

ALARA Practices and the Bruce 1 and 2 Retube Project

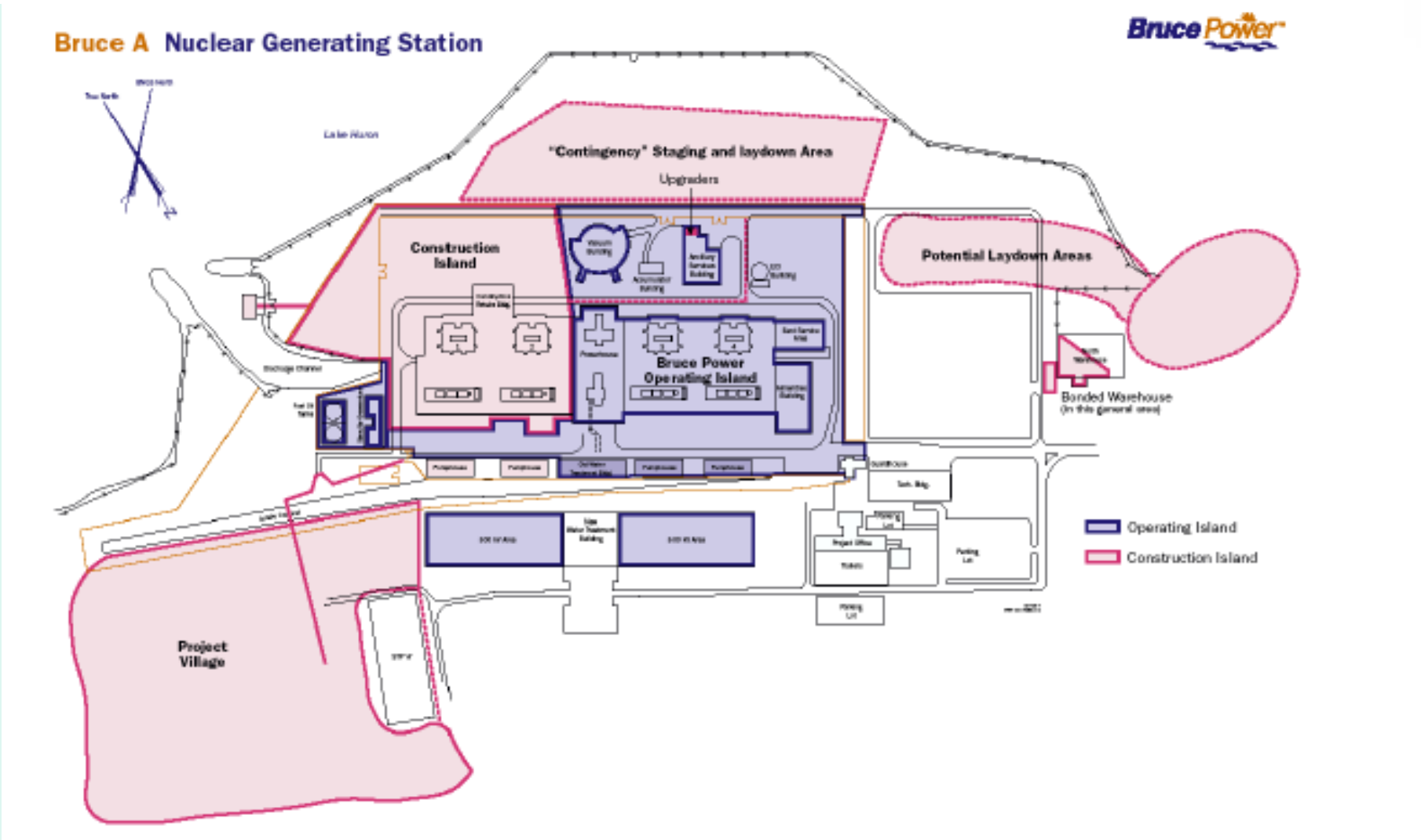
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Bruce Retube Project A.E.C.L.

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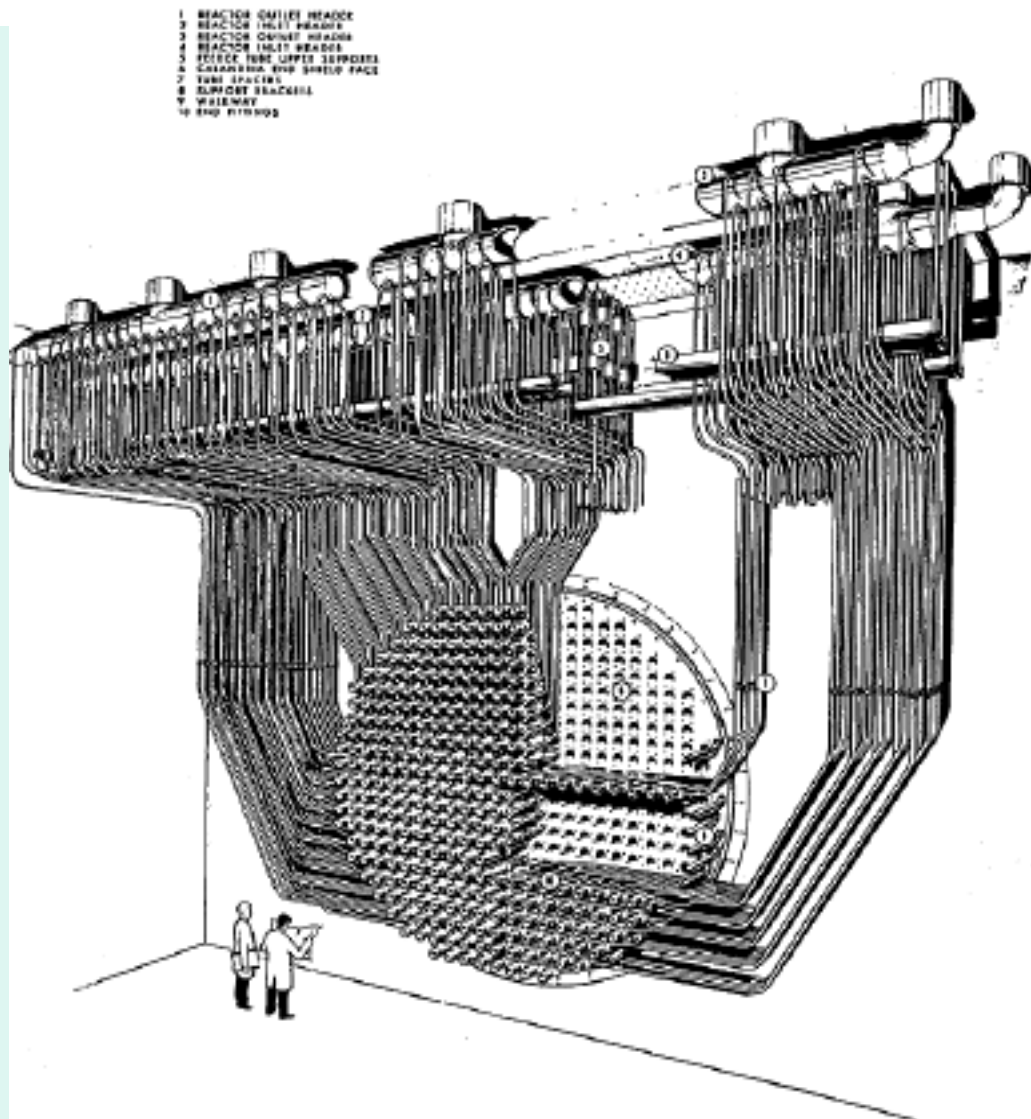
Retube Construction Island



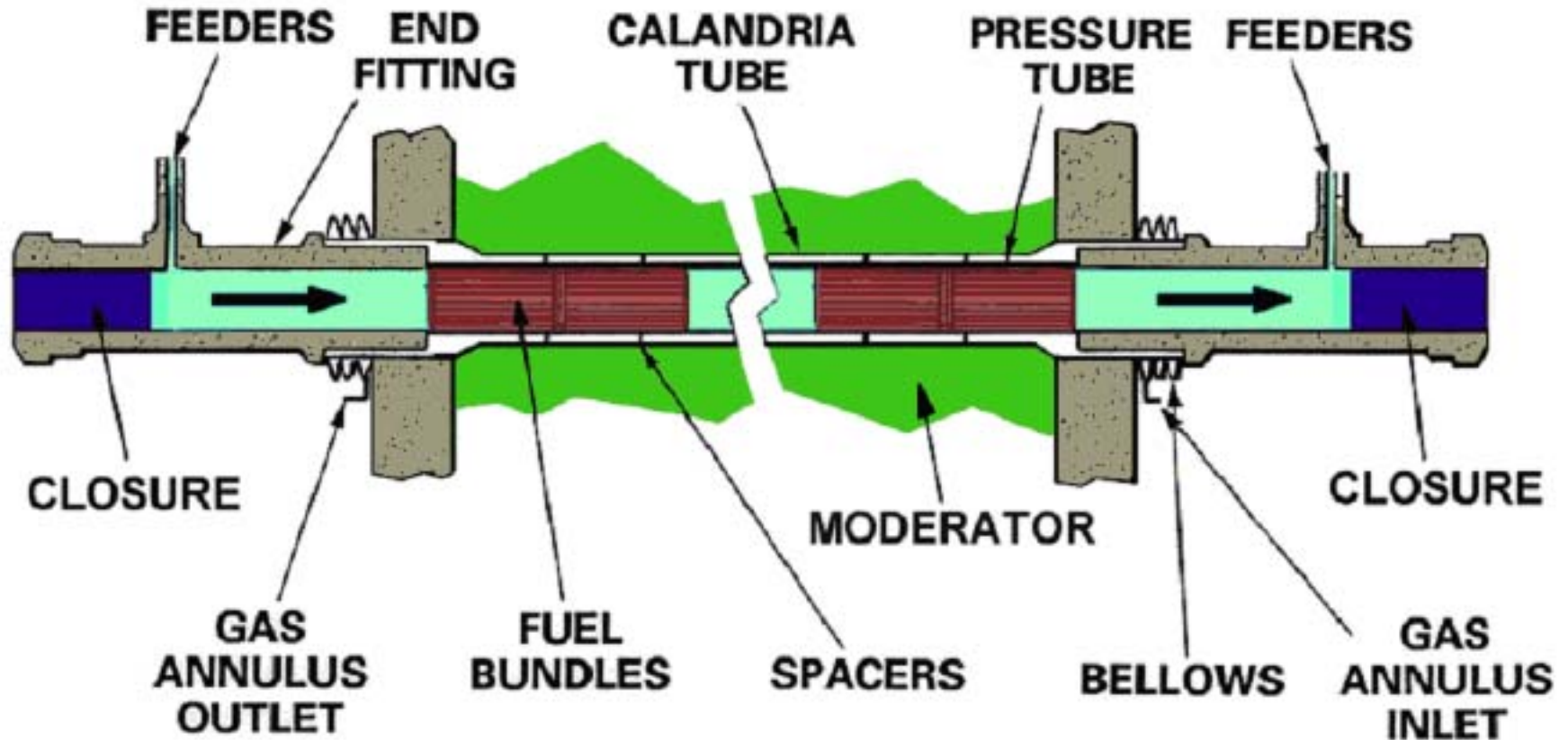
Bruce Retube Work Summary

- The scope of the work includes the removal and replacement of 480 Pressure tubes and 480 Calandria tubes in each of the two reactors at Bruce A, and the associated hardware.
- Unit 1 was shut down in 1997
- Unit 2 was shut down in 1995
- All Calandria and Pressure tubes have been removed from both reactors and are currently being replaced.

Bruce A 1 and 2



Bruce A Fuel Channel Assembly



Retube Removal Sequence

- Vault Preps
- Remove Closure plugs
- Disconnect Feeders
- Cut Pressure Tubes
- Cut Bellows and Stop Collars
- Remove End Fittings
- Remove and Reduce Pressure Tubes
- Remove and Reduce Calandria Tubes
- Refurbish Tube sheet bores

Retube Installation Sequence

- Clean and Inspect Calandria Tube-sheet Bore and Major and Minor Bores
- Install Calandria Tubes
- Install Fuel Channel Assembly

Calandria Tubesheet Inspection and Cleaning

- Tubesheet bore inspected for debris and defects.
- Some challenges with effects of radiation on image quality
- U2 experience with iron oxide



Calandria Tube (CT) Installation

3 Stage process

- Positioning CT
- Position CT insert and rolling Joint
- Leak test rolled joint

Initial challenges
around obtaining
seal on the
tubesheet



Fuel Channel Assembly Installation

- Precision work done in many stages
- Welding of End fitting occurs as a special shift
- 1 row at a time

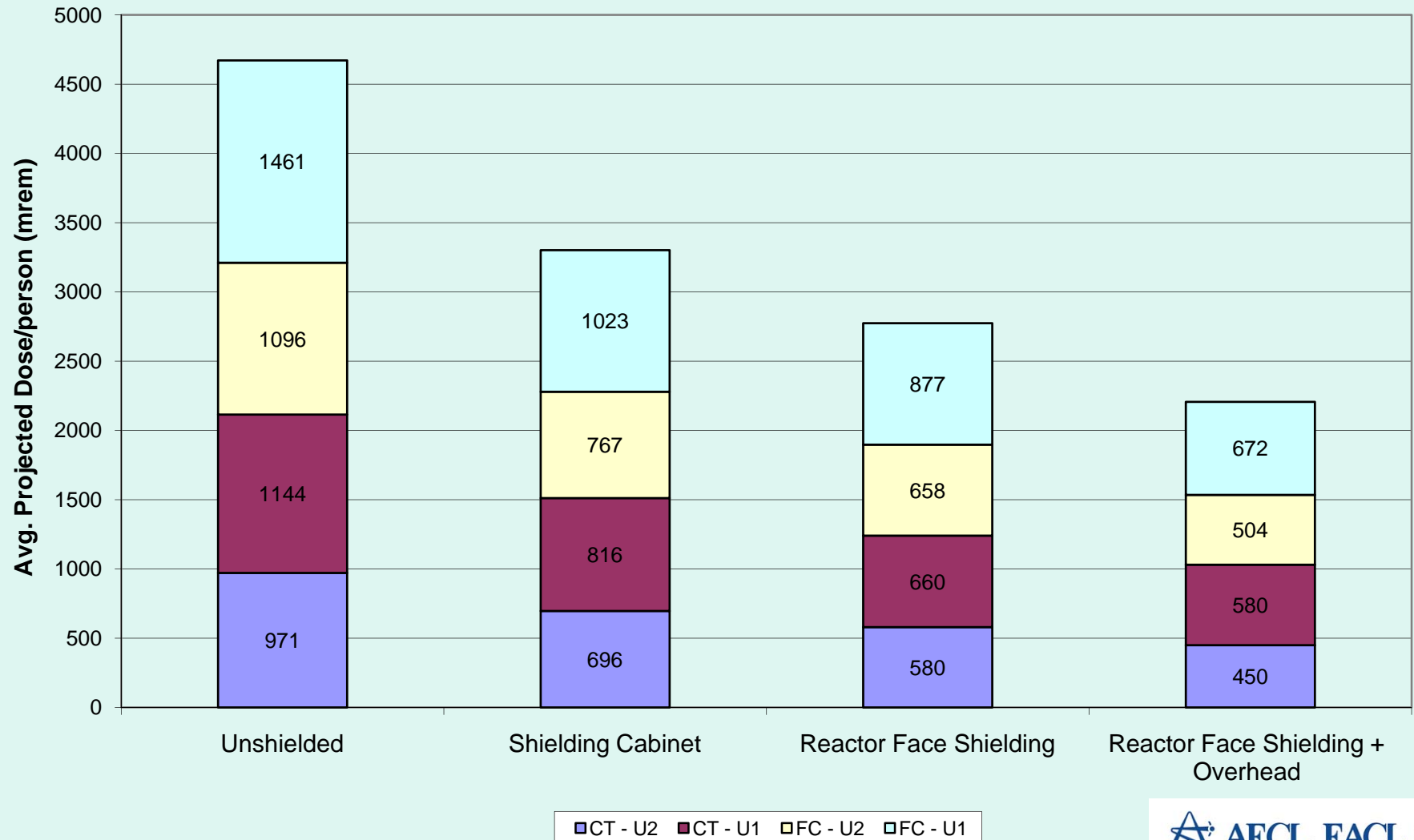


Radiation Hazard Levels During Installation

Radionuclide: Co-60	Dose Rate mrem/hr (mSv/hr)
<u>Open Lattice Site</u>	
Unit 1	10000 (100) 8000 (80) @ 30 cm 800 (8) @ center of platform
Unit 2	5000 (50) 4000 (40) @ 30 cm 400 (4) @ center of platform
<u>Reactor Face</u>	
Unit 1	25 (0.25) general
Unit 2	15 (0.15) general
<u>Feeders</u>	
Unit 1	60 (0.60) @ 30 cm
Unit 2	30 (0.30) @ 30 cm

Issues and ALARA Program Controls

Average Projected Installation Dose/Trade



Issues and ALARA Program Controls

Shielding provides Significant Dose savings at a reasonable cost

- ~2 rem vs >4 rem (The Administrative dose limit)
- @ a projected \$2150/rem saved

Specialized Work Groups

- Limited number of trades trained for each work series
- 1500 mrem (15 mSv) Exposure Control Level
- Significant time on the reactor face (4 – 8 months)
- Need for ALARA controls

Issues and ALARA Program Controls

Reactor Face Shielding

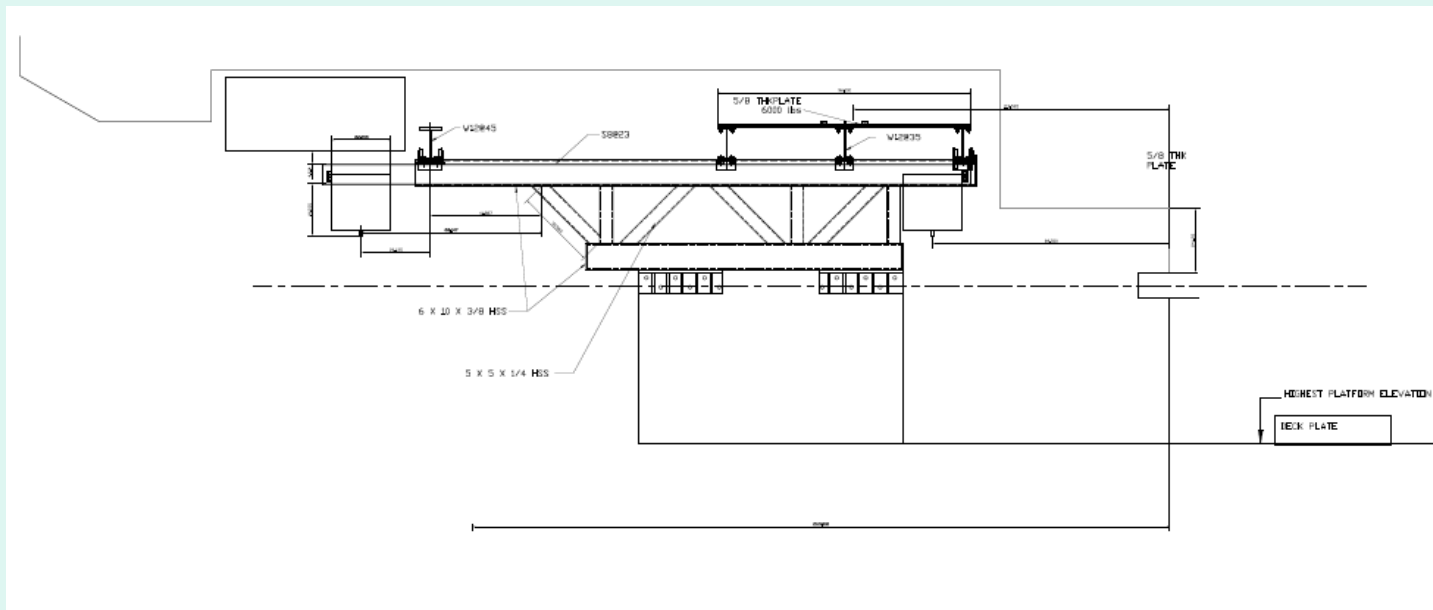
- Effective dose rate reduction of ~30-40% for general fields.
- Ability to work all four reactor faces in reduced dose rates



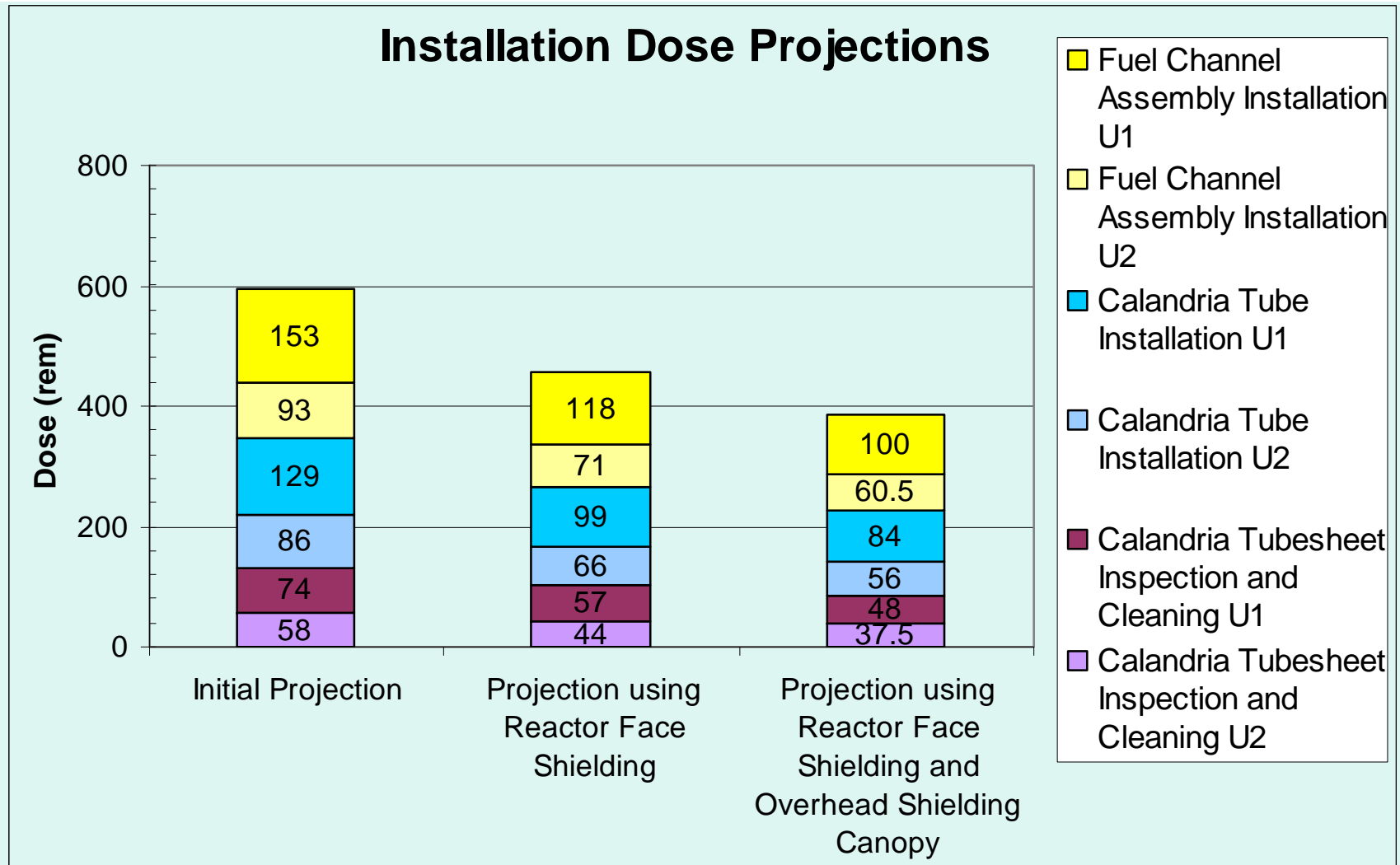
Issues and ALARA Program Controls

Overhead Shielding Canopy

- Provided Shielding from the feeders and upper level reactor face
- Effective dose rate reduction of ~15-20% for general fields



Dose Impact



Dose Performance

Work Series	UNIT 1		UNIT 2	
	Dose (man-rem)	Target	Dose (man-rem)	Target
Calandria Tubesheet Inspection and Cleaning	26.5(i/p)	48	38.5	37.5
Calandria Tube Installation	5 (i/p)	84	45 (i/p)	56
Fuel Channel Installation	-	100	2 (i/p)	60.5

Issues and ALARA Program Controls

Contamination Control

- Potential for high contamination during Calandria vessel inspections and Feeder J-Prep, include Co-60, Fe-55, Am-241.
- Vacuum and tenting erected to control spread of contamination
- Low levels of contamination during Installation series.
- Stringent house keeping: limit set for vault: 1000cpm over 5m² (pancake)

