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Calvert Cliffs ISFSI License Renewal and Expansion

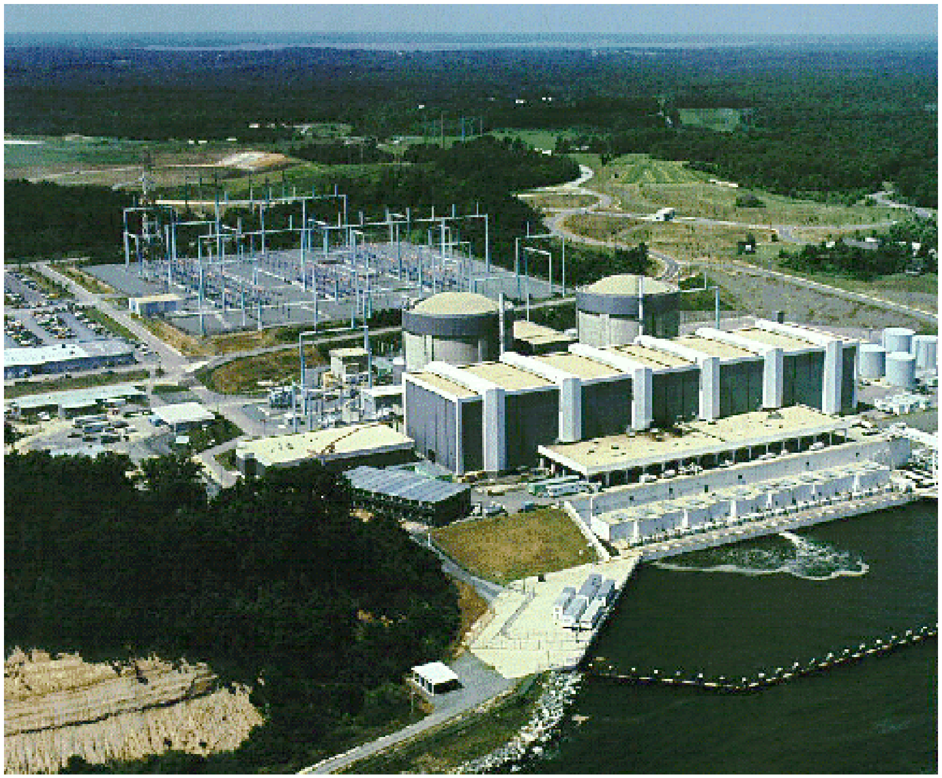
John Massari

Fleet Nuclear Fuels

NEI Used Fuel Management Conference

May 2013

Calvert Cliffs



Calvert Cliffs ISFSI Brief History

- Initial Site Specific License in November 1992
- Transnuclear NUHOMS design (24P, 32P after 2005)
- Loaded first dry shielded canister in 1993
- Currently have 48 24P and 24 32P DSCs loaded
- License Renewal
  - LRA Submitted 9/17/2010
  - NRC acceptance questions (10) received 12/2010; answered 2/2011
  - NRC 1st set of RAI questions on LRA (23) and Environmental Report (6) received April 2011; answered June 2011
  - NRC 2nd set of RAI questions received 10/2011, answered 12/2011
  - Lead Canister Inspection performed 6/2012, report submitted 7/2012
  - NRC 3rd set of RAI questions (3) received 10/2012, partial answer 4/2013, remainder in 6/2013
- Expiration Date was 11/30/2012 – Now expires if NRC denies LRA




Response to High Burnup Fuel RAI E-3

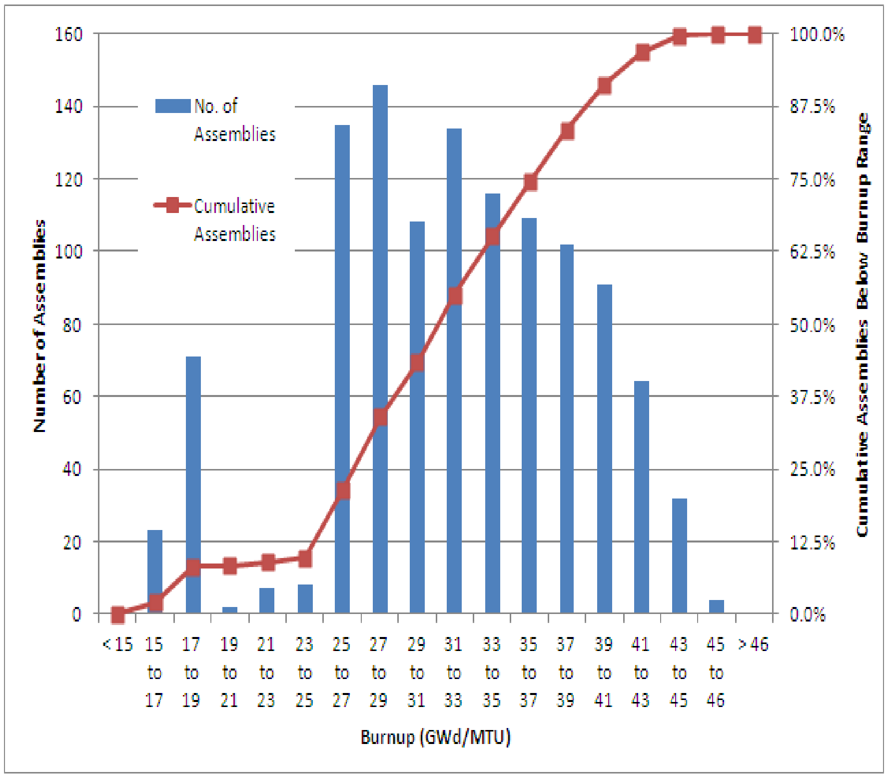
"Provide justification for the acceptability of the storage of high burnup fuel (HBF) by providing analyses and an aging management program …"

- Aging Management Program will take advantage of RAI allowance for a surrogate program
  - DOE/EPRI High Burnup Fuel Cask Demo Program Awarded on April 16, 2013
  - Load well characterized HBF of multiple cladding types into an existing bolted storage cask at North Anna
  - Use a specially instrumented lid, to begin collecting data on temperature, moisture content, and internal gas composition immediately
  - Perform hot cell examinations of "sister" rods, taken from the same HBF but not placed in dry storage, for baseline comparison
  - After 10+ years in storage, open the cask to perform visual and physical tests on the stored HBF.
- Margin Assessment Performed for Currently Loaded DSCs Containing HBF

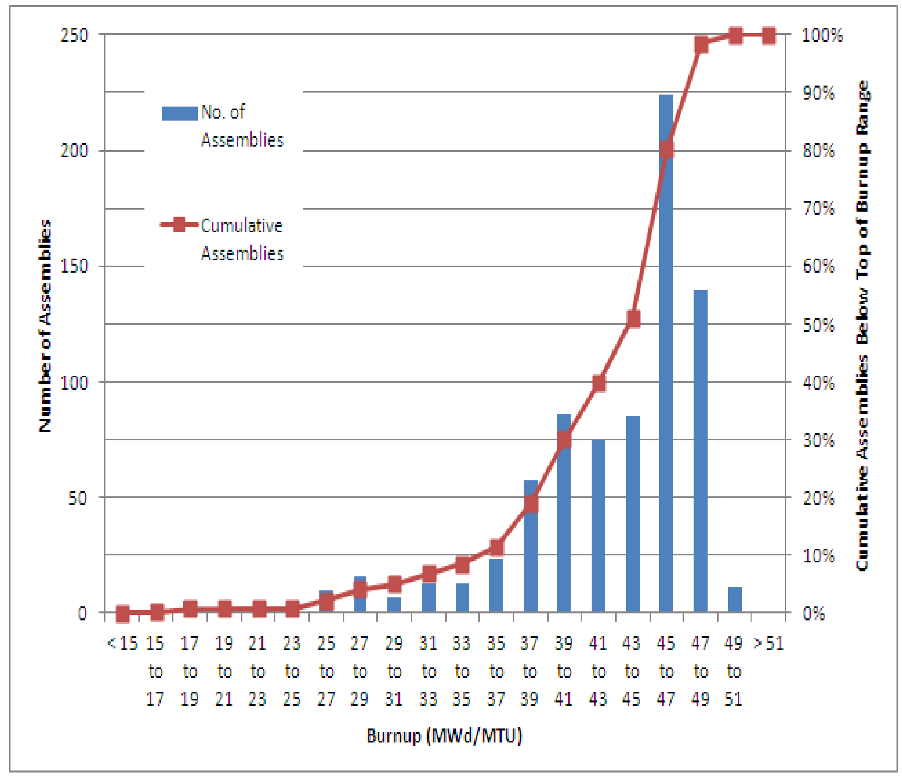



Burnup Distribution of Fuel in Storage at CCNPP

24P DSCs (48)



32P DSCs (24)

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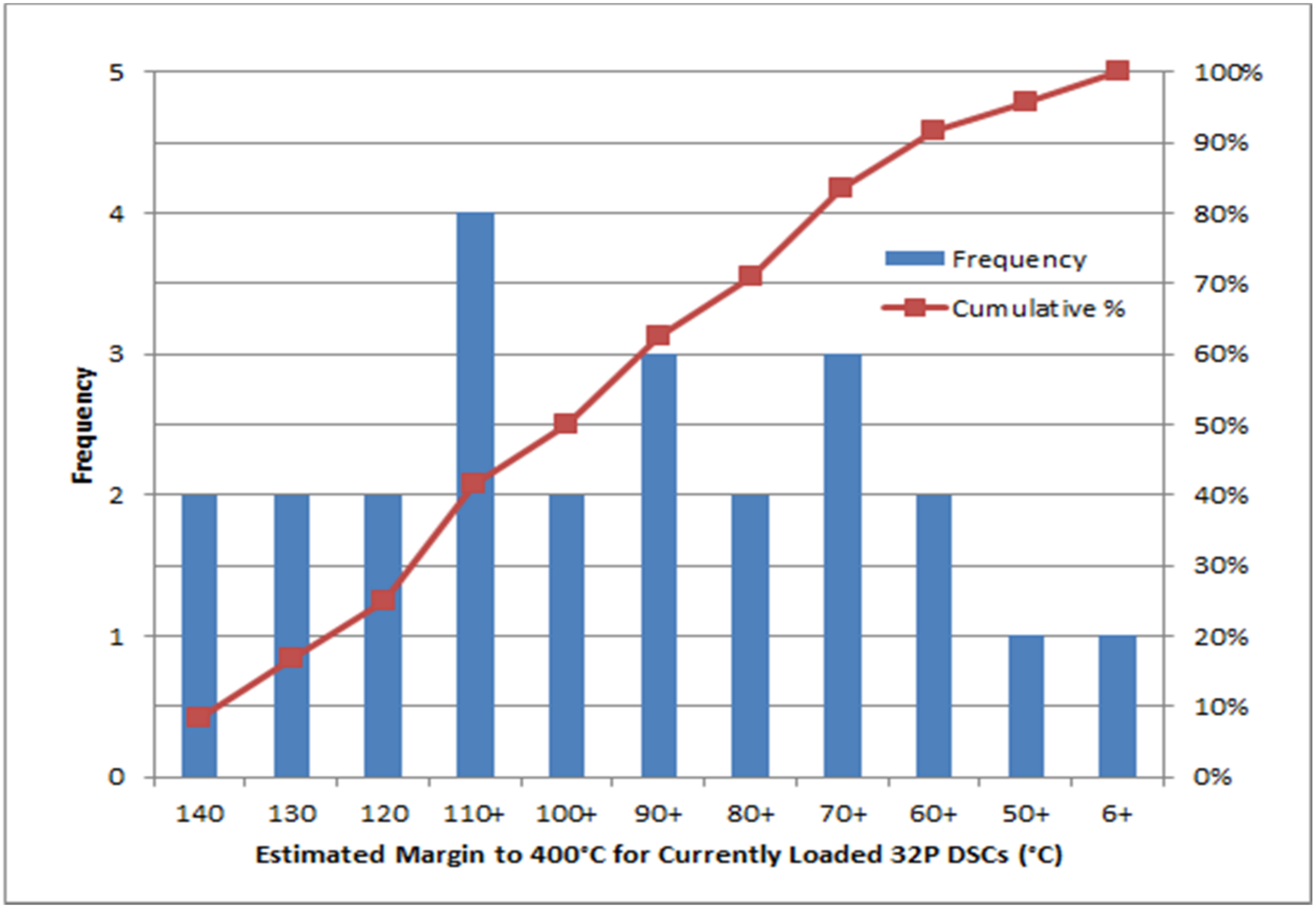
Estimated Margin to 400°C for Loaded 32P DSCs



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Margin Assessment Suggests Large Safety Factors for Radial Hydride Content

- Radial hydride content a function of burnup, peak cladding temperature (PCT) during loading and cladding hoop stresses
- Maintaining PCT < 400°C considered to minimize radial hydride precipitation
- EPRI/NEI/NRC interactions 10+ years ago resulted in development of a radial hydride precipitation model
- 96% have at least 4X less radial hydrides than at 400°C
- 70% have at least 10X less
- Larger safety factors may be possible from comparison of hoop stresses

Radial Hydride Concentration (ppm)

Hoop Stress (MPa)	Temperature (°C)									
	410	400	390	380	370	360	350	340	330	320
200	29.1	21.6	16.0	11.7	8.6	6.3	4.6	3.4	2.5	1.8
190	23.6	17.4	12.9	9.5	7.0	5.1	3.8	2.8	2.0	1.5
180	19.0	14.1	10.4	7.7	5.7	4.2	3.1	2.3	1.7	1.2
170	15.3	11.4	8.4	6.3	4.6	3.4	2.5	1.9	1.4	1.0
160	12.4	9.2	6.9	5.1	3.8	2.8	2.1	1.6	1.2	0.9
150	10.0	7.4	5.6	4.1	3.1	2.3	1.7	1.3	1.0	0.7
140	8.0	6.0	4.5	3.4	2.5	1.9	1.4	1.1	0.8	0.6
130	6.5	4.9	3.7	2.7	2.1	1.5	1.2	0.9	0.7	0.5
120	5.2	3.9	2.9	2.2	1.7	1.3	1.0	0.7	0.5	0.4
110	4.1	3.1	2.4	1.8	1.3	1.0	0.8	0.6	0.4	0.3
100	2.7	2.1	1.6	1.2	0.9	0.7	0.5	0.4	0.3	0.2
90	2.1	1.6	1.2	0.9	0.7	0.5	0.4	0.3	0.2	0.2
80	1.4	1.1	0.8	0.7	0.5	0.4	0.3	0.2	0.2	0.1
70	0.9	0.7	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1
60	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1

EPRI Report 1015048, "Spent Fuel Transportation Applications—Assessment of Cladding Performance: A Synthesis Report," December 2007.


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Summer 2012 Lead Canister Inspection


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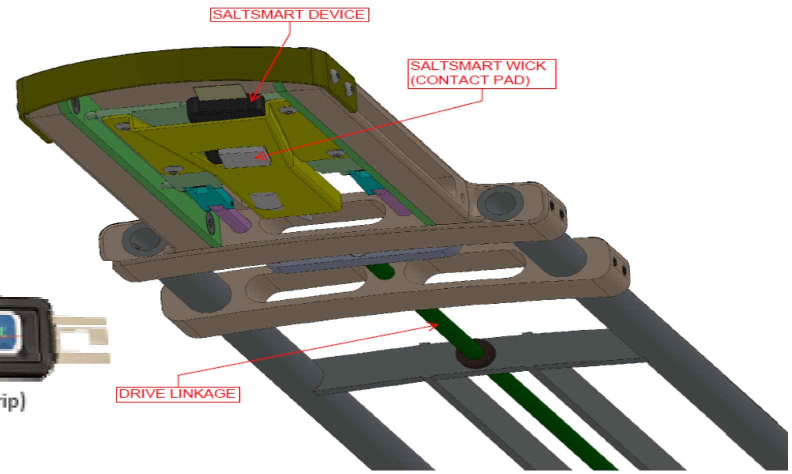
Salt Measurements and Surface Sampling

- Salt measurement performed using SaltSmart™ Device
- Measured 0.5 g/m^2 on DSC-1 top shell @ 1100 position at bottom edge (now considered unreliable due to incorrect calibration)
- Collected dust samples at 4 shell locations (1100 @ ~40”& ~20” from bottom end, 0300 @ bottom end, 0700 @ ~40” from bottom end)
- EPRI completed dust composition analysis on one sample – two others in process

SaltSmart Device (Strip)



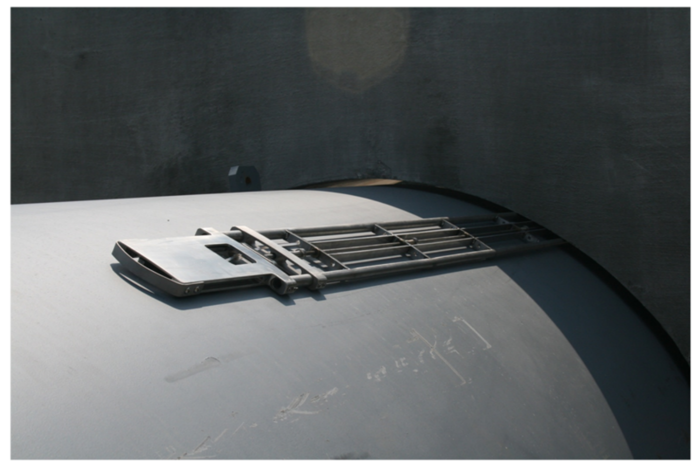


Photo courtesy of Transnuclear



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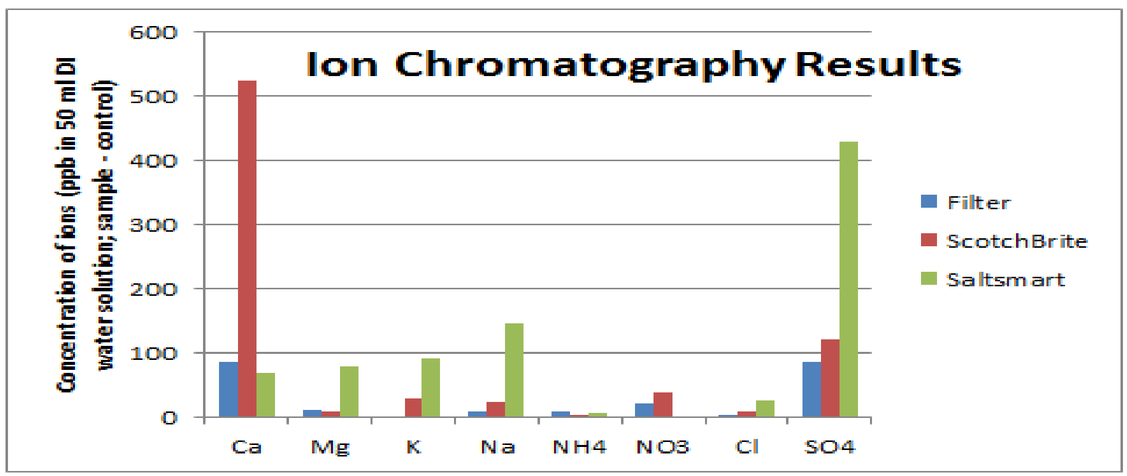
0300 Surface Sample Lab Analysis by EPRI

Summary of Concentrations from X-Ray Fluorescence[1]

	Filter Used[2] (mg/m2)	SaltSmart Used (mg/m2)
O	-[3]	161
Na	0.33	5
Mg	1.2	13.9
Al	3.7	27.7
Si	13	134
P	0.76	5.9
S	3.4	12
Cl	-	5.2
K	13	48.4
Ca	67	463
Ti	-[4]	23.4
Cr	215	3.1
Mn	29.1	8.0
Fe	1077	256
Ni	102	2
Cu	6.0	-
Zn	17.4	34.3
Zr	-	2.0

X-Ray Diffraction (ID crystaline phases)

- Magnesium Aluminum Silicate
- Sodium Silicate Hydrate
- Quartz, Silicon Oxide
- Gibbsite (Aluminum Hydroxide)
- Periclase, syn (Magnesium Oxide)
- Calcite, Calcium Carbonate
- Dolomite (Calcium Magnesium Carbonate)
- Magnetite, syn (Iron Oxide)



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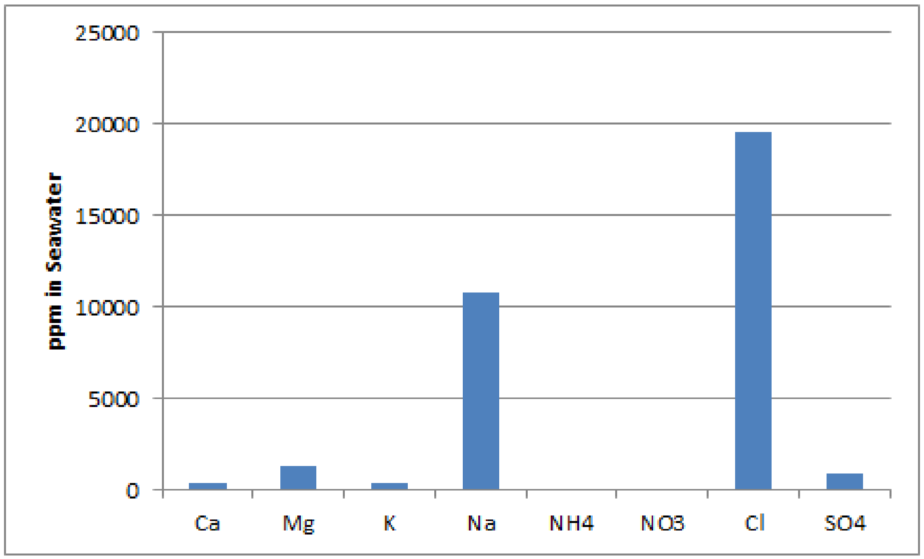
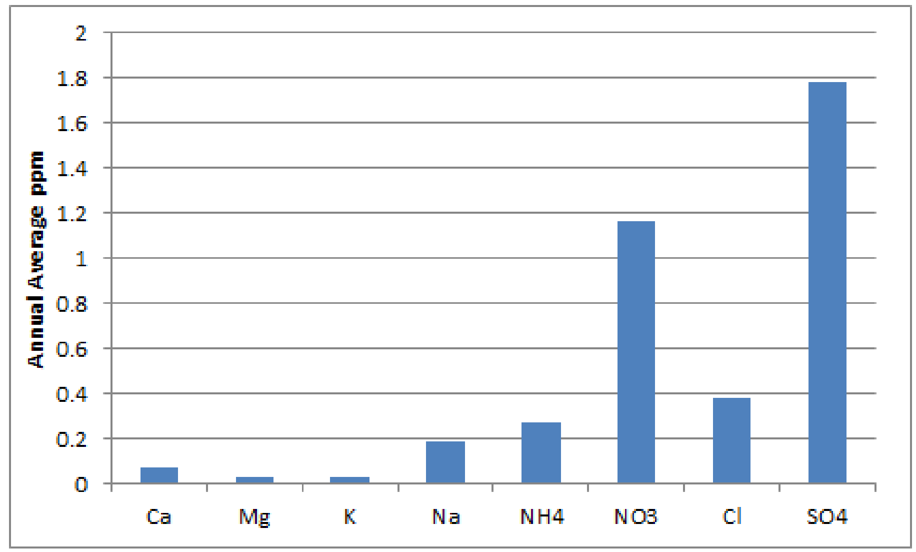
Rain and Seawater Composition for Comparison

Seawater



M.J. Atkinson and C. Bingman, "Elemental Composition of Commercial Seasalts," Journal of Aquariculture and Aquatic Sciences, Volume VIII, No. 2.

Seasonal Precipitation-Weighted Mean Concentrations for NADP Monitoring Station Near Calvert Cliffs (MD-13 Wye, MD) in 2004



EPRI Report 1013524, "Climatic Corrosion Considerations for Independent Spent Fuel Storage Installations in Marine Environments," June 2006.

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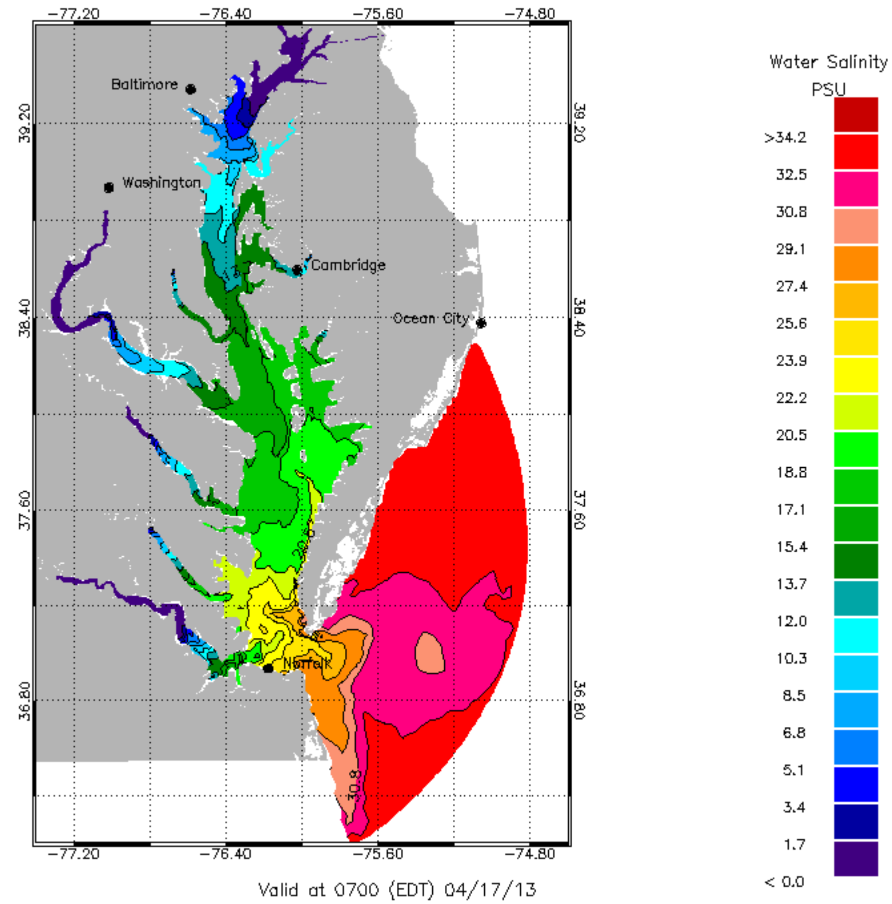
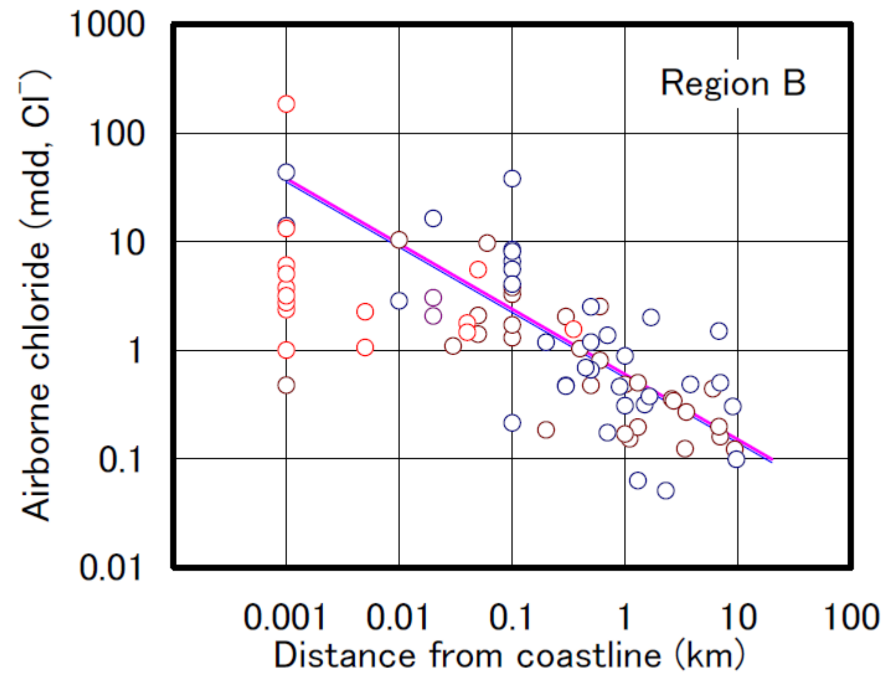
Possible Reasons for Low Salt Measurement





Tanaka, Y., Kawano, H., Watanabe, H., Tomoyoshi, N., "Study on Cover Depth for Prestressed Concrete Bridges in Airborne-Chloride Environments," PCI Journal, March-April 2006

http://tidesandcurrents.noaa.gov/ofs/cbofs/salinity_nowcast.shtml)

RAI E-1 and E-2 Responses Coming in June

RAI E-1 *– "Provide an evaluation that demonstrates that the loaded Dry Storage Canisters in horizontal storage modules at the CCNPP ISFSI currently maintain design-basis confinement integrity in order to satisfy the regulatory requirements of 10 CFR Part 72…"*

RAI E-2 – "*Provide a revised proposed aging management plan that considers the potential for SSC at the CCNPP ISFSI…"*

- E-1 Response Addresses Likelihood and Consequences
  - Likelihood of CISCC Occurring During the License Renewal Period
    - Thermal Analysis for DSC Heat Load Where Welds < 80°C
    - Time to Achieve Environment (Temperature, RH, Chloride Threshold) Needed for Initiation of CISCC
    - Fracture Mechanics Analysis of Residual Stresses in Welds
    - Crack Growth Rate Analysis for Time to Penetration after CISCC Initiation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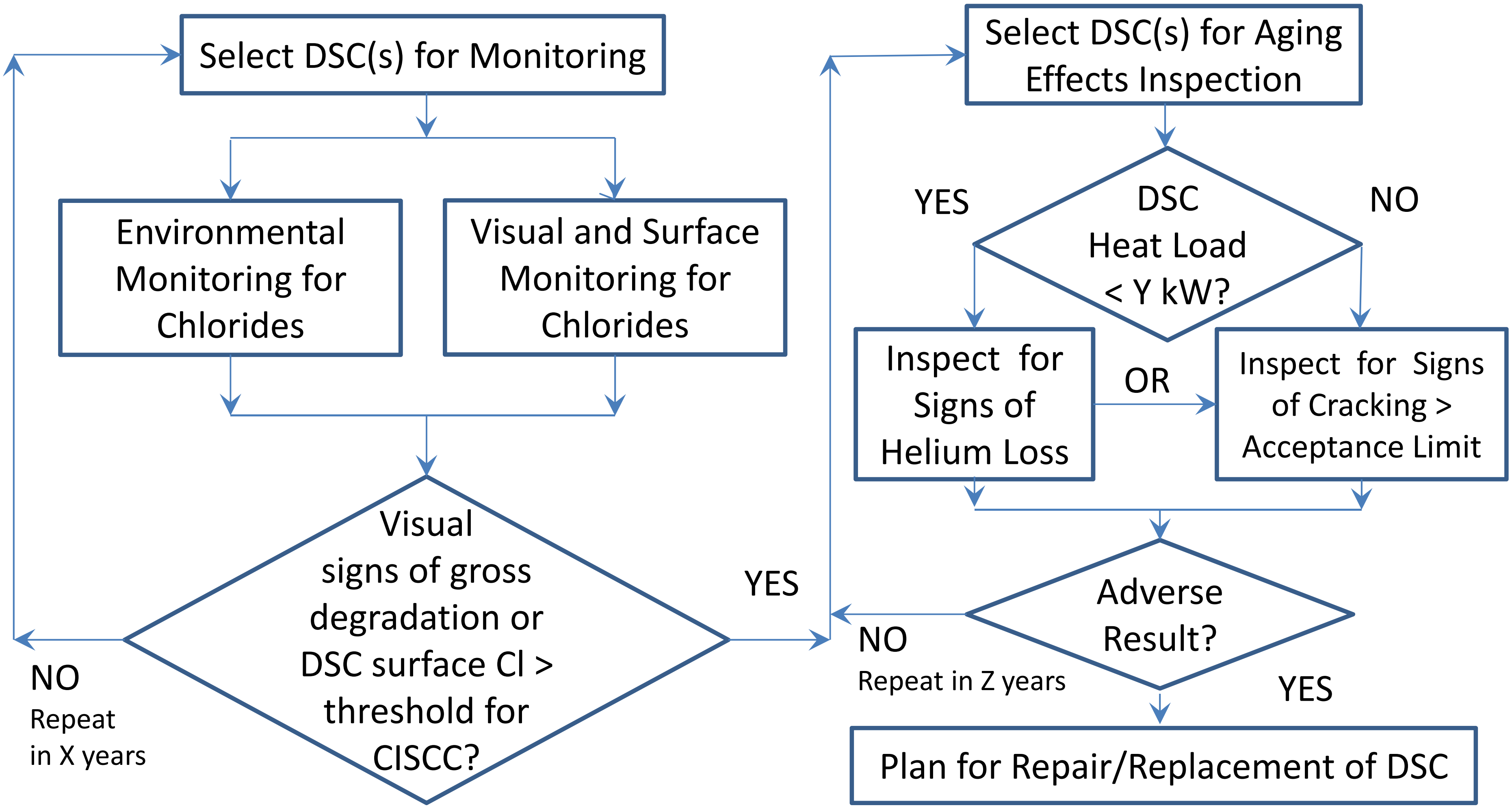
RAI E-1 Response (continued)

- Consequences of CISCC for Confinement Boundary functions
  - Intent is to provide information to risk-inform inspection and response to CISCC if it occurs, not support no-action
    - Analysis to Determine DSC Heat Load Where Times to Gross Clad Rupture on Air Exposure Become Much Longer than License Renewal Period
      - Uses EPRI NP-4524 Figure 3-9 per ISG-22
      - INL REA-2023 experience on time for oxygen levels to equalize with environment on loss of confinement in August 2005
    - Dose Analysis to Demonstrate that Doses Remain Below 72.104 and 72.106 Limits
      - Current ISFSI USAR Ch. 12.8.2.8 Design Basis Confinement Analysis and December 2011 Update for LR (ML11364A025)
      - INL REA-2023 Cask Experience
    - Discussion of Impact on DSC and Fuel Retrievability
    - Discussion of Impact on Ability to Perform Design Functions During DBEs




RAI E-2 Response – DSC Aging Management Program

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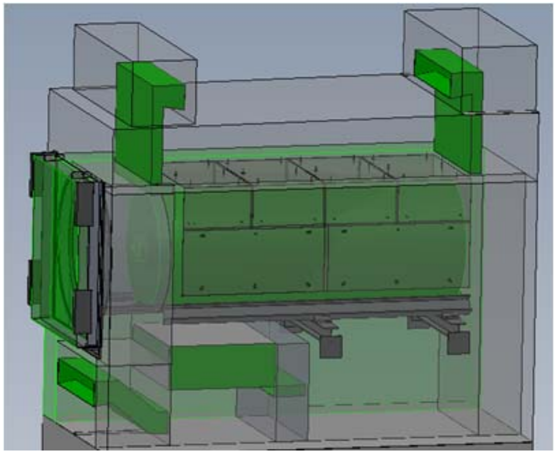
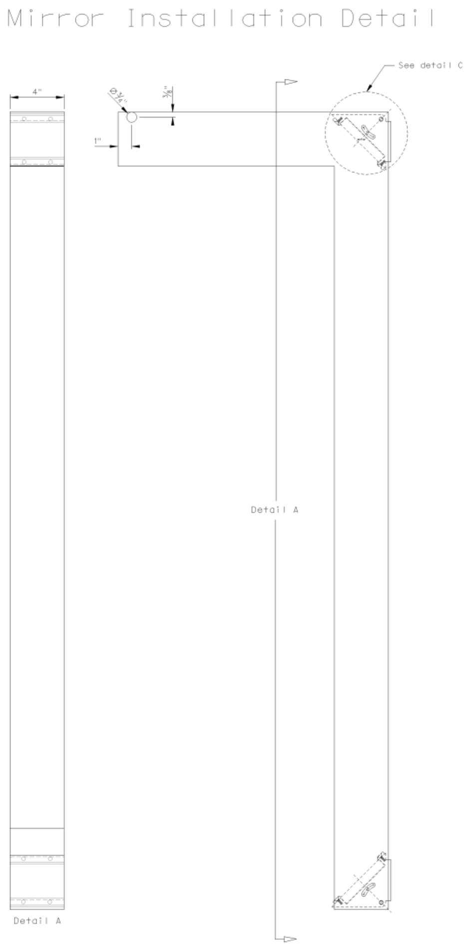
Additional Limited Inspection Planned for June 2013

- Attempting thermography of DSC Shell top and side using periscope in rear outlet vent
  - Thermal data for benchmarking models
  - Possible test to confirm helium presence in 24P DSC
    - PNNL model developed last year suggests larger ΔT between top and side of DSC with air versus helium





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