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Chris, Ed;

When I sent you our main comments on the draft Integrated Assessment ISG yesterday, I mentioned that we had other comments that I would send separately. The other comments that we have developed to date are attached.

Thanks,



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## Other Comments on the Integrated Assessment

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The format for the comments below is as follows: Page number in ISG / text being commented on in italic / comment / recommendation in subparagraph that follows. Suggested text is in red font.

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**Page 4:** *“(The loss of the UHS from causes other than flooding are not included.)”* It has never been totally clear that this does not include seismic failure of downstream dams. In the ACRS public meeting on the revision to RG 1.59 the ACRS questioned this point and the implication of the testimony is that downstream dam failures resulting in loss UHS would include consideration of seismic failures of the downstream dams.

Recommendation: The statement *“(The loss of the UHS from causes other than flooding are not included.)”* should be revised to make this clear - *“(The loss of the UHS from causes other than flooding, such as seismic failure, are not included.)”*

**Page 8:** *“The Integrated Assessment should also consider whether specific vulnerabilities may arise during modes of operation other than full-power (e.g., conditions where flood protection features may be bypassed or defeated for maintenance or refueling activities).”* The ISG should remain consistent with the scope and intent of the 50.54(f) with regard to evaluating all modes of operation. A qualitative analysis, of the expected plant configuration at the time of the flood event that identifies challenges to any flood protection or mitigation features is appropriate. The current state of practice will preclude the use of any PRA techniques to evaluate low-power and shutdown (LPSD) configurations.

Also, modes of operation and plant configuration are being integrated in this sentence and it is confusing.

Recommendations:

Clarify the guidance on the type of analysis that can be used.

Change the quoted sentence to – *“The Integrated Assessment should also consider whether specific vulnerabilities may arise during modes of operation or configurations other than normal full-power operation and configuration (e.g., conditions where flood protection features may be bypassed or defeated for maintenance or refueling activities)”*.

Change the prior sentence to read – *“In addition, the Integrated Assessment should describe the expected total plant response under other modes of operation, including a discussion of controls (such as programmatic controls) that are in place in the event that a flood occurs during any of these modes (e.g., during refueling)”*.

**Page 9:** Typo in footnote, *ref 28* should be ref *27*.

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**Page 14** *“quantify the reliability of the active features, other than flood doors and hatches, based on operating experience and other available data or information using traditional PRA or statistical techniques”*. This is discussed more completely in A.1.2.

Recommendation: change “quantify the reliability of the active features, other than flood doors and hatches, based on operating experience and other available data or information using traditional PRA or statistical techniques” to “**quantify the reliability of the active features in accordance with A.1.2**”.

**Page14** *“compare the performance, characteristics, and configuration of the flood protection feature(s) against appropriate, present-day design codes and standards (including Standard Review Plan Sections 3.4.1 and 3.4.2, Refs. (5) and (6)) to determine that the feature(s) conforms to good practices and is sufficiently robust (e.g., demonstrates an appropriate factor of safety)”* The 50.54(f) letter identifies the “application of present-day regulatory guidance and methodologies being used for ESP and COL reviews to the reevaluation of the flooding hazards at operating reactors”. These SRP sections are related to internal flood protection for onsite equipment failures and structural analysis. This appears to be an extension of the intent of the 50.54(f) letter from hazards to structural requirements / methodology. Without detailed comparison of the existing structural requirements / methodology of operating plants and these references and their sub-references the technical implications of this apparent extension isn’t clear.

Recommendations: Change to - “**compare the performance, characteristics, and configuration of the flood protection feature(s) against the governing design requirements for the plant**”.

**Page 15** *“The Integrated Assessment should also demonstrate that the flood protection system integrity is reliably maintained with margin based on comparison against appropriate performance criteria or quantification of feature or system reliability.”* It isn’t clear how this demonstration is to be provided.

Recommendations: Delete the sentence

OR change to “**The Integrated Assessment should also demonstrate that the flood protection system integrity is reliably maintained with margin based on comparison against appropriate performance criteria or quantification of feature or system reliability by examples to be provided later.**”

OR “**The Integrated Assessment should also demonstrate that the flood protection system has margin based on comparison against appropriate performance criteria or quantification of feature or system reliability.**”

**Page 15** *“In addition, if a flood protection feature or system is not able to accommodate the flood scenario parameters, the flood protection evaluation should determine at what flood height and under what associated effects, the flood protection feature or system is able to reliably accommodate a flood with margin.”* Since the feature or system has already been determined

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to not be adequate for the scenario it may be more relevant to know what the absolute capability is, that is without margin.

Recommendation: Change to – “In addition, if a flood protection feature or system is not able to accommodate the flood scenario parameters, the flood protection evaluation should determine at what flood height and under what associated effects, the flood protection feature or system is able to **accommodate a flood**.”

**Page 16** “An evaluation of mitigation capability is appropriate for sites that have not demonstrated that the flood protection systems are reliable and have margin.” If the intent is that an evaluation is required then it would be clearer to say it is required.

Recommendation: Change to – “An evaluation of mitigation capability is **required** for sites that have not demonstrated that the flood protection systems are reliable and have margin.”

**Page 18** first paragraph in section 7.3: clarify the expectations on the scope of the margin assessments.

Recommendation: Add the following after the second sentence in the first paragraph in Section 7.3: “Margins assessments should be performed for a flood protection feature or flood protection feature combinations that are not judged to be reliable or have margin. While “scenario-Based” assessments may assume flood protection features are failed, margin assessments may consider the probability of the flood protection feature failure in the impact assessment.”

**Page 18** second paragraph, second sentence: “plant system models should be updated or developed”. Plants do not currently have shutdown PRAs. Furthermore no PRA standard for shutdown PRAs has been developed. While ‘at-power’ PRAs can be enhanced to include additional mitigation components, such as those introduced due to FLEX, developing a full shutdown PRA model to quantify CCDP and LERP impacts should not be expected as part of the integrated assessment.

Recommendation: Change to “at-power plant system PRA models should be updated or enhanced”.

**Page 19** “When it is not feasible to use HRA concepts and approaches,” this is in reference to quantification so quantification should be included.

Recommend: Change to – “When it is not feasible to use HRA concepts and approaches to **quantify the reliability**”,

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**Page 19**, second bullet at the top of the page: “*When it is not feasible to use HRA concepts and approaches, use the criteria described in Appendix C to demonstrate acceptability of the operator manual actions. In such cases, for quantification purposes in a margin analysis, use an initial failure probability of no less than  $1 \times 10^{-1}$  if the criteria in Appendix C are met.*” The PRA standard and RG 1.200 includes guidance on quantifying HRA and employing engineering judgment. It is not clear what is meant by quantification not being feasible and then using Appendix C to quantify. Also stipulating a value of 0.1 for successfully meeting the Appendix seems overly conservative and identifying this value as a lower limit for Appendix C actions being met may be inconsistent with alternate HRA methods. Using Appendix A of SPAR-H and the limiting performance shaping factors from Section C.1, page 48, the human error probability can be calculated to be less than  $3 \times 10^{-2}$ . Thus a value on the order of  $5 \times 10^{-2}$ , which would account for any uncertainty in the categorization of PSFs, is more appropriate and is conservative. Note that the categorization characteristics contained in the ISG are clear and unambiguous; and that the source methodology is well known.

Recommendation: We have a couple of suggested options.

Either change to: “**When it is not feasible to use HRA concepts and approaches, use the criteria described in Appendix C to demonstrate acceptability of the operator manual actions. In such cases, for quantification purposes in a margin analysis, use an initial failure probability of no less than  $5 \times 10^{-2}$  if the criteria in Appendix C are met.**”

Or replace the text by a note that states:

“**Note that if Appendix C is used to demonstrate feasibility and reliability of a human action the selection of a human error probability should be appropriately justified.**”

If the parenthetical statement at the end of this bullet is retained, change the phrase “exceed the requirements” to “exceed the **nominal** requirements”

**Page 19** first sentence after second bullet: Suggest clarification.

Recommendation: Modify sentence as follows: “**In addition, for all resources and actions credited in the Margins evaluation, the evaluation should:** “

**Page 19** first paragraph after the send set of bullets: Requiring evaluation of all failure modes should be unnecessary if lesser failure modes can be shown to be bounded by more severe modes.

Recommendation: Clarify that lower mode evaluations can be subsumed by evaluation of more extreme failure modes.

**Page 20** “*Controlling Flood Mechanism(s)*” In earlier discussion it was noted that the identification of the conservatism of the analysis that led to the scenario may be useful in understanding the IA results and therefore it would be acceptable but not mandatory to include such information.

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Recommendation: Add a statement such as – **“If desired and useful to understanding the scenario parameters, describe the conservatism associated with the flooding analysis that led to the scenario parameters.”**

**Page 21** (two places) *“the reliability of active features”*, if Table A 1 is used this will not be available.

Recommendation: Change to – **“the reliability of active features or results of application of Table A 1.”**

**Page 21** *“Provide an evaluation (including sensitivity studies if appropriate) regarding the effectiveness of the total mitigation capability”* It isn't clear what this means. It would be helpful to list or described the elements against which the evaluation should be performed.

Recommendation: Change to – **“Provide an evaluation (including sensitivity studies if appropriate) regarding the effectiveness of the total mitigation capability in providing the following elements: - - - “**

OR

**“Provide an evaluation (including sensitivity studies if appropriate) regarding the effectiveness of the total mitigation capability as specified in the following bullets specific to scenario-based , margins-base and full PRA evaluations.”**

**Page 36** *“The following sections provide points of consideration in evaluating soil structures (embankment, levees, and berms), concrete barriers, seals and plugs, and drainage systems. In evaluating these types of barriers, licensees should refer to the guidance below as well as appropriate codes and standards to assess whether in place or planned systems conform to good practices.”* It isn't clear how these are supposed to be used in decision making or reporting.

Recommendation: Change to – **“The following sections provide points of consideration in evaluating soil structures (embankment, levees, and berms), concrete barriers, seals and plugs, and drainage systems. In evaluating these types of barriers, licensees should refer to the guidance below as well as appropriate codes and standards to assess whether in place or planned systems conform to good practices. Plant features not meeting the implied expectations associated with these points of consideration shall be identified and a technical judgment provided summarizing what their implications are if they are noteworthy and if not noteworthy why they are not.”**

**Page 39** *“Equipment should not be damaged or otherwise adversely effected by the flood event (e.g., due to direct inundation, humidity, hydrodynamic forces, or debris) or adverse environmental conditions.”* It is not practical to avoid any humidity.

Recommendation: **“Equipment should not be damaged or otherwise adversely effected by the flood event (e.g., due to direct inundation, excessive humidity, hydrodynamic forces, or debris) or adverse environmental conditions.”**

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**Page 40** “A.2 Evaluating flood protection systems” and **Page 14**. “Performance criteria” The relationship between these two sections is confusing. There is duplicate content, example: 6.2 - evaluate the feasibility and reliability of credited operator actions (including construction, installation, or other actions) through comparison against criteria described in Appendix C A.2 - the feasibility and reliability of operator manual actions that must be performed to install or construct barriers (e.g., flood gates, sandbag walls), including factors that can influence operator performance, as described in Appendix C

And there is important, seemingly more detailed content in 6.2 (presumed to be the higher level section) that is not included in A.2, example:

6.2 - compare the performance, characteristics, and configuration of the flood protection feature(s) against appropriate, present-day design codes and standards (including Standard Review Plan Sections 3.4.1 and 3.4.2, Refs. (5) and(6)) to determine that the feature(s) conforms to good practices and is sufficiently robust (e.g., demonstrates an appropriate factor of safety)

Recommendation: Clarify the relationship between these two sections

**Page 44** “*Individuals with experience assessing operator manual actions (e.g., for fire) should be included in the peer review team at sites relying on operator manual actions to protect against or mitigate a flood event.*” The intent of the sentence is appropriate, the use of “fire” implies it is a relevant “analog” to flooding which is not appropriate as fire and flooding events require significantly different action response times, types of actions, number of operators involved, etc. and is misleading in the sense that it implies there is an analogous, consensus-accepted approach.

Recommendation: Change to the following by **deleting (e.g. for fire)** - “**Individuals with experience assessing operator manual actions should be included in the peer review team at sites relying on operator manual actions to protect against or mitigate a flood event.**”

**Page 44** “*If the Integrated Assessment only involves the evaluation of permanent flood protection features using conventional engineering methods with no reliance on operator manual actions, the peer review team may consist of a single reviewer (the peer review team leader).*” An important role of the team leader should be to scope the required content of the review, which might be a multi-disciplined activity requiring multi-disciplined expertise. Therefore it is doubtful that the leader would have the necessary expertise to address a focused area such as flood protection engineering (e.g. structural and geotechnical engineering).

Recommendation: “**If the Integrated Assessment only involves the evaluation of permanent flood protection features using conventional engineering methods with no reliance on operator manual actions, the peer review team may consist of a single reviewer (the peer review team leader, provided that the team leader has appropriate**

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**expertise in flood protection engineering (e.g. structural and geotechnical engineering).”**

**Page 45** “*performance criteria applied*” There are no performance criteria defined in this document for mitigation evaluation. Therefore the intent of this review attribute is not clear.

Recommendation: Change to “– **performance criteria applied where guidance is provided in the ISG and where not the performance criteria developed and applied by the utility.**”

**Page 47** “*This appendix provides guidance on evaluating operator manual actions associated with flooding based on concepts and approaches used in human reliability analysis (HRA).*” It has been discussed during public meetings on several occasions that consensus methods for assessing reliability of operator(s) actions during flooding events do not exist and that use of existing methods entail a “best effort” type approach.

Recommendation: Change to: “**This appendix provides guidance on evaluating operator manual actions associated with flooding based on concepts and approaches used in human reliability analysis (HRA). Due to the nature of and variety of potential flooding events and responses it is anticipated that other approaches may used or developed for this purpose.**”

**Page 52** The following experience metrics are not relevant to this situation – a more appropriate measure would be training on the action or procedure. See recommendation below.

- *Low—less than 6 months experience and/or training. This level of experience/training does not provide the level of knowledge and deep understanding required to adequately perform the required tasks; does not provide adequate practice in those tasks; or does not expose individuals to various abnormal conditions.*
- *Nominal—more than 6 months experience and/or training. This level of experience/training provides an adequate amount of formal schooling and instruction to ensure that individuals are proficient in day-to-day operations and have been exposed to abnormal conditions.*
- *High—extensive experience; a demonstrated master. This level of experience/training provides operators with extensive knowledge and practice in a wide range of potential scenarios. Good training makes operators well prepared for possible situations.”*

Recommendation: Change to a training based metric along the lines of the following:

- **Low— on the job training obtained while performing flooding event actions during a flooding event.**
- **Nominal— training at the frequency of periodic compulsory site training**
- **High— training at the frequency of periodic compulsory site training for multiple training sessions and/or participation in the development of the training**

**Page 55** “Human factors engineering”: The discussion of this topic in the ISG point out the fundamental and significant differences in flooding related events and those typically addressed



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by HRA, yet the PSFs utilized are those for events associated with operators in a control room environment, such as major focus on instrumentation.

Recommendation: Recommend deleting this area until research is done to understand what the relevant human factors engineering PSFs are for flooding events.