RIC 2007

Generic Safety Issue 191 NRC-Sponsored Research

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Office of Nuclear Regulatory Research
March 13, 2007

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Focus of GSI-191 Research

- Evaluate if chemical reaction products would form in sump-pool environments
- Examine effect of chemical products, in combination with insulation and particulate debris, on sump screen pressure drop
- Study head-loss effects of particulate on fiberglass bed formed on sump screen
- Examine bypass characteristics of sump screen and study effect on throttle valve pressure drop
- Characterize the transportability of coating debris in water

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Significant Observations

- Integrated Chemical Effect Test (ICET) project confirmed potential for chemical reactions in a PWR containment pool post-LOCA and characterized the reaction products
  - Gelatinous material could develop during post-LOCA circulation
  - NUKON insulation with sodium hydroxide buffer environment produced a white precipitate that deposited on the insulation fibers
  - NUKON insulation with trisodium phosphate (TSP) buffer produced flocculent precipitate which deposited on the insulation fibers
  - NUKON/calcium silicate (cal-sil) insulation mixture with TSP buffer produced a white flocculent precipitate which coated the inside walls of the piping
  - NUKON/cal-sil insulation mixture with sodium hydroxide buffer produced the least quantity of debris, possibly due to calcium passivation of aluminum
  - NUKON insulation with sodium tetraborate produced the least precipitates

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Significant Observations (cont'd)

- The chemical effects head-loss research demonstrated that small quantities of aluminum compound precipitates in combination with a thin fiber bed can significantly increase the head loss across the sump screens
- Experimental measurements of pressure drop across debris beds demonstrated that cal-sil particulate and/or coating debris deposited in a fiber bed can produce a significant pressure drop across a sump screen

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Significant Observations (cont'd)

- The coating transport experiments demonstrated that for the coating properties and water velocities examined, the transport of coating chips was not significant
- The screen bypass/downstream effects experiments demonstrated that:
  - NUKON fibers, cal-sil particulate, and small fragments of reflective metal insulation (RMI) foil readily penetrated screens having a mesh size of ¼"
  - The effect on downstream globe-type throttle-valve performance was mixed, with combinations of NUKON and RMI having the greatest effect
  - Repeated loadings of debris had a cumulative effect on pressure drop

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Chemical Speciation Reports

- NUREG/CR-6914, “Integrated Chemical Effect Test Project”
- NUREG/CR-6913, “Chemical Effects Head-Loss Research”
- NUREG/CR-6915, “Aluminum Chemistry in a Prototypical Post-LOCA PWR Containment Environment”
- NUREG/CR-6912, “PWR Sump Screen Blockage Chemical Effects Test: Thermodynamic Simulations”
- ANL letter report evaluating chemical surrogates and examining performance of various sump-pool buffers

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Screen Head Loss Reports

- NUREG/CR-6913, “Chemical Effects Head-Loss Research…”
- NUREG/CR-6917, “Experimental Measurements of Pressure Drop Across Sump Screen Debris Beds…”
- NUREG-1862, “Development of Pressure Drop Calculation Method for Debris-Covered Sump Screens…”

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Downstream Effects Reports

- NUREG/CR-6885, “Screen Penetration Test Report”
- NUREG/CR-6902, “Effects of Insulation Debris on Throttle-Valve Flow Performance”

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Coating Debris Transport Report

- NUREG/CR-6917, “Hydraulic Transport of Coating Debris”

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Accomplishments

- All targeted GSI-191 related research has been completed. The respective papers have been published and are or soon will be available in ADAMS and on NRC's GSI-191 web site:

http://www.nrc.gov/reactors/operating/ops-experience/pwr-sump-performance.html

- There are no current plans for initiating additional GSI-191 related research. However, the staff continues to evaluate the need for additional confirmatory research to support review of licensee chemical effect evaluations