UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

June 22, 2011

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Draft SECY Paper, "OPTIONS FOR PROCEEDING WITH FUTURE LEVEL 3 PROBABILISTIC RISK ASSESSMENT ACTIVITIES"

Dear Chairman Jaczko:

During the 584th meeting of the Advisory Committee on Reactor Safeguards, June 8-10, 2011, we completed our review of the draft SECY paper, "Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities," dated June 7, 2011. Our Subcommittee on Reliability and Probabilistic Risk Assessment also reviewed these matters during its meetings on November 17, 2010, and May 11, 2011. During these reviews, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

CONCLUSION AND RECOMMENDATIONS

1. A full-scope comprehensive Level 3 probabilistic risk assessment (PRA) for an operating nuclear power plant site will improve our understanding of the risks from nuclear power plant accidents. Knowledge and experience gained from the performance of a modern Level 3 PRA will also enhance our capabilities to address emerging issues for operating plants, to support emergency planning, and to evaluate the integrated risks from proposed new plant designs and siting configurations.

2. A modified version of the staff's proposed Option 3 should be adopted. The project schedule should be consistent with acknowledged resource limitations and the timely completion of supporting technical tasks.

3. The staff should engage the participation of industry stakeholders to expeditiously select the most appropriate site and to ensure that the PRA models, assumptions, and data take maximum advantage of available plant-specific and site-specific information.

4. Performance of the Level 3 PRA should not rely on the use of excessively conservative assumptions or analytical simplifications that inappropriately characterize contributions from specific hazard sources and plant operating modes. Uncertainties should be explicitly identified, documented, and quantified for all elements of the analyses.

BACKGROUND

In the draft SECY paper, the staff presents three options for proceeding with future Level 3 PRA activities. The proposed options are:

Option 1: Maintain Status Quo – Continue Evolutionary Development of PRA Technology

Option 2: Conduct Focused Research to Address Identified Gaps in Existing PRA Technology Before Performing a Full-Scope Comprehensive Site Level 3 PRA

Option 3: Full-Scope Comprehensive Site Level 3 PRA – Operating Nuclear Power Plant

The draft SECY paper and its enclosures provide an historical background and context for these options. Major advantages and disadvantages of each option are summarized. The enclosures contain additional information to support the staff's recommendations and more detailed elaboration of specific technical issues. The staff has recommended that the Commission approve the implementation of Option 2.

DISCUSSION

Public understanding of the risks from currently operating and proposed new nuclear power plants should not be limited by surrogate measures such as core damage frequency or large (early) release frequency. Public, regulatory, and emergency planning information needs can be better informed by fully integrated Level 3 PRA assessments of the offsite risk and its contributors.

The substantial advancements in our understanding of severe accidents at nuclear power plants and their potential offsite consequences that have been accomplished since the NUREG-1150 studies need to be incorporated into new PRAs. Likewise, updated PRA models need to account for significant improvements in nuclear power plant operating experience, maintenance practices, and plant-specific guidance to mitigate the potential consequences from severe accidents. These enhancements may significantly affect the overall level of risk at a particular plant and the event scenarios that are the most important contributors to that risk, compared with earlier analyses. A Level 3 PRA can demonstrate the integrated effects from these improvements.

We agree with the staff’s conclusion that Option 1 would not provide an adequate understanding of integrated risk or its contributors to support future risk-informed regulatory decision making. We disagree with the staff's recommendation to proceed with Option 2, as it is described in the draft SECY paper. Option 2 identifies gaps in current PRA methods, models, and data that are first addressed by focused research to support an eventual full-scope Level 3 PRA. We are concerned that Option 2 does not directly integrate these preliminary research tasks with a clear plan and focused technical requirements to support completion of the PRA. It does not require early selection of the subject plant site or provide goals and context for the research activities. We recommend that the staff should implement a modified version of Option 3 according to a project plan and schedule that are commensurate with available supporting technical information, resources, and Commission priorities for coordinated research programs. Experience has shown that the most efficient process to identify key knowledge gaps is through the performance of an integrated plant-specific risk assessment. Identification, *a priori,* of general topics for which additional research may be warranted would not benefit from that

practical experience. The PRA accident scenario context and interim risk information can be used to more effectively define the scope and priorities for targeted research tasks that focus resources to develop the needed supporting information.

The modified Option 3 project plan should identify the time frames when research to resolve key technology gaps must be in place to support the PRA development. Early selection of the participating plant is a crucial element of the study, because the existing plant-specific PRA will provide an important context for related research. Elements of the full-scope analyses that require development of supplemental models, data, or methods should be extended to benefit from knowledge and experience that are gained in the early tasks, and from interim technical advances that are supported by continuing parallel coordinated research programs (e.g., human reliability analysis methods, fire models, etc.).

Additional targeted research tasks should be defined and integrated into the project plan to the extent that is necessary to support completion of the PRA with appropriate characterization of current uncertainties. These research tasks would address many of the issues from the staff's proposed Option 2 scope of work, but they are focused to the specific technical requirements for completion of the Level 3 PRA. To derive maximum benefit from interim results, key study milestones should retain a focus on completion of integrated Level 3 PRA analyses for specific hazard categories and plant operating states, rather than other possible partial work products. Active participation and collaborative input from industry stakeholders should be encouraged. The staff's preliminary evaluations have concluded that no site perfectly satisfies all of the identified desirable attributes with respect to the scope of existing PRA models and other relevant supporting analyses. Substantial effort may be required to expand the selected PRA models to address all of these issues, e.g., to develop realistic analyses of the integrated effects from fires, floods, seismic events, and other external hazards during low power operation and plant shutdown modes. Some of the identified deficiencies may be supplemented by plant-specific analyses that have been performed by a particular licensee. An informed collaborative effort to select the most appropriate site will affect all elements of the PRA, and is perhaps the most important first task in the study. We support the staff's intention of performing thorough human reliability analyses in all levels of the PRA, including the use of Severe Accident Management Guidelines.

Our understanding of BWR accident progression is likely to improve substantially, based on lessons to be learned from the recent core damage events at Fukushima Daiichi. However, it is likely that several years will be required to fully update our knowledge base and models to the extent that is necessary to support a realistic full-scope Level 3 PRA. Updating a PRA to fully account for this important phenomenological information could require extensive revisions to the Level 2 portions of the models. These refinements to BWR Level 2 and Level 3 PRA models are best delayed until the supporting information is available. Therefore, it would be prudent to select a PWR site for this initial study.

The use of excessively conservative assumptions or analytical simplifications to address issues for which the available PRA models or data are not well developed should be avoided in efforts to reduce the required resources. Experience has shown that those techniques often distort numerical measures of the absolute and relative risk contributions from specific hazards or accident scenarios. Uncertainties should be explicitly identified, documented, and quantified for all elements of the analyses.

We look forward to continuing our interactions with the staff to more fully refine the path forward for completion of this important Level 3 PRA study.

Additional Comments by ACRS Member Dana A. Powers are presented below.

Sincerely,

/RA/

Said Abdel-Khalik
Chairman

Additional Comments by ACRS Member Dana A. Powers

ACRS has voted to recommend a course of action different than that identified in the trade study of three options conducted by the NRC staff. ACRS is recommending a broad-scope, Level III probabilistic risk assessment for a single, unidentified PWR. I do not agree with my colleagues in making this recommendation.

There is no manifest regulatory need for the product of the proposed three-year undertaking. Indeed, it appears ACRS is making the recommendation largely to see if in fact a level III PRA that includes both internal and external accident initiators during both normal and shutdown operations can be done. Surely examination of one or more of the more comprehensive PRAs maintained by the licensees would be sufficient to satisfy curiosity.

ACRS implies that the proposed undertaking would be good experience for the staff at NRC involved in probabilistic risk assessment. The NRC staff, however, informs us that those likely to be assigned to the proposed project are currently fully subscribed. This seems entirely plausible in light of the several ongoing design certifications, COLs, the promise of many Fire PRAs to be submitted by licensees adopting the NFPA-805 fire protection standard as well as ongoing significance determinations for findings at currently operating plants and SPAR model upgrades. It is not at all apparent that the NRC professionals in the area of probabilistic risk assessment are in great need of further opportunities to burnish their credentials.

The NRC staff identifies several current research activities that would have to be completed to undertake a level III PRA of the scope envisaged. ACRS acknowledges this and seems to argue that a focus on a broad-scope PRA for a single plant would introduce needed discipline into the ongoing research activities. ACRS seems to have forgotten despite its own biennial review of the NRC's research program that every major research program underway at NRC is motivated by a well vetted, crucial, regulatory need. Does the ACRS really want to sacrifice these needs of the current regulatory process to the exigencies of schedule for the proposed project?

ACRS glibly notes that extensive characterization and quantification of uncertainties should be included in the project they propose. The ACRS should remember the cost and effort required in undertaking uncertainty quantification for the NUREG-1150 study. What aspects of current

agency activities does ACRS propose to suspend to free resources needed for what will be an heroic uncertainty study?

It is widely believed that the risk information derived from the assessment of risk at five representative nuclear power plants and reported in NUREG-1150 was of value to the risk informing of the regulatory process. This was especially so because the information from these studies of five particular plants was supplemented by the results of individual plant examinations submitted by licensees. A clear conclusion drawn from this wealth of risk information is that risk posed by a nuclear power plant is very dependent on details of plant design, details of the plant site, operation, and reliability history. It is not evident, then, that examination of a single plant as proposed by the ACRS will be sufficient to greatly augment the understanding of risk gained from these past efforts. Indeed, the ACRS report acknowledges that no single plant will be sufficient to meet all the aspirations ACRS has for its own, proposed undertaking.

It is well known that risk profiles of currently operating nuclear power plants have evolved since the time that the NUREG-1150 studies were completed. There have been evolutions in operating practices. Power levels have been increased fairly significantly at some plants. Fuels are being taken to higher burnups. Further evolutions will come as the NFPA-805 fire protection standard is adopted at some plants. Results of the investigations for GI-199 may produce additional changes in the risk profile of plants in the Central and Eastern United States. It may well be that updating the risk information derived from the NUREG-1150 study will be of great value to the regulatory process. This has not been established however. Certainly, the ACRS has not attempted to establish the value of the updated risk information to the regulatory process. Instead, ACRS devotes itself to outlining the project plan for its proposed exercise.

For these reasons, I decline to support the ACRS recommendation concerning options for future level III PRA activities. Option 2 as recommended by the NRC staff is a better alternative.

References:

1. Draft SECY paper, “Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities,” April 12, May 23, and June 7, 2011 (ML11090A041)

2. Enclosure 1 of Draft SECY Paper, “Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities,” April 12, May 23, and June 7, 2011 (ML11090A042)

3. Enclosure 2 of Draft SECY Paper, “The Structure and Evolution of Probabilistic Risk Assessment and Risk-Informed Regulation,” May 23 and June 7, 2011 (ML11144A077)

4. NRC Staff Draft Discussion Paper, “Options for Level 2 PRA and Interface to Level 3 PRA,” November 2010 (ML103060390)

5. Don Helton, “Scoping Study on Advanced Modeling Techniques for Level 2/3 PRA,” NRC Staff White Paper, May 2009 (ML091320447)

6. Nuclear Regulatory Commission, “Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants,” Final Summary Report, NUREG-1150, December 1990 (ML040140729)

We look forward to continuing our interactions with the staff to more fully refine the path forward for completion of this important Level 3 PRA study.

Additional Comments by ACRS Member Dana A. Powers are presented below.

Sincerely,

/RA/

Said Abdel-Khalik

Chairman

Additional Comments by ACRS Member Dana A. Powers

ACRS has voted to recommend a course of action different than that identified in the trade study of three options conducted by the NRC staff. ACRS is recommending a broad-scope, Level III probabilistic risk assessment for a single, unidentified PWR. I do not agree with my colleagues in making this recommendation.

There is no manifest regulatory need for the product of the proposed three-year undertaking. Indeed, it appears ACRS is making the recommendation largely to see if in fact a level III PRA that includes both internal and external accident initiators during both normal and shutdown operations can be done. Surely examination of one or more of the more comprehensive PRAs maintained by the licensees would be sufficient to satisfy curiosity.

ACRS implies that the proposed undertaking would be good experience for the staff at NRC involved in probabilistic risk assessment. The NRC staff, however, informs us that those likely to be assigned to the proposed project are currently fully subscribed. This seems entirely plausible in light of the several ongoing design certifications, COLs, the promise of many Fire PRAs to be submitted by licensees adopting the NFPA-805 fire protection standard as well as ongoing significance determinations for findings at currently operating plants and SPAR model upgrades. It is not at all apparent that the NRC professionals in the area of probabilistic risk assessment are in great need of further opportunities to burnish their credentials.

The NRC staff identifies several current research activities that would have to be completed to undertake a level III PRA of the scope envisaged. ACRS acknowledges this and seems to argue that a focus on a broad-scope PRA for a single plant would introduce needed discipline into the ongoing research activities. ACRS seems to have forgotten despite its own biennial review of the NRC's research program that every major research program underway at NRC is motivated by a well vetted, crucial, regulatory need. Does the ACRS really want to sacrifice these needs of the current regulatory process to the exigencies of schedule for the proposed project?

ACRS glibly notes that extensive characterization and quantification of uncertainties should be included in the project they propose. The ACRS should remember the cost and effort required in undertaking uncertainty quantification for the NUREG-1150 study. What aspects of current

Distribution:

See next page

Accession No:ML11164A050 **Publicly Available (Y/N)** Y **Sensitive (Y/N):** N
If Sensitive, which category?
Viewing Rights: ☒ NRC Users or ☐ ACRS only or ☐ See restricted distribution

OFFICE	ACRS	SUNSI Review	ACRS	ACRS	ACRS
NAME	JLai	JLai	CSantos	EHackett	EHackett for SAbdel-Khalik
DATE	6/21/11	6/21/11	6/21/11	6/22/11	6/22/11

OFFICIAL RECORD COPY

Letter to the Honorable Gregory B Jaczko, Chairman, NRC, from Said Abdel-Khalik, Chairman, ACRS, dated June 22, 2011

SUBJECT: Draft SECY Paper, "OPTIONS FOR PROCEEDING WITH FUTURE LEVEL 3 PROBABILISTIC RISK ASSESSMENT ACTIVITIES"

Distribution:
ACRS Staff
ACRS Members
B. Champ
A. Bates
A. Lewis
L. Mike
P. Lien
B. Rini
RidsSECYMailCenter
RidsEDOMailCenter
RidsNMSSOD
RidsNSIROD
RidsFSMEOD
RidsRESOD
RidsOIGMailCenter
RidsOGCMailCenter
RidsOCAAMailCenter
RidsOCAMailCenter
RidsNRROD
RidsNROOD
RidsOPAMail
RidsRGN1MailCenter
RidsRGN2MailCenter
RidsRGN3MailCenter
RidsRGN4MailCenter