NRC STAFF RESPONSES TO RECOMMENDATIONS
ON RESEARCH ACTIVITIES CONTAINED IN
ACRS, "BIENNIAL REVIEW AND EVALUATION OF THE NUCLEAR
REGULATORY COMMISSION SAFETY RESEARCH PROGRAM"

On February 26, 2018, the Advisory Committee on Reactor Safeguards (ACRS) submitted a letter to Chairman Svinicki regarding, "Biennial Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program." The ACRS found that overall, the U.S. Nuclear Regulatory Commission (NRC) safety research program, which is largely directed at fulfilling user need requests (UNRs) from the regulatory offices, appears to be meeting near-term agency needs satisfactorily. The report also contains a number of observations and recommendations about the NRC's safety research program. The NRC staff responses to the ACRS recommendations and observations are provided below.

RECOMMENDATION 1 - Prioritize Agency Research with Emphasis on Enterprise Risk Management of Research Activities

The ACRS identified that the current Office of Nuclear Regulatory Research (RES) process to prioritize agency research could be improved by performing a systematic assessment that emphasizes "enterprise risk" in research project selection, evaluation, and termination.

The staff agrees with the importance of systematically evaluating RES priorities to ensure that the agency is conducting research that is necessary and most important to the accomplishment of the agency's mission. In 2017, RES completed a re-evaluation of how research projects are prioritized and subsequently instituted a more systematic approach that reflects enterprise risk consistent with the agency's Enterprise Risk Management (ERM) methodology. The prioritization tool, as designed, provides insights about the relative priority of research projects, reflects input on priorities from the regulatory offices, and supports budget formulation and execution in the research program. The prioritization tool includes the elements of enterprise risk as described in the ACRS discussion under "Integration of RES Priorities." For example, the prioritization tool considers safety and risk impacts, deterministic factors such as engineering margins and defense-in-depth, ability to reduce uncertainty or to improve state-of-knowledge, generic fleet applicability, internal and external demand drivers, staff skill development or maintenance, and efficient use of agency resources. The staff used the tool initially in formulating the proposed budget for Fiscal Year 2020 and will enhance and refine the prioritization tool from lessons learned as the staff gains experience using the tool.

In regards to terminating research projects that have fulfilled their objectives or are otherwise no longer necessary, the termination of projects is informed by sunsetting provisions identified in SECY 02-0144, "Process Used to Determine When Further Research on a Particular Item Should be Close or Terminated," that include ending a project when (1) the work scope has been completed, (2) the knowledge gained from research is sufficient to satisfy the needs of the NRC user, or (3) the value of incremental knowledge from further research is no longer cost effective. In addition, during the last three years, the staff has explicitly considered establishing specific sunset provisions in responding to new requests for research and, as appropriate, is including conditions for termination in user need responses.

The NRC has implemented ERM as part of its performance management to provide enhanced agency-level oversight of important issues. The agency ERM framework is a graded tool, where

offices manage operational items with internal controls and observations. Office staff and management are responsible to identify and assess issues that would challenge agency success. If issues are crosscutting and of great importance to the agency, those are reported to a team of office directors to assess and identify agency actions that would be monitored and tracked. For research activities, the staff would identify, assess, and mitigate risks at the program and office level. For example, if core capabilities or our ability to maintain analytical computer codes are degraded, the staff would report this as a risk and take appropriate mitigative actions.

RECOMMENDATION 2 – Develop Long-Term Strategies to Address Emerging Technical Issues, Support Development and Maintenance of Analytical Tools and Databases, and Preserve Core Competencies

The ACRS recommended that RES should develop long-term strategies to address emerging technical issues, support development and maintenance of needed analytical tools and data bases, emphasize activities that improve regulatory efficiency, and identify and preserve needed core competencies.

The NRC staff agrees that development and effective implementation of long-term strategies are essential to ensuring the effectiveness and efficiency of the safety research program and to providing the research necessary for licensing and other regulatory functions. These strategies must be informed and developed with input from internal and external stakeholders. Currently, long-term strategy formulation is driven by agency strategic direction and environmental scanning as well as the development of research plans, the feasibility process, and a continuous process of self-assessment[1]. Specifically, SECY 18-0060, "Achieving Modern Risk-Informed Regulations," Enclosure 7, identified that the agency "should remain in stride and on pace with developments of new technologies in the private and public sector and to assess their significance with respect to the NRC's regulatory programs rather than waiting for industry to complete technology development before beginning significant NRC engagement such as anticipatory or confirmatory research, guidance development, or rulemaking. More proactive, forward-looking engagement will help to ensure that the NRC is prepared to regulate the potential use of the technology and not unnecessarily impede the implementation of new technologies." RES coordinates these activities and initiatives with the regulatory offices and with the Commission, as appropriate.

OBSERVATIONS – Related to the Division of Risk Analysis

In the division review, the ACRS identified the importance of activities to preserve advanced probabilistic risk assessment (PRA) analysis skills and tools. As the NRC continues to increase the use of risk information in regulatory decisionmaking, the staff continues to provide updated tools, methods, data, and technical support to meet agency needs and to provide staff with the capability to independently evaluate plant safety and risk. One goal is to keep up with and to apply PRA state-of-practice methods and tools. This goal is being achieved with the Level 3 PRA project and refinements to Standardized Plant Analysis Risk (SPAR) models. Using state-of-practice PRA methods and tools improves confidence in decisionmaking to help focus agency resources on the most risk significant issues. These risk analysis methods and tools also improve the staff's capability to review and to analyze agency and plant performance as

[1] RES uses office instruction PRM-001, *Process for Responding to Work Requests: Informal Assistance Requests, Feasibility Study Requests, Research Assistance Requests, User Need Requests, and Research Plans*, to coordinate and plan work activities.

part of the Accident Sequence Precursor program and the operating experience data evaluation program.

The ACRS acknowledged the ongoing collaborative efforts by the staff with external organizations in areas of seismic, flooding, and other external hazards and concurred with staff plans to update guidance as necessary. RES appreciates ACRS support of these efforts and intends to continue this work to address emergent agency needs as appropriate.

The ACRS noted that they were unaware of any research addressing the need for models to assess the risks involved with implementation of digital instrumentation and control (I&C) solutions and the need to quantify uncertainties affecting the reliability of passive heat removal and passive injection systems. At this time, the staff is providing support to the regulatory offices in developing the basis for further risk-informing the regulatory framework for I&C systems and components and in establishing PRA methods with sufficient quality to guide regulatory decisions for digital I&C technologies. The task will include the identification of potential gaps, challenges, and data/modeling tools needed to establish the feasibility of developing a risk-informed review approach.

In the area of passive system reliability, the staff will continue to evaluate whether additional research is warranted on models to quantify and to propagate the uncertainty of passive heat removal or passive injection systems. Using available state-of-the-knowledge tools, methods, and data, the staff will perform a feasibility study to estimate the potential contribution of passive system reliability on plant risk and on the safety significance of plant design attributes (especially for the advanced reactor design concepts). Lessons learned from this study, including the risk insights and technology gaps, will inform and guide the next steps in this process.

Regarding research programs to increase the realism of fire PRAs, the staff agrees with the ACRS's observation to complete the assessments of recent high energy arcing fault (HEAF) test results prior to beginning additional testing. These assessments, along with stakeholder interactions, are ongoing to ensure a better understanding of the phenomena as well as to ensure that any subsequent testing is representative of actual plant conditions and can be used to provide reliable and realistic estimates of the risks and consequences of HEAFs. Lastly, regarding the development of the Integrated Human Error Analysis System (IDHEAS) human reliability analysis (HRA) methodology, the staff agrees with this ACRS goal to develop a coherent and implementable methodology to guide future HRA development. As part of this effort, the staff is also applying the general methodology for specific applications (e.g., for event assessments and for operator actions outside of the control room). The staff looks forward to briefing the committee on the progress of these efforts and will continue to work with the committee on achieving the outcomes in response to the November 8, 2006, Staff Requirements Memorandum (SRM)-M061020 on this topic.

OBSERVATIONS – Related to the Division of Safety Analysis

The reactor safety program recognizes that maintenance and development of expertise and computer code capabilities are essential to fulfilling the NRC's mission. Computer codes support confirmatory reviews of safety analyses for the operating nuclear power plants and the development of capabilities to confirm the safety of advanced reactor designs. Most importantly, these codes inform regulatory decisionmaking that enhances the staff's effectiveness and efficiency.

The staff agrees that modernization of MELCOR and MACCS could be needed to support advancement of physical models and improvements in numerical solutions. Continued modernization of MELCOR and MACCS supports assessment of accident-tolerant fuel and advanced reactor licensing. The staff is currently developing a business case to support decisions on long-term strategies for ensuring the NRC's capabilities for confirming nuclear power plant safety, and modernization of MELCOR and MACCS will be considered as part of this analysis. Without the readiness of these tools, licensing reviews could require additional time, and deployment of advanced nuclear fuels and reactors may take longer. Resources available for this activity are balanced between supporting current confirmatory reviews and enhancing modeling capabilities. Most improvements are currently being made through incremental refinements made through cost-sharing agreements that are supportive of code modernization.

The staff agrees with the ACRS observation that clear communications with non-light water reactor (non-LWR) applicants are needed to identify what data will be required to support regulatory decisions. The NRC recently issued a guidance document, "Nuclear Power Reactor Testing Needs and Prototype Plants for Advanced Reactor Designs" (ML17312B567). This document describes the relevant regulations governing the testing requirements for advanced reactors, describes the process for determining testing needs to meet the NRC's regulatory requirements, clarifies when a prototype plant might be needed and how it might differ from the proposed standard plant design, and describes licensing strategies and options that include the use of a prototype plant to meet the NRC's testing requirements. In addition, the staff has and will continue to engage stakeholders on what data and other information will be needed to support non-LWR applicants through workshops, conferences, and periodic stakeholder meetings.

In its review of individual codes, the ACRS identified the key challenges facing the staff in maintaining its confirmatory codes. These themes include improving code modularity to facilitate code consolidation, improving staff access to the high performance computing environment, emphasizing the data needs for code validation of new design concepts, separating model development from the development of modern numerical solvers, and ensuring core competencies in the safety code areas.

The staff agrees with both the code development challenge areas noted by the ACRS as well as the potential solutions proposed. The staff intends to apply these solutions across not only the codes mentioned but the entire suite of NRC safety codes.

OBSERVATIONS – Related to the Division of Engineering

The ACRS identified several observations that would enhance organizational efficiencies and provide benefits to stakeholders. First, the ACRS encouraged the staff to undertake a more proactive role in the review and approval of revisions and supplements to consensus codes and standards promulgated by standards development organizations (SDOs) such as ASME[2]. This would address an apparent delay between the SDO's publication of new or revised codes and standards and their incorporation by reference into the *Code of Federal Regulations*. Although the staff agrees that, in some past instances, the approval of codes and standards has not been timely, the staff has made significant improvements in recent years, notably with respect to reviewing and approving the ASME Boiler and Pressure Vessel Code. For instance, the

[2] American Society of Mechanical Engineers

FY2018 rulemaking for 10 CFR 50.55a, “Codes and Standards,” incorporates by reference the 2015 and 2017 Editions of the ASME Code. This is, in part, attributable to focused and early engagement with SDOs on the standards development process to identify and resolve NRC technical concerns, and to strategic prioritization to align resources with those codes and standards that have the broadest safety significance.

Next, the ACRS recommended that the staff identify opportunities to reduce the scope of research in certain technical areas, recognizing that it is primarily the responsibility of licensees or applicants to generate data to support safety analyses. With respect to new and emerging technologies, the staff agrees that research programs need to take a balanced approach such that staff are sufficiently informed to ensure readiness for potential review of industry proposals. In addition, the staff agrees that NRC modeling, testing, and other experimental work is limited to the confirmation of safety rather than development of the fundamental technical basis for safety that is the responsibility of licensees and applicants. In regular engagements with industry counterparts, supplemented by the use of the new Feasibility Study Process, the staff surveys and monitors trends and indicators that suggest development and deployment of new technologies. As industry intentions become clearer, the staff works with regulatory offices to ascertain technical information needs well in advance of applications, licensing reviews, or rulemakings and guidance development. As an example, upon recognizing recent industry interest in advanced materials manufacturing for reactor components, the staff met with vendors, the National Laboratories, the National Institute of Standards and Technology, the Electric Power Research Institute (EPRI), and the U.S. Department of Energy (DOE) and conducted a public workshop to assess the technological readiness and near-term applications of these technologies. Future research plans will be shaped by monitoring industry progress and assessing safety significance of differences between these technologies and more conventional materials and methods. This approach, in principle, applies broadly to NRC research programs. The staff has sought opportunities to leverage cooperation by putting in place a number of cooperative research agreements with industry and DOE counterparts. These limit the need for NRC investment by providing access to key data needed for safety evaluations.

Related to the Feasibility Study Process, the ACRS recommended that “process improvement” topics be specifically solicited and input from external stakeholders be considered. The staff notes that the Feasibility Study Process is focused on technical topics that fill anticipated future research needs. The staff recognized the need for process improvement ideas and program innovation and has separately implemented an initiative called “Ideas Matter” that is intended to identify, assess, and implement these types of innovative ideas. With regard to the consideration of input from external stakeholders, the agency also evaluated both the internal and external perspective that the staff provided in SECY 18-0060 in formulating recommendations for transformation.

The ACRS recommended that the staff regularly reevaluate the need for continuing research in certain technical areas, such as for primary water stress corrosion cracking of alloy 690, and have a process for terminating research projects when appropriate. The staff agrees with the importance of aligning research with clearly identified technical information needs to support regulatory decisionmaking as well as periodic review to determine whether research projects should be sunset when no longer necessary. The RES staff works closely with counterparts in regulatory offices to assess the progress of research and to confirm if data acquired to date continue to justify the resource investment. The staff also works with industry, DOE, and international counterparts to determine the merits of the research, including opportunities to

sunset research no longer necessary. Decisions on terminating or deferring research activities are also made jointly with regulatory offices given agency priorities at the time of budget formulation and execution.

The ACRS recommended that staff make efforts to expeditiously release the Extremely Low Probability of Rupture (xLPR) computer code. Staff agrees with the ACRS and notes progress in this area. Since the briefing to ACRS, the NRC and EPRI have completed the development of an "Addendum to the Memorandum of Understanding on Cooperative Nuclear Safety Research" to facilitate xLPR maintenance and distribution, including domestic code distribution in the very near future.

Finally, the ACRS requested that staff give them an opportunity to provide input on the Digital Instrumentation and Controls (DI&C) Integrated Action Plan (IAP). Since the staff's briefing to ACRS on October 30, 2017, the staff met and briefed the ACRS on several occasions, including the DI&C Subcommittee briefings on DI&C Interim Staff Guidance (ISG)-06, "Licensing Process" revisions and the protection against common cause failure on May 17, 2018, and an IAP update on June 20, 2018. The staff is coordinating additional meetings with the ACRS on other elements of the DI&C IAP.