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

April 8, 2011

MEMORANDUM TO: ACRS MEMBERS

FROM: Maitri Banerjee, Senior Staff Engineer ***/RA/***
Reactor Safety Branch - A
Advisory Committee on Reactor Safeguards

SUBJECT: MINUTES OF THE ACRS FUTURE PLANT DESIGNS SUBCOMMITTEE REGARDING USE OF RISK INSIGHTS IN SMALL MODULAR REACTOR REVIEW - FEBRUARY 9, 2011

Minutes of the subject meeting have been certified on April 8, 2011, as the official record of the proceedings for that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc via e-mail: C. Santos
A. Dias

**UNITED STATES**
**NUCLEAR REGULATORY COMMISSION**
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**WASHINGTON, DC 20555 - 0001**

MEMORANDUM TO: Maitri Banerjee, Senior Staff Engineer
Reactor Safety Branch – A
ACRS

FROM: Dennis Bley, Chairman
Future Plant Designs Subcommittee
ACRS

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE FUTURE PLANT DESIGNS SUBCOMMITTEE REGARDING USE OF RISK INSIGHTS IN SMALL MODULAR REACTOR REVIEW - FEBRUARY 9, 2011

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting held on February 9, 2011, are an accurate record of the proceedings for that meeting.

/RA/ 04/08/2011

Dennis Bley, Chairman Date
Future Plant Designs Subcommittee

**Certified on: 04/08/2011**
**Certified By: Dennis Bley**

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE MEETING OF THE SUBCOMMITTEE ON
FUTURE PLANT DESIGNS REGARDING USE OF RISK INSIGHTS IN
SMALL MODULAR REACTOR REVIEW
ON FEBRUARY 9, 2011, IN ROCKVILLE, MARYLAND

On February 9, 2011, the ACRS Subcommittee on Future Plant Designs held a meeting in Room T-2B1, 11545 Rockville Pike, Rockville, Maryland. The purpose of the meeting was to receive a briefing from the NRC staff and the industry, regarding the staff's draft SECY Paper on the use of risk insights in their review of small modular reactor (SMR) licensing application. The meeting convened at 8:30 AM. The meeting was open to the public.

**Attendees**:

| **ACRS Members** | **Industry Presenter** | **NRC Staff** |
|---|---|---|
| Dennis Bley (Chairman) | Biff Bradley, NEI | Sud Basu, RES |
| Said Abdel-Khalik | **NRO/NRC Staff** | Daniel Hudson, RES |
| Joy Rempe | Lynn Mrowca | David Diec, NSIR |
| Jack Sieber | Thomas Kenyon | **Other Attendee** |
| John Stetkar | Don Dube | Thomas Spink, TVA |
| Bill Shack | Gregg Cranston | Steve Kline, Bechtel |
| Mike Corradini | John Segala | Paul Genoa, NEI |
| Sanjoy Banerjee | Samuel Lee | Jim Salderini, Bechtel |
| Sam Armijo | Steven Downey | Tammy Way, INL |
| Harold Ray | Todd Hilsmeier | Edward Burns, Westinghouse |
| Tom Kress (Consultant) | Eric Osterle | Jason Tokey, DOE |
| **ACRS Staff** | Stephanie Devlin | Charles Brinkman, Westinghouse |
| Maitri Banerjee (DFO) | Neil Ray | Steve Pope, B&W |
| **NRO Staff Presenters** | Chang-Yang Li | TJ Kim, B&W |
| Stewart Magruder | Arlon Costa | James Ross, GEH |
| Bill Reckley | | Ken Fletcher, Exchange Monitor |
| Tom Kevern | | Jim Kinsey, INL* |

* Participating over telephone bridge line

The presentation slides and handouts used during the meeting are attached to the Office Copy of the meeting transcript. The presentation to the Subcommittee is summarized below.

Opening Statement

Chairman Bley convened the meeting by introducing the ACRS members. He noted that the current briefing was to discuss the NRO staff's development of a draft Commission paper that discussed the use of risk insights in the licensing review of SMRs. In a Staff Requirements Memorandum last year the Commission directed the staff to integrate risk insights and develop risk-informed licensing review plans for each SMR. Chairman Bley noted that there were several policy issues requiring resolution strategies for SMR licensing. After noting that the telephone bridge line available to the stakeholders to listen to the proceeding would be opened in both directions for receiving comments and questions at the end of the meeting Chairman Bley invited the staff to begin the presentation.

Introduction and Staff Presentation

In his opening statements, Mr. Bill Reckley, NRO Branch Chief, noted the focus of the meeting was to discuss the SECY Paper being developed in response to the Staff Requirements Memorandum on how to incorporate risk insights into the SRM licensing review process. In addition, he noted the need for ACRS interface regarding the policy and technical issues related to SMR licensing. Chairman Bley asked about the schedule and Member Corradini wanted to know if and how the lessons learned from the ESBWR, AP1000 etc review would be incorporated in the SMR review.

Mr. Reckley presented a brief description of two integral PWR designs (NuScale and B&W/mPower), and related policy issues (control room staffing, emergency planning (EP) etc). He noted a white paper on EP from NGNP and a future paper from NEI on the issue and that the EP issue would be covered later in the presentation. A thermal hydraulic test facility and the control room simulator are being developed for NuScale at the Oregon State University. He then discussed the mPower design, potential construction at the TVA's Clinch River site, and noted that both companies had been submitting to NRC topical/technical papers on various design issues and analytical approaches. B&W is in the process of building their thermal hydraulic test loop in Lynchburg. TVA plans to pursue a Part 50 licensing process with B&W submitting the design certification application post construction permit (CP) issuance such that the operating license (OL) could be based on the certified design. A detailed discussion followed regarding the timing of each step (CP, OL, certification), schedule coordination and efficiencies involved, and how to maintain standardization if two initial modules are built per Part 50 and subsequent ones per Part 52. The staff will develop a process for such a possibility.

Upon Member Corradini's question Mr. Reckley noted that based on the trade press and discussions with Westinghouse, Westinghouse may pursue a small light water reactor different from the IRIS design (an international collaboration with Westinghouse as a member). Regarding NGNP, Mr. Reckley noted that the staff had received and has been reviewing white papers on licensing, policy and technical issues like risk-informed licensing, EP, fuel, high temperature material. DOE continues to work on developing private partnership (public/private partnership is

required by the Energy Policy Act of 2005). The staff has very little activity on fast reactors with some white papers submitted by the vendors.

Mr. Tom Kevern then presented the draft SECY paper developed in response to the SRM mentioned before including both the shorter and longer term elements. He noted the "Introduction" section of the SRP (NUREG-800) attached to the draft SECY Paper contained the risk-informed guidance on staff review of iPWRs as directed in the SRM. Design-specific review plans are being developed for iPWRs that will address the lessons learned from the staff review of ESBWR and AP1000, advanced reactors with innovative and passive features (Member Corradini's question). For example, SRP Chapter 8 on electrical power (off-site electrical power, grid structure and necessity for onsite AC power) developed for an active design is neither applicable to AP1000 and ESBWR, nor to the iPWRs. The staff interpreted the SRM direction to mean a revised framework that addressed the issue of risk, consistent with the existing Commission policy, regulations, and the way the NRC addresses risk significance and "safety related" determination. SRP sections are being modified, deleted, or new ones added to address iPWRs.

Upon Chairman Bley's question, Mr. Kevern clarified that the draft SECY paper dealt with the license application review approach, and separate staff activities were addressing the policy/technical issues related to the mechanistic source term, EP, control room staffing, security requirements etc. Chairman Bley asked about the impact of the policy issue related to the use of PRA to the review approach. Mr. Reckley noted that similarity of iPWRs to advanced PWR designs lessens the impact to the staff review process due to the inherent similarity in the physical processes involved. As a result, selection of design basis accidents (e.g., LOCA) could follow similar considerations. Mr. Kevern noted that the requirement of Part 52 to have a PRA done and provide the insights, submit the insights to the NRC was not going to change. The staff is not changing the way the review of the application for a reasonable assurance finding is done for a design certification or an operating license.

Member Stetkar noted that the current Part 52 submittals varied significantly in terms of consistency and quality in the underlying risk significance determinations, and if the staff was going to address that issue. The other members emphasized the need to incorporated lessons learned from the review of AP1000, ESBWR and likes to the subject process. Members noted the current SRP "Introduction" section refers to ISG-018 (reliability assurance program (RAP) interim guidance) on methodology and lacks specific risk assessment criteria. Applicants seemed to have interpreted the use of PRAs (vs. qualitative assessments) differently, for example, in the identification and treatment of RTNSS equipment in passive plants. The staff plans to share the lessons learned from NRC review of the large light water design center applications with the iPWR vendors. However, in terms of ensuring consistency, staff noted constraints, such as insufficient time to get a standardized approach on expectation for PRA use promulgated before the iPWR vendors submit application scheduled in the 2012 time frame. Mr. Reckley stated that the staff was not in a position to require a certain approach, but would consider the comment for pursuing with the industry.

Mr. Kevern discussed the staff proposed graded approach based on safety and risk significance that would integrate performance-based programmatic requirements. For most of the SSCs, the acceptance criteria are either design-oriented or performance-oriented. The staff is not changing the standard review plan process for any of the criteria related to the design or the process for safety determination, the concept of design-basis accident is maintained.

The proposed review approach will use performance oriented acceptance criteria (e.g., capability, availability, reliability and maintainability) and program requirements that measure or control that performance aspect. These programs could be the TS, RAP, ITAAC, availability control programs (e.g., RTNSS), maintenance rule, and the initial test program (IST). For availability programs like RTNSS, Mr. Kevern stated that staff's understanding has matured after review of design center applications like the ESBWR, such that efficiency improvements could be achieved. Some of these programs (e.g., IST) will be used in lieu of verifying performance capability via independent design analysis, for example for lower risk significant components. Member Shack noted that the proposed approach would add risk to the review process by pushing the element of verification/confirmation to a later date post design and construction. The members noted that in the proposed approach the safety related non-risk-significant components would get more treatment than a risk significant non-safety-related component (similar to 50.69 which is not mentioned in staff's SECY Paper given the voluntary nature of the rule). Some members opined that the staff approach might be compensating for the weakness in the methods employed in determining the risk-significance. Mr. Reckley stated that the proposed process reflects the existing rules and policies following the Commission directive.

Mr. Reckley noted that as a process usability exercise the staff had a National Lab run the categorization process (the proposed A1, A2, B1, B2 safety and risk significance categorization proposed in the subject SECY paper) for two iPWR designs (also provided to the SMR vendors). Based on a positive feedback, the staff has determined that to improve efficiency of staff review this process of establishing regulatory treatment categorization has to be done at the beginning of staff's review. Mr. Kevern then discussed the application of the proposed review process to a B1 and a B2 designated system.

The meeting broke for a short intermission, and upon return Mr. Kevern discussed how the SRP is planned to be "tailored" to develop design specific review plans for each iPWR design. For each unique iPWR design, specific SRP sections may need to be modified or eliminated, and new SRP sections may need to be developed for new components or designs (e.g., NuScale containment). This would be accomplished in design-specific review plans. The staff expects the SRP modification process to be iterative including pre-application interactions with the vendors, review of design information, SSC categorization, audit and documentation in an SER, with a template format of the SER also provided. The pre-application interactions have already started with NuScale and mPower and the staff has contracted several National Labs to develop iPWR design specific SRPs. The staff plans to have another interaction with the ACRS before moving full scope ahead on the SRPs.

A discussion followed regarding the availability of detail design information at the CP and design certification stages. It was pointed out by Member Ray and Consultant Dr. Kress that even at the CP review stage significant design information related to the design basis accidents and source terms needs to be provided and reviewed. Member Corradini asked about the possibility that the staff may need to repeat the review of conservatively bounded design information at the CP stage after more specific and detailed information becomes available at the design certification stage. It appeared that both NuScale and mPower had indicated that they plan to provide information that would satisfy the design certification review requirements at the CP review stage to prevent such a possibility. However, the TVA proposal to make a Part 50 (vice 52) application for a CP is not completely vetted yet by the staff regarding its impact to the proposed licensing framework.

Pre-application interactions with NuScale include staff review of preliminary categorization of the SSCs. Member Stetkar pointed out the need for more complete information at an early stage to avoid iterative review, and cautioned against getting locked into mindsets that may prevent making needed changes when more advanced and refined information (e.g., PRA) becomes available. Mr. Kevern noted that the design the staff and its consultants (National Labs) are reviewing is more advanced than conceptual, and involve a preliminary PRA, the subject of an upcoming staff audit. Chairman Bley pointed out the need for simulators and operating procedures in addition to the test facilities if PRAs are to be used in the review.

Mr. Kevern then discussed the staff proposed longer term risk-informed regulatory approach. It includes an iPWR pilot review using principles of technology neutral framework (NUREG 1860) in parallel with the actual review of the application, followed by developing insights applicable to technology neutral framework from pilot review (scheduled for 2012-13 timeframe). In the area of NGNP, with the ongoing continued pre-application interactions and review of white papers and ANS standard development, the staff would compare the NGNP regulatory approach in white papers with the principles of technology neutral framework in addition to a parallel review similar to the iPWR pilot review (should an NGNP application come in) to develop insights (2014-15). Additionally, staff's liquid metal reactor (LMR) review approach would include review of white papers and ANS standard development (in progress) to develop insights on technology neutral framework. The staff then plans to consolidate the insights and develop recommendation to the Commission (2015).

Mr. Reckley presented the status of the policy and technical issues related to the SMR licensing, the subject of SECY Paper 10-0034. In this paper, the staff discussed the licensing process issues (prototype, multi-module facility and manufacturing license), design requirement issues (defense-in-depth, use of PRA, source term and dose calculations, key component and system design, and aircraft impact assessment), operational issues (control room staffing, operational programs, multi-module installation issues, use of nuclear process heat, security and safeguards, EP, loss of large areas due to fires and explosions), and financial issues. The staff plans to make proposals to the Commission on these issues and engage ACRS. Mr. Reckley discussed the staff approach related to several of these issues and provided a schedule for the issuance of SECY papers that would present the staff recommended

framework for resolution of each issue. The issues related to defense-in-depth, PRA and LBE selection are now included in the risk-informed licensing approach discussed above. The members showed high interest in reviewing these papers.

Member Stetkar wanted to know the status of staff's work on developing recommendations for risk metrics for new reactors. Mr. Reckley noted that a SECY paper had been issued on the subject but that did not address SMRs.

Regarding control room staffing, an issue of interest to the members, the staff plans to use the approach of tasking analysis to determine adequate staffing level for multi-module operation to ensure adequate normal operation and post accident coverage. The staff is engaged in pre-application interactions with the vendors and plans to issue a SECY paper by the 3rd quarter of FY 2011. The staff envisioned the paper to provide a framework for staff's review approach that would lead to a recommendation on staffing level. The staff will embark upon the work of staffing level determination only after Commission approval of the approach. The staff's plan on other issues of consideration is similar. A lively discussion ensued regarding PRA/risk, and Member Stetkar noted that external events like seismic and flooding affecting multiple units would likely have a large contribution to risk. Need to learn from experience at non-nuclear facilities that use one control room for multi-unit operation was also pointed out by Members Sieber and Stetkar. Mr. Magruder of the staff noted that the industry had been reviewing this area, and in addition to plant operation, other issues like EP, plant maintenance, security etc. needed to be considered.

Mr. Reckley discussed the current staff thinking in the area of EP for SMRs, noting that several position/white papers and topical reports exist from the industry and the NGNP in this area. The staff is considering a graded approach where not exceeding the protective action guidelines at the exclusion area boundary could eliminate the need for emergency planning outside that distance, thus placing importance on the off-site dose consequence analyses for both the design basis and beyond design basis conditions. The NRC regulations allow a case-by-case determination of emergency planning zone size for plants less than 250 MWth authorized power level or for gas-cooled reactors. Member Stetkar noted that a risk metric in terms of dose might be more appropriate for the integrated perspective. Member Rempe noted the need for considering the timing of release. Mr. Reckley stated that there were a number of embedded issues (e.g., modeling of multiple modules under a natural disaster) within this broader topic that would have to be addressed.

Member Armijo asked about the licensed life for multi-module plants and Mr. Reckley noted that each module would have a separate 40 year license [from the time of NRC finding that Part 52.103 (g) has been met]. The staff would need to consider time for ACRS review of the SECY papers in their schedule.

Biff Bradley, Director of Risk Assessment at NEI, presented the industry view. The industry agrees fundamentally with the staff's approach as a starting point, but believes that the risk concepts in the staff's plan can be extended further in future and a more comprehensive plan for

use of risk insights can be developed. Member Stetkar asked if the industry is endorsing the staff's plan to risk-inform categorization of the SSCs and the LBE definition together with their plan for the EP framework. Mr. Bradley noted that the industry agreed with the general approach in staff's plan but that there should be some consideration of the higher level of safety inherent in the SMR design. The industry recognizes that similar to the new advanced LWR designs where a lot of the internal events risk factors have been designed out, the expected external events like the seismic, external floods, etc., which are potentially common cause types of initiators effecting multiple modules of an SMR, would be significant contributors to risk for these plants. It appeared from his comments that based on the experience of operating plants the industry would be more willing to follow the use of risk-information in areas like the maintenance program and TS. Although, the industry would like to see a more expanded use of risk information in regulatory decision-making, Mr. Bradley noted the 12 year history of NRC risk-informing the design basis did not bode well for expecting an increased use of risk information in SMRs.

The industry has much interest in the staff's work related to EP for SMRs as this would impact the financial considerations and could be a "show-stopper" for a company building only a couple of units of SMRs. He noted that the proposed approach of SSC categorization in four boxes would create a communication problem in terms of defining the meaning of "safety related but not risk significant," and vice versa. He noted the difficulty in starting the industry pilot program for 10CFR50.69. Also, how to deal with a framework where the external initiators are the risk-drivers? Chairman Bley pointed out the need for a thorough PRA for licensing decision-making, and how the industry would approach that in the absence of a site selection, especially for a non-LWR. Mr. Bradley recognized that for advanced LWRs it might be easier than the non-LWR designs where lack of operating data made it difficult to meet PRA standards.

After offering an opportunity for public comments (there were none), Chairman Bley asked the Subcommittee members for comments. Member Corradini pointed out the need for ACRS involvement in a timely manner, but he did not see a reason to rush as the staff's approach would need to be worked out on the first SMR application that would probably be an iPWR.

Member shack stated that the staff's approach on risk-informing the licensing process by categorizing the level of review was a good way to start. Regarding the PRA, Member shack noted that the process should be iterative with improved PRAs (as design is finalized), and that the potential benefit from risk-informing the process far overweighs (any other approach). Member Stetkar stated that it was incumbent upon the people developing, reviewing and using a PRA for decision-making to recognize the degree of design information that is available to support a PRA and identify where the holes are in the PRA very early in the process. The ACRS Chairman Abdel-Khalik noted that the ACRS should review the different policy papers that are being developed by the staff, for example on the emergency planning, multi-module facilities, mechanistic source term and control room staffing, and follow up with a letter as necessary.

Member Armijo noted that it was important to take the staff recommendations on policy issue resolutions to the Commission soon, and if the SMRs are truly safer then there should be some

recognition in the regulatory regime like a reduced EP zone, if justified. Member Ray noted that the regulatory process should allow for an applicant to use Part 50 to license a site and then invest in a more detailed design with an application under Part 52, albeit even at that point some probabilistic assessments may need to be deferred (AP 1000 experience). Resolving the siting issue under Part 50, and then during the OL review stage bringing in a design certification application under Part 52 to allow replication of the design installation seemed to be a more economically viable option to him. While agreeing with this comment and also with the staff's approach, Member Sieber noted that he would like to see how the details work out during the actual review of an application.

Consultant Kress noted that the staff would need a pretty good PRA to follow their plan. He noted that the staff and the industry recognized that these plants are likely to have external events as to risk dominant accidents, which can simultaneously affect all modules. This would affect the policy issues of source terms and siting. Development of design basis accidents needs to recognize the risk dominant external events before site approval, and sites have to have a specification of the total number of modules that can be installed before site approval. After agreeing with most of what was said, Chairman Bley noted that the PRA used for licensing decision-making had to be of good quality. He noted his interest in reviewing the staff paper on multi-module installation. After thanking the participants of the meeting, Chairman Bley adjourned the meeting at 11:55 am.