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

February 13, 2006

MEMORANDUM TO: ACRS Members

FROM: Eric A. Thornsbury, ACRS Senior Staff Engineer

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEE ON RELIABILITY & PROBABILISTIC RISK ASSESSMENT, NOVEMBER 17-18, 2005 - ROCKVILLE, MARYLAND

The minutes of the subject meeting, issued January 4, 2006, have been certified as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

electronic cc: J. Larkins
A. Thadani
S. Duraiswamy
M. Snodderly
J. Lamb

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

January 4, 2006

MEMORANDUM TO: George E. Apostolakis, Chairman
Reliability & Probabilistic Risk Assessment Subcommittee

FROM: Eric A. Thornsbury, ACRS Senior Staff Engineer

SUBJECT: WORKING COPY OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEE ON RELIABILITY & PROBABILISTIC RISK ASSESSMENT, NOVEMBER 17-18, 2005 - ROCKVILLE, MARYLAND

A working copy of the minutes for the subject meeting is attached for your review. Please review and comment on them. If you are satisfied with these minutes, please sign, date, and return the attached certification letter.

Attachment: Minutes (DRAFT)

cc: Reliability & Probabilistic Risk Assessment Subcommittee Members
J. Larkins
A. Thadani
M. Scott
S. Duraiswamy
M. Snodderly

UNITED STATES
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MEMORANDUM TO: Eric A. Thornsbury, ACRS Senior Staff Engineer

FROM: George E. Apostolakis, Chairman
Reliability & Probabilistic Risk Assessment Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE MEETING OF THE ACRS SUBCOMMITTEE ON RELIABILITY & PROBABILISTIC RISK ASSESSMENT, NOVEMBER 17-18, 2005 - ROCKVILLE, MARYLAND

I do hereby certify that, to the best of my knowledge and belief, the minutes of the subject meeting on November 17-18, 2005, are an accurate record of the proceedings for that meeting.

George E. Apostolakis
Subcommittee Chairman

2/10/06
Date

Issued: 4 January 2006
Certified: 10 January 2005

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MEETING OF THE ACRS SUBCOMMITTEE ON
RELIABILITY & PROBABILISTIC RISK ASSESSMENT
MEETING MINUTES - NOVEMBER 17-18, 2005
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Subcommittee on Reliability & Probabilistic Risk Assessment held a meeting on November 17-18, 2005, in Room T-2B3, 11545 Rockville Pike, Rockville, MD. The purpose of this meeting was to discuss the standardized plant analysis risk (SPAR) model development program. Eric Thornsbury was the Designated Federal Official for this meeting. The Committee received no written comments or requests for time to make oral statements from the public. The Subcommittee Chairman convened the meeting at 8:30 a.m. on November 17, 2005, recessed at 4:45 p.m., reconvened at 8:30 a.m. on November 18, 2005, and adjourned at 11:20 a.m..

ATTENDEES

ACRS Members

G. Apostolakis, Subcommittee Chairman
M. Bonaca, Member
R. Denning, Member
T. Kress, Member
E. Thornsbury, Designated Federal Official

Principal NRC Speakers

N. Chokshi, RES
R. Buell, INL
D. Dube, RES
E. Goldfeiz, RES
J. Mitman, RES
M. Cheok, RES
R. Schroeder, INL
S. Sancaktar, RES
J. Lehner, BNL

Other members of the public attended this meeting. A complete list of attendees is in the ACRS Office File and is available upon request. The presentation slides and handouts used during the meeting are attached to the office copy of these minutes.

OPENING REMARKS BY CHAIRMAN APOSTOLAKIS

George Apostolakis, Chairman of the ACRS Subcommittee on Reliability & Probabilistic Risk Assessment, convened the meeting at 8:30 a.m. Dr. Apostolakis stated that the purpose of this meeting was to discuss the standardized plant analysis risk model development program. He said the Subcommittee would gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee. The rules for participation in the meeting were announced as part of the notice of the meeting published in the Federal Register on November 1, 2005. Dr. Apostolakis acknowledged that the Committee had received no written comments or requests for time to make oral statements.

DISCUSSION OF AGENDA ITEMS

SPAR Model Development Program - Overview

Mr. Nilesh Chokshi, Branch Chief in the Office of Nuclear Regulatory Research, began the presentations. He first thanked the Committee for their previous reviews of some aspects of the SPAR program, particularly the station blackout study. He also thanked the Committee for this opportunity to discuss SPAR model development in detail, since many areas are in the formative stages of development. He stated that the presentations would cover the full spectrum of SPAR activities, including internal events, external events, LERF, and low power / shutdown. Mr. Chokshi noted that the staff is looking forward to getting feedback on the challenges the program is facing. He then introduced the members of the team that would participate in the briefings and introduced Mr. Michael Cheok to begin the formal presentations.

Mr. Cheok provided the Subcommittee with an overview of the presentations. He briefly described the structure of the models and the purpose of the program. He also provided a brief history of the evolution of the program and described how the staff uses the models in operating event assessments. The staff also uses SPAR models for SDP Phase 3 analyses, the ASP program, improving the quality of PRAs, supporting the resolution of GSIs, risk-informed reviews of license amendments, and independently evaluating risk for the fleet of plants. Mr. Cheok then provided an overview of the various program activities within the SPAR program: Level 1 internal events at full power, Level 1 internal events at low-power/shutdown conditions, Level 2 / LERF, and external events. In response to a question from Dr. Denning, Mr. Cheok explained that the staff has not planned low-power/shutdown models for all plants, just 15-20 models. These types of models rely heavily on information from the licensee.

Comments and Observations From the Subcommittee Members

- Dr. Apostolakis asked what PRA differences the standardized SPAR models have eliminated. Mr. Cheok responded that some examples include differences due to large event tree / small fault trees, basic event terminology, and success criteria.

- Dr. Denning asked if human reliability is also a standardized issue. Mr. Cheok confirmed that fact, and added that the models do not use plant-specific operating procedures or data.

- Dr. Bonaca asked how the staff updates the models. Mr. Cheok explained that it was a difficult issue, as the plants have no requirement to report changes in their models to the staff.

- Dr. Apostolakis noted the increasing use of binary decision diagrams in risk analysis and suggested the staff examine their use.

- Dr. Apostolakis asked how often the models disagree with the licensee models during SDP Phase 3 analyses. Mr. Steve Long, NRR, commented that disagreements often occurred whenever the finding is potentially greater than green. Mr. John Schroeder, INL, said that unique plant alignments and similar situations often create disagreements. Sometimes these are incorporated into the model, sometimes not.

- Dr. Bonaca and Dr. Denning asked in followup how much similarity exists between the SPAR and licensee models. Mr. Schroeder answered that the models have good agreement on the important events, but less agreement on less-important events.

- Dr. Kress asked if the program included severe accident models or Level 3. Mr. Cheok answered both negatively.

- Dr. Kress also suggested that the staff include late containment failures in the models. Mr. Cheok noted that the LERF models under development are expandable to include late failure.

Level 1 Internal Events

Mr. Robert Buell and Mr. John Schroeder, both from Idaho National Laboratory, presented the next portion of the meeting. Mr. Buell described the standardized structure of the models and how they have evolved over the years. He described the advantages of standardization and presented the standardized elements of the models, including standard methods, assumptions, initiating events, event trees, fault trees, failure data, and human reliability analysis. Mr. Buell continued the description of the standardized features by discussing the specific initiating events, frontline system fault trees, and support system fault trees used in the models. He also discussed the key BWR and PWR assumptions in the models' event trees.

Mr. Buell then concluded this portion of the presentation and passed it to Mr. Schroeder to provide a demonstration of the models. He explained how the SPAR models use the SAPHIRE program as the underlying software engine for the SPAR models. He showed the event trees for the Pilgrim model, and opened the Large LOCA tree in the graphical editor to demonstrate how to access the components of the model.

Mr. Schroeder then described how the SPAR-H method works with the SAPHIRE code. He demonstrated the ability to specify if a diagnosis is involved and how to apply performance shaping factors. Dr. Schroeder also described the SAPHIRE trouble reporting system to help users identify and solve issues encountered with the code and/or models. In response to questions from the Members, Dr. Schroeder demonstrated the uncertainty calculations performed within the model.

Following the demonstration, Dr. Buell discussed the major modeling assumptions in the SPAR models. First, he listed and described several general assumptions, such as no common cause failure modeling across systems, run failures occurring at time zero, and successful diagnosis in most sequences. Some BWR-specific modeling assumptions include loss of injection upon containment venting and early depressurization caused by suppression pool cooling failure. PWR-specific assumptions include the need for two PORVs for feed-and-bleed and a PWR-generic PORV challenge rate.

Dr. Buell continued by presenting the quality review process for the models, starting with the peer reviews performed on previous versions of the models. The quality review process for the current generation of models involves a detailed cut set level review between the SPAR model and the licensee model. This comparison examines the overall core damage frequency, conditional core damage probability for each initiating event, and Birnbaum importance measures for basic events.

The next portion of the presentation discussed the modeling issues the staff is currently working on. Dr. Buell discussed the list of ten issues driving the differences between the SPAR models and licensee models. He specifically reviewed the staff's work on loss of offsite power modeling, RCP seal failure modeling, CCF modeling, updated data values, sump plugging probabilities, support system initiating event fault trees, power recovery after battery depletion, injection following containment failure, PORV success criteria for feed-and-bleed, and core uncovery timing.

Following a break, Mr. Don Dube provided a discussion of lessons learned from the MSPI PRA quality reviews. First, he reviewed the MSPI program and the recommendations of the PRA quality task group. One alternative for assuring sufficient PRA quality is a cross-comparison of Birnbaum values in the licensee PRA to the same values in the SPAR models. Mr. Dube provided several examples of these comparisons to illustrate the process. In summary, this process identified several issues that the staff is addressing as part of the enhanced Revision 3 SPAR model development program. Mr. Dube also provided an algebraic derivation relating the risk achievement worth to the Fussell-Vesely importance measure.

Dr. Schroeder returned to the microphone to lead the final discussion of the day on uncertainties. He discussed data uncertainty issues related to initiating event frequencies, component failure rates, the use of generic data, various recovery parameters, and common cause alpha factors. Dr. Schroeder also discussed model structure uncertainties, many of which directly relate to the issues previously discussed as issues the staff is working.

Comments and Observations From the Subcommittee Members

- Dr. Bonaca noted that the example from the station blackout study was a good demonstration of the value of the SPAR models.

- Dr. Apostolakis asked how the thermal hydraulic success criteria are determined for the models. Mr. Buell answered that they rely on the success criteria in NUREG-1150.

- Dr. Apostolakis asked about coordination between ATHEANA and SPAR-H. Mr. Cheok explained that some coordination exists, including a review of the SPAR-H method by the ATHEANA team.

- Dr. Apostolakis also asked for the possible reasons why all plants now have a core damage frequency less than 10^{-4}. Mr. Cheok said this was due to both better analysis methods and actual changes at the plants. Dr. Apostolakis suggested that the staff should look at the most up-to-date risk numbers and brief the Committee. It might also be useful to the Commission. Dr. Denning pointed out that the staff should identify how much reduction is due to plant changes and how much is due to better analysis. The staff agreed to think about it.

- Dr. Denning and Dr. Apostolakis expressed surprise that human error was not one of the issues the staff is working. Dr. Buell explained that it did not show up as an issue driving differences in the models. Dr. Apostolakis believes they should still note it as an important issue.

- Dr. Apostolakis stated that the staff appears to be avoiding model uncertainty issues by declaring the use of a chosen model, such as with SPAR-H and seal LOCAs.

External Events Models

After a brief introduction by Mr. Cheok, Mr. Selim Sancaktar briefed the Subcommittee on the development of external event SPAR models. As introduction, Mr. Sancaktar noted that the staff currently performs SDP and ASP external event analyses on a case-by-case basis. Therefore, the staff needs SPAR external events models to support these analyses. The development of these models will incorporate internal flooding, internal fire, seismic events, and other external event scenarios into the current SPAR models to produce SPAR-EE models.

Mr. Sancaktar explained the products that this development program will produce and the status of the work. Six preliminary SPAR-EE models are complete, along with SAPHIRE software enhancements specifically to support this program. The staff is also creating external event handbooks for analysts to use. Future plans include completion of SPAR-EE models for all plants, use of the models in ASP analyses, and eventual validation of the models to the same level as the main SPAR models. The main challenge to the development of these models is obtaining the most up-to-date information from the licensees.

At the conclusion of the meeting, Mr. Sancaktar provided a demonstration of the external event models for the subcommittee.

Comments and Observations From the Subcommittee Members

- Dr. Denning noted that addressing uncertainty will be a big challenge in external events, LERF, and low power & shutdown models. Mr. Cheok agreed, and noted that they will achieve QA through use of the models.

- Dr. Apostolakis noted that another major difference in external event analysis is the location basis for the events. Dr. Denning noted that such a location basis makes the use of plant-specific details unavoidable for these models. Mr. Sancaktar explained that these models will depend heavily on previous scenarios analyzed in plant PRAs and IPEEEs. Dr. Denning agreed that the specific objectives of the SPAR models make the approach acceptable.

- Dr. Apostolakis and Dr. Denning stated their support for continued ACRS involvement in the development of these models.

LERF Models

Mr. Eli Goldfeiz, RES, introduced the session on the Large Early Release Frequency (LERF) SPAR model development program, then turned the presentation over to Dr. John Lehner, BNL, to provide the details of the program.

Dr. Lehner explained the objective of the program to provide user-friendly analysis tools for staff assessments of LERF. The program consists of three phases: evaluating previous models, preparing a detailed program plan, and implementing the plan. The staff is now in the implementation phase of the work. Dr. Lehner described the model development approach and the plan to use plant groups for the LERF SPAR models rather than individual plant models. He noted that three models are complete and have undergone internal BNL and NRC review, but have not yet been benchmarked against licensee models.

Dr. Lehner also presented example LERF results from the PWR Ice Condenser model. The next two models under development are for a BWR Mark III and a BWR Mark II. The primary outstanding issues involve the direct dependence between the LERF models and the main Level 1 SPAR models. Therefore, whenever the staff updates a Level 1 model, they must also update the LERF model. The staff is hoping to develop an automated interface to address this issue.

Comments and Observations From the Subcommittee Members

- Dr. Denning asked how the staff handles uncertainty in the LERF models. Dr. Lehner answered that the models are point-estimates and do not model uncertainty. Dr. Denning noted that this field can have high uncertainties, and therefore the staff should consider including it.

Low Power & Shutdown Models

Mr. Jeff Mitman, RES, provided the last formal presentation of the day on the SPAR low power & shutdown (LPSD) models. The objective of the work is to produce models to use in event assessments and to support reviews of risk-informed applications. The goal is to develop models by plant classes. Mr. Mitman discussed how the work is developing specific LPSD templates to apply to the Revision 3 SPAR models.

The staff has completed eleven models, and completed onsite QA of four models. Mr. Mitman also described the scope of the models in terms of operating modes, and reviewed the major inputs and assumptions included in the models. He then provided examples of a BWR event tree, the plant operating state selection process, and AC power failure and recovery event trees, and an ECCS event tree. Future plans for the models include the completion of four more models by the end of 2006, though the QA process is contingent on the availability of licensee PRA staff.

Comments and Observations From the Subcommittee Members

- Dr. Kress asked if the models presume knowledge of the operating states. Mr. Mitman responded that the models calculate an outage-average core damage frequency.

- Dr. Denning asked if the staff plans to include the spent fuel pool in the future. Mr. Cheok answered that the staff has not thought about that yet. Dr. Kress added that it would need to be a separate effort from the core damage models.

- Dr. Denning also asked about including external events in the low power & shutdown models. Mr. Mitman answered that the staff would like to add these eventually. Mr. Cheok added that the long-term goal would be to have complete models with low power & shutdown, LERF, and external events together.

Closing Discussions

Closing Comments and Observations From the Subcommittee Members

- Dr. Denning stated that he has a very favorable opinion of the work as a whole. The staff understands the limitations and objectives of the tools.

- Dr. Kress believes this is "really good stuff." He sees good potential for the Level 2 work, and would like to see it extended to Level 3. The QA procedures for the Level 1 models impressed him. He has some concern about the LPSD averaging approach, but it appears to be the right thing to do at this stage.

- Dr. Bonaca stated his belief that SPAR is a great project. It will be important both to staff in the field and those who do inspections. He thinks there should be a better way to get updates from licensees regarding their models.

- Dr. Apostolakis generally agrees with the positive comments made by the other Members. The QA for Level 1 is excellent. He believes it contributes to the safety culture of both the licensees and NRC. The SPAR program has a central importance for the agency.

SUBCOMMITTEE DECISIONS AND ACTIONS

The Subcommittee Members discussed the option of bringing the topic to the full Committee in February or March. Further discussions following the meeting led the Members to include many of their observations in the annual Research Report, and wait for further developments before bringing the SPAR Model Development Program to the full Committee.

BACKGROUND MATERIALS PROVIDED TO THE SUBCOMMITTEE PRIOR TO THIS MEETING

Documents	
1-1.	PWR SPAR Model Manual (Turkey Point)
1-2.	Appendix F to PWR SPAR Model Manual
2-1.	BWR SPAR Model Manual (Pilgrim)
2-2.	Appendix F to BWR SPAR Model Manual
3.	Papers on SPAR Modeling Issues
3-1.	Loss of Offsite Power Model
3-2.	Reactor Coolant Pump Seal Failure Modeling
3-3.	Common-Cause Failure Modeling
3-4.	Basic and Initiating Event Data
3-5.	Containment Sump Screen and Suppression Pool Strainer Plugging During LOCAs
3-6.	Support System Initiating Event Models
3-7.	Time to Core Uncovery for Station Blackout Sequences
3-8.	Recovery of Offsite Power Following Battery Depletion during Station Blackout (SBO)
3-9.	Coolant Injection Following Containment Overpressure Failure
4.	Rev 3P SPAR Model Cutset Level Review Process Guidelines
5.	Training Manual - Risk Assessment in Event Evaluations

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Note: Additional details of this meeting can be obtained from a transcript of this meeting available for downloading or viewing on the Internet at http://www.nrc.gov/ACRSACNW or can be purchased from Neal R. Gross and Co., Inc., (Court Reporters and Transcribers) 1323 Rhode Island Avenue, NW., Washington, DC 20005 (202) 234-4433.

SUMMARY: Section 651(e) of the Energy Policy Act of 2005 expanded the definition of byproduct material as defined in the Atomic Energy Act of 1954, as amended. To comply with the Congressional mandate, the Nuclear Regulatory Commission (NRC) is changing its regulations to expand the definition of byproduct material to include the following materials produced, extracted, or converted after extraction for use for commercial, medical, or research activities: (1) Discrete sources of radium-226, (2) accelerator-produced radioactive material, and (3) discrete sources of naturally occurring radioactive material, other than source material, that the Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and other appropriate Federal agencies, determines would pose a threat to public health and safety or the common defense and security similar to the threat posed by a discrete source of radium-226. To aid in the rulemaking process, NRC is holding a public meeting with a "roundtable" format (defined further in the body of this notice) to solicit input, that may be useful in drafting a proposed rule, from stakeholders. The meeting is open to the public, and all interested parties may attend. Individuals unable to attend the meeting will be able to listen by teleconference.

DATES: November 9, 2005, from 9 a.m. to 4 p.m. Registration is from 8:30 a.m. to 9 a.m.; however, all persons planning to attend the meeting are encouraged to preregister in order to facilitate security check-in on the day of the meeting.

ADDRESSES: Nuclear Regulatory Commission, Two White Flint North, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

FOR FURTHER INFORMATION CONTACT: Leslie Kerr, telephone (301) 415–6272, e-mail *lsk@nrc.gov*, of the Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001. Questions on the meeting format, including participation in the roundtable, should be directed to the meeting facilitator, Francis "Chip" Cameron. Mr. Cameron can be reached at 301–415–1642 or *fxc@nrc.gov*. To preregister to attend the meeting in person or to participate via teleconference, please contact Jayne McCausland, telephone (301) 415–6219, fax (301) 415–5369, or e-mail *jmm2@nrc.gov*.

SUPPLEMENTARY INFORMATION: Section 651(e) of the Energy Policy Act of 2005 (the Act) expanded the definition of byproduct material in Section 11e. of the Atomic Energy Act of 1954 to include certain naturally occurring and accelerator produced radioactive material (NARM) and required the NRC to provide a regulatory framework for licensing and regulating the additional byproduct material. The NRC is conducting a rulemaking to revise its regulations to expand the definition of byproduct material to include: (1) Any discrete source of radium-226 that is produced, extracted, or converted after extraction for use for commercial, medical, or research activities; (2) accelerator-produced radioactive material that is produced, extracted, or converted after extraction for use for commercial, medical, or research activities; and (3) any discrete source of naturally occurring radioactive material, other than source material, that is extracted or converted after extraction for use for commercial, medical, or research activities that the Commission determines, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, would pose a threat to public health and safety or the common defense and security similar to the threat posed by discrete sources of radium-226.

NRC is holding a public meeting on November 9, 2005 to solicit input from stakeholders on the regulation of NARM. The format for this public meeting will be a "roundtable" format. Participants at the roundtable will be the invited representatives of the broad spectrum of interests who may be affected by this rulemaking. The roundtable format is being used for this meeting to promote a dialogue among the representatives at the table on the issues of concern. Although the focus of the discussion will be on the invited participants at the table, an opportunity will be provided for comment and questions from the audience. Questions on the meeting format, including participation in the roundtable, should be directed to the meeting facilitator, Francis "Chip" Cameron. Mr. Cameron can be reached at 301–415–1642 or *fxc@nrc.gov*. An agenda for the meeting will be posted to the NRC's rulemaking website: *http://ruleforum.llnl.gov*.

Those planning to attend the meeting are encouraged to preregister for the meeting by notifying Ms. Jayne M. McCausland, telephone (301) 415–6219, fax (301) 415–5369, or e-mail *jmm2@nrc.gov*. If an attendee will require special services, such as services for the hearing impaired, please notify Ms. McCausland of these requirements when preregistering. Individuals unable to attend the meeting will be able to listen by teleconference. For teleconference information, please contact Ms. McCausland.

The NRC is accessible to the White Flint Metro Station. Visitor parking near the NRC buildings is limited.

Dated at Rockville, Maryland, this 20th day of October, 2005.

For the Nuclear Regulatory Commission.

Charles L. Miller,

Director, Division of Industrial and Medical Nuclear Safety, Office of Nuclear Material Safety and Safeguards.

[FR Doc. E5–6021 Filed 10–31–05; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards; Meeting of the ACRS Subcommittee on Reliability and Probabilistic Risk Assessment; Notice of Meeting

The ACRS Subcommittee on Reliability and Probabilistic Risk Assessment (PRA) will hold a meeting on November 17–18, 2005, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows:

Thursday, November 17, 2005—8:30 a.m. until the conclusion of business.

Friday, November 18, 2005—8:30 a.m. until the conclusion of business

The purpose of this meeting is to discuss the details of the Standardized Plant Analysis Risk (SPAR) program.

The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff, and their contractors 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, Mr. Eric A. Thornsbury, (Telephone: 301–415–8716) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 7:30 a.m. and 4:15 p.m. (ET). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes to the agenda.

Dated: October 25, 2005.

Michael L. Scott,

Branch Chief, ACRS/ACNW.

[FR Doc. E5–6020 Filed 10–31–05; 8:45 am]

BILLING CODE 7590–01–P

SECURITIES AND EXCHANGE COMMISSION

[File No. 1–06732]

Issuer Delisting; Notice of Application of Covanta Holding Corporation To Withdraw its Common Stock, $.10 Par Value, From Listing and Registration on the American Stock Exchange LLC

October 25, 2005.

On September 23, 2005, Covanta Holding Corporation, a Delaware corporation ("Issuer"), filed an application with the Securities and Exchange Commission ("Commission"), pursuant to Section 12(d) of the Securities Exchange Act of 1934 ("Act")[1] and Rule 12d2–2(d) thereunder,[2] to withdraw its common stock, $.10 par value ("Security"), from listing and registration on the American Stock Exchange LLC ("Amex").

On September 16, 2005, the Board of Directors ("Board") of the Issuer approved resolutions to withdraw the Security from listing and registration on Amex and to list the Security on the New York Stock Exchange, Inc. ("NYSE"). The Issuer stated that the Board determined that it is in the best interest of the Issuer to list the Security on NYSE, and is withdrawing the Security on Amex in order to avoid direct and indirect costs and the division of the market resulting from dual listing on Amex and NYSE.

The Issuer stated in its application that it has met the requirements of Amex Rule 18 by complying with all applicable laws in effect in the state of Delaware, in which it is incorporated, and provided written notice of withdrawal to Amex.

The Issuer's application relates solely to the withdrawal of the Security from listing on Amex, and shall not affect its continued listing on NYSE or its obligation to be registered under Section 12(b) of the Act.[3]

Any interested person may, on or before November 15, 2005, comment on the facts bearing upon whether the application has been made in accordance with the rules of Amex, and what terms, if any, should be imposed by the Commission for the protection of investors. All comment letters may be submitted by either of the following methods:

Electronic Comments

- Use the Commission's Internet comment form (*http://www.sec.gov/rules/delist.shtml*); or
- Send an e-mail to *rule-comments@sec.gov*. Please include the File Number 1–06732 or;

Paper Comments

- Send paper comments in triplicate to Jonathan G. Katz, Secretary, Securities and Exchange Commission, Station Place, 100 F Street, NE., Washington, DC 20549–9303.

All submissions should refer to File Number 1–06732. This file number should be included on the subject line if e-mail is used. To help us process and review your comments more efficiently, please use only one method. The Commission will post all comments on the Commission's Internet Web site (*http://www.sec.gov/rules/delist.shtml*). Comments are also available for public inspection and copying in the Commission's Public Reference Room. All comments received will be posted without change; we do not edit personal identifying information from submissions. You should submit only information that you wish to make available publicly.

The Commission, based on the information submitted to it, will issue an order granting the application after the date mentioned above, unless the Commission determines to order a hearing on the matter.

For the Commission, by the Division of Market Regulation, pursuant to delegated authority.[4]

Jonathan G. Katz,

Secretary.

[FR Doc. E5–6017 Filed 10–31–05; 8:45 am]

BILLING CODE 8010–01–P

[1] 15 U.S.C. 78*l*(d).

[2] 17 CFR 240.12d2–2(d).

[3] 15 U.S.C. 78*l*(b).

[4] 17 CFR 200.30–3(a)(1).

SECURITIES AND EXCHANGE COMMISSION

[File No. 1–08610]

Issuer Delisting; Notice of Application of SBC Communications Inc. To Withdraw Its Common Stock, $1.00 Par Value, From Listing and Registration on the Chicago Stock Exchange, Inc.

October 25, 2005.

On September 22, 2005, SBC Communications Inc., a Delaware corporation ("Issuer"), filed an application with the Securities and Exchange Commission ("Commission"), pursuant to Section 12(d) of the Securities Exchange Act of 1934 ("Act")[1] and Rule 12d2–2(d) thereunder,[2] to withdraw its common stock, $1.00 par value ("Security"), from listing and registration on the Chicago Stock Exchange, Inc. ("CHX").

The Board of Directors ("Board") of the Issuer approved a resolution on July 23, 2003 to, among other things, authorize certain officers of the Issuer to list or delist any of the Issuer's securities on or from any United States or foreign exchange, except to delist the Security from the New York Stock Exchange, Inc. ("NYSE"). The Issuer stated that the following reasons factored into its decision to withdraw the Security from CHX. First, the Issuer stated that the Security only infrequently trades on CHX. Over the past 12 months, shares of the Security traded on CHX represented 2% of the total shares of the Security traded on all national exchanges. Substantially all of the Security is traded on NYSE and in the over-the-counter market. Second, the Issuer intends to continue listing the Security on NYSE. The Security is registered under Section 12(b) of the Act,[3] and the Issuer is subject to the periodic and current reporting requirements under Section 13 of the Act.[4] Third, the continued listing of the Security is costly and unjustified, in the Issuer's opinion, in light of the limited trading volume of the Security.

The Issuer stated in its application that it has complied with applicable rules of CHX by complying with all applicable laws in the State of Delaware, the state in which the Issuer is incorporated, and by providing CHX with the required documents governing the withdrawal of securities from listing and registration on CHX. The Issuer's application relates solely to the withdrawal of the Security from listing

[1] 15 U.S.C. 78*l*(d).

[2] 17 CFR 240.12d2–2(d).

[3] 15 U.S.C. 78*l*(b).

[4] 15 U.S.C. 78m.

Advisory Committee on Reactor Safeguards
Reliability & Probabilistic Risk Assessment Subcommittee Meeting
Rockville, MD
17-18 November 2005

- Proposed Agenda -

Cognizant Staff Engineer: Eric Thornsbury (301-415-8716, eat2@nrc.gov)

	Topic	Presenter(s)	Time
	November 17		
	Opening Remarks and Objectives	G. Apostolakis, ACRS	8:30 - 8:45 am
I	SPAR Model Development Program Overview - Program history - Summary of activities - Agency uses of SPAR models	N. Chokshi, RES M. Cheok, RES	8:45 - 9:30 am
II	SPAR Model Development & Maintenance: Level 1 Internal Events - Standardized structure 1.25 hr [Break 10:15-10:30] - Model demonstration 30-45 min - Major modeling assumptions - 1hr [Lunch 12:30-1:30] - Quality reviews of new models - 1hr - Modeling issues being worked 1 hr [Break 3:15-3:30] - Model and parameter uncertainties - Model documentation 5 min	M. Cheok, RES D. Marksberry, RES R. Buell, INL J. Schroeder, INL MSPI review 30 min	9:30 am - 5:30 pm
	Recess for the day		5:30 pm
	November 18		
	Reconvene		8:30 am
III	Additional Model Development Activities - External events - Large early release frequency [Break 10:15-10:30] - Low-power & shutdown	M. Cheok, RES S. Stancaktar, RES J. Mitman, RES E. Goldfeiz, RES TBD, BNL	8:30 - 11:30 am
IV	Summary of Current & Future Work	N. Chokshi, RES M. Cheok, RES	11:30 am - 12:00 pm
	Closing Discussion and Future Plans	G. Apostolakis, ACRS	12:00 - 12:30 pm
	Recess		12:30 pm

Notes:
- Presentation time should not exceed 50% of the total time allocated for a specific item.
- Number of copies of presentation materials to be provided to the ACRS - 35.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETINGS ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT AND PLANT OPERATIONS

November 18, 2005
Date

PLEASE PRINT

NAME	AFFILIATION
John Schroeder	INL
Robert Buell	INL
Chuen-Ching Lin	BNL
Zoran Musicki	self - contractor

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETING ON RELIABILITY AND
PROBABILISTIC RISK ASSESSMENT AND PLANT OPERATIONS

November 18, 2005
Date

NRC STAFF SIGN IN FOR ACRS MEETING

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NAME	NRC ORGANIZATION
Don Marksberry	RES/DRAA/OERAB
Peter Appignani	RES/DRAA/OERAB
Steve Long	NRR/DRA
Don Dube	RES/DRAA/OERAB
Selim Sancaktar	RES/DRAA/OERAB
Chris Hunter	RES/DRAA/OERAB
Jim Vail	NRR/DRA/APOB
Nilesh Chokshi	RES/DRAA/OERAB
Chad Huffman	"
Jeff Mitman	"
Dan O'Neal	RES/DRAA/PRAB

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETINGS ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT AND PLANT OPERATIONS

17
November ~~18,~~ 2005
Date

PLEASE PRINT

NAME	AFFILIATION
Robert Buell	INL
John Schroeder	INL
Steve Eide	INL
Dean Raleigh	LIS, Scientech

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETING ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT AND PLANT OPERATIONS

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Don Dube	RES/DRAA/OERAB
Eli Goldfeiz	RES/DRAA/OERAB
Chris Hunter	RES/DRAA/OERAB
Chad Huffman	RES/DRAA/OERAB
Lynn Mrowca	NRR/DRA/APOB
James Vail	NRR/DRA/APOB
Dan O'Neal	RES/DRAA/PRAB
Charles Ader	RES/DRAA
Mike Cheok	RES/DRAA/OERAB
Nilesh Chokshi	RES/DRAA/OERAB
Jeff Mitman	RES/DRAA/OERAB

STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

Presentation to the Advisory Committee on Reactor Safeguards

November 17, 2005

Nilesh Chokshi, Branch Chief
Michael Cheok, Assistant Branch Chief
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

OUTLINE OF PRESENTATION

- Overview – Nilesh Chockshi & Mike Cheok (RES)
- Level 1 Internal Events – Robert Buell & John Schroeder (INL)
  - Standardized Structure
  - Model Demonstration
  - Major Modeling Assumptions
  - Modeling Issues being Addressed
  - Model and Parameter Uncertainties
  - Model Documentation
  - MSPI Lessons-learned (?) – Don Dube (RES)
- External Events Models – Selim Sancaktar (RES)
- LERF Models – John Lehner (BNL) & Eli Goldfelz (RES)
- Low power & Shutdown Models – Jeff Mitman (RES)
- Wrap-up – Mike Cheok (RES)

2

WHAT ARE SPAR MODELS?

- SPAR models are plant-specific PRA models that use:
  - Event trees to model accident sequence progression.
  - Fault trees to model plant systems and components.
  - Human reliability analysis (HRA) module to estimate human error probabilities.
  - Component failure and initiating event data based on national plant experience.

3

PURPOSE OF SPAR MODEL DEVELOPMENT PROGRAM

- To provide the NRC staff with readily available and easy-to-use analytical tools for use in performing risk-informed regulatory activities.

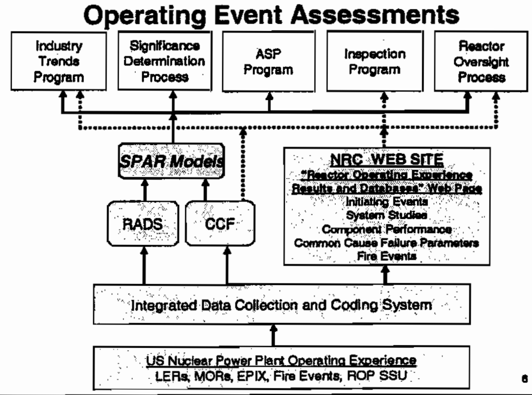
4

Evolution of the SPAR program

- Evolved from event tree – based models used at the start of the ASP program
- Revision 2 consisted of a set of 72 event tree/fault tree linked models and subjected the models to internal and external QA review
- Revision 3 is adding support systems, more initiating events, uncertainty analysis capability and subjected the models to benchmarking against licensee PRAs
- LP/SD, external events and LERF models are currently being developed

5

Overview: Use of SPAR Models in Operating Event Assessments



6

USES OF SPAR MODELS

- To evaluate risk significance of inspection findings in SDP Phase 3 analyses.
- To evaluate risk associated with operational events/conditions in ASP program.
- To improve the quality of PRAs.
- To perform analyses in support of GSI resolution (e.g., GSI-189 and GSI-191).
- To support staff's risk-informed review of license amendments.
- To provide independent capability to evaluate risk issues across the population of plants (e.g., verify MSPI; LOOP/SBO study).

7

AGENCY INTERFACES

- SPAR Model Users Group (SMUG) organized in 1999 – Members from NRR, RES, Regional Offices.
  - Provides technical direction for model development.
  - Produced SPAR Model Development Plan – approved by management in user organizations.
- SPAR Model development supported by two NRR User Need Requests
- SRA Counterpart Meetings - SPAR model training, guidance, etc. extensively discussed
- INL Help Desk function to support SPAR model users – extensively used by regional, NRR and RES analysts

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SPAR MODEL DEVELOPMENT PROGRAM ACTIVITIES

- Level 1, Internal Events - Full Power:
  - 72 Revision 3 SPAR models currently available.
  - 72 Enhanced Rev. 3 SPAR Models in FY07.
- Level 1, Internal Events – LP/SD:
  - 10 models completed. Onsite QA of 4 models completed.
  - 4 LP/SD SPAR Models in FY07. QA contingent on availability of licensee staff.

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SPAR MODEL DEVELOPMENT PROGRAM ACTIVITIES (Continued)

- Level 2/Large Early Release Frequency (LERF):
  - 3 models (PWR w/large dry containment, BWR Mark I & PWR Ice Condenser) completed.
  - Models for 10 lead plants by 2008.
- External Events (Fires, Floods, Seismic events):
  - Six models have been created by NRR/RES team.
  - Continuing to refine model development process.

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Related Topics

- SPAR model development is closely linked to SAPHIRE code development - SAPHIRE Version 8 will be an important tool for using the latest SPAR models for event assessment
- Future/Proposed ACRS presentations
  - December 2005 – SPAR-H
  - (proposed) Spring/Summer 2006 – SPAR Data
  - (proposed) Spring/Summer 2006 - SECY 05-0192 dated 10/24/05

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Idaho National Laboratory

SPAR Model Development & Maintenance: Level 1 Internal Events

ACRS Subcommittee Meeting

Robert Buell
John Schroeder

November 17, 2005

Topics

- Standardized Structure
- Model Demonstration
- Major Modeling Assumptions
- Quality Review of New Models
- Modeling Issues Being Worked
- Model and Parameter Uncertainties
- Model Documentation

Standardized Structure

- Standardized Plant Analysis Risk (SPAR) Models
  - Evolution of the models
    - Initially a plant-specific implementation of the Daily Events Manual event trees
    - Revision 2QA – Peer review by Sandia National Laboratory, largely subcontracted to SAIC
    - Revision 3I (interim) – Upgraded during SDP notebook review process
    - Revision 3 – New Seal LOCA model, updated data/templates, updated LOOP/SBO
    - Revision 3P (plus) – cut set level review

Standardized Structure - continued

- Advantages of standardization
  - Common tool set – SAPHIRE/GEM is the engine for all model development
  - Common skill set – NRC training program assures that all model users have the skills to use the common tool set
  - Uniformity of models helps identify true outlier plants
  - Automation makes industry-wide studies feasible (e.g., the station blackout study)

Standardized Structure - continued

- Standardized elements of the SPAR models
  - Methodology
  - Assumptions
  - Initiating events (based on NUREG/CR-5750)
    - No support system initiating event fault trees
  - Event trees (based on peer reviewed class models and consensus elements of PSAs)
  - Fault trees (based on published system studies when possible)

Standardized Structure - continued

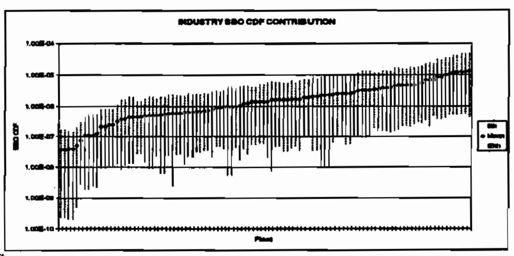
- Standardized elements of the SPAR models - cont
  - Failure data
    - EPIX based template set (1998 – 2002)
    - Common cause failures
      - Methods (NUREG/CR-5485)
      - Data (NPRDS, LERs, EPIX) (1990 – 2001)
    - Loss of offsite power frequency/recovery data (NUREG/CR-5496, 2005 Update to 5496)
  - Human reliability analysis and recovery modeling (SPAR-H, NUREG/CR-6883)

Standardized Structure - continued

- Standardized structure allows rapid testing/analysis of industry wide issues. This is a significant new tool for regulatory studies.
  - SAPHIRE macro capabilities, in conjunction with standardized, structure allow analyses on all 72 SPAR models in a short period.
  - The recent SBO risk study (NUREG/CR-TBD) is an example of these capabilities.
  - Other potential industry wide examples include
    - What-if data sensitivities
    - MSPI importance measure analyses
    - Etc.

Standardized Structure - continued

- Example of recent analysis of SBO risk using SPAR models



Standardized Structure - continued

- Small event tree/large fault tree (fault tree linked)
- Standard set of initiating event <u>candidates</u>
  - LLOCA, MLOCA, SLOCA, XLOCA, ISLOCA, LOOP, LOCHS, LOMFW, TRANS, LOVAC, LOVDC, LOSWS, LOIAS
  - Boiling Water Reactor (BWR) specific
    - IORV
  - Pressurized Water Reactor (PWR) specific
    - LOCCW, SGTR
  - Others added if greater than 1 percent contribution to total CDF in licensee model

Standardized Structure - continued

- Frontline system fault trees
  - System studies are the basis for RPS, EPS, AFW, HCI, and RCI.
  - Other frontline fault trees include
    - Most active components
    - All obvious operator actions
    - Fault tree guidelines used to simplify models in a standardized way
  - Standard CCF event modeling

Standardized Structure - continued

- Support system fault trees
  - Limited division level AC/DC power model
  - Fluid systems models (SWS, CCW, etc.) same rules as frontline models
  - Air and HVAC systems added as needed
- Human Reliability Analysis – SPAR-H
- Limited recovery modeling
  - Offsite power/diesels
  - Power conversion system
  - Support system initiating events

Standardized Structure - continued

- BWR general plant transient event tree structure
  - Functional groupings and frontline fault trees
    - Reactor shutdown (RPS)
    - Reactor coolant system integrity (SRV)
    - High pressure injection (MFW, RCI, HCI)
    - Depressurization (DEP)
    - Low pressure injection (CDS, LCI, LCS, VA)
    - Residual heat removal (PCS/CND, SPC, CSS, SDC, CVS)
    - Late injection (LI)

Standardized Structure - continued

- Key BWR event tree assumptions
  - SORV sequences are counted on the IORV event tree.
  - Early suppression pool cooling is required to support RCIC/HPCI operation.
  - Containment venting fails all injection with suction on the suppression pool. (Many LI models include the CVENTED variable.)
  - Containment failure causes loss of all injection. (Many LI models include the CFAILED variable.)

Standardized Structure - continued

- PWR general plant transient event tree structure
  - Functional groupings and frontline fault trees
    - Reactor shutdown (RPS)
    - Steam generator cooling (MFW, AFW)
    - Reactor coolant system integrity (PORV, LOSC)
    - High pressure injection or once through cooling (HPI, FAB)
    - Secondary side cooldown and RCS depressurization (SSC, PZR)
    - Residual heat removal (RHR, HPR)

Standardized Structure - continued

- Key PWR event tree assumptions
  - PORV challenge rate is not plant-specific or transient-specific.
  - Two PORVs required for feed and bleed
  - Success of feed and bleed provides time to recover steam generator cooling.

Standardized Structure - continued

- Other transients are based on the TRANS event tree
  - A unique sequence flag set is assigned to each initiator.
  - The sequence flag set defines the impact vector associated with the initiator.
    - When the initiator may be recovered, fault tree flag sets may be used to define the impact vector.
    - Choice of fault tree flag set vs. sequence flag set is made to minimize the number of special use fault trees that may be required.

Standardized Structure - continued

- BWR Loss of coolant accidents (LOCAs)
  - Large LOCAs
    - Reactor shutdown (RPS)
    - Vapor suppression (VSS)
    - Low pressure injection (LPI, LCI, LCS)
    - Residual heat removal (SPC, CSS, CVS)
    - Late injection

Standardized Structure - continued

- BWR Loss of coolant accidents (LOCAs) continued
  - Medium LOCAs
    - Reactor shutdown (RPS)
    - Vapor suppression (VSS)
    - Depressurization (HCI or DEP)
    - Low pressure injection (LCS, LCI, VA)
    - Residual heat removal (SPC, CSS, CVS)
    - Late injection (LI)

Standardized Structure - continued

- BWR Loss of coolant accidents (LOCAs) continued
  - Small LOCAs, IORVs
    - Reactor shutdown (RPS)
    - Vapor suppression if included in PSA
    - High pressure injection (MFW, RCI, HCI)
    - Depressurization (DEP)
    - Low pressure injection (CDS, LCS, LCI, VA)
    - Residual heat removal (PCS/CND, SPC, CSS, CVS)
    - Late injection (LI)

Standardized Structure - continued

- BWR Loss of coolant accidents (LOCAs) continued
  - Intersystem LOCAs
    - RHR letdown line 2-MOV failure initiator
    - Pipe integrity
    - Diagnosis
    - Isolation/Recovery
  - Excessive LOCAs
    - Initiator frequency 1.0E-7
    - Mitigation failure set to TRUE

Standardized Structure - continued

- PWR Loss of coolant accidents (LOCAs)
  - Large LOCAs
    - Accumulators (ACC)
    - Low pressure injection (LPI)
    - Residual heat removal (LPR)

Standardized Structure - continued

- PWR Loss of coolant accidents (LOCAs) continued
  - Medium LOCAs
    - Reactor shutdown (RPS)
    - High pressure injection and steam generator cooling (HPI, AFW)
    - Accumulators and steam generator cooling and low pressure injection
    - Cooldown and depressurization (SSC, PZR)
    - Residual heat removal (LPR, HPR)

Standardized Structure - continued

- PWR Loss of coolant accidents (LOCAs) continued
  - Small LOCAs
    - Reactor shutdown (RPS)
    - Steam generator cooling and high pressure injection (FW, AFW)
    - Once through cooling (FAB)
    - Cooldown and depressurization (SSC, PZR)
    - Residual heat removal (RHR, HPR)

Standardized Structure - continued

- PWR Loss of coolant accidents (LOCAs) continued
  - Intersystem LOCAs
    - HPI, LPI, RHR initiators
    - Pipe integrity
    - Diagnosis
    - Isolation/Recovery
  - Excessive LOCAs
    - Initiator frequency 1.0E-7
    - Mitigation failure set to TRUE

Standardized Structure - continued

- SGTR
  - Cognitive/Diagnosis failures
  - Reactor shutdown (RPS)
  - Steam generator cooling (FW)
  - High pressure injection and steam generator isolation (HPI, FAB, SGI)
  - Cooldown and depressurization (SSC, PZR)
  - Terminate or control injection (CSI)
  - Alternate heat removal (LTHR)
  - Residual heat removal (RHR)
  - RWST refill (RFL)

Standardized Structure - continued

- BWR Loss of offsite power/station blackout
  - Recovery of offsite power is questioned prior to demand for RHR on LOOP event tree.
  - Recovered sequences not developed (Peach Bottom is special case)
  - SBO always starts at time zero.
  - Emergency power system fault tree is based on simplified lineup.
  - Alternate alignments shown on SBO event tree
  - During a SBO HPCI/RCIC maintains level only until battery depletion.

Standardized Structure - continued

- PWR Loss of offsite power/station blackout
  - Recovery of offsite power on LOOP event tree is based on timing of RWST depletion (~6 hr).
    - Two hour recovery allows recovery of condenser (4 hr) and SG cooldown to the condenser followed by RHR.
    - Six hour recovery corresponds to RWST depletion and swapover to recirculation.
  - During SBO the time available for recovery is based on the WOG-2000 leak rates.
  - The battery depletion limitation is a significant limitation on time available for recovery.

Model Demonstration

- SAPHIRE (Systems Analysis Programs for Hands-on Integrated Reliability Evaluations)
- Project logic models
  - Event trees
  - Fault trees
  - Data

Model Demonstration - continued

- Graphical Evaluation Module (GEM) automation
  - Initiating event assessment
    - Code sets observed initiator to TRUE, others to FALSE
    - Code recalculates LOOP recovery values for observed LOOP class
    - User defines observed failures, degradations
    - Code makes any required CCF adjustments

Model Demonstration - continued

- Condition assessment
  - User provides duration of observed condition
  - User provides observed failures/degradations
  - Code makes CCF adjustments
- Common-cause failure adjustments
  - NUREG/CR-5485, Appendix E
  - Component failed (Equation E.11)
  - Component out of service (Equation E.12)
- Standard reports for each assessment type

Major Modeling Assumptions

- General
  - No recovery of AC power after battery depletion
  - CCF not modeled across systems
  - Pre-accident human errors not modeled
  - Run failures occur at time zero.
  - Failures subsequent to AC power recovery in SBO sequences can be neglected
  - Successful diagnosis is implied for all sequences
  - Instrumentation and control not explicitly modeled (implicit in data)
  - Errors of commission not modeled
  - Limited recovery modeling (SS initiators)
  - Service water environmental issues not modeled

Major Modeling Assumptions - cont

- BWR specific
  - Containment venting causes loss of injection with suction on suppression pool
  - Containment failure causes loss of all injection
  - Suppression pool cooling failure will force early depressurization (loss of HPCI/RCIC)
  - SORV events are included in IORV event tree
- PWR specific
  - Two PORVs are required for feed and bleed
  - Success of F&B allows time to recover SG cooling
  - PORV challenge rate is not plant or initiator specific

Quality Reviews of New Models

- SPAR Model Review History
  - Peer review performed by Sandia National Laboratory, largely subcontracted to SAIC, led to Revision 2QA.
  - Enhancement/expansion of the models occurred during the SDP notebook review process, led to Revision 3i series of models. QA review using detailed procedure and independent analyst.
  - Most recent modifications incorporate improved RCPSL models, the latest available LOOP/SBO information, and the latest available component failure rates. The resulting model cut sets are now being benchmarked against licensee PSA cut sets.

Quality Reviews of New Models - cont

- Model QA procedure
  - Open items list
  - Completion check list
- Model configuration control
  - Revision Control Software (being studied)
  - Model/Software currency
- Trouble reporting system on SAPHIRE web site
- Proceduralized detailed cut set level review

Quality Reviews of New Models - cont

- Detailed cut set level review - cont
  - Purpose of the review
    - Identify the significant differences between PSA and SPAR logic and modify the SPAR models where appropriate
  - The main steps in the review process
    - Obtain a deep cut of the licensee's cut sets and basic event definitions and values
    - Perform a SAPHIRE data-load of the cut sets
    - Identify 150+ of the most important events in the PSA and SPAR models

Quality Reviews of New Models - cont

- Detailed cut set level review - cont
  - Establish link between licensee events and SPAR events by coding licensee event name into SPAR basic event "Alternate Event Name" field
  - Build a change set that applies licensee probabilities to SPAR events
  - Load SPAR importance report and PSA importance report into comparison spreadsheet
  - Generate Birnbaum comparison plot
  - Identify the outliers and make modifications allowed by SPAR policy and precedent

Quality Reviews of New Models - cont

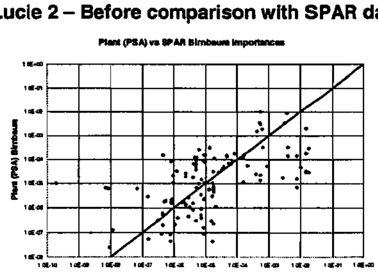
- Detailed cut set level review - cont
  - Comparisons are made at various levels of detail
    - Ratio of SPAR model overall CDF to licensee's CDF should be in the range of 0.5 to 2.0
    - Ratio of SPAR model CCDP to licensee's CCDP for each initiating event should be in the range of 0.5 to 3.0
    - Statistical comparison of SPAR basic event Birnbaums with licensee's Birnbaums should be less than 0.2 using comparison metric.

Quality Reviews of New Models - cont

- Detailed cut set level review - cont
  - Comparison metric is average "distance" or "angle" from the line X=Y on the comparison plot
    - "distance" is weighted by log of the value.
    - Events with large Birnbaums contribute more to the metric than events with small Birnbaums

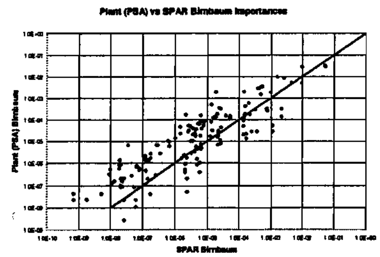
Quality Reviews of New Models - cont

- St. Lucie 2 – Before comparison with SPAR data (1.9)



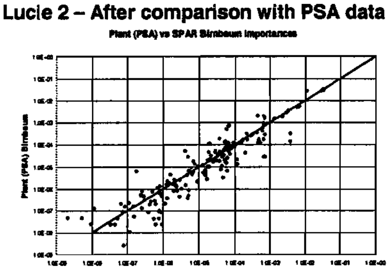
Quality Reviews of New Models - cont

- St. Lucie 2 – After comparison with SPAR data (.55)



Quality Reviews of New Models - cont

- St. Lucie 2 – After comparison with PSA data (.12)



Quality Reviews of New Models - cont

- Detailed cut set level review - cont
  - In the preceding figures significant outlying points have a story.
  - The dominant contributors to variance at St Lucie 2 involve CCF of the diesel generators, and DC bus failures.
    - St. Lucie 2 PSA has a much lower AC power recovery failure probability than SPAR model.
    - St. Lucie 2 PSA allows feed and bleed with one PORV.

Quality Reviews of New Models - cont

Plant	SPAR CDF – Nominal Data	SPAR CDF – PSA Data	PSA CDF
Columbia	3.14E-5	8.44E-6	6.36E-6
Indian Point 2	9.01E-6	9.22E-6	1.10E-5
Indian Point 3	8.70E-6	1.95E-5	1.14E-5
Kewaunee	1.63E-5	6.38E-5	3.83E-5
Oconee	7.42E-6	1.37E-5	2.28E-5
Palisades	2.73E-5	5.99E-5	7.00E-5
Pilgrim	1.29E-5	1.07E-5	6.39E-6
St. Lucie 1	4.51E-6	2.25E-5	2.27E-5
St. Lucie 2	3.59E-6	2.96E-5	2.15E-5
Susquehanna	4.08E-6	1.75E-6	3.06E-6
Turkey Point	2.70E-6	7.12E-6	4.25E-6

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Quality Reviews of New Models - cont

- SPAR CDF (PSA Data)/PSA CDF
  - Mean = 1.1
  - Variance = 0.2
- SPAR CDF (Nominal Data)/PSA CDF
  - Mean = 0.66
  - Variance = 1.9
- Mean of 0.66 with SPAR data suggests SPAR data have lower failure values than analogous PSA data.
  - Transient initiating event frequency
  - Turbine driven pumps
  - Emergency diesel generators
- Mean of 1.1 with PSA data suggests SPAR logic is conservative when compared to PSA logic.
  - No recovery after battery depletion
  - Two PORV success criteria

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Modeling Issues Being Worked

- Important modeling issues and status
  - Loss of offsite power modeling – Models updated
  - RCP seal failure modeling – Models updated
  - CCF Modeling – Models updated
  - Data values – Models updated
  - Sump plugging values – Pending NRC resolution
  - Support system initiating event fault trees (Working)
  - Power recovery after battery depletion (Working)
  - Continued injection after containment failure (TBD)
  - PORV success criteria during feed and bleed (TBD)
  - Time to core uncovery (TBD)

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Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Loss of offsite power modeling
    - Updated LOOP recovery curves
    - Updated RCP seal LOCA models
    - 24 hour emergency diesel generator mission
    - Two part emergency diesel generator hazard curve
    - Convolution of time based failures

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Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - RCP seal failure modeling
    - WOG 2000
      - Four seal failure modes with probabilities and associated leak rates
      - Core uncovery times per Westinghouse Emergency Procedure Guidelines
    - CE draft report
      - Three factors considered (timing, CBO, subcooling)
      - Core uncovery times per draft report
    - B&W plants
      - Westinghouse or Combustion Engineering seal failure models used

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Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - CCF Modeling
    - Alpha factor methodology
      - Equivalent to MGL methodology
    - Alpha factors recently updated
    - Conditional CCF calculations
      - Component failed (TRUE)
      - Component out of service (One)

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Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Data values
    - SPAR past - system study data (circa ~1990)
    - SPAR current - EPIX based data
    - Industry - Bayesian update of old generic sources with current plant specific data.
    - Data and methodology for inclusion of SWS environmental effects (water quality) is under development.

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Sump plugging values
    - NUREG/CR-6762, GSI-191 Technical Assessment: Parametric Evaluations for Pressurized Water Reactor Recirculation Pump Performance.
    - $LLOCA_{PWR}$ * 0.6 ~ 3E-6 increase in CDF
    - MLOCA * 0.1 ~ 4E-6 increase in CDF
    - $SLOCA_{PWR}$ * 0.01 ~ 4E-6 increase in CDF

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Support system initiating event fault trees
    - Point value
      - Underestimates event importances
      - Does not account for specific system configurations
    - Fault trees
      - Better estimate of event importances
      - Accounts for specific system configurations
      - Two general approaches
        - Multiplier method
        - Explicit events

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Power recovery after battery depletion
    - SPAR models give no credit for power recovery beyond battery depletion
      - Significant impact on SBO CDF
      - Significant impact on EDG importances
    - Considerations include
      - Diesel-driven injection sources
      - Availability and quality of procedural guidance
      - Capacity of water sources for continued injection, room heatup and other environmental concerns, duration of emergency lighting, switchyard battery life, etc

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Continued injection after containment failure
    - BWR issue
    - Industry credit varies widely (1.0 to 0.0)
    - Significant impact on importances of decay heat removal equipment
    - Issues
      - Environmental (steam)
      - Depressurization rates
        - Ability to inject with low pressure sources
      - Break location
      - Failure pressure, etc

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - PORV success criteria during feed and bleed
    - SPAR success is two PORVs in absence of detailed thermal hydraulic calculations
    - No consensus in industry PSAs
      - Industry approximately evenly split between one and two PORVs
      - No apparent correlation of PORV success to key factors such as relief capacity, injection pressure/capacity, etc.

Modeling Issues Being Worked - cont

- Important modeling issues and status - cont
  - Time to core uncovery
    - SPAR timing to core damage generally based on thermal hydraulic data from NUREG-1150
    - LOOP/SBO RCPSL core uncovery based on information in Westinghouse Emergency Procedure Guidelines and Combustion Engineering documents
    - Miscellaneous timing data from other NUREGs
    - SPAR project does not perform detailed plant-specific thermal hydraulic analyses

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Modeling Issues Being Worked - cont

- Loss of service water initiator frequency
  - Support system initiating event fault trees
  - Service water system study (environmental issues)
- Addition of low importance initiators
- Allocation of all bus failure initiating event failures to a single bus
- Steam generator tube rupture logic
- General modeling of common cause (cross-products)
- Simplified modeling of emergency diesel alignments

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Modeling Issues Being Worked - cont

- Recent Changes to the Models
  - New failure data including CCF alpha factors
  - Global use of template events including alpha factors
  - New reactor coolant pump seal LOCA logic
  - New LOOP initiator and offsite power recovery modeling
  - Conversion of CDF from 'per hour' to 'per year'

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Modeling Issues Being Worked - cont

- Future Enhancements
  - Splitting Transient event tree into LOCHS, LOMFW & TRANs
  - Addition of new SGTR logic
  - Dual/single unit LOOP logic
  - Consequential seal LOCA logic in Westinghouse plant models
  - Addition of lower importance initiators (>1%)
  - Additional detail in PWR main feedwater fault trees
  - Incorporate standardized ISLOCA methodology
  - Benchmarking against PSA cut sets
  - HEPs calculated using SPAR-H interface in SAPHIRE
  - To be included pending resolution of issues
    - Develop/implement fault tree based initiating events for support system initiators
    - Integrate all SPAR based logic into single master model (Level 1, LERF, Fire, Flood, External Events, LPSD, etc)

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Model and Parameter Uncertainties

- Data Uncertainty (Standard template list)
  - Initiating event frequencies
  - Component failure rates
  - Plant specific vs. generic data
  - Offsite power recovery failure parameters
  - Diesel generator recovery failure parameters
  - Alpha factors

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Model and Parameter Uncertainties - continued

- Model structure uncertainty
  - Plant-by-plant list of major issues
  - Estimate of issue impact
  - Resulting issues include
    - Support system initiating event fault trees (e.g., SWS environmental issues)
    - Power recovery after battery depletion
    - Continued injection after containment failure
    - Sump plugging values
    - Success criteria (PORVs required during FAB, other)
    - Time to core uncovery

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Model and Parameter Uncertainties - continued

- Uses of expert/licensee's judgment
  - Continued injection given containment failure
  - Recovery of power after battery depletion
  - Operation of turbine-driven pumps without indication/control
  - Seal LOCA model
  - Large/Medium LOCA frequencies

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Model and Parameter Uncertainties - continued

Key Sources of Uncertainty	SPAR Application
General data source/uncertainty	Eide & Rasmuson data and uncertainty
Plant specific vs. generic data	Generic industry wide data
HRA Methodology	SPAR-H Methodology
Sump plugging values	Generic value used until issue is resolved
Support system initiating event fault trees (e.g., SWS environmental issue)	Currently use point estimates while researching this issue
Power recovery after battery depletion	Currently no credit given, evaluating giving credit in limited applications
Run failures occur at time zero	Convolution not credited, evaluating
Success criteria	2 PORV min for F&B, licensee's in general
Seal LOCA model	WOG 2000 guidance
Continued injection after ctm failure	Moving from no credit to that of licensees
Diesel generator run time	24 hour mission
Large/Medium LOCA frequencies	NUREG/CR-5750 values
Operation of TDPs without DC power	High screening value used

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Model documentation

- Sections in main report
  - Introduction
  - Initiating Events
  - Event Tree Models
  - Fault Tree Models
  - Basic Event Data
  - Common Cause Failure Model
  - Reactor Coolant Pump Seal Model
  - Loss of Offsite Power Model
  - Human Reliability Model
  - Baseline Results

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Model documentation

- Sections in main report
  - Introduction
  - Initiating events
    - Translation from early reports
    - BWR summary table
    - PWR summary table

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Model documentation - continued

- Event tree models
  - Descriptions
  - Graphics
  - Success criteria
  - Linkage rules/flag sets

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Model documentation - continued

- Fault tree models
  - Fault tree modeling guidelines
  - Fault tree notes and comments
  - System dependency matrix
- Basic event data
  - Template events
  - Compound events
  - Template event data table

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Model documentation - continued

- Common-cause failure (CCF) model
  - Introduction to the Alpha Factor Method
  - Use of the CCF library module
  - Mention of special use capability
    - Set CCF input to TRUE
    - Set CCF input to 1.0
- Reactor coolant pump seal failure model
  - Westinghouse plants
  - Combustion Engineering plants
  - B&W plants

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Model documentation - continued

- Loss of offsite power model
  - LOOP recovery failure calculations
  - Diesel recovery failure calculations
- Human reliability model
  - Alignment, control, and operate events
  - System hardware recovery events
  - Summary table
  - Recovery rule listing
- Baseline results

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Model documentation - continued

- Appendices
  - Fault tree graphics
  - Basic event data report
  - Compound event data report
  - Common cause failure event data report
  - HRA worksheets
  - Revision log
  - Simplified piping diagrams

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Topics for In-depth Discussions

- Initiating event fault tree issues and development
- Convolving time based (run) failures

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STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

LESSONS LEARNED FROM MSPI PRA QUALITY REVIEWS

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U.S. Nuclear Regulatory Commission
November 17, 2005

1

What is the MSPI ?

- ***A measure of the deviation of plant system unavailability and component unreliabilities from baseline values, weighted by plant-specific risk importance measures***
- **MSPI = UAI + URI**
- **For unreliability:**

$$B_i (UR_i - UR_{iBL})$$

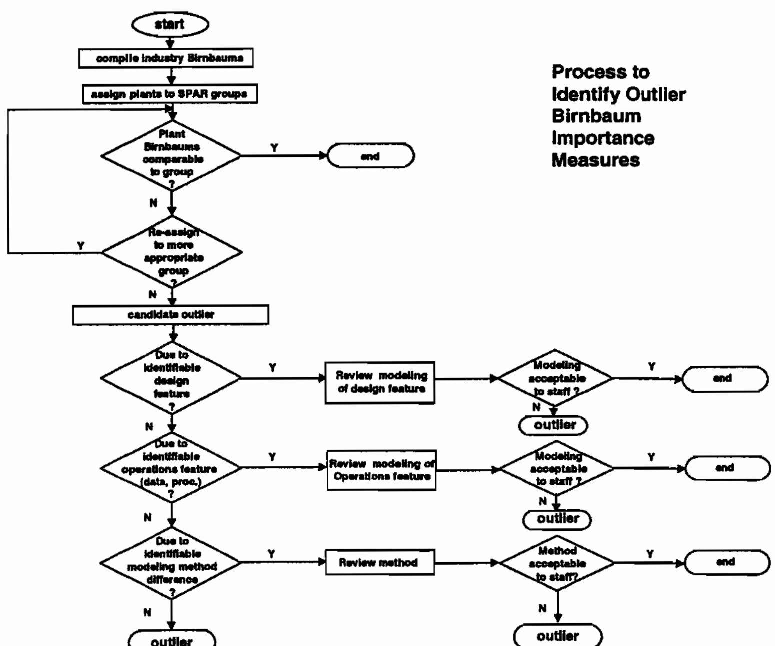
summed over all monitored components i in the system. The coefficients B_i are the component basic event Birnbaum importance values.

2

Recommendations of PRA Quality Task Group

- Licensees should assure that their PRA is of sufficient technical adequacy for MSPI by:
  - (a) Resolving the A and B F&O's from the peer review
  - (b) Performing a self-assessment using the NEI-00-02 process as endorsed by Appendix B of RG 1.200 for the ASME SLRs identified by the task group as being important to MSPI
- As alternative to (b) the industry has proposed and the NRC staff has agreed to rely on a cross-comparison of PRAs. The staff performed an additional review of industry values by comparing their PRA Birnbaum values to SPAR values.

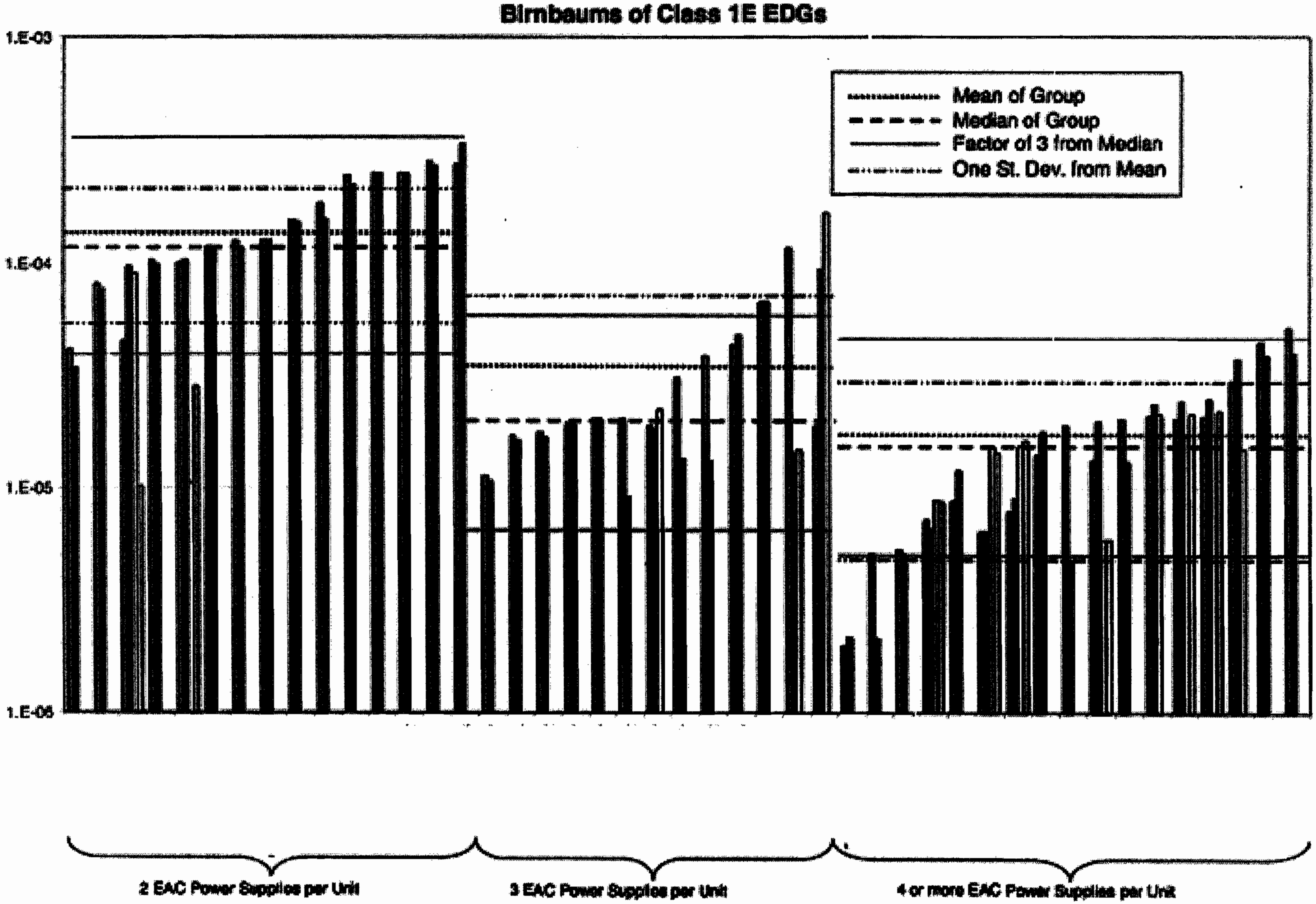
3

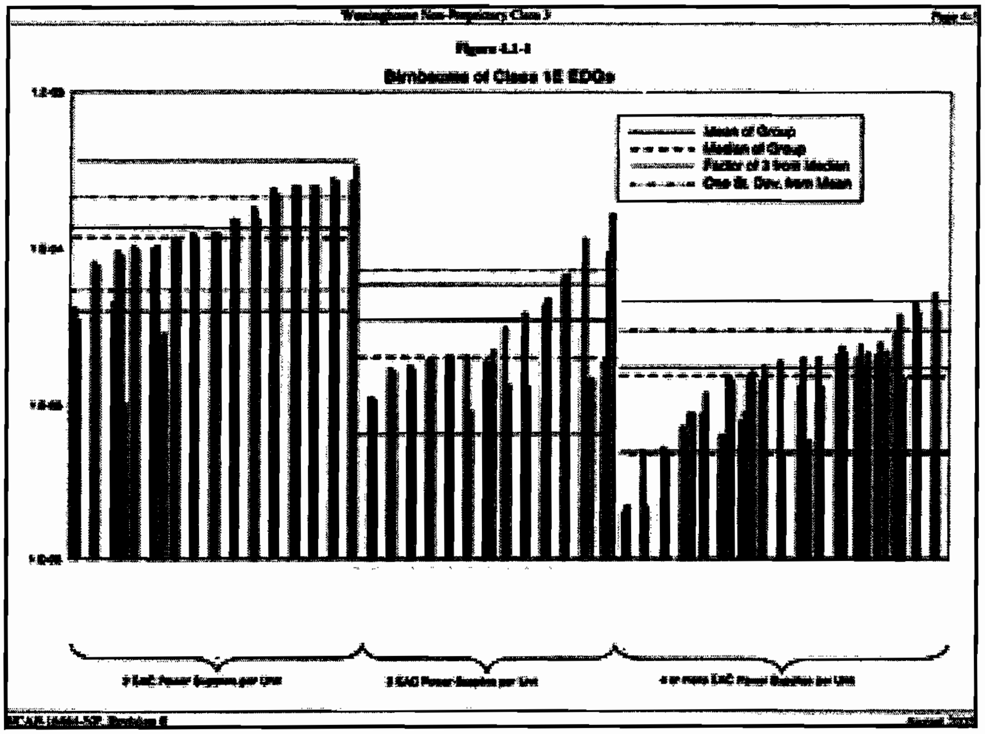


Process to Identify Outlier Birnbaum Importance Measures

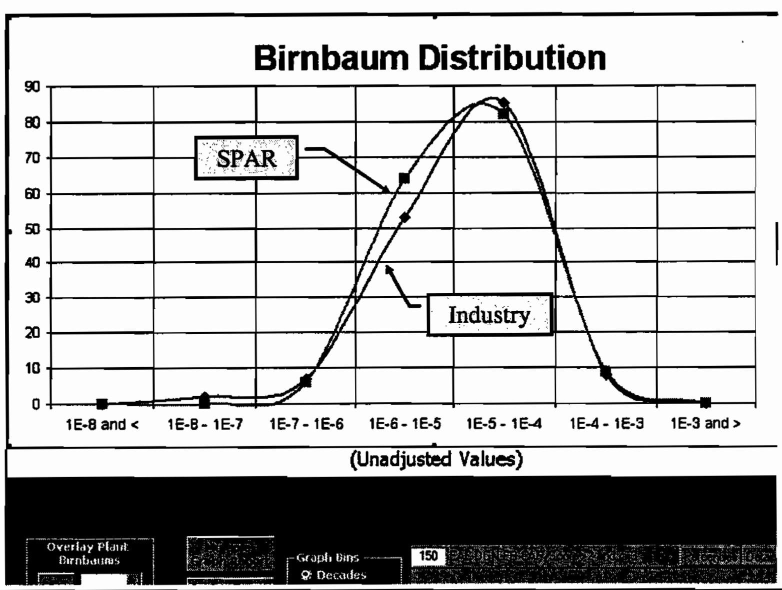
4

Figure 4.1-1


Birnbaums of Class 1E EDGs
1.E-03
1.E-04
1.E-05
1.E-06
Mean of Group
Median of Group
Factor of 3 from Median
One St. Dev. from Mean
2 EAC Power Supplies per Unit
3 EAC Power Supplies per Unit
4 or more EAC Power Supplies per Unit



Electrical Generators - Grouped Capability/Score >2 & <=3



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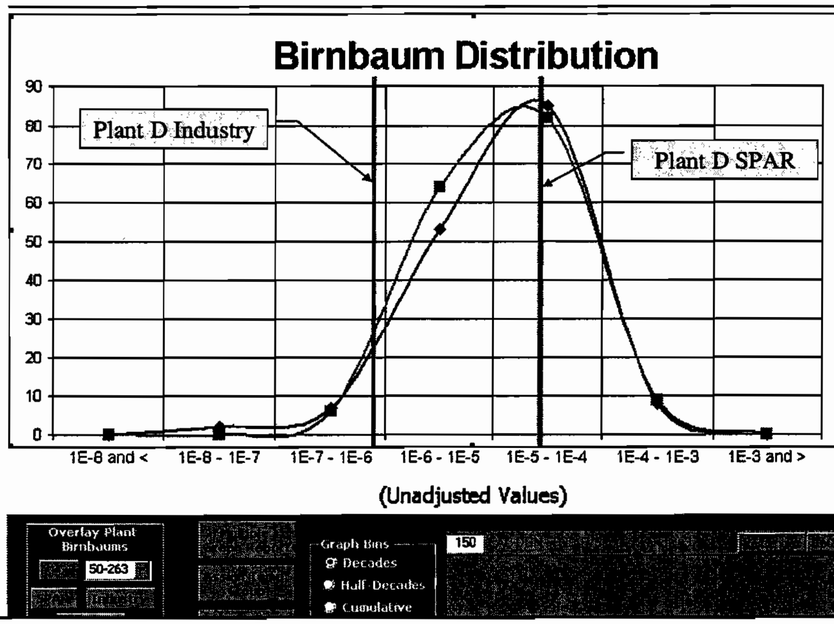
Electrical Generators - Grouped Capability/Score >2 & <=3



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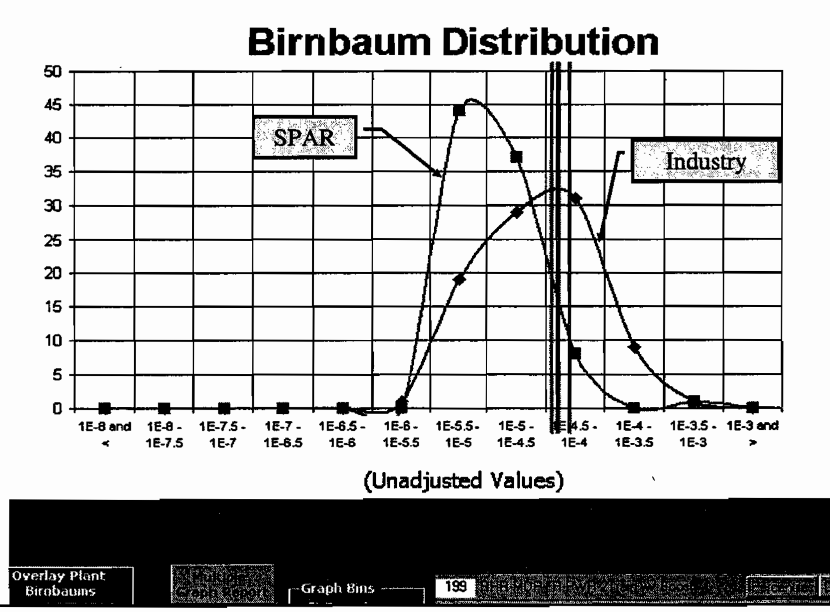
RHR MDPs – PWR 2 PP Systems w/ HPR Booster Function



8

Summary of MSPI PRA Issues

Open A&B Facts and Observations possibly affecting MSPI	16
Model truncation & convergence issues	14
Low loss of offsite power frequency issues	9
Low loss of service water frequency issues	5
Missing support system adjustment contribution to F-V	5
BWR 5/6 credit for RPV injection after containment failure	5
Station Blackout mitigation strategies issues	4
Offsite power recovery issues (after battery depletion, etc)	4
Unexplained model asymmetry issues	3
Common cause factor analysis issues	2
Control of turbine-driven pump without DC power	2
Low loss of DC bus initiator frequency	1
Missing test & maintenance basic event for EDGs	1

9

Summary of MSPI Generic SPAR Issues

- Loss of emergency AC power bus initiator frequency about an order of magnitude higher than industry average.
- Pressurizer PORV success criterion for feed and bleed is assumed to be two irrespective of plant design and analysis.
- Modeling asymmetries (e.g., loss of DC bus on only one division).
- Single value loss of service water frequency irrespective of plant site and design.
- Higher failure probability for local, manual control of turbine-driven AFW pump.
- Old RCP seal LOCA model for B&W plants.
- Small-LOCA frequency is lower than industry norm by nearly an order of magnitude because it does not include lower end of spectrum (e.g., small-small LOCAs).
- Instances where SPAR did not model T&M.

These issues are being addressed as part of the enhanced Rev 3 SPAR models.

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STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

Presentation to the Advisory Committee on Reactor Safeguards

November 18, 2005

Nilesh Chokshi, Branch Chief
Michael Cheok, Assistant Branch Chief
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

OUTLINE OF PRESENTATION

- Overview – Nilesh Chockshi & Mike Cheok (RES)
- External Events Models – Selim Sancaktar (RES)
- LERF Models – John Lehner (BNL) & Eli Goldfeiz (RES)
- Low power & Shutdown Models – Jeff Mitman (RES)
- Wrap-up – Mike Cheok (RES)

2

SPAR Models for External Events, LERF and LP/SD

- Objective of expanding the scope of SPAR models is to provide Agency staff with PRA tools consistent with guidance provided in RG 1.174 and RG 1.200
- Models are still in development stage
  - QA process will be similar to Rev 3 models to the extent possible.
  - Process/method for "Standardization" being defined.
  - Model specifications (e.g., scope, level of detail, etc.), limitations, etc, will be better defined following use of models in applications
  - Availability of licensee models has to be considered

Summary

- **The SPAR Model Development Program continues to provide tools that are used in many Agency programs**
  - **Evaluate risk significance of inspection findings as part of the ROP**
  - **Evaluate risk associated with operating events as part of the ASP program**
  - **Perform analyses in support of generic/safety issue resolution**
  - **Perform analyses in support of the staff's risk-informed review of license amendments**
  - **Independently verify performance indicators as part of MSPI.**
- **Some advantages of using SPAR Models**
  - **"Standardized" models reduce variability in results due to use of different models, inputs, and assumptions**
  - **Use of a single software package increases efficiency and reduces potential for analyst errors**
  - **Provides an independent verification of licensee risk evaluations and findings**

Path Forward

- **Complete Revision 3 enhancements by addressing the risk-important issues.**
- **Complete additional LP/SD, LERF, and external events models to increase the scope of risk assessments and thus to enhance Agency risk-informed decision making.**
- **Continue to enhance user-friendliness of software and models; continue interactions with Regional and NRR analysts through the SPAR Model Users Group (SMUG); and continue training of Regional and NRR analysts.**
- **Perform a peer review of models against consensus PRA Standards, keeping in mind the intended uses of the models.**

STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

EXTERNAL EVENTS

Selim Sancaktar
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

Overview

- **SDP and ASP currently perform external event analyses on a case-by-case basis.**
- **Need external events models to**
  - **Support Risk Significance of Inspection Findings in SDP Phase 3 Analyses**
  - **Evaluate Risk Associated with Operational Events/ Conditions in ASP Program.**

Scope / Methodology

- Incorporate internal flooding, internal fire, seismic event, other external events scenarios into SPAR models
- Use scenarios available from
  - Latest licensee PRAs
  - IPEEEs
  - SDP external events worksheets
- Use existing SPAR model event trees, fault trees, etc.

Methodology (continued)

- External event scenarios are defined and added to existing SPAR model to obtain SPAR-EE
- A scenario is defined in terms of its
  - Frequency
  - Type of reactor trip caused
  - SSCs, recovery actions, HEPs affected

Product

- A SPAR-EE model may have
  - 15-20 internal event categories
  - 5-10 internal flooding scenarios
  - 20-30 internal fire scenarios
  - 3-6 seismic event bins
  - 0-5 other external event scenarios
- New event/fault trees, basic events, operator actions may be introduced for special scenarios (seismic, MCR-evacuation, ..)
- Model running time comparable to SPAR
- Runs identical to SPAR; no additional user software training required

Status

- External events (fires, floods, seismic, etc.) feasibility and demonstration study completed
- Demonstrated that external events can be readily incorporated into the SPAR models
- Currently, six preliminary SPAR-EE models completed
  - Limerick
  - Salem
  - Kewaunee
  - Callaway
  - Wolf Creek
  - Indian Point 3

Related Activities

- SAPHIRE software enhancements specifically for SPAR-EE
- External event handbooks for analysts
- Coordination with ongoing NRR site visits for SDP external event workbook validation
- Discussions with WOG to seek data

7

Future Plans

- Complete SPAR-EE models for all plants
- Use SPAR-EE models on two ASP events in FY 2006
- Validate SPAR-EE models to the same level as SPAR models

8

Challenges

- Obtain the latest possible licensee external events models
- Achieve standardization
  - Among different plant models
  - Compliance with industry standards
- Define modeling scope and detail
- Define scope of application of models

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LERF SPAR Model Development

John R. Lehner (BNL), Eli Goldfeiz (NRC)

Presented to
Advisory Committee on Reactor Safeguards

November 18, 2005

energy BROOKHAVEN NATIONAL LABORATORY

LERF SPAR Model Development

- Objective
  - In response to the needs of the SPAR Model Users Group (SMUG), develop thorough but relatively simple, user-friendly analysis tools for the NRC staff to use in performing Large Early Release Frequency (LERF) assessments (seamless with Level 1 SPAR models)
- Program consists of three phases:
  - Phase 1, evaluating previous Level 2/LERF models, and Phase 2, preparing a detailed program plan, were completed in 2001
  - Phase 3, implement the program plan, is ongoing

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LERF SPAR Model Development

- Approach to Model Development:
  - Include current technical information on Level 2 phenomena relevant for LERF
  - Use less detail than NUREG-1150 models, but more detail than NUREG/CR-6595 models, to achieve better run times, scrutability.
  - Directly link Level 1 and Level 2 information to allow analysis of LERF contributors, precursor, etc.
  - Provide easy adaptation to other plants in a group
  - Allow possible later update to include late failures

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Plant Groups

- Unlike Level 1 SPAR models, there will not be a separate LERF model for every plant. Instead use the following LERF SPAR model groups: (may be modified)
  - 5 PWR large dry models
    - Westinghouse 4 loop
    - Westinghouse 3 loop
    - Westinghouse 2 loop
    - Combustion Engineering 2 loop
    - Babcock & Wilcox 2 loop
  - 1 PWR ice condenser model
  - 2 BWR Mark I models
  - 1BWR Mark II model
  - 1BWR Mark III model

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LERF SPAR Models Completed

- PWR, large dry, Westinghouse 4 loop
- BWR, Mark I, BWR/4 with RCIC
- PWR, ice condenser, Westinghouse 4 loop

- Models have undergone internal and NRC review, but have not yet been benchmarked against utility models

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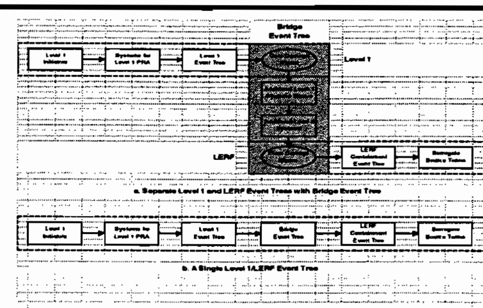
Logic Diagram for the LERF Methodology



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Plant Damage State Characteristics

The Six-Character PDS Designator Used in the SAPHIRE Model

6-character PDS Designator	Identifier
1. Reactor Coolant System (RCS) Pressure	H - high M - medium L - low X - don't know or irrelevant
2. Secondary System Pressure	P - at normal pressure D - depressurized E - early depressurization L - late depressurization X - don't know or irrelevant
3. Station Blackout (SBO) Status	N - no SBO F - fast SBO S - slow SBO X - don't know or irrelevant
4. Auxiliary Feedwater/Main Feedwater Status	N - successful A - failed X - don't know or irrelevant
5. Reactor Coolant Pump (RCP) Seal Status	N - successful R - failed X - don't know or irrelevant
6. Containment Bypass Status	Y - containment bypassed N - containment not bypassed X - don't know or irrelevant

Trace-ability of Results

Can group/trace results by:

- containment failure modes
- plant damage state designators
- any initiating event
- any Level 1 traceable parameter

PWR Ice-Condenser

CDF = 3. 2E-5/yr with 11% of end states going to LERF (3.6E-6/yr)

for PWR Ice-Condenser

LERF contributions by containment failure mode

PWR Ice-Condenser

LERF contributions by initiating event

Example: Draft LERF SPAR Results for PWR Ice-Condenser

SBO contributions to LERF

PWR Ice-Condenser

Fussel-Vesely importance measures of the ten most dominant events

Event Description	F-V importance For LERF
LOOP initiating event	0.52
Failure of igniter alternate power	0.52
Failure of prior hydrogen benign burn	0.52
Failure to recover emergency power in 4 hours	0.48
Failure to recover offsite power	0.48
Containment failure probability due to H2 DDT burn	0.47
SGTR initiator	0.41
Common cause failure of EDGs 1 and 2 to run	0.31
LER fraction of median pressure SGTR release	0.24
Operator fails to diagnose SGTR to start procedure	0.18

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Current Status

- Three models completed
  - All need to be benchmarked against utility models
- Current models under development are
  - BWR Mark III model (almost completed),
  - BWR Mark II model

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Current Status

- Issue to be resolved:
  - SPAR LERF models are directly linked to the SPAR Level 1 models
  - Level 1 models are still changing
  - Want to develop automated Level 1/LERF interface to address this issue

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STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

LOW POWER & SHUTDOWN

Jeff Mitman
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
November 17, 2005

1

Overview

- Objective: Develop LP/SD models to use in:
  - Event assessment
  - Support reviews of risk-informed applications
- Goal: Develop set of plant models covering all plant classes
- Approach: Use existing SPAR Rev. 3 models with LP/SD templates to develop
  - Event trees
  - Fault trees
  - Plant operating states (POS)
  - Initiating event frequencies
  - Reliability/unavailability data,
  - HRA/operator actions

2

Status

- 11 models completed
- Onsite QA of 4 models completed

Plant Class	Plant
Templates	BWR
	PWR
GE BWR 6	River Bend
	Grand Gulf
GE BWR 4 Mark I	Peach Bottom 2 & 3
W 3 Loop	Surry 1 & 2
W 4 Loop	Byron 1 & 2
	Diablo Canyon 1 & 2
	Millstone 3
CE	Millstone 2
	Palo Verde 1, 2 & 3
B&W	Oconee 1, 2 & 3
	Davis-Besse

3

Scope

- PWR modes:
  - Hot shutdown
  - Cold shutdown
  - Refueling
- BWR modes:
  - Cold shutdown
  - Refueling

4

Initiating Events

Internal events only:

- LOCA - pipe break: Loss of Inventory impacting normal decay heat removal (DHR)
- HLOCA - drain down: Loss of Inventory impacting normal DHR
- LOOP
- LOSDC – diversion or loss of DHR cooling
- ISOL – isolation of shutdown cooling loop

5

Scope Excluded

- LTOP: vessel or piping failures are very low probability events
- Reactivity: low probability event
- Spent fuel pool: not in current scope
- External events
- LERF/Level 2

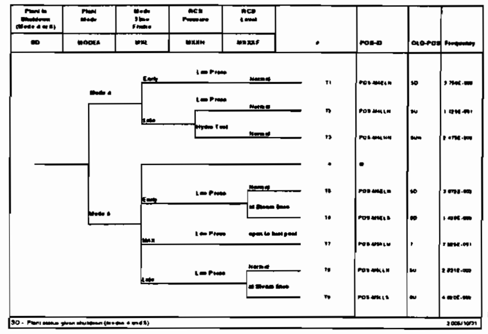
6

Major Inputs & Assumptions

- Models build on BWR and PWR templates which are based Grand Gulf (NUREG/CR-6143) and Surry (NUREG/CR-6144) studies
- Decay heat levels are binned into 4 time windows.
  - BWRs: <24 hours, 1 to 5 days, 5 days to 15 days, >15 days
  - PWRs: <75 hours, 3 to 10 days, 10 to 32 days, >32 days
- "Weighted-average" fractions for time spent in each POS
- Core damage end state is evaluated

7

Example BWR Event Trees: POS



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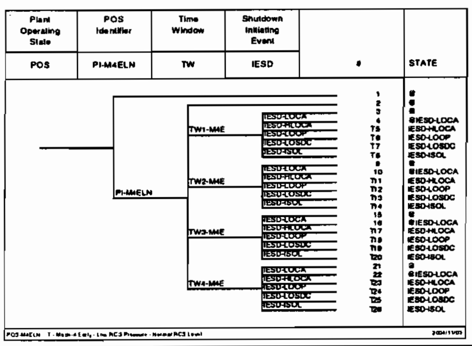
POS Selection



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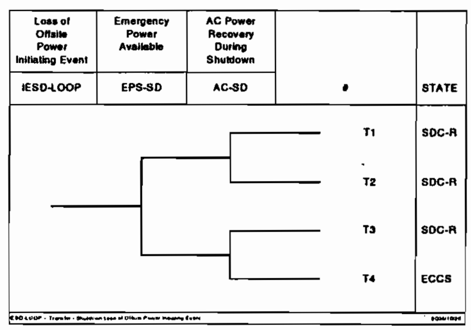
AC Power



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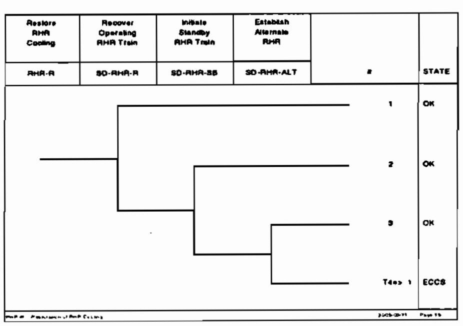
Recovery



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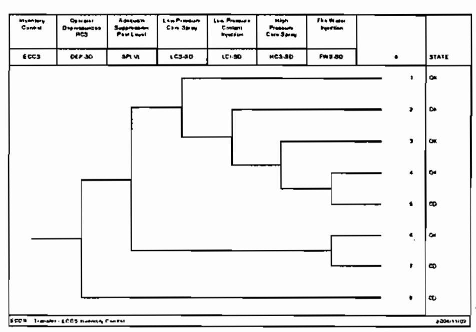
ECCS



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Future Plans

- Complete additional 4 LP/SD SPAR Models by 12/31/2006
- QA contingent on availability of PRA staff of licensees
- Develop analysis guidelines for LP/SD internal events

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