Calvert Cliffs Dry Fuel Storage

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Industry Lessons Learned

TransNuclear NUHOMS Design Independent Spent Fuel Storage Installation (ISFSI)

- Fuel Loaded Dry Storage Canister (DSC) stored in Horizontal Storage Modules (HSMs)

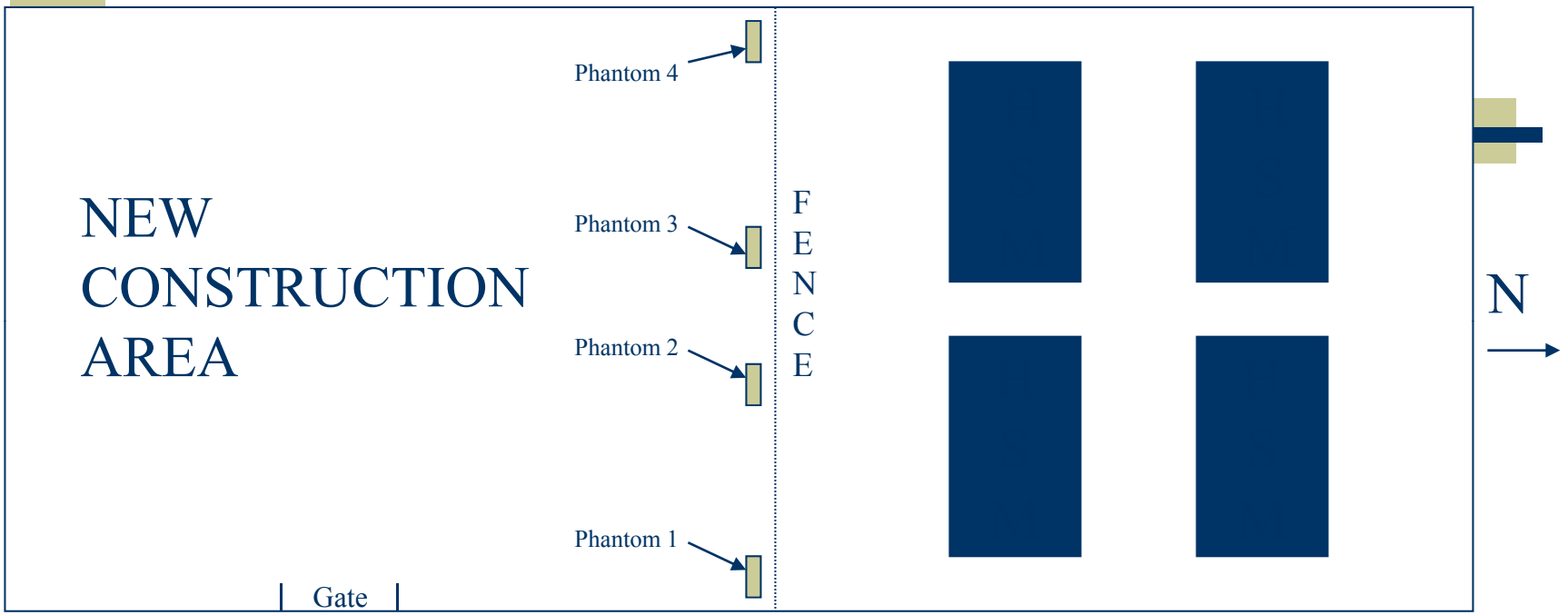
Calvert Cliffs ISFSI

- Licensed in 1992 for 120 HSMs
- Currently have 72 HSMs Built
- 63 HSMs loaded
  48 with 24P cask,
  15 with 32P cask

24P Dry Storage Canister (DSC) to 32P DSC

- Neutron Source Term Allowable
  Increased from $3.2X10^{8}$ to $4.175X10^{8}$ n/sec/assembly
- Gamma Source Term Allowable
  Increased from $1.53X10^{15}$ to $1.61X10^{15}$ MeV/sec/assembly
- Max Assembly Average Allowable Burnup
  Increased from <47,000 to <52,000 MWDMTU
- Number of ISFSI Loads per Year
  Decreased from Four to Three Cask Loads per Year

ISFSI Neutron Phantom Study Results



Total Hours: 1224

DLR Read Results:

Phantom #1

DLR#	Hs	Hn	Hd
50360	22	7	22
51007	23	9	23
50992	21	7	21

Phantom #2

DLR#	Hs	Hn	Hd
52403	26	14	26
50809	22	0	12
50840	23	11	23

Phantom #3

DLR#	Hs	Hn	Hd
52367	22	9	22
50337	27	0	13
50161	25	11	25

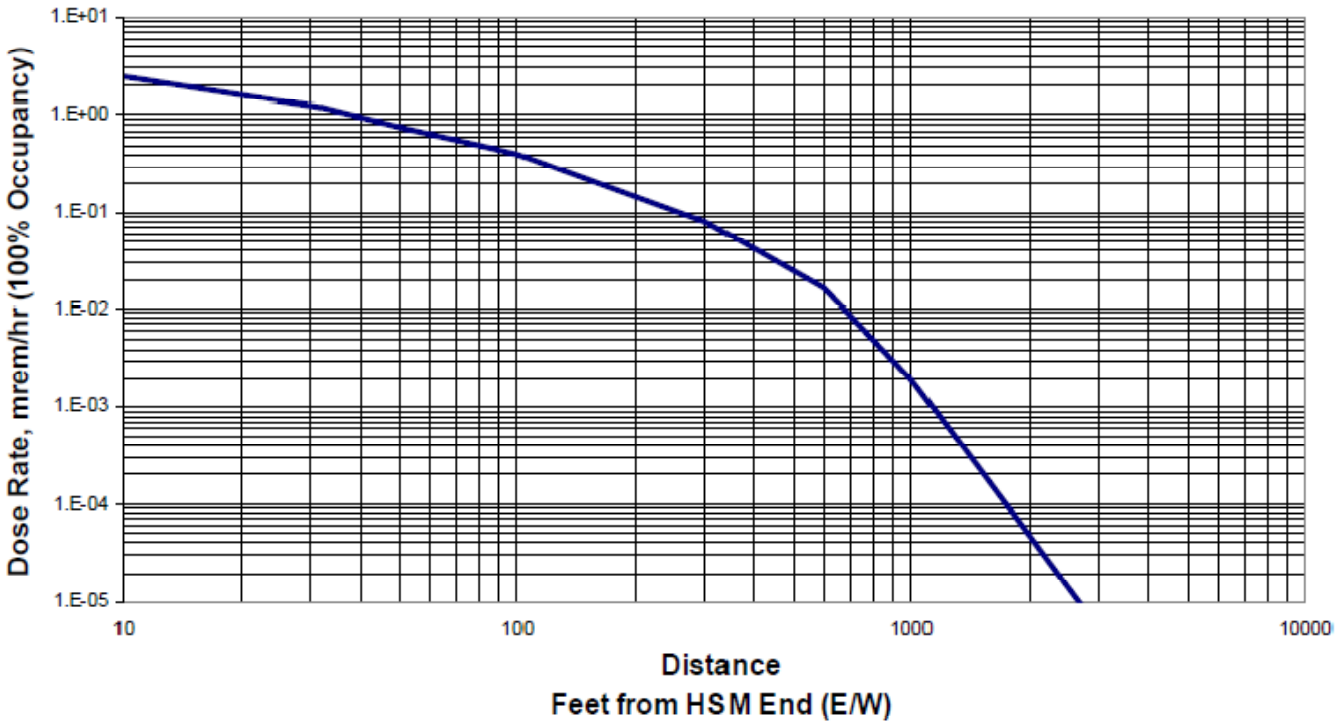
Phantom #4

DLR#	Hs	Hn	Hd
50831	24	9	24
52222	26	11	26
50441	23	9	23

Max dose rate (Hd) = 26 mrem/1224 h = 0.02 mrem/h;
Max dose rate (Hn) = 14 mrem/1224 h = 0.01 mrem/h

Max dose rate (Hs) = 27mrem/1224 h = 0.02 mrem/h;

Dose to the Public

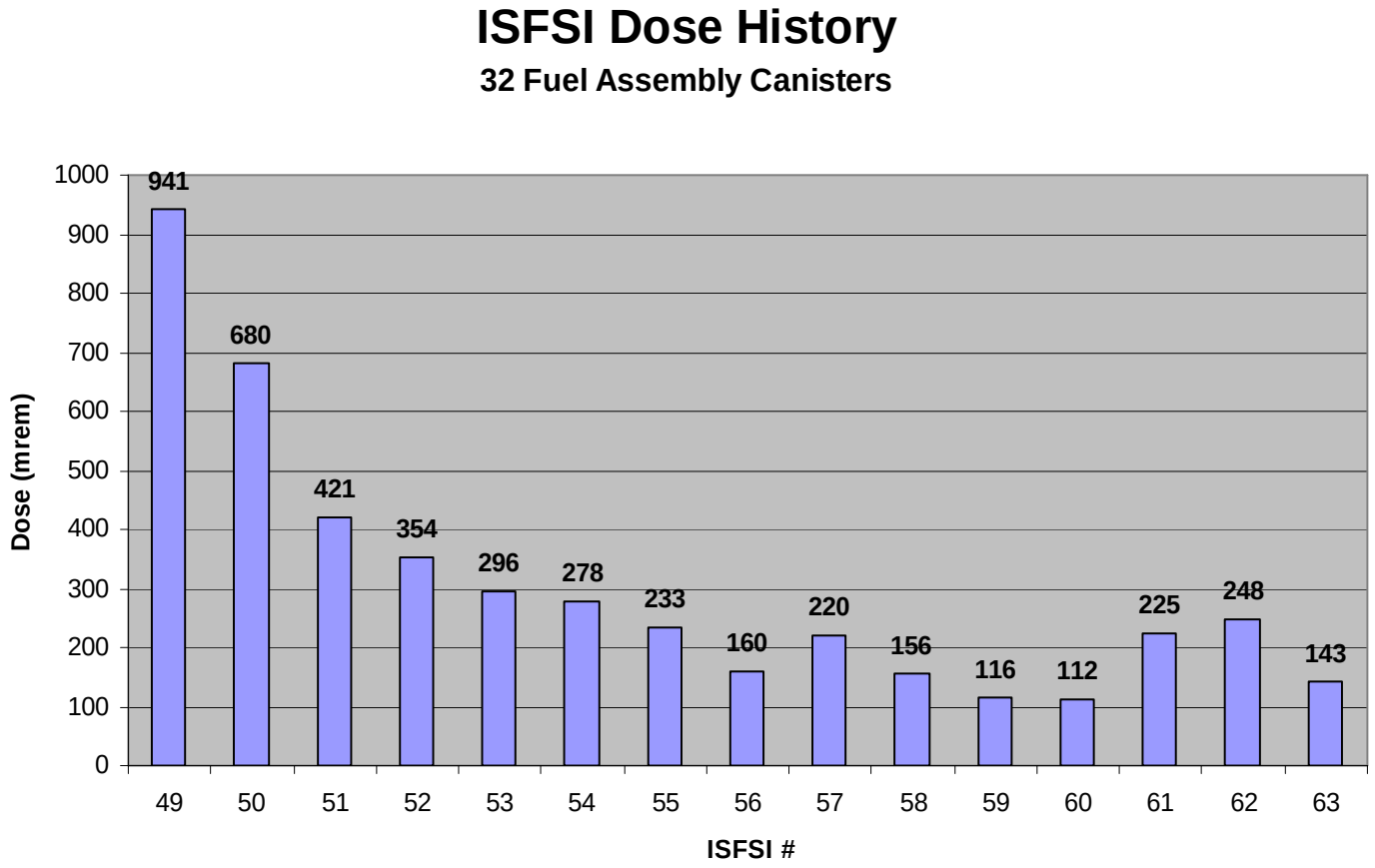


Dose to the Public

Table 6-9 Bounding Site Total Dose Rates (mrem/hr) as a function of Distance in the East-West Direction

Distance (ft)	24P (Ref. 2)	32P	24P/32P Bounding (USAR Fig 7.4-1)	Extended Burnup 32P	24P/32P/32P Ex BU Bounding
10	2.06E+00	2.45E+00	2.45E+00	1.86E+00	2.45E+00
30	-	9.74E-01	-	1.21E+00	-
31.6	1.07E+00	-	1.07E+00	-	1.21E+00
50.0	7.57E-01	-	7.57E-01	-	7.57E-01
60.0	-	4.25E-01	-	5.89E-01	-
80.0	4.93E-01	-	4.93E-01	-	4.93E-01
100.0	3.94E-01	2.89E-01	3.94E-01	3.77E-01	3.94E-01
300.0	7.86E-02	5.85E-02	7.86E-02	7.45E-02	7.86E-02
600.0	1.20E-02	1.08E-02	1.20E-02	1.66E-02	1.66E-02
1000.0	1.44E-03	1.62E-03	1.62E-03	1.93E-03	1.93E-03
3000.0	3.44E-06	5.28E-06	5.28E-06	3.51E-06	5.28E-06

Calvert Cliffs Dose Reduction

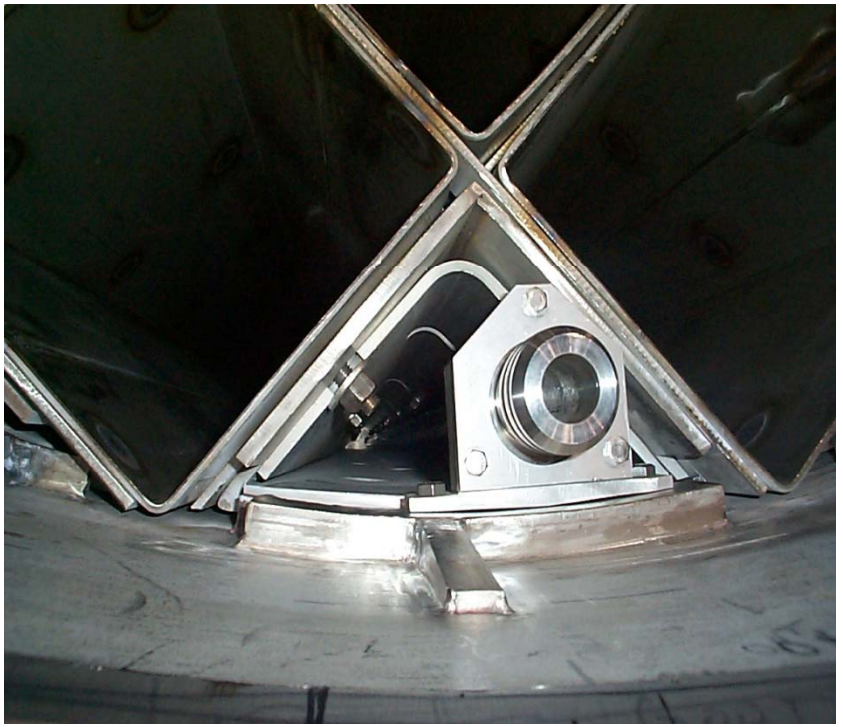


BACKGROUND

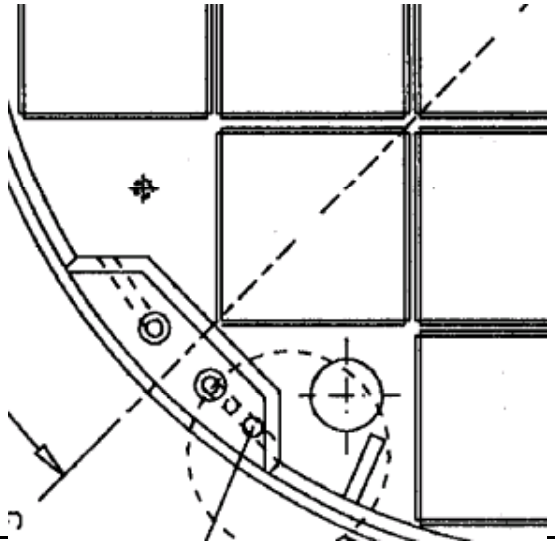
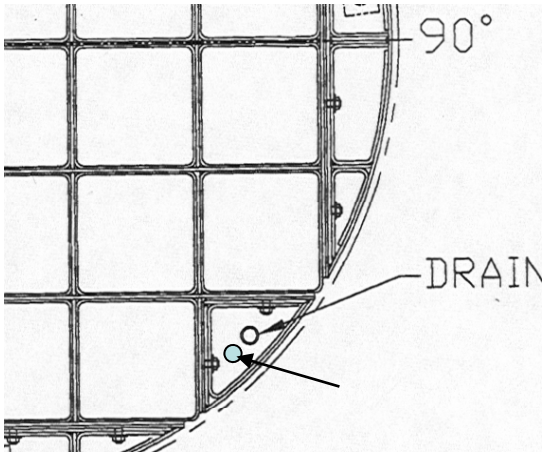
- During ISFSI loading 50, a NDE inspector's EPD alarmed on dose rate at 888 mrem/h.
- Surveys of the work area determined that there were higher than expected columns of radiation coming from the Vent & Siphon Ports of the Canister.
  - Vent contact measurement: 10 R/hr
  - Siphon contact measurement: 5 R/hr
  - Vent & Siphon Port Plug had Leaks at the Hanson fittings. NDE personnel used a Plastic Chimney Device Work Around to remove leaking Helium from the weld area.

Lessons Learned from Redesign of DSC

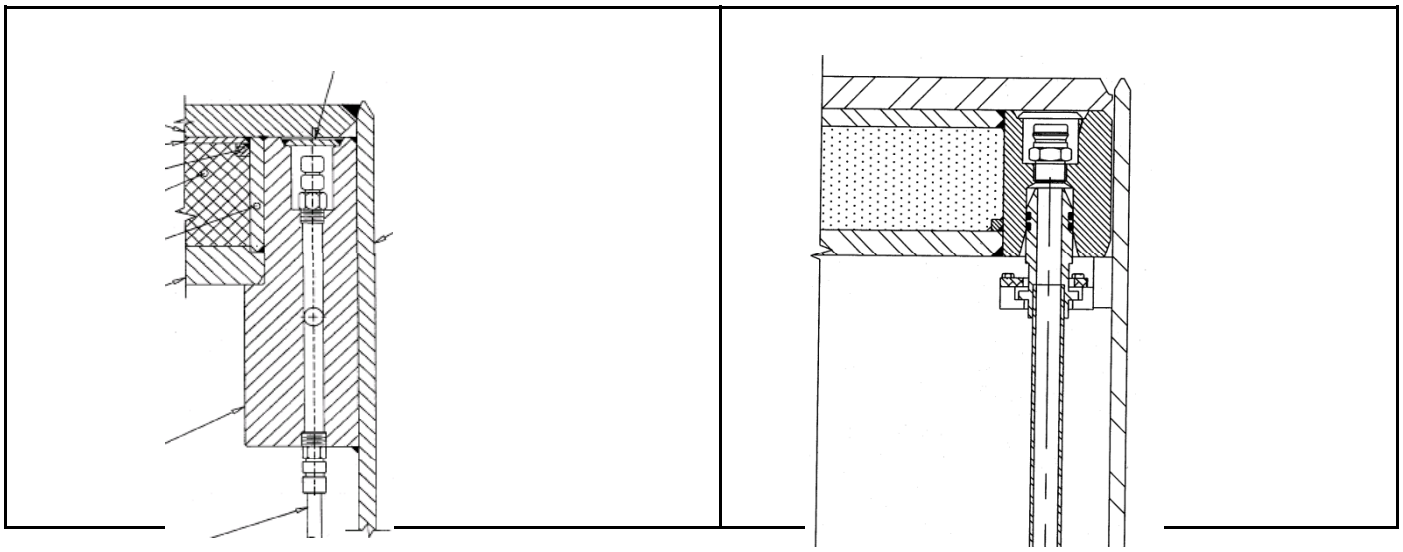
- Dry Storage Cask Design Change from 24P to 32P Canister
- Vent and siphon port design change- NOT reflected in Vendor Design drawings



Comparison of 24P and 32P Vent and Siphon Port Configurations

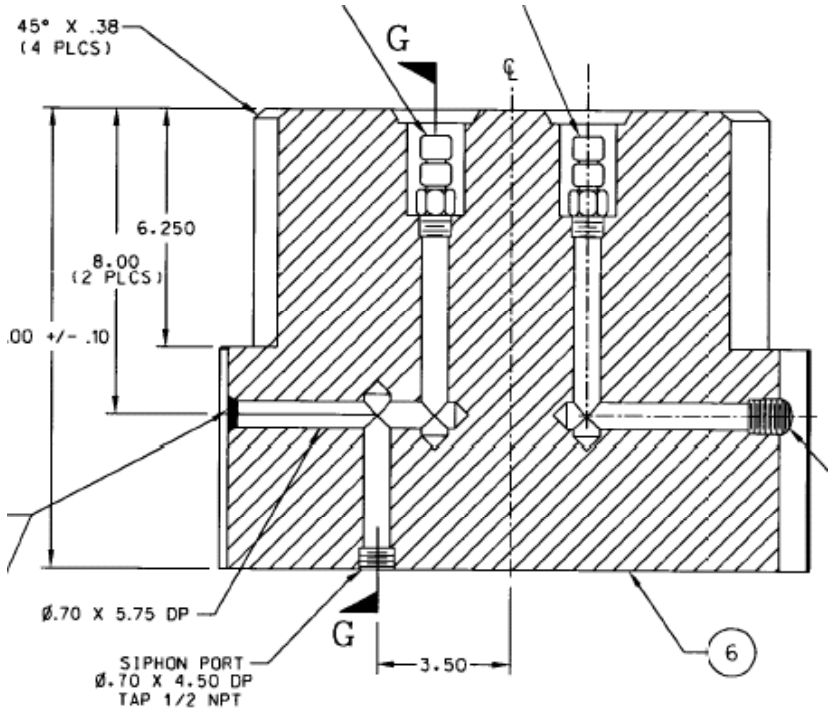
CCNPP NUHOMS-24P DSC	CCNPP NUHOMS-32P DSC
	

24P vs. 32P Vent/Siphon Port Design



Original Labyrinth Design of 24P Vent/Siphon Ports

- Note – the new 32P design did not provide a similar drawing or include the labyrinth the design.



PROBLEM STATEMENT

- What can be done both internally and externally to the Dry Shielded Canister (DSC) design to reduce the radiation streaming from the Vent & Siphon Ports.

Dose Rate Reduction

- Reduce the bottom of the vent port opening to 1 inch.
- Minimize dose to the welders and NDE inspectors by using:
  - Correct body positions
  - Temporary shielding, and
  - Experienced workers
  - Redesigned Hanson Fittings
- Design a shielding block that inserts into the top section of the vent & siphon ports .

Dose Rate Reduction

- Approximately 25% dose reduction at the Vent & Siphon Port (contact readings 8R/hr and 3 R/hr)
- Modification could be installed on next set of Canisters arriving later that year.
  - Would not require any additional analysis of the NUHOMS-32P design
  - Would require some DES & NFS engineering support.

Dose Rate Reduction

- Cask Washdown Pit would remain a locked high Rad area.
- Total Cost = Level of Effort
  - There would be no cost for the drawing change.
  - Radiation Safety had funds for making the shielding inserts
- Inserts were ready for first loadings in summer.
  - Change could be made on next set of Canisters shipped to Calvert.

Industry Events

Contamination Events

- Poor decon practices
- Failure of hoses and fittings
- Leaching from DSC metal exterior

Radiation Streaming

- Lower Vent opening in Storage Canister
- Out of round annulus gap between DSC and TC

Industry Events

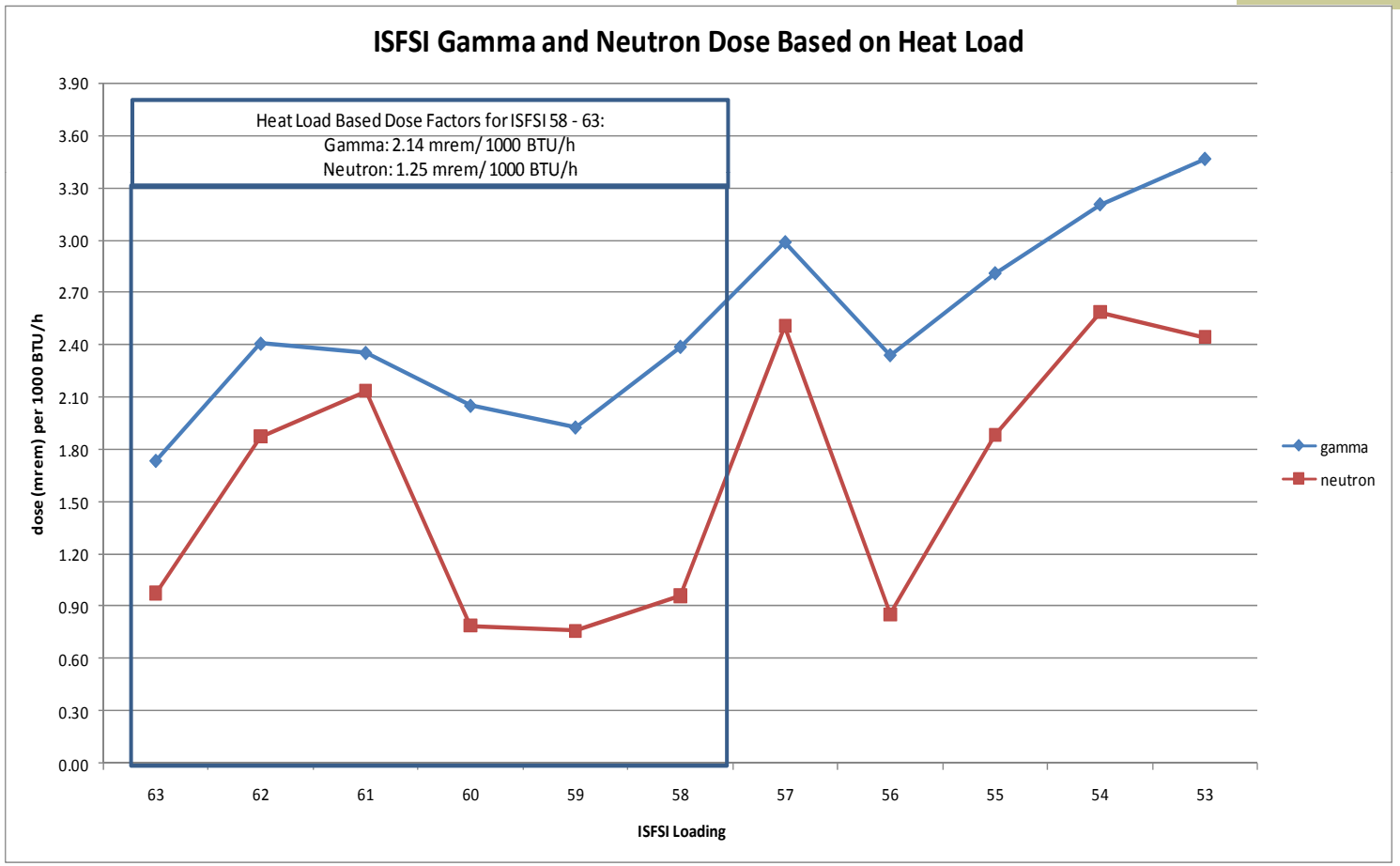
Airborne Events

- Use of decon agents- citric acid, trisodium phosphate
- Kr-85 from failed fuel

Work Management Issues

- Hydrogen Burn during welding operations
- Damage to HSMs, Casks
- DSC lid set uneven

Calvert Cliffs Gamma & Neutron Dose per 1000 BTU/Hours for Last Three Years



Results of tracking dose per 1000 BTU/h

- Gamma dose based on the heat load has been relatively consistent with an average factor of 2.14 mrem per1000 BTU/h through the last 6 fuel loads. This factor is now used to estimate gamma dose for each dry fuel storage campaign. The factor is reviewed and updated annually.
- Daily dose estimates and tracking for ISFSI focus on the gamma dose which is an accurate predictor of how well the ISFSI work is being performed, since it is directly measured by Electronic Dosimeter (instead of through dose estimating as with neutrons).
- Neutron dose based on heat load for the last 6 ISFSI loads has not been constant, varying widely from 0.76 to 2.13 mrem per1000 BTU/h. A heat load based neutron estimate is used for ISFSI loads using the average factor of 1.25 mrem per1000 BTU/h.

Calvert Cliffs Lessons Learned Shielding

- Designed and fabricated Tungsten Shield Plugs for Vent and Siphon Ports- later replaced with lead bricks.
- Lead shielding snakes and blankets
- 1” thick sheets of high density polyethylene

Calvert Cliffs Lessons Learned in Work Management

- Replaced leaking Hanson Fittings - eliminated the need for the chimney workaround.
- Load lowest burn-up fuel (oldest fuel) near the vent and siphon port locations.
- Used MX-12- Man Lift and rolling scaffolds to access rigging for DSC.
- Painted lines on truck bay floor for alignment of the TC/DSC trailer.
- Added Long handled tools for helium probes and application of vent and siphon port shields to keep extremities/whole body out of higher dose fields.
- Use a camera at the gauge during blowdown keeps attendant away from higher dose rates in the Cask Wash Pit.

Management Support

- PGM Challenge to ISFSI Crew!
  Congratulations on a great ISFSI move (#51)! The challenge of reducing the dose during this move by 20% was met, and as promised, the Plant General Manager cooked lunch.


Questions or Suggestions
Thank You!