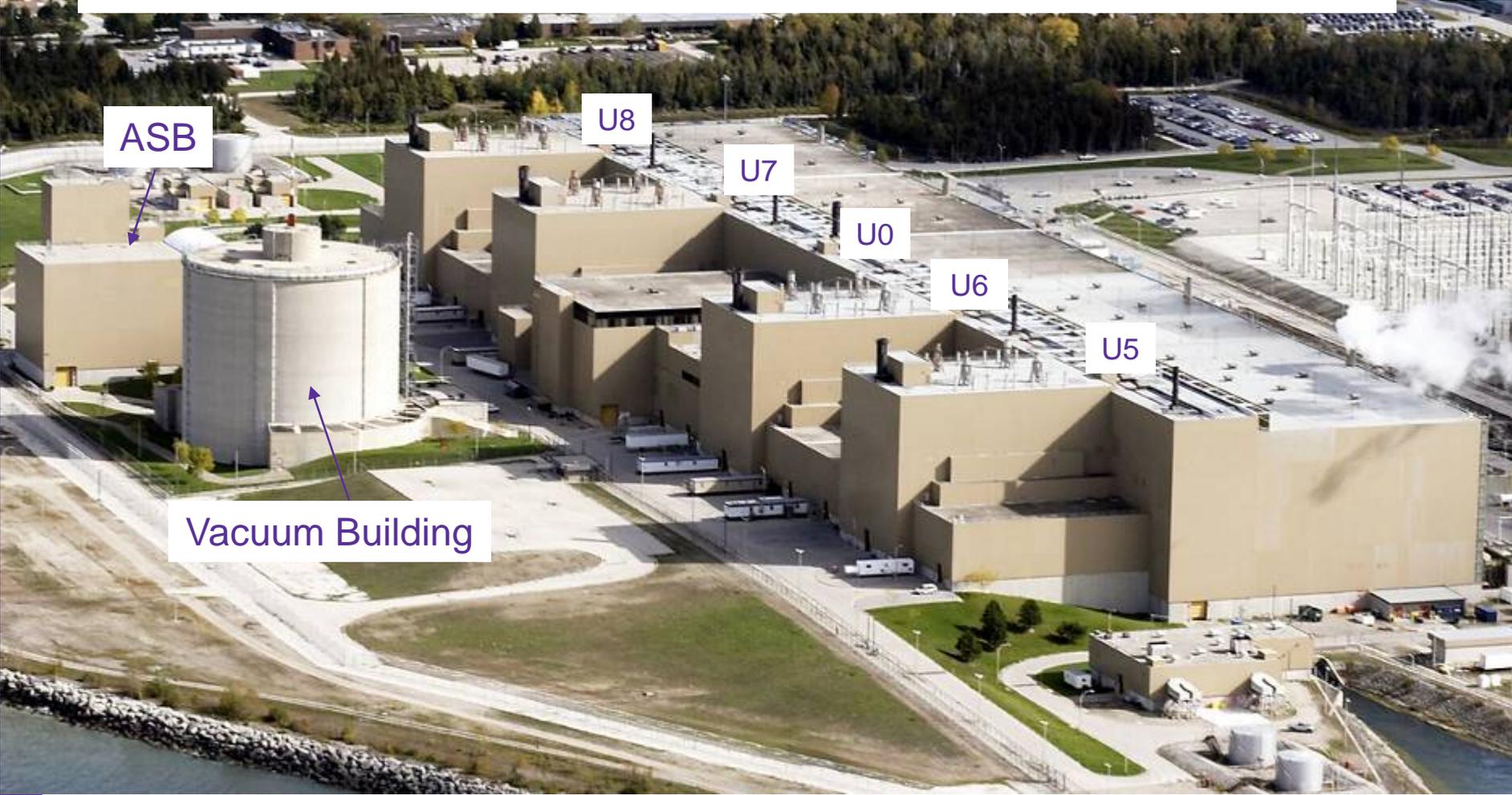
We are a partnership among Cameco Corporation, TransCanada Corporation, BPC Generation Infrastructure Trust, a trust established by the Ontario Municipal Employees Retirement System, the Power Workers' Union and The Society of Energy Professionals.

Our 2,300-acre site houses the Bruce A and B generating stations, which each hold four CANDU reactors. Six of those units are currently operational and combine to produce more than 5,000 megawatts, which is enough to power 20% of Ontario (Pop. 12M). We are also in the process of restarting the remaining two units at Bruce A, which will provide another 1,500 megawatts of emission-free electricity.

Understanding the size of our Site



Aerial View of Bruce B



Station Layout

- Each Station is laid out into 4 zoned areas.

- Zone 3 is an area that contains sources of radiation or contains

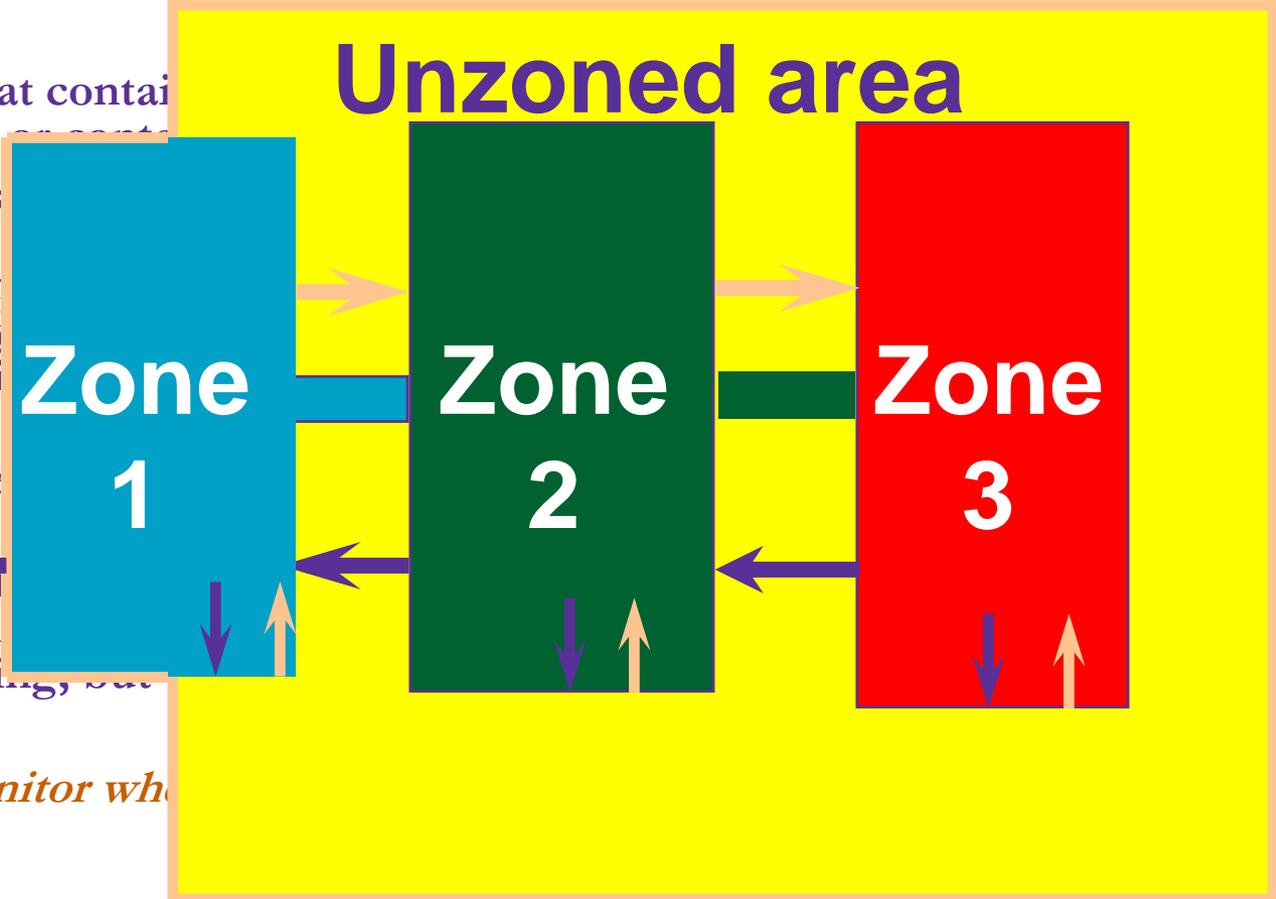
- Zone 2 is an area that is subject to cross-contamination from core equipment from core



- reactive systems monitoring mean are domain.

- Area is with to be free of contamination 3 (outside the building, outside

Unzoned area



Colour Code

- Zone 1
- Zone 2
- Zone 3
- Unzoned

Personnel must monitor when

Purple Arrow indicates that monitors is required.

Zone Boundary – Prior to Change

Zone 3 to 2 change



Zone 2 to 1 change



Why we have “Zones”?

- When the plants were first designed, hand and foot monitors, or friskers were the only means of monitoring contamination on workers.
- Large zoned area were created to decrease the probability of releasing contamination from the plant(s).
- Personnel were provided with radiation personnel protective equipment (Browns) to wear instead of their own clothing for contamination control. Coveralls, Underwear socks etc.
 - Allowed to be worn everywhere except Zone 1.
 - Are laundered as site in active laundry, and therefore have the potential to be contaminated with fixed contamination.

Small Improvements

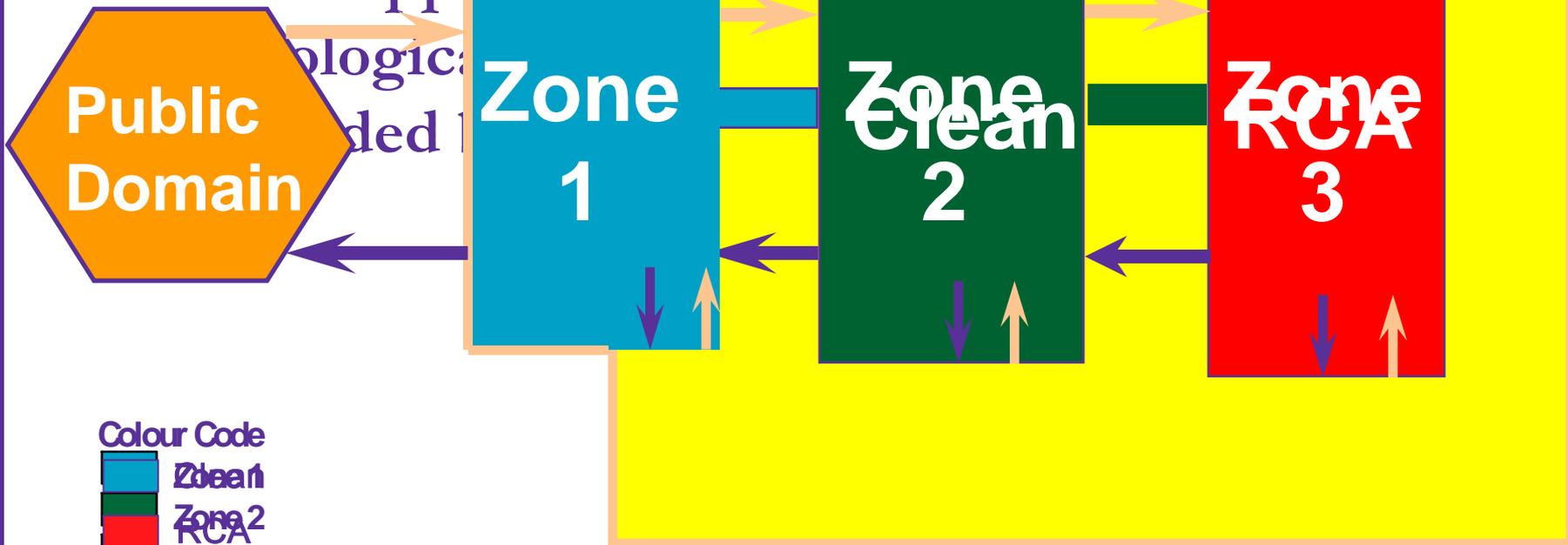
- Over the years, Bruce Power has increased its monitoring capability with the addition of whole body monitors and portal monitors at many exits from each plant. However, there are still many hand and foot monitors located at the Zone 3 – 2 boundary, and many of the whole body monitors are reaching the end of their life span.

Overall Project Rationale

- Problem(s):
 - The zone configuration prior to the change utilized multiple types of contamination monitors. These existing monitors:
 - Were near the end of useful life
 - Had poor reliability in some cases.
 - Limited body coverage in many locations.
 - One for one replacement would cost \$23.7M
 - Lack of Physical barriers at Zone 3 increases risk of cross contamination between zones
 - Must check all material exiting the station, although material released from the unzoned and zone 2 are likely clean.
 - We treat and launder our brown coveralls as potentially contamination when they are most likely clean. Relatively speaking, very few contamination events of coveralls.
 - High and complex maintenance costs.
 - Difficulty in following up on contamination events.
 - Many changes of clothing during the day for workers.

Vision of Rezoning

- Bruce Power
4 zoned app:



Colour Code

	Zone 1
	Zone 2
	RCA
	Zone 3
	Unzoned

Purple Arrow indicates that monitors is required.

Two-phase solution

■ Phase 1

- Installation of new WBM, barriers, and shielding
- Removal of obsolete monitoring devices (Hand and foot and older WBM)
- Introduction of new Personal Protective Equipment (PPE) and standards

■ Phase 2

- Formally rename the RCA
- Survey, and Verify Clean all surfaces outside the RCA
- Install new SAMs, Exit Monitors and Portal Monitors
- Introduce improved contamination control standards

Monitor reductions

277 Personnel Monitors were in plant @ BA and BB

PHASE 1

- 189 Old Monitors

+ 129 NEW Monitor

217 Monitors

PHASE 2

- 54 Old Monitors

163 Monitors *

*Significant decrease in maintenance requirements

Project Pre-requisites

- Determine if design and fabrication of shielding and barriers are going to be in house or contracted out.
- Perform extensive research on available contamination monitors in order ensure we were purchasing a product that would suit all our needs:
 - Delivery schedule
 - Customer support
 - Technical requirements

Prerequisites Continued...

- Gasless monitor.
- Comprehensive training for our staff.
- Advanced operating technology for easy maintenance.
- Must be robust to withstand high traffic.
- Quick detector repair/replacement, low cost.
- Superior geometry and body surface coverage.
- Be able to function from -10°C to 50°C (14°F to 122°F).
- Capability to be monitored remotely for maintenance and radiation protection purposes. (critical parameter).

RADOS



CeMoSys

CeMoSys is an extremely important system for Bruce Power due to the size of our facilities, and the number of monitors so we can be efficient in maintaining our monitors and controlling contamination at the source.

Past RPPE



Radiation Boots & Socks

New “Specialty” PPE:

■ **Speciality
Coverall**



■ **Regular Safety
Shoes/Boots**

- **Must be worn:**
 - as a base garment when performing electrical work where FR rated coverall is required (arc flash protection)
 - as a base garment under an Anti-C ensemble when performing contact contamination work
 - as a base garment under a plastic suit

New Contact Contamination Work RPPE:

■ **Speciality
Coverall**

+

■ **Anti-C
Ensemble**



■ **Regular
Safety
Shoes/Boots**



New Plastic Suit RPPE:

■ **Speciality
Coverall**

+

■ **Plastic
Suit**



■ **Regular
Safety
Shoes/Boots**



New “Work Coverall”



Project Planning

- 99 locations at Bruce B that required modifications.
- Each location had a needs analysis performed to determine the exact scope.
- Locations were prioritized to those getting new WBMs, visibility to personnel, Unit 8 Outage.
- Tasks at each location were prioritized as follows: shielding, power, LAN, WBM, barrier, painting.

Project Planning

- WBM installation estimate was 8 per week.
- Installed 61 new WBMs at Bruce B.
- The WBM installation was our critical path.
- Protective Clothing had to specified and ordered.
- Logistics for Protective Clothing turnover.
- COMMUNICATIONS

Implementation of Phase 1

- The whole project team's commitment has been very valuable for the execution of phase 1.
- Station stakeholders have been very involved.
- The *visible change* has been incredible and a symbol of real changes.
- We are finding contamination with our new monitors before personnel get to the last barrier.
- The change has been accepted reasonably well by employees.

Phase 2

- After the completion of Phase 1, we will be moving right into phase 2.
 - Move to 2 zoned approach
 - Purchase new monitors for station exit, portal monitors and SAMs
 - Require a lot of documentation revisions
- Much more involved
- Will require significantly more planning

Summary

- Communication was key to the success of this project. Staff are accepting if they feel part of the change.
- Complex projects require well developed strategies and dedicated resources.
- Protective clothing changes are the first in approximately 40 years in Canadian CANDU plants.
- Improvements have been realized in Zone 3/2 monitoring, effectively decreasing the size of the potentially contaminated area.
- Central monitoring is key to immediate and accurate follow up on events, quick and effective response to monitor breakdowns, and identification of potential problems affecting monitor operation.
- Sometimes change is only achievable with a life altering fundamental shift in thinking and environment.
- We have improved our contamination control within the plant, thereby eliminating risk to our other stakeholders...the public and the industry.

Thank You

Acknowledgements:

Amy Jacina (Project Field Team Engineer) for the original presentation from which this was adapted.