



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

June 28, 2011

MEMORANDUM TO:           ACRS Members

FROM:                    Sherry Meador                    /RA/  
                              Technical Secretary, ACRS

SUBJECT:                 CERTIFICATION OF THE MEETING MINUTES FROM  
                              THE ADVISORY COMMITTEE ON REACTOR  
                              SAFEGUARDS 582<sup>nd</sup> FULL COMMITTEE MEETING  
                              HELD ON APRIL 7-9, 2011 IN ROCKVILLE, MARYLAND

The minutes of the subject meeting were certified on May 25, 2011 as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment:  
As stated



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

May 25, 2011

MEMORANDUM TO: Sherry Meador, Technical Secretary  
Advisory Committee on Reactor Safeguards

FROM: Cayetano Santos, Chief */RA/*  
Reactor Safety Branch  
Advisory Committee on Reactor Safeguards

SUBJECT: MINUTES OF THE 582<sup>nd</sup> MEETING OF THE ADVISORY  
COMMITTEE ON REACTOR SAFEGUARDS (ACRS),  
APRIL 7-9, 2011

I certify that based on my review of the minutes from the 582<sup>nd</sup> ACRS Full Committee meeting, and to the best of my knowledge and belief, I have observed no substantive errors or omissions in the record of this proceeding subject to the comments noted below.

<b>OFFICE</b>	ACRS	ACRS:RSB/Sunsi
<b>NAME</b>	SMeador	CSantos/sam
<b>DATE</b>	05/25/2011	05/25/2011

OFFICIAL RECORD COPY

CERTIFIED

Date Certified: 05/25/2011

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During its 582<sup>nd</sup> meeting, April 7-9, 2011, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters and completed the following letters and memoranda:

#### LETTERS

Letters to R. W. Borchardt, Executive Director for Operations, NRC, from Said Abdel-Khalik, Chairman, ACRS:

- Chapters 2, 4, 5, 8, 10, 11, 12, 16, 17 and 19 of the Safety Evaluation Report with Open Items associated with the Calvert Cliffs Nuclear Power Plant, Unit 3, Combined License Application, dated April 19, 2011
- Draft Final Revision 3 of Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," dated April 20, 2011
- Response to the March 22, 2011, EDO Letter Regarding Comparison of Integrated Safety Analysis and Probabilistic Risk Assessment for Fuel Cycle Facilities, dated April 19, 2011

#### MEMORANDA

Memoranda to R. W. Borchardt, Executive Director for Operations, NRC, from Edwin M. Hackett, Executive Director, ACRS:

- Draft Final Regulatory Guides 8.2, 8.24, and 3.67, dated April 12, 2011
- Proposed Regulatory Guides DG-1264, DG-1206, DG-1207, DG-1208, DG-1209, DG-1210, and DG-1267, dated April 12, 2011
- Draft Revision 3 to NUREG-1022, "Event Reporting Guidelines 10 CFR 50.72 and 50.73," dated April 12, 2011
- Additional Information Regarding the Safety Evaluation Report for the License Renewal of Palo Verde Nuclear Generating Station, Units 1, 2, and 3, dated April 12, 2011

MINUTES OF THE 582<sup>nd</sup> MEETING OF THE  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

ROCKVILLE, MARYLAND

The 582<sup>nd</sup> meeting of the Advisory Committee on Reactor Safeguards (ACRS) was held in Conference Room 2B3, Two White Flint North Building, Rockville, Maryland, on April 7-9, 2011. Notice of this meeting was published in the *Federal Register* on March 23, 2011 (72 FR 16457-16458) (Appendix I). The purpose of this meeting was to discuss and take appropriate action on the items listed in the meeting schedule and outline (Appendix II). The meeting was open to public attendance.

A transcript of selected portions of the meeting is available in the NRC's Public Document Room at One White Flint North, Room 1F-19, 11555 Rockville Pike, Rockville, Maryland. Copies of the transcript are available for purchase from Neal R. Gross and Co., Inc., 1323 Rhode Island Avenue, NW, Washington, DC 20005. Transcripts are also available at no cost to download from, or review on, the Internet at <http://www.nrc.gov/ACRS/ACNW>.

ATTENDEES

ACRS Members: Dr. Said Abdel-Khalik (Chairman), Dr. J. Sam Armijo (Vice-Chairman), Mr. John Stetkar (Member-at-Large), Dr. Sanjoy Banerjee, Dr. Dennis Bley, Mr. Charles Brown, Dr. Michael Corradini, Dr. Dana A. Powers, Mr. Harold Ray, Mrs. Joy Rempe, Dr. Michael Ryan, Dr. William Shack, and Mr. John Sieber. For a list of other attendees see Appendix III.

I. Chairman's Report (Open)

[Note: Mr. Edwin Hackett was the Designated Federal Official for this portion of the meeting.]

Dr. Said Abdel-Khalik, Committee Chairman, convened the meeting at 8:30 a.m. In his opening remarks he announced that the meeting was being conducted in accordance with the provisions of the Federal Advisory Committee Act. He reviewed the agenda items for discussion and noted that no written comments or requests for time to make oral statements from members of the public had been received. Dr. Abdel-Khalik also noted that a transcript of the open portions of the meeting was being kept and speakers were requested to identify themselves and speak with clarity and volume.

II. Selected Chapters of the Safety Evaluation Report (SER) with Open Items Associated with the Calvert Cliffs, Unit 3 Combined License Application Referencing the U.S. Evolutionary Power Reactor (EPR)

[Note: Mr. Derek Widmayer was the Designated Federal Official for this portion of the meeting.]

The Committee met with representatives of UniStar Energy and the NRC staff to discuss the following Chapters of the safety evaluation report (SER) with open items associated with the review of the combined license (COL) application for Unit 3 of the Calvert Cliffs Nuclear Power Plant: Chapter 2, "Site Characteristics" (except for Sections 2.3 and 2.4); Chapter 4, "Reactor"; Chapter 5, "Reactor Coolant System and Connected Systems"; Chapter 8, "Electric Power"; Chapter 10, "Steam and Power Conversion"; Chapter 11, "Radioactive Waste Management"; Chapter 12, "Radiation Protection"; Chapter 16, "Technical Specifications"; Chapter 17, "Quality Assurance"; and Chapter 19, "Probabilistic Risk Analysis and Severe Accident Evaluation." Representatives of UniStar provided information on the characteristics of the Calvert Cliffs site, a general overview of the COL Items, and the major site-specific features of the U.S. EPR design which is referenced by the Calvert Cliffs, Unit 3, COL application. The staff discussed its schedule for reviewing the COL application and summarized the number of open items in each of these SER chapters.

The Committee issued a letter to the Executive Director for Operations on this matter, dated April 19, 2011, concluding that its review of these SER chapters has not identified any issues that merit further consideration by the Committee at this time. The Committee will review the staff's resolution of open items in these SER chapters in future meetings.

III. Events at the Fukushima Reactor Site in Japan

[Note: Mr. Edwin Hackett was the Designated Federal Official for this portion of the meeting.]

The Committee met with representatives of the NRC staff to discuss the events associated with the Fukushima reactor site in Japan. On March 11, 2011, a magnitude 9.0 earthquake and subsequent tsunami caused significant damage to the Fukushima Daiichi nuclear power station. The staff described the resulting accident sequence as well as the current status of each of the six units at the site. The staff described the purpose of Information Notice 2011-05; NRC inspection activities per Temporary Instruction 2515/183, "Followup to the Fukushima Daiichi Nuclear Station Fuel Damage Event"; and industry initiatives to verify and validate each plant's readiness to manage extreme events. The staff's presentation also discussed the near-term and long-term task force reviews directed by the Commission, attributes of the Tohoku earthquake and tsunami, the station blackout rule, emergency planning zones, and NRC incident response roles. This was an information briefing. No Committee action was necessary at this time. Per Commission direction via COMGBJ-11-0002, the Committee will review the long-term report of the NRC task force evaluating the events in Japan.

IV. Draft Final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and Cyber Security Related Activities

[Note: Mrs. Christina Antonescu was the Designated Federal Official for this portion of the meeting.]

The Committee met with representatives of the NRC staff to discuss draft final Revision 3 of Regulatory Guide (RG) 1.152 and other cyber security related matters. The staff's presentation described the current regulatory structure for cyber security, the regulatory developments to address cyber security throughout the lifecycle of a digital safety system, the relationship between RG 1.152 and RG 5.7, "Cyber Security Programs for Nuclear Facilities," and the modifications to RG 1.152 regarding a secure development and operational environment (SDOE). RG 1.152 was revised to address non-malicious challenges to digital safety system development and operation; enhance focus on 10 CFR Part 50 and Part 52 reliability requirements; and reflect the migration of cyber security provision to 10 CFR Part 73. The staff described the integration of 10 CFR Part 50 and Part 52 reviews with 10 CFR Part 73 reviews given the separation of SDOE and cyber security reviews. The staff briefly discussed RG 5.71 and the 148 cyber security controls to safeguard against vulnerabilities that an adversary can use to compromise equipment. Finally, the staff discussed their review of the "identification of hazards associated with digital systems," and the development of an internal procedure for coordination of reviews and inspections among headquarters and Regional staff.

The Committee issued a letter to the Executive Director for Operations on this matter dated April 20, 2011, recommending that Revision 3 of RG 1.152 not be issued until the following revisions are incorporated:

- RG 1.152, Revision 3, Regulatory Position 2.3, "Design Phase," should be revised to reference RG 5.71 and state that digital safety system designs should incorporate hardware and software architectures capable of providing a cyber security defensive architecture to combat malicious cyber security threats.
- Explicit statements that the licensing design reviews will not address cyber security design features for other than their effect on the safety system should be deleted.
- If the staff cannot provide hazard identification guidance for acceptable methods, RG 1.152 Regulatory Position 2.1, "Concepts Phase," should be revised to state that, while Annex D of IEEE Standard 7-4.3.2-2003 is not endorsed by the NRC, the hazard identification guidance in Annex D may provide useful information on the assessment of the susceptibility of safety systems to inadvertent access.

V. Human Factors Considerations with Respect to Emerging Technology in Nuclear Power Plants

[Dr. Hossein Nourbakhsh was the Designated Federal Official for this portion of the meeting.]

The Committee met with representatives of the NRC staff to discuss human factors considerations with respect to emerging technology in nuclear power plants. Specifically, the

effects of degraded digital instrumentation and control (I&C) systems on human-system interfaces (HSIs) and operator performance were discussed. The increased use of automation and other technologies in existing, new and advanced nuclear power plant designs has the potential to introduce new human factors engineering (HFE) challenges. The NRC has sponsored a research project at Brookhaven National Laboratory (BNL) to identify human performance research that may be needed to support the review of a licensee's implementation of new technology in nuclear power plants. The staff indicated that although digital technology potentially can improve operational performance, there are challenges to using this technology in nuclear power plants. Findings of the research project at BNL indicate that I&C degradations are prevalent in plants employing digital systems, and the overall effects on the plant's behavior can be significant, such as causing a reactor trip or equipment to operate unexpectedly. I&C degradations may affect the HSIs used by operators to monitor and control the plant. For example, deterioration of the sensors can complicate the operators' interpretation of displays, and sometimes may mislead them by making it appear that a process disturbance has occurred. The staff also indicated that the information obtained is used as the technical basis upon which to develop HFE review guidance. During the May 12-14, 2011, ACRS meeting, the Committee will consider a proposed report on this subject.

## VI. Discussion of Regulatory Guides

### Draft Final Regulatory Guides

The Committee decided not to review the draft final versions of the following Regulatory Guides and has no objection to the staff's proposal to issue them as final:

- Revision 1 to Regulatory Guide 8.2, "Administrative Practices in Radiation Surveys and Monitoring"
- Revision 2 to Regulatory Guide 8.24, "Health Physics Surveys During Enriched Uranium 235 Processing and Fuel Fabrication"
- Revision 1 to Regulatory Guide 3.67, "Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities"

### Proposed Regulatory Guides

The Committee decided not to review proposed revisions to the following Regulatory Guides and has no objection to the staff's proposal to issue them for public comment. The Committee would like an opportunity to review the draft final version of these guides after reconciliation of public comments:

- Proposed Revision 2 to Regulatory Guide 1.106 (DG-1264), "Thermal Overload Protection for Electric Motors on Motor-Operated Valves"
- Proposed Revision 1 to Regulatory Guide 1.169 (DG-1206), "Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"



- Proposed Revision 1 to Regulatory Guide 1.170 (DG-1207), “Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.171 (DG-1208), “Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.172 (DG-1209), “Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.173 (DG-1210), “Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 2 to Regulatory Guide 1.168 (DG-1267), “Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”

Draft Revision 3 to NUREG-1022, “Event Reporting Guidelines 10 CFR 50.72 and 50.73”

The Committee decided not to review draft Revision 3 to NUREG-1022, “Event Reporting Guidelines 10 CFR 50.72 and 50.73,” but would like an opportunity to review the draft final version of this NUREG after reconciliation of public comments.

Additional Information Regarding the Safety Evaluation Report (SER) for the License Renewal of Palo Verde Nuclear Generating Station, Units 1, 2, and 3

The Committee decided not to review additional information regarding the SER, for the Palo Verde Nuclear Generating Station License Renewal Application and has no objection to the staff’s proposal to issue the final SER.

VI. Executive Session

[Note: Mr. Edwin Hackett was the Designated Federal Official for this portion of the meeting.]

A. Reconciliation of ACRS Comments and Recommendations/EDO Commitments

- The Committee considered the EDO’s response of February 5, 2011, to comments and recommendations included in the December 13, 2010, ACRS report on the final safety evaluation report associated with the amendment to the AP1000 design control document. The Committee will consider a response to the EDO during their May 12-14, 2011, meeting.

- The Committee considered the EDO's response of March 4, 2011, to comments and recommendations included in the January 31, 2011, ACRS letter on the review of RAMONA5-FA for use in boiling water reactor stability calculations. The Committee decided that it was satisfied with the EDO's response.
- The Committee considered the EDO's response of March 24, 2011, to comments and recommendations included in the March 1, 2011, ACRS report on the safety aspects of the license renewal application for the Palo Verde Nuclear Generating Station. The Committee decided that it was satisfied with the EDO's response.
- The Committee considered the EDO's response of March 3, 2011, to comments and recommendations included in the January 24, 2011, ACRS letter on the draft final Revision 2 to RG 1.174 and Revision 1 to RG 1.177. The Committee decided that it was satisfied with the EDO's response.
- The Committee considered the EDO's response of March 1, 2011, to comments and recommendations included in the January 24, 2011, ACRS letter on the draft final rule, "Enhancement to Emergency Preparedness," and related regulatory guidance documents. The Committee will consider a response to the EDO during their May 12-14, 2011, meeting.
- The Committee considered the EDO's response of March 3, 2011, to comments and recommendations included in the January 24, 2011, ACRS report on the safety aspects of the Southern Nuclear Operating Company combined license application for the Vogtle Generating Plant, Units 3 and 4. The Committee decided that it was satisfied with the EDO's response.
- The Committee considered the EDO's response of March 31, 2011, to comments and recommendations included in the January 21, 2011, ACRS letter on the response to the January 21, 2011, EDO letter regarding the safety culture policy statement. The Committee decided that it was satisfied with the EDO's response.
- The Committee considered the EDO's response of March 22, 2011, to comments and recommendations included in the February 17, 2011, ACRS letter on the comparison of Integrated Safety Analysis (ISA) and Probabilistic Risk Assessment (PRA) for fuel cycle facilities (FCFs). The Committee issued a response letter to the Executive Director for Operations on this matter, dated April 19, 2011.

B. Report of the Planning and Procedures Subcommittee Meeting

Anticipated Workload for ACRS Members

The anticipated workload for the ACRS members through April 6, 2011 was discussed and the objectives were to:

- Review the reasons for the scheduling of each activity and the expected work product and to make changes, as appropriate
- Manage the members' workload for these meetings
- Plan and schedule items for ACRS discussion of topical and emerging issues

### Regulatory Guides (RG)

#### (a) Draft Final Regulatory Guides

The staff plans to issue the following Draft Final Regulatory Guides and would like to know whether the Committee wants to review them prior to being issued final.

- Revision 1 to Regulatory Guide 8.2, "Administrative Practices in Radiation Surveys and Monitoring"

Revision 1 of RG 8.2 was issued for public comments as draft regulatory guide DG-8035 on August 30, 2010, and the public comment period closed on October 29, 2010. The initial version of RG 8.2 was issued in 1973 to endorse American National Standards Institute (ANSI) Standard N13.2-1969, "Administrative Practices in Radiation Monitoring (A Guide for Management)." This standard has been withdrawn and it is no longer available from the ANSI. Additionally the NRC has revised 10 CFR Part 20, "Standards for Protection Against Radiation," developed NUREG-1556, "Consolidated Guidance about Materials Licenses," and NUREG-1736, "Consolidated Guidance: 10 CFR Part 20-Standards for Protection against Radiation" to further promulgate the NRC's regulatory positions. This revised regulatory guide describes acceptable administrative practices for surveys and monitoring of ionizing radiation in licensed institutions.

- Revision 2 of Regulatory Guide 8.24, "Health Physics Surveys During Enriched Uranium 235 Processing and Fuel Fabrication"

Revision 2 of Regulatory Guide 8.24 was issued for public comment as draft regulatory guide DG-8040 on March 22, 2010, and the public comment period closed on May 3, 2010. The initial version of RG 8.24 was issued in 1979. This update incorporates changes to NRC regulations and the addition of American National Standards Institute guidance. RG 8.24 specifies the types and frequencies of surveys that are acceptable to the staff of the Nuclear Regulatory Commission for the protection of workers in plants licensed to process enriched uranium and fabricate uranium fuel.

- Revision 1 of Regulatory Guide 3.67, "Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities"

Revision 1 of RG 3.67 was issued for public comment as draft regulatory guide DG-3039 on May 19, 2010, and the public comment period closed October 29, 2010. Revision 1 of RG 3.67 describes the preferred format and content of emergency plans for fuel cycle and materials

licensees to comply with the requirements of 10 CFR 30.32(i)(3), 40.31(j)(3), 63.161, 70.22(i)(3), 72.32, and 76.91. Regulatory Guide 3.67 was originally published in January 1992. Since that time, new regulations have been published and experience has been gained with the implementation of material and fuel cycle emergency plans. Revision of this regulatory guidance is necessary to update and improve the information provided.

### Proposed Regulatory Guides

The staff plans to issue the following Draft Guides and would like to know whether the Committee wants to review them prior to being issued for public comment.

- Proposed Revision 2 to Regulatory Guide 1.106 (DG-1264), “Thermal Overload Protection for Electric Motors on Motor-Operated Valves”

The current version of RG 1.106 is dated March 1977 and endorses Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 279-1971, “Thermal Overload Protection for Electric Motors on Motor-Operated Valves.” This standard has been superseded by IEEE Standard 603-2009, “Criteria for Safety Systems for Nuclear Power Generating Stations,” and RG 1.106 is being revised to endorse the new IEEE standard.

- Proposed Revision 1 to Regulatory Guide 1.169 (DG-1206), “Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.170 (DG-1207), “Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.171 (DG-1208), “Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.172 (DG-1209), “Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 1 to Regulatory Guide 1.173 (DG-1210), “Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”
- Proposed Revision 2 to Regulatory Guide 1.168 (DG-1267), “Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants”

These 6 draft regulatory guides describe the NRC staff’s position regarding the development and testing of software associated with digital instrumentation and control systems in nuclear power plants. They have been developed to work in conjunction with one another.

- Draft Revision 3 of NUREG-1022, "Event Reporting Guidelines 10 CFR 50.72 and 50.73"

The staff plans to issue draft Revision 3 of NUREG-1022, and would like to know whether the Committee wants to review it prior to being issued for public comment.

The changes to this draft NUREG are intended to be clarifying in nature and are not intended to offer a new staff position. However, judging from various public meetings on this subject held in 2010, some changes may involve different opinions between the staff and the external stakeholders.

#### Palo Verde License Renewal

The staff issued the SER related to the Palo Verde Nuclear Generating Station license renewal application on January 1, 2011. Subsequently, the applicant submitted additional information correcting the as-built materials for the Unit 2 steam generator divider plate bars and revising the commitment for aging management of these components. The staff concluded that this new information does not change their conclusions in the SER. The ACRS issued its report on the Palo Verde license renewal application on March 1, 2011.

#### Meeting with the Commission

The Commission will meet with the ACRS on June 6, 2011, at 10 A.M. to discuss topics of mutual interest.

#### ACRS site visits and meeting with Region II

The ACRS is scheduled to visit the MOX Fuel Fabrication Facility and Tritium Recovery Facility on Tuesday, July 26; visit to the Vogtle site on Wednesday, July 27; and meet with Region II on Thursday, July 28.

#### ACRS visit to the Naval Nuclear Propulsion Program (NNPP) training facility

ACRS members and staff have been invited to visit the NNPP training facility in Charleston, South Carolina on May 24, 2011. Arrival should be scheduled for Monday, May 23 since the meeting at the training facility is at 8:00 am on Tuesday, May 24. Departure should be scheduled the evening of May 24 or the morning of May 25 for those attending the Radiation Protection and Nuclear Materials Subcommittee meeting the afternoon of May 25. Clothing for this site visit is business casual.

#### Update on Ongoing Earthquake Studies

There are two ongoing studies that will provide updated seismic information for use in nuclear power plant licensing for the Central and Eastern United States (CEUS): the Seismic Source Characterization Study and the Next Generation Attenuation Models. In March 2011, the Committee agreed that Dr. Hinze, ACRS consultant, should brief the Committee on the status of these efforts. This briefing is tentatively being scheduled during the lunch break on Thursday, May 12, 2011.

#### Staff Requirements Memorandum (SRM) – SECY-10-014

In a March 21, 2011, SRM regarding SECY-10-014 (Options for Revising the Construction Reactor Oversight Process Assessment Program) the Commission approved the staff's recommended Option 3, to develop a construction assessment program that includes a regulatory framework, the use of a construction significance determination process to determine the significance of findings identified during the construction inspection program, and the use of a construction action matrix to determine the appropriate NRC response to findings.

#### Chairman's Tasking Memo Regarding Events in Japan

In a Chairman's tasking memorandum dated March 23, 2011, the staff was directed "to conduct a methodical and systematic review of our processes and regulations to determine whether the agency should make additional improvements to our regulatory system and make recommendations to the Commission for its policy direction." This review was divided into near-term (90-days) and long-term activities. The tasking memorandum also directed the ACRS to review the (long-term review report) "as issued in its final form and provide a letter report to the Commission."

#### Formation of a new ACRS Subcommittee

The NRC's task force plans to issue several reports associated with potential operational or regulatory issues affecting domestic operating reactors as a result of the evaluations regarding the events at the Fukushima Daiichi nuclear complex in Japan. The ACRS was directed to report to the Commission on the task force's long-term report. To help the Members prepare for this review a formation of a new "Fukushima Subcommittee" is recommended.

#### Quadripartite Meeting

France's Groupe Permanent pour les Réacteurs Nucléaires (GPR) is planning to host the next Quadripartite Plenary Meeting in France. The tentative dates are November 14-18, 2011. The list of topics proposed by the Members was discussed during the March 2011 meeting. The ACRS Chairman has suggested that the Fukushima event in Japan be the sole topic of the Quadripartite meeting.

#### New Resource Mailbox for Compensation

Members should begin submitting their hours to [ACRS.HRMS.Resource@nrc.gov](mailto:ACRS.HRMS.Resource@nrc.gov). Hours for pay period 8 (March 27 - April 9) should be submitted no later than Saturday, April 9, 2011.

#### Status of Selection of New Members

On Friday March 11, 2011, the ACRS and screening panel interviewed 3 candidates. The interviews for the fourth candidate are scheduled for the morning of Friday, April 8, 2011.

C. Future Meeting Agenda

Appendix IV summarizes the proposed items endorsed by the Committee for the 583<sup>rd</sup> ACRS Meeting, May 12-14, 2011

A list of documents that were provided to the Committee during the 582<sup>nd</sup> ACRS Meeting is listed in Appendix V.

The meeting was adjourned at 7:00 p.m. on April 8, 2011.

pursuant to 10 CFR 52.77, as well as technical information submitted pursuant to 10 CFR 52.79. This notice is being provided in accordance with the requirements found in 10 CFR 50.43(a)(3).

A copy of the application is available for public inspection at the Commission's Public Document Room (PDR), located at One White Flint North, Public File Area O1 F21, 11555 Rockville Pike (first floor), Rockville, Maryland, and via the Agencywide Documents Access and Management System (ADAMS) Public Electronic Reading Room on the Internet at the NRC Web site, <http://www.nrc.gov/reading-rm/adams.html>. The accession number for the cover letter of the application is ML081300460. Other publicly available documents related to the application, including revisions filed after the initial submission, are also posted in ADAMS. Persons who do not have access to ADAMS, or who encounter problems in accessing the documents located in ADAMS, should contact the NRC Public Document Room staff by telephone at 1-800-397-4209 or 301-415-4737, or by e-mail to [pdr@nrc.gov](mailto:pdr@nrc.gov). The application is also available at <http://www.nrc.gov/reactors/new-reactors/col.html>.

Dated at Rockville, Maryland, this 16th day of March 2011.

For the Nuclear Regulatory Commission.

**Joseph M. Sebrosky,**

Senior Project Manager, AP1000 Projects Branch 1, Division of New Reactor Licensing, Office of New Reactors.

[FR Doc. 2011-6846 Filed 3-22-11; 8:45 am]

BILLING CODE 7590-01-P

## NUCLEAR REGULATORY COMMISSION

### Advisory Committee on Reactor Safeguards; Notice of Meeting

In accordance with the purposes of Sections 29 and 182b of the Atomic Energy Act (42 U.S.C. 2039, 2232b), the Advisory Committee on Reactor Safeguards (ACRS) will hold a meeting on April 7-9, 2011, 11545 Rockville Pike, Rockville, Maryland. The date of this meeting was previously published in the **Federal Register** on Thursday, October 21, 2010 (74 FR 65038-65039).

#### Thursday, April 7, 2011, Conference Room T2-B1, 11545 Rockville Pike, Rockville, Maryland

8:30 a.m.-8:35 a.m.: *Opening Remarks by the ACRS Chairman* (Open)—The ACRS Chairman will make opening remarks regarding the conduct of the meeting.

8:35 a.m.-10:30 a.m.: *Selected Chapters of the Safety Evaluation Report (SER) with Open Items Associated with the Calvert Cliffs, Unit 3 Combined License Application Referencing the U.S. Evolutionary Power Reactor (EPR)* (Open/Closed)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff, UniStar, and AREVA regarding Chapters 4, 5, 8, 10, 11, 12, 16, 17, and 19 of the SER with Open Items associated with the Calvert Cliffs, Unit 3 combined license application referencing the U.S. EPR design. [Note: A portion of this session may be closed to discuss and protect information that is designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]

10:45 a.m.-12:45 p.m.: *Commission Paper on Emergency Planning for Small Modular Reactors* (Open)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff regarding a draft Commission Paper on emergency planning for small modular reactors.

1:45 p.m.-4:15 p.m.: *Draft Final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and Cyber Security Related Activities* (Open)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff regarding draft final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," the staff's resolution of public comments, and cyber security related activities.

4:30 p.m.-7 p.m.: *Preparation of ACRS Reports* (Open/Closed)—The Committee will discuss proposed ACRS reports on matters discussed during this meeting. [Note: A portion of this session may be closed to discuss and protect information that is designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]

#### Friday, April 8, 2011, Conference Room T2-B1, 11545 Rockville Pike, Rockville, Maryland

10 a.m.-10:05 a.m.: *Opening Remarks by the ACRS Chairman* (Open)—The ACRS Chairman will make opening remarks regarding the conduct of the meeting.

10:05 a.m.-11:30 a.m.: *Human Factors Considerations in Emerging*

*Technology in Nuclear Power Plants* (Open)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff regarding human factors considerations in emerging technology in nuclear power plants.

1 p.m.-2:30 p.m.: *Future ACRS Activities/Report of the Planning and Procedures Subcommittee* (Open/Closed)—The Committee will discuss the recommendations of the Planning and Procedures Subcommittee regarding items proposed for consideration by the Full Committee during future ACRS Meetings, and matters related to the conduct of ACRS business, including anticipated workload and member assignments. [Note: A portion of this meeting may be closed pursuant to 5 U.S.C. 552b (c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACRS, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.]

2:30 p.m.-2:45 p.m.: *Reconciliation of ACRS Comments and Recommendations* (Open)—The Committee will discuss the responses from the NRC Executive Director for Operations to comments and recommendations included in recent ACRS reports and letters.

3 p.m.-4 p.m.: *Preparation for Meeting with the Commission* (Open)—The Committee will discuss the topics for an upcoming meeting with the Commission.

4 p.m.-7 p.m.: *Preparation of ACRS Reports* (Open/Closed)—The Committee will continue its discussion of proposed ACRS reports. [Note: A portion of this session may be closed in order to discuss and protect information designated as proprietary by AREVA, pursuant to 5 U.S.C. 552b(c)(4).]

#### Saturday, April 9, 2011 Conference Room T2-B1, 11545 Rockville Pike, Rockville, Maryland

8:30 a.m.-1 p.m.: *Preparation of ACRS Reports* (Open/Closed)—The Committee will continue its discussion of proposed ACRS reports. [Note: A portion of this session may be closed in order to discuss and protect information designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]



1 p.m.–1:30 p.m.: *Miscellaneous (Open)*—The Committee will continue its discussion related to the conduct of Committee activities and specific issues that were not completed during previous meetings.

Procedures for the conduct of and participation in ACRS meetings were published in the **Federal Register** on October 21, 2010, (75 FR 65038–65039). In accordance with those procedures, oral or written views may be presented by members of the public, including representatives of the nuclear industry. Persons desiring to make oral statements should notify Ms. Ilka Berrios, Cognizant ACRS Staff (Telephone: 301–415–3179, E-mail: [Ilka.Berrios@nrc.gov](mailto:Ilka.Berrios@nrc.gov)), five days before the meeting, if possible, so that appropriate arrangements can be made to allow necessary time during the meeting for such statements. In view of the possibility that the schedule for ACRS meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should check with the Cognizant ACRS staff if such rescheduling would result in major inconvenience.

Thirty-five hard copies of each presentation or handout should be provided 30 minutes before the meeting. In addition, one electronic copy of each presentation should be emailed to the Cognizant ACRS Staff one day before meeting. If an electronic copy cannot be provided within this timeframe, presenters should provide the Cognizant ACRS Staff with a CD containing each presentation at least 30 minutes before the meeting.

In accordance with Subsection 10(d) Public Law 92–463, and 5 U.S.C. 552b(c), certain portions of this meeting may be closed, as specifically noted above. Use of still, motion picture, and television cameras during the meeting may be limited to selected portions of the meeting as determined by the Chairman. Electronic recordings will be permitted only during the open portions of the meeting.

ACRS meeting agenda, meeting transcripts, and letter reports are available through the NRC Public Document Room at [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov), or by calling the PDR at 1–800–397–4209, or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS) which is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> or <http://www.nrc.gov/reading-rm/doc-collections/ACRS/>.

Video teleconferencing service is available for observing open sessions of

ACRS meetings. Those wishing to use this service for observing ACRS meetings should contact Mr. Theron Brown, ACRS Audio Visual Technician (301–415–8066), between 7:30 a.m. and 3:45 p.m. (ET), at least 10 days before the meeting to ensure the availability of this service.

Individuals or organizations requesting this service will be responsible for telephone line charges and for providing the equipment and facilities that they use to establish the video teleconferencing link. The availability of video teleconferencing services is not guaranteed.

Dated: March 17, 2011.

**Andrew L. Bates,**

*Advisory Committee Management Officer.*

[FR Doc. 2011–6838 Filed 3–22–11; 8:45 am]

**BILLING CODE 7590–01–P**

## **NUCLEAR REGULATORY COMMISSION**

### **Advisory Committee on Reactor Safeguards (ACRS); Meeting of the ACRS Subcommittee on U.S. Evolutionary Power Reactor (U.S. EPR); Notice of Meeting**

The ACRS Subcommittee on U.S. EPR will hold a meeting on April 5, 2011, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance, with the exception of a portion that may be closed to protect information that is proprietary pursuant to 5 U.S.C. 552b(c)(4).

The agenda for the subject meeting shall be as follows:

#### **Tuesday, April 5, 2011—8:30 a.m. until 5 p.m.**

The Subcommittee will review (1) Chapter 6 of the Safety Evaluation Report (SER) with open items associated with U.S. EPR Design Control Document (DCD) and (2) Chapter 6 of the SER with Open Items associated with the Calvert Cliffs, Unit 3, Reference Combined License Application (RCOLA). The Subcommittee will hear presentations by and hold discussions with representatives of AREVA Inc., Unistar, the NRC staff and other interested persons regarding this matter. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the Full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official (DFO), Derek Widmayer (Telephone 301–415–7366 or E-mail:

[Derek.Widmayer@nrc.gov](mailto:Derek.Widmayer@nrc.gov)) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Thirty-five hard copies of each presentation or handout should be provided to the DFO thirty minutes before the meeting. In addition, one electronic copy of each presentation should be e-mailed to the DFO one day before the meeting. If an electronic copy cannot be provided within this timeframe, presenters should provide the DFO with a CD containing each presentation at least thirty minutes before the meeting. Electronic recordings will be permitted only during those portions of the meeting that are open to the public. Detailed procedures for the conduct of and participation in ACRS meetings were published in the **Federal Register** on October 21, 2010, (75 FR 65038–65039).

Detailed meeting agendas and meeting transcripts are available on the NRC Web site at <http://www.nrc.gov/reading-rm/doc-collections/acrs>. Information regarding topics to be discussed, changes to the agenda, whether the meeting has been canceled or rescheduled, and the time allotted to present oral statements can be obtained from the Web site cited above or by contacting the identified DFO. Moreover, in view of the possibility that the schedule for ACRS meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should check with these references if such rescheduling would result in a major inconvenience.

Dated: March 17, 2011.

**Yoira Diaz-Sanabria,**

*Acting Chief, Reactor Safety Branch B, Advisory Committee on Reactor Safeguards.*

[FR Doc. 2011–6828 Filed 3–22–11; 8:45 am]

**BILLING CODE 7590–01–P**

## **NUCLEAR REGULATORY COMMISSION**

### **Advisory Committee on Reactor Safeguards (ACRS); Meeting of the ACRS Subcommittee on Advanced Boiling Water Reactor (ABWR); Notice of Meeting**

The ACRS Subcommittee on ABWR will hold a meeting on April 6, 2011, Room T–2B1, 11545 Rockville Pike, Rockville, MD.

The entire meeting will be open to public attendance, with the exception of a portion that may be closed to protect information that is proprietary pursuant to 5 U.S.C. 552b(c)(4).

The agenda for the subject meeting shall be as follows:



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

**March 24, 2011**

**AGENDA  
582<sup>nd</sup> ACRS MEETING  
April 7-9, 2011**

**THURSDAY, APRIL 7, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE,  
ROCKVILLE, MD**

- 1) 8:30 AM - 8:35 AM      Opening Remarks by the ACRS Chairman (Open) (SAK/EMH)  
1.1) Opening Statement  
1.2) Items of Current Interest
- 2) 8:35 AM - 10:30 AM      Selected Chapters of the Safety Evaluation Report (SER) with  
Open Items Associated with the Calvert Cliffs, Unit 3 Combined  
License Application Referencing the U.S. Evolutionary Power  
Reactor (EPR) (Open/Closed) (DAP/DAW)  
2.1) Remarks by the Subcommittee Chairman  
2.2) Briefing by and discussions with representatives of the  
NRC staff, UniStar, and AREVA regarding Chapters 4, 5,  
8, 10, 11, 12, 16, 17, and 19 of the SER with Open Items  
associated with the Calvert Cliffs, Unit 3 combined license  
application referencing the U.S. EPR design

**[NOTE: A portion of this session may be closed to discuss  
and protect information that is designated as proprietary by  
AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]**

10:30 AM - 10:45 AM      **\*\*\* BREAK \*\*\***

- 3) 10:45 AM - 12:45 PM      Events at the Fukushima Reactor Site in Japan (Open/Closed)  
(SAK/EMH)  
3.1) Remarks by the Subcommittee Chairman  
3.2) Discussions regarding the events at the Fukushima  
Reactor Site in Japan

**[NOTE: A portion of this session may be closed to protect  
information provided in confidence by a foreign source  
pursuant to 5 U.S.C. 552b (c) (4).]**

12:45 PM - 1:45 PM      **\*\*\* LUNCH \*\*\***

- 4) 1:45 PM - 4:15 PM Draft Final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and Cyber Security Related Activities (Open) (CB/CEA)
- 4.1) Remarks by the Subcommittee Chairman
  - 4.2) Briefing by and discussions with representatives of the NRC staff regarding draft final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," the staff's resolution of public comments, and cyber security related activities

4:15 PM - 4:30 PM **\*\*\* BREAK \*\*\***

- 5) 4:30 PM – 7:00 PM Preparation of ACRS Reports (Open/Closed)
- 5.1) Selected Chapters of the Safety Evaluation Report (SER) with Open Items Associated with the Calvert Cliffs, Unit 3 Combined License Application Referencing the U.S. Evolutionary Power Reactor (Open/Closed) (DAP/DAW)
  - 5.2) Draft Final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and Cyber Security Related Activities (CB/CEA)

**[NOTE: A portion of this session may be closed to discuss and protect information that is designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]**

**FRIDAY, APRIL 8, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE, ROCKVILLE, MD**

- 6) 10:00 AM – 10:05 AM Opening Remarks by the ACRS Chairman (Open) (SAK/EMH)
- 7) 10:05 AM - 11:30 AM Human Factors Considerations with Respect to Emerging Technology in Nuclear Power Plants (Open) (DCB/HPN)
- 7.1) Remarks by the Subcommittee Chairman
  - 7.2) Briefing by and discussions with representatives of the NRC staff regarding human factors considerations with respect to emerging technology in nuclear power plants
- 11:30 AM - 1:00 PM **\*\*\* LUNCH \*\*\***

8) 1:00 PM - 2:30 PM

Future ACRS Activities/Report of the Planning and Procedures Subcommittee (Open/Closed) (SAK/EMH)

- 8.1) Discussion of the recommendations of the Planning and Procedures Subcommittee regarding items proposed for consideration by the Full Committee during future ACRS meetings.
- 8.2) Report of the Planning and Procedures Subcommittee on matters related to the conduct of ACRS business, including anticipated workload and member assignments.

**[NOTE: A portion of this meeting may be closed pursuant to 5 U.S.C. 552b (c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACRS, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.]**

9) 2:30 PM – 2:45 PM

Reconciliation of ACRS Comments and Recommendations (Open) (SAK/CS/YDS)

Discussion of the responses from the NRC Executive Director for Operations to comments and recommendations included in recent ACRS reports and letters.

2:45 PM - 3:00 PM

**\*\*\* BREAK \*\*\***

10) 3:00 PM – 4:00 PM

Preparation for Meeting with the Commission (Open) (SAK, et al./EMH, et al.)

Discussion of the topics for an upcoming meeting with the Commission

11) 4:00 PM – 7:00 PM

Preparation of ACRS Reports (Open/Closed)

Continue discussion of the proposed ACRS reports listed under Item 5. There may be 15 minute break at some point during this activity.

**[NOTE: A portion of this session may be closed to discuss and protect information that is designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]**

**SATURDAY, APRIL 9, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE,  
ROCKVILLE, MD**

12) 8:30 AM - 1:00 PM      Preparation of ACRS Reports (Open/Closed)  
Continue discussion of the proposed ACRS reports listed under Item 5. There may be 15 minute break at some point during this activity.

**[NOTE: A portion of this session may be closed to discuss and protect information that is designated as proprietary by AREVA and its contractors pursuant to 5 U.S.C. 552b(c)(4).]**

13) 1:00 PM - 1:30 PM      Miscellaneous (Open) (SAK/EMH)  
Discussion of matters related to the conduct of Committee activities and specific issues that were not completed during previous meetings, as time and availability of information permit.

**NOTES:**

- When appropriate, members of the public and representatives of the nuclear industry may provide their views during the briefings.
- During the meeting, phone number 301-415-7360 should be used in order to contact anyone in the ACRS Office.
- Presentation time should not exceed 50 percent of the total time allocated for a given item. The remaining 50 percent of the time is reserved for discussion.
- Thirty five (35) hard copies and one (1) electronic copy of the presentation materials should be provided to the ACRS in advance of the briefing.
- One (1) electronic copy of each presentation should be emailed to the Designated Federal Official 1 day before the meeting. If an electronic copy cannot be provided within this timeframe, presenters should provide the Designated Federal Official with a CD containing each presentation at least 30 minutes before the meeting.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
582<sup>nd</sup> FULL COMMITTEE MEETING

April 7-9, 2011

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TODAY'S DATE: April 7, 2011

<u>NAME</u>	<u>NRC ORGANIZATION</u>
1 Surinder Arora	NRC/NRO/DNRL
2 James Steckel	NRC/NRO/DNRL
3 <del>HRW LB</del>	<del>NRC/NRO/DCIP</del>
4 Joe DeMarshall	NRC/NRO/DCIP/CTSB
5 DAYNA Dority	NRC/NRO/DCIP/CTSB
6 Pete Hearn	NRC/NRO/DNRL/NARP
7 Ed Roach	NRC/NRO/DCIP/CHPB
8 Houh Phoa	NRC/NRO/DSRA
9 Jim Vu	NRC/NRO/DE
10 JC Schaefer	NRO/DCIP/CHPB
11 Robert Schaal	NRO/OSER/RSAC
12 Mike Canada	NRO/OSER/NARP
13 Jason Canreal	NRO/DNRL/NARP
14 Malcolm PATTERSON	NRO/DSRA/SPRA
15 Mark Kowal	NRO/DCIP/CTSB
16 Elizabeth Stuckle	NRC/OPA
17 JOSEPH COLACCINO	NRC/NRO/DNRL
18 Blake Purcell	NRC/NRR/PPR
19 Michael Benson	NRC/RES/DE
20 R Sullivan	NRC/NSIR
21 John Daily	NRR/DLR
22 Nathan SanFilippo	NRC/OEDO
23 Daniel Santos	NRC/NRO/OE
24 Aloysius Obodoako	NRC/NRR/DCI
25 Rosemary Hogan	NRC/RES/DE
26 Robert Roche-Rivers	NRC/RES/DE
27 Greg Makar	NRO/DE/CIBT
28 Stacey Feenberg	NRR/DPR/PGCB

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
582<sup>nd</sup> FULL COMMITTEE MEETING

April 7-9, 2011

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TODAY'S DATE: April 7, 2011

	<u>NAME</u>	<u>NRC ORGANIZATION</u>
1	Roger Pedersen	NRR / DIRS
2	EMMA WONG	NRR / DCI
3	MATT VADER	NRR / DCI
4	Kent Wood	NRR / DSS
5	UNDINE SHOU	NRR / DIRS
6	DAVID BEAULIEU	NRR / DPR
7	G. S. MATHARU	NRR / DE / EICB
8	Matthew McConnell	NRR / DE / EICB
9	TIM KOSGZ	NRR / DIRS
10	Bill Ruland	NRR / DSS
11	Rich Stattel	NRR / DE / EICB
12	Tim Massman	NRR / DE / EICB
13	STEVEN ARNDT	NRR / DE
14	George Simonds	NSIR / DSP
15	Gush Singh	NRR / DE / EICB
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
582<sup>nd</sup> FULL COMMITTEE MEETING

April 7-9, 2011

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TODAY'S DATE: April 7, 2011

	<u>NAME</u>	<u>AFFILIATION</u>
1	M.W. Gmyrek	AREVA
2	Jean-Luc BEGON	UNISTAR
3	MARK FINLEY	UNISTAR
4	CYRIL RODEW	UNISTAR.
5	LWAYNE A MASSIE	Unistar
6	Vincent Sorel	UNISTAR.
7	Joshua Reinert	AREVA
8	JOHN M. RUCKE	UNISTAR
9	RICK SZOCH	UNISTAR
10	MARTIN OWENS	AREVA
11	Gene Hughes	UNISTAR
12	Roberta Rampton	Reuters
13	Patricia Campbell	GE Hitachi Nuclear Energy
14	James Ross	"
15	VIJAY M NICERANI	NET
16	Neil Haggerty	NaStart
17	Kelli Voelsing	AREVA
18	Roy MATHEW	NRC
19	Maurcen Conley	Platts
20	Guy Wilson	nrc
21	PREM SAMAN	NRC
22	Dina Coppello	AD
23	Hanna Nonshy	Greenwire
24	Temile Tracy	Dow Jones
25	Theodore A. Messier	AREVA
26	GREG GIBSON	Unistar
27	<del>Rick Stattel</del>	
28	Jay Amin	Luminant



ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
582<sup>nd</sup> FULL COMMITTEE MEETING

April 7-9, 2011

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TODAY'S DATE: April 7, 2011

	<u>NAME</u>	<u>AFFILIATION</u>
1	Gordon Clayton	NEI
2	Jim McQuighan	UNISOM
3	Pat Samples	MNES
4	Bob Keible	Lumant
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
582<sup>nd</sup> FULL COMMITTEE MEETING

April 7-9, 2011

PLEASE PRINT

TODAY'S DATE: April 8, 2011

**NAME**

Michael Baggi

**NRC ORGANIZATION**

NRR/DIAs/IHPS



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

**AGENDA  
583<sup>rd</sup> ACRS MEETING  
May 12-14, 2011**

**THURSDAY, MAY 12, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE,  
ROCKVILLE, MD**

- 1) 1:30 PM - 1:35 PM      Opening Remarks by the ACRS Chairman (Open) (SAK/EMH)  
1.1)    Opening Statement  
1.2)    Items of Current Interest
- 2) 1:35 PM - 3:00 PM      Final Safety Evaluation Report Associated with the License  
Renewal Application for the Hope Creek Generating Station  
(Open) (WJS/PW)  
2.1)    Remarks by the Subcommittee Chairman  
2.2)    Briefing by and discussions with representatives of the  
NRC staff and PSEG Nuclear, LLC regarding the final  
safety evaluation report associated with the license  
renewal application for the Hope Creek Generating  
Station.
- 3:00 PM - 3:15 PM      **\*\*\* BREAK \*\*\***
- 3) 3:15 PM - 5:15 PM      Final Safety Evaluation Report Associated with the License  
Renewal Application for Salem Nuclear Generating Station, Units  
1 and 2 (Open) (JWS/KDW)  
3.1)    Remarks by the Subcommittee Chairman  
3.2)    Briefing by and discussions with representatives of the  
NRC staff and PSEG Nuclear, LLC regarding the final  
safety evaluation report associated with the license  
renewal application for Salem Nuclear Generating Station,  
Units 1 and 2.
- 5:15 PM - 5:30 PM      **\*\*\* BREAK \*\*\***
- 4) 5:30 PM – 7:00 PM      Preparation of ACRS Reports (Open)  
4.1)    Final Safety Evaluation Report Associated with the License  
Renewal Application for the Hope Creek Generating  
Station (WJS/PW)  
4.2)    Final Safety Evaluation Report Associated with the License  
Renewal Application for Salem Nuclear Generating  
Station, Units 1 and 2 (JWS/KDW)

- 4.3) Response to the February 5, 2011, EDO Letter regarding the Final Safety Evaluation Report associated with the AP1000 Design Control Document (DCB/WW)
- 4.4) Response to the March 1, 2011, EDO Letter regarding the draft Final Rule, "Enhancements to Emergency Preparedness," and related regulatory guidance documents (JDS/GSS)
- 4.5) Human Factors Considerations in Emerging Technologies (DCB/HPN)

**FRIDAY, MAY 13, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE, ROCKVILLE, MD**

- 5) 8:30 AM – 8:35 AM      Opening Remarks by the ACRS Chairman (Open) (SAK/EMH)
- 6) 8:35 AM - 10:30 AM      Advanced Reactor Research Plan (Open/Closed) (DCB/MB)
  - 6.1) Remarks by the Subcommittee Chairman
  - 6.2) Briefing by and discussions with representatives of the NRC staff regarding the Advanced Reactor Research Plan.

**[NOTE: A portion of this session may be closed in order to discuss and protect information that is proprietary pursuant to 5 U.S.C 552b(c)(4)]**

10:30 AM - 10:45 AM      \*\*\* **BREAK** \*\*\*

- 7) 10:45 AM - 12:15 PM      Future ACRS Activities/Report of the Planning and Procedures Subcommittee (Open/Closed) (SAK/EMH)
  - 7.1) Discussion of the recommendations of the Planning and Procedures Subcommittee regarding items proposed for consideration by the Full Committee during future ACRS meetings.
  - 7.2) Report of the Planning and Procedures Subcommittee on matters related to the conduct of ACRS business, including anticipated workload and member assignments.

**[NOTE: A portion of this meeting may be closed pursuant to 5 U.S.C. 552b (c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACRS, and information the release of which would constitute a clearly unwarranted invasion of personal privacy]**

- 8) 12:15 PM - 12:30 PM      Reconciliation of ACRS Comments and Recommendations  
(Open) (SAK/CS/YDS)  
Discussion of the responses from the NRC Executive Director for Operations to comments and recommendations included in recent ACRS reports and letters.
- 12:30 PM - 2:00 PM      **\*\*\* LUNCH \*\*\***
- 9) 2:00 PM - 3:30 PM      Preparation for Meeting with the Commission (Open) (SAK/EMH)  
Discussion of topics for the meeting with the Commission on June 6, 2011.
- 3:30 PM - 3:45 PM      **\*\*\* BREAK \*\*\***
- 10) 3:45 PM – 7:00 PM      Preparation of ACRS Reports (Open/Closed)
- 10.1) Final Safety Evaluation Report Associated with the License Renewal Application for the Hope Creek Generating Station (WJS/PW)
  - 10.2) Final Safety Evaluation Report Associated with the License Renewal Application for Salem Nuclear Generating Station, Units 1 and 2 (JWS/KDW)
  - 10.3) Response to the February 5, 2011, EDO Letter regarding the Final Safety Evaluation Report associated with the AP1000 Design Control Document (DCB/WW)
  - 10.4) Response to the March 1, 2011, EDO Letter regarding the draft Final Rule, "Enhancements to Emergency Preparedness," and related regulatory guidance documents (JDS/GSS)
  - 10.5) Human Factors Considerations in Emerging Technologies (DCB/HPN)
  - 10.6) Advanced Reactor Research Plan (DCB/MB)
- [NOTE: A portion of this session may be closed in order to discuss and protect information that is proprietary pursuant to 5 U.S.C 552b(c)(4)]**

**SATURDAY, MAY 14, 2011, CONFERENCE ROOM T-2B1, 11545 ROCKVILLE PIKE, ROCKVILLE, MD**

- 11) 8:30 AM - 1:00 PM      Preparation of ACRS Reports (Open/Closed)  
Continue discussion of the proposed ACRS reports listed under Item 10. There may be 15 minute breaks at some point during this activity.

**[NOTE: A portion of this session may be closed in order to discuss and protect information that is proprietary pursuant to 5 U.S.C 552b(c)(4)]**

12) 1:00 PM - 1:30 PM

Miscellaneous (Open) (SAK/EMH)

Discussion of matters related to the conduct of Committee activities and specific issues that were not completed during previous meetings, as time and availability of information permit.

**NOTES:**

- When appropriate, members of the public and representatives of the nuclear industry may provide their views during the briefings.
- During the meeting, phone number 301-415-7360 should be used in order to contact anyone in the ACRS Office.
- Presentation time should not exceed 50 percent of the total time allocated for a given item. The remaining 50 percent of the time is reserved for discussion.
- Thirty five (35) hard copies and one (1) electronic copy of the presentation materials should be provided to the ACRS in advance of the briefing.
- One (1) electronic copy of each presentation should be emailed to the Designated Federal Official 1 day before the meeting. If an electronic copy cannot be provided within this timeframe, presenters should provide the Designated Federal Official with a CD containing each presentation at least 30 minutes before the meeting.

LIST OF HANDOUTS  
582<sup>nd</sup> ACRS MEETING  
APRIL 7-9, 2011

- I. Opening Remarks by the ACRS Chairman
  1. Opening Remarks
  2. Items of Interest
  
- II. Selected Chapters of the Safety Evaluation Report (SER) with Open Items Associated with the Calvert Cliffs, Unit 3, Combined License Application Referencing the U. S. Evolutionary Power Reactor (EPR)
  3. Proposed agenda
  4. Status Report
  5. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application, – Safety Evaluation with Open Items for Portions of Chapter 2, “*Site Characteristics*,” October 2010
  6. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 4, “*Reactor*,” March 2010
  7. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 5, “*Reactor Coolant System and Connected Systems*,” March 2010
  8. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 8, “*Electric Power*,” January 2010
  9. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 10, “*Steam and Power Conversion*,” June 2010
  10. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 11, “*Radioactive Waste Management*,” October 2010
  11. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 12, “*Radiation Protection*,” March 2010
  12. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 16, “*Technical Specifications*,” October 2010
  13. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 17, “*Quality Assurance*,” March 2010
  14. Calvert Cliffs Nuclear Power Plant, Unit 3 Combined License Application – Safety Evaluation Report with Open Items for Chapter 19, “*PRA and Severe Accident Evaluation*,” April 2010

LIST OF HANDOUTS  
582<sup>nd</sup> ACRS MEETING  
APRIL 7-9, 2011

- III. Events at the Fukushima Reactor Site in Japan
  - 15. Table of Contents
  - 16. Meeting Schedule
  - 17. Status Report
  - 18. Information Notice 2011-05
  - 19. Slides from March 18, 2011 NRC All-Hands Meeting
  - 20. Slides from March 21, 2011 Commission Meeting
  - 21. Tasking Memorandum dated March 23, 2011
  
- IV. Draft Final Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and Cyber Security Related Activities
  - 22. Table of Contents
  - 23. Proposed Agenda
  - 24. Status Report
  
- V. Human Factors Considerations with Report to Emerging Technology in Nuclear Power Plants
  - 25. Table of Contents
  - 26. Proposed Schedule
  - 27. Status Report
  - 28. U.S. Nuclear Regulatory Commission, "Human Factors Considerations with Respect to Emerging Technology in Nuclear Power Plants," NUREG/CR-6947, BNL-NUREG-79828--2008, October 2008
  - 29. O'Hara, J., Higgins, J., Brown, W., & Fink, R., "*Human Factors Considerations with Respect to Emerging Technology in Nuclear Power Plants: Detailed Analysis*," BNL Technical Report No. 79947-2008, Upton, NY: Brookhaven National Laboratory. 2008
  - 30. John O'Hara, Bill Gunther, and Gerardo Martinez-Guridi, "The Effects of Degraded Digital Instrumentation and Control Systems on Human-system Interfaces and Operator Performance: HFE Review Guidance and Technical Basis," Brookhaven National Laboratory, Technical Report BNL-91047-2010, February 2010





# UNISTAR NUCLEAR ENERGY

**Presentation to ACRS Full Committee**

**U.S. EPR™**

**Calvert Cliffs Nuclear Power Plant Unit 3**

**FSAR Chapters 2 (Part-1), 4, 5, 8, 10, 11, 12, 16, 17,19**

**SER with Open Items**

**April 7, 2011**



# Introduction



- Greg Gibson, Senior Vice President, Regulatory Affairs, will lead the Calvert Cliffs Unit 3 presentation.
- Presentation was prepared by UniStar and is supported by AREVA (U.S. EPR Supplier).
  - Mark Finley (UniStar - Engineering Manager)
  - Richard Szoch (UniStar - Director of Testing & Programs Development)
  - Jean-Luc Begon (UniStar - Manager of Electrical/I&C Engineering)
  - Gene Hughes (UniStar - Director of PRA)
  - Ted Messier (AREVA - Meteorologist/Principal Scientist)
  - Josh Reinert (AREVA - COLA PRA Lead)

# Calvert Cliffs Unit 3 Overview



<u>Calvert Cliffs Unit 3 Summary</u>					
<u>Chapter</u>	<u># Departures</u>	<u>#Exemptions</u>	<u># SER Open Items</u>	<u># SER Open Items Responses Submitted</u>	<u>Item of Interest</u>
2 (Part 1)	2	1	3	3	*
4	0	1	2	2	
5	0	0	3	3	
8	0	0	1	1	*
10	0	0	2	2	
11	0	0	5	5	
12	0	0	4	4	
16	1	1	1	1	
17	0	0	11	11	*
19	0	0	7	7	*
Totals	3	3	39	39	-

# Items Of Interest



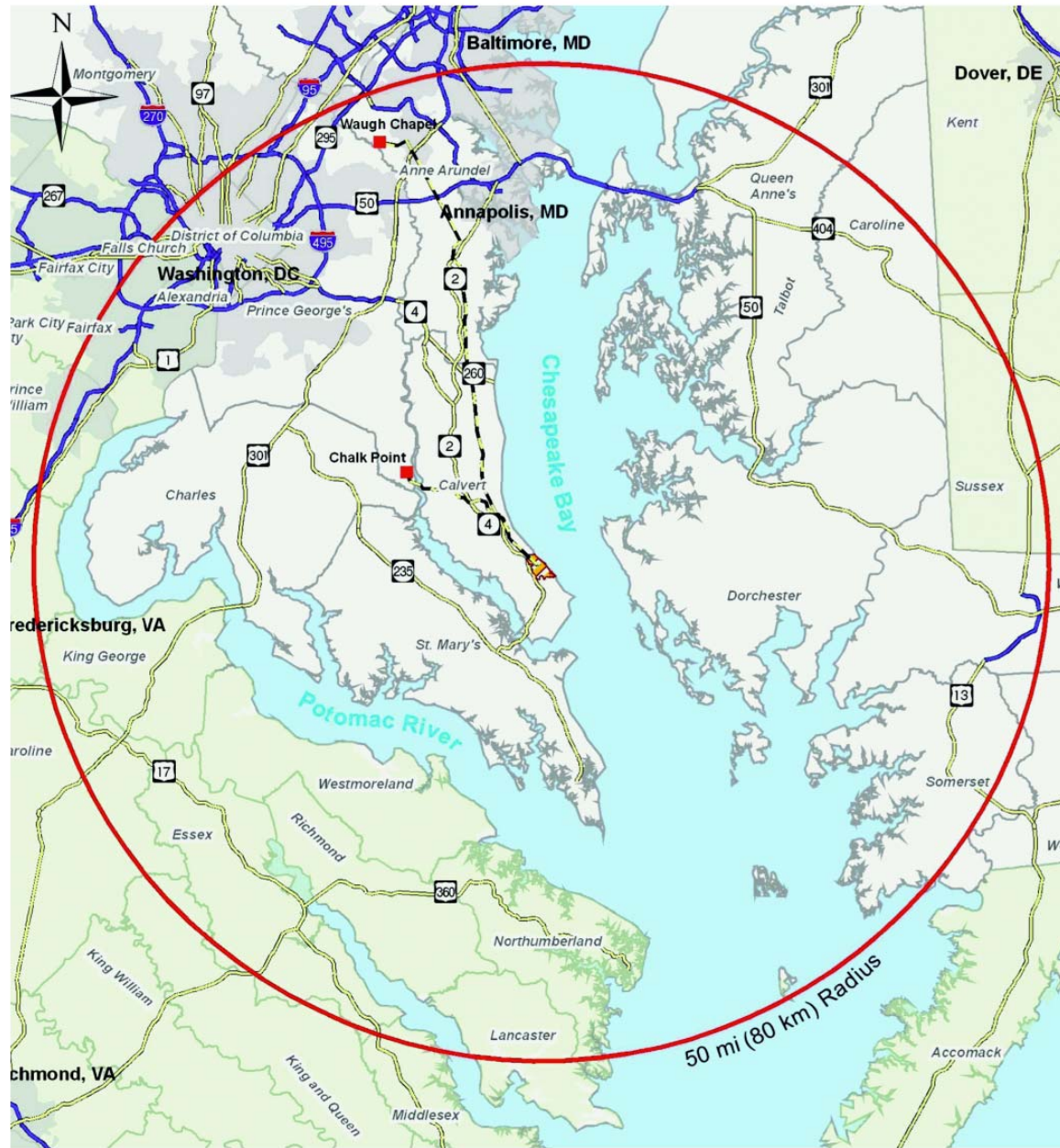
- The below listed site specific information is discussed in detail in today's presentation:
- Chapter 2, (Part 1), Site Characteristics
- Chapter 8, Electrical Power
- Chapter 17, Quality & Reliability Assurance/ Chapter 19 PRA



# Calvert Cliffs Unit 3 ACRS Full Committee Meeting Introduction

- UNE is responsible for the design of Calvert Cliffs Unit 3 and develops the design primarily through contracts with Bechtel and AREVA who have joined in a Consortium to develop the detailed design of the US EPR.
- RCOLA authored using 'Incorporate by Reference' (IBR) methodology.
- To simplify document presentation and review, only supplemental information, or site-specific information, departures or exemptions from the U.S. EPR FSAR are contained in the COLA.
- The focus of today's presentation will be a summary of the first 9½ FSAR Chapters that have been presented to the U.S. EPR ACRS Subcommittee.





# List of Chapters



- Chapter 2, Sections 2.1, 2.1, 2.2 & 2.3, Site Characteristics
- Chapter 4, Reactor
- Chapter 5, Reactor Coolant System
- Chapter 8, Electric Power
- Chapter 10, Steam and Power Conversion System
- Chapter 11, Radioactive Waste Management
- Chapter 12, Radiation Protection
- Chapter 16, Technical Specifications
- Chapter 17, Quality Assurance and Reliability Assurance
- Chapter 19, Probabilistic Risk Assessment /Severe Accident Evaluation



# ACRS Full Committee Meeting Agenda

## Based on Presentations to Subcommittee



- Chapter 2 (Part 1)
  - Meteorology
- Chapter 8
  - Off-site Transmission System
- Chapter 17 & Chapter 19
  - Reliability Assurance /PRA
- Conclusions



# **Chapter 2, (Part 1), Site Characteristics Meteorology**

Presented by Mark Finley  
UniStar Engineering Manager



# Meteorological Design Parameters



- Discussion at the ACRS Subcommittee for Calvert Cliffs Unit 3 Chapter 2 (Part 1) related to meteorological design parameters and the margin associated to these parameters.
- Next is a brief review of the significant meteorological design parameters and their associated site specific (Calvert Cliffs Unit 3) and generic (US EPR) values.
- A conservative approach has been used to set the design parameters in accordance with the associated regulatory requirements.



## Maximum Rainfall Rate



- The maximum rainfall rate is generally associated with tropical storms.
- There is no clear trend in the annual number of tropical storms.
- The National Weather Service calculated 100-year annual recurrence interval for rainfall in the site region (Solomons, MD), using as much as 126 years of historical data, is **3.28 inches/hr**.
- Thus, there is reasonable assurance that the generic maximum rainfall rate of **19.4 inches/hr** will not be exceeded.
- A site specific maximum rainfall rate of **18.5 inches/hr** will be used for design of the one site specific safety structure (UHS M/U Building).



# Roof Snow Load

- Winter snow volumes are projected to decrease while winter precipitation amounts are projected to increase.
- The site-specific characteristic value was determined to be **38 psf** (pounds per square foot) using ISG-07 and as much as 113 years of historical data:
  - (1) the 100-year return period snowpack,
  - (2) the historical maximum snowpack,
  - (3) the 100-year return period snowfall event, and
  - (4) the historical maximum snowfall event in the site region.
- Thus, there is reasonable assurance that the roof snow load generic design value of **100 psf** will not be exceeded.
- A snow and ice load of **65 psf** will be used for design of the one site specific safety structure (UHS M/U Building).



# Maximum Non-Tornado Wind Speed

- There are no specific projections regarding wind speed.
- Thus, there is no basis to assess the possible impact on the ASCE 7-05 Basic Wind Speed (3-second gust).
- The site-specific characteristic value was determined to be **95 mph** (miles per hour) (50-year return period value) using ASCE 7-05, which included the results of an analysis of hurricane wind speeds.
- The 100-year return period value was determined to be **102 mph.**
- Thus, there is reasonable assurance that the maximum non-tornado wind speed generic design value of **145 mph** will not be exceeded.
- The 100-year return period value of **102 mph** will be used for design of the one site specific safety structure (UHS M/U Building).

# Tornado



- There is insufficient evidence to determine whether trends exist in small-scale phenomena such as tornadoes.
- Thus, there is no basis to assess the possible impact on the tornado maximum wind speed.
- The site-specific characteristic value was determined to be **200 mph** using Regulatory Guide 1.76.
- Thus, there is reasonable assurance that the maximum tornado wind speed design value of **230 mph** will not be exceeded.
- The site-specific characteristic value of **200 mph** will be used for design of the one site specific safety structure (UHS M/U Building).



# Maximum Temperature Values

- The amount of warming later in the century depends on the mitigation of greenhouse gas emissions.
- The 0% exceedance maximum dry bulb temperature is 102°F.
- If the projected mid century annual average temperature increase of 3°F (1.7°C) is added to the 0% exceedance maximum dry bulb temperature of 102°F, the result is  $102^{\circ}\text{F} + 3^{\circ}\text{F} = \mathbf{105^{\circ}\text{F}}$ .
- Thus, there is reasonable assurance that the site extreme temperature value of **115°F** will not be exceeded.
- The 0% exceedance maximum dry bulb temperature of 102°F will be used for the ventilation design of the one site specific safety structure (UHS M/U Building).





# Meteorological Design Parameters Conclusions



- Significant margin is available to generic meteorological design values to accommodate future changes in climate for Calvert Cliffs Unit 3.
- Although not as much margin is available for site specific design values, these values are also conservative and monitoring programs at site will be used to assure design margins are assessed in the future should climate change.

# ACRS Full Committee Meeting Agenda

## Based on Presentations to Subcommittee



- Chapter 2 (Part 1)
  - Meteorology
- **Chapter 8**
  - **Off-site Transmission System**
- Chapter 17 & Chapter 19
  - Reliability Assurance /PRA
- Conclusions



# **Chapter 8, Electrical Power Off-site Transmission System**

Presented by Jean-Luc Begon  
UniStar Supervisor of Electrical/I&C Engineering

# Off-site Transmission System Calvert Cliffs Unit 3

One three phase 500 kV transmission line from the CCNPP site to the Chalk Point Substation in Anne Arundel County (18 Miles)



Two separate three phase 500 kV transmission lines (single right-of-way) from the CCNPP site to the Waugh Chapel Substation in Anne Arundel County (48 Miles)

# Off-site Transmission System Regulatory Design Bases



## Appendix A to part 50

### General Design Criteria for Nuclear Power Plants

#### *Criterion 17--Electric power systems:*

... Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. ...

Calvert Cliffs Unit 3 design meets the Regulatory Design Bases

# Off-site Transmission System Loss Of Offsite Power - PRA



- Loss of Offsite Power (LOOP) event frequency is approximately  $1.7E-02/\text{yr}$  for the Calvert Cliffs Unit 3 site.
- This LOOP event frequency value used in the U.S. EPR FSAR PRA model is  $1.9E-02/\text{yr}$ .

LOOP event frequency for Calvert Cliffs Unit 3 site is bounded by the value in the U.S. EPR PRA model.



## Off-site Transmission System Specific Design Parameters

- 500 kV line design criteria
  - Wind Speed: 100 mph for wires  
125 mph for towers
  - Ice Loading: 1½ inch radial
  - Physical Separation: one tower collapse does not affect other lines.
  - Electrical Fault: one electrical fault does not affect other line.



# Off-site Transmission System Tornadoes in Calvert County

- In the period from January 1, 1950 through December 31, 2006, twelve (12) tornadoes were reported in Calvert County. This corresponds to an annual average of 0.2 tornadoes per year.
- The magnitude of the tornadoes ranged from F0 to F2, as designated by the National Weather Service.
  - An F0 tornado has estimated wind speeds less than 73 mph.
  - An F1 tornado has estimated wind speeds between 73 and 112 mph.
  - An F2 tornado has estimated wind speeds between 113 and 157 mph.
- The widths of the paths of the 12 tornadoes in Calvert County were estimated to range from 17 to 200 yards.





## **Off-site Transmission System Loss of 500KV lines in Calvert County**

- Historical Data for Grid at Calvert Cliffs Unit 1 & 2
  - No grid related loss of offsite power since 1985.



## Off-site Transmission System Summary

- Proposed design meets 10 CFR Part 50 Appendix A design criterion 17 (Physical independence).
- Calvert Cliffs Unit 3 LOOP event frequency is bounded by the U.S. EPR PRA model.
- Lines are designed with requirements to cope with extreme weather conditions.
- No grid related loss of offsite power at Calvert Cliffs Unit 1 & 2 since 1985.
- Should a loss of offsite power occur the U.S. EPR can rely on:
  - Full load rejection (Island mode – Plant supplying itself)
  - Four Emergency Diesel Generators
  - Two Alternate Current sources

# ACRS Full Committee Meeting Agenda

## Based on Presentations to Subcommittee



- Chapter 2 (Part 1)
  - Meteorology
- Chapter 8
  - Off-site Transmission System
- Chapter 17 & Chapter 19
  - Reliability Assurance /PRA
- Conclusions



**Chapter 17 Quality and Reliability Assurance**  
**Chapter 19 PRA/Severe Accident Evaluation**  
**Reliability Assurance /PRA**

Presented by Gene Hughes  
UniStar Supervisor of PRA  
and  
Richard Szoch  
UniStar Supervisor of Testing &  
Programs Development

# Reliability Assurance



RAP



EXPERT  
PANEL  
REVIEW

RISK SIGN'T  
SSC LIST

- CAP/QA
- Procurement
- Fabrication
- Construction
- Installation
- Testing

M-RULE  
NEI 07-02A  
Program

DESIGN

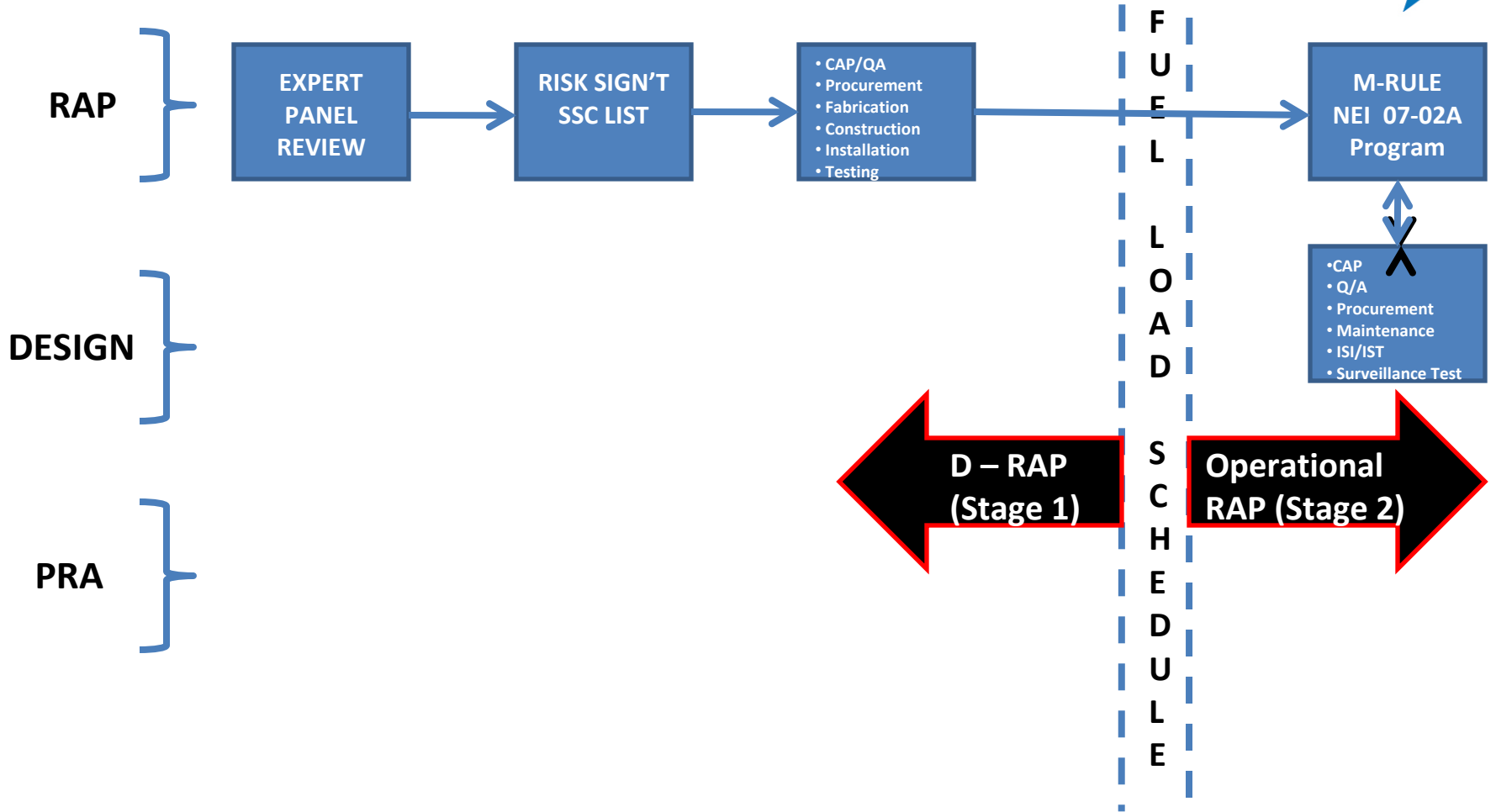


- CAP
- Q/A
- Procurement
- Maintenance
- ISI/IST
- Surveillance Test

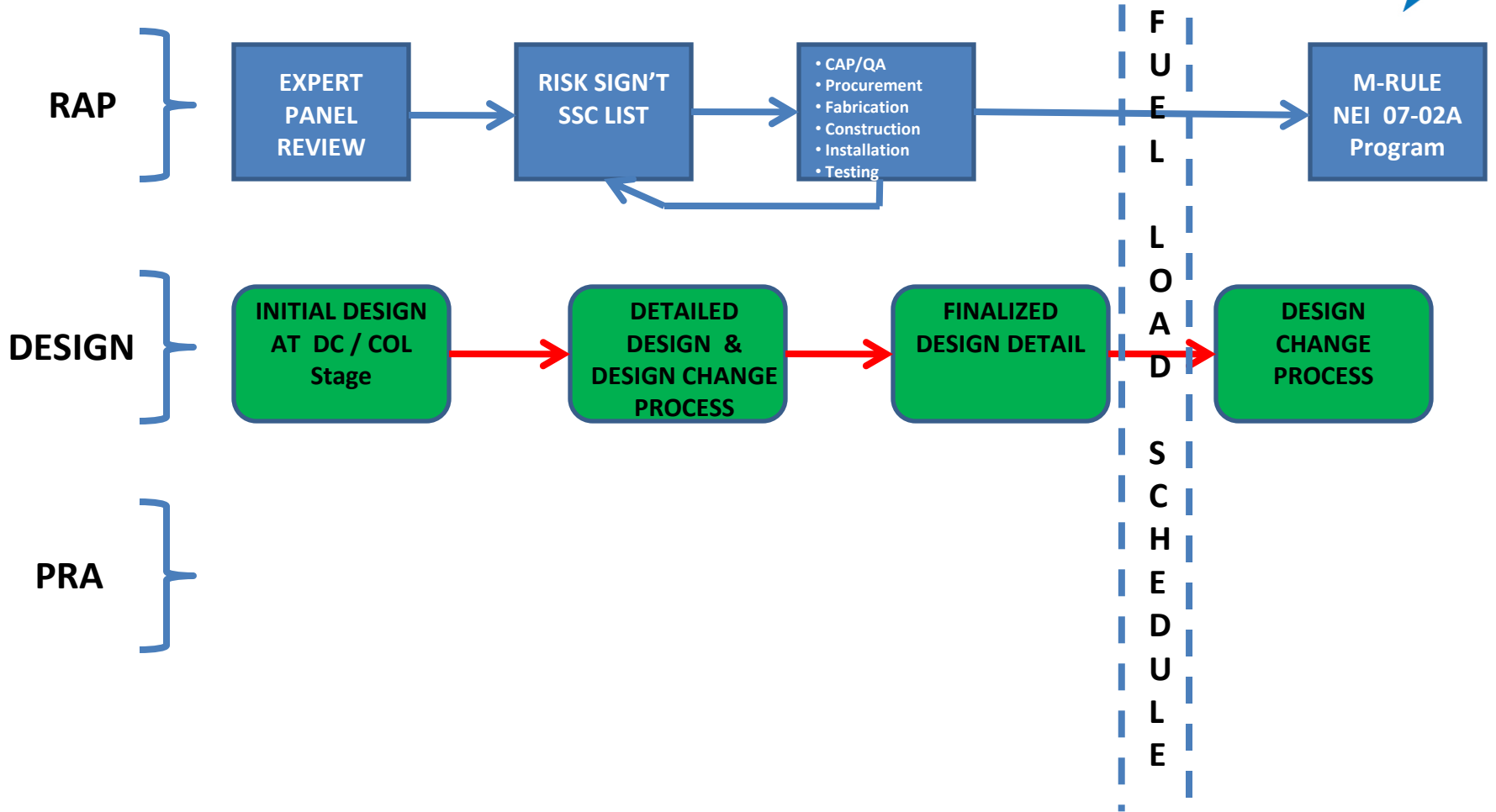
PRA



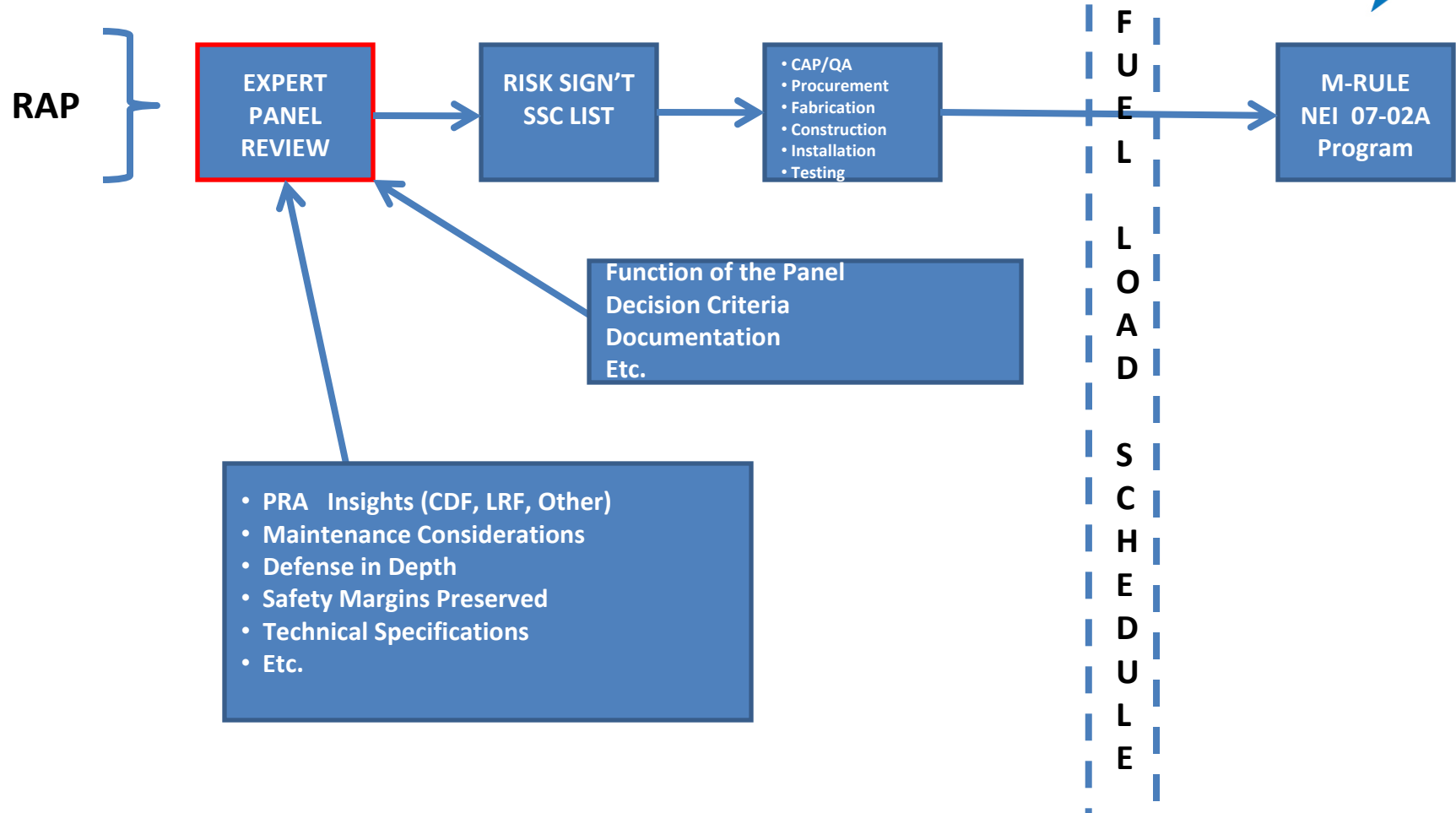
# Reliability Assurance



# Reliability Assurance

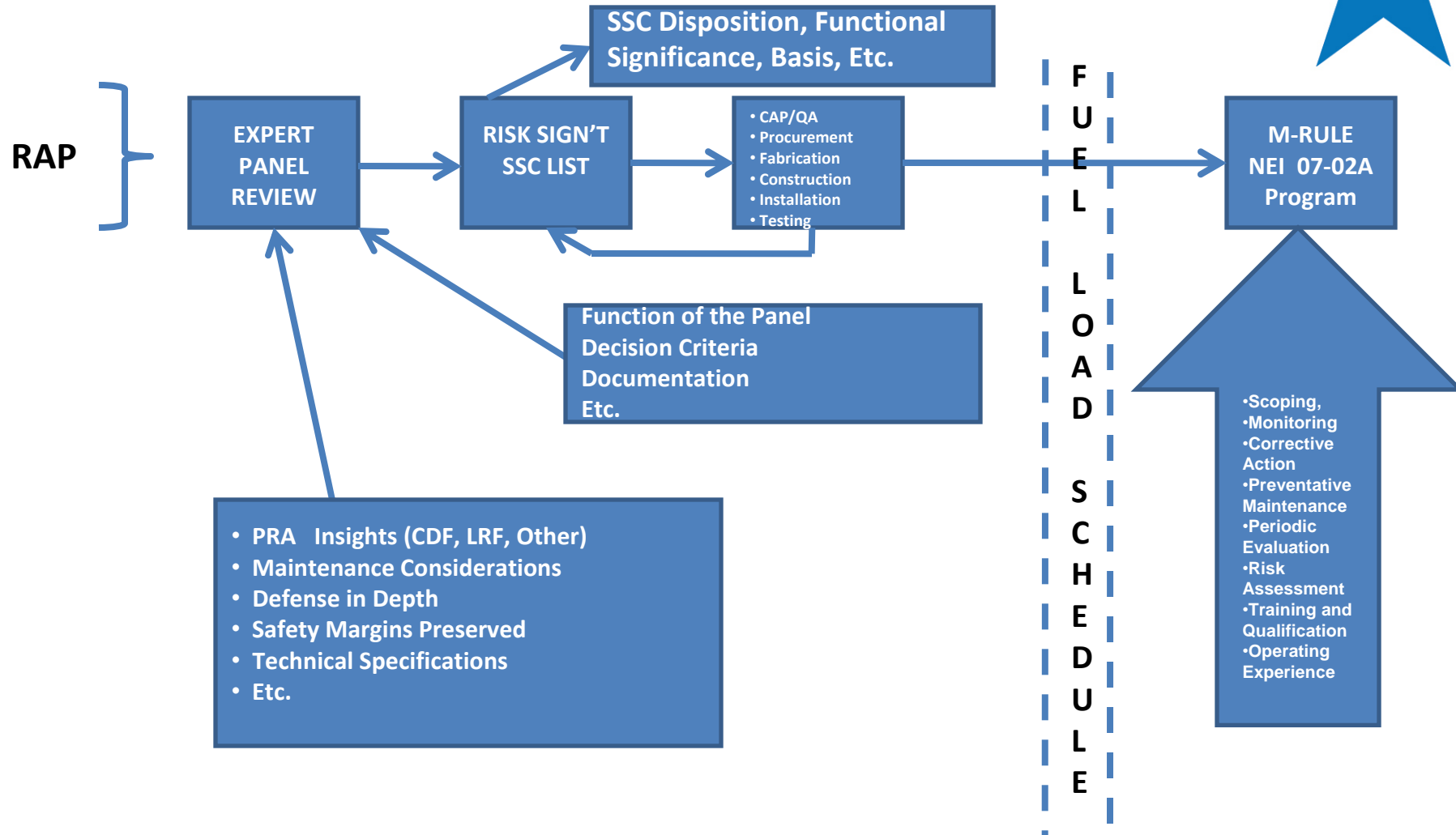


# Reliability Assurance

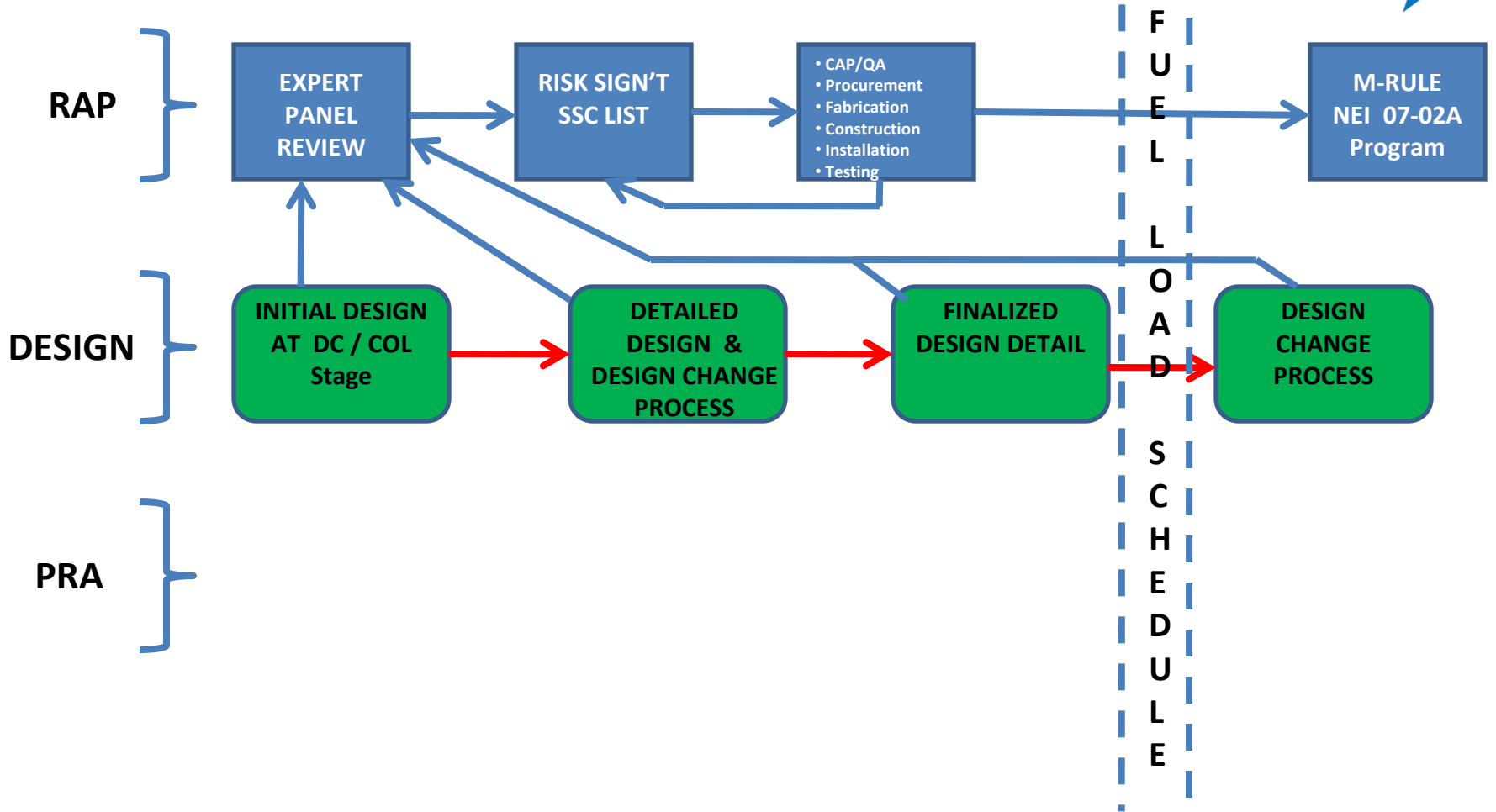




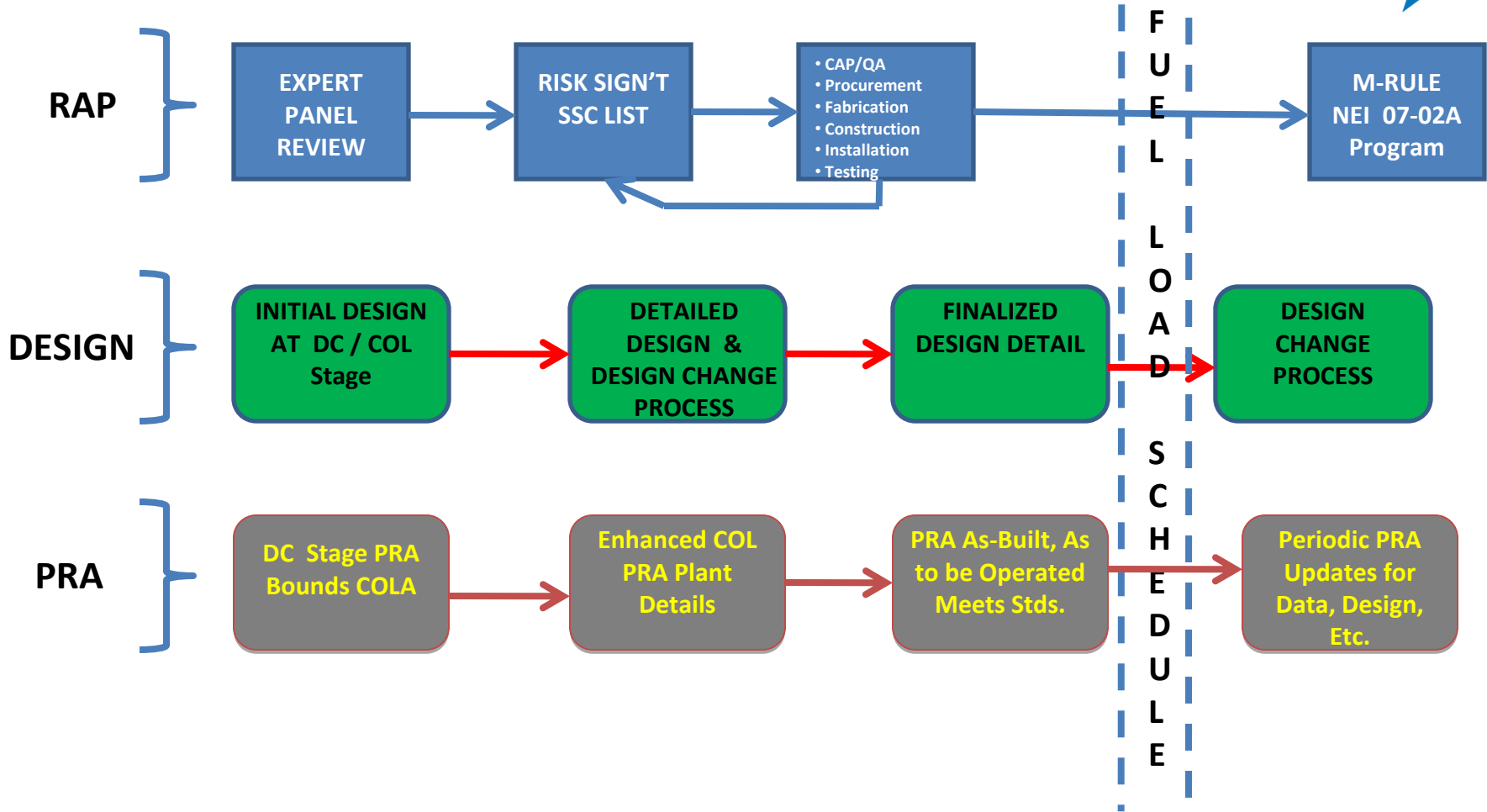
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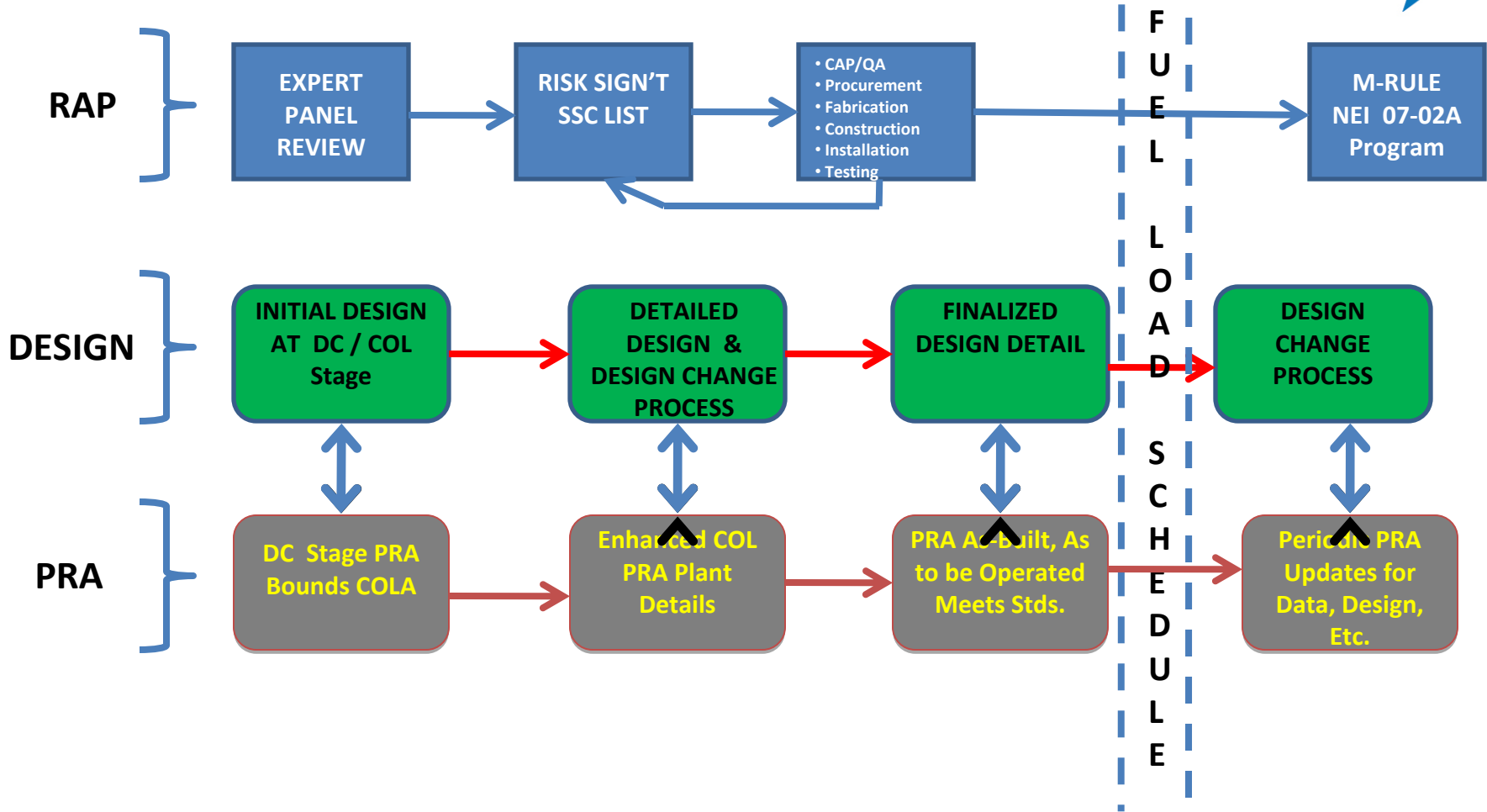
# Reliability Assurance



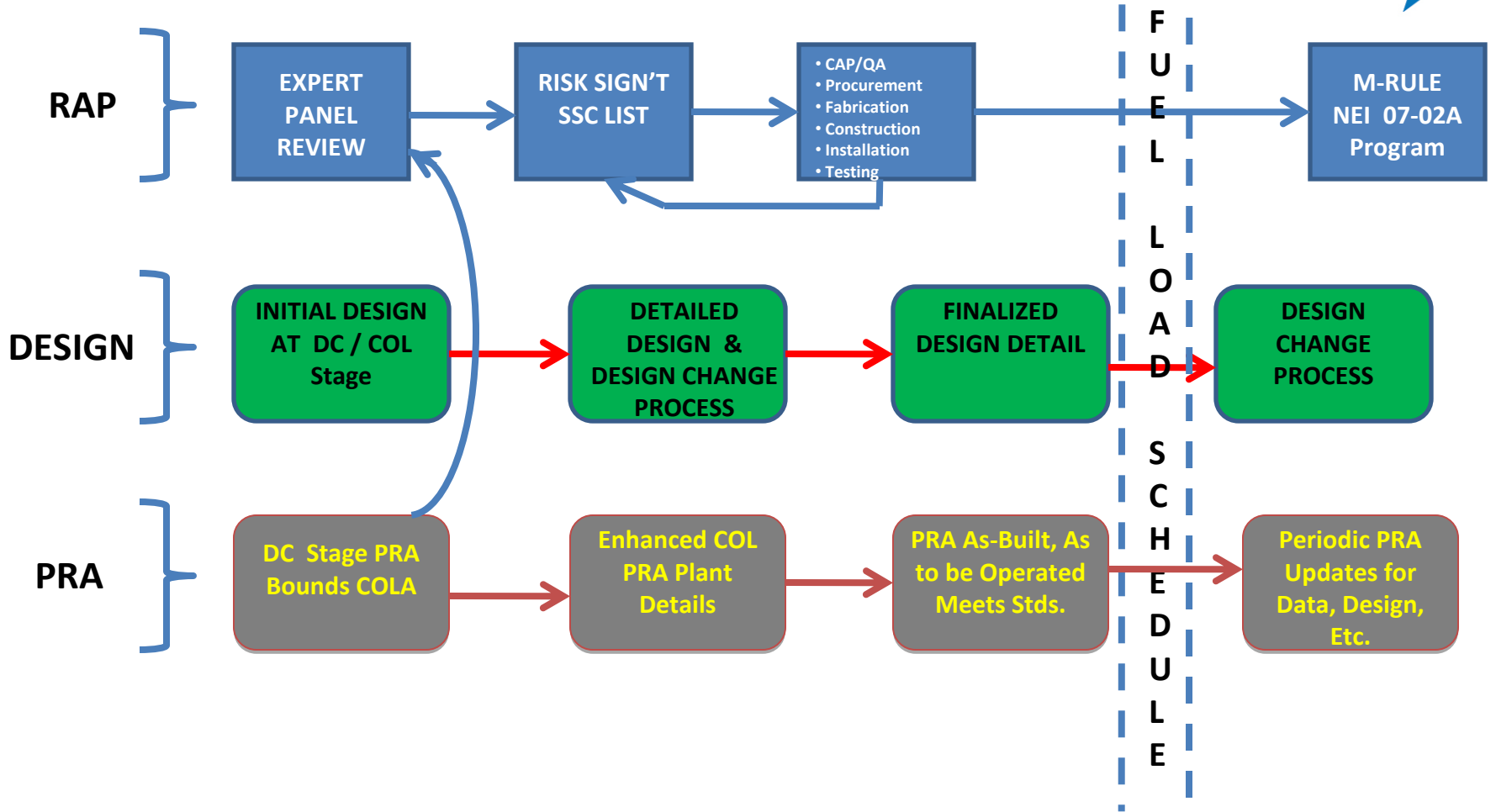
# Reliability Assurance



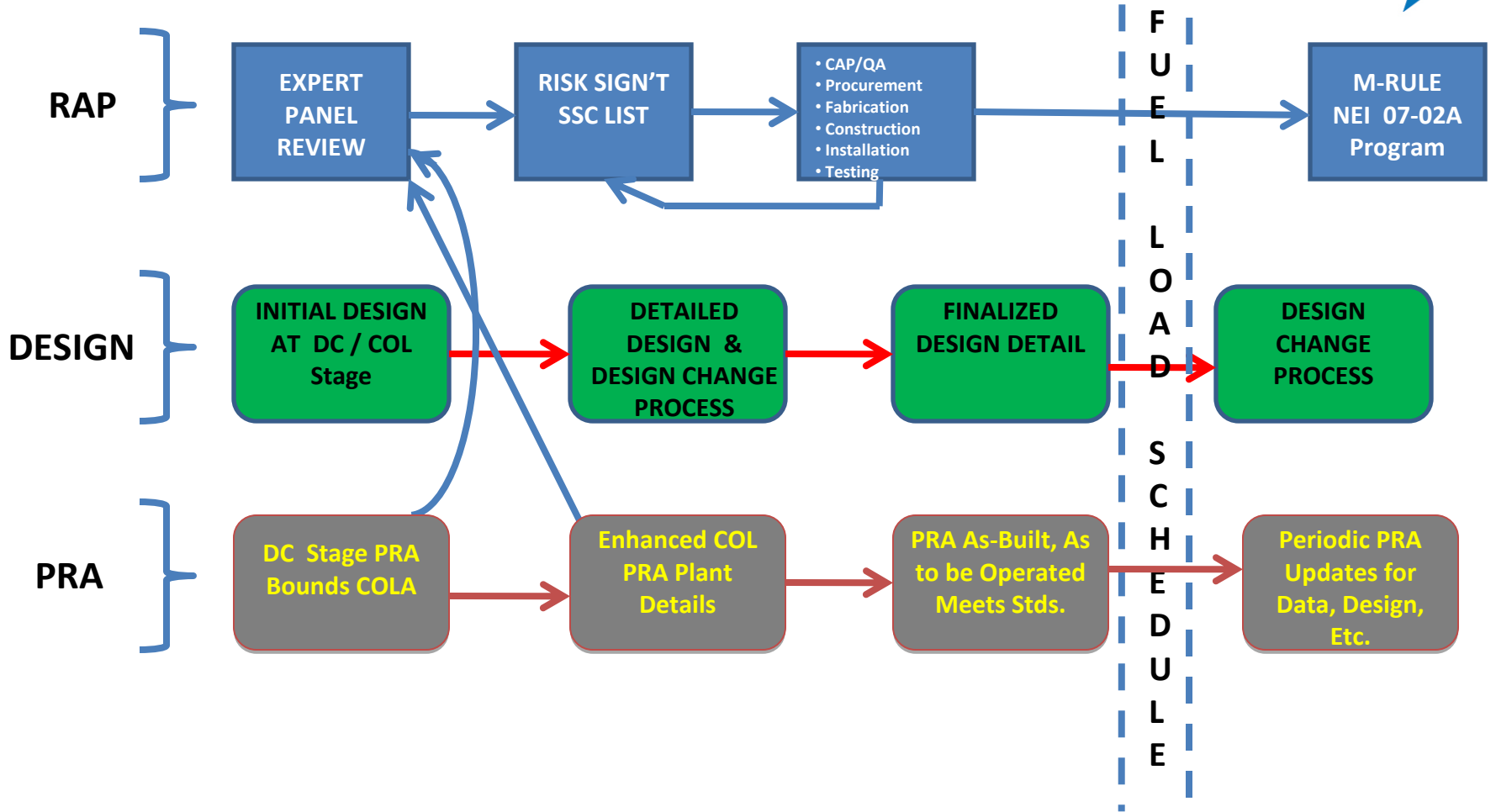
# Reliability Assurance



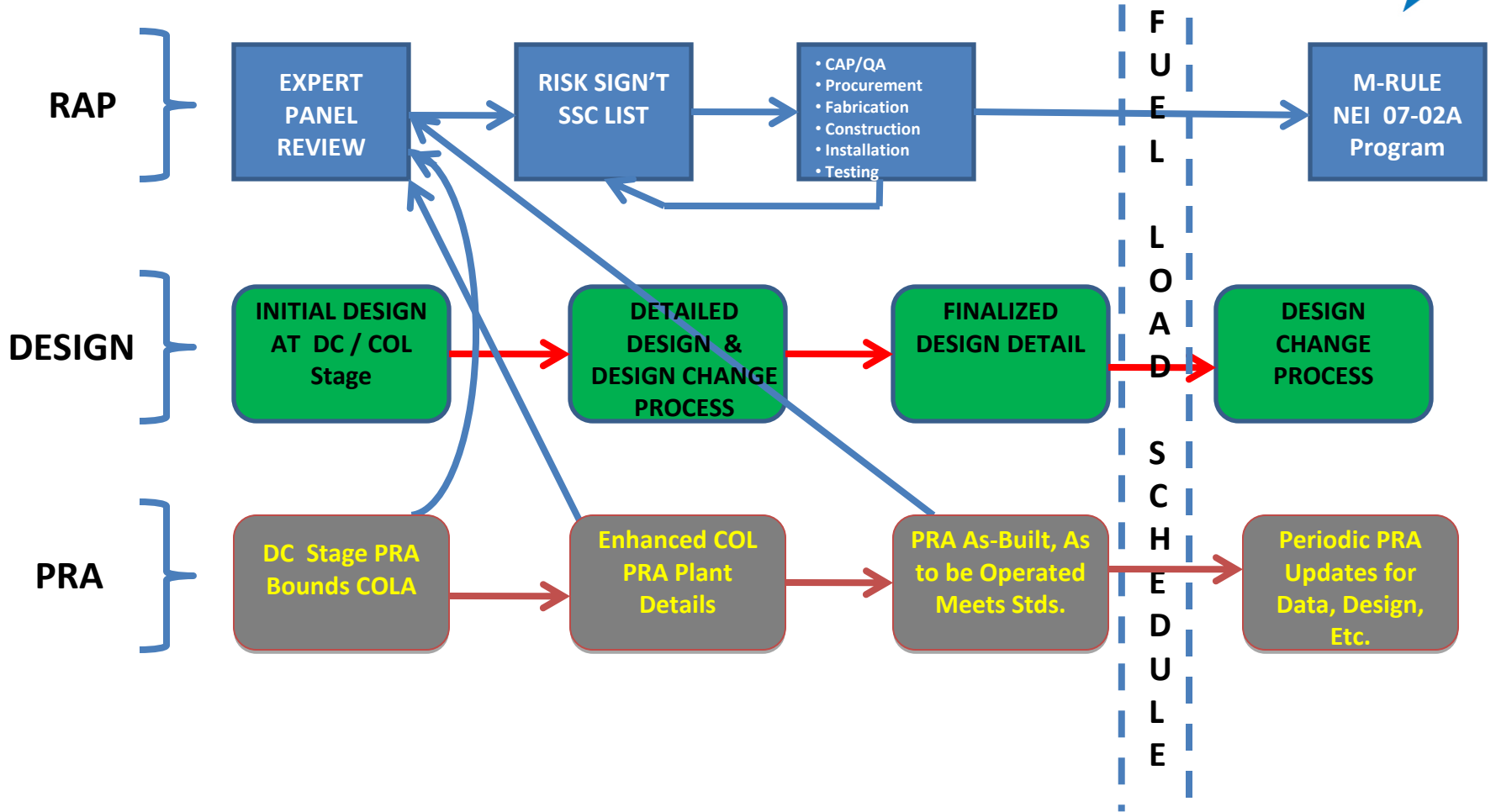
# Reliability Assurance



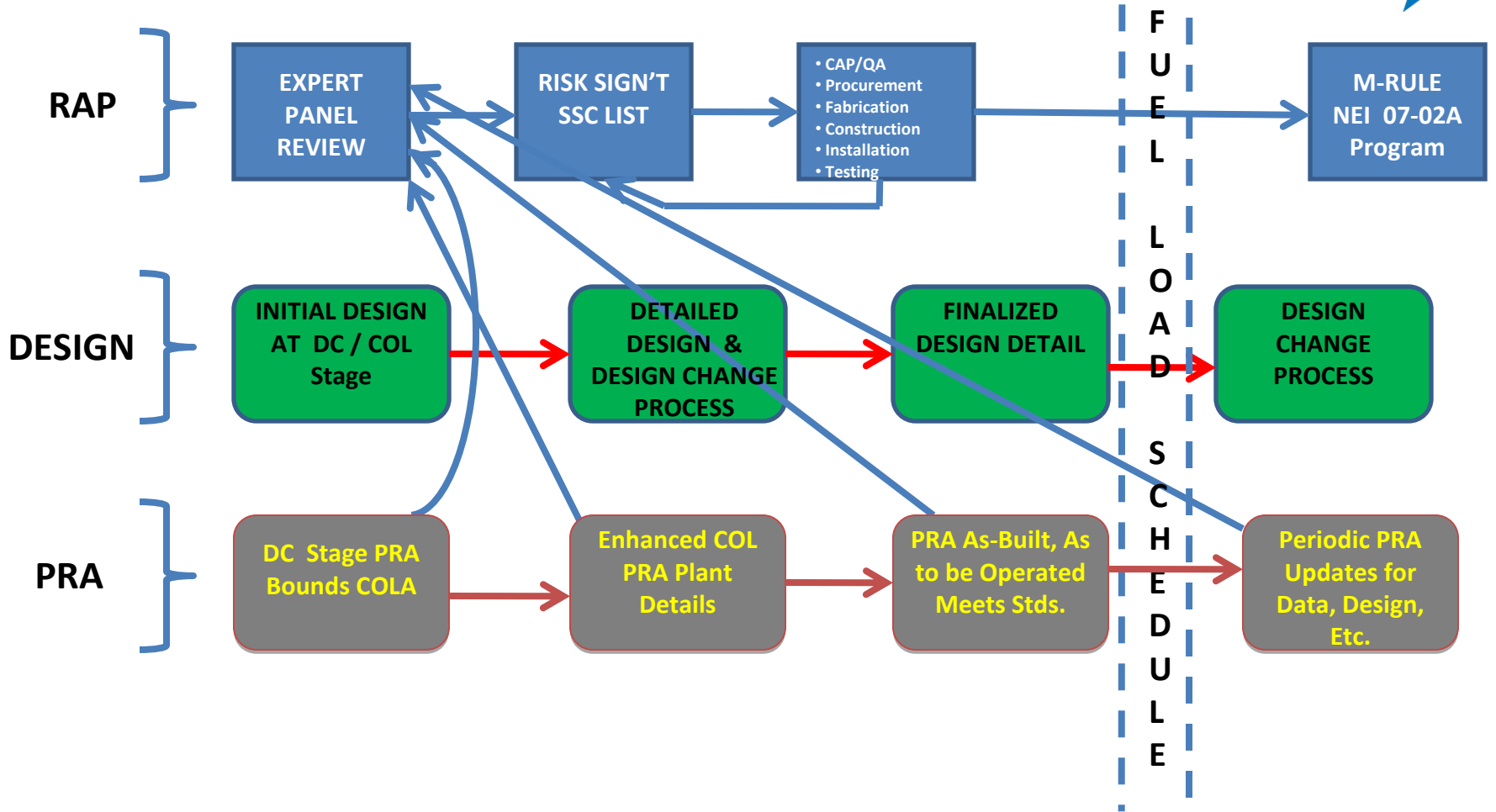
# Reliability Assurance



# Reliability Assurance



# Reliability Assurance





# Reliability Assurance



- RAP Expert Panel – Membership

- Designated individuals having expertise in the areas of:
  - Risk Assessment
  - Operations
  - Maintenance
  - Engineering
  - Quality Assurance
  - Licensing

- RAP Expert Panel – Categorization

- Identify a risk categorization of the component based on PRA insights (where the component is modeled)
- Develop a risk categorization of the component based on deterministic insights
- Designate the overall categorization of the component

# Reliability Assurance

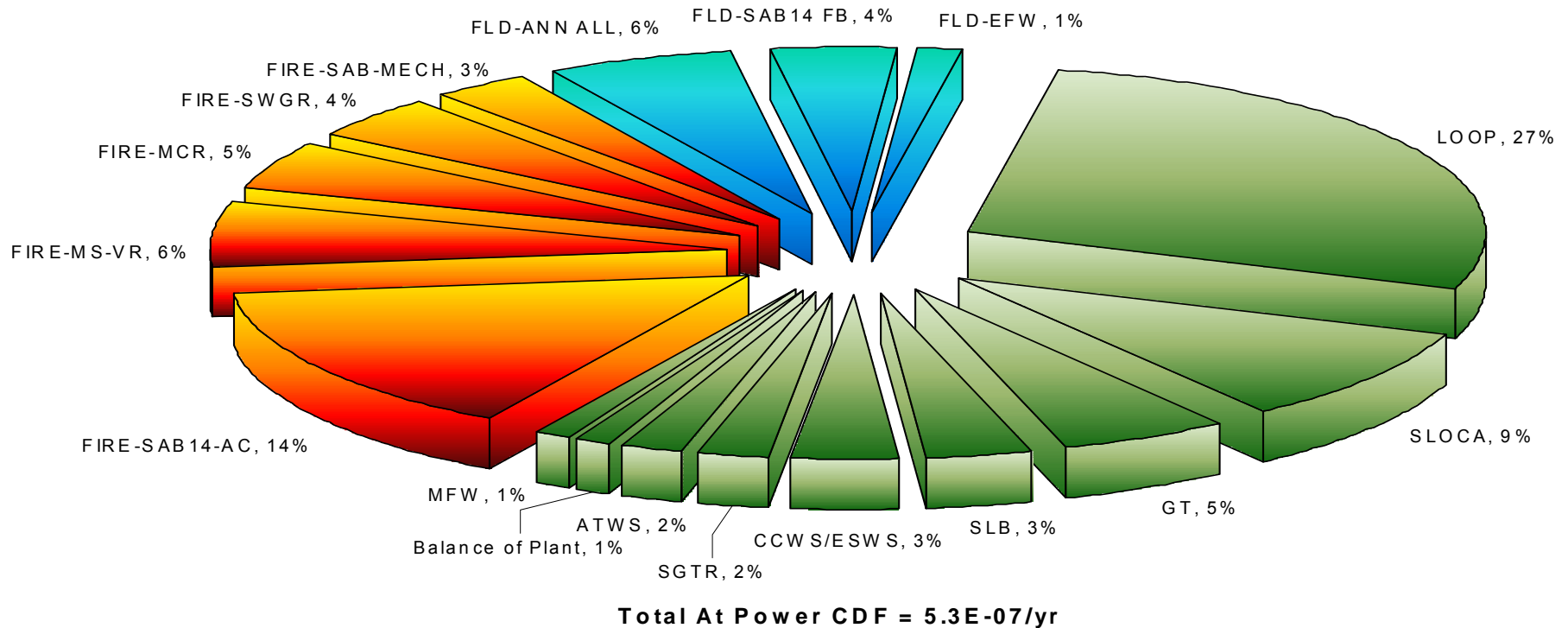


- RAP Expert Panel – Risk Ranking
  - PRA Ranking: based upon its Fussell-Vesely (FV) importance and its risk achievement worth (RAW)
  - Deterministic Ranking regardless of whether they are also subject to the PRA risk categorization process
    - Is the function used to mitigate accidents or transients?
    - Is the function specifically called out in the Emergency Operating Procedures (EOPs)?
    - Does the loss of the function directly fail another risk-significant system?
    - Is the loss of the function safety significant for shutdown or mode changes?
    - Does the loss of the function, in and of itself, directly cause an initiating event?

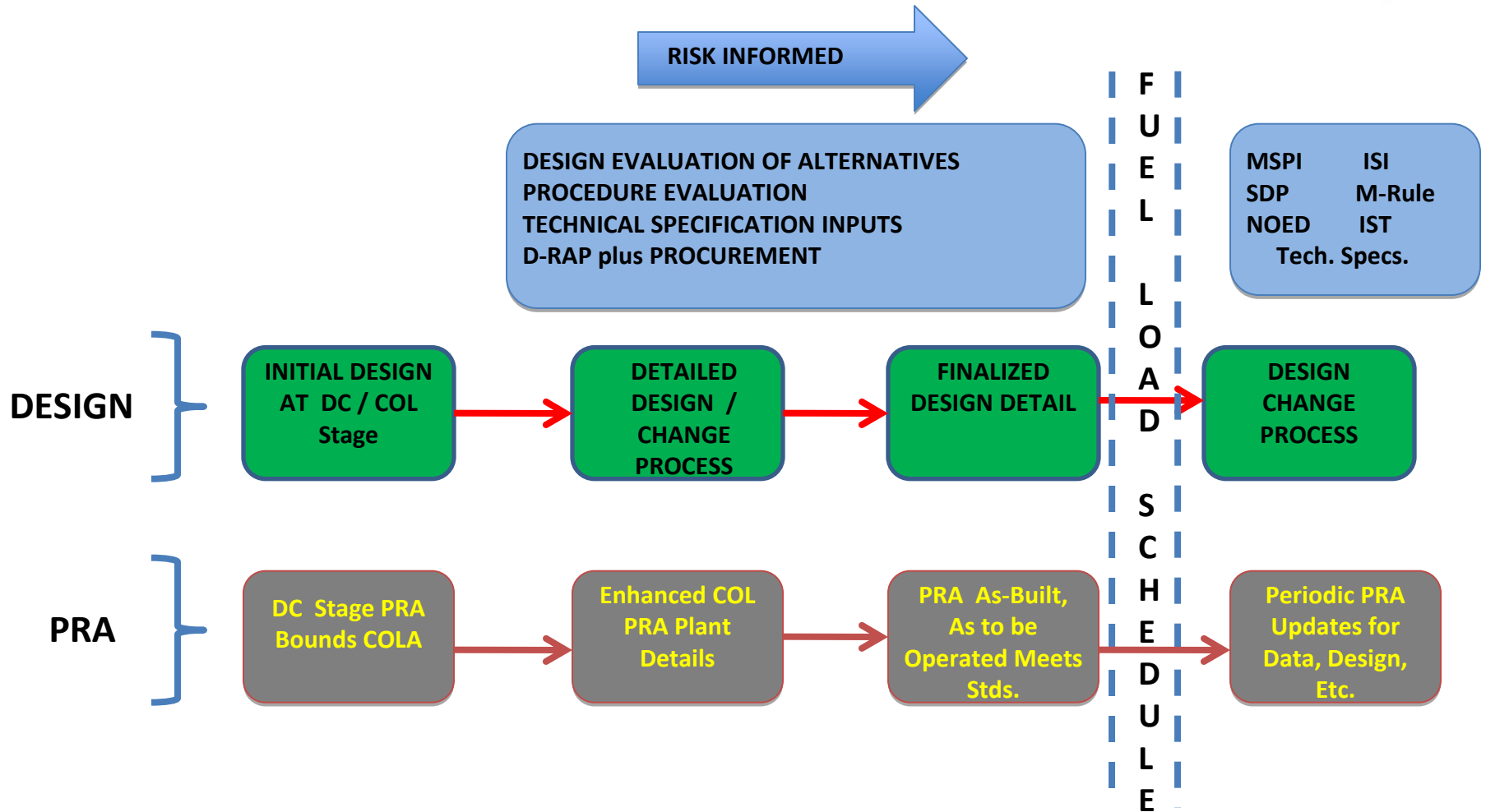
# Probabilistic Risk Assessment and Severe Accident Evaluation Calvert Cliffs 3 COLA PRA



## Summary of U.S. EPR FSAR and Calvert Cliffs 3 PRA Results At-Power Events



# Probabilistic Risk Assessment and Severe Accident Evaluation Update During Design and Construction



# Probabilistic Risk Assessment and Severe Accident Evaluation Site Specific Features




- LOOP Frequency Bounded by U.S EPR Design Certification
- UHS Makeup Water System – Adequate capacity 72 hour plus makeup
- Circulating Water System – Evaluated and treatment confirmed
- Raw Water System, includes Essential Service Water Normal Makeup Supply – Not in PRA (no recovery action to credit Raw Water System)
- Sewage Water Treatment System – Not in PRA
- Security Access Facility, including warehouse – Not in PRA
- Central Gas Distribution System – Discussed under External Events
- Potable and Sanitary Water Systems – Not in PRA

# Probabilistic Risk Assessment

## External Events



<b>Calvert Cliffs Unit 3</b>	
Seismic	Not screened, a seismic margin assessment was performed.
High Winds	Screened by meeting the SRP high winds criteria. Calvert Cliffs Unit 3 design wind is 102 mph, DC design wind speed is 145 mph, therefore, all design certification structures have large additional margins.
Tornadoes	Screened at CDF = 5.4E-08 per year.
Tornado Missiles	Bounded by tornadoes.
Aircraft Crash	Screened at CDF = 4.7E-08 per year.
Highways	Highway hazards have no adverse impact due to large distance from the hazard.
Waterways	For ammonia, there are < 5 shipments per year. RG 1.78 allows screening if < 50 shipments.
Pipelines	Pipeline hazards have no adverse impact due to large distances from the hazard.
Railroads	Railroad hazards are screened because there are no railroad lines within 5 miles of the plant.
Nearby Facilities	Gasoline explosion is screened on an initiating event frequency < 1.0E-07 per year. Gasoline toxic gas is screened on having > 2 minutes to don breathing apparatus. All other nearby facility hazards have no adverse impact due to large distances from the site.
Turbine Missiles	The frequency of unacceptable damage from turbine missiles is less than or equal to 1E-07 per year.
Collisions with UHS Makeup	Screened on no adverse impact, because it is not as initiating event. UHS basins provide a total of six days of accident mitigation without makeup.
Lightning Strike	Screened at CDF < 1E-07 per year, with most of risk included in the LOOP risk.
External Flooding	Screened by meeting the SRP external flooding criteria. Structures in the power block area have a minimum grade slab of 84.6 ft or higher. Probable maximum storm surge level is 17.6 ft. Coincidental wind-wave action is 33.2 ft. Probable maximum tsunami is 3.8 ft. Flood protection for the UHS makeup water intake structure includes measures to withstand static and dynamic flooding forces and waterproofing to prevent the flooding of the interior of the structures.



# ACRS Full Committee Meeting Agenda

## Based on Presentations to Subcommittee

- Chapter 2 (Part 1)
  - Meteorology
- Chapter 8
  - Off-site Transmission System
- Chapter 17 & Chapter 19
  - Reliability Assurance /PRA
- **Conclusions**

# Conclusions



- No ASLB Contentions.
- There are three (3) departures and three (3) exemptions.
- Responses have been submitted to all thirty-nine (39) SER Open Items.
- As of April 7, 2011, 60% of the Calvert Cliffs Unit 3 COLA has completed Phase 3 and these Chapters are ready to move to Phase 4.



# Acronyms

- **ACRS – Advisory Committee on Reactor Safeguards**
- **ASLB – Atomic Safety & Licensing Board**
- **ASCE – American Society of Civil Engineers**
- **CAP – Corrective Action Program**
- **CCWS Component Cooling Water System**
- **CDF – Core Damage Frequency**
- **CFR – Code of Federal Regulations**
- **COL – Combined License**
- **COLA – Combined License Application**
- **CWS – Circulating Water System**
- **DC – Design Certification**
- **DOE – Department of Energy**
- **DRAP – Design Reliability Assurance Program**
- **EDF – Électricité de France**
- **EFWS – Emergency Feedwater System**
- **EPGB – Emergency Power Generating Building**
- **ESW(S) – Essential Service Water (System)**
- **ESWB – Essential Service Water Building (Consisting of ESWCT & ESWPB)**
- **ESWCT(S) – Essential Service Water Cooling Tower (Structure)**
- **EOP – Emergency Operating Procedures**
- **FIRE-SAB-MECH – Fire in Safeguard Buildings, Mechanical Areas**
- **FIRE-SWGR – Fire in Switchgear Building**
- **FIRE-SAB14-AC – Fire in Safeguard Buildings 1 or 4 Switchgear Room**
- **FIRE-MS-VR – Fire in MFWS (Main Feedwater) / MSS (Main Steam) Valve Room**
- **FLD-ANN ALL – Flooding in containment annulus that disables all 4 safety trains.**
- **FSAR – Final Safety Analysis Report**
- **ESWPB – Essential Service Water Pump Building**
- **Fire-MCR – Fire in the Main Control Room**
- **FLD-EFW – Flooding from the EFW system**
- **FLD-SAB14 FB – Flooding in a Safeguard Building**
- **FSER – Final Safety Evaluation Report**
- **GMRS – Ground Motion Response Spectra**
- **GT – General Transient**

# Acronyms

- **HCLPF – High Confidence, Low Probability of Failure**
- **IBR – Incorporate by Reference**
- **ISI – Inservice Inspection**
- **ISLOCA – Interfacing System Loss of Coolant Accident**
- **ISRS – In-Structure Response Spectra**
- **IST – Inservice Testing**
- **LOCA – Loss of Coolant Accident**
- **LOOP – Loss of Offsite Power**
- **LRF – Large Release Frequency**
- **MAAP – Modular Accident Analysis Program**
- **MCR – Main Control Room**
- **MFW(S) Main Feedwater (System)**
- **MSPI - Mitigating System Performance Index**
- **NEI – Nuclear Energy Institute**
- **NOED – Notice of Enforcement Discretion**
- **NRC – Nuclear Regulatory Commission**
- **M-Rule – Maintenance Rule**
- **M/U – Makeup**
- **OSP – Offsite Power**
- **PRA – Probabilistic Risk Assessment**
- **QA – Quality Assurance**
- **RCOLA – Reference COL Application**
- **RCP – Reactor Coolant Pump**
- **RHR(S) – Residual Heat Removal (System)**
- **SAMDA – Severe Accident Mitigation Design Alternatives**
- **SD – Shutdown**
- **SDP – Significance Determination Process**
- **SER – Safety Evaluation Report**
- **SGTR Steam Generator Tube Rupture**
- **SLBI – Steam Line Break Inside Containment**
- **SLBO – Steam Line Break Outside Containment**
- **SLOCA – Small Loss of Coolant Accident**
- **SMA – Seismic Margins Assessment**
- **SRP – Standard Review Plan**
- **SSC – Structures, Systems, and Components**
- **SSE – Safe Shutdown Earthquake**
- **UHS – Ultimate Heat Sink**
- **ULD – Uncontrolled Level Drop**



# Presentation to the ACRS Full Committee - 582<sup>nd</sup> Meeting

**Briefing on EPR Design Certification Application Safety Evaluation  
Report with Open Item for Chapters 2, 4, 5, 8, 10, 11, 12, 16, 17, and 19**

**Surinder Arora  
Project Manager**

**April 7, 2011**

# Major Milestones Chronology U.S.NRC

United States Nuclear Regulatory Commission  
*Protecting People and the Environment*

07/13/2007	Part 1 of the COL Application (Partial) submitted
12/14/2007	Part 1, Rev. 1, submitted
03/14/2008	Part 1, Rev. 2, & Part 2 of the Application submitted
06/03/2008	Part 2 of the Application accepted for review (Docketed)
08/01/2008	Revision 3 submitted
03/09/2009	Revision 4 submitted
06/30/2009	Revision 5 submitted
07/14/2009	Review schedule published
09/30/2009	Revision 6 submitted
04/12/2010	Phase 1 review completion milestone
12/20/2010	Revision 7 submitted
01/12/2011	ACRS reviews complete for Chapters 2 (Group I), 4, 5, 8, 10, 11, 12, 16, 17 & 19

# Review Schedule

<b>Phase - Activity</b>	<b>Target Date</b>
<b>Phase 1</b> - Preliminary Safety Evaluation Report (SER) and Request for Additional Information (RAI)	April 2010 (Actual)
<b>Phase 2</b> - SER with Open Items	November 2011
<b>Phase 3</b> – Advisory Committee on Reactor Safeguards (ACRS) Review of SER with Open Items	February 2012
<b>Phase 4</b> - Advanced SER with No Open Items	June 2012
<b>Phase 5</b> - ACRS Review of Advanced SER with No Open Items	October 2012
<b>Phase 6</b> – Final SER with No Open Items	January 2013

NOTE: The target dates are current as of March 4, 2011. The target dates are reviewed periodically and are subject to change.

# Review Strategy

- Pre-application activities
- Acceptance Review of the application
- COLA has chapters and sections incorporated by Reference
- Review of COLA site specific information in conjunction with the DC review. Same technical reviewers in most cases.
- Frequent interaction with the applicant
  - ♦ Teleconferences
  - ♦ Audits
  - ♦ Public meetings
- Use of Electronic RAI System (eRAI)
- Phase discipline

# Summary of SER with OI: Chapter 2 Site Characteristics

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
2.0	Site Characteristics	0	0
2.1	Geography and Demography	0	0
2.2	Nearby Industrial, Transportation, and Military Facilities	10	0
2.3	Meteorology	70	2
	Totals	80	2

# Summary of SER with OI: Chapter 4 Reactor

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
4.1	Summary Description (IBR)	0	0
4.2	Fuel System Design (IBR w/supplement)	1	1
4.3	Nuclear Design (IBR)	1	1
4.4	Thermal-Hydraulic Design (IBR)	0	0
4.5	Reactor Materials (IBR)	0	0
4.6	Functional Design of Reactivity Control Systems (IBR)	0	0
	Totals	2	2



# Summary of SER with OI: Chapter 5 Reactor Coolant System and Connected Systems

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
5.1	Summary Description (IBR)	0	0
5.2	Integrity of the Reactor Coolant Pressure Boundary	10	2
5.3	Reactor Vessel	5	0
5.4	Component and Subsystem Design	13	1
	Totals	28	3

# Summary of SER with OI: Chapter 8 Electric Power

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
8.1	Introduction	1	0
8.2	Offsite Power System	10	0
8.3	Onsite Power System	14	0
8.4	Station Blackout	2	0
	Totals	27	0

# Summary of SER with OI: Chapter 10 Steam and Power Conversion System

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
10.1	Summary Description (IBR)	0	0
10.2	Turbine-Generator	2	0
10.3	Main Steam Supply System	4	0
10.4	Other Features of Steam and Power Conversion System	5	1
	Totals	11	1

# Summary of SER with OI: Chapter 11 Radioactive Waste Management



SRP Section/Application Section		Number of RAI Questions	Number of SE Open Items
11.1	Source Terms (IBR)	0	0
11.2	Liquid Waste Management System	4+1*	2
11.3	Gaseous Waste Management Systems	2+1*	1
11.4	Solid Waste Management Systems	1	0
11.5	Process and Effluent Radiological Monitoring and Sampling Systems	2	0
	Totals	9+2*	3

# Summary of SER with OI: Chapter 12 Radiation Protection

SRP Section/Application Section		Number of RAI Questions	Number of SE Open Items
12.1	Ensuring that Occupational Radiation Exposures are ALARA	5	0
12.2	Radiation Sources	2	0
12.3	Radiation Protection Design Features	8	4
12.4	Dose Assessment (IBR)	0	0
12.5	Operational Radiation Protection Program	1	0
	Totals	16	4

# Summary of SER with OI: Chapter 16 Technical Specifications

SRP Section/Application Section		Number of RAI Questions	Number of SE Open Items
16.1	Introduction		
16.2	Summary of Application		
16.3	Regulatory Basis		
16.4	Technical; Evaluation	22	1
16.5	Post Combined License Activities		
16.6	Conclusions		
	Totals	22	1

# Summary of SER with OI: Chapter 17

## Quality Assurance and Reliability Assurance

SRP Section/Application Section		Number of RAI Questions	Number of SE Open Items
17.1	Quality Assurance During Design (IBR)	0	0
17.2	Quality Assurance During the Operations Phase	0	0
17.3	Quality Assurance Program Description (IBR)	0	0
17.4	Reliability Assurance Program	9	7
17.5	Quality Assurance Program Description	6+1*	1
17.6	Description of Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule	3	2
17.7	Maintenance Rule Program		
	Totals	18+1*	10

# Summary of SER with OI: Chapter 19 Probabilistic Risk Assessment and Severe Accident Evaluation



<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
19.1	Probabilistic Risk Assessment	24	6
19.2	Severe Accident Evaluations	1	1
19.3	Open, Confirmatory, and COL Action Items Identified as Unresolved (IBR)	0	0
	Totals	25	7





**Advisory Committee  
on Reactor Safeguards  
Fukushima Event and Issues**

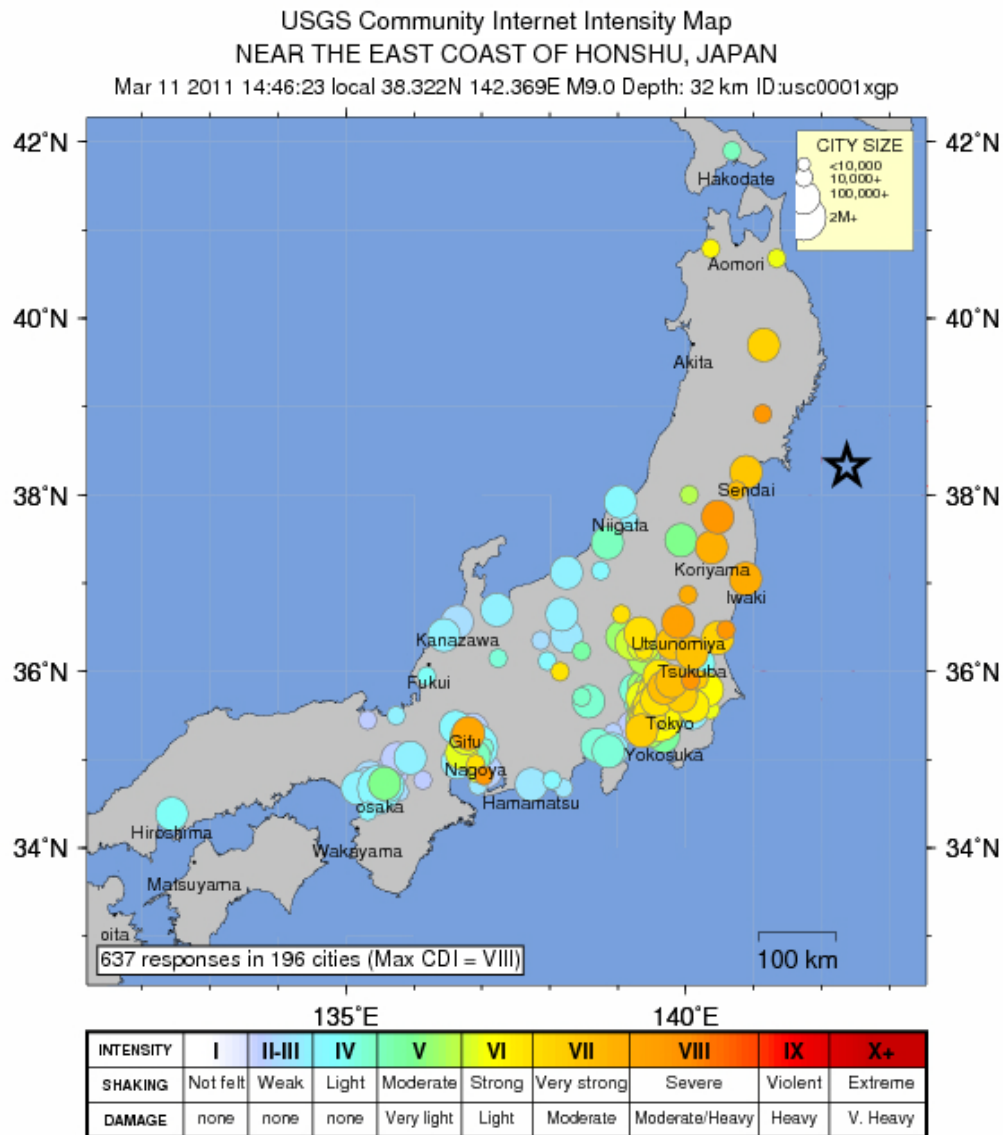
April 7, 2011

# Agenda

- Introduction – Bill Ruland (5 min)
- Sequence of Events – John Thorp (10 min)
- Information Notice – Eric Bowman (5 min)
- Industry Actions and Temporary Instruction – Tim Kobetz (5 min)
- Near Term Task Force – Barry Westreich (10 min)
- Seismic Attributes – Syed Ali (5 min)
- Station Blackout – George Wilson (10 min)
- NRC Incident Response – Brian McDermott (10 min)
- Emergency Preparedness – Randy Sullivan (10 min)

# Tohoku Pacific Earthquake

- 14:46 (Local) March 11, 2011
- Magnitude 9.0 Earthquake
  - 4th largest in the world since 1900 (USGS)
  - Largest in Japan since modern instrument recordings began 130 years ago (USGS)
- Resulted in a Tsunami that is estimated to have exceeded 32 feet in height (NISA)



Processed: Thu Mar 31 06:47:13 2011

# Affected Nuclear Power Stations

– **Onagawa NPS**

- All 3 units scrambled

– **Fukushima Dai-ichi (I) NPS**

- Units 1, 2, 3 scrambled
- Units 4, 5, 6 already shutdown

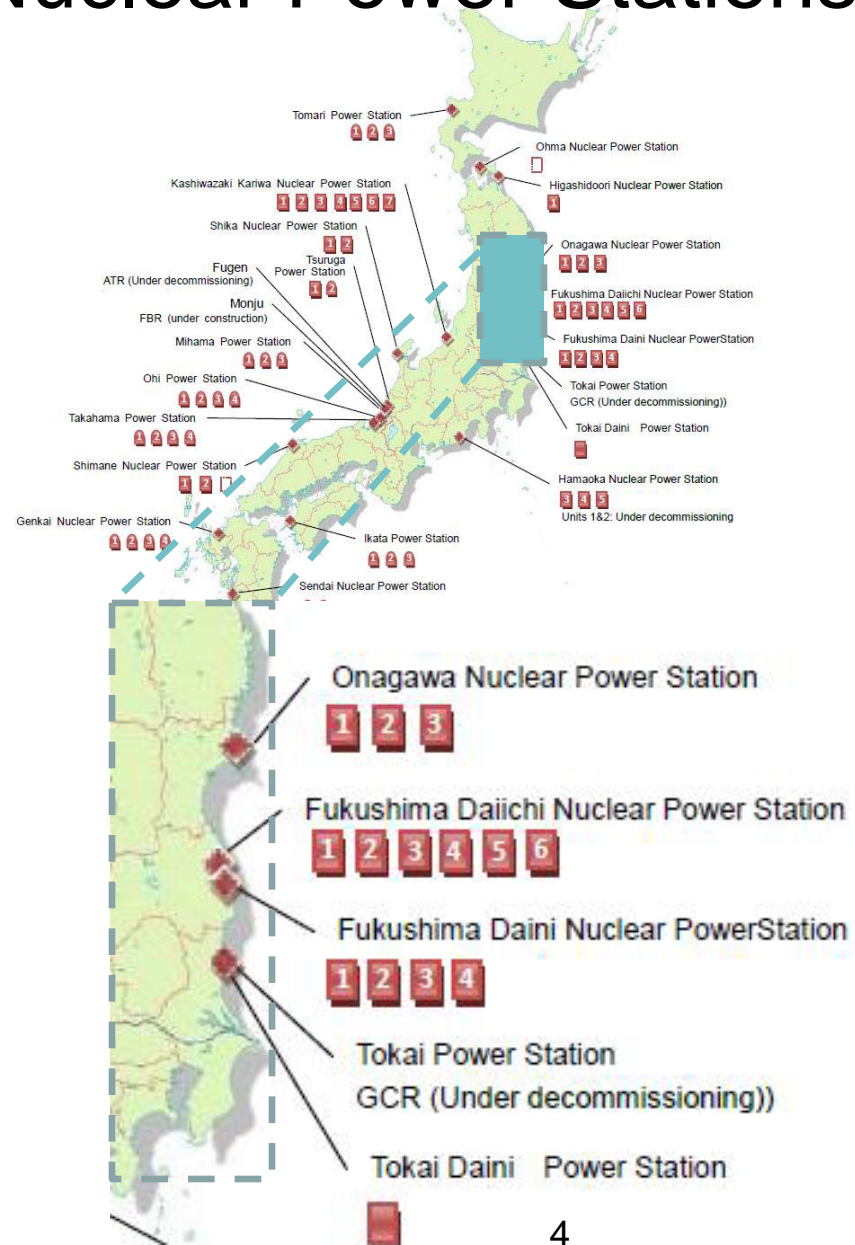
– **Fukushima Dai-ni (II) NPS**

- All 4 units scrambled

– **Tokai**

- Scrammed (single unit site)

Source: NISA



## Extended SBO at Fukushima Dai-ichi

- **Earthquake**
  - Reactor Units 1, 2, and 3 scram
  - Loss of offsite power to all 6 units
- **Tsunami**
  - Loss of emergency AC power
- **Extended Station Blackout**



# Accident Sequence

- **Reactor coolant flow after SBO**
  - Reactor isolation makeup water system
- **Loss of coolant flow**
  - Utility established seawater injection
- **Elevated primary containment pressure**
- **Explosions**
  - Damaged reactor buildings for Units 1, 3 and 4
  - Unit 2 explosion in primary Containment- reactor building not damaged, possible torus damage

## 5 April Status: Units 1,2 and 3

- Cores reported to be damaged
  - Extent unknown
  - Salt buildup from seawater injection
- All units have offsite AC power available
  - Equipment verification in progress
- Freshwater injection via:
  - Feedwater line
  - Low pressure coolant injection
- High radiation levels in containment and site

## Status: Units 4, 5, and 6

- Unit 4
  - Core offloaded to spent fuel pool (SFP)
  - An explosion caused significant damage to Unit 4 reactor building
  - SFP cooling system not functional
  - SFP being cooled periodically by injection of fresh water from a concrete truck pump
- Units 5 and 6
  - On external AC power with core cooling functional
  - SFP cooling is functional on both units





**Fukushima Dai'ichi Nuclear Power Station**

# Information Notice 2011-05

- Purpose: to provide high level discussion of earthquake effects at Fukushima Daiichi and allow licensee review and consideration of actions to avoid similar problems.
- Background discussion of pertinent regulatory requirements
  - General Design Criteria 2 (or similar)
  - “B.5.b Requirements” for beyond design basis events
    - Interim Compensatory Measures Order EA-02-026, Section B.5.b
    - License Conditions
    - 10 CFR 50.54(hh)(2)
  - Station Blackout Rule, 10 CFR 50.63

# Industry Initiatives

- An industry-wide assessment to verify and validate each plant site's readiness to manage extreme events
- Initiatives include licensee verification of:
  - Each plant's capability to manage major challenges, and losses of large areas of the plant due to natural events, fires or explosions
  - Each plant's capability to manage a total loss of off-site power
  - Verifying the capability to mitigate flooding and the impact of floods
  - Performing walk-downs and inspection of important equipment needed to respond successfully to extreme events like fires and flood including identification of any potential that equipment functions could be lost during seismic events appropriate for the site, and development of strategies to mitigate any potential vulnerabilities.

# NRC Inspection Activities

- Temporary Instruction 2515/183, “Followup to the Fukushima Daiichi Nuclear Station Fuel Damage Event
- Inspection uses a combination of assessment of licensee actions and independent inspections
- The inspection is for fact/data gathering to help evaluate whether future regulatory actions may be necessary.

# Near-Term Task Force

- Commission Direction for Near-Term Review
  - Conduct a methodical and systematic review of relevant NRC regulatory requirements, programs, and processes, and their implementation, to recommend whether the agency should make near-term improvements to our regulatory system
  - Recommendations for the content, structure, and estimated resource impact for the longer-term review
  - Independent from industry efforts
  - Milestones
    - 30-day Commission meeting (5/12/11)
    - 60-day Commission meeting (6/16/11)
    - 90-day final report, SECY, and Commission meeting (7/19/11)

# Longer-Term Review

- Commission Direction for Longer-Term Review
  - Specific information on sequence of events and equipment status
  - Evaluate policy issues
  - Potential interagency issues
  - Lessons learned for facilities other than operating reactors
  - Receive input and interact with all key stakeholders
  - Report within six months after beginning of long-term effort
  - ACRS to review final long-term report (as issued in its final form), and provide letter report to the Commission

# Tōhoku Earthquake and Tsunami

- Earthquake Data\*
  - Magnitude 9.0
  - Epicenter: ~109 miles from Fukushima site
  - Peak Ground Acceleration
    - 1.0g up to 2.75g at 80 miles from epicenter
    - ~0.30g to 0.58g in Fukushima Prefecture

\*California Coastal Commission. "The Tōhoku Earthquake of March 11, 2011: A preliminary Report on Implications for Coastal California "

# Tōhoku Earthquake and Tsunami

- Tsunami Data\*
  - Peak amplitude reports vary
  - Reached shore within ~ one hour after the earthquake
  - Up to six miles of run-up in flat regions

\*California Coastal Commission. "The Tōhoku Earthquake of March 11, 2011: A preliminary Report on Implications for Coastal California "



# Tōhoku Earthquake and Tsunami

- NPP Foundation Accelerations\*

<b>Location</b>	<b>Design Japanese Regulatory Guide g</b>	<b>Observed g</b>
Daiichi Unit 2	.45	.56
Daiichi Unit 6	.46	.45
Daini Unit 1	.44	.23
Daini Unit 2	.44	.20

\*TEPCO Press Release April 01, 2011: The record of the earthquake intensity observed at Fukushima Daiichi Nuclear Power Station and the Fukushima Daini Nuclear Power Station (Interim Report).

# Station Blackout– Background

- **NRC issued SBO Rule (10 CFR 50.63) in 1988**
- **Each plant must be able to withstand for a specified duration and recover from a SBO**
- **Regulatory Guide (RG) 1.155, “Station Blackout,” - endorsed NUMARC 87-00 industry guidance for SBO rule**
- **All 104 plants met the SBO rule requirements at the time of the staff’s review**
  - Safety Evaluations
  - Pilot Inspections

# Station Blackout - Implementation

- **Coping Duration**
  - Factors affecting Offsite power design
  - Factors affecting Onsite power system
- **Coping Methods**
  - AC independent
  - Alternate AC
- **Procedures**
  - Restoration of AC power
  - Non essential DC loads for stripping
  - Actions for loss of ventilation
  - Grid Interface

# **NRC Incident Response**

- **Response Decisions**
- **NRC Roles**
- **Areas of Focus**
- **Coordination, Support and Outreach**
- **Current Status of Response**

# Emergency Planning Zones

- Two emergency planning zones (EPZ) around each nuclear power plant
  - 10 mile EPZ – plume exposure planning zone
    - Response within hours
  - 50 mile EPZ – ingestion exposure planning zone
    - Response within days
- EPZ size established:
  - Encompasses most accident sequences
    - WASH 1400 Reactor Safety Study
    - Conservative Assumptions
  - Provides a substantial basis for expansion of response beyond the EPZ should it be needed

# PAR for U.S. Citizens in Japan

- Recommendation for 50 mile evacuation
  - Limited and uncertain data available
  - Significant challenges to 3 units and 4 spent fuel pools
  - Potential for large offsite release existed
  - Rapidly modeled aggregate cores to simulate potential release
  - Decision to expand evacuation was prudent given the uncertain conditions

# Questions?

Of course, nuclear power plants in the USA should operate at reduced power levels pending the resolution of PRM-50-93.

I have told ACRS subcommittees and the full committee that 2200 is too high and I have cited the thoroughly researched PRM-50-93. About one year ago the NRC assigned a high priority to review of PRM-50-93 with a deadline of September 30, 2010. Next, NRC dropped that deadline, using the excuse that a further petition submitted by Mark Edward Leyse called for a merger of review activities and an indefinite schedule. So, now we have Fukushima, a slow-moving event that among other consequences led to the production of a lot of hydrogen. The NRC and the NEI still tell everybody that 2200 is based on sound science and many media reports cite 2200 as the starting point for hydrogen production at Fukushima.

That events at Fukushima jolted the Commissioners and led to all kinds of excitement at NRC including this from a press release, *“The Nuclear Regulatory Commission has voted to launch a two-pronged review of U.S. nuclear power plant safety in the aftermath of the March 11 earthquake and tsunami and the resulting crisis at a Japanese nuclear power plant. The Commission supported the establishment of an agency task force, made up of current senior managers and former NRC experts with relevant experience. The task force will conduct both short- and long-term analysis of the lessons that can be learned from the situation in Japan, and the results of their work will be made public.”*

This morning, April 6, 2010, I witnessed the congressional proceedings that were induced by Fukushima with participation by NRC, NEI, UCS and ANS. Fukushima is characterized by a relatively slow moving set of events. Nevertheless, the NRC has placed reactions to those events as a far higher priority than reacting to the far more significant implications of PRM-50-93. PRM-50-93 addresses events that move fast, in addition to the slow-moving scenes at Fukushima.

Indeed, if the NRC had responded in a timely manner to the earlier PRM-50-76 and then with its second chance had responded to the far more thoroughly documented PRM-50-93, it would have tools in place for evaluating the course of hydrogen production at Fukushima. Today, the NRC does not have those tools.

Training tools at the NRC should be corrected by reducing the incorrect 2200 that is too high. Of course, nuclear power plants in the USA should operate at reduced power levels pending the resolution of PRM-50-93.





**U.S.NRC**

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

# Regulatory Guide 1.152, Revision 3

Steven Arndt, NRR / DE

Tim Mossman, NRR / DE / EICB

April 7, 2011

## Purpose

- Provide an overview of digital system safety and cyber security licensing and oversight
- Present the modifications to Regulatory Guide 1.152 regarding a Secure Development and Operational Environment (SDOE)
- Address ACRS questions regarding coordination between NRR, NRO and NSIR and future work associated with regulatory guidance development in this area

## Desired Outcomes

- Achieve common understanding of the NRC's licensing and oversight for digital system safety and cyber security
- Address all ACRS questions
- Receive ACRS recommendation to issue Regulatory Guide 1.152, Revision 3

# Contents

- History of digital system safety and cyber security
- Overview of the current regulatory structure relative to digital system safety and cyber security
  - Overview of planned activities regarding safety and cyber security
- Modifications to Regulatory Guide 1.152

## Timeline (1 of 2)

- NRC Issues RG 1.152 (Nov. 1985)
- NRC Issues RG 1.152, Rev 1 (Jan. 1996)
- Terrorist Attacks (Sept. 2001)
- NRC Issues Order EA-02-026 (Feb. 2002)
- NRC Issues Order EA-03-086 (April 2003)

## Timeline (2 of 2)

- NEI Issues NEI 04-04, Rev. 1 (Nov. 2005)
- NRC issues RG 1.152, Rev. 2 (Jan. 2006)
- NRC issues ISG-01 (Dec. 2007)
- NRC Issues 10 CFR73.54 (Mar. 2009)
- NRC Issues RG 5.71 (Jan. 2010)
- *NRC Issues RG1.152, Rev.3 (June 2011)*

# Regulatory Overview

- NRR / NRO licensing reviews
  - Digital Safety Systems
- Regional Inspection
  - Digital Safety System instillation, operations
- NSIR cyber plan review
  - Digital Safety, Important to Safety, Security and Emergency Preparedness Systems
- NSIR / Regional Implementation Inspection
  - Major plant upgrades or Digital Safety Systems

# Safety and Security Framework

- RG 1.152, Revision 3 will bring NRC guidance in line with revisions to regulation (Parts 50 and 73) and provide consistent guidance to industry
- NRC will continue to assure digital system safety and cyber security under this framework



## Safety Framework

- 10 CFR 50.55(a)(h) codifies IEEE Std. 603-1991
- Regulatory Guide 1.152 endorses IEEE Std. 7-4.3.2
  - IEEE Std. 7-4.3.2 – 2003 did not address security

# REGULATORY GUIDE 1.152, REVISION 3 CHANGES

## RG 1.152 Changes

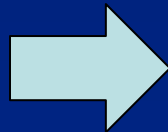
- Modification to address predictable, non-malicious challenges to digital safety system development and operation
- Enhanced focus on Part 50/52 reliability requirements
- Reflection of migration of cyber security provisions to 10 CFR 73

# Mapping of Security / Reliability Guidance (1 of 3)

- Cyber-specific provisions for Concepts and Requirements phases migrated to RG 5.71, Appendix C 12.2

RG 1.152  
Rev. 2

Sections 2.1 -2.2  
Concept &  
Requirements



RG 5.71

Security Controls  
Section C 12.2

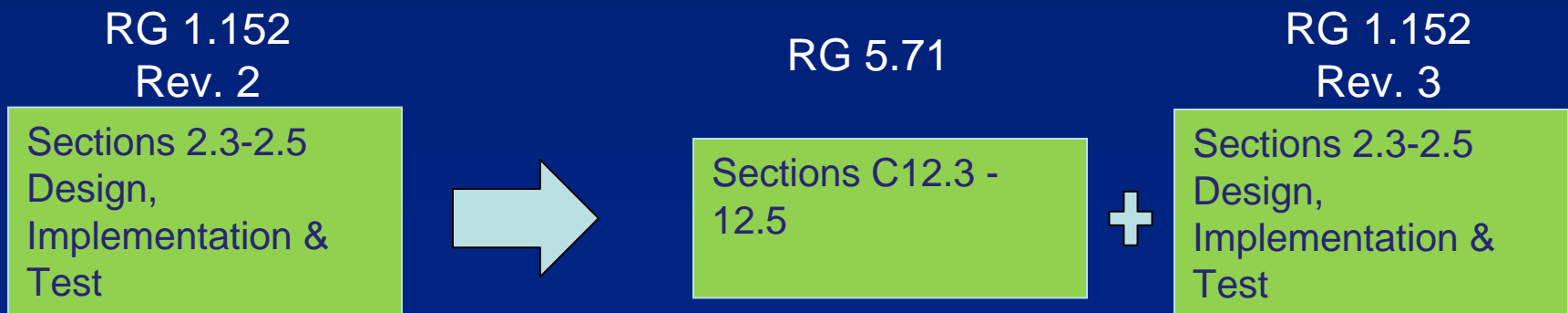


RG 1.152  
Rev. 3

Sections 2.1 -2.2  
Concept &  
Requirements

# Mapping of Security / Reliability Guidance (2 of 3)

- Cyber-specific provisions for Design, Implementation & Test phases migrated to RG 5.71, Appendix C 12.3 – 12.5

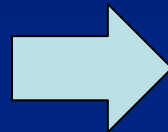


# Mapping of Security / Reliability Guidance (3 of 3)

- Post-Factory Acceptance Phases are not used in Part 50 licensing determinations
- Guidance is more thoroughly covered under 73.54 as elaborated in RG 5.71

RG 1.152  
Rev. 2

Section 2.6-2.9  
Site Acceptance  
Operations  
Maintenance  
Retirement



RG 5.71

Section C12.6 & Cyber Security Program  
Operation & Maintenance

## **RG 1.152, Revision 3**

- Revision 3 is ready for release
- Since 10 CFR 73.54 and RG 5.71 have been issued, RG 1.152 is being revised to:
  - Remove references to the term “cyber-security”
  - Remove direction to evaluate systems against malicious actions or attacks under Part 50
  - Remove guidance pertaining to life-cycle phases beyond what is credited in Part 50 / 52 licensing reviews

## **RG 1.152, Revision 3**

- RG 1.152, Revision 3 is clarifying its focus on:
  - Protection of the development environment from inclusion of undocumented, unneeded, and unwanted code (Criterion III, “Design Control,” of 10 CFR Part 50, Appendix B)
  - Controls to prevent inadvertent access to systems (IEEE Std. 603-1991, Clause 5.9)
  - Protection against undesirable behavior of connected system (IEEE Std. 603-1991, Clause 5.6.3)
- To avoid confusion between Part 50 / 52 and Part 73 “security,” Regulatory Guide 1.152, Revision 3 adopted the use of the term “secure development and operational environment” in its place



# “Secure Development Environment”

- Definition: The condition of having appropriate physical, logical and programmatic controls during the system development phases (i.e., concepts, requirements, design, implementation, testing) to ensure that unwanted, unneeded and undocumented functionality (e.g., superfluous code) is not introduced into digital safety systems
- Applicants should protect their development environments such that unwanted, unneeded and undocumented code is not included in safety systems
  - These types of code increase the potential for a system to exhibit unpredictable and undesirable behavior

## Secure Development Guidance

- Each phase of the development process has unique characteristics
- As part of their Concepts phase assessment, applicants should identify opportunities where superfluous requirements, features or code could be introduced into the system
- The adequacy of appropriate development phase controls adopted will be dependant on the results of the assessment

## Platform versus Application

- An applicant should be prepared to describe the secure environment controls that will be applied to both the platform software and the application software
  - It is anticipated that these two software products may be developed at different times
  - These software products could also be developed at different locations by different personnel under different development processes

# “Secure Operational Environment”

- Definition: The condition of having appropriate physical, logical and administrative controls within a facility to ensure that the reliable operation of digital safety systems are not degraded by undesirable behavior of connected systems and events initiated by inadvertent access to the system
- Applicants should provide design features and/or protective measures to ensure that the reliability of the digital safety system is not compromised by:
  - Undesirable behavior by connected systems (per Clause 5.6.3 of IEEE Std. 603-1991)
  - Inadvertent access to the safety system (per Clause 5.9 of IEEE Std. 603-1991)

# Independence from Other Systems

- Undesirable behavior of connected digital systems includes consideration of failures, as well as other off-nominal behaviors, such as:
  - Excessive data transmission
  - Corrupted data transmission
  - “Missing” or out-of-sequence messages
  - Transmission of out-of-range data
- Applicants should consider these types of occurrences for digital safety systems and have features provided to ensure that the safety function will be unaffected

## Access Control

- For digital systems, access controls must consider physical, as well as logical, points of access
  - Digital systems often feature points of access (e.g., USB ports) in their design
  - Systems residing on networks may be accessed from other connected systems on the same network
  - Applicants should provide, via plant controls enabled by system and facility design features, reasonable assurance that only authorized personnel will be able to access the system

## Example SDOE Events

- Examples of non-malicious, undesirable behavior of connected systems impacting other plant (non-safety) systems
  - Browns Ferry, Unit 3 – August 2006 event
  - Oconee, Unit 3 – November 2008 event
- Example of non-malicious, inadvertent access event that impacted a (non-safety) digital plant system
  - Hatch, Unit 2 - March 2008 event

# Public Comments Summary

- 38 comments received
- Incorporated:
  - Several language / editorial changes to the document that improved the RG's background and regulatory positions
  - Clarifying scope of Part 50 versus Part 73
- Not incorporated:
  - Requests to delete secure operational environment provisions in favor of programmatic coverage per RG 5.71 and NEI 08-09
  - Requests to reference ISG-04
  - Several out-of-scope requests
- Deferred
  - Requests for additional guidance pertaining to Concept phase assessments and use of pre-developed systems



## Future RG 1.152 Activities

- IEEE 7-4.3.2 – 2010
  - IEEE 7-4.3.2-2010 was very recently issued by IEEE and will be evaluated for NRC endorsement
  - RG 1.152 will be updated, as applicable
- Both staff and industry (per public comments received) would like to see more guidance published regarding:
  - Format and content of Concept phase assessments & Failure analysis
  - Treatment of pre-developed systems

# Cyber Security Framework

- 10 CFR 73.54 / Regulatory Guide 5.71 published
  - Performance-Based, Program focused
  - FOCUS: Prevention of Radiological Sabotage
  - Consistent with regulatory approach for physical security
- Security is a process not a state

## RG 5.71 Security Controls

- 148 Cyber Security Controls safeguard against currently known vulnerabilities that an adversary can use to compromise a system or equipment
  - Technical Security Controls
    - Example: B.4.2 User Identification and Authentication - A username and password
  - Operational & Management Security Controls
    - Example: C.11.4 Configuration Change Control - Authorizing and documenting changes to CDAs

# Cyber Security Features

- Digital safety systems may include features that serve a cyber security purpose
  - Cyber security features included in a Digital Safety System should have been developed under safety-quality processes
- Those features should be described in a Part 50 / 52 application such that:
  - NRC staff will evaluate whether the cyber feature will degrade reliable system function
- The cyber function adequacy will be addressed under Part 73

## **NRR / NRO / NSIR Coordination**

- Inter-Office Instruction is being developed
  - NRR / NRO / NSIR / Regional Office activities
    - New Reactor Licensing
    - Digital Safety System Licensing
    - Cyber Security Oversight & Inspections
  - Information from Digital Safety System reviews can inform cyber inspections
    - Schedules, timing, scope
    - Inspection procedures

## Future Regulatory Activities

- 10 CFR 50.55(a)(h) rulemaking in process to codify IEEE Std. 603-2009
- RG 1.152, Revision 4 to address IEEE Std. 7-4.3.2-2010 and other needed guidance
- SRP Chapter 7 update
- RG 5.71 & SRP Chapter 13 updates
  - NRC Endorsement of NEI 08-09
- Development of Cyber Security Inspection Program

## Summary

- Provided an overview of digital system safety and cyber security licensing and oversight
- Presented the modifications to Regulatory Guide 1.152 regarding a Secure Development and Operational Environment (SDOE)
- Addressed ACRS questions regarding coordination between NRR, NRO and NSIR and future work associated with regulatory guidance development in this area

## Overview

- Background – Sean Peters
- Effects of Degraded I&C on HSIs and HP– Jing Xing
- HF Aspects of CONOPs of SMRs – John O'Hara (BNL)



## Background

- HP research issues associated with emerging technologies
  - 2003 - OECD/NEA Workshop
  - 2006 - CSNI/SEGHOFF/HRP Workshop – Future control station designs and human performance issues in NPPs
  - 2008 - BNL Tech Report No. 79947-2008 - HF considerations with respect to emerging technology in nuclear power plants: Detailed analysis
  - 2008 - NUREG/CR-6947 – HF considerations with respect to emerging technology in nuclear power plants: Summary
  - 2009 - CSNI/WGHOFF Technical Opinion Paper – Research program topics on HP in new nuclear plant technology
  - 2010 - CSNI/WGHOFF/NRC Workshop - Research on HF for the design and operation of new nuclear plant technology
  - 2010 – User Need – NRO-2010-005

## Current Projects

- Update NUREG-0711 (2011)
- NUREG-0700
- Update NUREG-0800
- Develop NUREG-0711 Companion Document
- Impact of Automation on CR Design
- Methods for Measuring Workload, SA and Teamwork
- Computerized Procedures
- Integrated Systems Validation
- Staffing Verification & Evaluation for Advanced CR Designs
- HF Aspects in CONOPS of Modular Design
- HFE Methods and Tools
- Update NUREG-0711 (2013)

# Human Factors Aspects of Operating Small Modular Reactors

NRC RES Project JCN N-6862

*ACRS Meeting  
April 8, 2011*

**BROOKHAVEN**  
NATIONAL LABORATORY

*a passion for discovery*

 **Office of  
Science**  
U.S. DEPARTMENT OF ENERGY



# The Team

- U.S. Nuclear Regulatory Commission

Amy D'Agostino and DaBin Ki

Jing Xing, Team member Emeritus

- Brookhaven National Laboratory

John O'Hara , Jim Higgins, and Richard Deem

# Topics

- Background
- Objectives
- Methodology
- Concept of Operations Model
- Preliminary SMR Issues
- Summary of Current Status
- Path Forward

# Background

- Advanced reactors and advanced reactor technology are being developed and implemented
- Small modular reactors (SMRs) are one of the options
  - 400 megawatts electric (MWe) or less (our definition)
  - scalable, may be operated in groups to obtain desired output
  - diversity of reactor technologies (LWRs, LMRs, HTGRs)
- Research is needed to provide a better understanding of the human performance implications of SMRs
- The U.S. Nuclear Regulatory Commission (NRC) initiated work to examine the human factors engineering (HFE) and ConOps aspects of SMRs

# Objective

- To identify the human factors aspects associated with the monitoring and control of multi-unit SMRs
- Assess where NRC guidance documents need to be enhanced for review of modular design

# Methodology

- Develop a Concept of Operations (ConOps) model addressing the HFE aspects of a design
  - to identify the needed information and structure its organization
  - to develop a ConOps questionnaire to guide subsequent tasks
  
- Identify issues related to SMR operations
  - an issue is defined as an aspect of SMR design or operations that are novel and may indicate a need for enhanced review guidance to better support SMR HFE Reviews
  - staff review of information about SMR design and operations from documentation and site visits to identify the human-performance issues
  - obtained information about the operations of “surrogate systems,” i.e., systems whose operations pose similar human performance demands related to multi-module operations

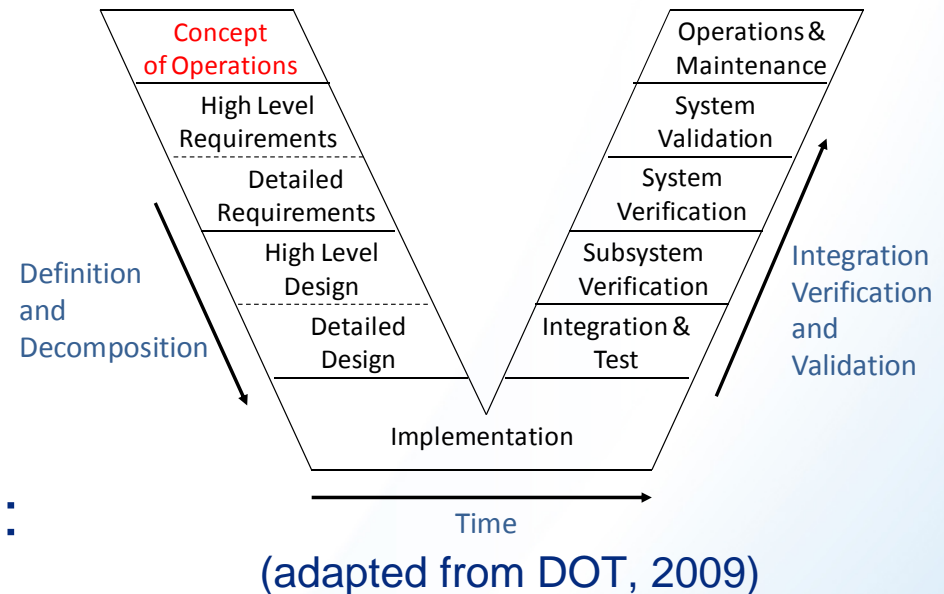


# Methodology

- Evaluate current NRC regulations and review guidance
  - is the guidance suitable to address issues of human performance in SMRs
  - what aspects of the regulations and guidance may need to be enhanced for review of modular design
- Identify the implications of SMR human performance issues for human reliability analysis
- Develop insights for the use of the research results for future research and review activities

# ConOps Model Development

- Vision of what plant operation should be like
- Integral to the systems engineering process
- IEEE Standard 1362 (IEEE, 2007) states that a ConOps:



... describes system characteristics of the to-be-delivered system from the user's viewpoint. The ConOps document is used to communicate overall quantitative and qualitative system characteristics to the user, buyer, developer, and other organizational elements (e.g., training, facilities, staffing, and maintenance). It describes the user organization(s), mission(s), and organizational objectives from an integrated systems point of view. (p. 1)

# ConOps Model Development

- A ConOps reflects top-down and bottom up considerations
  - from the top, the concept reflects the high-level goals for system operations
  - from the bottom, the technological infrastructure needed to support the ConOps



# ConOps Model Development

- ConOps is considered in the NRC HFE review process, per NUREG-0711
- A more detailed model of ConOps to support information collection and organization for SMRs was developed
- Six ConOps dimensions were defined



# CONOPS Dimensions

- Plant's Missions
  - the high-level goals the plant expectedly will achieve
  - can be described in terms of
    - goals and objectives, e.g., electrical generation, other production goals, and safe performance
    - high-level functions – the functions that must be undertaken (regardless of the performing agent) to achieve the plant's goals
    - boundary conditions – the operating envelope of the design
    - constraints – an aspect of the design, such as a specific staffing plan or the use of specific technology, that are design drivers

# CONOPS Dimensions

- Roles and Responsibilities of All Agents
  - addresses the relative roles and responsibilities of personnel and plant automation and their relationship
  - definition of human roles and responsibilities in a system is the first step toward human-system integration
  - usually specified to some level before design work begins and is refined using a variety of evaluation techniques, such as operating experience review, function and task analysis, and testing
  
- Staffing, Qualifications, and Training
  - addresses approaches to staffing the plant, including staffing levels and personnel qualifications, and training
  - the ways in which shift teams will be structured and the types of interactions between team members and other people

# CONOPS Dimensions

- Management of Normal Operations
  - addresses concepts for how the plant will be operated by personnel to manage its normal evolutions, such as start-up, low power, full power, and shutdown
  - how personnel will interact with plant functions, systems, and components to accomplish their main tasks of monitoring and controlling the plant through these normal evolutions
  - how control room (and other) resources are designed to support their activities, e.g., the HSIs, procedures, and supporting infrastructure

# CONOPS Dimensions

- Management of Off-Normal Conditions and Emergencies
  - addresses concepts for how degraded conditions, disturbances and emergencies will be handled, and how responses to such situations will be determined
  - considerations include
    - degraded I&C and HSI conditions (such as a faulty sensor, loss of an aspect of automation, or of electronic communication, or a workstation)
    - failed equipment, such as pumps and valves
    - loss of plant systems that must be compensated for, such as the failure of cooling water
    - emergencies that may impact safety, such as a loss of coolant accident (LOCA)
- Management of Maintenance and Modifications
  - addresses concepts for system maintenance, installing upgrades, and configuration management



# Identify SMR Issues

- SMR Information sources
  - general publications addressing the operational and HFE aspects of SMR designs (including key NRO reports)
  - industry SMR meetings by DOE, NRC, and vendors
  - site visits and interviews
- Data collections structured by ConOps questionnaire
- Three classes of SMRs were examined

Reactor	MWe	Vendor
<b>Integral PWRs (iPWRs)</b>		
International Reactor Innovative and Secure (IRIS)	335	Westinghouse Electric Corp
NuScale	45	NuScale Power, Inc.
mPower	125	Babcock & Wilcox
<b>Gas-cooled Reactors</b>		
Gas Turbine-Modular Helium Reactor (GT-MHR)*	285	General Atomics
Pebble Bed Modular Reactor (PBMR)*	175	Westinghouse Electric Corp.
<b>Liquid-metal Reactors (LMRs)</b>		
Super-Safe, Small and Simple (4S)	10	Toshiba Corp.
Hyperion Power Module (HPM)	25	Hyperion Power Generation, Inc.
Power Reactor Innovative Small Module (PRISM)	311	GE Hitachi Nuclear Energy

# Identify SMR Issues

- Surrogate system information sources
  - general publications
  - site visits and interviews
- Data collections structured by ConOps questionnaire
- Surrogate systems
  - nuclear naval vessels
  - refineries
  - continued on next slide



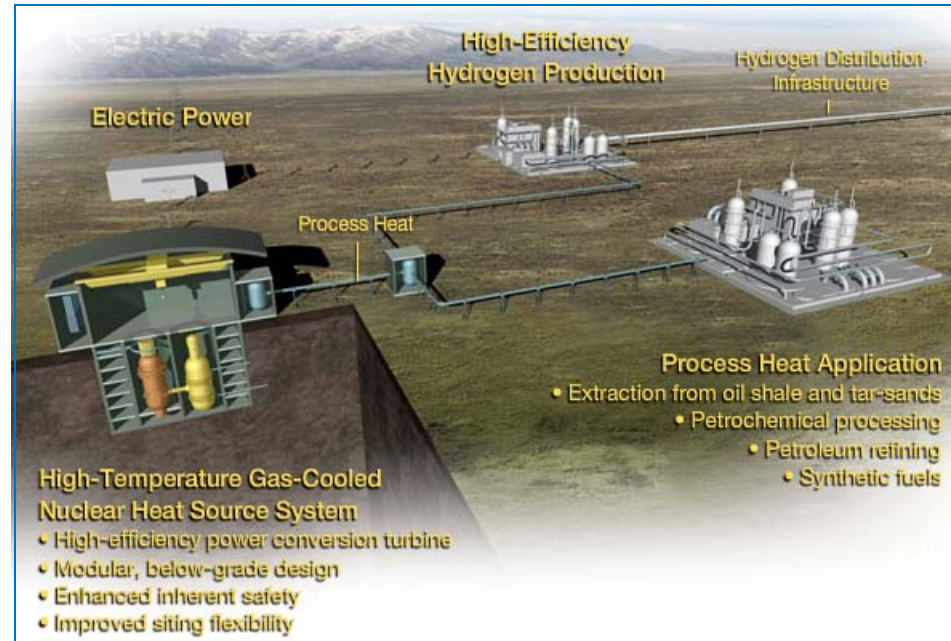
# Identify SMR Issues

- Surrogate systems (continued)
  - tele-intensive care units
  - unmanned vehicles



# Results: Preliminary SMR Issues

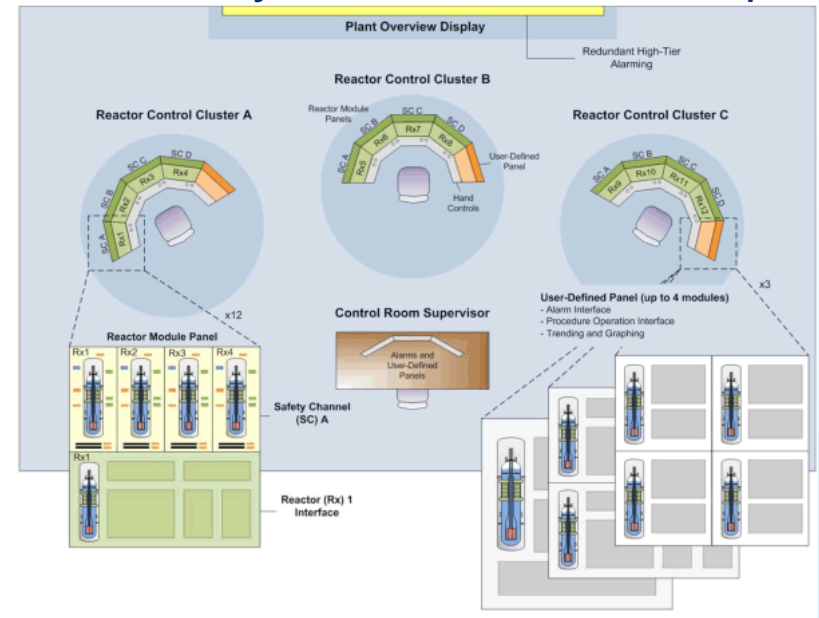
- Plant's missions
  - New Goals, Objectives, and Functions
  - Limited Predecessor Plants and Operating Experience
- Roles and responsibilities of all agents
  - High Degree of Automation for All Operations
  - Function Allocation to Support Automation Decisions
- Staffing, qualifications, and training
  - Staffing Levels (10 CFR 50.54m exemption)
  - New Positions (for secondary functions and other novel operations such as module transfer)



# Results: Preliminary SMR Issues

- Management of Normal Operations
  - Non-LWR Processes
  - Impact of Adding Modules During the Operation of Other Modules
  - Refueling Strategies
  - Module/unit Differences in Surrogate Systems
  - Multi-unit Situation Awareness
  - Control Room Configuration and Workstation Design for Multi-Modular Teams
  - HSI Design for Multi-module Monitoring and Control
  - HSIs for Secondary Functions

## *Preliminary NuScale MCR Concept*



# Results: Preliminary SMR Issues

- Management of Off-Normal Conditions and Emergencies
  - Operational Team Organizational Transitions to Manage Off-Normal Units in Surrogate Systems
  - New Hazards associated with Non-LWR design (e.g., higher operating temperatures and sodium coolant)
  - Potential Impacts of Unplanned Shutdowns or Degraded Conditions of One Module on Other Modules
  - Identification of Risk-Important Human Actions (RIHAs) when One Operator/Crew is Managing Multiple SMRs
  
- Management of Maintenance and Modifications
  - Modular Construction
  - New Maintenance Practices

# Summary of Current Status

- A ConOps model was developed and has provided a useful tool for obtaining information about SMRs and surrogate systems
- Information about the design and operations of SMRs has been obtained
  - ConOps of SMRs not fully developed at this point
- Information from surrogate systems has been obtained
- Preliminary issues were identified in each of the ConOps dimensions examined

# Path Forward

- Finalize the list of issues identified from all information sources
- Determine HRA implications of SMR ConOps
- Develop insights for use of the results



# Human Factors and Digital I&C Degradation

Brookhaven National Lab  
Human Factors and Reliability  
Branch, DRA/RES/NRC

# Honk if you want to stop your VW Jetta

NEW YORK (CNNMoney) -- Volkswagen of America is recalling about 71,000 of the German automaker's new 2011 Jetta sedans for a wiring problem that could cause the car to turn off when the horn is used.



COURTESY: VOLKSWAGEN

- “Power is ON” may be viewed as a pre-condition in the logic.
- Inadvertently, the implicit dependencies are not tracked (i.e., no deterministic procedure in place)
- Horn short circuit can disable “Converter Box.”
- Converter box” has to be enabled, functional, and turned ON to supply power (and enable) engine controller.
- “Engine controller” has to be operational for controlled motion of vehicle.
- If “Engine controller” is OFF and vehicle is in motion, “vehicle motion control” is in an unknown state (i.e., controllability cannot be assured).

# Digital age in NPP



Control Room with Analog HSIs

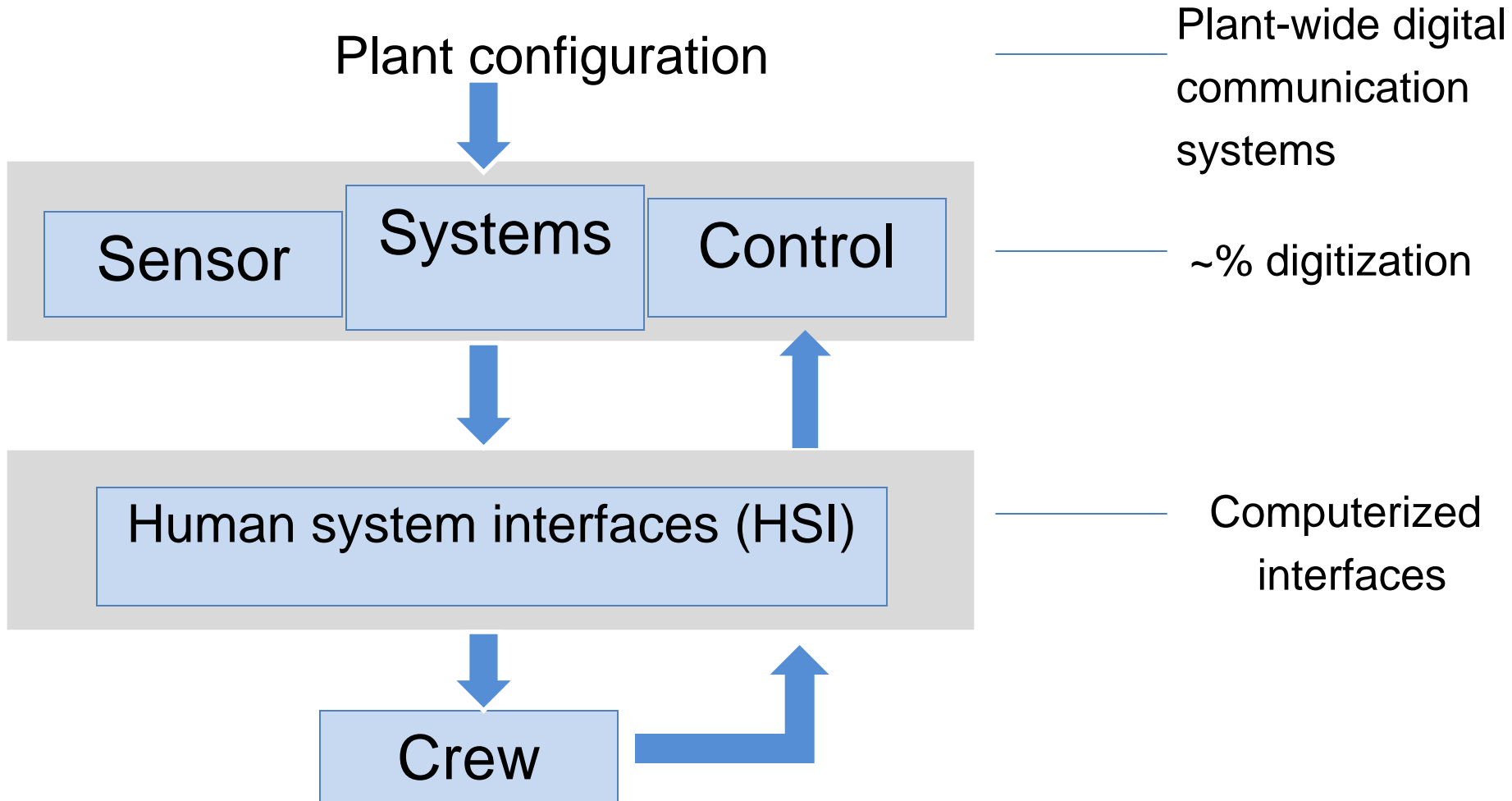


Control Room with Computer-based HSIs

# Outline

- I. Digital I&C degradation/failures
- II. Human factors (HF) research in digital I&C degradation
- III. HF in the NRC's Digital I&C research

# Digital I&C in NPP



# Differences in analog and digital I&C degradation

Analog - hardware degradation

- Limited failure modes
- Able to be pre-determined
- Traceable

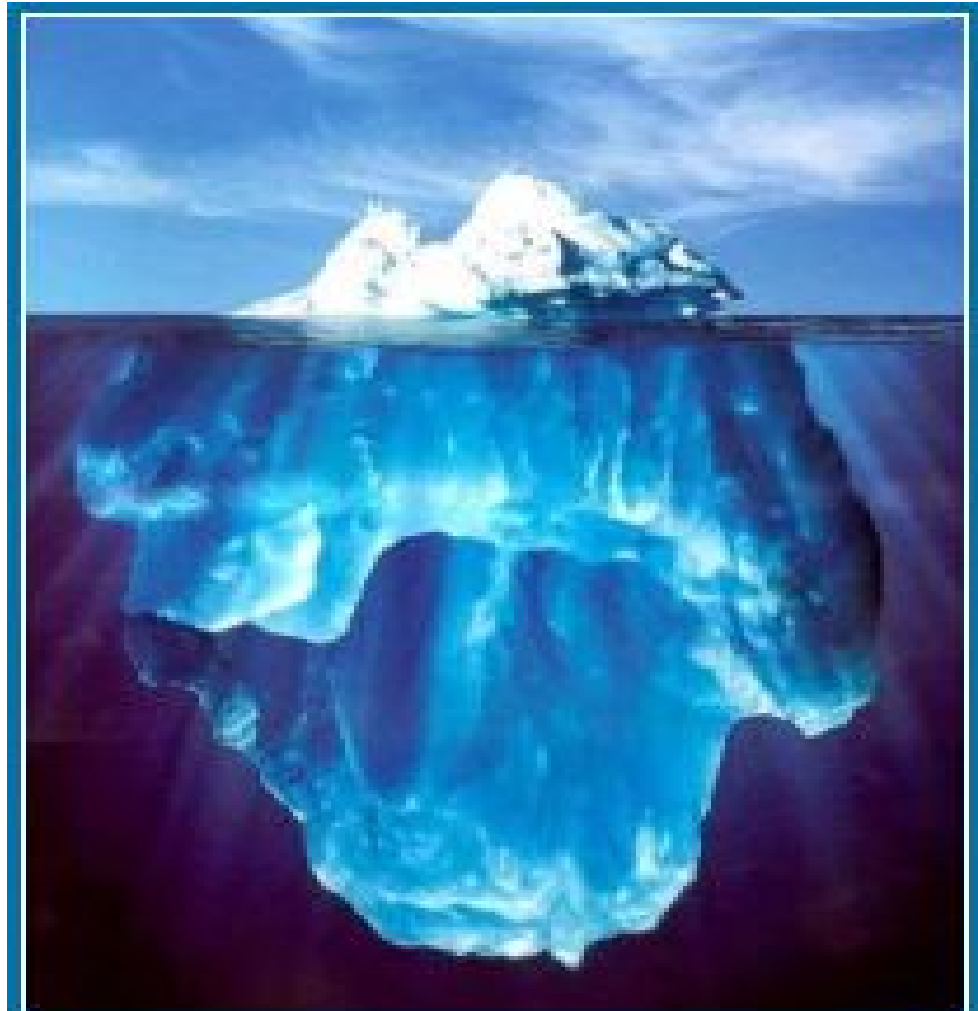
Digital - programmable hardware and software faults

- Unlimited failure modes
- Not able to be pre-determined
- Often untraceable

# Current efforts in identifying digital I&C failure modes

There are digital I&C failure databases such as COMPSIS.

The revealed failures are merely the tip of the iceberg.



# Contributing factors to digital I&C failures

- Engineering errors due to increasing functionality
- Complexity in software and control logic
- Interdependency among systems
- Uncertainty in V&V process
- Faults resulting from maintenance, upgrades, and configuration changes



# Outline

- I. Digital I&C degradation/failures
- II. Human factors (HF) research in digital I&C degradation
- III. HF research in the NRC's Digital I&C research

# N-6526: Human Factors Aspects of Operations Under Conditions of Degraded I&C

Performance period: 2007-2010

Deliverable: Technical Report BNL-91047-2010

The Effects of Degraded Digital Instrumentation and Control  
Systems on Human-system Interfaces and Operator  
Performance: HFE Review Guidance and Technical Basis

John O'Hara, Bill Gunther, and Gerardo Martinez-Guridi

Brookhaven National Laboratory

# Degraded I&C and human performance

Plant personnel and the I&C system work together to:

- perceive basic parameters
- monitor the plant's processes, performance, and various barriers that prevent release of radioactive material
- adjust operations as needed
- respond to transients, accidents, and other failures



I&C degradation may significantly lower the operator's ability to monitor systems and take control actions

# Project Objectives

1. Understand the impact of I&C degradations on human performance
2. Develop technical basis for including considerations of degraded I&C in the NRC's human factors engineering (HFE) activities
3. Develop HFE review guidance on degraded digital I&C

# What we know about digital I&C: Ideal vs. Reality

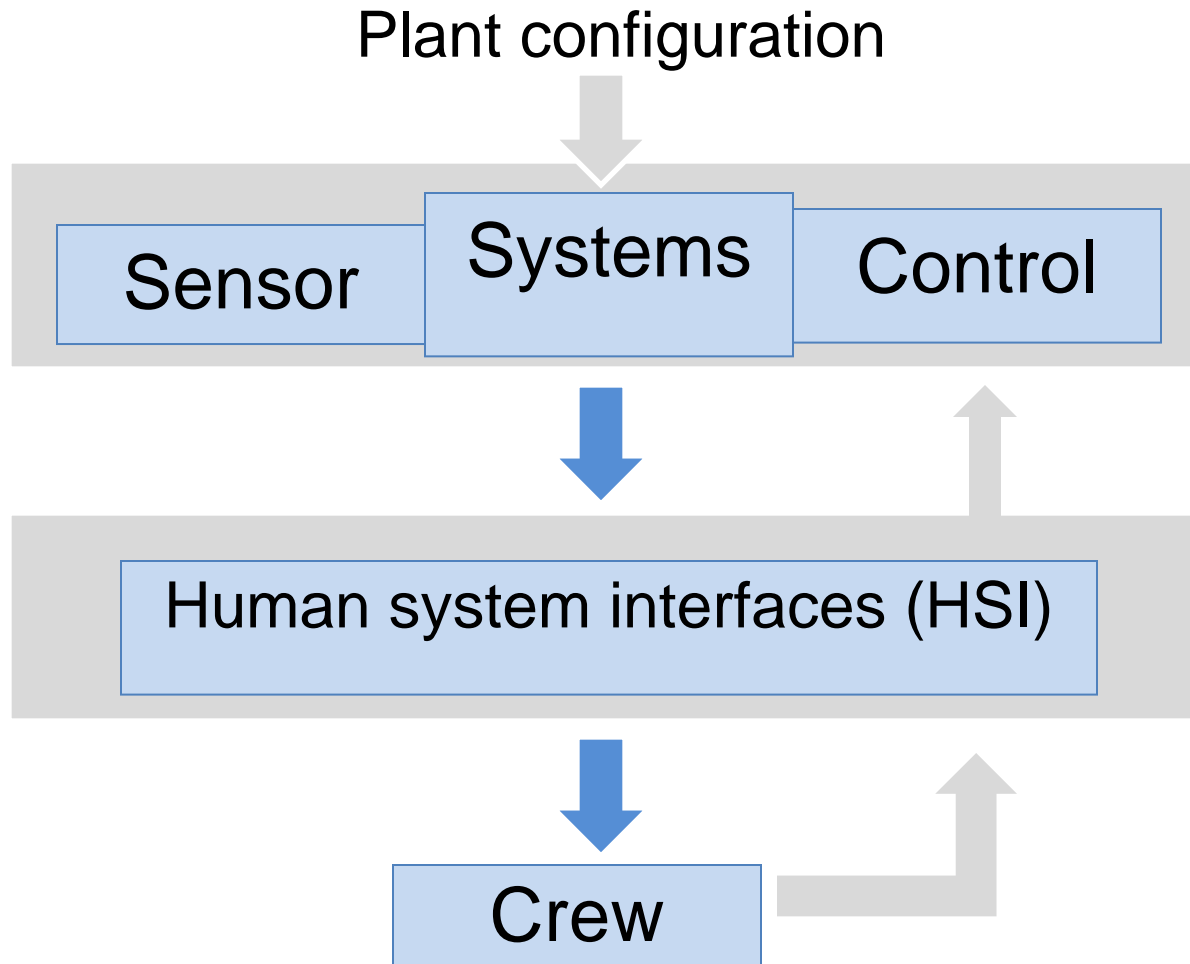
## Ideal

- Digital I&C characterization of safety and non-safety systems
- Digital I&C failure data and failure modes
- Data about failures on operators, systems, and the plant safety

## Reality

- No standard Digital I&C characterization
- Limited Digital I&C failure data and modes are being studied
- Few studies address the effects of failures on operators

# Scope of the project



# Technical Approach

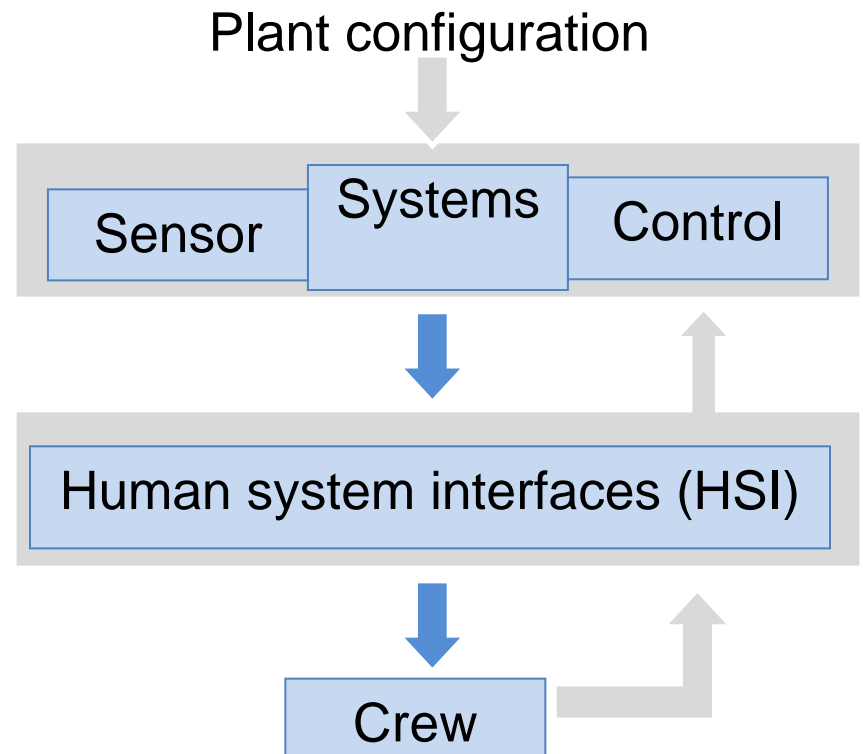
1. Develop a generic framework integrating digital I&C system and human performance
2. Use the framework to evaluate available information to generalize the effects of degraded I&C on human performance
3. Develop HFE review guidance

# Goal: Digital I&C – HSI - human performance framework

Available information about digital I&C failures are not associated with operator performance. So, we need a generic framework to consider I&C systems, HSI, and human performance as an entity.

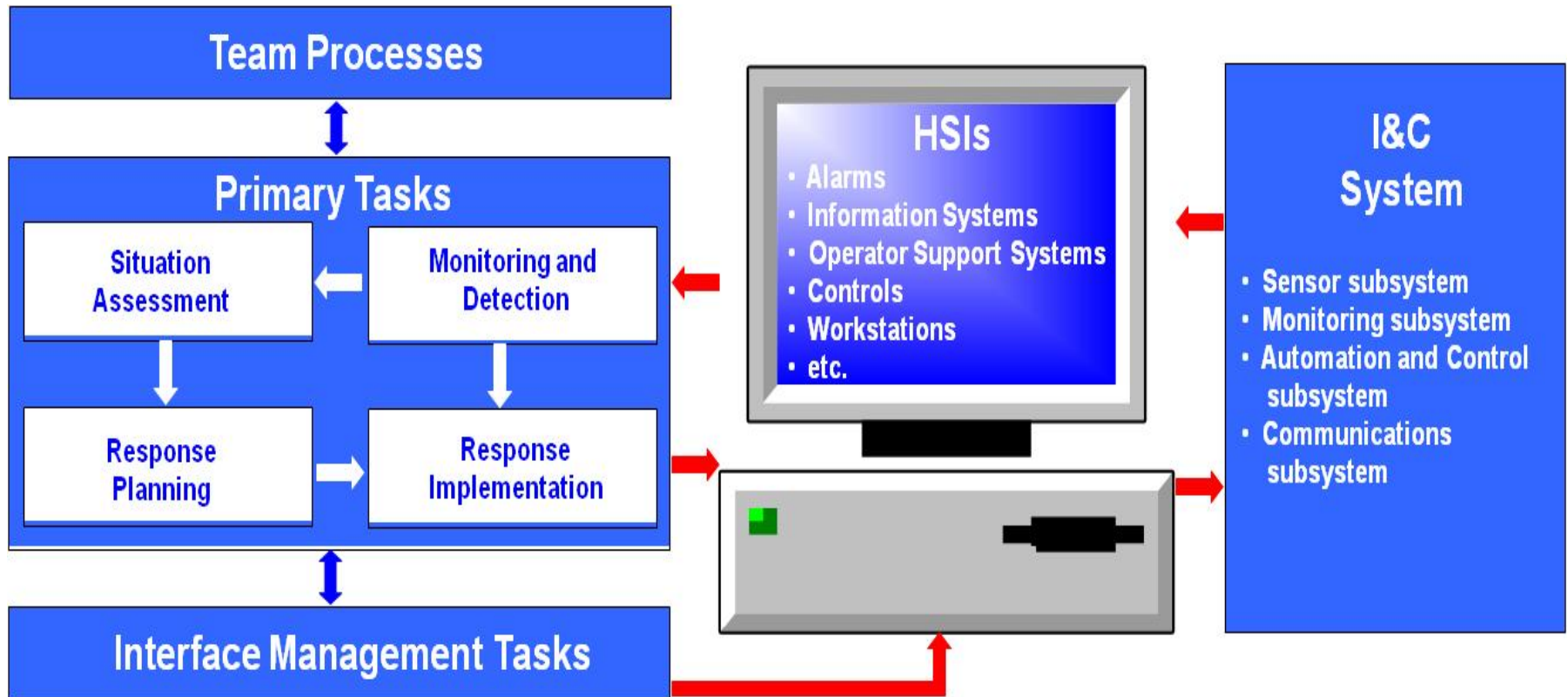
## Development of the framework:

- Identify design-independent functional elements within each level
- Links between the elements are design-specific.





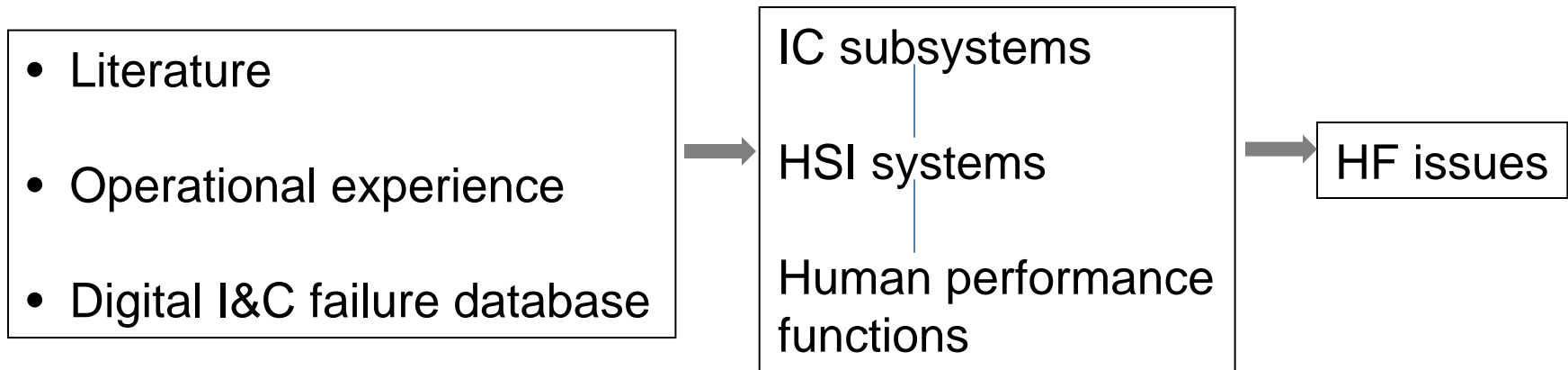
# Digital I&C - Human Performance Framework



# Goal: Develop the technical basis for human performance effects under degraded I&C

## Approach:

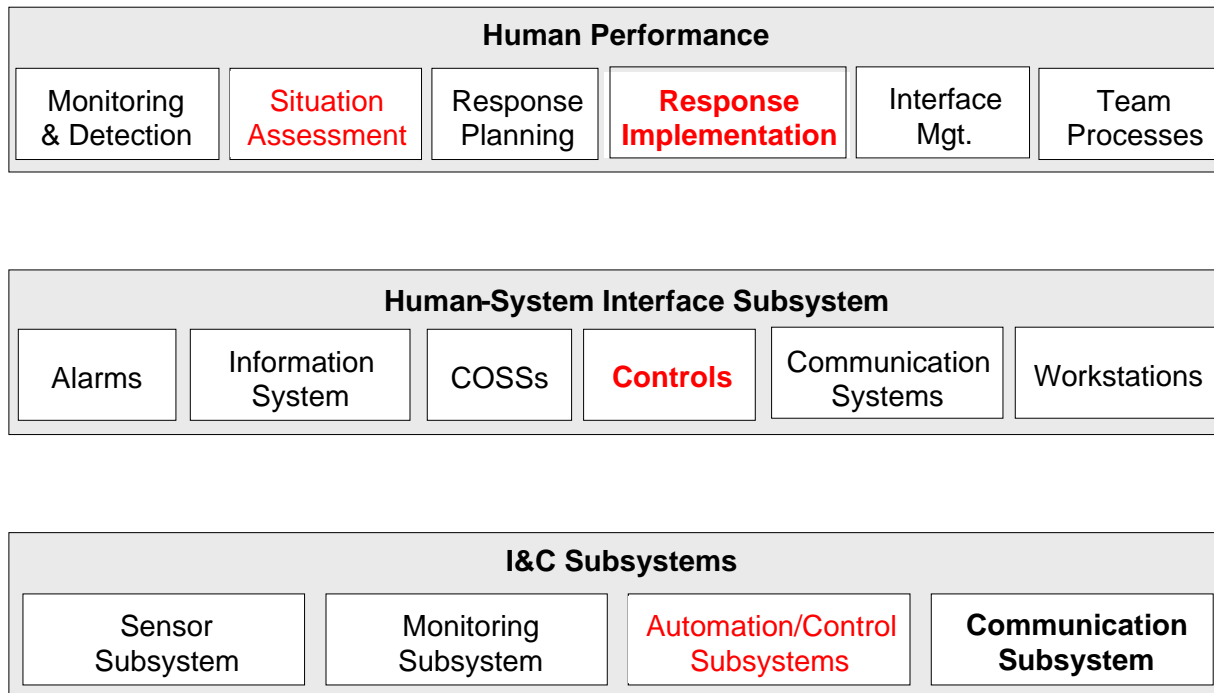
- Use the framework to analyze available information and generalize information about the impacts of degraded I&C on human performance
- Extract and identify HF issues
- Apply HF principles to address the issues -> review guidance



# Analysis of Operating Experience Example

## NRC IN 2009-03: Spurious Safety Injection with Failure to Reset

- Failed zener diode resulted in logic problems



### Human factors issues:

- Required several local manual actions to recover
- Operations and I&C personnel awareness limitations
- Procedural guidance less than adequate

# Results of analysis

1. Established evidence that digital I&C degradation can affect all aspects of human performance.
  - Example-delayed or locked-up information impacts operators' situational assessment
  - A single failure can misguide operators' understanding of plant status.
2. Identified HF issues related to degraded I&C
  - Example-Personnel detection of digital system degradation
  - Transition to back-up systems (when and how)

# Results:

## Impacts of degraded I&C on human performance

- I&C degradations can impact the HSIs that operators use to monitor and control the plant and, therefore, operator performance
- A single failure can mislead operators about the plant's state
  - the problem is more complex when the control system uses different information than the operators; it may appear to be malfunctioning to operators in view of their information and understanding of the situation; operators may take inappropriate actions based on the erroneous information
- Important degradation of the digital system may not be alarmed nor communicated to operators in a timely way, potentially causing a delayed response
- Degraded conditions may not immediately affect the system's functionality and may not be communicated to the operators creating latent failures and, subsequently, more serious events, should there be additional failures or changes in conditions

# Impacts of degraded sensor & monitoring subsystems

- Poor situation awareness associated with degradations of the sensor and monitoring subsystems
- Sensor degradations can make displays difficult to understand
  - graphical displays that integrate information appear more subject to the effects of sensor degradation than simpler displays
- Operators may have difficulty distinguishing between process and sensor failures
- Operators' task performance worsens as the magnitude of sensor noise increases

# Impacts of degraded automation and control subsystem

- Poor situation awareness and response planning associated with degradations of automatic systems
- Automation degradations are often difficult to detect
- When automation fails, operators may be challenged to assess the current status of the tasks that automation was performing and the systems it was controlling
- When automation fails teamwork is affected when operators have to manually perform automation's tasks, thereby changing the roles and responsibilities of crew members
- Factors contributing to this difficulty include over reliance on automation and poor HSI design for monitoring automation

## Impacts of degraded communication subsystem

- As time lags increase, the operator's control performance decreases
- The operator's closed-loop control (control based on feedback) becomes increasingly unstable
- Operators shift control strategies becoming increasingly open-loop (control based on prediction rather than feedback)



# Goal: Develop the NRC's HF review guidance

10 CFR 50.34(f)(2)(iii):

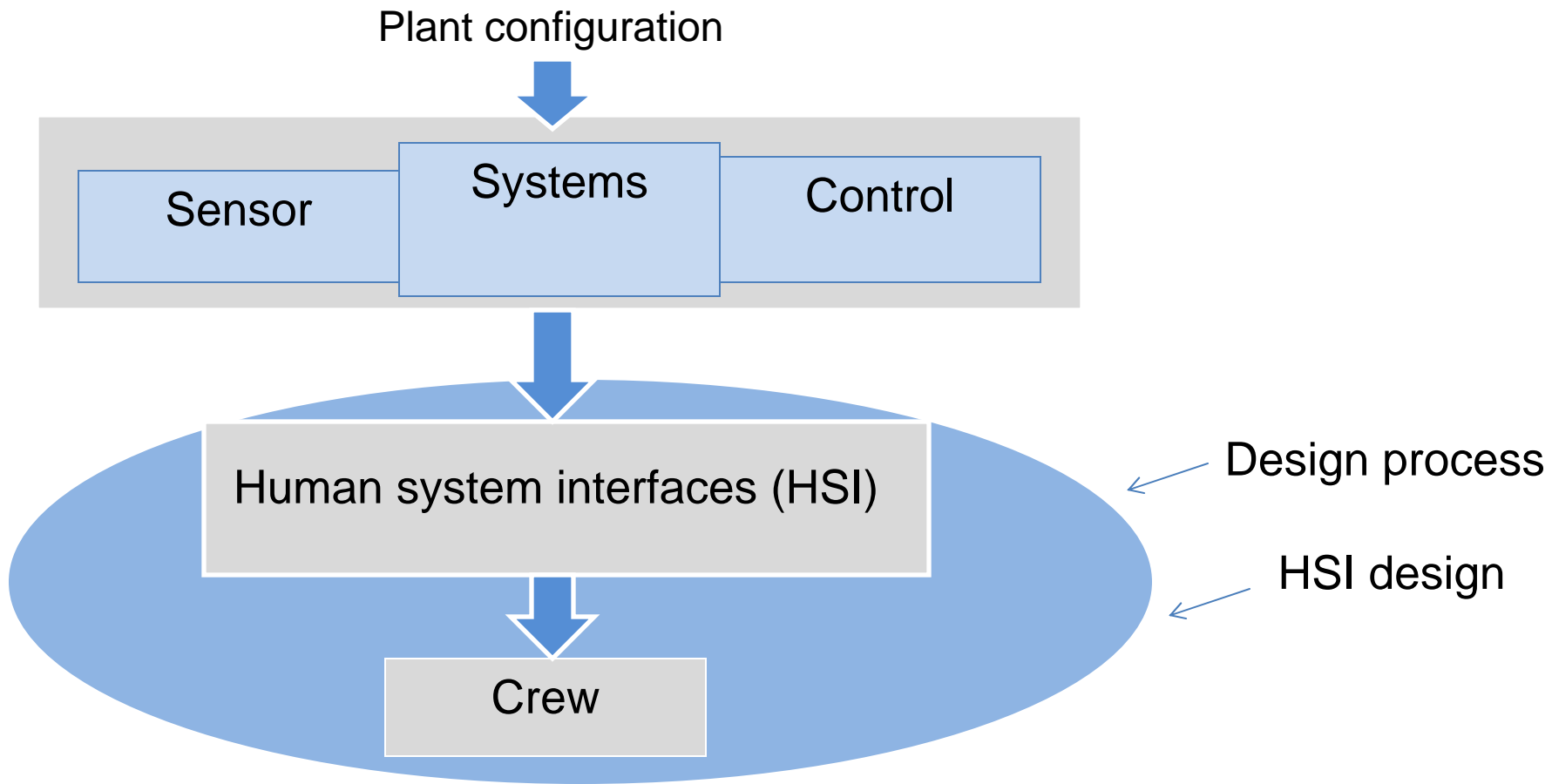
Control room design [shall] reflect state-of-art human factors principles.

- NRC's Standard Review Plan (NUREG-0800, Ch.18) describes the staff's review activities to verify that accepted HF engineering principles are incorporated during an NPP design process.
- NRC's Human Factors Engineering Review Model (NUREG-0711) provides guidance for detailed review of design process.
- Human-System-Interface (HSI) Design (NUREG-0700)

Digital I&C degradation guidance needs enhancement

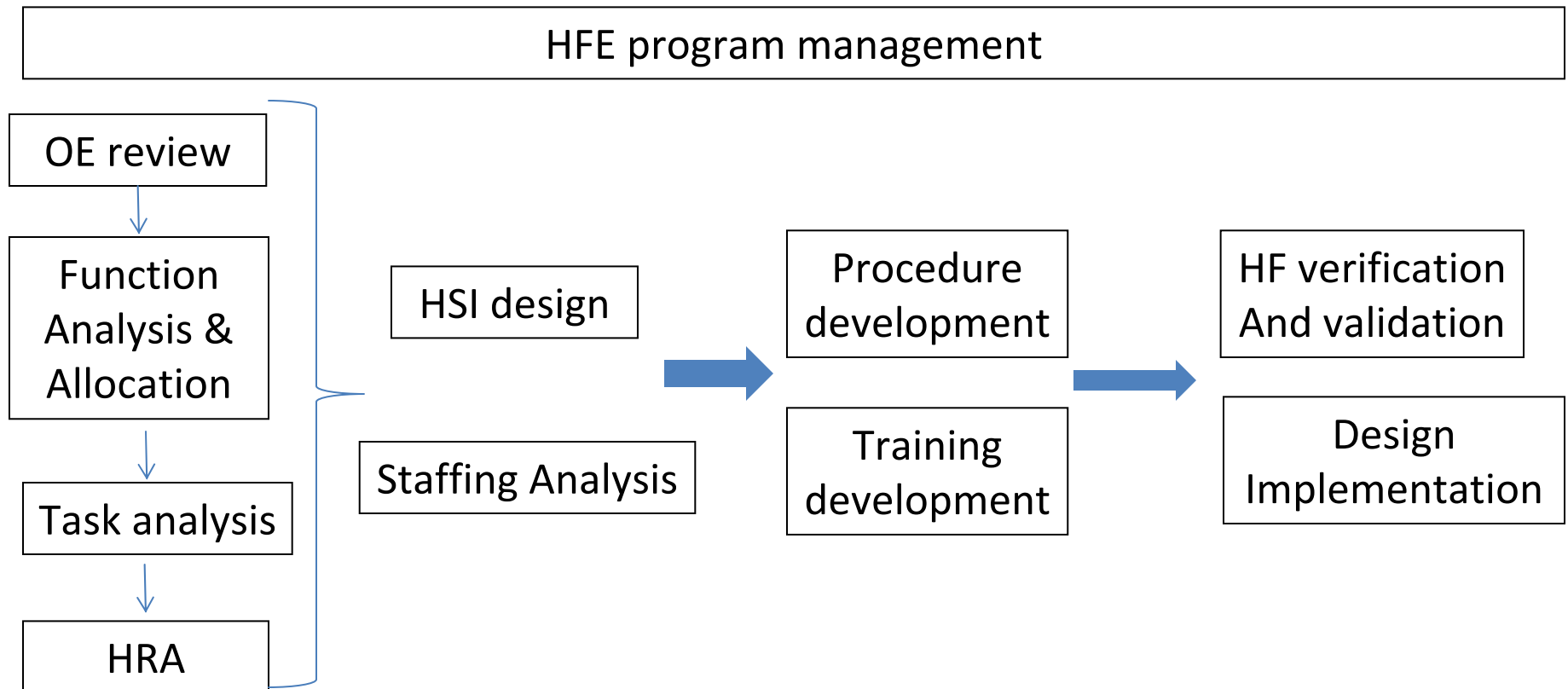
# HFE Review Guidance

1. Analyze the impacts of I&C degradations on HSIs and operator performance during the design development process
2. Improve the HSIs so that they support operators in monitoring the I&C system and in detecting and managing degraded I&C conditions



# HFE review guidance for degraded I&C

Guidance for design process: Addressing degraded I&C at every HFE elements of the design process



# Examples of guidelines for design process

## **Operational experience review:**

- Applicants should review operating experience to identify the effects of failure modes and degraded conditions of the HSI and I&C subsystem on personnel performance.

## **Task analysis:**

- The applicant's task analysis should identify the task requirements for managing HFE-significant I&C degradations so that risk-important tasks can be performed.

# Guidance for HSI design

Total 11 guidelines for HSI design in three categories:

## 1. HSIs for Monitoring I&C System Conditions

- The HSI should provide information about each I&C subsystem's status and performance parameters needed to monitor the HFE-significant aspects of the system and detect I&C degradations.

## 2. HSI Response to I&C System Changes

- The HSI should support operators in determining the steps for failure recovery or back-up actions

## 3. Information source and quality

# Summary of the project

1. Analyzed and generalized the impacts of degraded I&C on human performance
2. Established a technical basis that degraded I&C impacts human performance
3. Developed HF review guidance to improve operators' ability to monitor digital I&C systems and detect and manage degradations.

# Research Challenges

- Further analysis using a more fine-grained I&C system characterization
- Effects of sensor degradations on different types of display formats
- Identification of the effect of maintenance on I&C system degradation
- Analyze methods to identify HFE-significant I&C degradations

# Outline

- I. Digital I&C degradation/failures
- II. Human factors (HF) research in digital I&C degradation
- III. HF in the NRC's Digital I&C research



# The NRC's Digital I&C Research Plan

Safety aspects  
of digital system

Security aspects

Advanced NPP  
concepts

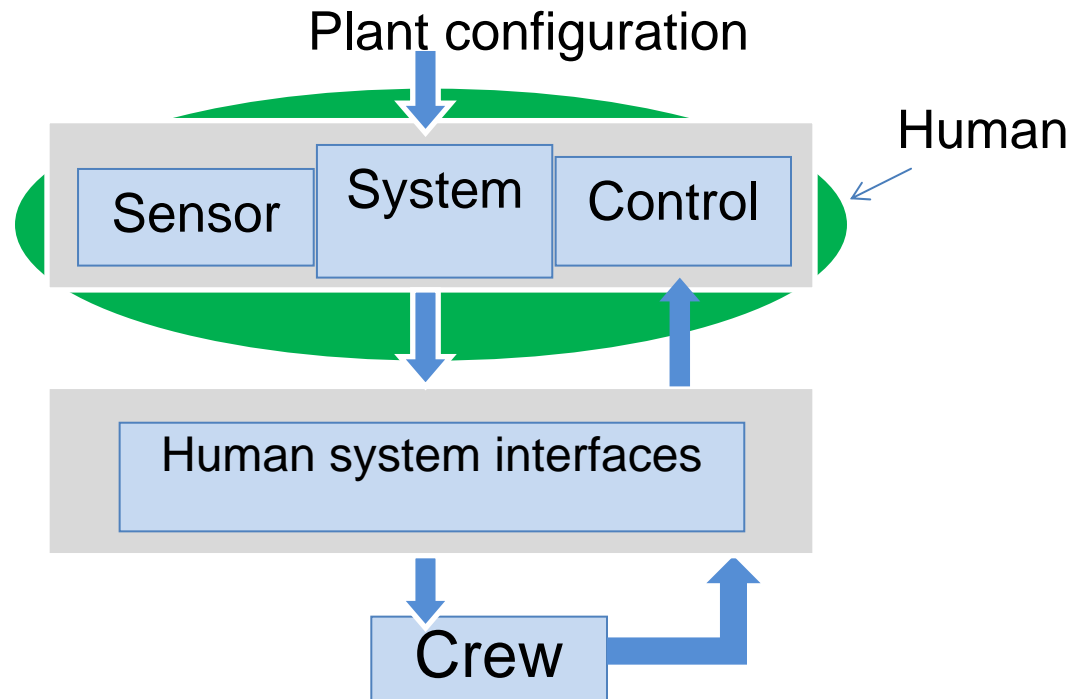
Knowledge  
management

- 3.1.1 Communications among plant-wide systems
- 3.1.2 Safety assessment of tool automated processes
- 3.1.3 Development of benchmark and reliability data
- 3.1.4 Integrated plant and DI&C system modeling
- 3.1.5 Analytic assessment of DI&C systems
- 3.1.6 Digital system PRA
- 3.1.7 Diagnostics and prognosis

# 3.1.5 Analytic assessment of DI&C systems

This research will develop an NRC capability for effective and efficient assessment of digital instrumentation and control (DI&C) systematic failures during the system lifecycle. The developed knowledge base will evolve iteratively.

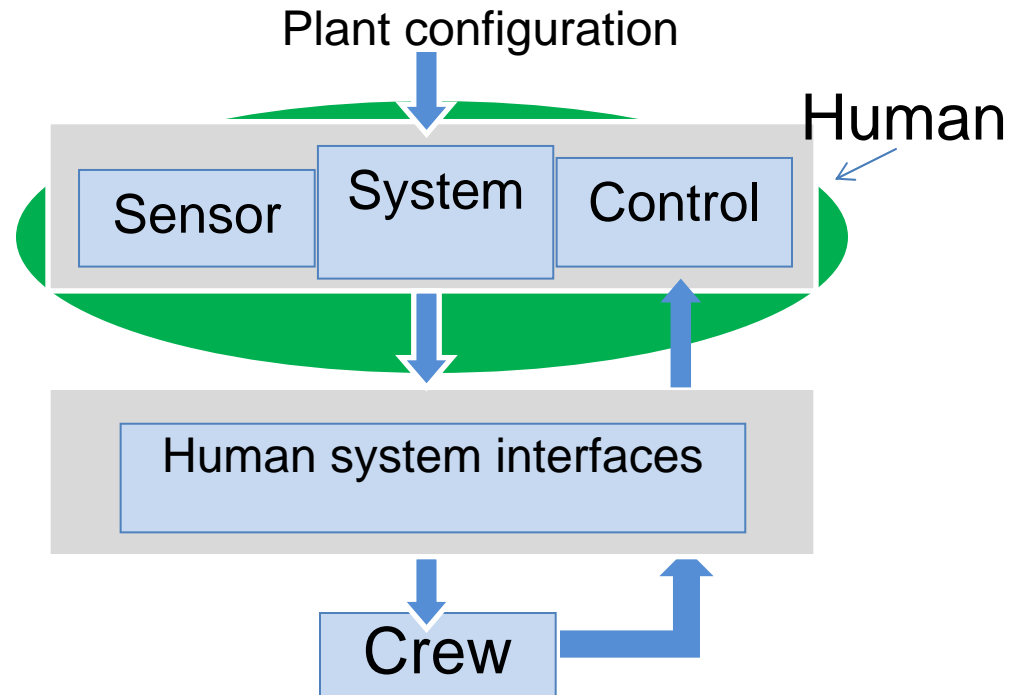
- Identify credible failure modes typical of software-intensive DI&C systems and determine the interaction of these failure modes with the rest of the systems, operating crew, and the plant by developing fault/failure models.



## 3.1.6 Digital System PRA

This research is to identify and develop methods, analytical tools, and regulatory guidance to support (1) NPP licensing decisions using information on the risks of digital systems and (2) including models of digital systems into NPP PRAs.

- Identify failure modes of digital systems and determine the effects on systems
- Methods for HRA associated with digital systems
  - Human errors related to HSIs.
- Human errors during upgrade of hardware and software



# Future HF Research in Digital I&C