



ECCS Suction Strainers Near Field Effects & Scaling Issue No. 11

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Topics

Issue Overview – Near Field Effects

URG Guidance for BWR's – Near Field Effects

GSI-191 Guidance for PWR's – Near Field Effects

Issue Overview – Scaling

URG Guidance for BWR's – Scaling

GSI-191 Guidance for PWR's – Scaling

Resolution Strategy

Next Steps and Milestones

Conclusions

Near Field Effects Issue Overview

Settling of debris materials on test tank surfaces (e.g., floor) was noted in some of the PWR strainer tests

When debris settling occurs during testing, some of the debris does not deposit on the test article surfaces raising concerns that the measured head loss may be non-conservative

Assurance is needed that any near-field settling during BWR strainer testing was similar or less than would occur following a LOCA in the plant, or consistent with the analysis

Near Field Effects

URG Guidance for BWRs

- URG tests of several strainer designs used mechanical agitation to prevent debris settling
- URG does not contain specific guidance on how to perform strainer tests
- URG states that debris would not be expected to settle during initial blowdown and chugging phases of LOCA
- URG provides option for licensees to use Appendix B of NUREG-6224 to estimate fraction of debris settled after high-energy pool dynamics subside

Near Field Effects

GSI-191 Guidance

NEI 04-07 does not provide specific guidance on testing PWR strainers for near field effects

NRC guidance letter¹ provides considerations to be addressed in testing PWR strainers for near field effects:

- Need to justify that flow conditions (velocity and turbulence) near the test article are prototypical or conservative regarding debris settling for plant LOCA conditions

1: NRC Staff Review Guidance Regarding Generic Letter 2004-02 Closure in the Area of Strainer Head Loss and Vortexing (March 2008)

Scaling Issue Overview

Geometric Scaling

- Debris distribution on strainer test articles shall simulate the debris distribution on the plant strainer for LOCA plant conditions
- Geometric scaling of plant LOCA conditions to head loss test conditions shall be representative or conservative
- Typically an area-based ratio (i.e., equivalent debris volume and flow rate per unit area) is used to scale from plant conditions to test conditions

Temperature Scaling

- Strainer debris head loss tests are generally performed with a test article at ambient temperature conditions
- Head loss test results shall be realistically or conservatively scaled with temperature to plant LOCA conditions

Scaling

URG Guidance for BWRs

Geometric Scaling

- Not addressed in URG

Temperature Scaling

- URG proposed a head loss correlation that used water viscosity for temperature scaling
- NRC staff did not approve URG head loss correlation because of concerns regarding correlation accuracy unrelated to temperature scaling
- As a result of the lack of an acceptable URG approach, temperature scaling was done by each vendor

Scaling

GSI-191 Guidance

NRC guidance letter (March 2008) provides considerations to be addressed regarding scaling:

- Geometric scaling
 - Area-ratio based scaling for strainer tests can be an acceptable method to determine plant head loss
 - However, need to review plant strainer geometry to ensure flow approach velocities at the strainer surfaces are nearly uniform before applying area-ratio based scaling.
 - Non-uniform flow velocities at the strainer surfaces can affect debris distribution on the strainer and overall head loss
- Temperature scaling
 - Temperature scaling with water viscosity is acceptable provided there are no bore holes or other non-uniformities in the debris bed

Near Field Effects & Scaling Resolution Strategy

Conduct survey of strainer vendors regarding previous testing and scaling methods used to develop BWR strainer design bases

Results of survey to be provided to NRC with supporting white papers

VENDOR	Near Field Effects	Geometric Scaling	Temperature Scaling	Existence of Boreholes or Non-uniformities
PCI	Well agitated	Tests used geometric strainers scaled by surface area	Water viscosity and density per NUREG-6224	TBD
GEH	Well agitated	Test and plant strainers are similar	Water viscosity	No evidence
ENERCON	TBD	TBD	TBD	TBD
ABB/W	TBD	TBD	TBD	TBD

Near Field Effects & Scaling

Key Relationships to Other Issues

Issue 3: Head Loss Predictions

- Near field effects can affect test results upon which strainer head loss predictions are based
- Both geometric and temperature scaling can affect strainer head loss predictions
- Scaling concerns relative to bore holes and thin debris beds will be further addressed as part of issue #3 resolution

Next Steps and Milestones

Develop draft near field effects and scaling survey	4Q 2010
Survey vendors for summary of all generic tests	1Q 2011
Survey utilities for summary of plant-specific tests	1Q 2011
Survey responses due	2Q 2011
Create draft near field effects and scaling white papers and survey summaries	2Q 2011
Submit white papers to NRC	3Q 2011
Address NRC concerns and issue final report	1Q 2012