Specific Questions Raised by Auditors during Audit Related Teleconferences and Related RAIs
(List is compiled from pre-conference email communications)

Date of Discussion	Topic	Question	Related RAI
05/16		Is inter-module CCF coupling any different than inter-unit CCF coupling?	
5/25		It appears that nonsafety SSCs were included in the accident sequence analysis that is part of the seismic margins analysis. Was the seismic capacity of any nonsafety SSCs “credited” in reaching the final determination of the seismic margin? I don’t believe there is a discussion of the treatment of nonsafety SSCs in the seismic margins notebook. Is that correct?	
5/25	ATWS	Is there an analysis of TRN-14A with BOC kinetics (ER-P060-7076)? Sensitivity study in Appendix B comes close but it assumes one train of DHRS is available.	
07/18	Development of NRC staff’s MELCOR model	We would like to discuss the topic of “getting remaining input for the development of the NRC staff’s MELCOR model”. Today, I will send you a list of data items we have identified to date (I will call you to give you the password for the file). The discussion tomorrow would be to get NuScale’s general reaction to the list and talk about the most efficient way to deal with the list and provide feedback. We would not expect NuScale to be addressing specific items on the list during tomorrow’s call.	
08/08	Development of staff’s MELCOR model	Attached is the second list of data items needed for MELCOR modeling that our contractor has prepared. I think we have said that this would be coming at some of our previous calls. In addition to this, and for scenarios involving failure of containment isolation, we need information describing the containment evacuation system line to model flow out of the containment through that line, such as flow area, flow resistance, nominal flow rate, orifices or other flow restrictions. Can we discuss this request at our phone call on Tuesday?	
5/16	Document request	Access to Chapter 19 documents in ERR for a couple of containment systems reviewers. ER_P060_4715_R0_TRN_07T__General_Transient_with_Stuck_Open_RSV_and_No_Mitigatio n.pdf ER_P060_4748_R0_LEC_06T__RVV_LOCA_with_No_Mitigation.pdf ER_P060_4749_R0_LCC_05T__Charging_Line_Break_Inside_Containment_with_No_Mitigatio n.pdf ER_P060_4750_00_LCU_03T__Unisolated_Charging_Line_LOCA_Outside_Containment, No_Mitigation.pdf ER_P060_4857_R0_LCC_05T__Charging_Line_Break_Inside_Cntmt_Complete_ECCS_Failure _wECN.pdf ER_P060_7047_R0_LCU_05T__Unisolated_Charging_Line_LOCA_Outside_Cntmt_with_CFDS , ECCS.pdf ER_P060_7050_R0_LEC_09T__ECCS_Valve_LOCA_with_Charging_Injection.pdf ER_P060_7076_R0_TRN_14A__General_Transient_with_Cycling_RSV__ATWS_.pdf TRN-08T: General Transient with Reactor Safety Valves Failed to Open and No Mitigation, ER-P060-7075, Rev 0 (needs to be added to ERR)	
05/23	Document request	Please see if we can get the following additional documents in ERR. Note that these were not listed in the PRA documents list: Reactor Building Internal Flooding Report, ER-F010-3359 Control Building Internal Flooding Report, ER-F170-3391	8892

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Date of Discussion	Topic	Question	Related RAI
05/30	Document request	Can I request the following be added to the ERR? Chemical and Volume Control System Notebook P011 ER-P011-7011 Containment Flooding and Drain System Notebook P011 ER-P011-7012 Electrical Systems Notebook P011 ER-P011-7015	
05/31	Document request	Can we request NuScale to put Uncertainty and Sensitivity Analysis Methodology, ER-0000-2358 in the ERR?	
06/06	Document request	Can we have the following added to the ERR? Demineralized Water System Notebook P011 ER-P011-7014	
07/18	Fire PRA	I need some help understanding the assumptions behind the evaluations in Appendix G, “Fire Scenarios” of ER-P012-7022 particularly related to how failure mode dispositions (e.g., FDF, SHS, None) are made for various targets. For example, I would like to understand why the containment isolation valve SOVs are dispositioned as “None” for scenario IE-FIRE-3-ECCS. I would like some help in understanding the statements in comment column, “Fire damage to fiber optic cabling will not operate component. Fire damage to copper cabling in this area may compromise manual control switch but will not interfere with isolation auto-function. If primary control is damaged by fire, controls will automatically transfer to backup controller. Valve can be operated locally.” Also would like some help understanding below: For CIV SOVs, is the effect of FDF short to ground which will lead to CIV closure? Can a subsequent hot short reopen the CIV? For CIV SOVs, is the effect of SHS failure to close since the solenoid will remain energized? For ECCS SOVs, is the effect of FDF short to ground which will lead to ECCS actuation after IAB opens? For ECCS SOVs, is the effect of SHS failure to open since the solenoid will remain energized? Finally, clarification on fire areas routed with cabling for both divisions would be helpful too.	
07/18	Fire PRA	If we have time, I would like to discuss the top two cut-sets in FSAR Table 19.1-45 also.	
08/01	Fire PRA	Table 19.1-45 CDF cut set #2: The assumed fire-induced failure of an ECCS solenoid valve appears to be hot short. Is a hot short is necessary for ECCS to spuriously actuate, or is a short to ground sufficient to induce a spurious ECCS actuation?	
07/20	In-vessel retention	As part of our review of in-vessel retention (IVR) of core debris in the reactor vessel lower plenum, staff found a potential mistake in the following document in the NuScale ERR: “Analysis of In-vessel retention in the Rector Pressure Vessel,” ER-P020-3536-R0. Page 12 of the document states the surface area of a hemisphere is $3*Pi*R^2$. This potential mistake is carried into Equations 2-2 and 2-4. Is this a typo (3 versus 2) or was this formula ($3\pi R^2$) carried through the calculations of heat flux? If it was carried through, what is the impact of correcting the error on the computed results that support the demonstration of IVR?	

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05/09	Level 1 Model (ECCS model)	In the LOOP event tree there are sequences in which all offsite and onsite ac power is failed, reactor trip is a success, DHRS is success, recovery of ac power is failed and ECCS (ECCS-T01) is failed. It seems that complete failure of ECCS where no valves open would be OK since you have reactor trip and decay heat removal. Is the ECCS failure here a worst case partial ECCS actuation in which you have either 1 or more vent valves open and no return valves, or 1 or more return valves opening with no vent valves opening?	
04/27	Level 1 Model (uncertainty)	We would like to tee up a couple items on the document, ER-P010-7080, "Analysis of Event Tree Model Uncertainty in the Level 1 PRA." I mainly would like any clarification on the following: • When the document was issued (3/10/2016), certain design parameters (e.g., ECCS setpoints) were not finalized. Are the conclusions in the document still valid based on the design as reflected in the DCA? • The document identifies uncertainties for future analysis. Were these analyses performed?	8840
08/01	Level 1 PRA	RAI-26 clarification: Response states, "Simulations were performed including a failure of containment isolation on the CES line penetration." Can we see this evaluation in the ERR? Were isolation failures on other lines evaluated (e.g. CVCS)?	
08/01	Level 1 PRA	FSAR Figure 19.1-21 – What is the rationale for the event tree transfer to CVCS LOCA inside containment when CVCS charging line isolation fails?	
07/27	Level 2 PRA (large release frequency)	The NuScale application used a large release frequency metric of less than 10-6 large releases per year to show that the design meets the Commission's Safety Goal Policy. As part of this metric, the application defined a large release as an acute exposure of greater than 200 rem to an individual located at a distance of 0.167 miles from the reactor for 96 hours. We have reviewed a number of documents in the ERR but have not been able to find a discussion or analysis that supports your conclusion that this large release frequency metric (including the large release definition of 200 rem over 96 hours) is equivalent to or less than the Commission's Safety Goal Policy's quantitative health objectives for cancer fatality risk and prompt fatality risk. Is such a discussion available to us via documents in the ERR? We have read that document (ER-P000-7004) and could not find: A discussion or analysis that supports your conclusion that this large release frequency metric (including the large release definition of 200 rem over 96 hours) is equivalent to or less than the Commission's Safety Goal Policy's quantitative health objectives for cancer fatality risk and prompt fatality risk. The bottom of page 8 mentions the "quantitative health objective for prompt fatality risk," but it does not states how NuScale's LRF metric compares with it. Also, ER-P000-7004 does not mention the "quantitative health objective for cancer fatality risk."	8977
05/16	Multi-module	The following assumption is made for the multi-module PRA analysis: "*Inventory make-up via CVCS and CFDS operator actions occur sequentially not simultaneously".* Why is this an important assumption in the analysis?	

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05/16	Multi-module	It looks like the coupling mechanism for the initiating events in Table 2-1 would be the same for a multi-unit site having identical units, except perhaps loss of support system. True?	
05/16	Multi-module	Seems like some NuScale multi-module LOOP events would be same as for a multi-unit site and some would not. For example, a grid failure would affect all units on a site or all modules. But a plant centered or switchyard centered event would only affect one unit, at a multi-unit site, and all modules at a NuScale site. True?	
05/16	Multi-module	In Section 19.1.7 of the FSAR, I am having a hard time understanding the coupling mechanism: "Similar Plant Response." The "similar plant response" characteristic given in the discussion of the "Similar Plant Response" coupling mechanism, i.e., recovery of off-site power before battery depletion seems like it would simply be a series of human actions that affect all modules following loop. It is not clear how it differs from "Shared Human Events".	
05/16	Multi-module	Could you give me some examples of Basic Events affected by the "Physical Parameter" coupling mechanism and how they would be affected?	
05/16	Multi-module	In Section 19.1.7 of the FSAR, I don't understand the meaning of "CVCS Pipe Break Location/Size events" and why they are a coupling mechanism.	
06/27	Multi-module	Questions pertaining to table 19.1-78: a. What is the rationale for selecting a value of 1.0 for the multi-module adjustment factor (MMAF) on the RSV Demand Probability Event (seems high)? b. Why is the MMAF for Passive Safety System Reliability ECCS events an order of magnitude higher than the MMAF for the Passive Safety System Reliability DHR events	
06/27	Multi-module	Would like to better understand the following statements from Table 19.1-76: a. The CVCS makeup provision following an incomplete actuation of ECCS would align to a supply from the boron addition system when each module's CVCS makeup isolation valve fails to the open position and each module's makeup combining valve fails to the boron addition system position. b. The ELV system, although associated with a single module, has loads like DWS which are associated with multiple modules. The loss of DWS would impact water makeup capacity for LOCA events. c. Loss of EDSS common loads would complicate emergency response efforts from the MCR with the loss of emergency lighting, loss of control room habitability supporting equipment and failure of the monitoring from both the safety display and indication system and plant protection system. (How was this handled in the multi-module PRA?)	
06/27	RTNSS	The results of the focused PRA are discussed briefly in section 19.1.9 and Table 19.1-22 of the FSAR. That information indicates that the core damage frequency and large release frequency increase by 4 orders of magnitude when all non-safety related SSCs modeled in the PRA are assumed to be failed. Is there information in the non-docketed material that would explain which non-safety systems contribute most to the change in risk metrics derived from the focused PRA?	
04/18	Seismic Margins	Although we talked about a spreadsheet in our meeting, after reviewing our internal material, we concluded that the most effective way to answer the question about bioshield fragility calculations, was to annotate the seismic margins report (ER-P040-7026 Tables K-1 and K-2. We feel the spreadsheet is not self-explanatory and that the text and the added pdf notes provided in "pages 120-124 of ER-P040-7026.pdf" are more helpful.	

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<table>
<tr><th>Date of Discussion</th><th>Topic</th><th>Question</th><th>Related RAI</th></tr>
<tr><td>04/18</td><td>Seismic Margins</td><td>We've also added "ES-0303-3685Rev0_annotated.pdf" which is Reference 1.4.21 to ER-P040-7026; we've annotated this file to address the "UHRS" question, which is a term that the SMA doesn't use. The pdf notes relate the five time histories to CSDRS and ISRS.</td><td>8899</td></tr>
<tr><td>04/18</td><td>Seismic Margins</td><td>With regard to demand factor determination, we highlighted the relevant verbiage in ER-P040-7026 and added a pdf note.</td><td></td></tr>
<tr><td>05/09</td><td>Seismic Margins</td><td>The entry below appears in Table 19.1-40 of the FSAR. Is the reference to the ASME/ANS PRA Standard referring to the section on Seismic PRA or Seismic Margins?

<table><tr><td>Seismic sequences are mapped to those in the internal events PRA but augmented with seismically induced SSC initiating events and seismically induced SSC failures.</td><td>Common engineering practice and co
ASME/ANS PRA Standard.</td></tr></table></td><td>8899</td></tr>
<tr><td>05/16</td><td>Seismic Margins</td><td>Section 2.3.1.2: induced leaks are mentioned. What induces the leaks? Does this include effects of minor module rotation due to corbel bearing failure in multiple modules during a seismic event?</td><td>8899 (in part)</td></tr>
<tr><td>04/25</td><td>Severe Accident Analysis</td><td>What versions of the MELCOR code and the NuScale design were used for the MELCOR calculations in TR-0915-17565 Accident Source Term Methodology (cases STDBA No. 1, STDBA No. 2, STDBA No. 3, and STDBA No. 4)? Where are these calculations documented?</td><td>8903</td></tr>
<tr><td>04/25</td><td>Severe Accident Analysis</td><td>Where are the break elevation and flow area that were used for the following scenarios listed?
ER_P030_4524_R0 SAMDA Cat 2: Isolated CVCS LOCA Outside Containment Offsite Consequences
ER_P030_4525_R0 SAMDA Cat 1 CVCS LOCA Inside Containment Offsite Consequences
ER_P030_4526_R0 SAMDA Cat 3 Unisolated CVCS LOCA Outside Containment Offsite Consequences
TR-0915-17565 Accident Source Term Methodology (sequences STDBA No. 1 and STDBA No. 2)</td><td></td></tr>
<tr><td>04/25</td><td>Severe Accident Analysis</td><td>Where is break flow area (from the RCS to the secondary system) was used for the following scenario listed?
ER_P030_4528_R0 SAMDA Cat 5 Unisolated steam generator tube failure offsite consequences</td><td></td></tr>
<tr><td>04/25</td><td>Severe Accident Analysis</td><td>DCD 19.2.6.2 states "The two release categories identified in the Level 2 PRA were further refined into eight release categories to more realistically estimate the offsite consequences of severe accidents." Where is the description of how the two release categories were refined into eight?</td><td></td></tr>
<tr><td>04/27</td><td>Severe Accident Analysis</td><td>We would like any clarification on the following:

In our call on Tuesday, NuScale said that their MELCOR severe accident calculations for Chapter 19 (severe accident mitigation), SAMDA analysis, and the Source Term Topical Report all used the same CVCS line break size (0.00389 square feet which is 0.560 square inches)</td><td></td></tr>
</table>

Date of Discussion	Topic	Question	Related RAI
		based on the orifice in the CVCS line. However, the following two documents in the ERR give a CVCS line break size of 0.758 square inches) based on the orifice in the CVCS line: ER-P060-4749, CVCS break inside containment with no mitigation ER-P060-4857, CVCS break inside containment with complete ECCS failure	
05/09	Severe Accident Analysis	The total cesium releases listed in the last row of Tables B-6, B-10, B-13, and B-17 are different from the total cesium releases listed in Table B-18. For example, for Release Category 1, Table B-6 gives a total cesium release of 7.49E-6 while Table B-18 gives a total cesium release of 3.1E-3. Is this a typo?	
5/19 (emails between J. Curry and J. Schaperow)	Severe accident analysis	Section 19.2 of the NuScale DCD contains a section on thermally induced steam generator tube failure (pages 19.2-27 to 19.2-28). The section states "The probability of an SGTF during high-temperature severe accident conditions was developed conservatively assuming the primary side was depressurized and the secondary side was pressurized." I found (and read through) the following underlying report on steam generator tube failure which you put in the ERR: ER_P010_3782_R0, "Steam Generator Tube Failure Probabilistic Risk Assessment Report." Section 2.0 of the report contains the approach for estimating the probability of an SGTF both during normal operation and during high temperature severe accident conditions. Section 3.0 of the report describes the analysis and results for normal operation. Where can I find the analysis and results for high temperature severe accident conditions?	8889
06/20	Severe Accident Analysis	1. Table 7.1-4 of the NuScale FSAR lists the elevations for ECCS actuation signals. Where could we find the zero elevation that these are based upon? For example, is the zero elevation the bottom of the outer surface of the RPV bottom head or the pool floor? 2. Figure 3-1 and Figure A-1 of ER-P020-4450-R0, "Analysis of In-Vessel Retention in the Containment Vessel," show cross sections of the lower head of the CNV. Figure 3-1 appears to show that the bottom of the outer surface of the CNV bottom head is in contact with a horizontal structure and that this horizontal structure is in contact with the reactor pool floor. Where can we find the distance from the bottom of the outer surface of the CNV bottom head to the pool floor? Where can we find what parts of this distance are occupied by water and what parts by structures? 3. Where can we find the height of the CVCS charging line discharge point (in the RPV's riser) relative to the bottom-most point on the inside surface of the RPV bottom head? We found on page 12 of ER_P060_4857_R0, "LCC-05T: Charging Line Break Inside Containment with Complete ECCS Failure, from a PRA Level 2 Perspective," that the RPV-side junction of the CVCS charging line is {{ }} feet from the bottom of the CNV skirt. However, since the staff's MELCOR model elevations are relative to the bottom-most point on the inside surface of the RPV bottom head, we would still need to	

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		know the elevation difference between the bottom of the CNV skirt and the inside bottom-most point on the inside surface of the RPV bottom head. 4. Page 9.3-159 of the NuScale FSAR states "each CFDS subsystem includes two parallel, 100-percent-capacity centrifugal pumps." The staff notes that CFDS was assumed to inject in the MELCOR calculation described in Appendix A, "Sensitivity Analysis of Containment Flooding" in ER-P060-4750-R0, "LCU-03T: Unisolated Charging Line LOCA Outside Containment with No Mitigation, from a Level 2 Perspective." Where can we find the capacity of the CFDS to flood the containment during an accident (e.g. flow rate, shutoff head, pump head curve), the discharge location into the containment, and what indication(s) the operators would use to decide when to inject? 5. Page 19.1-167 of FSAR Chapter 19 states "Based on the RPV ultimate pressure capacity analysis, a flange gap is expected to form at the outer o-ring of the pressurizer heater access ports in an RPV overpressure sequence." Where could we find a drawing or schematic showing the location of this flange gap?	
08/08	Severe accident analysis	We are reviewing the text in FSAR 19.2 section on "equipment survivability." We had some questions that we would like to discuss during an upcoming audit call. So, we copied the text from the FSAR into a Word document and marked it up using the "Comment" feature of Word. Our questions are shown in the attached.	
06/27	System design	Do the back-up diesel generators require dc power to start? If so, is the power source local to the machine and part of the diesel start subsystem or is the dc power fed from the highly reliable dc power system?	
08/08	Severe accident analysis	Attached is the second list of data items needed for MELCOR modeling that our contractor has prepared. I think we have said that this would be coming at some of our previous calls. In addition to this, and for scenarios involving failure of containment isolation, we need information describing the containment evacuation system line to model flow out of the containment through that line, such as flow area, flow resistance, nominal flow rate, orifices or other flow restrictions. [The requested data was placed in NuScale's ERR.]	
07/25	Severe accident analysis	Please find attached the request for data (in a format that can be manipulated) we discussed earlier. Please let me know if this request can be accommodated and how much time it will take. [This request was for output in electronic format for three MELCOR calculations that NuScale performed. The requested output was provided on a disk enclosed with NuScale letter from Zackary Rad to Gregory Cranston dated August 3, 2017.]	
07/18	Severe accident analysis	Attached is my proposed edited version of NRO's list of requested design data. (Please note that this does not include RES's list of requested design data.) [The requested data was placed in NuScale's ERR.]	