NuScale Human Factors Engineering
Implementation Plans Review Comments

Operating Experience Review	
Page 4 last paragraph	Table 1-2 is cited in the paragraph but the table it's referring to is Table 1-3 "NUREG-1275 Human Performance Studies"
NUREG-0711 compliance matrix	Wrong section numbers.
Section 1.2.1, "Predecessor and Related Plants and Systems"	Lack of detail: *An initial screening is performed on each OER source to determine if further evaluation is necessary to identify potential HFE issues related to NuScale design. If there is no correlation between the operating experience related to these eliminated systems and components and the NuScale design, the OER document is closed as non-applicable*… What criteria are used in the screening? (See also block 1 in Figure 2-1)
Section 1.2.3, "Related HSI Technology"	Lack of Detail: First paragraph, last sentence, lists the sources of HSI technology that controls multiple processes not related to nuclear. General identifiers are used… non-nuclear plants, US military and petrochemical industry. Detail is not provided. Which plants, what in the military, etc.?
Section 1.2.3, "Related HSI Technology"	Lack of Detail: Last paragraph, first sentence… *NuScale visits sites of selected installations*… Which ones?
Section 1.2.4, "Issues Identified by Plant Personnel"	Lack of detail: *NuScale conducts interviews with plant personnel (nuclear and nonnuclear industries) based on experience with systems or technology applicable to the new design. Each interview is conducted in accordance with the applicable NuScale procedure*... without providing <u>which</u> plant staff will be interviewed. Also, I didn't see any description of the actual interview procedure (cited here), or a reference in Section 6.1 "Referenced Documents." "Plant personnel" needs to be more specifically defined. Include an outline of the review procedure
Section 2.1, "OER Process"	General clarification: Figure 2-1, Point 3 in the diagram, NO path leads to "OER team approve?"… YES path leads to "Transfer OE to engineering tracking database"… Is this database the same as the OER database, or HFE ITS? In this figure there's the OER database, engineering tracking database, and the HFE ITS. Also, the YES path for Point 2 says to "Capture OE in database"… Which one?

Section 4.0, "Results Summary report"	IP says the report will contain "a description of **how** issues identified by plant personnel during interviews are screened, reviewed, evaluated, and incorporated or not included in the NuScale design." How these actions are accomplished should be described in the IP. The results ("description of, and findings from, interviews with plant personnel or other users") need to be included in the RSR. *Each bullet in this section except for one lends itself to this language. The second bullet provides "a list of the OE documents reviewed" that will be included in the RSR. The last bullet, regarding IHAs, gives what seems like a "mix." The top bullet has the *how* issues will be identified related to IHAs are screened, reviewed, etc., but the sub-bullets essentially quote 0711.
General Concern	There's no discussion of the actual format of the OER database itself. In other IPs we are given a glimpse of what the actual database table (or portions of it) looks like.
General Comment	In some sections there was a lack of detail. (-) Document organization greatly facilitates our review (+)
Functional Requirements Analysis / Functional Allocation	
Page 4, Section 2.4	First sentence states that "Members of the HFE team *analyze* each function within the plant functions list to determine the appropriate level of automation." What criteria are used to analyze each function? Second paragraph, first sentence: "The HFE team reviews the *function-related design documents*…" Which documents are function-related? Third paragraph that begins with "When the function": states that "To conduct requirements analysis, the HFE team *synthesizes* the conditions…" What is meant by synthesizes? What is the scope of the synthesis? How is it done? In essence, what are the measureable criteria the staff can use to asses this?
Page 6, Section 2.5.1	Table 2-2 provides example criteria for the function allocation (FA). Although some of the items in the table may be criteria that are used during FA, the IP mentions that they are not the NuScale automation criteria. Is the FA criteria provided in the FRA/FA procedure (Reference 8.2.2)?
Page 8, Section 2.5.4	Second bullet, second sentence: "In Figure 2-1, Point 2, SMEs evaluate the complexity of full automation for the intended function. **In most cases, it is technically feasible to automate**"… Why (what is the basis for this statement)?
Task Analysis	
Page 6	Please clarify: Figure 3-1, "General Flow Chart for TA Steps," contains a statement to "see reference 2.2.4" (next to the triangle labeled "Feasibility and Reliability").

	Reference "2.2.4" is not listed in the Task Analysis Implementation Plan (TA IP).
Pages 7-8, Section 3.3, Screening Methodology	With respect to Criterion 5.4(2) and Section 1.2.2, "Review Elements" of NUREG-0711, which says, "To determine whether an IP is acceptable, the NRC staff evaluates whether the IP is detailed, i.e., the IP describes the methodology in a step-by-step format to ensure that the applicant's design personnel can reliably use the IP, and that knowledgeable engineers will obtain consistent results from executing the methodology:" Section 2.2, "Types of Tasks," lists the types of tasks that will be included in the selection process. The list conforms to Criterion 5.4(1). Section 3.3, "Screening Methodology," describes how some of these types of tasks will be screened, but it does not describe how the following types of tasks will be screened to identify tasks that will be analyzed: tasks that are new, tasks that are significantly different, tasks related to monitoring of automated systems, tasks related to identifying failure of automation, and tasks anticipated to impose high demands. • Describe the criteria that will be applied by the task analysis subject matter experts (TA SME) to screen and select these types of tasks for analysis. • Describe the resources the TA SME(s) use to screen these types of tasks.
Page 7, Section 3.3.1	With respect to Criterion 5.4(2) of NUREG-0711 and Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.3.1, "Normal, Abnormal, Emergency, and Alarm Response Procedure Tasks" says "procedures are generally not available during early task analysis; therefore TA personnel include former operators of commercial U.S. nuclear power plants and other subject matter experts. Where procedures are not available for initial TA, the tasks to be analyzed are based on procedures from similar systems and processes." • It is not clear how using former operators in the task analysis process resolves the fact that procedures are not available; please clarify this. • Specify what kinds of "other" subject matter experts will be available as a resource for the TA SME. • Describe any resources other than procedures that could be used to identify tasks that represent the full range of plant operating modes. (Note: Section 3.3.2 provides examples of documents that will be used to identify tasks related to surveillances). • Describe examples of "procedures from similar systems and processes" that the TA SME can use. •
Page 8, Section 3.3.3	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.3.3 says that "[…….]" will review the OER to identify tasks that could have potentially negative consequences if not performed correctly.

	This section refers to the Operating Experience Review Implementation Plan (OER IP) and provides examples of negative consequences. The OER IP does not include direction to the SME(s) performing the OER to identify OE about improperly performed tasks that resulted in the negative consequences described in the TA IP. Align the OER IP and TA IP to ensure that the TA SME(s) review OE to select these kinds of tasks for analysis.
Page 9, Section 3.4	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Describe the kinds of resources the TA SME(s) should use to write the detailed task narratives.
Page 9, Section 3.4	With respect to Criterion 5.4(3) and Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.4, "Detailed Task Narratives," states that the TA SME should document the "type of decision." Describe the types of decisions that the TA SME should document.
Page 10, Section 3.5	Please clarify: Section 3.5, "Task Sequencing Development and Decomposition into Task Elements," states that <u>each</u> task is decomposed. Figure 3-1, "General Flow Chart for TA Steps," states that [……]. Clarify whether or not the OSD is the tool used to decompose <u>each</u> task, and whether or not an OSD should be developed for each task selected for analysis.
Page 10, Section 3.5	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Describe any resources available to the TA SME(s) to decompose tasks and create the OSDs.
Page 10, Section 3.5	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.5, "Task Sequencing Development and Decomposition into Task Elements," describes in general terms how an operational sequence diagram (OSD) is developed, and an example is provided, but the process for developing the OSD is not provided in a step-by-step format. • Provide clear directions for how the TA SME(s) "decompose" tasks. • According to the example, it appears that the TA SME should begin the OSD with a high level function described in the FRA/FA report. Describe how the TA SME should start to develop the OSD. • Describe whether or not the symbols in Figure 3-2 have any specific meaning. If so, describe how the TA SME should use the symbols.

	• Describe how, or if, the OSD will be documented.
Page 15, Section 3.8	With respect to Criterion 5.4(6) and Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.8, "Number of People Required for Tasks," states that the [……..] is documented in the task narrative. Section 3.4, "Detailed Task Narratives," lists the information required to be documented in the task narratives; however, information about the number of people who are required to perform the task is not included. Describe how the TA SME(s) should document the number of people required for tasks.
Page 15, Section 3.9	With respect to Criterion 5.4(7) and Section 1.2.2 of NUREG-0711: Section 3.9, "Knowledge and Abilities Identification," states that tasks are analyzed to determine the knowledge and abilities required to perform the task. Section 3.4, "Detailed Task Narratives," lists the information required to be documented in the task narratives; however, information about the knowledge and abilities required to perform the task is not included. Describe how the TA SME(s) should document the knowledge and abilities.
Page 16, Section 3.11	Please clarify: Table 3-1, "Criteria and Rating Factors for Situational and Performance-Shaping Factors," [……]; however, Section 3.11 "Situation and Performance Shaping Factors," states that [……..]. Also, frequency is listed as a performance shaping factor, but it is not clear if a value of 5 is associated with daily tasks or tasks that are performed rarely. • Clarify whether or not the rating scale starts at 0 or 1. • Clarify if a 5 is related to low or high frequency.
Page 12, Section 3.6	With respect to Criterion 5.4(5) and Section 1.2.2, "Review Elements," of NUREG-0711: • Describe how Criterion 5.4(5) is satisfied. It is not clear if the time required is calculated only for tasks associated with important human actions or if it will be calculated for each task. Criterion 5.4(5) says time required should be estimated for each task. Note that Criterion 5.4(9) provides additional guidance for estimating time required for IHAs. • Describe how (or if), the OSD is used to determine the time required.
Page 12, Section 3.6	With respect to the second bullet and the additional information listed under the seventh bullet of Criterion 5.4(9):

	Section 3.6 states that "The time required calculation is based on an understanding of the sequence of operator actions…" • Describe how the time required calculation is based on a documented sequence of operator actions (please clarify if the OSD is used to develop the time required for IHAs). • Provide the calculation used to determine "time required." Sections 3.6 and 3.7.2 describe the inputs, but no equation is provided.
Page 12, Section 3.6	With respect to the third bullet of Criterion 5.4(9): Section 3.6 states that "if measurements are not feasible due to the maturity of the design, two different SMEs develop independent assessments for time required for IHAs." • Describe any techniques that will be used to minimize bias when estimates of time required are derived using methods that are dependent on expert judgment, and describe how uncertainties in the analysis of time required are identified and assessed. • Describe any resources that the TA SME(s) will use to assess time required if measurements are not feasible.
Page 21, Section 5	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Section 5.0, "Task Analysis Outputs," states that the TA generates the complete HSI inventory and the characteristics of that inventory. Section 3.12, "Inventory of Alarms, Controls, and Indications," lists factors that the TA SME(s) consider and document. Describe how the TA SME will document the HSI inventory and the characteristics of that inventory.
Page 14, Section 3.7.2	With respect to the eighth bullet of Criterion 5.4(9): Provide the basis for the adequacy of the time margin described in Section 3.7.2, "Time Margin."
Page 9, Section 3.4	With respect to Criterion 5.4(3) and Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.4, "Detailed Task Narratives," states that the TA SME should document the "cognitive and physical workload (for the whole operating crew)." No other guidance in this section is provided for the TA SME to use to determine the workload; however, workload is discussed in Section 3.7.1, "Workload Assessment." • Describe how the TA SME will determine the workload associated with the performance of the task in Section 3.4. • Describe how the TA SME will determine workload for "the whole operating crew."

Page 13, Section 3.7.1	With respect to Criterion 5.4(3) and Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.7.1, "Workload Assessment," describes how workload is calculated, and an equation is provided. • Provide an equation the TA SME can use to calculate the time engaged (Teng). • Define "expected secondary task factors," and describe how the TA SME will identify them. • Clarify whether or not the OSD is used to determine the Teng. • Describe how the TA SME(s) will document the time engaged, time available, and workload values.
Page 14, Section 3.7.1	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.7.1, "Workload Assessment," states, "A risk-assessment based workload analysis is often used in place of a conservative go-no-go decision early in TA before the sum of the workload is evaluated. Tasks may be redefined if evaluated as high risk for workload." It isn't clear from this statement what, if any, actions the TA SME(s) should perform. • Describe the steps that are part of a "risk-assessment based workload analysis." • Clarify what is meant by a "go-no-go decision." • Describe what is meant by "tasks may be redefined," and describe any actions the TA SME(s) should take to "redefine" tasks.
Page 7, Section 3.2	With respect to Section 1.2.2, "Review Elements," of NUREG-0711: Section 3.2, "Methodology Summary," lists the steps involved in the task analysis. One of these is [……]. This is also listed in Figure 3-1. Describe what action(s) the TA SME(s) need to take to perform this step.
Page 9, Section 3.5 of the Staffing and Qualifications IP; and Section 3.7.1 of the TA IP	Please clarify: Section 3.5, "Baseline Assumptions," of the Staffing and Qualifications Implementation Plan (S&Q IP) states that "TA determines the minimum MCR shift contingent for <u>various module configurations</u> and operating modes including shutdown and refueling modes through workload analysis… operator workload is determined by the collective time required/time available calculation." Because the operators may be operating up to 12 modules from one control room, it is possible that each module is in a different configuration or mode. Thus, there will be many combinations of module configurations. Different combinations will have different workload values and staffing levels. • Provide an initial assumption for the TA SME(s) about how many

	modules are to be analyzed during task analysis. For example, if the TA SME(s) are to initially identify tasks associated with operating a single module, then include this in the TA IP. • Describe how the workload for operating more than one module at a time, and the required staffing, will be determined. • Section 3.7.1, "Workload Assessment," in the TA IP does not describe how a "collective time required/time available calculation" is determined. Please describe this in more detail.
Page 8, Section 2.5.4 of the FRA/FA IP; and Page 4, Section 2.2 of the TA IP	Section 2.5.4, "Function Allocation Decision Making Criteria," in the FRA/FA IP states, "Monitoring of complex automation is evaluated in task analysis." Section 2.2, "Types of Tasks," of the TA IP states, "Tasks related to monitoring and control of automated systems that are safety-related or risk-significant…are included in the TA selection process." • Describe how tasks related to the monitoring of non-safety related and non-risk significant systems controlled by "complex automation" will be included in the task selection process.
Page 33, Section 5.4.2 of the HSI Design IP; and Page 3, Section 2.1 of the TA IP	Please clarify: Section 5.4.2, "Technical Support Center," of the HSI Design IP, states, "TA is conducted for TSC personnel tasks to ensure ease of understanding and use of the HSIs for those personnel not subject to the training requirements of operations personnel." Section 2.1, "Applicable Facilities," states that "Tasks to be analyzed are those performed by licensed and non-licensed operators in the following locations: technical support center (TSC) - limited to tasks that directly support event mitigation and plant stabilization by the operating crew." Align the statements in both documents about the scope of the task analysis for the TSC.
Treatment of Important Human Actions	
None.	
Staffing and Qualifications	
Page 3, Section 2.2	May need to re-characterize manning level so it is not called an exemption.
Page 6, Section 3.4	How does "NuScale Concept of Operation" document interface with IPs?
Page 11, Section 4.0	Not clear how "the assignment of tasks to personnel" is addressed in the RSR. Note: individual responsibilities is addressed in Section 3.1.
HSI Design	
Page 6, Section 2.3	"Only code of federal regulations, staff requirements memoranda, and regulatory guides listed in this plan are considered design requirements for HSI." Words could be interpreted as limiting the applicability of regulation.

Page 6, Section 2.3	Inconsistency in that Section 2.3.4 lists NUREGs which are not listed in previous sentence as a design requirement but are not in Section 2.4 that specifically addresses guidance. Which category do NUREGs fall into?
Page 8, Section 2.3.4	Were NUREG-0711 and 0800 intentionally omitted?
Page 16, Section 3.5	Didn't find an overview of teamwork and communications: 8.4.2(2) 3rd bullet How do you address, "covering the technical bases demonstrating that they constitute a state of the art HSI design supporting personnel performance?" (I would say this basis is derived from the factors listed in Sections 2.2.1 and 2.2.2, or Section 5.2 but how were these lists derived?)
Page 21, Section 4.4	Lack of Detail: "The HFE team (see Reference 10.2.1) is involved in decisions to deviate from the guidance." Need to see direction on when deviations can be taken to know whether results will be satisfactory .
Page 22, Section 5.1.1	"In addition, administrative controls require the operator to inform the CRS prior to actuating any IHA controls, thus allowing for peer checking of those actions." How is an administrative control credited in the design communicated to a COL holder? Are you planning on including a COL action item?
Page 23, Section 5.1.3	The current material is good but doesn't cover the HFE element of the design. NUREG-0700 contains the HSI related criteria we are looking for and it would be helpful to have that referenced here along with some minimum statement of what will be done since the style guide is part of an iterative design process.
Page 23, Section 5.1.4	"The NuScale HSI supports minimum staffing. The passive features, modular design and high degree of automation (see Reference 10.2.1) reduce the number of alarms, controls, indications, and procedures. The automation, along with the reduced task burden of managing the HSI, enhances the ability of operators to maintain situation awareness of overall plant conditions." This is an example of a statement that needs to be quantified so that the staff can make the conclusion that the HSIs do support minimum staffing.
Page 23, Section 5.1.6	Remote shutdown facility and local control station environments not addressed. (Criterion 8.4.4.1(6) in NUREG-0711) Note the following from RG 1.196: 2.6 Reactor Control - This Regulatory Position provides guidance for assessing whether a radiological, hazardous chemical, or smoke challenge could result in the inability of the control room operators to control the reactor from the control room, or in the event of a smoke challenge, from the control room or the alternate shutdown panel. This Regulatory Position does not address the performance of the reactor controls and instrumentation systems that are affected by environmental conditions caused by a radiological, hazardous chemical, or smoke event, nor does it address human engineering (i.e., temperature, vibration, sound, or lighting).

	The current material is good but doesn't cover the HFE element of the design. NUREG-0700 contains the HSI related criteria we are looking for and it would be helpful to have that referenced here along with some minimum statement of what will be done since the Style guide is part of an iterating design process. Note that the auxiliary system designs should be complete as part of the design cert therefore inputs should be available to the HFE design.
Page 24, Section 5.1.6	"Auxiliary systems such as heating, ventilation, air conditioning, and lighting systems are designed by other engineering disciplines, but the HFE team is arranged and placed within the overall engineering organization in such a way as to be able to affect design decisions (see Reference 10.2.1, section 4.2)." These designs are completed as part of the DCD application. Consequently the conditions and ranges should be defined and available as design inputs to the control room HFE design.
Page 27, Section 5.3	While the style guide is iterative, we typically review the style guide in its initial stage even at the implementation level. From our perspective the style guide is basic guidance used to direct the design process. Not having it makes it seem that the design process is incomplete.
Page 27 Section 5.3.1	At a results level this section would be acceptable. At an IP level questions come up like: • "The review emphasis may shift as the design matures. The review step includes at least one of the following efforts for a particular iteration of the design:" First sentence implies all elements are addressed with varying priority. Second sentence implies only applicable items might are reviewed. • "identification of usability issues based on human factors expert inspection and/or heuristic evaluation" What guidance is used for this inspection/evaluation? A heuristic evaluation could be most anything. What guidance does the person doing it follow? What is this bullet doing that the next one doesn't? • "Selection of the best of multiple candidate approaches or conflicting guidelines for a particular HSI design problem, based on pre-defined criteria and thorough review of design characteristics." What are the predefined criteria? Actions like this need to be quantified.
Page 28, Section 5.3.2	Acceptance criterion 8.4.6.2(2) not completely addressed. Testbed and performance measures did not appear to be included.
Page 30, Section 5.3.2	"Test crew individuals of the design or design feature they are selected to test."

	Don't understand this sentence.
Page 30, Section 5.3.2	"This process includes a random selection from a pool of operators who meet the required qualifications." We would interpret this as having or have held an operating license for the Control Room positions based on the preceding sentence that says crew selection will ensure the plant personnel represent the population of U.S. operating crews. Given NuScale's unique design do you want to apply this degree of expertise during the early design tests or make it a graded approach as you do with the test bed in Table 5-1, "Design Maturity"?
Page 33, Section 5.4.2	"Workstation arrangements in the TSC are different from those in the MCR as roles and responsibilities differ; however, the arrangement and location of SDCV indications and alarms are similar in both locations." How will the differences be determined? (Is it in this scope or being addressed elsewhere?) I assume SDCV indications and alarms are unique to each module. Does this mean the TSC will have 12 panels similar to the control room layout or is the display more limited?
Page 33, Section 5.4.2	The text says offsite radiological information will be provided in the TSC. What information is included? My experience is that most offsite monitoring was for long term biologic impact and was not automated. Offsite release data was collected by people because of the variability of plume direction.
Page 34, Section 5.4.4	"Thus, the HSIs in the RSF are organized in a way that promotes maintenance of safe shutdown capabilities." There is insufficient detail on how this will be accomplished.
Page 36, Section 6.0	"The NuScale plant HSI is designed to accommodate specific types of I&C and HSI system failures. Procedures govern operator identification of and response to the various failure modes." There is insufficient detail on how this will be accomplished. How does loss of site ac affect displays? This goes back to which displays are SR/NSR. How does loss of one bus affect control room (are Work stations supplied by different buses, which power loss is hardest to detect and how is that detection accomplished?) How does operator know when there is an IC software issue requiring the use of DAS?
Human Performance monitoring	
None.	
Design Implementation	
None.	