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Docket: PROJ0769

U.S. Nuclear Regulatory Commission  
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**SUBJECT:** NuScale Power, LLC Submittal of "Human Factors Engineering Staffing and Qualifications Implementation Plan," RP-0914-8538-P, Revision 2 (NRC Project No. 0769)

**REFERENCE:** Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of 'Human Factors Engineering Staffing and Qualifications Implementation Plan,' RP-0914-8538-P, Revision 1 (NRC Project No. 0769)," dated March 14, 2016 (ML16074A434)

NuScale Power, LLC (NuScale) hereby submits Revision 2 of the "Human Factors Engineering Staffing and Qualifications Implementation Plan" (RP-0914-8538-P). NuScale previously submitted Revision 1 of this document by the referenced letter dated March 14, 2016. The purpose of the revision is to provide clarification related to completion of staffing plan validation in the human factors engineering (HFE) staffing and qualifications element. The need for the clarification was identified during recent pre-application meetings between NuScale and the NRC's HFE staff.

Enclosure 1 is the nonproprietary version of the implementation plan entitled "Human Factors Engineering Staffing and Qualifications Implementation Plan." Enclosure 2 is the proprietary version. NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request.

This correspondence includes preliminary and/or conceptual information which reflects the current stage of the NuScale design and may be subject to change.

Please feel free to contact Steven Mirsky at 301-770-0472 or at [smirsky@nuscalepower.com](mailto:smirsky@nuscalepower.com) if you have any questions.

Sincerely,



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- Enclosure 1: "Human Factors Engineering Staffing and Qualifications Implementation Plan," RP-0914-8538-NP, Revision 2, nonproprietary version
- Enclosure 2: "Human Factors Engineering Staffing and Qualifications Implementation Plan," RP-0914-8538-P, Revision 2, proprietary version
- Enclosure 3: Affidavit, AF-0416-48470

**Enclosure 1:**

“Human Factors Engineering Staffing and Qualifications Implementation Plan,” RP-0914-8538-NP,  
Revision 2, nonproprietary version

# **Human Factors Engineering Staffing and Qualifications Implementation Plan**

March 2016

Revision 2

Docket: PROJ0769

NuScale Nonproprietary

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## 1.0 Introduction

### 1.1 Purpose

The objective of staffing and qualifications (S&Q) analysis is to determine the number and qualifications of licensed operator personnel required for safe and efficient NuScale plant operation under all operating conditions based on task and regulatory requirements.

### 1.2 Scope

Applicable licensed operator personnel numbers and qualification analyzed under S&Q activities are consistent with those of the overall human factors engineering (HFE) program as described in the HFE Program Management Plan (Reference 6.2.1) and in Section 3.3.

The S&Q Implementation Plan (IP) includes staffing evaluations for activities performed by licensed control room operators, and does not include staffing analysis for maintenance or refueling activities, activities completed by craft/technical personnel (i.e., mechanical, electrical, or instrumentation and controls (I&C) maintenance; health physics; chemistry; engineering; or information technology), or activities associated with the technical support center, emergency operations facility, operations support center, or any other emergency response facilities unless they are determined to impact licensed operator workload. If licensed operator workload is impacted, then the area of concern is analyzed to a degree sufficient to quantify the impact to licensed operator workload or staffing and develop any human-system interface (HSI) or staffing adjustments required to address the specific task and associated staffing requirements.

The numbers and qualifications of nonlicensed operator personnel are beyond the scope of this document.

### 1.3 Abbreviations and Definitions

Table 1-1 Abbreviations

Term	Definition
ANSI/ANS	American National Standards Institute/American Nuclear Society
CFR	Code of Federal Regulations
COL	combined license
CRS	control room supervisor
DCD	design control document
FA	function allocation
FRA	functional requirements analysis



<b>Term</b>	<b>Definition</b>
HED	human engineering discrepancy
HFE	human factors engineering
HFEITS	human factors engineering issues tracking system
HSI	human-system interface
I&C	instrumentation and controls
IHA	important human action
IP	implementation plan
ISV	integrated system validation
MCR	main control room
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission (technical report of the United States Nuclear Regulatory Commission)
OER	operating experience review
RIS	regulatory issue summary
RO	reactor operator
RSR	results summary report
S&Q	staffing and qualifications
SME	subject matter expert
SM	shift manager
SMR	small modular reactor
SOC	sampling of operational conditions
SRO	senior reactor operator
STA	shift technical advisor
TA	task analysis
TIHA	treatment of important human actions
V&V	verification and validation

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Table 1-2 Definitions

Term	Definition
VISION	A database program that is used to track training program development from task analysis through objectives and simulator development. This program is used at NuScale to document FRA/FA and task analysis.

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## **2.0 Applicable Regulatory Guidance for Staffing and Qualifications**

### **2.1 Standard Review Plan Guidance on Staffing and Qualifications**

NuScale's response to Standard Review Plan (Reference 6.1.2) section 13.1.1 Management and Technical Support Organization:

- A combined license (COL) applicant that references the NuScale plant design certification will provide a description of the corporate or home office management and technical support organization.

NuScale's response to Standard Review Plan Section 13.1.2 – 13.1.3 Operating Organization:

- A COL applicant that references the NuScale plant design certification will provide a description of the proposed structure, functions, and responsibilities of the onsite organization necessary to operate and maintain the plant.
- A COL applicant that references the NuScale plant design certification will provide a description of the qualification requirements for each management, operating, technical, and maintenance position described in the operating organization.

### **2.2 Code of Federal Regulations Guidance on Staffing and Qualifications (10 CFR 50.54(m))**

The NuScale plant is designed to operate up to twelve modules from a single main control room (MCR), which is not specifically addressed in 10 CFR 50.54(m) (Reference 6.1.3). Due to NuScale's passive safety systems, simple operation, automation, reduced licensed operator workload, limited important human actions (IHA), and ample time to complete operator actions, the NuScale plant has been designed with the assumption that there will be a staffing solution that does not comply with 10 CFR 50.54(m).

SECY-11-0098 (References 6.1.15) provides the NRC staff's proposed approach to resolving the issue of the appropriate number of on-site licensed operators for multi-module nuclear power plants, and potential requests for exemptions from the on-site operating staffing requirements in 10 CFR 50.54(m).

SECY-11-0098 recommends "a two step approach to address operator staffing requirements for SMRs. In the near-term, applicants can request exemptions to the current operator staffing requirements in 10 CFR 50.54(m) and the staff will review the request using existing or modified guidance. Once experience is gained, the staff would initiate the long-term solution, which is to revise the regulations to provide specific control room staffing requirements for SMRs." As the first SMR vendor to develop a design based on a different licensed operator staffing requirement and control room configuration than that required by 10 CFR 50.54(m), NuScale is in the unique position of working with the NRC in exercising the existing guidance. Consistent with SECY-11-0098, NuScale is using the existing guidance in NUREG-0800, NUREG-0711, and NUREG-1791 to provide the technical justification for an alternate staffing solution. By incorporation of the guidance in NUREG-1791, specifically section 10, Review the Staffing Plan Validation, into the Staffing and Qualification (S&Q) RSR, the approval of

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the S&Q RSR would constitute a favorable review of the staffing plan validation and stand as the technical justification for the alternate staffing regulation that would be addressed in the DC rule.

NUREG-0711 section 6.4 Review Criteria, item (2) states that NUREG-1791 and NUREG/CR-6838 (Reference 6.1.19) should be used for plant staffing levels that require an exemption from 10 CFR 50.54(m).

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}}<sup>2(a),(c)</sup>

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### 3.0 Staffing and Qualifications Methodology

#### 3.1 Initial Staffing Levels

Minimum MCR staffing levels as well as operator roles and responsibilities are described in detail in Concept of Operations (Reference 6.2.9). {{

}}<sup>2(a),(c)</sup> Due to the NuScale plant's passive safety systems, simple operation, automation, expected reduced licensed operator workload, and limited important human actions, a twelve-module NuScale plant is planned to be operated with a minimum MCR shift contingent of three licensed reactor operators (RO) and three licensed senior reactor operators (SRO) covering the roles of shift manager (SM), shift technical advisor (STA), and control room supervisor (CRS). This initial staffing level is subject to change following completion of the analyses described below.

#### 3.2 Task Analysis Inputs

As described in the Human Factors Engineering Task Analysis (TA) IP (Reference 6.2.4), TA results are used to determine sufficiency of the defined crew roles and responsibilities and the assumed crew size for all plant operating modes and conditions. Personnel tasks, addressed in TA, are assigned to staffing positions considering

- task characteristics, such as the knowledge and abilities required, relationships among tasks, time available, and time required to perform the task
- the operator's ability to maintain situation awareness within the area of assigned responsibility
- teamwork and team processes such as peer checking
- workload associated with each job within the crew

#### 3.3 Determining the Number and Qualifications of Licensed Operator Personnel

The scope of S&Q analyses includes determining both the number of licensed operator personnel and their qualifications. For the purposes of this implementation plan, licensed operator personnel include operators and senior operators as defined by 10 CFR 55.4 (Reference 6.1.4). Licensed operators' roles and qualifications include those of a SM, a CRS, a STA, and three ROs.

S&Q analyses define numbers and qualifications of licensed personnel for the full range of conditions and tasks, including operational tasks (under normal, abnormal, and emergency conditions).

#### 3.4 Iterative Nature of Staffing Analysis

Human engineering discrepancies (HED) are generated during all aspects of the NuScale HFE program as described in the Human Factors Engineering Program Management Plan (Reference 6.2.1). HEDs generated during those HFE program

elements described below that affect the S&Q analyses are resolved as part of S&Q when possible. These HEDs serve to confirm or change the initial staffing goals for the MCR crew. Initial staffing goals are modified in an iterative fashion through the use of the HED process as information from other HFE elements and S&Q analyses, evaluations, and tests becomes available.

### **3.5 Basis for Staffing and Qualification Levels**

The initial staffing goals for the MCR crew are identified in Section 3.1 and further described in Concept of Operations (Reference 6.2.9). Staffing goals for the MCR crew are an input to or an impact on many of the HFE program elements and are ultimately confirmed during integrated system validation (ISV) as part of human factors V&V (Reference 6.2.7). The initial staffing goals are subject to revision based on the results of HFE analyses, including operating experience review (OER), FRA/FA, TA, HSI Design, and S&Q. The methodologies used in the analyses of these HFE elements are described in the corresponding IPs. Results of these analyses, as described in their respective results summary reports (RSR), provide the basis for any changes to the initial staffing levels assumed in Concept of Operation.

The following sections describe the methodology NuScale is using to perform the S&Q analyses and evaluations to determine and confirm the acceptability of staffing levels, staffing qualifications, and roles and responsibilities for safe operation of a multi-module nuclear power plant with the potential for different states of operation.

A top criterion for staffing is individual and crew task performance. Successful task performance is the main criterion for evaluating a proposed staffing level. However, crew task performance can be negatively impacted by other factors. High workload and poor situation awareness are examples of factors that can lead to poor task performance and are addressed during the S&Q analyses. S&Q analyses include periodic tests conducted at increasing levels of design maturity, procedure development, simulator fidelity, and operator training. These are described below and in Reference 6.2.10.

#### **3.5.1 Operating Experience Review**

The NuScale plant is a new and innovative modular, passive design with no commercial nuclear reactor power plant considered as a direct predecessor. Nonetheless, the operating experience of current commercial nuclear power plants is analyzed as described in the Human Factors Engineering Operating Experience Review Implementation Plan (Reference 6.2.2) because many systems and components similar to those in the NuScale design are also found in operating nuclear power plants. The NuScale design also has a high degree of automation. Therefore, initial staffing goals for the MCR crew and qualifications are based on staffing levels and qualifications from commercial nuclear power plants taking into account the passive features and a high degree of automation.

Operating experience at commercial nuclear power plants is reviewed as described in Reference 6.2.2 and includes

- operational strengths and weaknesses resulting from staffing levels

- initial staffing goals for the MCR crew and their bases, including a description of significant similarities and differences
- staffing considerations described in NRC Information Notice 95-48, "Results of Shift Staffing Study" (Reference 6.1.6)
- possible impact on staffing of requirements of work hour limits, required break times, and required days off, as specified in 10 CFR 26.205, Work Hours (Reference 6.1.7) as part of the fitness-for-duty rule
- Regulatory Issue Summary (RIS) 2009-10, Communications between the NRC and Reactor Licensees during Emergencies and Significant Events (Reference 6.1.8)
- automatic action crediting described in NRC Information Notice 97-78, "Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times" (Reference 6.1.9)
- NUREG/IA-0137, A Study of Control Room Staffing Levels for Advanced Reactors (Reference 6.1.16)
- high-workload personnel tasks identified as problematic

The OER focus is on the unique features of the NuScale design that include multi-module applications, use of digital control systems, heavy use of automation, and use of computer-based procedures. It identifies human performance errors that may indicate strengths or weaknesses in commercial nuclear power plant staffing and qualifications. Human performance errors are evaluated to determine if strengths are maintained and weaknesses are resolved by the NuScale design. OER bases related to S&Q are re-confirmed during S&Q analyses to ensure they remain valid.

### **3.5.2 Functional Requirements Analysis and Function Allocation**

The functional requirements analysis (FRA) determines plant functions performed to satisfy plant safety objectives and identifies the preferred normal and emergency success paths used to control those functions. The function allocation (FA) assigns these success paths to human, automated, or shared actions. The process for assigning or allocating success paths is described in the Human Factors Engineering Functional Requirements Analysis and Function Allocation Implementation Plan (Reference 6.2.3) and includes consideration of the complexity and time criticality of controlling these success paths. The function allocation considers not only primary task allocation to personnel but also the responsibility to monitor automatic functions, detect I&C and HSI degradations and failures, and to assume manual control when necessary.

The initial FA allocates functions to an individual operator based on HFE criteria and may not fully consider the operating crew as a whole. Scenario-based tests are performed early in the design and repeated during testing of the design as it matures as part of HSI design task support verification. S&Q analyses perform a review of initial FA with the goal of identifying where requirements for performing human-allocated actions may exceed the qualifications of the assigned staff or cause an overload that could be mitigated by sharing the actions among team members or changing the role of the assigned individual.

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During S&Q analyses HEDs may be generated in order to bring about changes to FRA/FA during successive iterations.

### 3.5.3 Task Analysis

The functions assigned to licensed operator personnel from FRA/FA define their roles and responsibilities for both manual actions and monitoring of or backup to automation. Human actions performed to accomplish these functions are grouped to obtain common objectives or goals. TA helps to define operator staffing and qualifications for each task and includes an assessment of workload and time margins for task execution. For more detail on TA, see the Task Analysis IP (Reference 6.2.4).

Initially, tasks are identified via system task level analysis and systems tasks are combined into system level functional groups. As the TA progresses, multi-system functions are combined.

The initial results of TA are used to develop the HSI, define the roles and responsibilities of personnel, develop the draft operating procedures, capture knowledge, skills, and abilities, and identify training needs, all of which are captured in the VISION database.

TA inputs to S&Q analyses include

- time available/required to perform a task
- subject matter expert (SME) estimates of the workload involved
- knowledge, skills, and abilities for personnel
- personnel communication and coordination, including interactions between individuals for diagnosing, planning, and controlling the plant, and interactions between personnel for administrative, communications, and reporting activities
- the job requirements resulting from the sum of all tasks allocated to each individual inside the MCR

TA may identify required workload outside of the MCR, such as fire brigade support; however, licensed operators who fill a minimum shift staffing role are not assigned collateral duties that prevent them from fulfilling their licensed operator duties within the MCR (Reference 6.2.12). Determining the staff required outside of the MCR is beyond the scope of this IP.

S&Q analyses consider tasks from the full scope of TA (i.e., a wide range of plant operating modes, including startup, normal operations, low-power and shutdown conditions, transient conditions, abnormal conditions, emergency conditions, and severe accident conditions) (see Reference 6.2.4).

S&Q related HEDs that may be generated during TA are tracked in human factors engineering issues tracking system (HFEITS) and resolved and used to challenge the initial staffing goals for the MCR crew.

It is recognized that the control room staff is responsible for implementing the initial emergency response per 10 CFR 50.47, Emergency Plans (Reference 6.1.10) using the



guidance contained in NUREG-0654, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants (Reference 6.1.11). That responsibility includes diagnosis, assessment, mitigation, emergency declaration, offsite notifications, and implementing emergency measures within the site boundary, including protective measures and aid for onsite personnel. For determining the workload for licensed control room staff, the diagnosis, assessment, mitigation, and declaration are evaluated. A bounding assumption is then made that the shift manager is dedicated to emergency response duties. This is a reasonable assumption based on OE from existing commercial nuclear plants and is validated during the V&V element when an emergency plan is developed and can be fully exercised.

### 3.5.4 Treatment of Important Human Actions

Important human actions (IHA) are identified as described in the Treatment of Important Human Actions (TIHA) Implementation Plan (Reference 6.2.5). Detailed TA determines the feasibility and reliability of IHAs. TA also performs a workload assessment, time margin assessment, and determines the number of people required to accomplish a task as well as the knowledge and abilities that determine qualifications. The workload analysis conducted as part of the S&Q element includes all of the IHAs and confirms

- the assumptions that IHAs can be conducted within the time available by the minimum licensed MCR staff for all applicable plant operating modes and conditions
- availability, degree of clarity, and indication cues for manipulation of the human-system interface (HSI)

S&Q analyses consider the findings in NUREG/CR-6753 (Reference 6.1.12) related to the contribution of human performance to risk.

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}}<sup>2(a),(c)</sup>

HEDs related to IHAs that are identified during OER, FRA/FA, TA, or TIHA elements are evaluated and resolved prior to completion of the S&Q element and documented in the S&Q RSR.

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### 3.5.5 Procedure Development

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}}<sup>2(a),(c)</sup>

S&Q related HEDs identified during procedure development are entered into the HED database. Procedure development related HEDs that affect human factors V&V scenarios (Reference 6.2.7) are resolved prior to ISV. Other procedure development related HEDs may be resolved prior to completion of design implementation (see Reference 6.2.8).

### 3.5.6 Training Program Development

S&Q analyses provide input to the training program development related to knowledge, skills, and abilities to be attained and maintained. As S&Q analyses encompass licensed operator personnel, they provide input essential to coordinating actions between individuals inside and outside the MCR. The training program includes this set of knowledge, skills, and abilities.

S&Q related HEDs identified during training program development are entered into the HED database. Training program development related HEDs are resolved during human factors V&V (see Reference 6.2.7) or design implementation (Reference 6.2.8) as applicable.

### 3.6 Baseline Assumptions

Prior to completion of staffing analyses, a twelve-module NuScale plant is assumed to be operable with an MCR shift contingent of three licensed ROs and three licensed SROs covering the roles of SM, STA, and CRS. S&Q analyses are conducted to validate the initial staffing goals for the MCR crew. Maximum MCR staffing is related to capacity of ventilation systems and considerations such as lighting or ambient noise and, as such, is not analyzed during S&Q activities. HSI design defines constraints for lighting or noise. Ventilation system capacity is determined by another engineering discipline. Prior to S&Q analyses, the initial staffing goals for the MCR crew reflect the resolution of staffing-related HEDs from OER, FRA/FA, TA and TIHA.

Qualification requirements (education and job experience) for the licensed operator personnel are described in ANSI/ANS 3.1, Selection, Qualification, and Training of Personnel for Nuclear Power Plants (Reference 6.1.13). Licensed operators are trained and qualified per ACAD 10-001, Guidelines for Initial Training and Qualification of Licensed Operators (Reference 6.1.20).

### 3.7 Evaluation of Staffing and Qualifications

Initial staffing levels are described in Section 3.1. Bases for licensed operator personnel staffing are established as described in Section 3.5 using input from other HFE program

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elements to support the initial staffing goals for the MCR crew (numbers and qualifications baseline) described in Section 3.6. S&Q evaluations confirm or modify the baseline to achieve the final staffing and qualifications.

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}}<sup>2(a),(c)</sup>

### 3.7.1 Plant Conditions Selection

Scenarios selected for S&Q analyses are identified using input from other HFE program elements

- OER identifies situations and technologies that affect human performance and evaluates these for effects on crew size or qualifications.
- FRA/FA identifies success paths to determine best allocation of functions. FRA/FA also identifies associated workload to control those success paths while maintaining critical functions (including monitoring of automatic functions).
- TA identifies constraints where time required to conduct a task is less than time available. Secondary tasks, distractions, and process delays (e.g., valve stroke time or digital processing time) are considered within time required constraints. Licensed operator workload is determined by the collective time required/time available calculation. S&Q identifies a sample size of the tasks that have highest workload conditions and a sample size of those that have the lowest workload conditions.
- TIHA identifies both probabilistic and deterministic important human actions that are included in the S&Q scenarios.
- Human factors V&V identifies the need to identify a range of operational conditions to guide task support verification, HFE design verification, and ISV by means of performing sampling of operational conditions (SOC). {{

}}<sup>2(a),(c)</sup>

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}}<sup>2(a),(c)</sup>

The scenario selection includes those items that are unique to NuScale such as situations evaluating changing conditions on multiple modules, common system interface failures and their effect on multiple modules, high levels of automation, and beyond design basis events. For workload considerations, certain plant evolutions that are planned and executed with additional staff beyond the minimum proposed are not included. For example, a reactor startup is not an activity that is performed as an unplanned evolution or needs to be done in an expeditious manner with a minimum crew, therefore it is not considered. Refueling operations are also not considered (except as a potential distraction) in the workload assessment. They are performed by a dedicated staff (including an SRO) separate from the main control room operating staff. The control room operators have little direct interaction with the refueling team.

S&Q analyses are also conducted for scenarios that, in SME judgment, would challenge the baseline operating crew (initial staffing goals for the MCR) in terms of numbers or qualifications. {{

}}<sup>2(a),(c)</sup>

### **3.7.2 Licensed Operator Personnel Crew S&Q Evaluation Testing**

In support of the S&Q element to evaluate the acceptability of licensed operator staffing levels, testing is focused on operator performance, workload, and situation awareness during challenging plant operating conditions. Evaluation criteria are established and used to determine the acceptability of operator performance and the adequacy of the HSI to permit operators to correctly diagnose and mitigate high workload scenarios and to ensure the proposed staffing plan is acceptable. For a detailed list of evaluation criteria, see Reference 6.2.10.

The simulator is able to support the test performance of the required scenarios. For additional information about the status of the simulator, see Reference 6.2.10. The testing environment is based on the proposed control room. Certain environmental factors may not necessarily reflect the actual control room.

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}}<sup>2(a),(c)</sup>

At least three simulator scenarios are performed utilizing two crews of operators familiar with the plant design and HSI development to test baseline staffing levels and the impact of workload on crew performance. This is a formally documented usability test to ensure the adequacy of the proposed operating staff to manage the highest possible workload and to manage other challenging conditions. Formal ISV testing requirements are not within the scope of this testing plan. While usability of the HSI is important and any problems identified are tracked and corrected, this test is not specifically designed to evaluate the adequacy of the HSI; those tests are being performed as part of the HSI testing as discussed in Reference 6.2.11.

Data are collected using time measurements, NASA TLX, pre-screened questionnaires related to situation awareness, performance measures developed as task attributes by SMEs during TA, independent expert HFE observations, and post-test critiques similar to those used in current operating plant training programs, with focus on improvements to the design, HSI, procedures, and conduct of operations and not on the individual crew members.

The testing plan results are evaluated and included as part of the S&Q RSR (see Section 4.0). As each test is performed, lessons learned are captured and incorporated as needed to enhance the ability of the operator to identify key parameters and to manage the workload demands.

The RSR also lists the changes made to the HSI, conduct of operations, or design as appropriate. By utilizing an integrated, systematic approach to evaluate the workload conditions for an operating crew, the goal to determine, with reasonable assurance, the minimum licensed operator staffing for a multi-unit (up to 12 units) NuScale plant is established.

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## 4.0 Staffing and Qualifications Results Summary Report

Results of S&Q are compiled in an RSR. The S&Q RSR includes

- a description of the process used to determine initial and final staffing levels
- initial and final staffing levels
- the assignment of tasks to personnel
- a description of necessary qualifications of personnel
- input to the staffing evaluation from the other pertinent HFE elements, or a justification as to why no input was included. Examples include
  - scenarios derived from OER findings
  - scenarios from FRA/FA in which success paths for functions allocated to humans may exceed the qualifications of the assigned staff or cause an overload
  - scenarios from TA in which time required to conduct a task is less than time available
  - scenarios which, in SME judgment, would challenge the baseline licensed operator personnel crew in terms of numbers or qualifications
  - scenarios to exercise IHAs from the TIHA element
- the plant conditions for which the initial staffing levels for the MCR crew were evaluated, including the basis for selecting those conditions
  - results of validating the final staffing levels and a description of any changes to initial staffing goals for the MCR crew numbers based on analyses including how conclusions were reached
  - a description of any changes to initial staffing goals for the MCR crew qualifications based on the analyses including how conclusions were reached
  - HEDs generated during previous HFE elements resolved during S&Q
  - HEDs generated, or generated and resolved during S&Q for plant conditions that cannot be managed by the initial staffing goals for the MCR crew
  - test results and conclusions from staffing validation and workload test

## 5.0 NUREG-0711 Conformance Evaluation

Table 5-1 indicates where each NUREG-0711, Revision 3 criterion is met in this IP.

Table 5-1. Conformance with NUREG-0711

Review Criteria Stated in NUREG-0711, Rev. 3	S&Q IP Section No. and paragraph
<p>6.4 Review Criteria</p> <p>(1) The applicant should address the applicable staffing and qualifications guidance in NUREG-0800 Section 13.1.</p> <p><i>Additional Information:</i> The NRC’s reviewers for Chapter 18 of NUREG-0800 should verify that the reviews of Section 13.1 were completed.</p>	<p>Sections 1.2 and 2.1, all paragraphs</p>
<p>(2) The applicant should address the applicable staffing and qualifications guidance in 10 CFR 50.54.</p> <p><i>Additional Information:</i> As part of their verification, the Chapter 18 reviewers should assure that staffing meets the requirements of 10 CFR 50.54. For plant staffing levels that require an exemption from 10 CFR 50.54, the NRC’s reviewers should use the guidance in NUREG-1791 (Persensky et al., 2005) and NUREG/CR-6838 (Plott et al., 2004).</p>	<p>Section 2.2, all paragraphs</p>
<p>(3) The applicant should use the results of the task analysis as an input to the staffing and qualification analyses. Personnel tasks, addressed in task analysis, should be assigned to staffing positions to ensure that jobs are defined considering:</p> <ul style="list-style-type: none"> <li>• the task characteristics, such as the knowledge and abilities required, relationships among tasks, time required to perform the task, and estimated workload</li> <li>• the person’s ability to maintain situation awareness within the area of assigned responsibility</li> <li>• teamwork and team processes, such as peer checking</li> </ul>	<p>Section 3.1, all paragraphs</p>
<p>(4) The applicant’s staffing analysis should determine the number and qualifications of operations personnel for the full range of plant conditions and tasks, including operational tasks (under normal, abnormal, and emergency conditions), plant maintenance, plant surveillance, and testing.</p> <p><i>Additional Information:</i> The staffing analysis should address how the activities performed by personnel listed in Section 2.4.1, General HFE Program Goals and Scope, Criterion (5) impact and/or interface with the MCR. A reasonable approach is using predecessor plant data as a starting point for the analysis and adjusting the staffing numbers in accord with information from the new plant’s design.</p>	<p>Section 3.0, all paragraphs</p>

Review Criteria Stated in NUREG-0711, Rev. 3	S&Q IP Section No. and paragraph
(5) The applicant's staffing analysis should be iterative; that is, the initial staffing goals should be modified as information from the HFE analyses from other elements becomes available.	Section 3.4, all paragraphs
<p>(6) The applicant should address the basis for staffing and qualification levels considering the specific staffing-related issues noted below. These considerations may be identified in other HFE elements or in related source documents as follows:</p> <ul style="list-style-type: none"> <li>• Operating Experience Review <ul style="list-style-type: none"> <li>– operational problems and strengths resulting from staffing levels in predecessor designs</li> <li>– initial staffing goals and their bases, including staffing levels of predecessor designs and a description of significant similarities and differences between predecessor and current designs</li> <li>– staffing considerations described in NRC Information Notice 95-48, "Results of Shift Staffing Study"</li> <li>– possible impact on staffing of requirements of limits to work hours, required break times, and required days off, as specified in 10 CFR 26.205, Work Hours, as part of the Fitness for Duty Rule</li> <li>– Regulatory Issue Summary (RIS) 2009-10, Communications Between the NRC and Reactor Licensees During Emergencies and Significant Events</li> </ul> </li> </ul>	<p>Section 3.5</p> <p>Section 3.5.1, all paragraphs</p>
<ul style="list-style-type: none"> <li>• Functional Requirements Analysis and Function Allocation <ul style="list-style-type: none"> <li>– potential mismatches between functions allocated to personnel and their qualifications</li> <li>– changes to the roles of personnel due to modifying the plant's systems and HFE aspects</li> </ul> </li> </ul>	Section 3.5.2, all paragraphs



Review Criteria Stated in NUREG-0711, Rev. 3	S&Q IP Section No. and paragraph
<ul style="list-style-type: none"> <li>• Task Analysis                             <ul style="list-style-type: none"> <li>– time needed to perform a task, and the workload involved</li> <li>– personnel communication and coordination, including interactions between individuals for diagnosing, planning, and controlling the plant, and interactions between personnel for administrative, communications, and reporting activities</li> <li>– the job requirements resulting from the sum of all tasks allocated to each individual inside and outside the control room</li> <li>– potential decreases in the ability of personnel to coordinate their work due to changes to the plant</li> <li>– availability of personnel considering other work that may be ongoing, and for which operators may be responsible outside the control room (e.g., fire brigade)</li> <li>– actions identified in 10 CFR 50.47, NUREG-0654, and procedures to implement an initial accident response in key functional areas, as denoted in the emergency plan</li> <li>– staffing considerations described by the application of ANSI/ANS 58.8-1994, "Time Response Design Criteria for Safety-Related Operator Actions" (ANS, 1994), if used by the applicant</li> </ul> </li> </ul>	Section 3.5.3, all paragraphs
<ul style="list-style-type: none"> <li>• Treatment of Important Human Actions                             <ul style="list-style-type: none"> <li>– the effect of staffing levels on the performance of the identified important HAs</li> <li>– the effect of staffing levels on personnel coordination for important HAs</li> <li>– NUREG/CR-6753, Review of Findings for Human Performance Contribution to Risk in Operating Events</li> </ul> </li> </ul>	Section 3.5.4, all paragraphs
<ul style="list-style-type: none"> <li>• Procedure Development                             <ul style="list-style-type: none"> <li>– staffing demands resulting from requirements to concurrently use multiple procedures</li> <li>– personnel knowledge, abilities, and authorities identified in the procedures</li> </ul> </li> </ul>	Section 3.5.5, all paragraphs
<ul style="list-style-type: none"> <li>• Training Program Development                             <ul style="list-style-type: none"> <li>– concerns about coordinating personnel that are identified during the development of training</li> </ul> </li> </ul>	Section 3.5.6, all paragraphs

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## 6.0 References

### 6.1 Source Documents

- 6.1.1 U.S. Nuclear Regulatory Commission, "Human Factors Engineering Program Review Model," NUREG-0711, Rev. 3, November 2012.
- 6.1.2 U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," NUREG-0800, March 2007.
- 6.1.3 *U.S. Code of Federal Regulations*, "Conditions of licenses," Section 50.54, Part 50, Title 10, "Energy," (10 CFR 50.54).
- 6.1.4 *U.S. Code of Federal Regulations*, "Definitions," Section 55.4, Part 55, Title 10, "Energy," (10 CFR 55.4).
- 6.1.5 *U.S. Code of Federal Regulations*, "Additional Standards for Licenses, Certifications, and Regulatory Approvals," Section 50.120, Part 50, Title 10, "Energy," (10 CFR 50.120).
- 6.1.6 U.S. Nuclear Regulatory Commission, "Results of Shift Staffing Study," Information Notice 95-48, 1995.
- 6.1.7 *U.S. Code of Federal Regulations*, "Work Hours," Section 26.205, Part 26, Title 10, "Energy," (10 CFR 26.205).
- 6.1.8 Regulatory Issue Summary (RIS) 2009-10, Communications between the NRC and Reactor Licensees during Emergencies and Significant Events.
- 6.1.9 U.S. Nuclear Regulatory Commission, "Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times," Information Notice 97-78, 1997.
- 6.1.10 *U.S. Code of Federal Regulations*, "Emergency Plans," Section 50.47, Part 50, Title 10, "Energy," (10 CFR 50.47).
- 6.1.11 U.S. Nuclear Regulatory Commission, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," NUREG-0654, Rev. 1, November 1980.
- 6.1.12 U.S. Nuclear Regulatory Commission, "Review of Findings for Human Performance Contribution to Risk in Operating Events," NUREG/CR-6753, March 2002.
- 6.1.13 American National Standards Institute/American Nuclear Society, ANSI/ANS 3.1-2014, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants," ANS, LaGrange Park, IL.

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- 6.1.14 U.S. Nuclear Regulatory Commission, "Human Factors Engineering (HFE) Insights for Advanced Reactors Based Upon Operating Experience," NUREG/CR-6400, 1996.
  - 6.1.15 SECY-11-0098, Operator Staffing for Small or Multi-Module Nuclear Power Plant Facilities, July 2011.
  - 6.1.16 U.S. Nuclear Regulatory Commission, "A Study of Control Room Staffing Levels for Advanced Reactors," NUREG/IA-0137, November 2000.
  - 6.1.17 U.S. Nuclear Regulatory Commission, "Guidance for Assessing Exemption Requests from the Nuclear Power Plant Licensed Operator Staffing Requirements Specified in 10 CFR 50.54(m)," NUREG-1791, July 2005.
  - 6.1.18 BNL Technical Report No. 20918-1-2015, Methodology to Assess the Workload of Challenging Operational Conditions In Support of Minimum Staffing Level Reviews, March 2015.
  - 6.1.19 U.S. Nuclear Regulatory Commission, "Technical Basis for Regulatory Guidance for Assessing Exemption Requests from the Nuclear Power Plant Licensed Operator Staffing Requirements Specified in 10 CFR 50.54(m)," NUREG/CR-6838, February 2004
  - 6.1.20 ACAD 10-001, Guidelines for Initial Training and Qualification of Licensed Operators, April 2004

## **6.2 Referenced Documents**

- 6.2.1 NuScale Human Factors Engineering Program Management Plan, RP-0914-8534.
- 6.2.2 NuScale Human Factors Engineering Operating Experience Review Implementation Plan, RP-0914-8535.
- 6.2.3 NuScale Human Factors Engineering Functional Requirements Analysis and Function Allocation Implementation Plan, RP-0914-8536.
- 6.2.4 NuScale Human Factors Engineering Task Analysis Implementation Plan, RP-0914-8537.
- 6.2.5 NuScale Human Factors Engineering Treatment of Important Human Actions Implementation Plan, RP-0914-0839.
- 6.2.6 NuScale Human Factors Engineering Human System Interface Design Implementation Plan, RP-0914-0840.
- 6.2.7 NuScale Human Factors Engineering Verification and Validation Implementation Plan, RP-0914-0843.

- 6.2.8 NuScale Human Factors Engineering Design Implementation Implementation Plan, RP-0914-0844.
- 6.2.9 Concept of Operations, RP-0215-10815.
- 6.2.10 Control Room Staffing Plan Workload Analysis, RP-1215-20253.
- 6.2.11 NuScale Human Factors Verification and Validation Testing Plan, RP-116-20605
- 6.2.12 Conduct of Operations, RP-1215-19691

**Enclosure 2:**

“Human Factors Engineering Staffing and Qualifications Implementation Plan,” RP-0914-8538-P,  
Revision 2, proprietary version



**Enclosure 3:**

Affidavit, AF-0416-48470

## NuScale Power, LLC

### AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman , state as follows:

- (1) I am the Vice President of Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale
- (2) I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
  - (a) The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
  - (b) The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
  - (c) Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
  - (d) The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
  - (e) The information requested to be withheld consists of patentable ideas.
- (3) Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying implementation plan reveals distinguishing aspects about the process, method, or other trade secret by which NuScale develops and implements its Staffing and Qualifications.

NuScale has performed significant research and evaluation to develop a basis for this process, method, or trade secret and has invested significant resources, including the expenditure of a considerable sum of money.


The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

- (4) The information sought to be withheld is in the enclosed implementation plan entitled Staffing and Qualifications Implementation Plan. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.

- (5) The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
- (6) Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
- (a) The information sought to be withheld is owned and has been held in confidence by NuScale.
  - (b) The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
  - (c) The information is being transmitted to and received by the NRC in confidence.
  - (d) No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
  - (e) Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on April 1, 2016.



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Thomas A. Bergman