



# **Peer Review Evaluation of Post-LOCA Chemical Effects**

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**Public Meeting to Discuss the Resolution of GSI-191  
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## Chemical Effects Issue Resolution

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- GSI-191 Chemical Effect Technical Issue Resolution:
  - NRC staff review of WCAP Topical Reports
    - WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191"
    - WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid."
    - Pending WCAP on chemical model refinement
  - GSI-191 licensee audit process
  - Staff interaction with strainer vendors and the PWR Owners Group
  - **Evaluation of issues identified by chemical effects peer review panel members**



## Background

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- The NRC conducted an external review of NRC-sponsored research in chemical effects during 2005 – 2006.
- A phenomena identification and ranking table (PIRT) exercise was conducted in parallel to more fully identify and explore possible chemical effects.
- The review and chemical effects PIRT exercise identified and evaluated 108 chemical phenomena.
  - Peer review NUREG 1861: Published 12/2006
  - PIRT Summary report: Draft under review
- Initial ranking conducted as part of PIRT
  - 41 issues: unique with at least one high importance ranking.
  - 67 issues: ranked lower or could be combined with other issues.



## Staff Evaluation of PIRT Results

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- Joint NRR/RES team evaluated each of 41 unique items.
- Staff considered relevance to ECCS performance and available technical information.
  - 5 phenomena are potentially advantageous
  - 2 phenomena have no practical implications
  - 34 phenomena are potentially deleterious
    - 15 issues can be dispositioned based on available technical information or planned industry evaluations (well-known phenomena).
    - 19 issues merit additional analysis by NRC and industry
- Staff plans to develop technical justification supporting disposition of all issues.
- Most issues have been previously communicated to industry.



## **PIRT Issues: Potentially Advantageous Chemical Phenomena**

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- Deposition within containment pool
- Settling within containment pool
- Effects of precipitation/co-precipitation and ripening inhibiting transportability
- Organic complexation
- Particulate settling within reactor core
  
- NRC has no further plans to study these issues.



## PIRT Issues Dispositioned from Available Information

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- Effects due to RCS coolant chemistry variations at pipe break
- Significance of hydrogen sources in containment
- Radiolytic conversion of  $N_2$  to  $HNO_3$
- Impact of silica in RCS and RWST
- Contributions from submerged lead shielding
- Heat exchanger deposition and clogging
- Blockage of reactor core flow passages



## **PIRT Issues to be Included in Industry Evaluations**

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- Effect of containment pool pH variability
- Role of boron
- Jet impingement: concrete ablation and coatings
- If credit sought for corrosion inhibition
  - Consider pipe break scenarios where inhibiting material may not be produced
  - Consider likelihood of material to be transported to containment pool
- Short-term debris dissolution (prior to ECCS recirculation).
- Precipitation resulting from cooling in heat exchanger



## Remaining Issues for Disposition

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- Radiation/Radiolysis effects
  - Redox potential changes: alter corrosion and species formation
  - Hypochlorite formation: increase metallic (Al) corrosion rates
  - Properties of filtered inorganic and organic materials
  - Hydrothermal hydrolysis: transform organic/inorganic materials into particles or gels
  
- Corrosion/Dissolution rate effects
  - Concrete aging and material alloying effects
  - Catalytic or inhibition effects
  - Galvanic corrosion effects
  
- Role of organics and coatings
  - Organic sources (RCP oil tank failure)
  - Significance of organic materials on agglomeration
  - Coating dissolution





## Remaining Issues for Disposition, cont.

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- Post-LOCA conditions that affect inorganic agglomeration
- Additional debris production
  - Crud production and spallation within the RCS
  - Precipitation within reactor core
  - Biological fouling
  - Co-precipitation
  - *Carbonate formation*
- *ECCS pumps: Seal abrasion, seal leaching, and internal erosion/corrosion due to chemical effects*
- Reactor fuel chemical effects
  - Deposition of chemical products
  - *Diminished heat transfer due to deposition*
  - *Spalling of deposits*



## Disposition Strategy

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- Disposition of remaining (19) issues will consider
  - Industry mitigation strategies
  - More detailed consideration of plant conditions
  - Ongoing industry testing
  - NRC-scoping analyses: literature review, conservative calculations, limited conservative experiments.
- The purpose of NRC-sponsored scoping analyses is to inform review of chemical effect evaluations in GL2004-02 submittals.
- The NRC is also working in parallel with industry to resolve remaining issues.



## Implications on Chemical Effects Evaluations

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- Issues that have formally been identified for consideration remain applicable
- All issues except the following have been previously identified
  - Potential for biological fouling within the ECCS
  - Possible additional debris contributions from spalled reactor fuel deposits created by post-LOCA chemical effects
  - Coating dissolution
- Industry evaluations are not currently expected to address these previously unidentified phenomena.



## Peer Review Issue Disposition: Path Forward

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- Project timeline
  - Initiate evaluations: June/July 2007
  - Provide initial evaluations: August/September 2007.
  - Complete evaluations: December 2007.
- The NRC intends to communicate results from evaluations as they become available.
- The NRC welcomes industry input to inform these evaluations.