



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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**THE U.S. NUCLEAR REGULATORY COMMISSION STAFF FEEDBACK REGARDING
XE-100 LICENSING MAINTENANCE STAFF OPTIMIZATION WHITE PAPER
(EPID L-2021-LRO-0066)**

SPONSOR AND SUBMITTAL INFORMATION

Sponsor: X Energy, LLC

Sponsor Address: 801 Thompson Avenue
Rockville, MD 20852

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Brief Description of the White Paper: The white paper, "Xe-100 Licensing Maintenance Staff Optimization White Paper," presents the approach that X Energy LLC (X-energy) intends to use to determine the maintenance staffing plan at an Xe-100 site. X-energy requested the U.S. Nuclear Regulatory Commission (NRC) staff to review this white paper and provide feedback.

The NRC staff make no regulatory findings on this white paper, and nothing herein should be interpreted as official agency positions. The NRC staff's comments provided in the attachment are specific to the white paper as submitted. The NRC staff encourages further pre-application engagement, especially for novel design features or planned approaches that differ from currently operating reactors. Early discussions help to facilitate the NRC staff understanding of the unique aspects of the X-energy concept of operation. This will be helpful when considering other related topics such as control room staffing and other subsequent submittals.

TECHNICAL ASSESSMENT

The NRC staff notes that the white paper provides a reasonable approach to how X-energy plans to conduct maintenance. Future interactions regarding the human factors program should include information about how the maintenance tasks will be addressed during human factors analysis and testing. Specific NRC staff feedback is provided in the following comments.

Enclosure

General Comments

1. The white paper describes how X-energy plans for the operations staff to interrelate with maintenance activities (e.g., production field technician (PFT) role positions). It also explains how the human factors design process is being used to inform the design of maintenance jobs, procedures, and human-system interfaces. The NRC staff notes that in general, this approach seems reasonable and in agreement with NRC guidance in NUREG-0711, "Human Factors Engineering Program Review Model," and Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."
2. The human factors review considers factors that impact control room operators. Maintenance tasks are an example of one such factor that should be accounted for such as during an operating experience review, task analysis, or during an integrated system validation as described in NUREG-0711. Future discussions and/or submittals regarding the human factors program should describe how maintenance tasks will be addressed during human factors analysis and testing. For instance, as discussed in NUREG-0711, integrated system validation testing scenarios may simulate maintenance tasks using time frames estimated by subject matter experts familiar with the X-energy design, thereby providing the operators with realistic maintenance challenges.
3. Section 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," of 10 CFR does not contain any regulatory requirements for maintenance staffing. The white paper does not present information how X-energy will approach implementing, or complying with, the requirements specified in 10 CFR 50.65. The staffing necessary to demonstrate compliance with 10 CFR 50.65 are those that are focused on implementing the programs to meet the regulatory requirements contained in the rule. X-energy's approach seems to indicate that many of the staff performing these functions will be remote from the site. Future discussions and/or licensing documents should describe how the remote staff will implement an effective program for the site that achieves compliance with the regulations in 10 CFR 50.65.
4. In section 3.1.1, "Appendix B Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," of the white paper, X-energy commits to meeting the requirements of Appendix B to 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." It also states, "staffing of personnel performing maintenance activities supporting these activities must be sufficient to support and perform these tasks."

Criterion II of Appendix B to 10 CFR Part 50 states, in part, "The program shall provide for indoctrination and training of personnel performing activities affecting quality as necessary to assure that suitable proficiency is achieved and maintained."

The white paper describes how X-energy will develop a methodology to determine equipment reliability and schedule maintenance as determined by performance. This is based on a maintenance strategy developed by the Electric Power Research Institute (EPRI). It uses information gained by condition monitoring to determine time-based or condition-based maintenance. One of the three options provided by X-energy, is a run-to-maintenance (RTM) condition. X-energy propose to cross-train maintenance personnel and rely on contractors to conduct maintenance activities.

Criterion I, "Organization," of Appendix B to 10 CFR Part 50, allows for the delegation of activities to contractors. However, it also recognizes that because of the many variables involved, such as the number of personnel and the type of activities being performed, the organizational structure for executing the quality assurance (QA) functions may take various forms. As further noted in Criterion I, the organization performing activities affecting quality must be clearly established and delineated in writing. Therefore, X-energy should ensure this process is fully developed and documented in future licensing submittals, including explanation of how it will be effectively implemented.

5. The concept of "Production Organization" was mentioned in section 6.1.1 of the white paper. The NRC staff notes that the NRC's Safety Culture Policy Statement (76 FR 34773; June 14, 2011) contains relevant information that X-energy could consider when preparing future licensing documents. In particular, language used in the white paper to describe facility organizational characteristics could have inadvertent consequences affecting culture. The white paper describes such an organization as "typically separated in the US Nuclear utilities, but often combined in the non-nuclear industry." The NRC staff Safety Culture Policy Statement defines nuclear safety culture, in part, as "the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals." The policy statement communicates the "expectation that individuals and organizations establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions." Use of the term "Production Organization" to describe the group primarily responsible for safe plant operation could imbue an expectation that production is the organization's main priority, potentially over competing goals, which would not be in alignment with the Policy Statement.
6. In section 6.1.3 of the white paper, X-energy states that one of the responsibilities for the PFT is to "support control room personnel." Future licensing submittals should describe the nature of this support, specifically any potential impacts on the conduct of operator tasks within the control room.
7. In section 6.1.3 of the white paper, X-energy discusses the performance of "tool pouch tasks" which are activities a field technician will be able to perform independently, without the need for a work order. X-energy representatives discussed in more detail these tasks during the public meeting held on January 10, 2022. The meeting summary and X-energy's presentation slides can be located at ADAMS Accession No. ML22021B658. X-energy representatives stated that the tool pouch task concept is discussed in EPRI guidance 3002007020, "Nuclear Maintenance Applications Center: Maintenance Work Package Planning Guidance." The NRC staff notes that this approach for maintenance activities differs from the approach traditionally used at operating nuclear plants and could potentially reflect a loss of certain controls such as peer observation/verification, inter-departmental communication, authorization, and/or awareness of activities. Future licensing submittals should describe how activities with the potential to affect the performance of safety-significant structures, systems, and components will be controlled adequately by procedures and/or instructions, in accordance with Criterion V Appendix B 10 CFR Part 50. Entry criteria dictating when it is appropriate to perform such tasks without prior approval should be clear so that there will be adequate control over potential unsupervised and less-coordinated work activities.

