U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Filtering Strategies Rulemaking Public Meeting

August 21, 2014

Purpose of this public meeting

- Discuss performance goals
- Discuss “getting to done” for the draft regulatory basis
- Discuss alternative mapping (new alternatives)
- Discuss use of information provided by industry
- Discuss MELCOR Mark II
- Discuss MACCS methodology
- Discuss PRA Discussion
- Discuss Human Reliability Analysis (HRA)

Agenda

9:00am – 9:10am	Welcome, introductions, and logistics
9:10am – 10:15am	NRC presentation on new alternatives and performance goals
10:15am – 11:00am	NRC presentation on MELCOR
11:00am – 11:10am	Break
11:10am – 12:00pm	NRC presentation on MACCS
12:00pm – 1:00pm	Lunch
1:00pm – 2:00pm	Continuation of NRC presentation on MACCS
2:00pm – 2:30pm	NRC presentation on HRA
2:30pm – 2:45pm	Break
2:45pm – 4:45pm	Industry presentation on PRA and MAAP
4:45pm – 4:55pm	General comments/discussion
4:55pm – 5:00pm	Closing remarks

Announcements

- Category 2 Public Meeting
  - Comments during presentations should be only on the material being presented
  - General public comments are provided at the end of the morning and afternoon
- Teleconference Number:
  - 888-807-8339 and the passcode is 24308
- Webinar:
  - https://www1.gotomeeting.com/register/850602264

Announcements (cont'd)

- Please make sure to say your name before you make a statement for the transcriber
- Introductions around the room
- If you are on the telephone, please introduce yourself now and send an email to Aaron.Szabo@nrc.gov confirming your attendance

Public Meeting Summaries and Related Documents

- August 7, 2014 NEI 3rd Response to NRC request (ML14219A124)
- July 31, 2014 NEI 2nd Response to NRC request (ML14212A473)
- June 18-19, 2014 (ML14176B132)
- June 4, 2014 meeting between ERIN and NRC/RES

Public Meeting Summaries and Related Documents (cont'd)

- May 31, 2014 NEI 1st Response on detailed cost estimates (ML14202A417)
- NRC letter to NEI (ML14134A055)
- April 30, 2014 (ML14136A292)
- April 18, 2014 letter to ERIN from NRC/RES on MACCS input code (ML14108A261)
- March 26-27, 2014 (ML14093A098)
- January 2014 phone call between NRC/NRR and NEI (ML14035A156)
- December 12, 2013 (ML13357A794)

Public Meeting Summaries and Related Documents (cont'd)

- November 12, 2013 NEI workshop presentation (ML13337A500)
- November 6, 2013 (ML13324A953)
- September 19, 2013 (ML13277A332)
- August 14, 2013 (ML13238A328)
- July 11, 2013 (ML13211A395)
- June 26, 2013 (ML13203A074)
- June 13, 2013 (ML13199A216)

Performance Goal

- The staff is recommending the following performance goal:
- Protect public health and safety by minimizing potential releases of significant amounts of radioactive material following severe accident sequences through containment failure prevention measures and release reduction measures for BWR with Mark I and Mark II containments.

Getting to Done

- What will be included in the draft regulatory basis:
  - Federal register notice discussing the regulatory basis and requesting comment
  - Regulatory analysis and backfitting discussion/analysis
  - Performance goal and criteria
  - Technical feasibility

Getting to Done (cont’d)

- Performance Criteria:
  - What does the performance criteria mean and why should it be used?
  - How is success determined for each criteria?
  - Does the alternative successfully meet the criteria?
- Backfitting:
  - Is the alternative determined to be Adequate Protection of public health and safety?
  - Is the alternative a substantial safety enhancement?
  - Is the alternative cost-beneficial?

Change of Rulemaking Name

- Previous Name:

  Filtering Strategies and Severe Accident Management of BWR with Mark I and Mark II Containments Rulemaking

  (Filtering Strategies Rulemaking)

- New Name:

  Containment Protection and Release Reduction of BWR with Mark I and Mark II Containments Rulemaking

  (CPRR Rulemaking)

New Alternatives

1. No Action/Base Case
   – EA-13-109, FLEX, EPG/SAG Rev. 3
2. Overpressurization Prevention Measures
   – Codify EA-13-109 in rulemaking
3. Containment Failure Prevention Measures
   A. Water addition via RPV
   B. Water addition via DW

New Alternatives (cont'd)

4. Release Reduction + Containment Failure Prevention Measures
   A. Filtration Strategies
      i. WW/DW cycling
      ii. Water management + no WW/DW cycling
      iii. WW/DW Cycling + water management
   B. Small Filter
      i. Manual Wetwell First (WWF) pre-CD + manual WWF post-CD
      ii. Manual WWF pre-CD + manual drywell first (DWF) post-CD
      iii. Manual WWF pre-CD + passive DWF post-CD
      iv. Passive DWF pre-CD + passive DWF post-CD
   C. Large Filter
      i. Manual WWF pre-CD + manual WWF post-CD
      ii. Manual WWF pre-CD + manual DWF post-CD
      iii. Manual WWF pre-CD + passive DWF post-CD
      iv. Passive DWF pre-CD + passive DWF post-CD

How the NRC is evaluating plant differences in complying with EA-13-109

- The NRC has a process established within NUREG/BR-0058 for evaluating compliance with previous regulations
- The staff will have a "best estimate" assumption for how the industry is complying with EA-13-109
- The staff will also develop sensitivities assuming:
  - All licensees have complied in that fashion
  - No licensees have complied in that fashion

How this affects the evaluation

- If the staff assumes the unit has already implemented the option, than the benefits and costs are "sunk" (i.e., they are equivalent to zero as they have already occurred)
  - There will still be procedural costs for implementing the rule and any necessary new guidance with the rule
  - There could also be residual benefits for codifying the action

Use of Information Requested by Industry

- Cost Estimates
  - Used to inform cost estimates for regulatory analysis and backfit analysis
- Assumptions related to BWROG EPG/SAG Rev 3
  - Used as reliance for staff's technical analysis in PRA, HRA, and MELCOR
- BWR Mark I and Mark II site-specific information
  - Ensures that modeling is representative of reality
  - Where there are differences, determining if they are significant and if the model should be modified

Contact Information

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Filtering Strategies Rulemaking: MELCOR Mark II Discussion

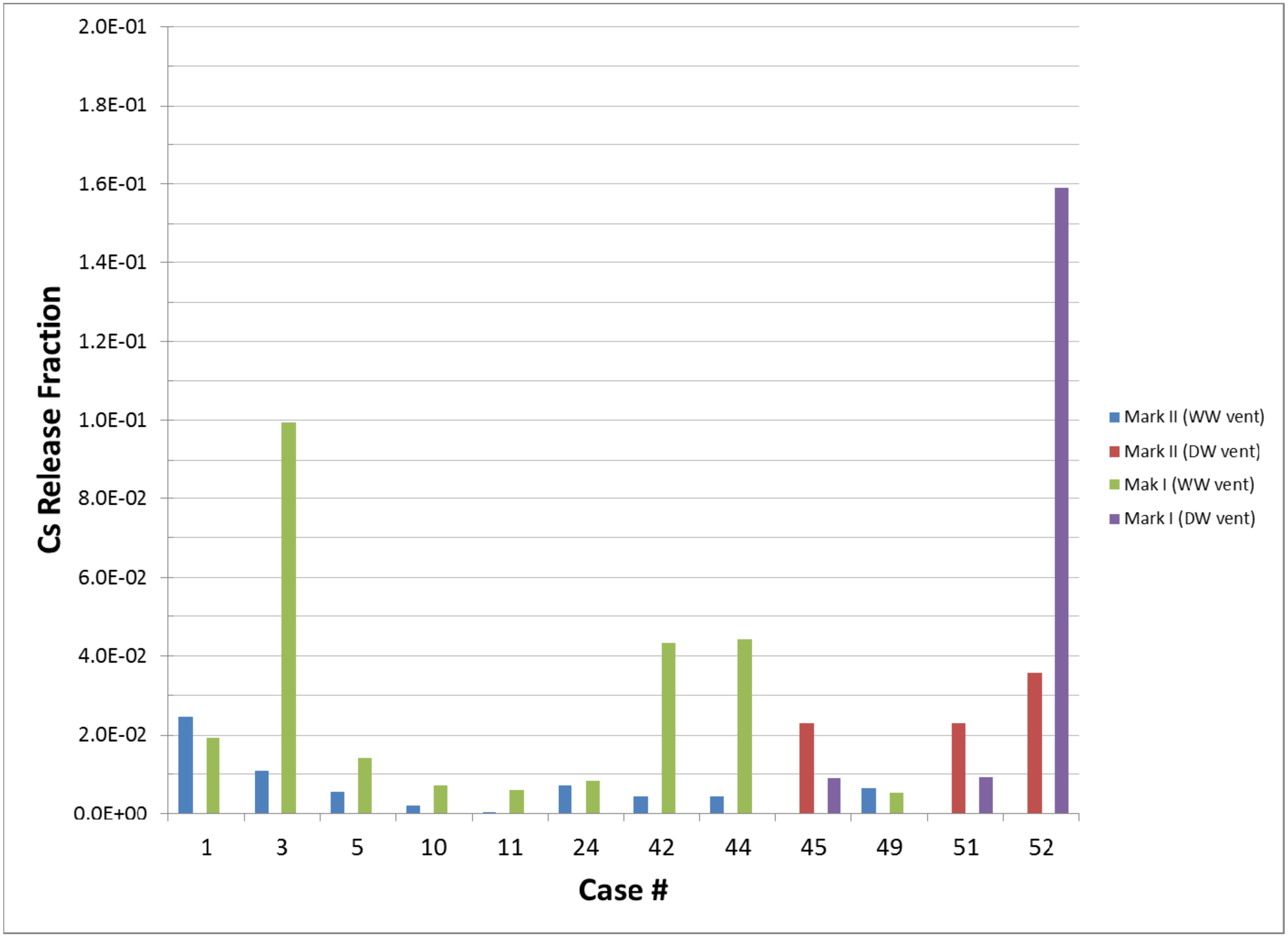
August 21, 2014

MELCOR Run Matrix for Mark II

- **Same initial and boundary conditions as for Mark I analysis**
- **Run matrix condensed compared to Mark I analysis (e.g., vent cycling cases not considered)**
- **Sensitivities to containment design**

			Pre Core Damage					Post Core Damage				
		RPV Pressure control	RCIC Operation				Anticipatory Venting	Flex Operation		SRV Operation	Venting	
		Availability (hr)	RCIC Availability (hr)	RCIC Suction	Failure Temp (F)	Open SRV after RCIC fails	Setpoint (psig)	Injection @ LH failure	WW Level Control Injection @ 21' (gpm)	Allow SRV stuck open failure?	Location	Setpoint
Option	Case											
1	1	72	16	SP	230	N	15	-	-	Y	WW	PCPL
1	3	4	4	SP	230	N	15	-	-	N	WW	PCPL
1	5	72	16	CST	230	N	15	-	-	Y	WW	PCPL
2A	10	72	16	SP	230	N	15	RPV	500	Y	WW/DW	PCPL
2A	11	72	16	SP	230	Y	15	RPV	500	Y	WW/DW	PCPL
3A	24	72	16	SP	230	N	15	DW	500	Y	WW/DW	PCPL
2A	42	4	4	SP	230	N	15	RPV	500	N	WW/DW	PCPL
3A	44	4	4	SP	230	N	15	DW	500	N	WW/DW	PCPL
3A	45	-	16	SP	230	-	-	DW	500	Y	DW	PCPL
3A	49	-	0	-	-	-	-	DW	500	Y	WW/DW	PCPL
3A	51	-	16	SP	230	-	15	DW	500	Y	DW	15
3A	52	-	16	SP	230	-	15	DW	500	N	DW	15

MELCOR Preliminary Results for Mark II (Cs release fraction)



Filtering Strategies Rulemaking: PRA Discussion

August 21, 2014

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Filtering Strategies Rulemaking: Offsite Consequence Analysis: MACCS Modeling

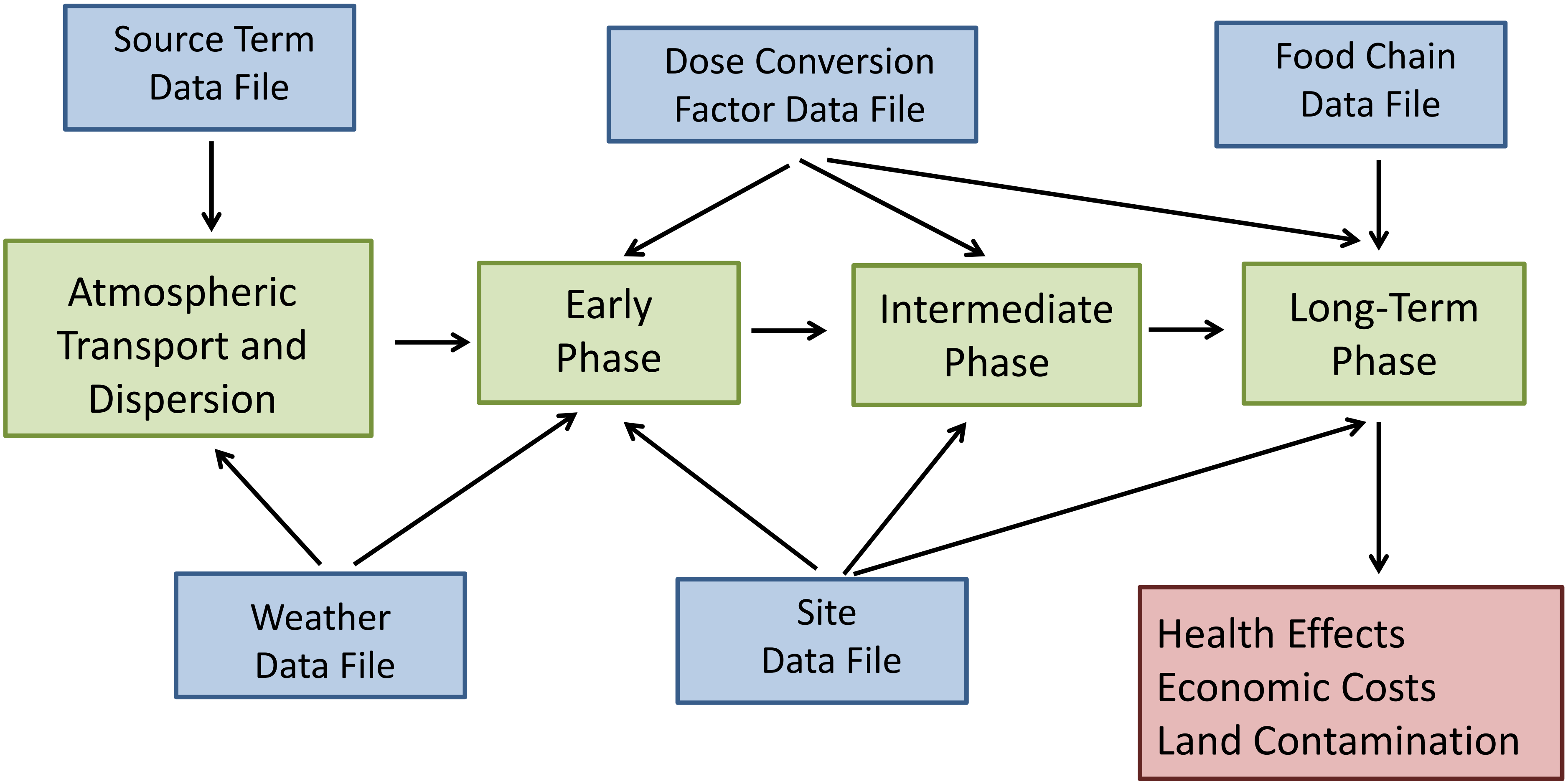
August 21, 2014

Modeling Approach

- Develop site-specific MACCS project files (models) for a reference BWR Mark I site and a reference BWR Mark II site

- Incorporate currently available data sources and consequence modeling best practices

MACCS Overview (1)



MACCS Overview (2)

	EPA PAG Accident Phase		
	Early (Emergency) Phase	**Intermediate Phase**	**Long-Term Phase**
Typical Duration and Time Frame	~ 1 week, starting at the time of the accident's initiating event	0 – 1 year, starting at the end of the early phase	30 - 50 years, starting at the end of the intermediate phase
Protective Actions	• Sheltering • Evacuation • Relocation • KI Ingestion	• Relocation	• Interdiction • Decontamination • Condemnation
Exposure Pathways	• Cloudshine • Groundshine • Inhalation • Skin deposition	• Groundshine • Inhalation of resuspended materials	• Groundshine • Inhalation of resuspended materials • Food and water ingestion

Source Terms and Binning Strategy

- 41 MELCOR source terms for Mark I, 12 for Mark II
- Range of DFs applied to source terms for releases through vented pathways: 10, 100, and 1000
- 164 total Mark I source terms, 48 for Mark II
- Binning strategy used for efficiency of consequence analysis
- Binning based on cesium and iodine
- 18 source term bins for Mark I, 9 for Mark II

BWR Mark I Source Term Bins

Bin	Bin Cs Range (%)	Bin I Range (%)	Representative Case	Rep Case Cs (%)	Rep Case I (%)	Start of Release (hrs)
1	0.0002 - 0.001	0.001 - 0.01	28DF1000	0.0006%	0.006%	15.9
2	0.001 - 0.003	0.01 - 0.03	48DF100	0.002%	0.02%	11.4
3	0.003 - 0.01	0.03 - 0.1	10DF100	0.01%	0.08%	16.3
4	0.01 - 0.03	0.1 - 0.3	7DF1000	0.02%	0.26%	14.9
5	0.03 - 0.1	0.3 - 1.0	11DF10	0.06%	0.78%	14.4
6	0.1 - 0.3	1.0 - 3.0	48	0.23%	1.69%	11.4
7	0.3 - 1.0	3.0 - 10.0	15	0.60%	5.85%	15.9
8	0.3 - 1.0	10.0 - 20.0	46	0.98%	11.01%	14.8
9	1.0 - 2.0	2.0 - 4.0	5DF10	1.05%	2.89%	24.2
10	1.0 - 2.0	4.0 - 10.0	5	1.39%	6.46%	24.2
11	1.0 - 2.0	10.0 - 20.0	8	1.49%	19.25%	14.9
12	1.0 - 2.0	20.0 - 40.0	1	1.93%	22.68%	14.9
13	2.0 - 4.0	3.0 - 10.0	41DF1000	3.40%	7.65%	9.8
14	2.0 - 4.0	10.0 - 20.0	22dw	2.82%	18.64%	15.9
15	2.0 - 4.0	20.0 - 40.0	53	2.79%	29.05%	18.4
16	4.0 - 10.0	10.0 - 20.0	41	4.54%	14.10%	9.8
17	4.0 - 10.0	20.0 - 40.0	3DF10	8.85%	24.65%	9.8
18	10.0 - 20.0	20.0 - 40.0	52	15.90%	34.32%	18.4

BWR Mark II Source Term Bins

Bin	Bin Cs Range (%)	Bin I Range (%)	Representative Case	Rep Case Cs (%)	Rep Case I (%)	Start of Release (hrs)
1	0.00001 - 0.0001	0.0001 - 0.001	11DF1000	0.00004%	0.0005%	20.3
2	0.0001 - 0.001	0.001 - 0.01	5DF1000	0.0006%	0.005%	32.2
3	0.001 - 0.01	0.01 - 0.1	42DF100	0.0043%	0.037%	14.3
4	0.01 - 0.1	0.1 - 1.0	11	0.042%	0.45%	20.3
5	0.1 - 0.4	1.0 - 3.0	51DF10	0.23%	2.01%	17.6
6	0.4 - 1.0	3.0 - 10.0	5	0.55%	4.94%	32.2
7	1.0 - 2.0	~ 10.0	3	1.09%	10.26%	14.3
8	2.0 - 3.0	~ 20.0	1	2.46%	19.81%	22.8
9	3.0 - 4.0	~ 30.0	52	3.57%	28.67%	17.6

Site Data

- Population based on 2010 Census
  - Scaled to 2013 using state-level population growth rates
- Economic values based on 2007 data
  - Scaled to 2013 using CPI-U
- Land use based on 2007 data
  - Land vs. water fraction
  - Farm vs. nonfarm fraction

Weather Data

- Onsite meteorological tower data used for reference sites
  - Wind speed
  - Wind direction
  - Precipitation
  - Atmospheric stability

- Mixing layer data from EPA database [1] and report [2]

Atmospheric Transport and Dispersion

- Gaussian plume segment model with dispersion lookup table based on Bixler et al. conversion of Eimutis & Konicek formulation [3]
- Surface roughness based on land use data from USDA CropScape database [4]
- Dry deposition velocities based on expert elicitation data [5]
- NRC RG 1.145 plume meander model [6]

Early Phase
Protective Actions and Costs

- Evacuation parameters based on 2014 ETE report for each reference site
- Shielding beyond EPZ reflecting Offsite Response Organization (ORO) instruction to shelter in place
- Early phase relocation parameters consider release timing, plume travel time, ORO notification time, and mobilization/evacuation times
- Daily compensation cost per person for lodging, food, and lost income

Intermediate Phase
Protective Actions and Costs

- Accounts for time period needed to plan the long-term recovery and cleanup actions
- Duration of 3 months selected to approximate weighted average planning time
- Dose criterion based on linear extrapolation of location-specific annual habitability criterion
- Daily compensation cost per person for lodging, food, and lost income

Long-Term Phase
Protective Actions and Costs

- Annual habitability criterion based on location-specific guidance
- Decontamination costs scaled from past studies using CPI-U to 2013
- Cost parameters either scaled from past studies using CPI-U to 2013 or based on more current data

Dosimetry and Health Effects

- Dose conversion factors based on EPA's FGR-13 [7]
- Deterministic health effect model parameters based on expert elicitation data [5]
- Stochastic health effect model parameters based on SOARCA Eckerman report [8]

Planned Sensitivity Calculations for Regulatory Analysis

- Population density
- Delay to start evacuation
- Increase in nonevacuating cohort fraction
- Intermediate phase duration
- Long-term phase habitability criterion

Selected References

[1] U.S. Environmental Protection Agency, Support Center for Regulatory Atmospheric Modeling, "SCRAM Surface Meteorological Archived Data: 1984-1992," http://www.epa.gov/ttn/scram/surfacemetdata.htm

[2] U.S. Environmental Protection Agency, Office of Air Programs, AP-101, "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States," Research Triangle Park, NC, January 1972.

[3] Napier, B.A., J.P. Rishel, and N.E. Bixler, PNNL-20990, "Final Review of Safety Assessment Issues at Savannah River Site, August 2011," Pacific Northwest National Laboratory, December 2011.

[4] U.S. Department of Agriculture, National Agricultural Statistics Service, CropScape 2013, http://nassgeodata.gmu.edu/CropScape

[5] U.S. Nuclear Regulatory Commission, NUREG/CR-7161, "Synthesis of Distributions Representing Important Non-Site-Specific Parameters in Offsite Consequence Analyses," Washington, DC, April 2013.

[6] U.S. Nuclear Regulatory Commission, Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Washington, DC, November 1982.

[7] U.S. Environmental Protection Agency, EPA 402-R-99-001, "Federal Guidance Report No. 13, Cancer Risk Coefficients for Environmental Exposure to Radionuclides," Washington, DC, September 1999.

[8] Eckerman, K.F., Letter Report, "Radiation Dose and Health Risk Estimation: Technical Basis for the State-of-the-Art Reactor Consequence Analysis Project," ML12159A259, Oak Ridge National Laboratory, Oak Ridge, TN, January 2012.

United States Nuclear Regulatory Commission

Protecting People and the Environment

Filtering Strategies Rulemaking: Human Reliability Analysis

August 21, 2014

Presentation Outline

- Understand the scenario and human tasks
  - Study assumptions
  - Scenarios and key human tasks
  - Comments on the industry's base scenario timeline
- Calculate human error probabilities (HEPs)
  - Characterize the challenges to human performance
  - Current status

Basis of Assumptions

- The reference plant of this study is a BWR plant with Mark I containment in a duel reactors site.
- Assumptions are mainly based on the following publicly available documents:
  - NEI 12-01 “Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities the plant condition immediately after the initiating event” [ML12125A412]
  - NEI 12-06 “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide” [ML12143A232]
  - NEI 13-06 “Enhancements to Emergency Response Capabilities for Beyond Design Basis Accidents and Events” [ML14049A002]
  - NEI 14-01 “Emergency Response Procedures and Guidelines for Extreme Events and Severe Accidents” [ML14049A005]
  - Licensee response to NRC’s information request regarding the emergency preparedness staffing [ML13121A087]
- The study-specific assumptions supersede the above general assumptions when applicable.

Key Assumptions

- Initiating event and structure, system and component damage

- A 0.7g earthquake occurred when the reference plant is at full power operation and during a back shift (weekend or night shift)
  – Same assumption used in the spent fuel pool consequence study [SECY-13-0112]
- Plant status following the earthquake
  – Reactor automatically scrammed
  – Caused an extended loss of ac power (ELAP) event
  – All non-seismic class I structures are severely damaged
  – The spent fuel pools are intact
  – *Earthquake-induced-fire: occupies the 5 fire brigade personnel and a control room operator for 1.5 hours (based on timing info in the H.B. Robinson fire event on 3/28/2010)
  – *Earthquake-induced-flood: Upper stream dam failure does not cause a flood above the grade level. [UFSAR]

*EPRI-1025294 "Seismic-induced-fire and seismic-induced-flood are two likely additional events following a beyond-design-basis earthquake"

Key Assumptions

- Equipment availability

- The FLEX equipment and required fuel and parts, etc. are available.
- The non-seismic-class-I installed equipment are damaged by the earthquake. The systems and components within the non-seismic-class-I structures are not available for event mitigation.
- All installed ac power is not available.
- Other key equipment availabilities are explicitly specified in the probabilistic risk assessment (PRA) event trees.
- The equipment stored in the regional response centers (RRC) arrives onsite 24 hours after the initial request. This HRA study does not evaluate the reliability of the 24 hours commitment.

Key Assumptions

- Communication, training, and technical support center

- Communication is available but limited.
- The plant staff and the RRC staff are trained on operating the FLEX equipment shipped to the site
- When the severe accident management guidelines (SAMGs) are entered, the TSC is ready to take the ultimate decision maker's responsibility.
  - Except in cases where RCIC and HPCI failed at time zero, the earliest time that the SAMG entry criterion is met is 7.6 hours after the initial earthquake.

Main information used for scenario and human task analysis

- BWROG's EPG/SAG rev. 3
- The reference plant's information available to NRC
  - Operation procedures and system drawings
  - Updated Final Safety Analysis Report (UFSAR)
  - Responses to NRC orders
- Industry provided information in public meetings and responses to NRC's requests for information
- Information obtained from the NRC WG and resident inspectors in the reference plant

Example information used for the analysis - Base scenario timing information (ML13059A305)

Action Item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
	0	Event Starts	NA	Plant @100% power
1	0	SBO, Reactor Scram	NA	
2	0.5 min	HPCI and RCIC start automatically on -48 inch signal	N	This is an approximation – depending on how the event is initiated, RCIC could start automatically or be manually started by the operator.
3	5 min	Operators shut down HPCI	N	As long as RCIC is in service, HPCI operation is not required. This is not time critical because HPCI could remain in operation if the CST is available, and could be used for makeup if the operator chooses to use it. The operator will secure HPCI if it is not needed for RPV makeup or if CST is not available for use in the CST – CST mode of operation (RPV pressure control).
4	20 min	Commence cooldown of RPV at 80F/hr	N	T-101 and SE-11 currently direct RPV depressurization. This is not time critical. This is the PB strategy for coping with an SBO condition. The RPV could remain pressurized. However, eventual RPV depressurization would be required due to the approach to HCTL limits.

Reference information:

- Action timeline
- Key actions

Example of information used for the analysis

- Onsite staff utilization (ML13121A087)

Time / Pos	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120
EO #1	Report to MCR	Check EDGs			Defeat RCIC Temp Isolation			
EO #2	Report to MCR	Check EDGs			Defeat RCIC Temp Isolation			
EO #3	Report to MCR	Establish Backup N2		Monitor Turb and M-G Sets, Vent Generators			Prepare to Vent Containment	
EO #4	Report to MCR	Establish Backup N2		Monitor Turb and M-G Sets, Vent Generators			Prepare to Vent Containment	
EO #5	Report to MCR	Remove ECCS Fuses				Equalize CSTs		
EO #6	Report to MCR	DC Load Shed				Line-up DDFP for Injection		
EO #7	Report to MCR	DC Load Shed					Defeat RCIC Low Press isolation	
EO #8	Report to MCR	Establish RCIC Ventilation						

Reference information: Action timeline, number of personnel to perform the tasks, and action duration.

Human tasks modeled in PRA

- All tasks are implemented in with and without dc conditions

Task	Failure mode
Shed dc load	Not have the dc load shed < 1 hour
Depressurize RPV to approximately 200 psig at less than 100 °F/hr rate	Not depressurize the RPV Overly depressurize RPV
Deploy FLEX generator to charge batteries	Not charge dc before core damage Not charge dc before RPV breach
Deploy FLEX pump to inject into RPV	Not inject before core damage Not inject before RPV breach Not inject before liner melt through
Depressurize RPV for FLEX pump water injection	Not charge dc before core damage Not charge dc before RPV breach
Open wet well / dry well vent before core damage	Not vent between containment pressure is 15 psig and core damage
Close wet well/dry after core damage	Not close vent between core damage and containment pressure reaching 60 psig.
Use FLEX pump to makeup torus	Not makeup before torus level is lower than the bottom of the downcomer legs
Black start and run RCIC	RCIC not inject before core damage RCIC not inject before RPV breach RCIC not inject before liner melt through

Overview of calculating human error probability (HEP)

- A task's HEP is dependent on its challenges on human performance which in turn is represented by four macrocognitive functions (MCF):
  - Detecting (plant abnormality)
  - Understanding (the plant status and the problem)
  - Deciding (an appropriate response plan)
  - Action (to carry out the response plan)
- Each human failure event (HFE) modeled in PRA should include all four MCFs. The HEP may be dominated by one or two MCFs.
- Failure in any of the macro-cognitive functions fails the task.
- The task's failure probability is sum of its macro-cognitive functions' failure probabilities.

Calculate a MCF's failure probability

- A MCF's failure probability is determined by the status of a set of pre-defined factors (performance influencing factors, PIFs)
- The PIFs are identified
  - Based on a large psychological literature review conducted by NRC (NUREG-2114)
  - Developed a model to integrate the NUREG-2114 results and to bridge the gaps. The model:
    - Identifies the subset of cognitive functions to achieve the MCF.
    - Conditions affecting the performance of each subset of cognitive functions are identified.
    - PIFs are identified to represent the conditions.

The Understanding MCF

- Examples of subset cognitive functions and PIFs

The subset cognitive function

1. Assess information integrity
2. Have the right mental model
3. Evaluate past and present situation, diagnose problems / resolve conflicts
4. Prognosis of situation evolution
5. Verify / confirm the understanding
6. Communicate the assessment

PIFs affecting the element 1 subset cognitive function

- Inadequate or inconsistent information from systems
- System behavior is not expected and cannot be explained
- System behavior is not apparent due to cue masking
- Distributed information across time (Overturning updates) - Situations that require integrating information over time periods

Examples of Tasks that Challenge the Understanding Macro-Cognitive Function

- Have an early understanding of the plant encountering an ELAP event for a timely decision on deploying FLEX equipment and requesting support from the RRCs.
- SAMG:
  - Has the core debris breached the RPV?
  - Can RPV level be restored to above the top of active fuel?
  - Can RPV level be restored to above the bottom of active fuel level?
  - Can RPV injection rate be restored and maintained about the Minimum Debris Retention Injection Rate?

PIFs Affecting the Understanding Macro-Cognitive Function – General PIFs

- Workload
  - Parallel and intermingled cognitive tasks
  - Unfamiliar and complex tasks
  - Concurrent activities distract attention from the task
  - Performing the task requires frequent information updates
  - Time demanding task
  - Long working hours on non-routine, stressful tasks
  - Performing non-routine, cognitive demanding tasks right after a high cognitive workload period
- Information availability, accuracy, convergence, and distribution
- The knowledge breadth and depth required to understand the situation
- Bias (familiar with a superficially similar but fundamentally different situation)
- Job aid quality (e.g., procedures and human system interface)
- Supervision, peer check, and communication

PIFs Affecting the Understanding Macro-Cognitive Function – Specific PIFs (partial list)

INFORMATION ACCURACY:	☐ **Flaw in system state indication** ☐ **Information may be inaccurate (e.g., the information may not have been updated in a timely manner, the source may be inherently unreliable, or inaccurate information may be provided due to degraded sensors, problems in communication)** ☐ **Inadequate updates of plant information (Could be the information perceived by a party (e.g., MCR) but failed to inform another party (e.g., TSC))**
INFORMATION ADEQUACY: By only looking at if all essential information to understand the situation is available.	☐ Inadequate information from system to understand the situation (to support decision making) due to reasons such as cue masked. ☐ No clear guidance on communicating risk / uncertainties. ☐ Transition in system control state is not communicated. ☐ Guidance does not ask to search for additional / redundant information for verification. ☐ No clear guidance for the content of communication for different purposes (e.g., communication to upper or lower levels, with other parties).
INFORMATION CONVERGENCE: By looking at all available information	☐ Available information does not converge to reaching to a coherent understanding of the situation. ☐ Ambiguous Cues - multiple, alternative, explanations for the pattern of symptoms observed. Cue and information are exchangeable here. ☐ Inadequate leadership reconciling different view points

Current Status on the HEP quantification methodology

- The specific PIFs for each MCFs are identified:
  - This enables to characterize the performance context in a systematic and comprehensive manner.
  - The PIFs are linked to psychological literature.
- Equations to calculate a MCF's failure probability based on its PIFs' status is still under development
- For the rulemaking, expert judgment will be used to estimate the HEPs with input of the PIFs' status and scenario description.
  - There is no NRC endorsed HRA method for severe accidents and extreme events.
  - The analysis follows the established HRA process for good quality.
  - The MCFs' PIFs have the right coverage at right detail to characterize the performance challenges.

Backup Slides

Mapping of Alternatives

New Alternatives	Previous Alternatives
1	1
2A	1
3A	2A
3B	3A
4Ai(1)	2B
4Ai(2)	3B
4Aii(1)	2D
4Aii(2)	3D
4Aiii(1)	2C
4Aiii(2)	3C
4Bi(1)	4-2A
4Bi(2)	4-3A
4Bii	New - similar to 6C, but with small filter; only water addition to DW
4Biii	New - similar to 6B, but with small filter; only water addition to DW
4Biv	New - similar to 6A, but with small filter; only water addition to DW
4Ci(1)	5-2A
4Ci(2)	5-3A
4Cii	6C; only water addition to DW
4Ciii	6B; only water addition to DW
4Civ	6A; only water addition to DW

Additional Information Requested

- Small Filter
  - Technical specifications
  - Decontamination factor as a function of particle size
  - Operator actions and timing necessary to operate
  - Has a small filter ever been developed or constructed?
  - Has there been any testing and validation of a small filter?

Additional Information Requested (cont'd)

- SRV Operation:
  - Discussion of assuming no AC power, whether the SRVs require using pneumatic pressure provided by nitrogen accumulators to main the RPV pressure at the SRVs' relief set pressures soon after reactor scam

Additional Information Requested (cont'd)

- Generic methodology and modeling:
  - When is SAWA initiated?
  - Is SAWM essentially the same as SAWA with flow throttling to ensure that the wetwell is not flooded? When is SAWA transitioned into SAWM?
  - Why is industry evaluating drywell venting without a filter?
  - Why is industry not considering DW venting in the absence of SAWM?
  - What does SAWM mean with regard to RPV water addition? What water management action(s) is/are performed?
  - Please define "vent control." Is it vent cycling between a specific pressure band? If so, what pressure band?
  - Do all EPRI alternatives assume anticipatory venting? If so, at what containment pressure?
  - Please define "filter path." Is the filter path synonomous with vent path? If so, is the vent path only out of the WW vent?
  - Please define "manual" with regard to the filter path. Is it manual operation of the vent?
  - Please differentiate between EPRI ase 5B ("manual" filter path) and EPRI case 6C ("all manual" filter path)