

Bruce A, Units 1 & 2 Restart RP Issues After Refurbishment

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Bruce Power

- 8 PHW CANDU reactors on a 2,300 acre site
 - 6 operating – Bruce B (4x822 MW units), Bruce A (2x750 MW units)
 - 2 units in refurbishment at BA and planned for other units
 - Units 1 and 2 also designated ‘Restart’ units



Units 1 and 2 Refurbishment

- Units shut down in 1995 and 1997
- Rebuilding from reactor internals out.
 - First-time evolution in CANDU industry
 - Literally ‘gutted’ reactor internals
- Included steam generator replacement (8 each)
 - Have been prepped for shipment to Europe for recycling
- Both units have a history of fuel integrity challenges
 - Unit 1 crushed an entire fuel element in 1979
 - Multiple cycles with fuel integrity issues at both units



Radiological Conditions

- Serious internal exposure event (SEN 286)
- $\beta\gamma/\alpha$ ratios as low as 1
- Average $\beta\gamma/\alpha$ ratios ~ 7
- Many areas $\beta\gamma/\alpha < 30$
- Air-fed plastics replaced by PAPRs
- Lapels not currently in use
 - Planning taking place currently for implementation



Radiological Conditions

- Tritium largely gone
- Systems drained for Refurbishment
- Bulk Heads installed for isolation
 - Tritium from operating units mitigated
 - First in industry
 - Systems with high Tritium concentrations drained either on shutdown or for refurb
 - Will be removed prior to startup



Startup From Refurbishment

- Many Systems being refilled
 - Some filled with Heavy Water
 - High Tritium Levels
 - As high as 8 mCi/cc
 - ~3200 valves overhauled during refurbishment
 - Numerous leaks to date on recommissioning



Startup From Refurbishment

- With reintroduction of H^3 , airborne protective strategies must be continuously re-evaluated based on changing conditions
- With reactor startup, $\beta\gamma/\alpha$ ratios will change over time
- Survey requirements for original startup will be modified to take advantage of modern technology
 - Telemetry, Cameras, etc.
- Bulk Head removal combines units 3 and 4 ventilation, later, unit 2



Startup From Refurbishment

- RP program for Restart was not maintained consistent with operating unit RP program
 - Deliberate decision for project
 - Streamlined administrative processes, allowed for quicker changes to processes and procedures
- Alpha Event prompted changes in restart that have not been implemented as comprehensively in operating units
 - EPRI Alpha guidance not initially included in Restart
- Used dedicated RP ‘technicians’ vs. traditional Green Manning model



Startup From Refurbishment

- **New instrumentation**
 - iCAMs, iSOLO, iMATIC, 43-5 probes, etc.
- **New Count Room Equipment**
 - Gamma Isotopic
 - Alpha Isotopic
- **New Respiratory Protection**
 - PAPRs



Current Focus

- Transition of procedural guidance back to operating program procedures
- Transition of programmatic improvements in Restart to Operating Program guidance
- Transition of Instrumentation from Restart units to Operating Units
- Rezoning units 1 and 2 to match operating units
- Evaluating organizational structures
 - ‘Self’ vs. ‘Service’ protection model being evaluated
 - Roles and Responsibilities being better defined



Conclusions

- **Very complex radiologically**
 - Systems being restored
 - Return to Reactor operations
 - Nuclide mix will need systematic reevaluation
 - Tritium will be reintroduced with simultaneous and ongoing changes in ratios
- **Conditions will be continually changing for some time**



Conclusions

- Program upgrades with operating units required
- Rezoning of units 1 and 2
- Properly anticipating changes is crucial to avoiding events
- Solid focus on event prevention and human performance tools is key

