JAMES H. RILEY
Technical Advisor

1201 F Street, NW, Suite 1100
Washington, DC 20004
P: 202.739.8130
jhr@nei.org
nei.org

NUCLEAR ENERGY INSTITUTE

4/25/2013
78FR24439

6

May 28, 2013

Ms. Cindy K. Bladey
Chief, Rules, Announcements, and Directives Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Industry Comments on Draft Interim Staff Guidance (ISG) for Performing Assessment of Flooding Hazards Due to Dam Failure (JLD–ISG–2013–01), Docket ID NRC–2013–0073)

Project Number: 689

Dear Ms. Bladey:

On April 25, 2013, the U.S. Nuclear Regulatory Commission (NRC) issued a Federal Register Notice (78FR24439) soliciting public comments on draft "Guidance for Assessment of Flooding Hazards Due to Dam Failure" (JLD–ISG–2013–01). The Nuclear Energy Institute (NEI)[1] submits the attached comments on behalf of the nuclear energy industry.

If there are any questions on this material, please contact me at 202-739-8137; jhr@nei.org.

Sincerely,

James H. Riley

Attachment

c: Mr. Christopher B. Cook, NRO/DSEA/RHMB, NRC
Mr. Edward Miller, NRR/JLD/JPMB, NRC

NEI Fukushima Flooding Task Force

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

Dam Failure ISG - Industry Comments

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
General	The ISG is not clear on how off-site temporary structures can be credited for flood protection	Temporary off-site structures may already be in place for some plants.		
Sec. 1 / p. 1	"Failures of water-storage or water-control structures (such as onsite cooling or auxiliary water reservoirs and onsite levees) that are located at or above the grade of safety-related equipment are potential flooding mechanisms."	List should specifically exclude tanks. Note that the 50.54(f) letter only asks for external flood evaluations	Specifically include "tanks" in the list.	We need to develop additional guidance on the scope of the ISG as well as the flooding reevaluations in general.
Sec 1.3.1, p 2	Many sites have owner-controlled levees, embankments, dams, cooling ponds, etc. above power block grade that are licensed by the NRC as Seismic Category I. These structures were evaluated as Seismic Category I in the licensing basis / safety analysis report and affirmed as such by the NRC in a safety evaluation report. These structures are typically controlled via operating procedures, preventative maintenances, and surveillance tests. However, the Dam Failure ISG does not discuss an alternative, shortened assessment or screening path specifically for these types of structures, nor does the ISG make any reference to the term Seismic Category I. Do Seismic Category I water retention structures qualify for an abbreviated screening process that credits their NRC approved design and operation?	The ISG is not clear on how seismic category 1 structures are to be evaluated for flooding effects. Allowing for the analysis of these structures during the Fukushima 50.54(f) letter seismic reevaluations could lead to questions on the completeness of the Integrated Assessment which may have been completed prior to the seismic reevaluation.		
Sec. 1.3.2 / p. 4	4th full paragraph of p. 4, last sentence: "In lieu of a detailed analysis, one can simply assume that the dam fails under appropriate loading and move on to estimation of the consequences."	In lieu of a detailed analysis, does the licensee have any alternate options to justify that a dam (which is not screened-out according to Section 3) will not fail, rather than simply assuming dam failure?	Explain what is meant by a detailed analysis – analyze non-failure or analyze how the failure would occur. Clarify if there are any alternative options to simply assuming dam failure in lieu of a detailed analysis. For example, if a federal agency can provide justification that the dams they own and operate will not fail under the scenarios described in this ISG, clarify if	We understand that the details of sharing analysis results performed by other federal agencies is still being developed and that the intent of the ISG is to allow use of analyses prepared by other agencies as long as the analysis meets the guidance in the ISG.

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
			the licensee can rely on the assertion of a federal agency in lieu of a detailed analysis.	
1.3.2, p. 4	"Dam failure flood hazard estimation will require collecting data on the dam (s) to be analyzed (e.g., design documents, construction records, maintenance, and inspection program, planned modifications)"	What can be done if records cannot be located? Are there any reasonable assumptions that can be made? Are there a minimum set of records needed. Note that the rigor of justification is going to be dependent on the availability of information.	If detailed historical information cannot be obtained, recent (last 5 years) inspection reports and evaluations by the dam regulator can be used to determine if there are flaws or vulnerabilities that should be evaluated for dam failure risk.	
1.3.2, p. 4	"Transport of sediment and debris by flood waters should be considered."	Not clear what this statement is requiring and how to perform a sediment and debris analysis beyond engineering judgment. Where is sediment a concern? What scale/type of debris is of concern? The ISG leaves this evaluation up to the licensee and will probably result in large variation. Additional guidance on how to deal with debris and sediment in the dam break flood wave is needed.	If an analysis is required and expected to be part of the report, this statement would need to be expanded to further characterize when sediment and debris needs to be considered and the specific concerns that need to be addressed. If the concern is to consider sources of large debris in the routing path that could be transported to the nuclear site, it should be stated as such.	
Sec. 1.4.2, p. 7	General comment: This section states that the probability target for judging the likelihood of a particular failure mode/scenario (either from a single hazard or appropriate combination) is $1x10^{-6}$ annual probability. From the above statement it appears that dams which are safe for floods with a probability of 10^{-6} per year need not to be checked for failure during PMF.	If it can be demonstrated that a dam will not fail during a flood with probability of 10^{-6} per year, can hydrologic dam failure be excluded without considering PMF?	More clarification is required to clarify that dams not failing for 10^{-6} flooding can be considered as safe and potential failure during PMF does not need to be evaluated.	We understand that the 10^{-6} criteria will be removed.
1.4.2, p. 7	Last bullet - staff position states "...acceptable to use the $1x10^{-4}$ annual frequency ground motions, at spectral frequencies important to the dam, for seismic evaluation of dams, instead of $1x10^{-6}$, as discussed above. However, appropriate engineering justification must be provided to show that the dam has sufficient seismic margin. Otherwise the $1x10^{-6}$ ground motions should be used."	• It is not clear how the 10^{-4} and 10^{-6} criteria should be used. If sufficient margin cannot be established with the 10^{-4} criteria, how could adequate justification be achieved with the 10^{-6} criteria when it is associated with a larger earthquake? • What constitutes sufficient margin if a 10-4 seismic hazard analysis is performed verses a 10-6 seismic hazard analysis?	• Clarify how the two seismic criteria are to be used • Provide guidance on what amount of margin is sufficient.	We understand that the 10^{-6} criteria will be removed.

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
Sec 1.4.2, p. 8	2nd bullet on p. 8, next to last sentence: "However, appropriate engineering justification must be provided to show that the dam has sufficient seismic margin."	No quantitative criteria for "sufficient margin" are provided.	The 10^{-4} annual frequency ground motion is comparable to GMRS. Factor of safety in NRC regulatory guidance for liquefaction and slope stability for GMRS can be used to demonstrate "sufficient margin."	We understand that the 10^{-6} criteria will be removed.
Sec. 1.4.2, p.8	2nd bullet on p. 8, last sentence: "Otherwise 10^{-6} ground motions should be used."	The 10^{-6} ground motion criteria appears to be more conservative than NRC ISG-20, "PRA based Seismic Margins Analysis" where 1.67 * GMRS is used as a screening criteria. Comment also applies to Sec 5.3.1, p. 48, 1st paragraph.	"Otherwise 10^{-6} ground motions should be used." should be replaced by "Otherwise dam seismic capacity greater than 1.67*(10^{-4} ground motions) should be demonstrated."	We understand that the 10^{-6} criteria will be removed.
Sec. 1.5.3, p. 10	Staff Position, 1st bullet: "If a federally owned dam is identified as critical to the flooding reanalysis, the licensee should contact NRC promptly. NRC will act as the interface between these agencies and licensees. Memoranda of Agreement or other mechanisms are being developed to facilitate sharing of data (including necessary safeguards to protect sensitive information) between NRC and the appropriate federal agencies."	• If information from a federal agency is considered classified, would this information be limited to the government agencies or would the licensee be involved? •	Following the development of the Memoranda of Agreement, include in this ISG information regarding how to handle requests for information that may be considered classified by a federal agency.	We understand that a Memorandum of Agreement is under development that will describe how information can be communicated and controlled.
Sec. 1.5.3 / p. 10	Staff Position, 1st bullet: "It is important to note that in many cases federal agencies that own or operate dams have a conducted detailed failure analysis. To the extent these analyses are applicable, they should be used in the Recommendation 2.1 flooding reanalysis."	Details of the agency's existing dam failure analyses may not be provided to the licensee or may be considered classified. If the full details of the agency's existing analyses are not available to the licensee, it may not be possible to determine that the analyses are applicable and meet the criteria for the Recommendation 2.1 flooding reanalysis.	Clarify whether the onus is on the licensee or the federal agency to determine that the existing dam failure analyses performed by federal agencies are applicable and meet the criteria for the Recommendation 2.1 flooding reanalysis, in the event that the details of these analyses are not provided to the licensee.	We understand that a Memorandum of Agreement is under development that will describe how information can be communicated and controlled.
Sec 1.5.3, p. 10	Staff Position, 1st bullet: "In the case of dams and levees owned or operated by U.S. federal agencies, the federal agency responsible (owner/operator) for the dam should be involved in any discussions, including possibly reviewing any analysis performed."	It is unclear if this possible review is to occur as part of the evaluation or concurrently with NRC review. It is noted that the NRC-mandated schedule for evaluations may not permit such agencies to perform a review given their other commitments and responsibilities. This statement would appear to imply support for using previous analyses of upstream structures that have been reviewed and accepted by the federal owner/operators of such structures. FERC is a federal agency		

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
		which does not own or operate dams, but directly regulates dam safety of licensed hydropower dams.		
Sec 1.5.3, p. 10	Staff Position, 3rd bullet: "In most cases dams and levees will be owned and operated by private entities and regulated by a state agency. In this case, the licensee should interact directly with the owner and regulator. The licensee should notify NRC if they encounter difficulties in obtaining information. On a case-by-case basis, NRC may be able to provide some assistance in interfacing with state agencies."	Based on experience, many dam owners consider dam safety-related information to be highly sensitive. Dissemination of information related to dam failure mechanisms, dam stability, and hydraulic capacity is likely to be restricted. FERC has a specific designation, "CEII," (Critical Energy Infrastructure Information) that is applied to "sensitive" information, thereby, labeled as non-public. The NRC should consider proactively reaching out to state dam safety regulatory agencies to inform them of forthcoming information requests from plant owners and to emphasize the importance of this information to support these evaluations. There can be hundreds or even thousands of dams in the watershed upstream of a nuclear facility; therefore, direct interaction with each owner would/could be cost and time prohibitive.		
Sec. 2.2.3, p. 20	Last bullet in list: "Inability to warn in advance..."	Unlike the other bullets in the list, this bullet seems more like a consequence of failure rather than a causative failure mechanism, except possibly in the case of a cascading failure sequence, which is discussed in the next section.	Suggest deleting bullet, or clarifying how it might apply as a failure mechanism. It is understood that the failure mechanism is associated with the failure of upstream dams.	We understand that the text will be modified to indicate the concern with upstream dams and to focus on failures that my result in inability to warn in advance.
Sec 3.2, p. 23	Item 1c: "The lowest stage should correspond to the 500-year flood elevation estimated in step (b)."	Why was 500-year flood data selected to be used for analyses rather than 100-year data?		
Sec. 3.2, p. 24	Item 4: "Hydrologic Model Method (see Figure 13): Use an available rainfall-runoff-routing software package (e.g. HEC-HMS) to assess dam failure scenarios."	Can HEC-1 be used as the hydrological model method?		
Sec 3.2.1, p. 28	2nd para. : "Topographic information from LiDAR or a DEM at the location of the hypothetical dam is used to develop a stage-storage function for the	Grouping a large number of dams together would result in an unrealistically large reservoir volume. Applying actual topographic information to develop a stage-storage		

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
	hypothetical dam. This stage storage function is used to determine the water surface elevation of the hypothetical dam."	function for such a reservoir may result in very large water surface elevations and, thus, very large hydraulic head. The ISG should acknowledge (similar to the wording in the third paragraph) that the hypothetical dam should be representative of the collective dam heights of the individual structures it represents, while simultaneously representing an appropriately conservative scenario through the application of a hypothetical collective storage volume. In addition, selecting breach development parameters, such as breach development time, require engineering judgment in consideration of the fact that the dam in question is hypothetical and not an actual structure.		
Sec 4.2.2.3, p. 34	Staff Position, 2nd bullet: "...at least one turbine should always be assumed to be down (e.g., for maintenance or other reasons) in performing flood routings."	• Dam operators typically perform their maintenance activities outside of the flood season. Assumption that one unit is out of service is excessive. • Overly conservative assumption	• Assume all units are usable, use full power plant discharge capacity. • In large river systems with multiple generating dams does each generating dam have to consider one turbine out of service?.	We understand that the document may be revised to allow for justification of turbine availability in large river systems with multiple generating dams.
4.2.2.3, p. 34	"The potential for flood-borne debris to reduce spillway capacity should be considered."	There is no industry standard on how to address debris. Additional guidance should be provided on how to address flood-borne debris blockage.		We understand that this additional guidance is being developed.
Sec. 4.2.2.3, p. 34	3rd sentence under Potential for Reservoir Debris to Block Spillway: "As a rule of thumb, spillway bays with a clear distance less than 40 feet (less than 60 feet in the Pacific Northwest) are vulnerable to debris plugging."	• The criteria for considering potential debris blockage at a spillway are not clear. If a spillway is gated with 40-foot wide gates, are there criteria for how much blockage should be considered or how the spillway capacity may be reduced by flood-borne debris? • "This statement needs a reference." Could not find the source	• If debris blockage is considered as a potential vulnerability of a spillway, clarify criteria regarding spillway capacity reduction.	We understand that this additional guidance is being developed.

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
4.2.6, p 38	Staff Position: As written, the guidance is ambiguous as to the evaluation(s) that should be conducted for gate failure. Further, it does not address gate failure for multiple upstream dams.	There are infinite permutations for failure of gates given the information provided. The second staff position is incomplete	Clarify the guidance for gate failure.	We understand that this additional guidance is being developed.
4.2.7.1, p 38	Staff Position: The potential for basin to generate mud/debris flows should be considered.	What is the significance and concern with mud/debris as it relates to dam failure analysis or impact to the reservoir? Are basin specific studies being recommended or required?	The purpose analyzing mud/debris needs to be described including the hazard/risk associated with mud flows.	We understand that this section may be deleted or modified to address debris and sediment, not mud.
4.2.7.2, p 39	Staff Position: Impact loads on structures due to waterborne debris should be considered. In general, methods outlines in the FEMA Coastal Construction Manual and average size/weight for objects specified in ASCE Standards are acceptable.	What structures need to be evaluated for impact loads for the HRR versus the IA? Does this apply only to the dams and appurtenances? If this analysis is intended for the NPP site, discrete velocities will be required at each structure being evaluated. The debris sources along with the size and depth of the flood will determine the volume	Clarify position on the conditions being used to generate the debris (PMF or dam failure, etc) and where impact loads must be evaluated. If IA assumes all flooded SSC's are lost, would debris dynamic load analysis would not be required, or is it only intended to determine if flood retaining structures survive the debris impacts?	We understand that the following two staff positions will be added to address this item: • Loads due to waterborne debris carried by flood waters should be considered with regard to impacts on the dam (i.e., gates and associated mechanical equipment, appurtenances, parapets, etc.). • In the case of dam break flood waves, debris impacts to SSCs important to safety should be considered. Note that we believe that the second of the above bullets should be changed as follows to provided additional clarification: "...<u>loads due to</u> debris impact ... should be <u>determined</u>."
Sec 5.2.1, p. 46	3rd para. : "This type of cracking eventually leads to isolated blocks within the dam that subsequently rotate and swing downstream or downstream, releasing the reservoir."	Please reword this sentence to clarify the intent.		
5.2.4, p 48	Staff position for levee failure during a seismic event - assumption of starting water level is not indicated.		Starting water level should be consistent with that assumed for a seismic dam failure evaluation	
Sec .5.6, p.	Staff Position, 1st bullet: "Dam failure due	• The "maximum full pool level" generally	• Suggested change: "Dam analysis to	

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
55	to an earthquake should be considered for both maximum normal operating ("full pool") and average reservoir levels."	corresponds to a 10%/year frequency. Thus, the joint event failure probability considering the maximum normal operating full pool level is conservative by an order of magnitude. • Head water/tail water relationship prescribed is not possible for multiple reservoirs being simulated in a continuous hydraulic model for cascading dam failures.	show sufficient margin for 10^{-4} ground motions should consider median (or average) reservoir levels. Maximum operating full pool level (10 percentile) should be considered with 10^{-3} ground motions." • Revise guidance for the head water/tail water relationship as applied to cascading dam failures.	
Sec. 5.6, p. 55	"Given the hazard frequency target of $1x10^{-6}$ discussed in Section 1.4.2, the dam failure flood wave at the site should be combined with flows of a frequency that result in a combined annual probability of $1x10^{-6}$. For example, if the dam fails under a 10^{-4} ground motion, combine the dam break flood wave with a 100-year flood. If the dam fails under a 10^{-3} ground motion, combine the dam break flood wave it with a 1000-year flood."	• In the example, the combined event probability does not reasonably account for the fact that the 1000-year flood is a seasonal event and the maximum flood water level at the plant site for the 1000-year river flood is present for a limited part of the year only. The earthquake ground motion (and the resulting flood wave) and the 1000-year flood are independent events. Thus, the joint probability of occurrence of the combine event should consider the limited duration of the maximum flood level for a 1000-year flood. • The combining of an earthquake and a flood by simply multiplying their annual probabilities of occurrence does not allow for the very small duration within a year for the earthquake to coincide with a longer but still only a fairly small fraction of a year for the duration of most floods. • This paragraph is changed from previously expressed NRC positions as discuss in public meetings • What combination should be applied if seismic failure is just assumed?	• Suggested change: "For example, if the dam fails under a 10^{-4} ground motion, combine the dam break flood wave with a 10-year flood. If the dam fails under a 10^{-3} ground motion, combine the dam break flood wave with a 100-year flood. This example assumes that the high flood level at the plant site for the 10-year and 100-year floods will last approximately 1-month (10% of one year) or less before receding." • See methodology in: Event Combination Analysis for Design and Rehabilitation of U.S. Army Corps of Engineers Navigation Structures by Bruce R. Ellingwood, Contract Report ITL-95-2, July 1995, US Army Corps of Engineers, Waterways Experiment Station • Use event combinations as previously described in public meetings: 1. seismic hazard frequency target of $1x10^{-4}$ with 25 year flood, 2. 0.5 x seismic hazard frequency target	We understand that the ANS 2.8 seismic and flooding event combinations (modified with 10^{-4} ground otion) will be used in the final version of the ISG. i.e., • 10^{-4} ground motion with 25 year flood (Alt 1), • ½ of 10^{-4} ground motion with ½-PMF or 500 year flood, whichever is less (Alt 2)

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
			of $1x10^{-4}$ with 500 year flood.	
Sec. 6.1.3 / p. 67	General comment: It is unclear whether the sunny day failure mechanism is applicable to levees, since levees are normally subject to water loading only during flooding events.	It is recognized that levee failure should be assumed if the levee is overtopped. Levee failure at elevations less than overtopping should be investigated; however, it is debatable whether these conditions can be considered "sunny day."	Suggest consideration be given to removing levees from the sunny day failure mechanism section, and adding the information about levee failures included here to the hydrologic failure mechanism, with additional information as needed.	The guidance on levees was moved from this section but the heading for the 6.1.3 still needs to be deleted.
6.2, p 68	"Sunny day failure may be excluded from further consideration if it can be shown by the licensee that the probability of failure is 10^{-6} per year or less. The 10^{-6} value is chosen since there is not sufficient data to allow for accurate calculations of this event. Reasonable arguments justifying the case for a lower failure probability include but are not limited to a recurring dam inspection and monitoring program, expert assessments that the dam is in good condition, and detailed inspection reports."	What methodology for estimating a probability of failure is 10^{-6} per year or less would be acceptable to the NRC for sunny-day failure including piping or internal erosion failures.		We understand that a probabilistic approach to sunny day dam failure exclusion will not be included in the document. Sunny day failures will need to be considered for all critical dams assuming the dams withstand hydrologic event .
Sec. 6.2.1 / p. 68	Staff Position bullet: "Reasonable arguments justifying the case for a lower failure probability include but are not limited to…"	It is unclear what "lower failure probability" means in this context. Does it mean lower than 10^{-6} failure probability?	Additional description of how to apply probability to the sunny day failure mechanism and possible pathways to take credit for non-failure would be helpful.	We understand that a probabilistic approach to sunny day dam failure exclusion will not be included in the document.
Sec. 6.2.1 / p. 68	The Staff Position states that reasonable arguments for a lower than 10^{-6} per year risk of sunny day failure can be made using the existence of recurring dam inspection, monitoring program, expert assessments that the dam is in good condition and detailed inspection reports.	Federal agency dam owners generally have all of this information at hand. Utilities would have to request this data from the Federal agency dam owners.	Propose that the NRC ask the federal agency dam owners to agree via an MOU to provide this data to certify that their dams need not be analyzed in detail for a sunny day failure.	We understand that a probabilistic approach to sunny day dam failure exclusion will not be included in the document.
Sec 6.2.2 / p. 68	The Staff Position to use the maximum observed or maximum normal pool elevation for the sunny day breach analysis is excessive.	• "the maximum observed pool elevation" may be a very extreme event and not reflect sunny day conditions, which if considered in conjunction with runoff from a PMP could result in an unreasonable predicted maximum pool elevation. Such an extreme historical event may have a very low frequency and short duration relative to historical operation depending on the riverine system and the upstream	• The default starting water surface elevation used in flood routings for evaluation of overtopping or sunny day failure is the maximum normal pool elevation. Other starting water surface elevations may be used with appropriate justification.	We understand that the text will be modified to read: "…the default initial water level used in breach analysis and flood routings for evaluation of sunny-day failure should be the higher of the maximum observed pool elevation or the maximum normal pool elevation. Other water levels may

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
		watershed. • The implication of the term "sunny day" is that it occurs during non-flood conditions. Use of the maximum observed pool links it to the inflow of record for the dam.		be used with justification (e.g., records showing that water levels above max normal poll are infrequent and of short duration)." Note that it would be useful to describe the attributes of a justification of "infrequent" and "short duration".
Sec 8.1, p. 72	2nd paragraph: "However, by using a dam-breach flood prediction model and making several applications of the model wherein the breach width parameter representing the combined lengths of assumed failed monoliths is varied in each application, the resulting reservoir water surface elevations can be used to indicate the extent of reduction of the loading pressures on the dam. Since the loading diminishes as the breach width increases, a limiting safe loading condition which would not cause further failure may be estimated."	The benefit of this process is unclear. The maximum loading condition during an overtopping event would be present at time zero for all monoliths. Since failure of a single monolith is assumed to be quite short (on the order of minutes), reductions in upstream water levels are likely to not be significant enough to reduce pressures on other monoliths. Sensitivity analyses incorporating peak downstream breach flows and water surface elevations should also be considered as appropriate approaches to estimating breach width.		
Sec 8.2.2, p 76	"However, their paper does not provide clear criteria for selecting the erodibility index."	Xu and Zhang (2009) do not provide detailed criteria for selecting the erodibility index because they state that they used definitions in a paper by Briaud, which provides detailed definitions.		We understand that the Xu and Zhang (2009) breach methodology alone is not recommended for the 2.1 hazard re-analysis and if used, would have to be bench-marked against another approach.
Sec 8.2.2, p 76	"In addition, anecdotal evidence suggests that their relation for failure time may be biased in favor of longer times (Wahl, 2013)."	• Xu and Zhang define failure time differently than in other empirical breach parameter studies. This means that one must use their failure time estimates in a breach model (e.g. HEC-RAS) in a way that is consistent with their definition. It is not a fundamental deficiency or flaw in the method. • The difference in reported failure time is more appropriately characterized as a difference in how it is defined based on the	Remove the statement	We understand that the Xu and Zhang (2009) breach methodology alone is not recommended for the 2.1 hazard re-analysis and if used, would have to be bench-marked against another approach.

Section / Page	Comment	Concern	Proposed Resolution	Current Status (If applicable)
		starting and ending point. Not sure that anecdotal evidence is appropriate for an ISG document		
Sec 8.2.2, p 76	Xu and Zhang – "However, their paper does not provide clear criteria for selecting the erodibility index."	Xu and Zhang do not provide detailed criteria for selecting the erodibility index because they state that they used the J. L. Briaud (2009) definitions.	Revise the statement to say "The paper references the J. L. Briaud (2009) criteria for selecting the erodibility index."	We understand that the Xu and Zhang (2009) breach methodology alone is not recommended for the 2.1 hazard re-analysis and if used, would have to be bench-marked against another approach.
Sec 8.2.2.1, p 77	Uncertainty in Predicted Breach Parameters and Hydrographs	It should be not necessary to cover the extreme values if there is a sound basis for limiting the range	It is useful to recognize that "uncertainty" in regression equations is associated with "unexplained variance" and that physical arguments/engineering justifications can be made as to where in the range of "uncertainty" a particular dam would be expected to fit given its physical characteristics that are not specifically included in the "explained variance" represented by the mathematical form of the regression equation. Therefore it may not be appropriate to perform sensitivity analyses over the entire range of uncertainty on predicted breach parameters (or predicted peak breach flow rates).	
Sec 10.2, p. 84	2nd complete sentence : "Accurate estimates of flood elevation in areas of changing topography and near large objects in the flow field will typically require two-dimensional analysis."	Suggest adding "localized" to sentence, as it is typically not necessary to perform two-dimensional analysis of the entire inundation area, which may be hundreds of miles long: "….will typically require localized two-dimensional analysis."		