REQUEST FOR ADDITIONAL INFORMATION 370-2475 REVISION 1

5/20/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 18 - Human Factors Engineering
Application Section: 18.9

QUESTIONS for Operating Licensing and Human Performance Branch (AP1000/EPR Projects) (COLP)

18-47

NUREG-0711, Section 10.4.1, Criteria 1 & 2 state:

1. *A systems approach to the training of plant personnel should be developed that addresses applicable guidance in NUREG-0800 Section 13.2 ("Training"), as defined in 10 CFR 55.4, and as required by 10 CFR 52.78 and 50.120.*

2. *The overall scope of training should be defined including the following:*
   - *categories of personnel (e.g., senior reactor operator) to be trained*
   - *specific plant conditions (normal, upset, and emergency)*
   - *specific operational activities (e.g., operations, maintenance, testing and surveillance)*
   - *HSIs (e.g., in the main control room, emergency operations facility, remote shutdown panel, local control stations)*

Section 18.9.2.1 of the US-APWR DCD states:

A systems approach to the training of plant personnel that addresses applicable guidance in Reference 18.9-1, Section 13.2 (“Training”, 13.2.1), as defined in 10 CFR 55.4 (Reference 18.9-3), and as required by 10 CFR 52.78 (Reference 18.9-4) and 10 CFR 50.120 (Reference 18.9-5) is employed. The overall scope of training is defined to include the following:

- *Categories of personnel to be trained (e.g., SRO) (Reference 18.9-6, Subsection 4.1.4)*
- *Specific plant conditions (e.g., normal, upset, and emergency, as identified in Section 18.4)*
- *Specific operational activities (e.g., operations, maintenance, testing, and surveillance, as identified in Section 18.4)*
- *HSIs (e.g., in the MCR, RSC, TSC, and LCSs)*

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criteria 1 & 2 of NUREG-0711 section 10.4.1 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other

- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criteria 1 & 2 of NUREG-0711, section 10.4.1.

NUREG-0711, Section 10.4.1, Criterion 3 states:
The training program should provide reasonable assurance that personnel have the qualifications commensurate with the performance requirements of their jobs. Training should address:

- *the full range of positions of operational personnel including licensed and nonlicensed personnel whose actions may affect plant safety*
- *the full range of plant functions and systems including those that may be different from those in predecessor plants (e.g., passive systems and functions)*
- *the full range of relevant HSIs (e.g., main control room, remote shutdown panel, local control stations) including characteristics that may be different from those in predecessor plants (e.g., display space navigation, operation of "soft" controls)*
- *the full range of plant conditions*

Section 18.9.2.1 of the US-APWR DCD states:
The training development program provides reasonable assurance that personnel have the qualifications commensurate with the performance requirements of their jobs.

Training addresses the following:

- *The full range of positions of operations and maintenance personnel whose actions may affect plant safety:*
  - *Licensed operators*
  - *Non-licensed operators*
  - *Shift supervisors*
  - *Shift technical advisor*
  - *I&C technicians*
  - *Electrical maintenance personnel*
  - *Mechanical maintenance personnel*
  - *Radiological protection technicians*
  - *Chemistry technicians*
  - *Engineering support personnel*

- *The full range of plant functions and systems that may affect plant safety, including those that may be different from those in predecessor plants (e.g., passive systems and functions). This training encompasses maintenance activities related to technical specifications surveillances. For other maintenance activities, such as corrective maintenance, this is limited to removing equipment from service and restoring equipment to service*

- *The full range of relevant HSIs (e.g., MCR, RSC, and LCSs) including characteristics that may be different from those in predecessor plants (e.g., display navigation or operation of “soft” controls)*

- *The full range of plant conditions*

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criterion 3 of NUREG-0711 section 10.4.1 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other
- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criterion 3 of NUREG-0711, section 10.4.1.

NUREG-0711, Section 10.4.2, Criteria 1 - 3 state:

1. *The roles of all organizations, especially the applicant and vendors, should be specifically defined for the development of training requirements, development of training information sources, development of training materials, and implementation of the training program. For example, the role of the vendor may range from merely providing input materials (e.g., EPG) to conducting portions of specific training programs.*

2. *The qualifications of organizations and personnel involved in the development and conduct of training should be defined.*

3. *Facilities and resources such as plant-referenced simulator and part-task training simulators needed to satisfy training design requirements and the guidance contained in ANSI 3.5 and Regulatory Guide 1.149 should be defined.*

Section 18.9.2.2 of the US-APWR DCD states:

The roles of all organizations (e.g., MHI, plant owners, and vendors) are specifically defined for the development of training requirements, the development of training information sources, the development of training materials, and the implementation of the training program. For example, the role of the vendor may range from merely providing input materials (e.g., emergency procedure guidelines) to conducting portions of specific training programs. The qualifications of organizations and personnel involved in the development and conduct of training are defined. Facilities and resources, such as plant-referenced simulator and part-task training simulators, needed to satisfy training design requirements, and the guidance contained in ANSI/ANS 3.5 (Reference 18.9-10) and RG 1.149 (Reference 18.9-11), are defined.

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criteria 1 – 3 of NUREG-0711 section 10.4.2 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other

- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criteria 1 – 3 of NUREG-0711, section 10.4.2.

NUREG-0711, Section 10.4.3, Criteria 1 & 2 state:

1. Learning objectives should be derived from the analysis that describes desired performance after training. This analysis should include but not be limited to training needs identified in the following:

- *Licensing Basis - Final Safety Analysis Report, system description manuals and operating procedures, facility license and license amendments, licensee event reports, and other documents identified by the staff as being important to training*
- *Operating Experience Review - previous training deficiencies and operational problems that may be corrected through additional and enhanced training, and positive characteristics of previous training programs*
- *Function Analysis and Allocation - functions identified as new or modified*
- *Task Analysis - tasks identified during task analysis as posing unusual demands including new or different tasks, and tasks requiring a high degree if coordination, high workload, or special skills*
- *Human Reliability Analysis - coordinating individual roles to reduce the likelihood and/or consequences of human error associated with risk-important HAs and the use of advanced technology*
- *HSI Design - design features whose purpose or operation may be different from the past experience or expectations of personnel*
- *Plant Procedures - tasks that have been identified during procedure development as being problematic (e.g., procedure steps that have undergone extensive revision as a result of plant safety concerns)*
- *Verification and Validation (V&V) - training concerns identified during V&V, including HSI usability concerns identified during validation or suitability verification and operator performance concerns (e.g., misdiagnoses of plant event) identified during validation trials*

2. Learning objectives for personnel training should address the knowledge and skill attributes associated with all relevant dimensions of the trainee's job, such as interactions with the plant, the HSIs, and other personnel. Table 10.1, below, shows these dimensions.

Section 18.9.2.3 of the US-APWR DCD states:

Learning objectives for the training program reflect the desired performance after training.

Learning objectives are derived from the following areas:

- *Licensing Basis – Design control document/final safety analysis report, technical specifications, system description manuals and operating procedures, facility license and license amendments, LERs, and other documents identified by the staff as being important to training*

- *OER – Previous training deficiencies and operational problems that may be corrected through additional and enhanced training, and positive characteristics of previous training programs*
- *FRA/FA – Functions identified as new or modified*
- *Task Analysis – Tasks identified during task analysis as posing unusual demands including new or different tasks, and tasks requiring a high degree of coordination, high workload, or special skills*
- *HRA – Coordinating individual roles to reduce the likelihood and/or consequences of human error associated with risk-important HAs and the use of advanced technology*
- *HSI Design – Design features whose purpose or operation may be different from the past experience or expectations of personnel*
- *Plant Procedures – Tasks that have been identified during procedure development as being problematic (e.g., procedure steps that have undergone extensive revision as a result of plant safety concerns)*
- *V&V – Training concerns identified during V&V, including HSI usability concerns identified during validation or suitability verification and operator performance concerns (e.g., misdiagnoses of plant event) identified during validation trials*

Learning objectives for personnel training address the knowledge and skill attributes associated with relevant dimensions of the trainee's job, such as interactions with the plant, the HSIs and procedures, and with other personnel. In developing the learning objectives for each training area, the dimensions of Table 10.1 of NUREG-0711 (Reference 18.9-12) are evaluated for applicability.

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criteria 1 & 2 of NUREG-0711 section 10.4.3 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other
- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criteria 1 & 2 of NUREG-0711, section 10.4.3.

<u>NUREG-0711, Section 10.4.4, Criteria 1 - 4 state:</u>

1. *The design of the training program should be defined to specify how learning objectives will be conveyed to the trainee. The definition should include:*
   - *The use of lecture, simulator, and on-the-job training to convey particular categories of learning objectives should be defined.*
   - *Specific plant conditions and scenarios to be used in training programs should be defined.*
   - *Training implementation considerations such as the temporal order and schedule of training segments should be defined.*
2. *Factual knowledge should be taught within the context of actual tasks so that personnel learn to apply it in the work environment. The context of the job should be defined, and it should be represented meaningfully to help trainees to link the*

knowledge to the job's requirements. Training that addresses theory should be integrated with training in using procedures.

3. *Training programs for developing skills should be structured so that the training environment is consistent with the level of skill being taught. It should support skill acquisition by allowing trainees to manage cognitive demands. For example, trainees should not be placed in environments teaching high-level skills, such as coordinating control actions among crew members, before they have mastered requisite, low-level skills, such as how to manipulate control devices.*
4. *Training should address rules for decision-making related to plant systems, HSIs, and procedures. It should include rules for accessing and interpreting information and rules for interpreting symptoms of failures of systems, HSIs, and procedures. This training should cover acquiring new decision-making rules and eliminating existing ones that are not appropriate to the design.*

Section 18.9.2.4 of the US-APWR DCD states:

The design of the training program is defined to specify how learning objectives are conveyed to the trainee. The following parameters are included:

- *The mixture of classroom lectures, simulator training, and on-the-job training, to convey particular categories of learning objectives*
- *The specific plant conditions and scenarios used in training programs*
- *Training implementation considerations, such as the temporal order and schedule of training segments*

Factual knowledge is taught within the context of actual tasks so that personnel learn to apply it in the work environment. The context of the job is defined, and it is represented meaningfully to help trainees to link the knowledge to the job's requirements. Training that addresses theory is integrated with training in using procedures.

Training programs for developing skills is structured so that the training environment is consistent with the level of skill being taught. It supports skill acquisition by allowing trainees to manage cognitive demands. For example, trainees should not be placed in environments teaching high-level skills, such as coordinating control actions among crewmembers, before they have mastered requisite, low-level skills, such as how to manipulate control devices.

The training program addresses rules for decision-making related to plant systems, HSIs, and procedures. It includes rules for accessing and interpreting information and rules for interpreting symptoms of failures of systems, HSIs, and procedures. This training covers acquiring new decision-making rules and eliminating existing ones that are not appropriate to the design.

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criteria 1 – 4 of NUREG-0711 section 10.4.4 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other
- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criteria 1 – 4 of NUREG-0711, section 10.4.4.

NUREG-0711, Section 10.4.5, Criteria 1 - 3 state:

1. *Methods for evaluating the overall effectiveness of the training programs and trainee mastery of training objectives should be defined, including written and oral tests and review of personnel performance during walkthrough, simulator exercises, and on-the-job. Evaluation criteria for training objectives should be defined for individual training modules. Methods for assessing overall proficiency should be defined and coordinated with regulations, where applicable.*
2. *Methods for verifying the accuracy and completeness of training course materials should be defined.*
3. *Procedures for refining and updating the content and conduct of training should be established, including procedures for tracking training course modifications.*

Section 18.9.2.5 of the US-APWR DCD states:
Methods for evaluating the overall effectiveness of the training programs and trainee mastery of training objectives are defined, including written and oral tests and the review of personnel performance during walkthrough, simulator, and on-the-job exercises (or "table top reviews" during the design certification phase). The evaluation criteria for training objectives are defined for individual training modules. The methods for assessing overall proficiency are defined and coordinated with regulations, where applicable. The methods for verifying the accuracy and completeness of training course materials are defined. The procedures for refining and updating both the training content and conduct of training are established, and include procedures for tracking training course modifications.

The US-APWR DCD restates the NUREG-0711 criteria and does not demonstrate, with sufficient detail, **how** criteria 1 – 3 of NUREG-0711 section 10.4.5 will be met. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other
- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology

Please provide detailed information to satisfy criteria 1 – 3 of NUREG-0711, section 10.4.5.

NUREG-0711, Section 10.4.6, Criteria 1 & 2 state:

1. *Personnel should undergo periodic retraining.*
2. *The applicant should evaluate whether any changes or increases in retraining are warranted following plant modernization programs.*

Section 18.9.2.6 of the US-APWR DCD states:

Personnel undergo periodic retraining. The periodicity of the retraining is established based on regulatory requirements (e.g., Reference 18.9-5, Appendix E) and Human Performance Monitoring (see Section 18.12).

Section 18.9.2.6 of the US-APWR DCD restates the first criterion in NUREG-0711 section 10.4.6, it also states that 10 CFR 50.120 is the basis for the periodic retraining. This does not demonstrate, with sufficient detail, **how** the criterion in the regulatory guidance or the regulations will be met. In addition, section 18.9.2.6 does not provide a plan that describes how MHI will evaluate whether any changes or increases in retraining should be warranted following plant modernization programs. Please provide detailed information to satisfy criteria 1 & 2 of NUREG-0711, section 10.4.6. The information to meet this criterion should:

- Provide complete process descriptions
- Provide a flow diagram, or similar graphic example, that illustrates the relationship of the different process steps to each other
- Contain a description of the applicable technical requirements with sufficient quality, to enable the staff to verify that the product conforms to the intent of the methodology