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EXCERPT

NEI 03-08 [Addenda]

Materials Initiative Guidance

Addenda to NEI 03-08 Guideline for the Management of Materials Issues

June 2009

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The initial MDM and IMT will be revised/updated as necessary. Following each update, the responsible IP will provide updates to the Strategic Plan as appropriate to ensure that it continues to properly reflect the evolving state of knowledge and experience within the industry.

The current strategic issues identified by the process described above are:

- Nickel Based Alloy SCC

  Stress corrosion cracking of Alloy 600 and nickel-based weld material is the single biggest challenge facing the PWR industry. Stress corrosion cracking in RPV-head nozzles, instrument penetrations, pressurizer heater sleeves and piping system butt-welds are frequent occurrences. While symptoms can be detected and in some cases treated, a more fundamental and thorough knowledge is needed to properly explain this phenomenon. Research into the cracking mechanism, mitigation and the key elements affecting crack propagation as well as evaluation of replacement materials and fabrication processes is important for longer term asset management.

- NDE Technology

  As plants age, new degradation occurs. Recent plant experience with cracking of Alloy 600/82/182 materials is an example. Means to accurately detect and size such cracking is paramount to determining component integrity and remaining life. The need for NDE accuracy and sensitivity is a function of in-field geometry and parameters such as component size, materials involved and component function. The technical challenges related to volumetric examination are highly dependent on the metallurgical properties of the material(s) and the configuration, which impacts access to the area of concern. Flaw sizing limitations combined with uncertainty of crack behavior and growth often leads to conservative assumptions and actions to assure component/plant integrity.

  A significant component in the effective management of nickel-based alloy weld metal SCC is the need for appropriate NDE technology to inspect the specific areas of interest and concern. Mitigation strategies rely on being able to ascertain the material conditions prior to applying the mitigation technique. Demonstrated and tested NDE of these nickel based alloy weld materials is needed to support remaining life assessments and to identify flaws prior to occurrence of leakage.

  Work on UT technology and development of delivery systems play a key role in our ability to find and manage degradation as well as comply with 10CFR50.

- High Fluence Issues in BWRs and PWRs

  Reactor internals are subjected to continual neutron fluence. It is known that high fluence leads to reductions in fracture toughness (embrittlement), early initiation of SCC, and increases in SCC crack growth rates. However, the degree and rate of these effects is not very well understood. While mitigation strategies are available for locations at low fluences their efficacy at higher fluence levels is not fully understood. Aging

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management strategies for irradiated stainless steel and nickel based alloys and their weldments depends on early resolution of these issues. Research into this damage mechanism and the key elements affecting the relevant materials of construction, inspection techniques to identify these irradiation assisted degradation mechanisms, as well as evaluation of replacement materials and fabrication processes, is important for longer term asset management.

- Steam Generator Tubing

  Domestically, steam generator tubes are made from nickel based Alloy 600 as well as higher chromium Alloy 690. The degradation mechanisms affecting steam generator tubing can be several, originating from both primary and secondary sides. Secondary side mechanisms can be complicated and not easily understood. Consequently, to assure prolonged performance of replacement steam generators with Alloy 600TT (thermally treated) and Alloy 690TT tubing, a diligent effort should be made to develop an understanding of the mechanisms involved in the degradation of the original equipment and its possible relevance to new replacement materials.
  Laboratory corrosion test data and worldwide in-plant performance data to date of Alloy 600TT and Alloy 690TT indicates superior corrosion-resistant behavior to that exhibited by Alloy 600MA. As such, efforts to confirm this behavior and justify longer periods between tube inspections should be pursued.

- Nuclear Fuel Integrity

  Fuel cladding is the first of three physical barriers to prevent radioactivity release to the environment. During the last few years, the overall industry fuel failure rate has trended upward as increased fuel duty and new water chemistry environments have been introduced. Improved fuel reliability is the top priority for the industry. This has been recognized by the development of the "Zero Defect Fuels Initiative" in August 2006. As of this date, nuclear fuels issues will be managed under the fuels initiative, not under the Materials Initiative.

- Water Chemistry

  Water chemistry is cross cutting and can have a direct impact on materials performance and degradation. It is part of the root cause of many degradation issues as well as a potential vehicle for mitigative solutions. Actions taken to minimize problems in one area have potential side effects that may range from innocuous to severe. Improving water chemistry knowledge, identification of parameters to be used by owners to improve chemistry performance at plants and development of mitigation options are keys to managing aging effectively for the future.

  As the issue programs develop and align their strategies and work plans to address the strategic issues discussed above, schedules and milestones will be provided indicating when the industry can expect issue resolution. This information will be reflected in future revisions to the Annual Work Plan.

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