UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 5, 2025

Mr. James Fogarty
Licensing Manager, Xe-100
X Energy, LLC.
530 Gaither Road, Suite 700
Rockville, MD 20850

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION'S FINAL SAFETY EVALUATION
             FOR X ENERGY, LLC'S TRAINING PROGRAMS METHODOLOGY TOPICAL
             REPORT, REVISION 4 (EPID NO: L-2024-TOP-0008)

Dear Mr. Fogarty:

By letter dated December 9, 2024 (Agencywide Documents Access and Management System
(ADAMS) Accession No. ML24344A156), X Energy, LLC., (X-energy) submitted Revision 4 of
its Training Programs Methodology topical report (TR) to the U.S. Nuclear Regulatory
Commission (NRC) for review. The TR would be used by a reactor applicant or licensee to
establish, implement, and maintain Xe-100 training programs that are based on a systems
approach to training (SAT) in order to meet training program requirements in Title 10 of the
Code of Federal Regulations (10 CFR) Section 50.120, "Training and qualification of nuclear
power plant personnel," and 10 CFR Part 55, "Operators' Licenses."

The NRC staff's final safety evaluation (SE) for X-energy's Training Programs Methodology TR
is enclosed. The NRC staff concluded that the TR is acceptable, subject to the limitations
documented in the SE. The NRC staff requests that X-energy submit an accepted version of the
Training Programs Methodology TR within 3 months of the receipt of this letter. The accepted
version shall incorporate this letter and the enclosed SE.

J. Fogarty   - 2 -

If you have any questions, please contact Adrian Muñiz via email at Adrian.Muniz@nrc.gov.

Sincerely,

Signed by Philpott, Stephen
on 09/05/25

Stephen Philpott, Acting Chief
Advanced Reactor Licensing Branch 2
Division of Advanced Reactors and Non-Power
  Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Project No.: 99902071

Enclosure: As stated

cc: X-Energy Xe-100 via GovDelivery
      jmaddocks@x-energy.com

J. Fogarty   - 3 -

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION'S FINAL SAFETY EVALUATION
            FOR X ENERGY, LLC'S TRAINING PROGRAMS METHODOLOGY TOPICAL
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            DATED: SEPTEMBER 5, 2025

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X ENERGY, LLC., - FINAL SAFETY EVALUATION OF TOPICAL REPORT "XE-100 TRAINING PROGRAMS METHODOLOGY," REVISION 4 (EPID L-2024-TOP-0008)

SPONSOR AND SUBMITTAL INFORMATION

Sponsor: X Energy, LLC.

Sponsor Address: 530 Gaither Road
                          Rockville, MD 20850

Docket/Project No.:   99902071

Submittal Dates: March 27, 2024, and December 9, 2024

Submittal Agencywide Documents Access and Management System (ADAMS) Accession Nos.: ML24089A243 and ML24344A156.

Brief Description of the Topical Report:

By letter dated March 27, 2024 (ADAMS Accession No. ML24089A243), X Energy, LLC (X-energy), submitted licensing Topical Report (TR)-006012, Revision 3, "Xe-100 Training Programs Methodology." Following the U.S. Nuclear Regulatory Commission (NRC or Commission) staff's regulatory audit of Revision 3 of TR-006012 (ML25093A326), X-energy submitted Revision 4 (hereafter referred to as the TR) by letter dated December 9, 2024, (ML24344A156).

The TR provides a methodology to be used by an applicant or licensee to establish, implement, and maintain Xe-100 training programs that are based on a systems approach to training (SAT) in order to meet training program requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.120, "Training and qualification of nuclear power plant personnel," and 10 CFR Part 55, "Operators' Licenses." An applicant or licensee that uses this methodology to develop Xe-100 training programs for licensed operators will need to seek Commission approval or National Nuclear Accrediting Board (NNAB) accreditation of training programs used for the licensing of operators, including requalification programs. The NRC staff reviews training programs for nuclear power plant personnel as part of its review of the operational programs submitted at the operating license/combined license (OL/COL) application stage.

For additional details on the submittal, please refer to the documents located at the ADAMS Accession Numbers identified above.

Enclosure

REGULATORY EVALUATION

Regulatory Basis:

As discussed in the synopsis and conclusion sections of the TR, X-energy requested the NRC staff's review and approval of its methodology for developing training programs that are based on the SAT.

The regulatory requirements and guidance that the NRC staff considered in its review of the TR are as follows:

- Regulation 10 CFR 55.31, "How to apply," which includes the requirements for applicants applying for an operator license. Specifically, 10 CFR 55.31(a)(4) applies to individual applicants when applying for an operator license at a facility licensee site. To apply for a reactor operator or senior reactor operator license at a specific facility, an applicant must provide, among other things, evidence that they have successfully completed their facility licensee's requirements to be licensed as an operator or senior operator, including details of the applicant's qualifications, details regarding courses of instruction administered by the facility licensee, a description of the nature of the training received at the facility, and the startup and shutdown experience received. As an alternative to providing these details in the application, the Commission may accept certification that the applicant has successfully completed a Commission-approved training program that is based on a systems approach to training and that uses a simulation facility acceptable to the Commission.[1]

- Regulation 10 CFR 50.120, "Training and qualification of nuclear power plant personnel," which includes the requirements for establishing training and qualification programs.

    o Regulation 10 CFR 50.120(b)(1) states in part, each nuclear power plant operating license applicant, by 18 months prior to fuel load, and each holder of an operating license must establish, implement, and maintain a training program that meets the requirements of paragraphs (b)(2) … of this section. Additionally, holders of a combined license must establish, implement, and maintain the training program that meets the requirements of paragraphs (b)(2).

    o Under 10 CFR 50.120(b)(2) the training program must be derived from a systems approach to training as defined in 10 CFR 55.4, "Definitions."

- Regulation 10 CFR 55.4 states, in part, that the systems approach to training means a training program that includes the following five elements:

    1. Systematic analysis of the jobs to be performed.

    2. Learning objectives derived from the analysis which describe desired performance after training.

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[1] The NRC staff did not evaluate the TR methodology for compliance with 10 CFR 55.31(a)(4) but considered the potential impacts of implementation of the TR methodology on a future operator license applicant's application.

3. Training design and implementation based on the learning objectives.

4. Evaluation of trainee mastery of the objectives during training.

5. Evaluation and revision of the training based on the performance of trained personnel in the job setting.

- NUREG-1220, "Training Review Criteria and Procedures," Revision 1, provides criteria for evaluating the implementation of a systems approach to training and is used by the NRC staff to review training programs for compliance with the requirements of 10 CFR 50.120 and 10 CFR 55, as applicable. Applicants or licensees can also comply with the requirements of 10 CFR 50.120 without being accredited by the NNAB (58 FR 21904, 21908; April 4, 1993). NUREG-1220 has been revised to be consistent with this regulation, and the guidance will be used by the NRC staff for program evaluations. Therefore, the NRC staff determined that NUREG-1220 is the most applicable guidance to use to determine compliance with 10 CFR 50.120(b)(2) and 10 CFR 55.4 in review of the TR.

TECHNICAL EVALUATION

The NRC staff reviewed the TR using NUREG-1220, Revision 1 which provides guidance to the NRC staff for evaluating whether a licensee's training program is based on a systems approach to training. The TR does not contain a training program. Instead, the TR contains a methodology to develop Xe-100 training programs. Therefore, the NRC staff considered whether the TR methodology, if followed by an applicant referencing this TR, could result in a training program that meets the criteria in NUREG-1220. The NRC staff's review of this TR does not constitute the Commission's approval of a training program as required, in part, by 10 CFR 55.31(a)(4). As the TR notes in the synopsis, the review and approval of training programs developed with the TR methodology is outside the scope of the TR.

The TR contains multiple sections; however, as stated in the synopsis and conclusion of the TR, X-Energy requested the NRC staff's approval of a methodology for developing training programs that are derived from a systems approach to training as required by 10 CFR 50.120(b)(2) and defined in 10 CFR 55.4. Therefore, the NRC staff limited its review to TR section 3, "X-energy Systems Approach to Training for the Xe-100," and how the training program methodology described in that section, if implemented, could result in a training program that meets the requirements of 10 CFR 50.120(b)(2) and 10 CFR 55.4. Thus, the NRC staff does not make any determinations or conclusions on any information in other sections of the TR, though it provided context for the NRC staff's review of TR section 3.

The NRC staff reviewed TR section 3 using NUREG-1220, "Training Review Criteria and Procedures," Revision 1 and the definition of the systems approach to training in 10 CFR 55.4. The NRC staff's technical evaluation is organized as follows:

- Section 1.0 contains the NRC staff's evaluation of how the TR methodology, if implemented, could result in a training program that satisfies the first element of the SAT for a systematic analysis of the job(s) to be performed.

- Section 2.0 contains the NRC staff's evaluation of how the TR methodology, if implemented, could result in a training program that satisfies the second element of the SAT for learning objectives which are derived from the analysis and describe the desired performance after training.

- Section 3.0 contains the NRC staff's evaluation of how the TR methodology, if implemented, could result in a training program that satisfies the third element of the SAT for the design and implementation of training which is based on the learning objectives.

- Section 4.0 contains the NRC staff's evaluation of how the TR methodology, if implemented, could result in a training program that satisfies the fourth element of the SAT which involves the evaluation of trainee mastery of objectives during training.

- Section 5.0 contains the NRC staff's evaluation of the fifth element of the SAT process which involves the evaluation and revision of training based on the performance of trained personnel in the job setting.

In addition, as part of the technical review, the NRC staff conducted a regulatory audit that concluded on October 15, 2024 (ML25093A326).

1.0   SAT element 1: Systematic analysis of the job to be performed

According to NUREG-1220, Revision 1, the analysis element of the SAT means that plant and training staff use a systematic analysis process to identify the job tasks and associated knowledge and skills needed to meet job performance requirements. The analysis element of a training program is systematic if it includes the following characteristics:

1.1.   A systematic method is used to identify job tasks.
1.2.   Tasks are objectively selected for training.
1.3.   Tasks are differentiated for initial and continuing training.
1.4.   The results of analysis are adequate for the subsequent development of learning objectives.
1.5.   New or changed tasks are analyzed to determine training needs.

The NRC staff reviewed TR section 3.1, "Analysis Phase," which contains X-energy's methodology for conducting the analysis phase of an SAT based training program, to confirm that it contains a systematic process to identity job tasks and associated knowledge and skills for use in training, including the characteristics above.

First, for Characteristic 1.1 above, the NRC staff reviewed how the TR directs use of a systematic method to identify job tasks. According to the TR, the Analysis Phase consists of four activities: Needs Analysis, Job Analysis, Task Analysis, and Cognitive Analysis. The Job Analysis is specifically used to identify tasks for a specific job or position and includes inputs from the Xe-100 human factors engineering program, plant design, and safety analysis. TR section 3.1.2, "Job Analysis," states that a "Job Analysis is conducted to produce a list of duty areas and tasks for specific job or position. A Job Analysis evaluates what the individual does on the job (performance-based tasks) rather than what the individual must know to perform the

job." TR section 3.1.2 also describes who participates in a Job Analysis, which states "Job incumbents and subject matter experts participate in Job Analysis by providing input and reviewing job requirements. Training and Line supervision review and approve Job Analysis results….Personnel familiar with the Job Analysis process (e.g., job incumbents, subject matter experts, training staff) generate a task list derived from a Job Analysis." TR section 3.1.2 includes a list of specific criteria for task statements that meets NUREG-1220 Revision 1 guidance for being systematic. For example, consistent with NUREG-1220, the TR states that task statements must consist of a logically ordered set of steps able to be executed with consistent results on different occasions by different people and requires a record of review and approval. Based on the above, the NRC staff concludes that the TR methodology for the analysis phase contains a systematic method to identify job tasks.

For Characteristics 1.2 and 1.3, the NRC staff reviewed the TR for the determination of whether tasks are objectively selected for training and if tasks are differentiated for initial and continuing training.

TR section 3.1.2.1 states that "Difficulty, Importance, and Frequency (DIF) Analysis [is used to] determine whether a task should be trained and how often the task should be retrained….The DIF results are averaged to determine one of the following outcomes for each task: no training, initial training only, or initial and continuing training." The TR identifies the participants for required reviews of the DIF analysis, as the job analysis participants. The details of who participates in job analysis is identified in section 3.1.2 of the TR, which states, "Job incumbents and subject matter experts participate in Job Analysis by providing input and reviewing job requirements." Based on the NRC staff's review of TR section 3.1.2.1, the staff concludes that the DIF analysis is a systematic method for determining whether tasks are objectively selected for training and, when selected for training, how tasks are differentiated for initial and continuing training, consistent with NUREG-1220.

Next, for Characteristic 1.4, the NRC staff reviewed the TR to determine if the methodology requires results from analysis activities to be used in the development of learning objectives. Because actual results from analysis activities are not available, the NRC staff cannot make a determination on the adequacy of results; this will be done at the time of training program review or inspection. TR section 3.1.3, "Task Analysis," states that "Task Analysis produces a defined list of job attributes required for satisfactory task performance. Task analysis reviews task statements within the context to their plant application to identify characteristics of the task. These characteristics are used to design and develop training content for incumbent qualification." The TR includes a list of characteristics of task analysis including: initial conditions, standards, elements (steps), tools, equipment, safety concerns, associated performance or cognitive statements required, and branch steps and alternate paths of the task. Additionally, the TR states that "Task Analysis includes all aspects of job performance, including but not limited to tasks important to safe plant operation and tasks related to the foundational theory of plant operations."

TR section 3.1.4, "Cognitive Analysis," states that "Cognitive Analysis is an iterative process that is conducted to systematically group and organize cognitive elements into common or prerequisite training cognitions. These cognitions are then analyzed to determine a training recommendation, i.e., no training, initial training, or initial and continuing training. If initial and continuing training are recommended, the Cognitive Analysis also recommends a retrain frequency. Subject matter experts and/or job incumbents participate in a Cognitive Analysis by

providing input and reviewing job and task requirements." Accordingly, the NRC staff concludes that the TR methodology requires results from analysis activities to be used in the development of learning objectives, which is consistent with NUREG-1220.

Lastly, for Characteristic 1.5, the NRC staff reviewed the TR for determination of whether the methodology requires new or changed tasks to be analyzed to determine training needs. TR section 3.1.1 states that a "Needs Analysis is performed to identify potential training needs, to suggest and approve training solutions, and where possible recommend non-training solutions to improve personnel performance." The TR specifies items that can result in the generation of a needs analysis, including "training requests…feedback, observation of task performance, audit or assessment finding, plant or human performance event, or engineering change with training program impact." Based on the NRC staff's review of TR section 3.1.1, the staff concludes that the TR method for conducting a Needs Analysis requires a training program to include a determination of whether training is needed for new or changed tasks, consistent with NUREG-1220.

Based on the evaluation of the characteristics discussed above, the NRC staff concludes that the TR contains an acceptable methodology for the analysis element of the SAT because the TR describes a method for a systematic process for identifying job tasks, differentiating and selecting tasks for initial and continuing training, and analyzing new or changed tasks to determine if training is needed. The TR methodology requires the results of the analysis activities to then be used to develop training learning objectives. As discussed above, this methodology is consistent with the guidance of NUREG-1220 for the Analysis element, and therefore, is acceptable.

2.0   SAT element 2: Learning objectives are derived from the analysis which describes the desired performance after training

According to NUREG-1220, Revision 1, learning objectives should support successful job performance by reflecting analysis results and by providing conditions and standards for job performance behaviors and actions expected of trainees upon the completion of training. A method of objective design is considered systematic if it includes the following characteristics:

   2.1   Learning objectives exist for tasks selected for training.
   2.2   Learning objectives conditions, actions and standards reflect job performance requirements.
   2.3   Learning Objectives are revised as needed to reflect job changes.

The NRC staff reviewed TR section 3.2, "Design Phase," which contains X-energy's methodology for developing learning objectives to confirm that it contains a systematic process to design learning objectives for tasks selected for training, learning objectives reflect job performance requirements, and learning objectives are revised as needed to reflect job changes. The guidance in NUREG-1220 pertains to the review of learning objectives and not the process to develop them; therefore, the NRC staff focused on how the TR methodology could be used to develop learning objectives that satisfy the characteristics above.

First, for Characteristic 2.1, the NRC staff verified that the TR contains a methodology to consistently create learning objectives for the tasks selected for training. TR section 3.2.2, "Develop Learning Objectives," states that "learning objectives are created, validated, or revised

from results of the Analysis Phase." The TR also specifies the use of terminal and enabling objectives. Terminal objectives are "derived from the task statement" and focus on "the overall results of the training" while enabling objectives are "written for each task element that a trainee must master to successfully complete the associated terminal objective." Based on this, the NRC staff concludes that the TR contains a methodology that will consistently create learning objectives for tasks that are selected for training, consistent with NUREG-1220.

Next, for Characteristic 2.2, the NRC staff reviewed the TR for how the methodology for developing learning objectives includes a process to consistently create conditions, actions and standards that reflect job performance requirements. TR section 3.2.2, "Develop Learning Objectives," states that learning objectives consist of "three components: a condition, an action, and a standard….The condition statement clearly states the condition(s) that will exist at the time of trainee performance." Regarding action statements, TR section 3.2.2 states that "the action verb should identify trainee behavior that is observable, measurable, and applicable to trainee performance." Regarding the standard component of learning objectives, the TR states that "the standard statement identifies the standard for evaluating student performance…[and] are derived from job standards identified during analysis." Based on this, the NRC staff concludes that the TR contains a methodology for consistent development of learning objectives with job performance conditions, actions and standards that reflect job performance requirements, consistent with NUREG-1220.

Finally, for Characteristic 2.3, the NRC staff reviewed how the TR methodology ensures that learning objectives are revised, when needed, to reflect job changes. TR section 3.1.1, "Needs Analysis," states that a "Needs Analysis is performed to identify potential training needs, to suggest and approve training solutions, and where possible recommend non-training solutions to improve personnel performance." The TR specifies activities that trigger a needs analysis, including "training requests…feedback, observation of task performance, audit or assessment finding, plant or human performance event, or engineering change with training program impact." Additionally, TR section 3.5, "Evaluation Phase," documents the expectation that Xe-100 training programs are maintained through a process of evaluation, assessment and correction; this includes changes to training material as a result of "new and modified procedures and plant changes, as well as…applicable operating experience." TR section 3.5.2, "Facility Issues and Events," states that "facility events should be evaluated for potential training program impact." Furthermore, TR section 3.2.2, "Develop Learning Objectives," states that "learning objectives are…revised from results of the Analysis Phase." Based on the above, the NRC staff concludes that the TR contains a methodology for consistent revision of learning objectives to reflect job changes, consistent with NUREG-1220.

The NRC staff concludes that the TR contains an acceptable method for producing learning objectives, derived from the analysis process, that support successful job performance and provide conditions, actions and standards that reflect job performance requirements. This process includes revising learning objectives as needed to reflect job changes. As discussed above, this process is consistent with the guidance in NUREG-1220 for SAT element 2, and therefore, is acceptable.

3.0   SAT element 3: Training design and implementation is based on the learning objectives

According to NUREG-1220, Revision 1, the content of training programs should be derived from learning objectives and sequenced and presented for effective learning. A method of training

material design and implementation is considered systematic if it includes the following characteristics:

    3.1   Lesson plans are structured to provide for consistent presentation.
    3.2   Depth of content is adequate to support mastery of learning objectives.
    3.3   Information is presented in a sequence (within a lesson as well as among several lessons) that supports effective learning.
    3.4   Training is adequately presented.
    3.5   Personnel providing classroom, on-the-job, laboratory and simulator training are proficient in the methods and techniques for successful presentation in the particular setting.

The NRC staff reviewed TR section 3.3, "Development Phase," which contains X-energy's methodology for creating training material to confirm that it contains a systematic process for the design and implementation of training based on the learning objectives. The guidance in NUREG-1220 pertains to the review training plans and training presentation and not the process to develop these products; therefore, the NRC staff focused on how the TR methodology could be used to design and implement training that satisfies the characteristics above.

For Characteristic 3.1, the NRC staff reviewed the TR methodology to determine if lesson plans will be structured to provide for consistent presentation of training. TR section 3.3.1 states that "training materials contain the following elements to ensure consistent presentation: Learning objectives, Adequate amount and detail of content to ensure consistency, [and] support materials (e.g., equipment, tools, audiovisual, other equipment)." Based on the NRC staff's review of TR section 3.3.1, the staff concludes that the TR contains a systematic methodology for lesson plans to be structured to provide consistent presentation, consistent with NUREG-1220.

For Characteristic 3.2, the NRC staff reviewed the TR methodology for the determination of whether the depth of content is adequate to support the mastery of learning objectives. TR section 3.3.1 states that an "appropriate delivery method aligns with the cognitive level of the learning objective. For example, if a learning objective requires analysis of a system fault, the supporting material cannot solely focus on the purpose and general function of the system; instead, the content must incorporate learning at the higher cognitive learning objective." Based on this, the NRC staff concludes that the TR contains a systematic methodology for ensuring that the depth of content is adequate to support the mastery of the learning objectives, consistent with NUREG-1220.

For Characteristic 3.3, the NRC staff reviewed the TR for the determination of whether the methodology requires information to be presented in a sequence (within a lesson as well as among several lessons) that supports effective learning. TR section 3.2.4 states that "[t]emporal order is primarily based on progressing the content from low cognitive learning objectives to high cognitive learning objectives and providing trainees with introduction, background, fundamental, simple concepts before presenting detailed, advanced, complex concepts within a given curriculum topic." Based on this, the NRC staff concludes that the TR contains a systematic methodology for presenting information in a sequence that supports effective learning, consistent with NUREG-1220.

For Characteristics 3.4 and 3.5, the NRC staff also reviewed the TR for the determination of whether the methodology requires training to be adequately presented, and personnel providing classroom, on-the-job, laboratory, and simulator training to be proficient in the methods and techniques for successful presentation in the particular setting. TR section 3.4.2 states that instructors are "proficient in the methods and techniques for successful presentation in the training setting and asset they are using. Instructors should be prepared, as evident by their performance in the classroom using questioning skills, coaching skills, and learning techniques for optimal trainee mastery of the learning objectives. Effective delivery of training includes consistent adherence to the approved training material…." The NRC staff concludes that the TR contains a systematic methodology for ensuring the adequate presentation of training, and that the personnel providing classroom, on-the-job, laboratory and simulator training will be proficient in the methods and techniques for successful presentation in the particular setting, consistent with NUREG-1220.

The NRC staff concludes that the TR contains an acceptable method for the training design and implementation based on the learning objectives, including methods for structured lesson plans for consistent presentation, adequate depth of content, and sequencing of information to support effective learning, a methodology for training presentation and proficiency of the personnel providing training for successful presentation that is consistent with the guidance of NUREG-1220, and is therefore, acceptable.

4.0   SAT element 4: The evaluation of trainee mastery of objectives during training

According to NUREG-1220, Revision 1, trainees should be evaluated during all aspects of training to determine their progress toward the mastery of job performance requirements. A method of evaluating trainee mastery of objectives is considered systematic if it includes the following characteristics:

    4.1   A relationship exists between job performance requirements or learning objectives and test items.
    4.2   Trainee performance is evaluated regularly.
    4.3   Trainee remediation is provided when appropriate.
    4.4   Continuing training contains performance requirements for difficult, important, or infrequent tasks.
    4.5   Training and task performance exemptions are objectively based.
    4.6   Evaluations of task performance test the trainees' mastery of job performance requirements.

The NRC staff reviewed TR section 3.3, "Development Phase," and section 3.4, "Implementation Phase," which contains X-energy's methodology for the evaluation of trainee mastery of objectives during training. The guidance in NUREG-1220 pertains to the review of training program material including procedures, lesson plans, test items, qualification records, and corrective actions. The TR describes a process to develop a training program that encompasses the evaluation of the trainee mastery of learning objectives and does not contain training program material. Therefore, the NRC staff focused on how the TR methodology could be used to create this aspect of a training program that satisfies the characteristics above.

For Characteristic 4.1, the NRC staff reviewed the TR to determine if, within the context of a training program, the methodology establishes a relationship between job performance

requirements or learning objectives and test items. TR section 3.3.6, "Development of Cognitive and Performance Evaluations," states "cognitive examinations adequately sample the course objectives to ensure trainee mastery of the course content requisite knowledge….Sufficient evaluation items from each lesson plan's learning objectives are included on the exam to adequately assess student comprehension and mastery of the content….Performance objectives derived from tasks or skills selected for training are evaluated with performance evaluations as identified in the design phase." Thus, the NRC staff concludes that the TR contains a systematic methodology for ensuring that a relationship exists between job performance requirements and test items, which is consistent with NUREG-1220.

For Characteristic 4.2, the NRC staff also reviewed the TR to determine whether it establishes a methodology for regularly evaluating trainee performance. TR section 3.4.3, "Evaluation and Remediation," states that the "examination process is used to verify trainee comprehension of the topics of the learning objectives. Cognitive learning objectives are examined using cognitive examination methods. Performance learning objectives are examined using performance evaluation methods. All training requires trainee evaluation. Proper implementation of evaluation requires specific guidelines for planning, exam security, delivery, scoring, post-evaluation review, and feedback." TR section 3.4.3 also states that the "examination process is used to verify trainee competence of the learning objectives. Cognitive learning objectives are examined using cognitive evaluation methods. Performance learning objectives are evaluating using performance evaluation methods." Based on this, the NRC staff concludes that the TR contains a systematic methodology for evaluating trainee performance regularly, which is consistent with NUREG-1220.

For Characteristic 4.3, the NRC staff reviewed the TR to determine whether it establishes a methodology for providing trainee remediation when appropriate. TR section 3.4.3 states that remediation "includes review of the evaluation results, review of satisfactory response(s), training material review to close knowledge gaps, studying, and attempting a new evaluation. At a minimum, the remediation evaluation must retest on the concepts missed by the trainee on the original evaluation through items evaluating those learning objectives." Based on this, the NRC staff concludes that the TR contains a systematic methodology for remediating trainees when appropriate, which is consistent with NUREG-1220.

For Characteristic 4.4, the NRC staff reviewed the TR to determine whether it establishes a methodology for continuing training to contain performance requirements for difficult, important, or infrequent tasks. TR section 3.1.2.1 states that "Difficulty, Importance, and Frequency (DIF) Analysis [is used to] determine whether a task should be trained and how often the task should be retrained….The DIF results are averaged to determine one of the following outcomes for each task: no training, initial training only, or initial and continuing training." The NRC staff concludes that the TR contains a systematic methodology for continuing training containing performance requirements for difficult, important, or infrequent tasks, which is consistent with NUREG-1220.

For Characteristic 4.5, the NRC staff reviewed the TR to determine whether it establishes a methodology for training and task performance exemptions to be objectively based. TR section 3.4.1.1, "Exemption and Equivalence," documents X-energy's methodology of providing exemptions to training and task qualification requirements. Section 3.4.1.1 states that "Training personnel review recorded evidence of prior training and performance history to specify training and/or performance evaluation activities that meet established acceptance criteria. Training

personnel document justification of requested outcomes, attach objective evidence, and route the request to the Line for approval." Based on this, the NRC staff concludes that the TR contains a systematic methodology for objectively determining training and task performance exemptions, which is consistent with NUREG-1220.

For Characteristic 4.6, the NRC staff reviewed the TR to determine whether it establishes a methodology for evaluations of task performance to test the trainees' mastery of job performance requirements. TR section 3.2.3.1, "Performance Level," documents X-energy's methodology of providing consistent performance of training and evaluation. Section 3.2.3.1 states "Performance level…of OJT and performance evaluation is selected as follows." Criteria are provided for perform, simulate, and discuss levels of performance. For example, section 3.2.3.1 states that the perform mode "is preferentially selected when possible," simulate mode "is selected when the Perform (P) mode is unfeasible due to the potential impact of trainee error, the impact of repositioning equipment, operating mode, equipment availability, or other limitations and considerations that make task performance undesirable." Discuss mode "is the least-preferred mode [and] should be used infrequently." Based on this, the NRC staff concludes that the TR contains a systematic methodology for evaluating task performance that tests the trainees' mastery of job performance requirements, which is consistent with NUREG-1220.

The NRC staff concludes that the TR contains an acceptable method for the evaluation of trainee mastery of objectives during training, including a relationship between job performance requirements, or learning objectives, and test items, regulator trainee evaluation and remediation processes that is consistent with the guidance of NUREG-1220. The NRC staff also concludes that the TR contains an acceptable method for ensuring that continuing training will be based on DIF analysis, training and task performance exemptions will be objectively based, and trainee mastery of job performance will be ensured through task performance tests that is consistent with the guidance of NUREG-1220, and therefore, is acceptable.

5.0   SAT element 5: The evaluation and revision of training based on the performance of trained personnel in the job setting

According to NUREG-1220, Revision 1, plant and training staff should use a systematic process to evaluate the effectiveness of the training and qualification programs and to determine and direct the needed revisions. A method to evaluate and revise training based on the performance of trained personnel in the job setting is considered systematic if it includes the following characteristics:

5.1   Trainee critiques are reviewed to identify potential improvements to the programs.
5.2   On-the-job work experiences are solicited from trainees and job incumbents to identify jobs/tasks for which they felt inadequately prepared to perform.
5.3   Information is solicited from supervisors on performance by new job incumbents to identify tasks for which they were inadequately prepared to perform.
5.4   Information on degraded task performance is solicited from job incumbents and supervisors.
5.5   External factors (change actions) are evaluated to identify their impacts on job performance requirements.
5.6   Changes in job performance requirements result in changes to training and training materials.

The NRC staff reviewed TR section 3.5, "Evaluation Phase," which contains X-energy's methodology for evaluating training programs. The guidance in NUREG-1220 pertains to the review of course critiques, feedback from trainees, job incumbents and supervisors, and other information associated with the evaluation and revision of training and not the process to develop these products; therefore, the NRC staff focused on how the TR methodology incorporates processes to evaluate and revise training that satisfy the characteristics above.

For Characteristic 5.1, the NRC staff reviewed the TR methodology for how trainee critiques will be used to identify potential improvements to training programs. TR section 3.5.1, "Collect and Analyze Feedback," states that "Training personnel collect trainee feedback during the Implementation Phase. Effective evaluation of the training program includes reviewing the trainee feedback and initiating actions, when necessary, to improve the training program curriculum for future offerings. Training feedback is solicited to gather the following data:

- Adequacy of training in providing background knowledge,
- Adequacy of training in developing associated skills,
- Degree to which training is related to job requirements, and
- Degree to which training prepared trainees to fulfill job requirements."

Based on the above, the NRC staff concludes that the TR contains a systematic method to review trainee critiques to identify potential improvements to the training programs, consistent with NUREG-1220.

For Characteristics 5.2 and 5.3, the NRC staff reviewed the TR methodology to determine if on-the-job work experiences will be solicited from trainees and job incumbents to identify jobs/tasks for which they felt inadequately prepared to perform, and whether information will be solicited from supervisors on performance by new job incumbents to identify tasks for which they were inadequately prepared to perform. TR section 3.5.1 states that "When a trainee completes the initial training program, a Post Training Effectiveness Evaluation is conducted to assess the effectiveness of the training program to prepare the trainee for the job. Feedback from the trainee, job incumbents, and Line management is included in the evaluation to assess how well the training program prepared the trainee for independent job performance. This information is typically collected six months to a year following course graduation."

TR section 3.5.1 also states that feedback is collected from supervisors for "Tasks for which new job incumbents were inadequately prepared, kinds of errors being committed by job incumbents, suggestions for improvements in initial and continuing training," and "potential changes in training program job requirements." The TR includes a list of the type of feedback collected that is in alignment with the guidance in NUREG-1220. The NRC staff concludes that the TR contains a systematic method for soliciting on-the-job work experiences from trainees and job incumbents to identify jobs/tasks for which they feel that they are inadequately prepared to perform. Furthermore, the NRC staff concludes that the TR contains a systematic method for soliciting information from supervisors on performance by new job incumbents to identify tasks for which they were inadequately prepared to perform, which is consistent with NUREG-1220.

For Characteristic 5.4, the NRC staff reviewed the TR methodology for how information about degraded task performance will be solicited from job incumbents and supervisors. TR section 3.5.6, "Assessing the Approved Training Program Effectiveness," documents X-energy's

methodology for assessing the training program with the feedback solicited from job incumbents and supervisors. Section 3.5.6 states that "information should be reviewed for any potential objective or factual data related to training program performance by evaluating the analyzed elements associated with the tasks selected for training as identified in the Analysis phase. Data can be identified through any method, such as trainee feedback, line performance, or assessments and analyzed into a Post Training Effectiveness Evaluation." The NRC staff concludes that the TR contains a systematic method to solicit information about degraded task performance from job incumbents and supervisors, which is consistent with NUREG-1220.

For Characteristic 5.5, the NRC staff reviewed the TR methodology to determine if external factors (change actions) will be evaluated to identify their impact on job performance requirements. TR section 3.5.4, "Facility Modifications and Procedure Changes," documents X-energy's methodology for assessing facility changes and their impact on the training program. Section 3.5.4 states that "[f]acility design changes, modifications, or procedure changes that impact equipment operation, maintenance, or user interface could alter the original information assessed in the training program job and task analysis and associated elements to which the training curriculum was designed. Consequently, any design changes to the facility must be reviewed for potential impact to the training program."

TR section 3.5.5, "Industry Regulatory Changes and Operating Experience," documents X-energy's methodology for assessing external factors and their impact on the training program. Section 3.5.5 states that "[r]egulatory changes and industry operating experience shall be reviewed for applicability and incorporated into the associated training programs accordingly." The NRC staff concludes that the TR contains a systematic method to evaluate external factors to identify their impact on job performance requirements, which is consistent with NUREG-1220.

For Characteristic 5.6, the NRC staff reviewed the TR methodology to determine if changes in job performance requirements will result in changes to training and training materials. TR section 3.5, states that the evaluation phase is used "to assess the effectiveness and efficiency of the training programs…. The outcome of the Evaluation Phase is the initiation of necessary actions to improve gaps identified in the training programs." TR section 3.1.1, "Needs Analysis," states that a "Needs Analysis is entered as the result of Evaluation Phase activities." The NRC staff concludes that the TR contains a systematic method for evaluating changes in job performance requirements that will result in changes to training and training materials, which is consistent with NUREG-1220.

The NRC staff concludes that the TR contains an acceptable method for the evaluation and revision of training based on the performance of trained personnel in the job setting, including methods for the review of trainee critiques for potential improvements to the programs, solicitation of work experiences from trainees and job incumbents to identify jobs/tasks which they felt inadequately prepared to perform, information from supervisors on performance by new incumbents to identify tasks for which they were inadequately prepared to perform, and information on degraded task performance is solicited from job incumbents and supervisors that is consistent with the guidance of NUREG-1220. The NRC staff also concludes that the TR contains an acceptable method for analyzing external factors evaluations for the impact on job performance requirements, and a process for ensuring changes in job performance requirements result in changes to training and training materials that is consistent with the guidance of NUREG-1220.

LIMITATIONS

1. As stated in both the synopsis and conclusion of the TR, X-energy requests the NRC staff's approval of a methodology for developing training programs that are derived from a systems approach to training as required by 10 CFR 50.120(b)(2) and 10 CFR Part 55, and defined in 10 CFR 55.4. The NRC staff's review and conclusions in this SE are limited to section 3 of the TR. The NRC staff did not review or make any determinations on sections in the TR that contain additional information not related to the SAT methodology in TR section 3.
2. The NRC staff's approval of this TR is limited to a methodology to develop a training program. An applicant that uses the methodology in this TR to develop its Xe-100 training program must provide its training program to the NRC staff for review to verify compliance with applicable regulations (i.e., 10 CFR 50.120, 10 CFR 55.4, and 10 CFR Part 55).

CONCLUSION

The NRC staff compared X-energy's TR-006012, Revision 4, "Xe-100 Training Programs Methodology," for developing training programs using a systems approach to training process to the guidance listed in NUREG-1220, section D, "SAT Element Evaluation." The NRC staff determined that the methodology discussed in the TR is consistent with the review criteria outlined in NUREG-1220 for the development of an SAT methodology. Therefore, the NRC staff determined that the TR provides an acceptable methodology for developing SAT-based training programs as defined in 10 CFR 55.4 and required by 10 CFR 50.120(b)(2) and 10 CFR Part 55, subject to the limitations discussed above.

REFERENCES

1. ANSI/ANS-3.1-2014, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants."

2. *U.S. Code of Federal Regulations*, "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter 1, Title 10, "Energy."

3. *U.S. Code of Federal Regulations*, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter 1, Title 10, "Energy."

4. *U.S. Code of Federal Regulations*, "Operators' Licenses," Part 55, Chapter 1, Title 10, "Energy."

5. U.S. Nuclear Regulatory Commission, "Qualification and Training of Personnel for Nuclear Power Plants." Regulatory Guide 1.8, Revision 4.

6. U.S. Nuclear Regulatory Commission, "Training Review Criteria and Procedures," NUREG-1220, Revision 1.

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