Point Lepreau Refurbishment ALARA / RP Update

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ISOE Symposium

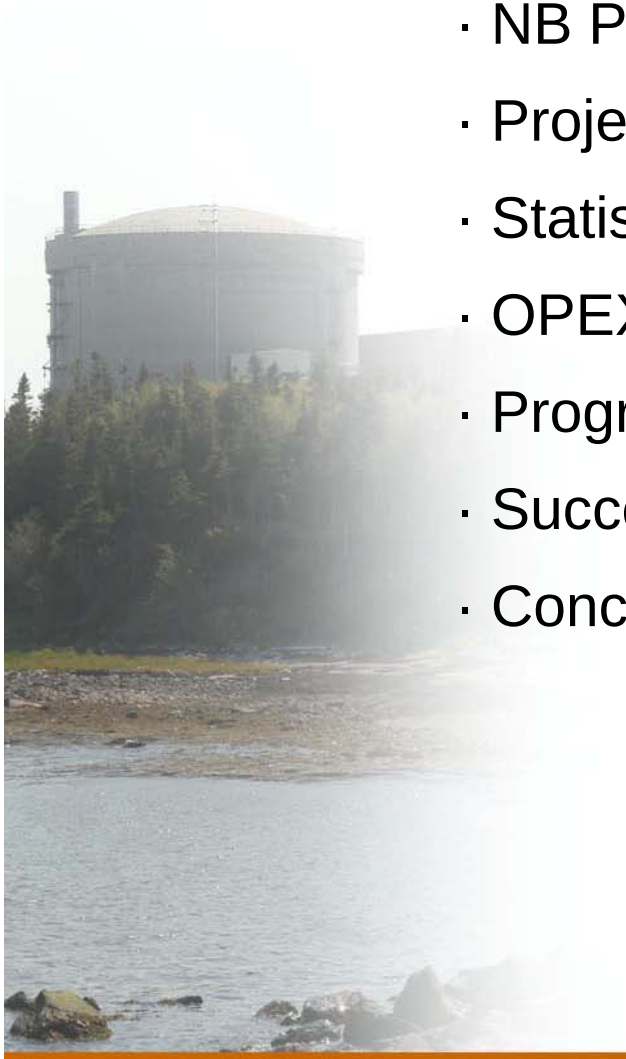
Florida, 2010

A VITAL PART OF NEW BRUNSWICK

Énergie NB Power

Nucléaire Nuclear

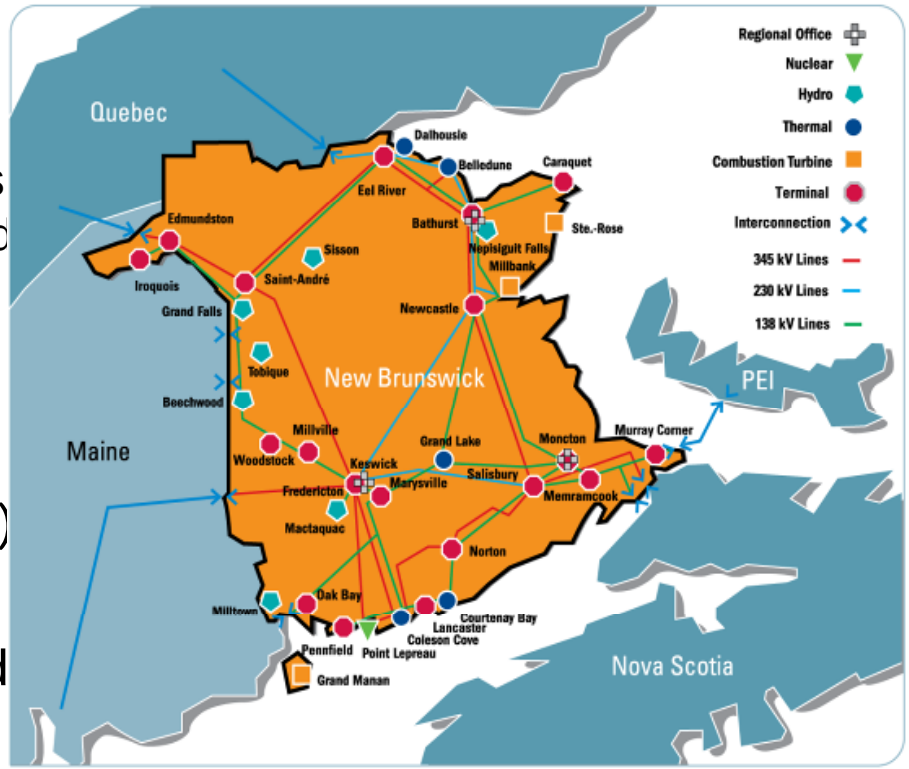
Agenda



- NB Power
- Project overview
- Statistics
- OPEX / Lesson learned
- Program improvements
- Successes
- Conclusions

NB Power Grid

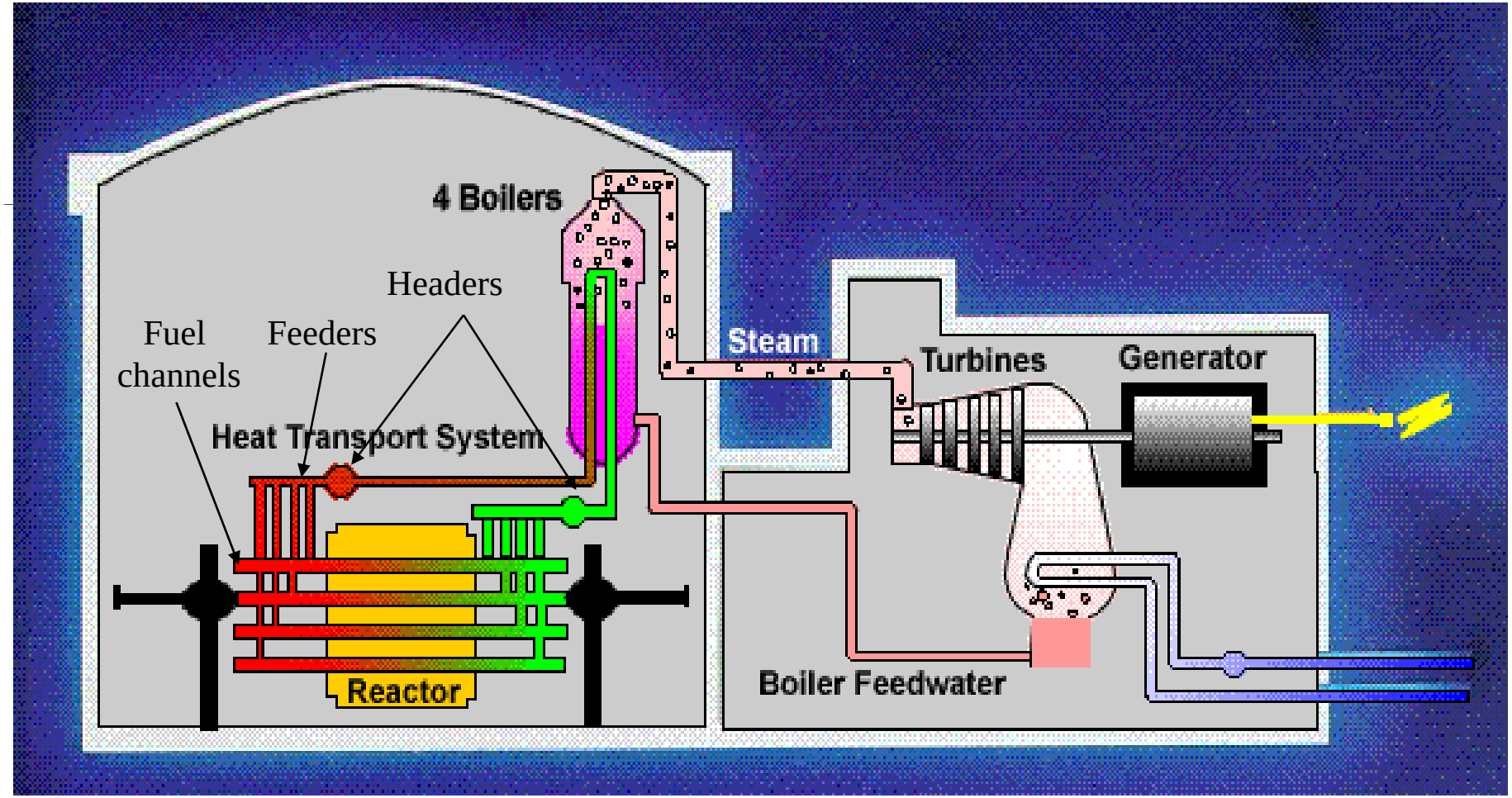
- Generating capacity: 3959 MW
- Fuels
  - Nuclear, Oil, Coal, Gas Orimulsion®, Hydro and Diesel
- NB Power Nuclear
  - Single Unit
  - CANDU 6 (635 MW)
  - 685 employees
  - 30 % electricity need



Top Priority

- Safety is our top priority
  - Integrated joint health and safety committee with all on-site contractors and NB Power
  - Continue to maintain some of the highest standards for health, safety and training throughout refurbishment and beyond
  - High degree of ownership of standards for safety and training by all contractors

How a CANDU Works

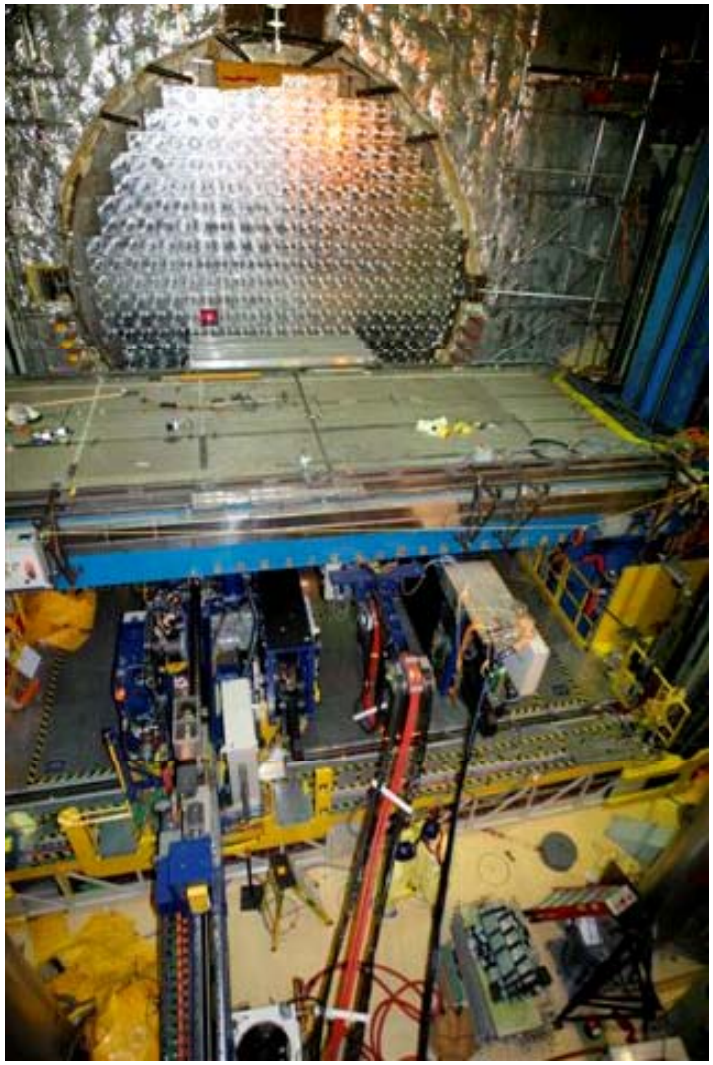


Phases of Refurbishment

- 1999 – 2005
  - Project Planning
- 2005
  - Project approval
- 2008 - Phase I
  - Shutdown the plant
  - Defueling of the reactor
  - Preparation of work isolation
- Phase II
  - Execution of the outage work
- Phase III
  - Commissioning
  - Return to service

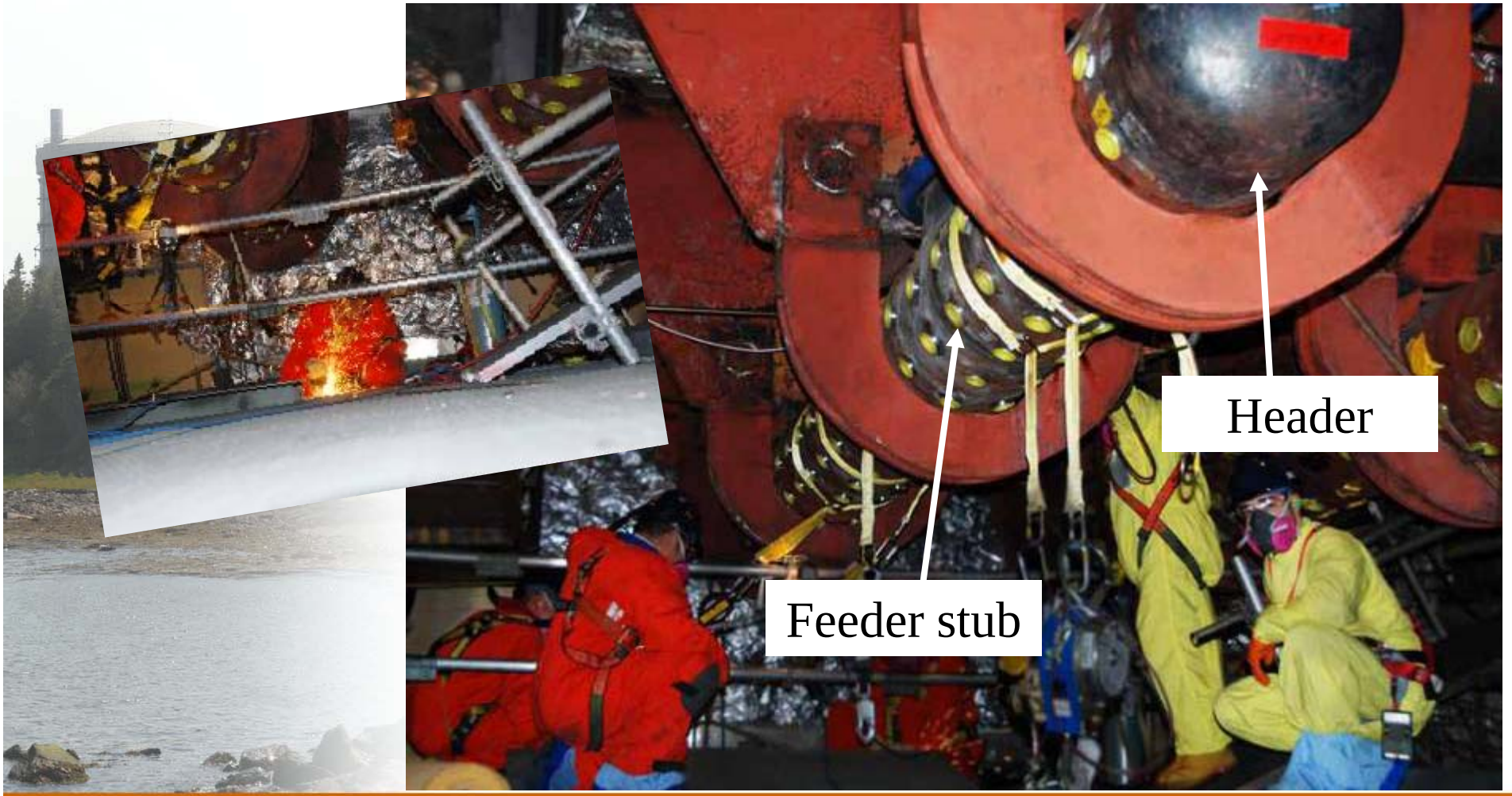
Retube Activities

- Feeder removal and installation
- Fuel channel removal and installation
  - Pressure tubes and calandria tubes

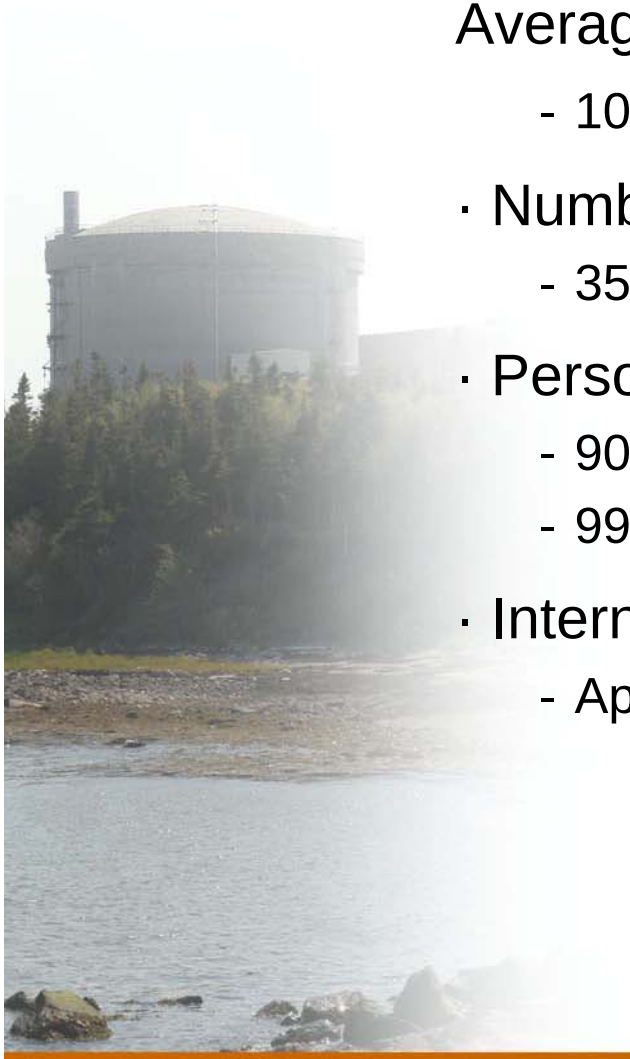


Retube Activities

- Upper feeder installation in progress



Statistics



Average number of PAD entries per day

- 1000 – 1200

· Number of people on dose records

- 3500

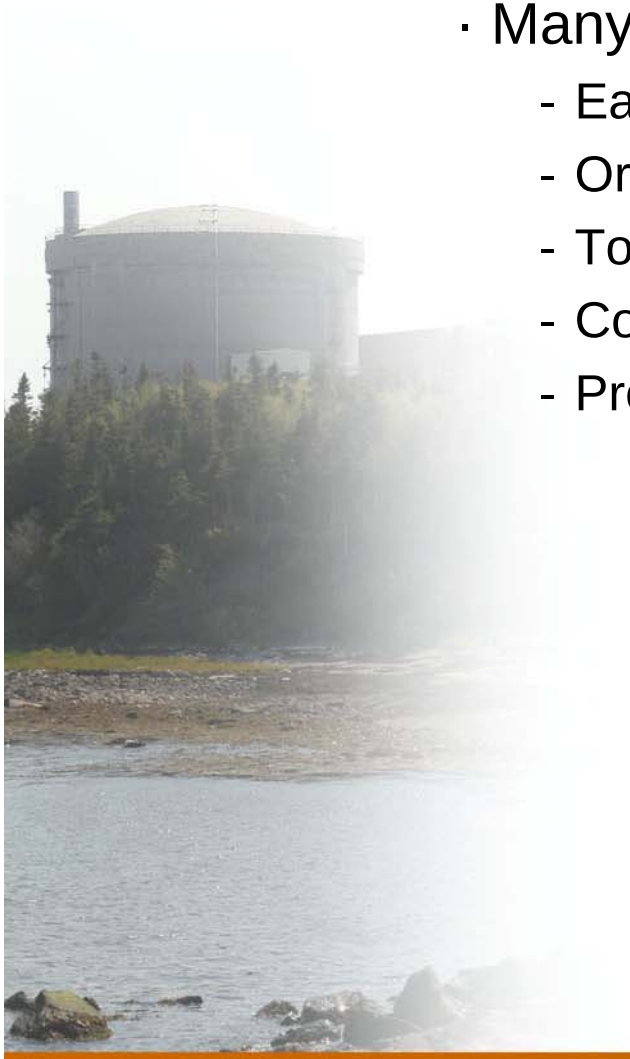
· Personal dose to date - (demolition)

- 90% less than 2.0 mSv (2 rem)
- 99% less than 4.5 mSv (4.5 rem)

· Internal dose

- Approximately 1-3% of whole body dose

OPEX / Lessons Learned



- Many lessons learned
  - Early decisions with ALARA implications
  - Organizational issues
  - Tooling issues
  - Contractor management issues
  - Program issues

Early ALARA Decisions

- Source Term Management
  - Conscious decision not to decontaminate (CANDECON or other)
    - › Concern about damage to balance of heat transport system
    - › Concern about waste management
- Feeder removal
  - Originally planned to remove lower section only
  - Decided to remove entire feeder
    - › Concern about future inspections
    - › Removed source term
    - › Created welding challenge

Organization

- NBPN and AECL radiation protection programs were separate and independent
  - Now integrated, excellent team work
  - Many seconded resources
- Initial planning for Protection Assistants was based on equipment working at full capacity and activities generally proceeding sequentially
  - Underestimated requirements
- NB Power Nuclear (NBPN) and Atomic Energy Canada Limited (AECL) worked together to provide additional resources and a radiation protection structure to address the increased requirements
  - Significant cost implications

Protection Assistants / Use of AVTS

- Challenges to Protection Assistant support
  - AVTS used but did not reduce number of PAs required
  - Outage extension challenging the PA resources
  - Trained significant number of yellow qualified staff
    - › Helped PAs, but significant draw on training staff
- Mentoring provided by experienced staff
- Yellow and green qualified individuals have gained significant on the job experience
- Many people have moved from yellow to green based on experience gained (accelerated progression)
  - No neutrons, minimal tritium
- Although occasional challenges, excellent overall performance especially given the hazards

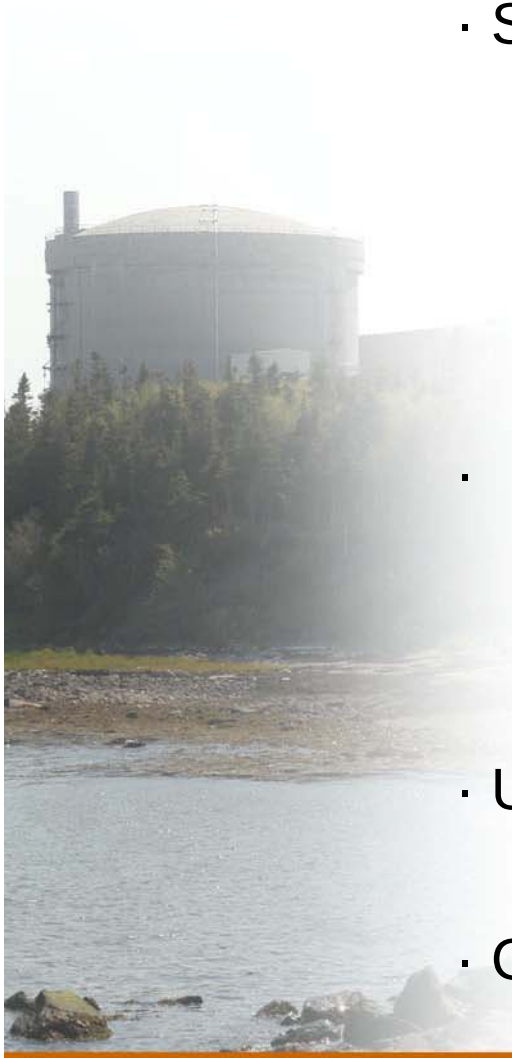
Tooling Development and Operation

- Significant use of large mock up training facility
  - Definite benefits
  - Did not prevent tooling issues in the field
- Feeder removal
  - Tool issues led to initial delays, modified process
  - Task completed under dose budget by using new process
  - New process led to contamination challenges
- End Fitting Removal
  - Slower than expected
  - Parallel work activities, open beam work
  - No significant issues
- Pressure Tube Removal
  - Very significant fields (Sv/h fields, mSv/h contamination)
  - Significant tooling challenges
  - PA intensive
  - Generally well planned and executed

Tooling

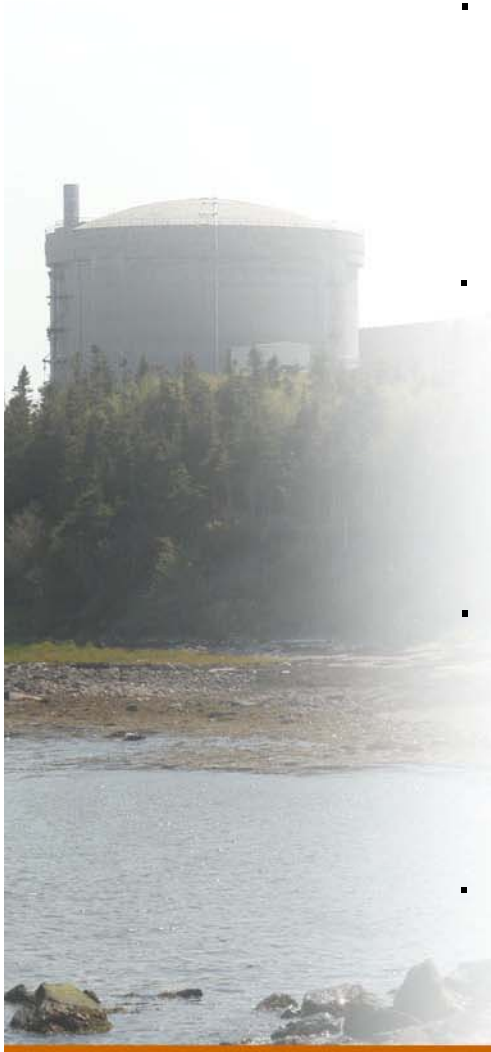
- Radiography
  - Potentially 2000-2500 welds requiring radiography
  - Significant risk and potential dose
- Phased array
  - AECL developed and got system approved
- Technical challenges
  - Phased array showed “more” than radiography
  - Needed to disposition differences
  - Many re-welds

Contamination Control and Monitoring



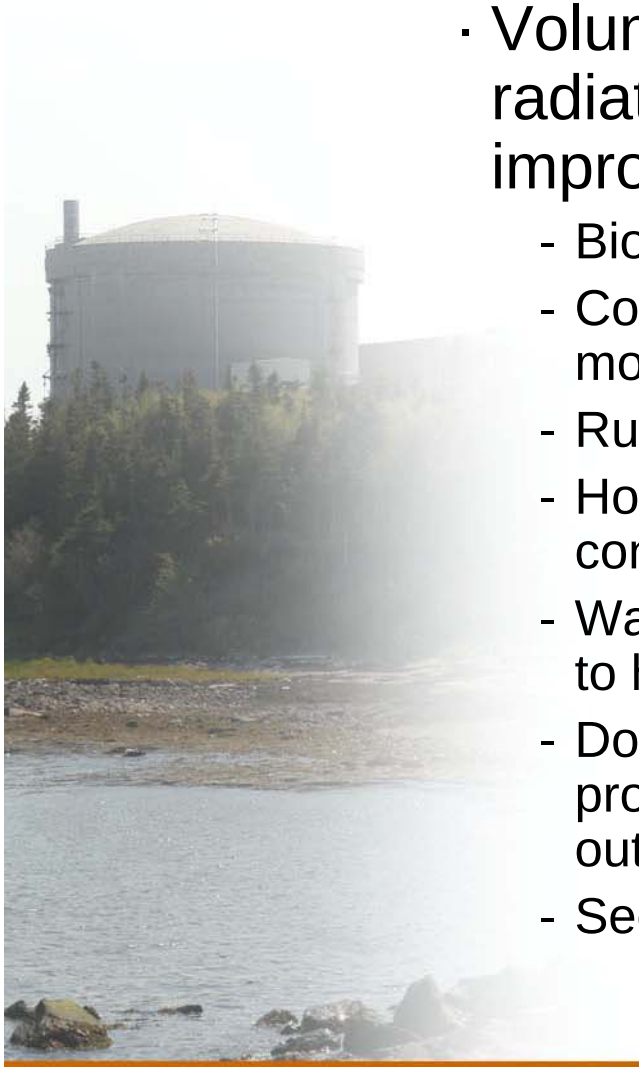
- Scrubs
  - Implemented washable scrubs at start of outage
  - New change facilities, new cafeteria facilities
  - Increased traffic
    - › Never had accurate estimate of manpower loading, total number of workers
- Inter-zonal monitoring
  - Increased capabilities at start of outage
  - Installed intra-zonal monitoring (in Zone 3)
  - Staffed last barrier to improve behaviours
- Unexpected alpha contamination
  - Additional monitoring, dedicated clean up effort
- Given nature of work, issues well managed

Contractor Management



- Nuclear is different
  - Many workers did not understand why, did not have “nuclear” awareness
  - Significant challenge to provide sufficient and appropriate oversight to contractor staff
- Watershed event
  - Stuck pressure tube stub prevented proper closing of waste container lid
  - Lack of assessment and planning when resolving issue
  - Issues that led to cause of stuck pressure tube stub and lack of planning investigated and corrected
- Subsequent activities
  - Developed specific procedures / protocols for unplanned high hazard work
  - Greater awareness of hazards and understanding of requirements of working in the nuclear field
- Oversight / Oversight / Oversight …

Programmatic Improvements



- Volume of work and number of people doing radiation work required program improvements:
  - Bioassays – improved system to “flip flags”
  - Contamination control – attendant at the whole body monitors have addressed issues
  - Rubber areas – weekly rubber area inspections
  - Housekeeping – expectations being pushed, contractors cooperating
  - Waste management – new bags being implemented to help in field
  - Dosimetry – staff at reactor building entrance to provide added attention, improvements to PAD sign-out system
  - Second dose desk at personnel airlock

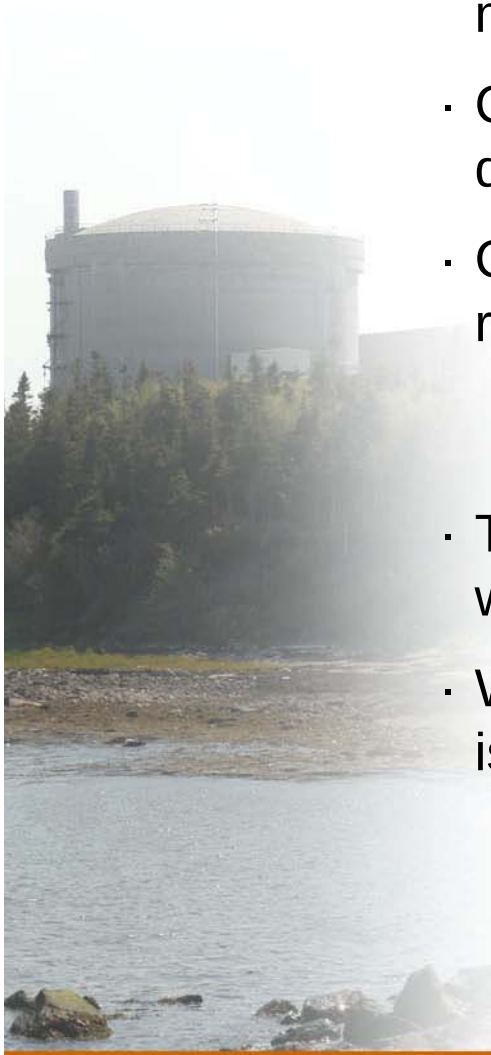
Dose Summary

- Pre-outage estimate 8.3 Sv
  - Based on main activities, no detailed estimate for "other" or "non critical path" activities
- Current estimate 11.3 Sv
- Difference:
  - Schedule delays
  - Improved details and estimates for "other work"
  - Reflects contingency work

Recent High Hazard Work Successes

- Volume Reduction System (VRS) Maintenance
  - High hazard work
  - Optical sensor (lots of debris)
  - Dealing with inconel garter springs, dose rates up to 10 Sv/h (1000 rem/h)
  - Removal of 7 Sv/h (700 rem/h) dust from VRS, dose received 117uSv (11.7 mrem)
  - Replaced VRS waste chute (1.1 mSv (110 mrem))
    - › planning included mock-up, which improved performance
  - OPEX for calandria tube removal phase
- Dismantling of volume reduction system
  - Detailed planning and mock-up
  - Used experienced team
  - Fields of up to 20 Sv/h (2000 rem/h), lots of contamination potential
  - Budget of 8 mSv (800 mrem), expended 6.4 mSv (640 mrem)
  - No contamination spread

Conclusions



- Radiation Protection and ALARA team has overcome many challenges
- Contract staff matured to understand “Why nuclear is different”
- Challenges require staff to work with unprecedented radiation fields and contamination
  - ALARA respected, no overexposure or significant loss of contamination control
- There are still many opportunities for improvement within the RP program
- We continue to stay focused on the most important issues while working to address the low level issues