

UNITED STATES NUCLEAR REGULATORY COMMISSION Nuclear Safety Research Review Committee Washington, D.C. 20555



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24 February 1992

Mr. Eric S. Beckjord Director Office of Nuclear Regulatory Research U.S. Nuclear Regulatory Commission Washington, DC 20555

Subject: Topics Presented to the Nuclear Safety Research Review Committee, Rockville, Maryland, 25 and 26 November 1991

Dear Mr. Beckjord:

This report summarizes the views on the topics presented to the Nuclear Safety Research Review Committee (NSRRC) at a meeting held in Rockville, MD on 25 and 26 November 1991. The two main topics on the agenda were nuclear power plant aging research and the waste management research program. These two topics were preceded by a discussion with Dr. Ivan Selin, Chairman, Nuclear Regulatory Commission, who raised several issues for the Committee to consider at subsequent meetings. The issues raised by Chairman Selin to the NSRRC are:

- 1) What is the right level of research that should be conducted by the NRC?
- 2) What are the three or four highest priority functional areas for research by NRC, and how well is the NRC doing in these areas?
- 3) What skills and research will NRC need for advanced reactors and will the skills or disciplines be fundamentally different from those needed for the current generation of reactors?
- 4) How well is NRC using the results from probabilistic risk assessments to prioritize the use of resources by licensors and licensees, to address generic applications and to assess plant specific situations?
- 5) How well is NRC addressing advanced instrumentation and control issues which have fundamentally different failure mechanisms, common mode considerations, and software verification and validation issues?

At its next meeting, the NSRRC plans to discuss these questions and to begin to formulate a response to the Chairman.

AGING RESEARCH

The NSRRC is impressed with the breadth of scope of NRC's aging research program which is organized into six topics: reactor pressure vessel (RPV), piping, steam generators and non-destructive evaluation, electrical and mechanical components, concrete structures, and the joint US-USSR coordination program. About two-thirds of the funding is spent in the reactor pressure vessel and the electrical and mechanical component areas. The aging program is a comprehensive program addressing many complex issues relevant to power plant operations, licensing and license extension.

Particularly notable among the topics discussed was the Reactor Vessel Program and the years of prior research that provided a basis for the NRC assessment of the Yankee power plant. The heart of the reactor vessel studies is the combined HSST HSSI program which has been active since 1966. Basic insights have been obtained into irradiation damage of thick-walled pressure vessels and the fracture mechanics of thick sections and information has been provided on pressurized thermal shock (PTS) LTOP, and low upper shelf toughness. Computer codes (OKA-P and VISA II) have been developed to model PTS and sealed vessel tests on PTS have been conducted.

Given the breadth of the program, the Committee did not have adequate time to address the topics in depth, but it does appear that the research efforts are of high quality. NSRRC, however, has a concern that insufficient attention has been given to the closure of the research efforts, the manner in which results will be or can be implemented, and to the future direction of the program. These concerns will be addressed below and specific examples will be cited to clarify the point. These examples should not be construed as all inclusive or in need of a detailed response by the staff to the Committee, but rather that attention should be directed to the concerns themselves as a necessary program management responsibility.

Closure

Closure has not been well defined for the various topics in the aging program. The program appears to be directed toward a new definition or understanding of the concept of aging. All of the issues specified for the reactor and coolant pressure boundary are issues that were identified in the earliest days of nuclear safety design and regulation. The same is true for piping, structures and electrical components and for the last 15 years, for steam generators and PTS issues. RES should develop a closure plan and schedule for each area in the aging research program that in part provides a more comprehensive justification for further research of basic principles and of aging.

The Nuclear Plant Aging Research (NPAR) Program is essential in establishing criteria for electrical and mechanical components relating to plant life extension. Although funding reductions have delayed NPAR, it does appear that the high priority issues have been addressed. As a part of the plan for closure, justification should be presented for continuing research on these components.

NSRRC also encourages RES to proceed with the closure of its research on concrete structures both prestressed and reinforced. NSRRC acknowledges and concurs with the foreign (Japanese) supported program on prestressed concrete containments, by the foreign (Japanese) supported program on prestressed concrete containments,

Implementation of Results

The Committee did not have the time to probe how effectively the research findings on aging are or can be implemented by utilities into their maintenance programs. As the findings are transformed into policies or regulations, consideration should be given to the system as a whole and an optimum maintenance program. For example, industry's current maintenance efforts to address the aging of electrical and mechanical components are not appropriately considered in NRC's program.

A general concern of the Committee is the direction and implementation of the results of the reactor vessel research program. Current thermal shock problems in the United States are being addressed by the use of "low leakage" fuel loadings to reduce the neutron fluence on the reactor vessel walls. In most cases, this will allow current plants to reach the end of the 40-year license. The current NRC program on pressure vessel annealing has a heavy emphasis on phenomenological aspects, i.e., embrittlement, annealing, and reembrittlement of specimens, and progress is being made. However, the time scale for this work may be too long to provide a sufficient understanding of the phenomena to allow the NRC to make a regulatory determination that a specific vessel can or cannot continue to be used. Alternately, there may be insufficient information available to dictate that a specific vessel would have to be annealed if the plant is to continue operation. In some cases, annealing may be the only alternative, and there is no experience with annealing of commercial pressure vessels in the United States.

Other options such as primary system depressurization, heating the water to be used for high pressure injection, or relocating or redirecting the high pressure injection flow down through the core and up through the annulus are not a part of the current program.

So that an adequate technical basis for life extension decision is available, RES should reevaluate its reactor vessel research program to determine if:

- Phenomenological research can be accelerated or complemented with other data to eliminate the need for annealing
- · Demonstration of annealing in the United States is required, or

• The other options noted above are more desirable means to address the critical implementation issues that will arise.

Attention needs to be given to the implementation of the results from "flaw definition" research related to steam generator tubes. For example, a percentage through-wall criterion is not necessarily an adequate performance indicator for steam generator tubes. Given such a criterion, the Trojan plant has found that their steam generators far exceed screening limits when subjected to burst tests. Utilities thus have to go to extraordinary means to mitigate a phenomenon that appears to have no safety significance.

Future Directions

The committee notes that the program for Mark I steel containment has yet to be started. If there are still technical uncertainties to be resolved, priorities and commensurate funding should be provided. In addition, a program of sufficient magnitude is needed to resolve steel containment corrosion issues.

Since the Reactor Vessel Program is a comprehensive research activity that has been pursued over a number of years, and since it has added value to licensing decisions, the NSRRC recommends that RES examine this program to determine what research management lessons can be learned. Was there a particular aspect of the program or group of tasks that was most useful? What aspects were not useful? What led to the initiation of the useful work? Is PTS research a good test case to measure the efficiency rather than only effectiveness of the scope of the large, long research efforts in reactor vessels? Obviously such an assessment would be incomplete since in the future data from another portion of the program may be needed to answer a question.

NSRRC also would like to perform a selective review of the electrical and mechanical components program area to determine independently the worth of this effort. As the first step, a copy of the peer reviews for Phase I and Phase II, if available, for the following topics should be sent to each of Committee members:

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- Heat Exchangers
- High Pressure Emergency Core Cooling
- Low Pressure/RHR Emergency Core Cooling
- Control Rod Drive, BWR
- Balance of Plant Component Aging Effects
- Risk Evaluation of Significant Aging Effects

Upon review of these documents, the Committee may seek additional insights from the peer reviewer.

HIGH LEVEL WASTE

The NSRRC is encouraged by the progress being made in developing and staffing the high-level research program, and in the establishment of Systematic Regulatory Analyses. The NRC has a comprehensive and well-managed basic research program dealing with high-level nuclear waste safety. Now that the CNWRA has been established and is operating in a highly professional manner, the NRC program is self-contained and devoid of any obvious conflicts of interest. Through the funding of unsolicited proposals, conducting of conferences and joint projects with various organizations on the national and international levels, excellent communications with the scientific, engineering, and regulatory establishments are maintained. The in-house program of the NRC compliments and interacts favorably with the CNWRA activities.

Although some progress is being made it is not yet adequate to address the HLW issues. NSRRC is particularly disappointed with the progress that is being made under the HLW program on performance assessment. Progress to date seems to be minimal on this key aspect of the program. The Committee requests a report on the progress and plans for performance assessment.

The Committee welcomed the opportunity of being updated on the studies involving volcanism and regional tectonics--topics raised by the Committee's 18 May 1990 Report covering the meeting at the Center for Nuclear Waste Regulatory Analyses in 19-20 March 1990. The proposed NRC research program on the regional tectonics seeks to resolve the divergent views on the rates of tectonic processes. The initial phase of the program will involve new and more accurate techniques for measuring strain and the Committee wishes to be kept informed. The overall view of the NRC is that if they can reduce the technical uncertainties concerning the site and regional tectonics, acceptance of the regulatory position can be advanced. Groundwater hydrology also plays an essential role. Every effort should be made to understand the potential interactions between seismic and hydraulic phenomena, and the variations in the unsaturated zone for both the short and the long term.

The Committee supports the NRC research approach in seeking to assess uncertainties in the conceptual, predictive and consequence models involving the volcanic activity associated with the proposed site of the repository. The Committee suggests that updates be supplied as the program develops and milestones are set.

The Committee also had the benefit of reviewing progress reports on natural analogs, as well as a briefing on the status of high-level waste performance assessment efforts. Since insufficient time was available to review the Center's technical accomplishments and as a follow-through on Research's 9 July 1990 response to the Committee's 18 May 1990 report, the Committee suggests that the program updates be sent to the Committee on remaining major topics, such as the tasks for the integrated waste package experiments, geochemistry and hydrology, and thermohydrology. The Committee continues to emphasize the importance of seeking pragmatic, technical solutions that are effectively communicated to all interested parties, including the public.

An essential question is whether the level of effort is commensurate with the seriousness of the problems being studied. Because of the extensive effort by DOE to develop the Yucca Mountain site and the implications of the repository on the future of nuclear power in the country, the committee questions the sufficiency of funding and the urgency of the research effort being undertaken by NRC at the present time. The questions involving the water table and the regional volcanic hazard are of particular concern. The Committee suggests that the NRC consider whether a substantial increase (by a factor of 2 or 3) in the research effort in these areas is merited. Such an effort would require an integrated attack on the key questions and would, of necessity, involve the leading national experts in the related areas. The timeliness and usefulness of information from DOE's heavily-funded program to the resolution of licensing issues should, of course, be assessed before funding changes are made.

Specific problems that merit study include:

- 1) Variations in the depth of the regional water table and their causes
- Circumstances (if any) under which the water table could be elevated to include the repository
- Circumstances under which groundwater percolation could transport radionucleides to the water table and subsequent implications
- 4) The probabilistic distribution of regional volcanism in space, time, and magnitude

OTHER ISSUES

Although they were not topics to be discussed at the meeting, NSRRC remains concerned about:

- 1. The resolution of the differences between the LLNL and EPRI seismic criteria, and
- 2. The inspection and interpretation of TMI-2 vessel'samples to determine vessel failure modes and probabilities as well as core debris cooling parameters.

In your response to this letter, the Committee would appreciate a brief statement of the NRC program goals in each of these areas and a list of milestones extending through the completion of these tasks.

If you have any questions regarding this report, please contact me at (703) 883-7750.

Sincerely,

David L. Morrison

Chairman Nuclear Safety Research Review Committee

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