Response To Commissioners' Technical Assistants Questions

1. Important Aspects of Human Performance:

Human performance has a significant impact on the design, operation, maintenance, and decommissioning of nuclear reactor facilities. Specifically, operating experience indicates that latent failures resulting from deficient human performance in maintenance, testing, or work processes can impact equipment failure probabilities. PRA analyses indicate that a significant human contribution to risk is in failure to respond appropriately to accidents. The analyses further indicate that human performance is important to the mitigation and recovery from failures. The primary goal of the RES human performance activities is to support the agency's strategic goal of maintaining reactor safety. The research activities of the program are also consistent with the RES vision (SECY-99-281) to conduct independent experiments and analysis, to develop technical bases for realistic safety decisions, and to prepare the agency for the future by evaluating safety issues involving current and new designs and technologies. The recent SECY-00-0053, "NRC Program on Human Performance in Nuclear Power Plant Safety," discusses in detail an integrated program for human performance. There are three major activities with various tasks that are planned for FY 2001- FY 2003. The first major activity is to continue the development of an agency wide integrated human performance and reliability plan which incorporates risk insights from operating experience. Analysis to date shows the importance of latent errors in risk significant events. The second major activity is to develop human performance guidance to support NRR and regional reviews of human-performance related events (User Need NRR 98-025). This includes an assessment of the role of human performance as a cross cutting issue in the revised reactor oversight process. It also includes improving data used in human reliability analysis as well as development of improved human reliability analysis based on operational experience. The third major activity is to develop technical basis for review guidelines that will be used in subsequent years to evaluate human performance. This activity includes development of review guidance for hybrid control rooms now being implemented and maintaining a international cooperation through continued participation in the OECD Halden Reactor Program.

Impact of not doing work

Assessments to date by RES of the Accident Sequence Precursor (ASP) data have determined that many significant precursors were caused by deficient human performance. Without the planned research as discussed above, the understanding of the causes and implications of human performance issues will not be well understood. The role of human performance in the revised oversight process will not be assessed. Human Reliability Analysis used in PRA will continue to be a significant contributor to the overall uncertainty in PRA. In addition, as most of the major nuclear countries continue to invest in understanding human performance, NRC will be the only major nuclear country without research on human performance.

3. Chairman's Increase on Source Term Facility

Spent Fuel Pool--Source Term and Cladding Integrity: Provide technical studies and advise to user office in response to ACRS concerns regarding spent fuel pool accident risk.

In its letter dated April 13, 2000, the ACRS expressed some concerns regarding the validity of technical basis that had been used to support the proposed spent fuel pool decommissioning

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rule making. One of the ACRS concerns is related to the appropriateness of the source term used in the study, which was derived from a database which is primarily confined to conditions representative of a severe accident in a steam environment.

Development of an appropriate source term for radionuclide releases in an air environment which is more representative of spent fuel pool, dry cask, and certain reactor accidents presently requires the staff to rely on acquisition and assessment of experimental data from foreign sources. NRC development of regulatory guidance for analysis of radionuclide releases from fuel degradation in an air environment would substantially benefit from use of existing domestic facilities, specifically the fission product testing facilities (HI/VI) at Oak Ridge National Laboratory which were developed to provide independent capability for studying the release rate, chemical form, and transport behavior of fission products released from commercial LWR fuel.

This ex-reactor facility is comprised of a high temperature induction heated furnace with a series of sequentially operated collection systems to trap the various isotopes and the different forms of releases. Earlier tests at ORNL were some of the first to study the releases from what was then considered higher burnup fuel. These tests were important to confirming that the dominant forms of iodine released were not the more volatile forms of I_2 or HI but that the iodine was released in a form (e.g. CsI) more easily deposited, either in the RCS or containment. These findings have had a profound impact on our revision of thinking about source term behavior and on our regulatory treatment in the revised source term. The data from the HI/VI testing has been important to the development and validation of release models used in severe accident codes. As the industry strives for newer, more efficient fuel management strategies with higher fuel burnup, it is important that specialized separate effects facilities such as this ORNL facility be maintained to address the impacts of fuel changes on accident fission product releases and their mechanisms.

Currently, the NRC is entirely dependent on the international research community for data on the effects of fuel design and management on fission product release behavior. This applies not only to higher burnup but MOX fuel application as well. Additional emerging issues for which additional data are needed include the possible effects of decrepitation of fuel and overheating of fuel in an air environment, as might occur in certain spent fuel pool and dry storage accidents. Extending or manipulating existing data to situations beyond its originally intended purpose without verifications can lead to unintended or unsupported outcomes.

Outcome:

While the primary goal of RES source term research activities is to support the agency's strategic goal of maintaining safety, ancillary benefits include developing realistic estimates of the risk associated with spent fuel pool and dry storage accidents, hence improving public confidence and at the same time reducing unnecessary regulatory burden. This research will provide a sustainable fission products testing capability to address emerging source term issues that were not part of the original source term research.

Restart of the HI/VI facilities would have several advantages in addition to preserving a test facility in the U.S. in an area where the U.S. did the pioneering work. Location of this facilities in the continental U.S. makes shipping of fuel rods (e.g., high burnup and weapon grade MOX) much easier than overseas shipments.

Impact of not doing the work:

In its response to the ACRS, the staff stated in a letter dated May 26, 2000, that additional technical work can be completed in a timely fashion such that the rulemaking schedule is not impacted. In a memorandum to Gary Holahan from Farouk Eltawila dated July 17, 2000, RES provided NRR with a technical assessment of cladding behavior based on the best available information and noted that confirmatory work is recommended to verify the robustness of the findings. With regard to the source term issues for spent fuel pool accidents (i.e., ruthenium and fuel fines releases), it is noted that RES consequence analyses to support the rulemaking activity on spent fuel accident is a conservative interpretation of limited data that is available in the open literature. Further tests on source term of the type discussed above would likely result in a reduction in the magnitude of the source term, and further confirm the staff findings. This may be particularly important if land contamination becomes an issue as a result of a comparison that is underway of spent fuel pool accident risk with the quantitative health objectives for early fatalities and cancer fatalities.

In addition to the source term issues in the area of spent fuel pool accidents, there also are source term issues in the areas of reactor accidents and accidents for dry storage casks containing spent fuel. With regard to reactor accidents, the revised (NUREG-1465) source term is used for cores with the maximum fuel rod burn-up of 62 Mwd/t. The experimental basis for using the revised source term for higher burn-ups does not exist.

With regard to dry storage casks containing spent fuel, RES is undertaking an assessment of the risk from dry storage cask accidents for the purpose of risk-informing the regulatory requirements. As with spent fuel pool accidents, releases of ruthenium and fuel fines are expected to be important issues. Earlier experimental data show that significant ruthenium releases from unclad fuel pellets in air are possible at relatively low temperatures. Again, experimental data to do more than make conservative bounding estimates of source terms do not exist. We expect that a better quantification of accident source terms will be needed. If this work is not performed, the staff will continue to use the existing conservative source term data, which might not be suitable for risk-informing the regulations. This may particularly be a problem for licensing of spent fuel storage facilities, because of the low acceptance criteria for consequences from accidents at these facilities.

Data on source terms for mixed oxide (MOX) fuel also is limited.

In conclusion, unnecessary conservatism in our source term estimates has the potential to burden licensees and move us away from the initiatives currently in place to reduce such unnecessary burdens and use more realistic assumptions in the regulatory process. A more realistic source term also will also help to surface more important safety issues and will result in a better focus of NRC resources.

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