

Palo Verde Nuclear Generating Station Generic Letter 2004-02

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Introductions

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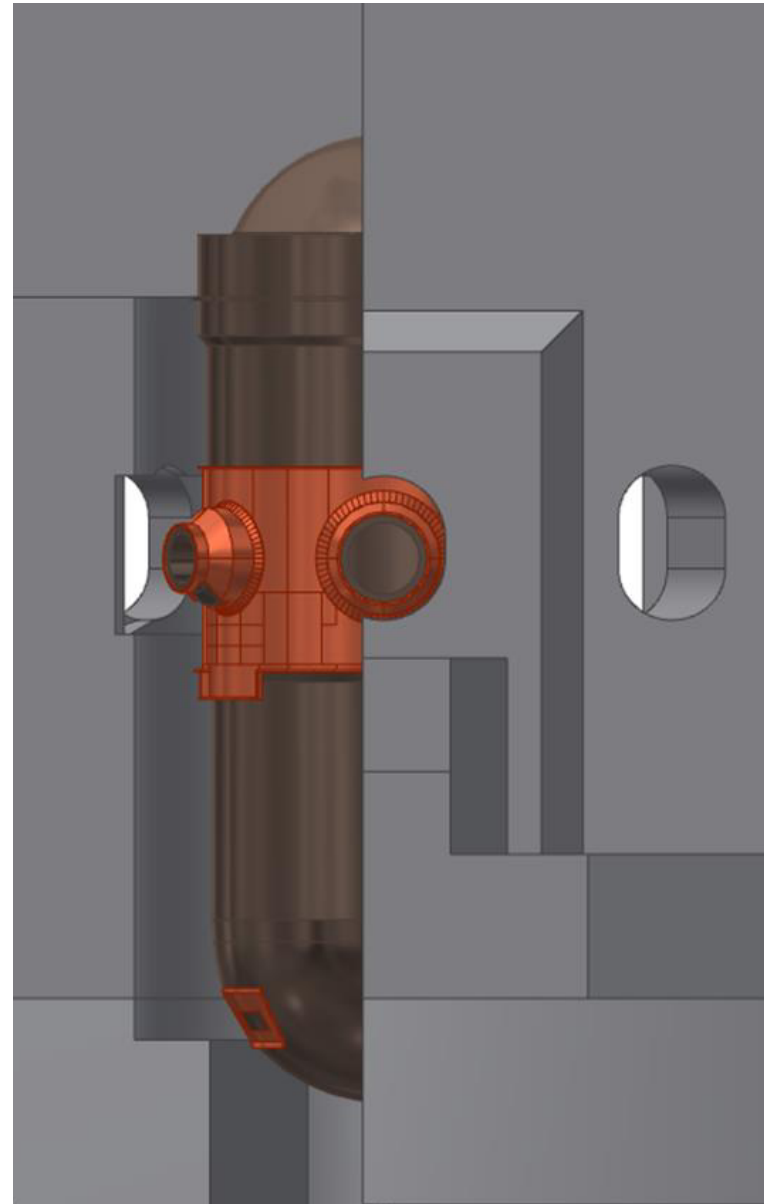
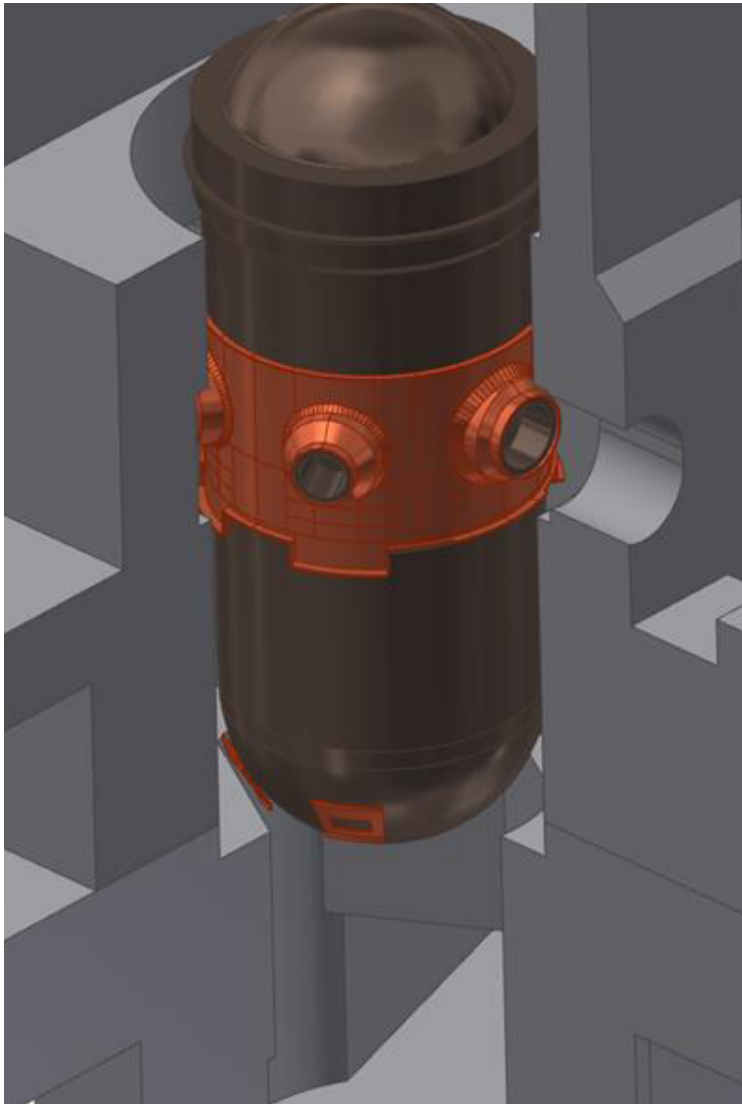


Background

- 12/18/2013 - APS submitted Revision 2 to Supplemental Response to NRC Generic Letter 2004-02
- 4/15/2015 – PVAR 4644513 documents that APS failed to identify and evaluate Microtherm on the Reactor Vessel
- 6/10/2015 – Initial Public Meeting with NRC
- 8/26/2015 – Follow up Public Meeting with NRC

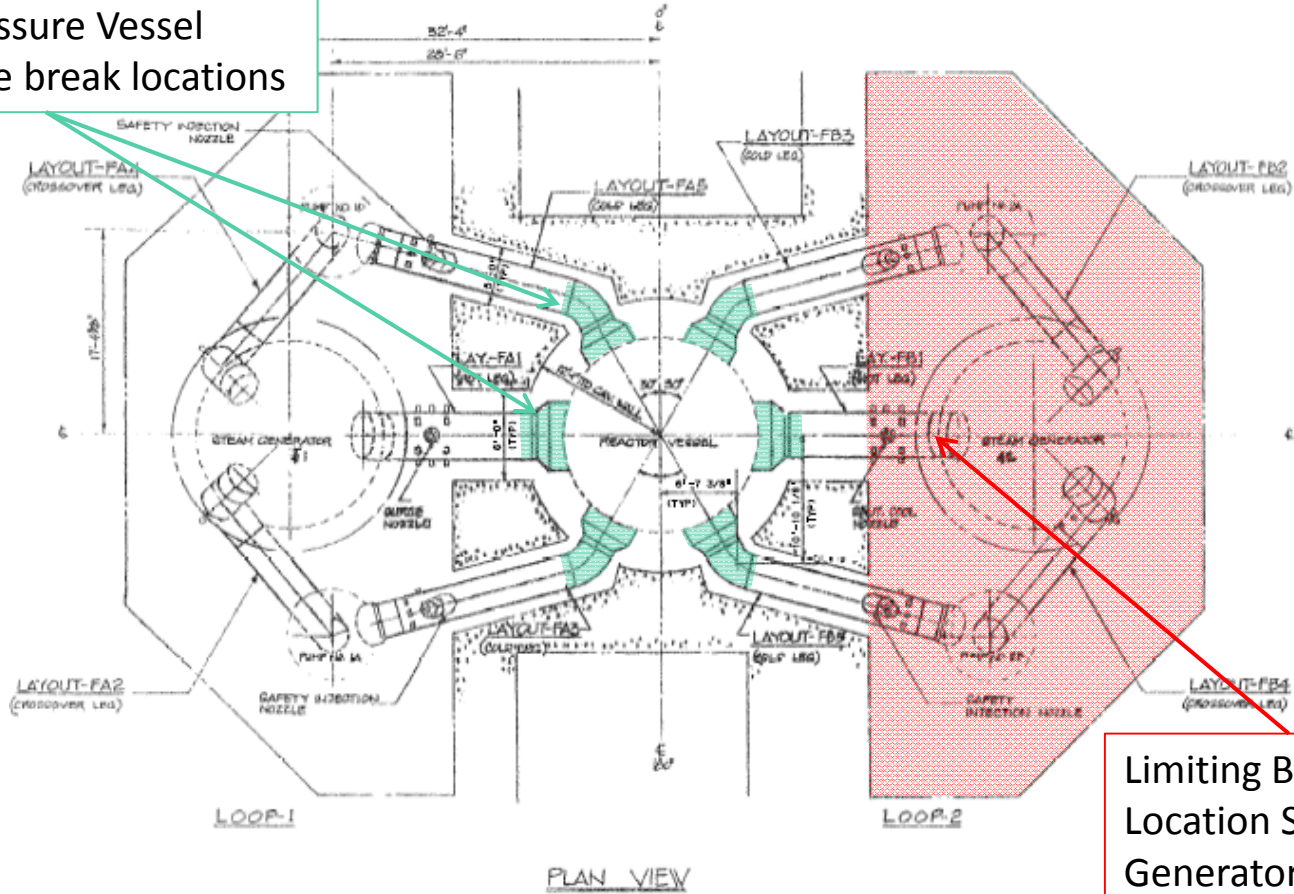


Microtherm Locations



Break Locations

Reactor Pressure Vessel (RPV) Nozzle break locations

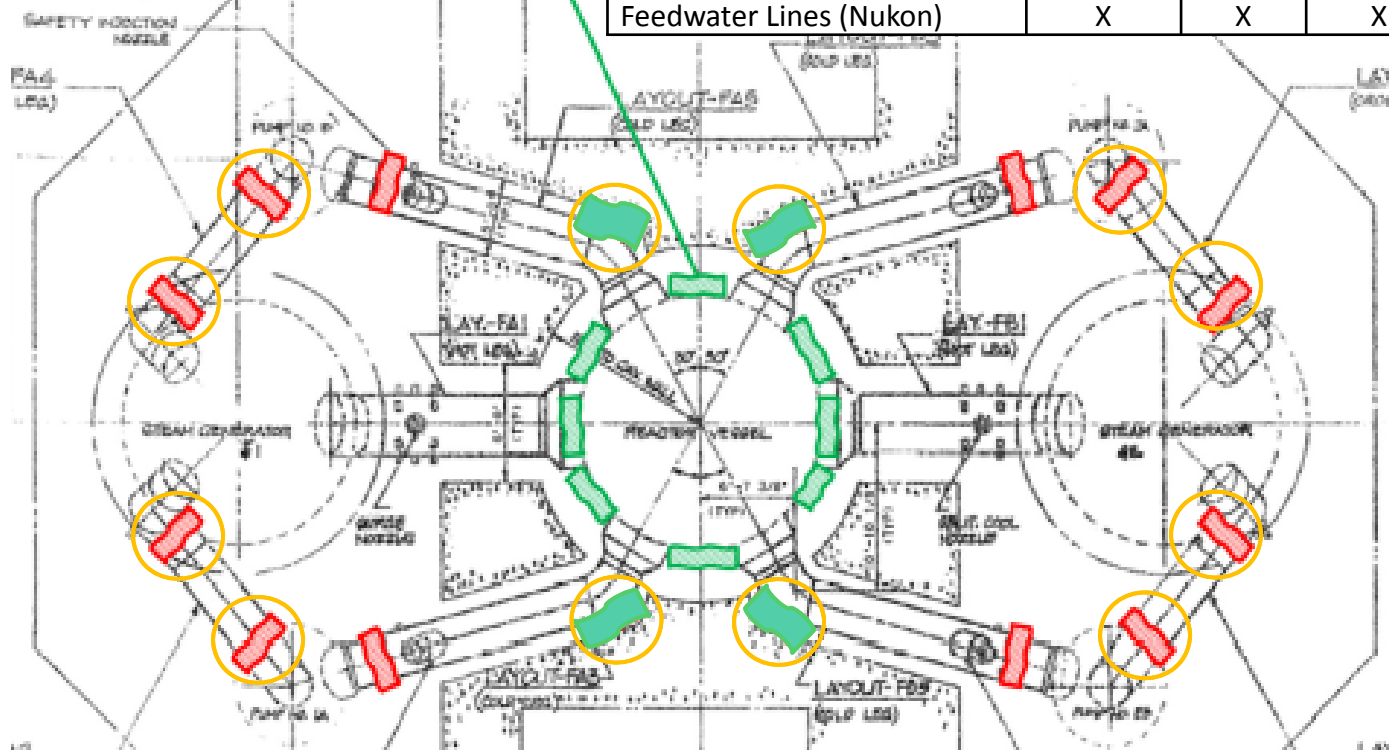


Limiting Break Location Steam Generator Hot Leg Nozzle

Extent of Condition

LOCATION	Unit 1	Unit 2	Unit 3	Planned Disposition
Cold Leg 1A, 1B, 2A, 2B RTD	X	X	X	Remove
Below RPV Nozzle	X	X	X	Addendum
RPV Cavity	X	X	X	Addendum
RPV ICIs	X	X	X	Addendum
Crossover 1A, 1B, 2A, 2B RCP Nozzle			X	Remove
Crossover 1A, 1B, 2A, 2B SG Nozzle			X	Remove
Cold Leg 1A, 1B, 2A, 2B RPV Elbow			X	Remove
RCP Stops 1A, 1B, 2A, 2B			X	Remove
Feedwater Lines (Nukon)	X	X	X	Remove

These Temp-Mat sections (typ.) are located beneath the RPV nozzle elevation



Red: Temp-Mat Impacting Existing Break Location (SG HL Nozzle)

Green: Temp-Mat Impacting New RPV Break Location

Unit 3 Only



Overview of Results

- Palo Verde was, and remains, a “low fiber plant”
- Transported fiber quantities from D-ring and RPV nozzle breaks are within the amounts used in Palo Verde head loss testing
- Microtherm impact is inconsequential – NPSH and structural limits are maintained (based on comparative analysis)
- Open surface area precludes typical high headloss impact of Microtherm on debris beds



Results of Analysis

- **Debris Generation**

- Removal of Temp-Mat in the D-rings restores analysis-of-record (AoR) D-ring break conditions
- Removal of Temp-Mat at Cold Leg RPV Nozzles keeps fiber quantity for breaks at RPV nozzles within test-of-record (ToR)
- Microtherm ZOI based on robustness of encapsulation
- Encapsulated Microtherm ZOI and restrained separation of pipe at RPV nozzle breaks – BWR Owners Group Utility Resolution Guidance ratio method – limits the quantity of Microtherm that is generated

Results of Analysis (cont)

- **Debris Transport**

- D-ring break - Temp-Mat
 - No Temp-Mat generated because it is removed
- RPV nozzles breaks – Temp-Mat
 - All Temp-Mat Fines are considered to transport from Reactor Cavity to strainers
 - Small and Large Temp-Mat pieces generated to the Reactor Cavity will not transport to strainers based on TKE and low flow velocity in upward vertical flow path of 24 to 42 feet (for all flow scenarios)
- RPV nozzles breaks – Microtherm
 - All generated Microtherm is considered to transport to the strainers

Results of Analysis (cont)

- **Chemical Effects (CE) Load**

- Estimated using Palo Verde-supplied WCAP-16530-NP spreadsheet
- Palo Verde ToR used higher CE loads than defined by AoR
- Salem U2 Test 6 (S2T6) used in comparative analyses for headloss

- **D-ring break**

- Normalized CE load (lbm/ft^2) is under 70% of ToR and less than 55% of S2T6

- **RPV nozzle breaks**

- Normalized CE load (lbm/ft^2) is slightly under (98% of) ToR and less than 80% of S2T6



Results of Analysis (cont)

- **Head Loss / NPSH**
 - Comparative analysis with S2T6 indicates Palo Verde NPSH and structural limits are not challenged
 - S2T6 fiber, particulate, Min-K and CE loads bound Palo Verde with Microtherm debris quantities
 - S2T6 had no open area – fully developed debris bed with a thickness of 0.3 inches
 - Palo Verde had (and retains) open screen area
 - Differences in approach velocities compensated by open strainer area
 - Open strainer area sufficient to address Microtherm for RPV break

Summary

- **A resolution path exists for D-ring and RPV nozzle break cases**
 - Open Strainer Area is comparable with original testing area
- **Removal of Fiber in D-Ring**
 - RTD Temp-Mat (all 3 units)
 - Temp-Mat in Unit 3 D-Ring
 - Nukon on Feedwater Line (all 3 units) for increased CE margin
- **Removal of Cold Leg RPV Elbows in Unit 3**
- **Addendum to the Supplemental APS Response to GL 2004-02 (Mid-April 2016)**



We SAFELY and efficiently generate electricity for the long term

