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Status of U.S. Activities to Address Pressurized Water Reactor Sump Performance

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Generic Safety Issue 191 & Generic Letter 2004-02

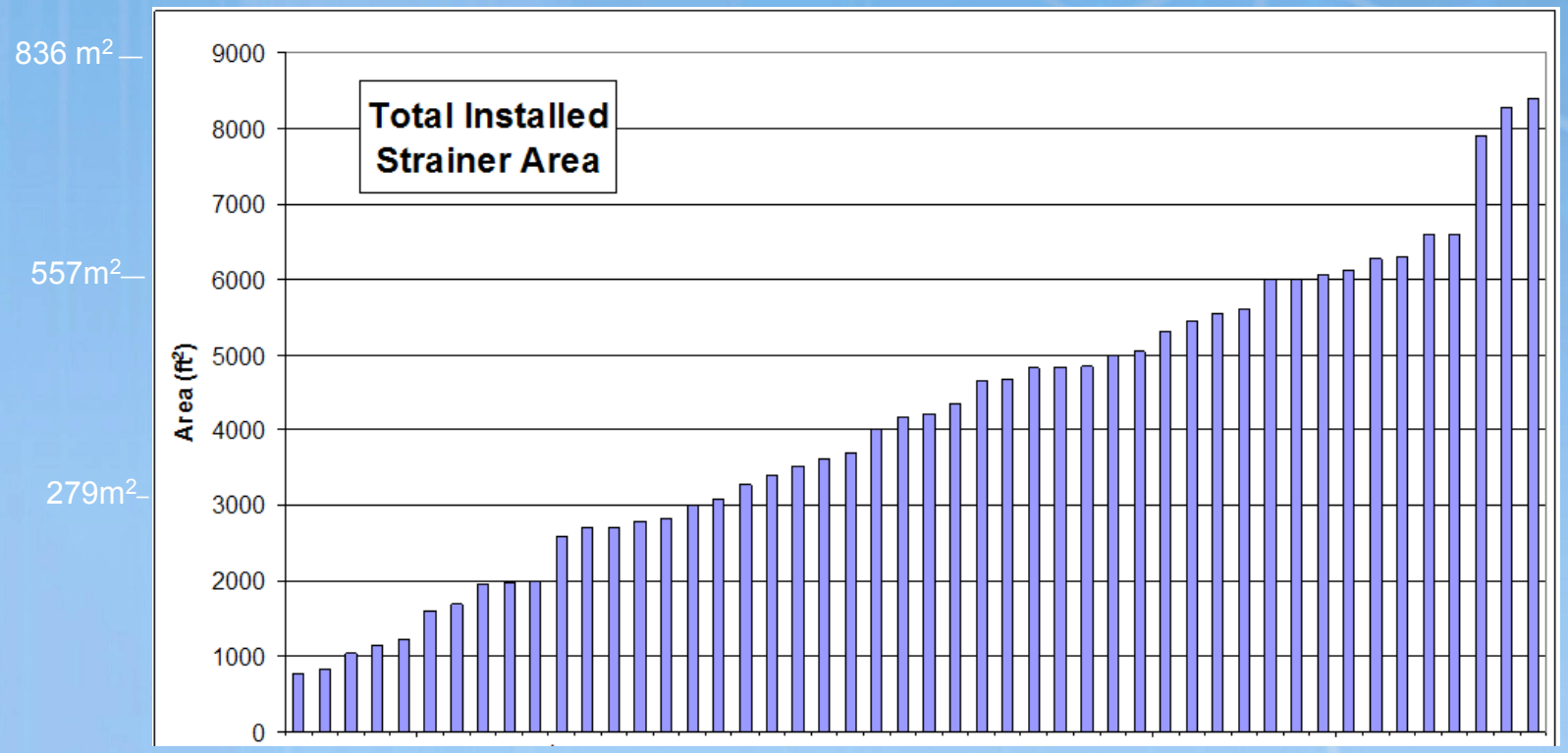
- Generic Safety Issue 191 was initiated in late 1990s to address pressurized water reactor (PWR) sump performance issues
  - Water spilling onto the containment floor during a loss-of-coolant accident (LOCA) may need to be pumped back through the core (recirculated) to keep the core cool
  - This water may entrain debris that could clog the inlet strainer to the emergency core cooling system (ECCS) or the inlet to the core itself
- Generic Letter (GL) 2004-02 requested that operators of U.S. pressurized-water reactors (PWRs) (http://www.nrc.gov/reading-rm/doc-collections/gen-comm/gen-letters/2004/gl200402.pdf)
  - Perform a plant-specific analysis of the emergency core cooling system and containment spray system in recirculation mode when mechanistically considering post-LOCA debris
  - Based on the results of the analysis, implement any corrective actions necessary to ensure compliance with regulatory requirements
    - NRC did not identify specific plant modifications to be made
- GL 2004-02 requested completion of corrective actions by December 31, 2007

Overview of Licensees' Corrective Actions

- All U.S. PWRs have installed significantly larger (1 to 2 orders of magnitude) ECCS sump strainers in response to GL 2004-02

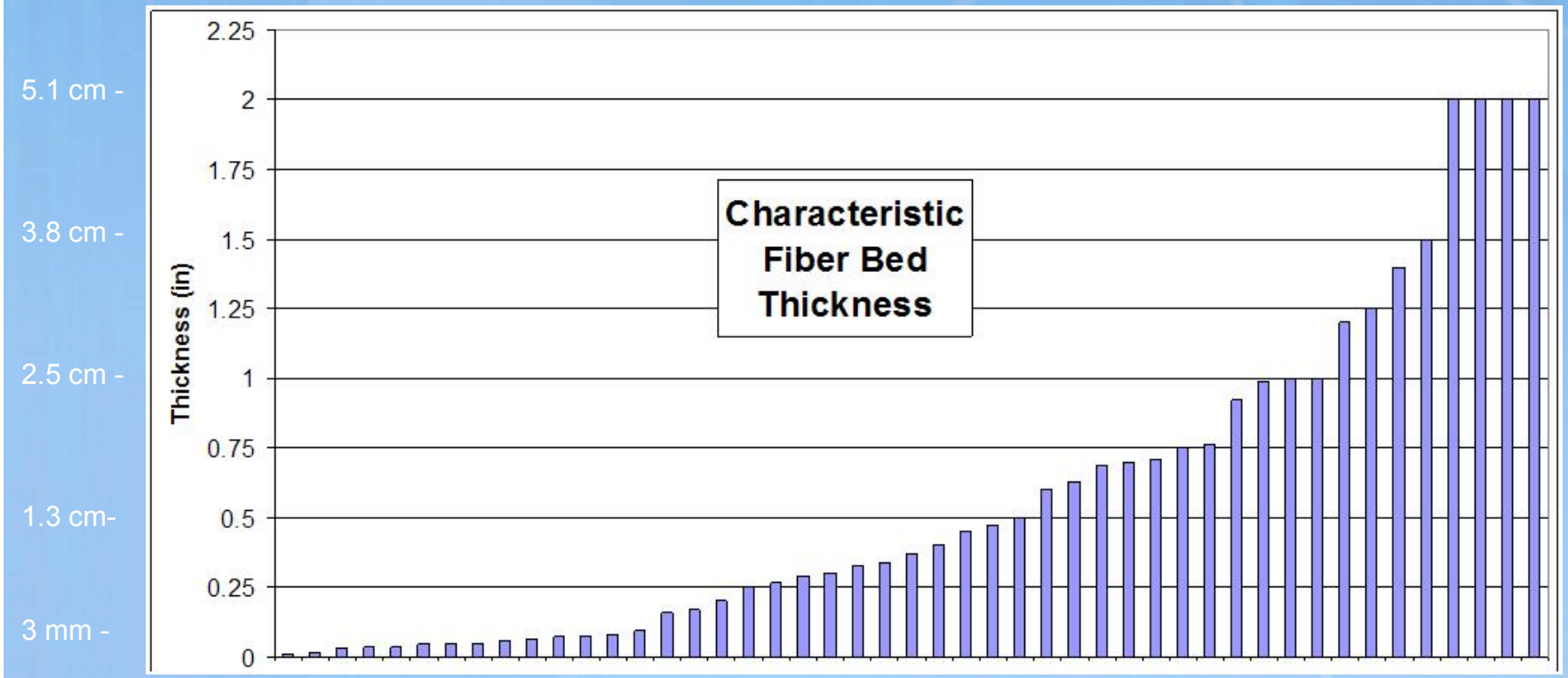
- Licensees have also performed, or will perform, other modifications, for example:
  - Insulation modifications to reduce problematic debris
  - Sump buffer replacement to reduce precipitate formation
  - Installation of debris interceptors upstream of strainers
  - Installation of trash racks over refueling canal drains
  - Increasing minimum required refueling water tank level
  - Modification of gates in bioshield wall to prevent debris blockage and water hold up

U.S. PWRs
Total Installed Strainer Area



(Preliminary Draft Data)

U.S. PWRs
Potential Fiber Bed Thickness



(Preliminary Draft Data)

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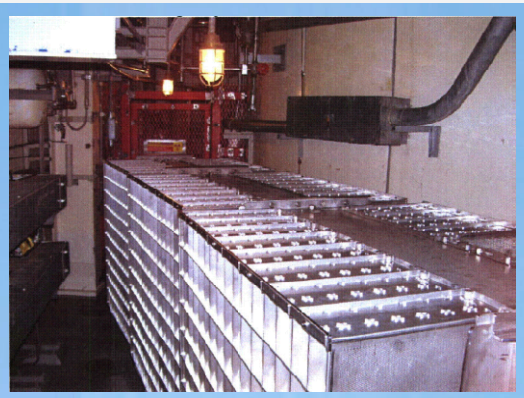
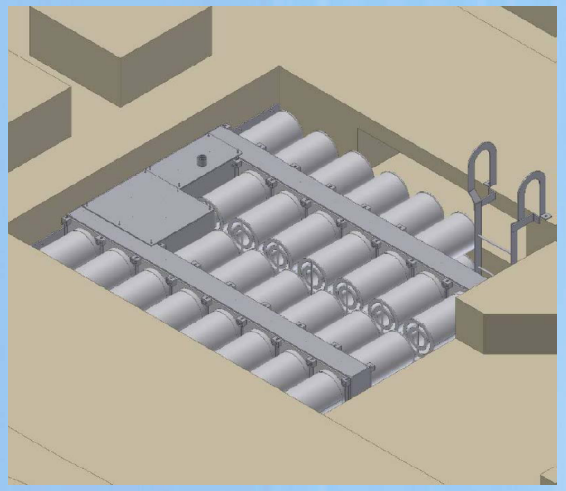
Photo Gallery





Responses to Generic Letter 2004-02

- All licensees submitted responses in 2005 and 2006 – many actions not yet complete
- Supplemental responses submitted February/March 2008
- NRC completing detailed plant-specific “holistic” review
- Review addresses whether, with due regard for uncertainties in individual technical areas, there is reasonable assurance that the plant is in compliance with the applicable regulations (i.e., that adequate long-term core cooling would be provided)

Generic Letter 2004-02 – Results of Detailed Reviews

- NRC has informed several licensees without significant fibrous or other problematic debris that the NRC has few or no questions regarding the adequacy of their sump performance
  - exception is in-vessel downstream effects (next slide)
- NRC has sent or will send questions regarding the testing and analyses performed to most other licensees
- Additional reviews will be needed for some licensees who did not submit complete supplemental responses in February 2008

Generic Letter 2004-02 – In-Vessel Downstream Effects

- The small fibers that go through the strainer is then transport downstream eventually into the core
- The concern is if these small fibrous material that pass through the strainer can then clog flow through the core
- Testing is being performed by the fuel vendors to address these in-vessel downstream effects and a revised report is expected this spring
- When the in-vessel downstream effects report is received, the NRC staff will review it and develop a safety evaluation
- Licensees will need to address this specific area shortly after the issuance of the safety evaluation

Licensee Responses

- Licensee responses to NRC questions are expected to be of the following types:
  - Demonstration that existing approach in an area is technically adequate
  - Holistic demonstration of sufficient overall conservatism in analysis to account for uncertainties or non-conservatism in a given area
  - Change from existing approach in an area to an approach acceptable to the NRC

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Future Head Loss Testing Strategy

- Essentially all PWR licensees have performed one or more rounds of head loss testing for GSI-191
- To resolve NRC questions, additional head loss testing may be necessary for some licensees due to questions on prototypicality of existing testing
- If future head loss testing is necessary, staff expects that licensees will “test to success” by identifying and testing several contingency plans until a successful result is achieved

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Generic Letter 2004-02 – Closeout

- NRC plans to issue a GL 2004-02 closeout letter to each PWR licensee when
  - All supplemental responses from the licensee have been received and reviewed by the staff
  - All questions have been adequately addressed by the licensee
- If a plant has not completed all modifications but has a satisfactory strainer evaluation in place and an acceptable plan and commitment for completing remaining modifications, NRC plans to close the GL 2004-02 review for that plant
- NRC staff will track all corrective actions to completion at all plants

Generic Letter 2004-02 – Resolution Timeline

- The NRC is currently projecting the resolution of GSI-191 technical issues by December 2009
- Some PWR licensees may not complete final plant modifications until after 2010 or 2011 due to when the next refueling outage is scheduled
- NRC is considering conditions under which such longer-term conditions would be granted

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Conclusions

- All U.S. PWRs have installed significantly larger ECCS sump strainers and made other plant improvements in response to GL 2004-02
  - Vulnerability to post-LOCA debris effects is substantially reduced
- Additional head loss testing may be necessary for some plants to demonstrate adequate strainer performance
- NRC currently projects closure of GL 2004-02 reviews by December 2009
  - Some plant modifications may continue into 2010 or 2011 and will be tracked by NRC staff

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Access to NRC Documents

- Documents generated by NRC are typically publicly available
- Many public documents associated with GSI-191 may be found on the NRC's PWR Sump Performance Website: http://www.nrc.gov/reactors/operating/ops-experience/pwr-sump-performance.html
- Public documents not posted on sump website are available online through our ADAMS document management system: http://www.nrc.gov/reading-rm/adams/web-based.html