# 2014 ISOE ALARA Symposium

## Engineered Shielding Solutions:

## Innovative Alternatives to Traditional Concrete Block Shielding in BWR's

Presented by:


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# Presentation Summary

- Present a case study of the design and application of a mobile shielding system installed at Brunswick Station (BWR)
- Problem statement
- Design approach
- Shielding analysis
- Installation
- Benefits
- Questions?



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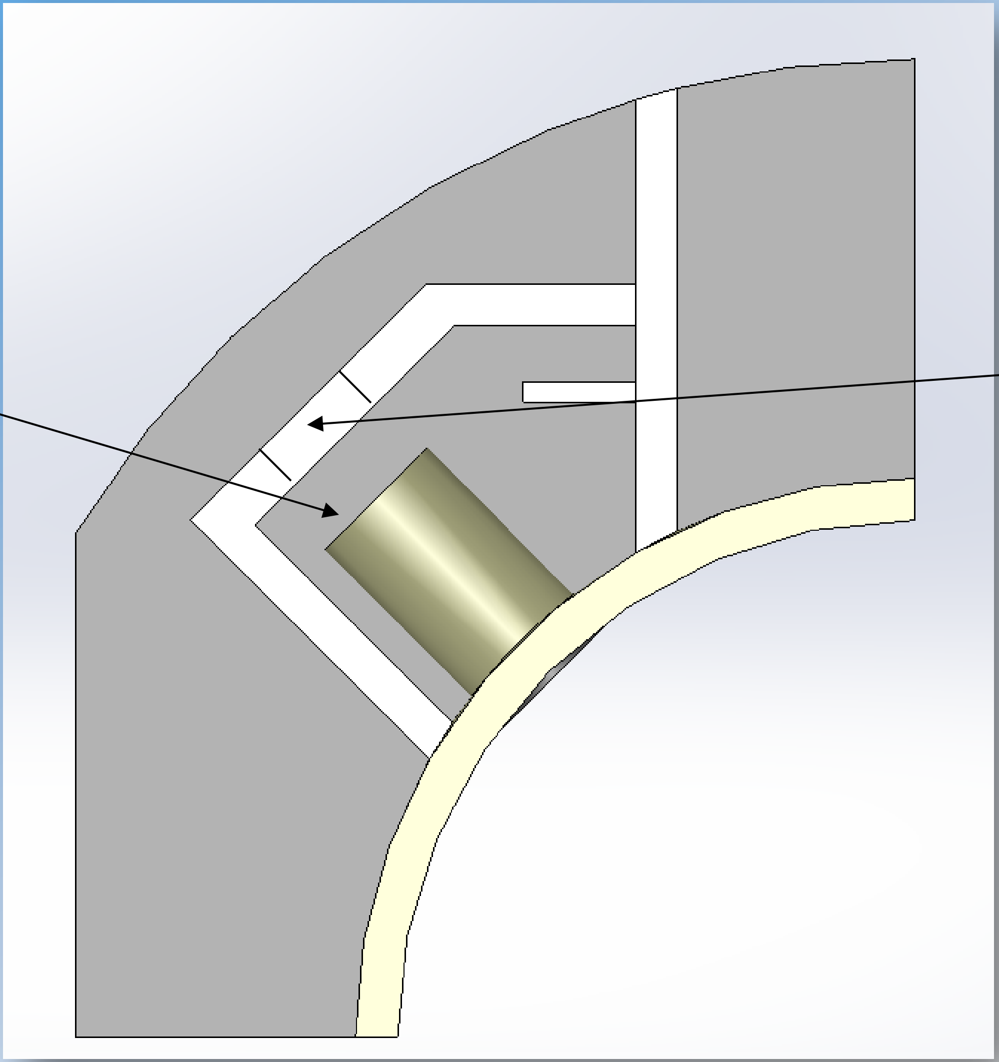
# The Problem

- Removal of U2 “B” recirc. pump motors from the drywell required.
- Access path was through drywell personnel airlocks and required that airlocks be removed for clearance.
- Pulling airlock and motor rigging required removal of 3’ concrete block plug and a portion of wall in front of airlock.
- Work was critical path on outage schedule, and would require beginning wall removal while still on line.
- Removal and replacement of block wall labor intensive; 10-12 days and 1440 – 1728 man hours.
- Removal and replacement dose intensive, 35 Rem est.
- Future work would also require airlock removal.

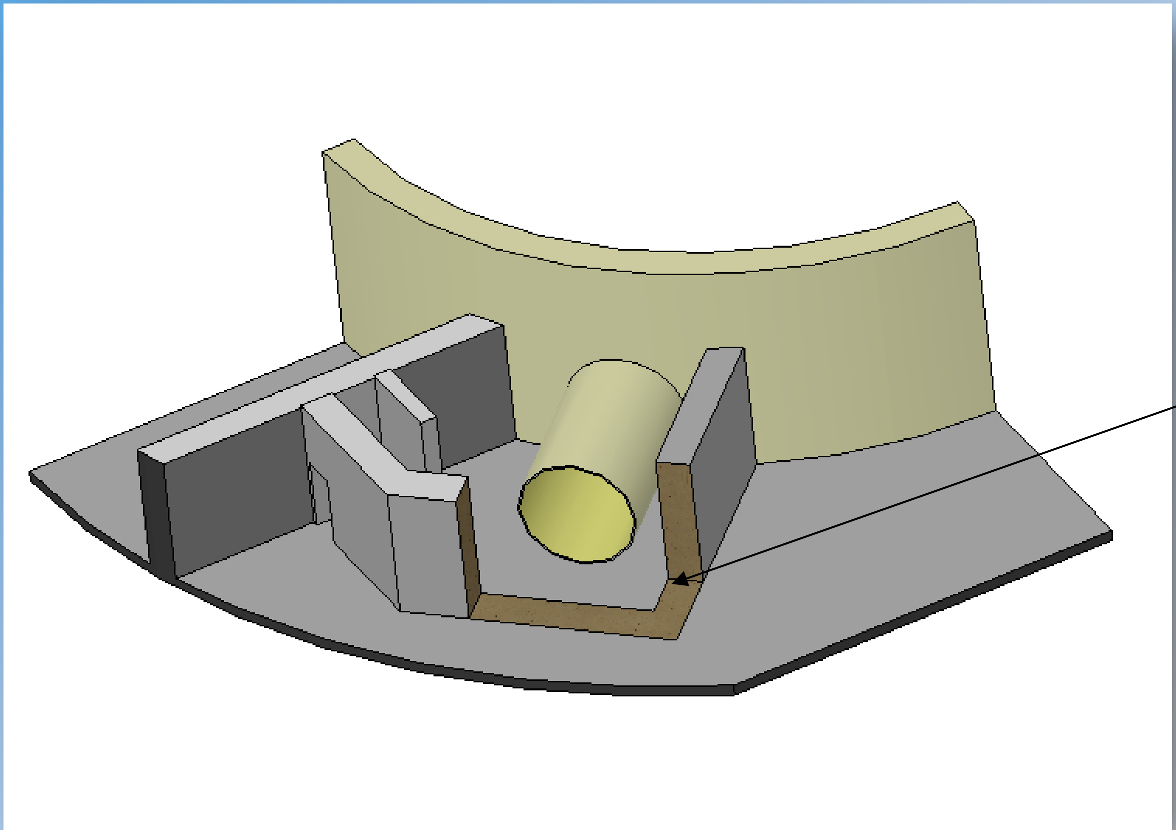
Access door

Exterior of bio-shield

Airlock tunnel



Bio shield wall with stacked block access plug 3' thick



Bio-shield to be removed to support airlock and component replacement



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# The Concept

- A shield wall that could be rapidly moved in sections to allow needed access
- Shielded panel mounted on a permanently installed track
- Shield wall to replace concrete blocks
- Use additional shadow shields to block streaming around track area
- Allow installation of wall prior to removal of block wall in a lower dose rate area.


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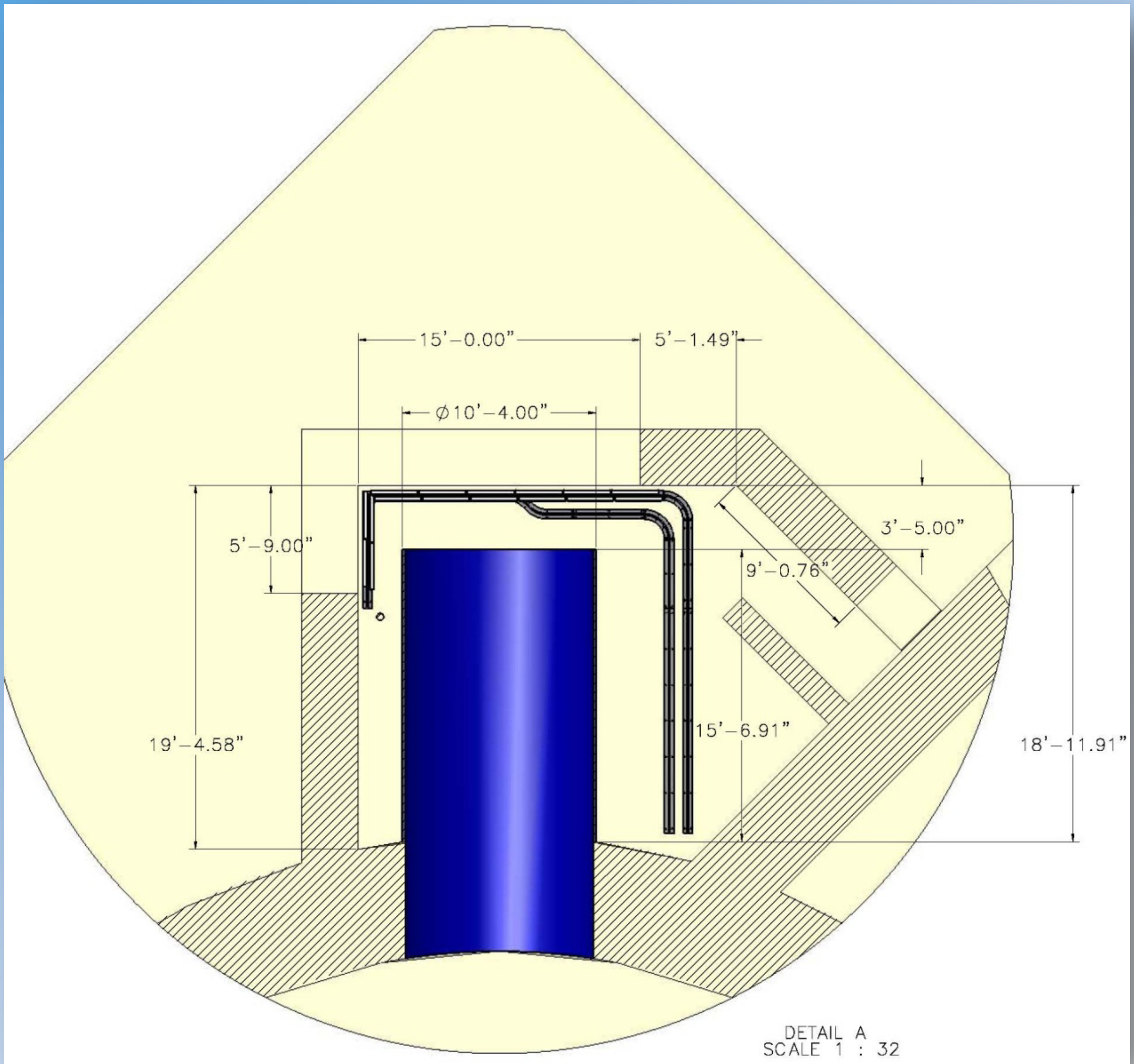




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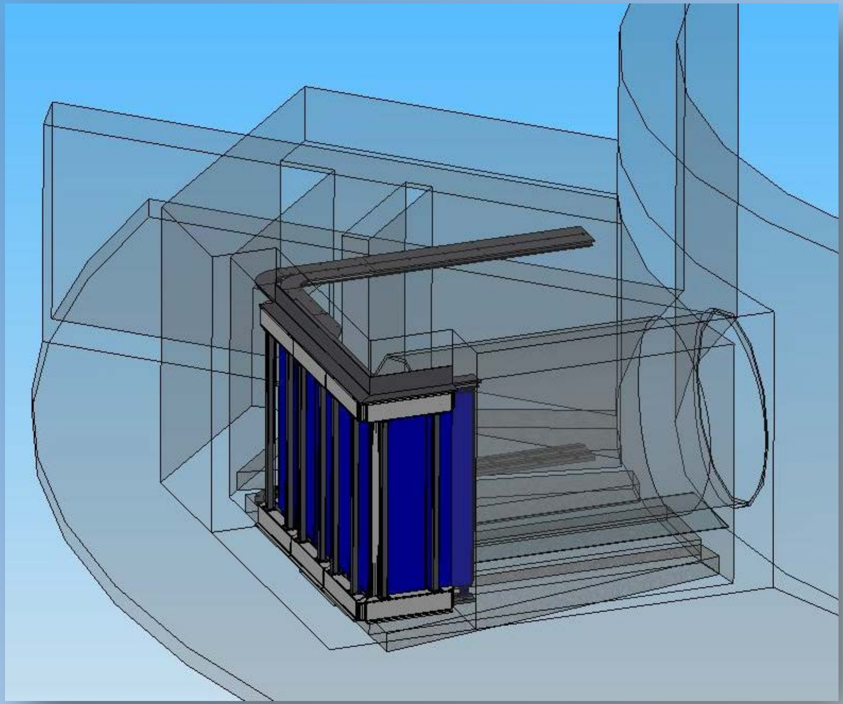

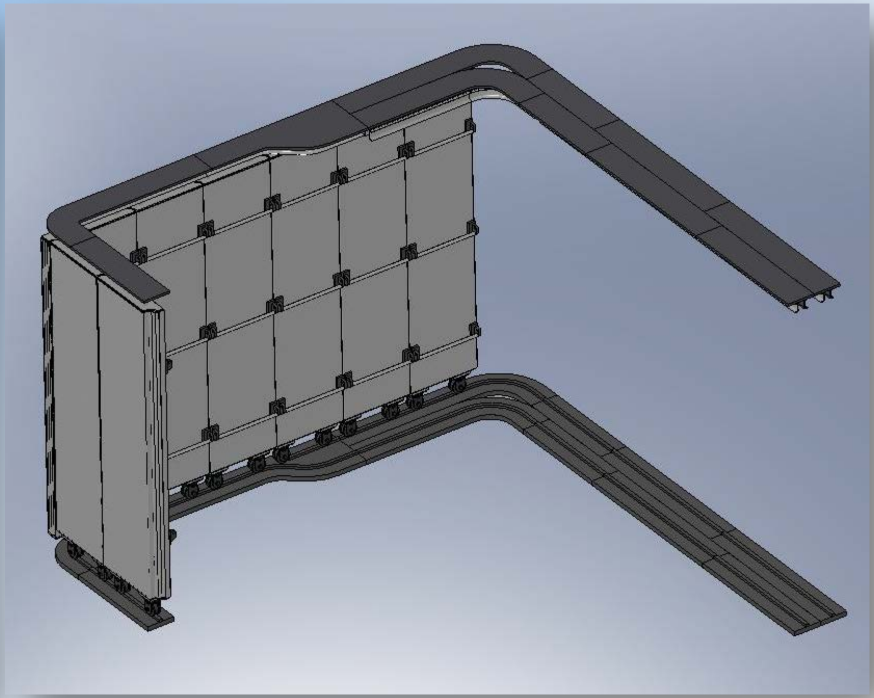



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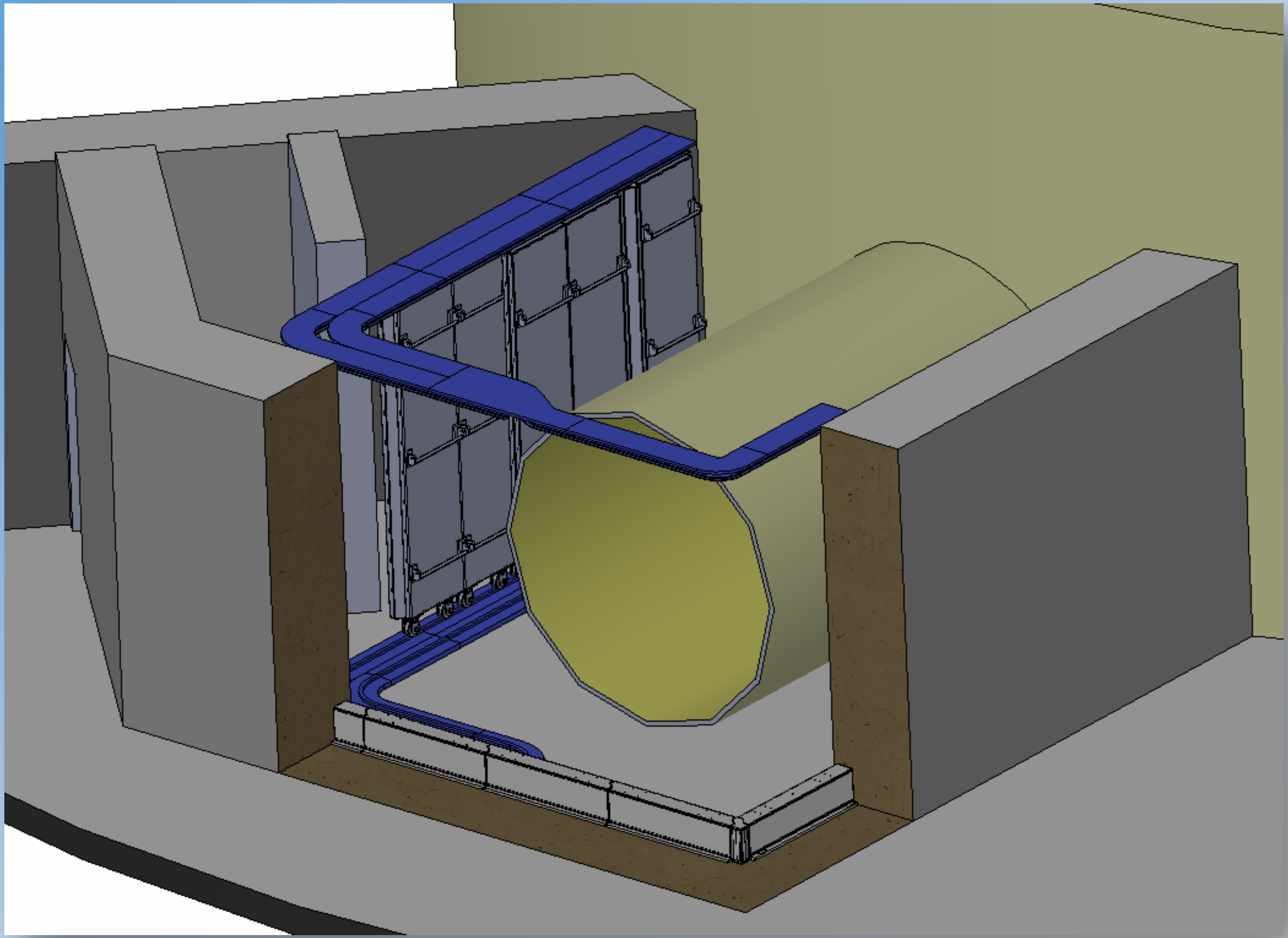



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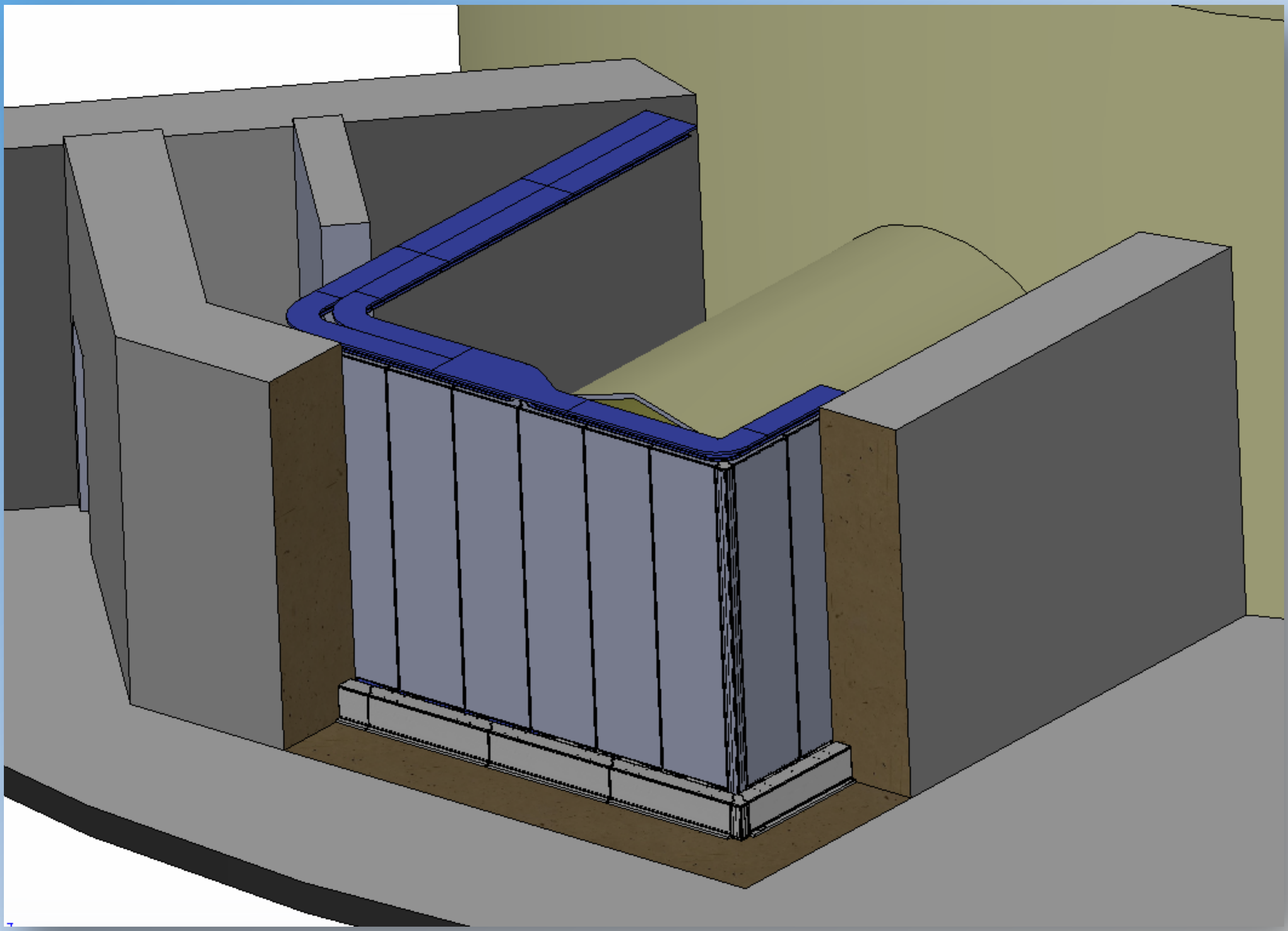



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# The Challenges

- Gamma/neutron radiation fields
- Seismic qualification
- Space restrictions
- Interferences
- Logistics of installation – design to allow installation of segmented track and shield panels prior to the removal of the bio-shield wall.



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# Shielding Design Basis

- 20 mrem/hr gamma
- 60 mrem/hr neutron, assumed 1MeV energy.
- Shielding goal: attenuation for less than 1 mrem/hr gamma/neutron, including secondary emissions by neutron capture.

# Shielding Design

- Design optimized shield stack up, using lead, steel, virgin and borated polyethylene.
- Designed to minimize use of borated poly due to availability and expense.
- Position of lead investigated to minimize secondary gamma emission.
- Shielding analysis performed using MCNP analysis and predicted shielded dose rates of 0.57 mrem/hr gamma and 0.27 mrem/hr gamma.



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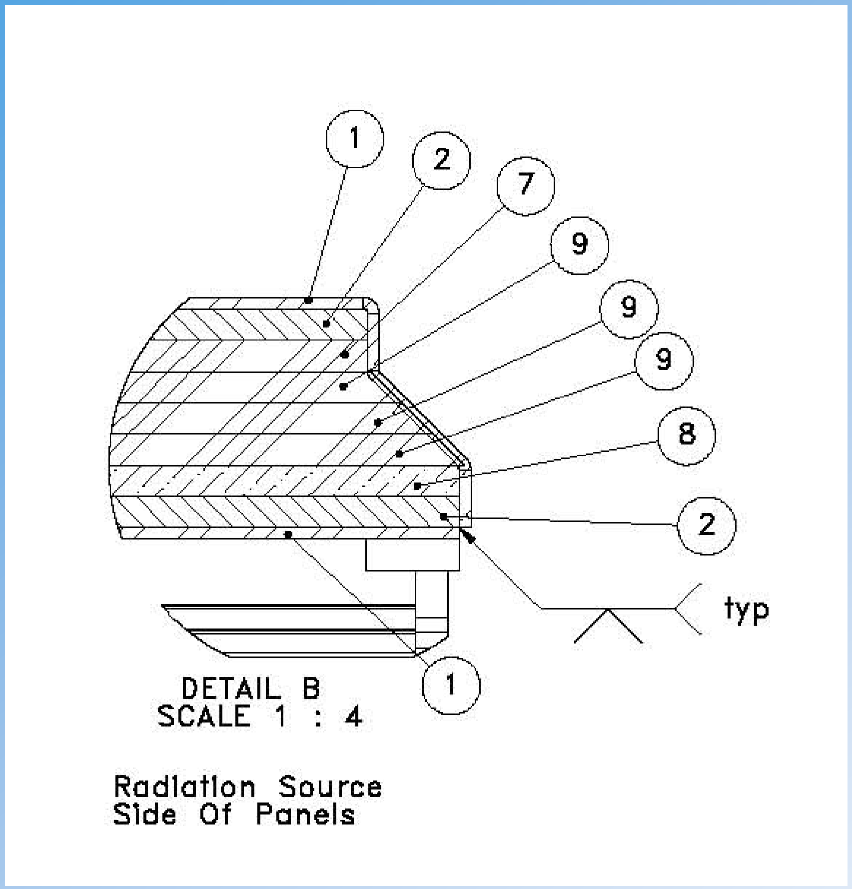


| | Layer Thickness [in] | No. Layers | Material |
|---|---|---|---|
| 1 | 0.25 | 2 | Carbon Steel |
| 2 | 1 | 2 | Lead |
| 7 | 1.0 | 1 | 5% Borated Polyethylene |
| 8 & 9 | 1.0 | 4 | Virgin Polyethylene |

# Installation



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# Benefits

- Gamma and neutron dose rate were reduced to < 1 mrem/hr on backside of wall and exceed block wall performance.
- Exposure saving estimated to be 35 rem for removal and replacement of concrete wall alone.
- Based on performance, second shield wall also installed in U1.
- 3 rem received during installation of the modular wall in U2, and 2.5 for U1.

# Benefits

- ≈1530 man-hours saved by avoiding the dismantling and reassembly of block wall.
- Rolling wall can be opened or closed in ≈15 minutes.
- 2.5 weeks required to install rolling shield wall and remove concrete wall.
- Sequenced installation allowed wall removal of block wall in low radiation field.
- Airlock area now routinely opened to improved access/egress to drywell, improved doffing station configuration.


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Questions ??

Thanks -



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