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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SUBMITTAL OF THE X-ENERGY XE-100 WHITE PAPER, "PHYSICAL PROTECTION SYSTEM APPROACH," REVISION 2

SPONSOR INFORMATION

Sponsor: X Energy, LLC (X-energy)
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Docket /Project No(s): 99902071

DOCUMENT INFORMATION

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Submittal Agencywide Documents Access and Management System (ADAMS) Accession No.: ADAMS Accession No. ML22098A228

Brief Description of the White Paper: The purpose of this white is to describe the elements of the approach X-energy is employing to develop a physical security program template for an Xe-100 high temperature, gas-cooled reactor (HTGR) plant. X-energy requested that the NRC provide comments on the physical security approach to inform X-energy's development of licensing topical reports and project-specific applications associated with the Advanced Reactor Demonstration Project (ARDP).

REGULATORY ASSESSMENT

Regulatory Basis

NRC staff are making no regulatory findings on this white paper and nothing herein should be interpreted as an official agency position.

The NRC staff observations are focused on the physical security protection approach detailed in the white paper. Physical protection programs are required by Title 10 of the *Code of Federal Regulations* (10 CFR), Part 73, "Physical Protection of Plants and Materials." Accordingly, NRC staff observations are associated with the following regulatory requirements from Part 73.

- 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," provides the requirements for physical protection programs for nuclear power reactors.

- 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance," provides the requirements for the physical protection system for the transportation special nuclear material of moderate and low strategic significance.

TECHNICAL ASSESSMENT

General Comments

1. X-energy's proposed development of a licensing topical report (TR) for a standard Xe-100 physical protection system (PPS) for meeting requirements of 10 CFR 73.55 should conform to the current revision of guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 13.6.1, "Physical Security – Combined License and Operating Reactors" and Section 13.6.2, "Physical Security — Review of Physical Security Designs – Standard Design Certification and Operating Reactor Licensing Applications." Because the requirements in 10 CFR Part 73 are technology-independent, the guidance in these NUREG-0800 sections are generally applicable to HTGRs like the Xe-100. The development of the TR should pay specific attention to guidance within NUREG-0800 with respect to the scope of the technical review for physical security, addressing the necessary information for the NRC staff to determine that the regulatory requirements are met.
2. Examples and information contained in submitted licensing documents must be sufficiently detailed to (1) demonstrate how the requirements of 10 CFR Part 73 will be met, (2) describe how regulatory requirements for PPS are met, and (3) how operational requirements for physical protection systems provide protection against the Design Basis Threat (DBT) of radiological sabotage as established by the performance and prescriptive design requirements of 10 CFR 73.55(b). The staff has found insufficient levels of detail in many past submittals; therefore, ensure that enough detail is provided for the staff to determine that the regulatory requirements are met.
3. X-energy's white paper describes several changes to 10 CFR 73.55 that are currently in draft and not yet approved by the Commission. Regarding the development of a standardized Xe-100 PPS design TR, X-energy should only address the current 10 CFR 73.55 requirements; however, X-energy may include methods or approaches to the PPS design that are not described in 10 CFR 73.55 to meet the performance objective and requirements of 10 CFR 73.55(b). X-energy may consider alternatives to the existing requirements in 10 CFR 73.55 through use of 10 CFR 73.55(r), and/or request regulatory exemptions from these requirements utilizing the regulatory guidance/technical basis from the proposed limited scope rule, "Alternative Physical Security for Advance Reactors," (RIN 3150-AK19) to the extent appropriate for developing their site protective strategy.
4. X-energy's development of a licensing TR for the design of the standard Xe-100 PPS should address only the portion of the design that would be standardized for all Xe-100 plants. The standardized design should not address or request staff findings on the portion of the design that would be site-specific. Applications that use the TR must evaluate site-specific conditions for the site-specific PPS design. For example, a method of accomplishing the interdiction/neutralization function in the PPS design may be the

use of local law enforcement (LE), where the local LE capabilities and response times to support the required function will vary with the LE entities present at the specific Xe-100 plant site.

5. Throughout the white paper, the protection scheme goal is discussed as being either the prevention of significant core damage and/or the prevention of significant radiological release. Clarification of the intended goal of the overall protection scheme, (i.e., prevention of significant core damage, or prevention of offsite release above part 100.11 (10 CFR 50.34) reference values) will be needed for the proposed TR.

If the goal is the prevention of significant core damage, define the term. Is it based on damage just to the fuel, or the potential release from damaged fuel? If the definition relies on a potential release, consider clarifying the level (dose) that would be considered and how it relates to the objective of protecting the plant personnel and facility and preventing sabotage that could result in offsite doses above 25 rem total effective dose equivalent (TEDE) in 2 hours at the site boundary.

6. Clarify the use of "theft". The NRC staff assumes that this is addressing the security of "fresh fuel," pursuant to 10 CFR 73.67. Irradiated fuel is protected by complying with 10 CFR 73.55, therefore protection against theft does not need to be covered by the Physical Protection Program. Is X-energy proposing additional security measures to protect against theft of irradiated fuel?

Specific Observations by Section:

Section 1, "INTRODUCTION"

Section 1.1, "PURPOSE"

Consider clarifying the white paper's first use of the term "security plan" by identifying that it includes a physical security plan (PSP), training and qualification plan (T&QP), safeguards contingency plan (SCP), and cyber security plan (CSP), if applicable.

Section 2, "XE-100 PLANT DESCRIPTION"

Section 2.2, "REACTOR SAFETY DESIGN"

Page 14, identify the specific regulation and regulatory limits when discussing an offsite release from a Design Basis Accident at 400 meters. Are these the regulatory limits defined in Section 3.3 of this white paper?

Section 3, "XE-100 INHERENT AND PASSIVE SAFETY CHARACTERISTICS"

Section 3.1, "XE-100 PLANT FEATURES AFFECTING SECURITY APPROACH"

See section 5.1.1, "Anticipated Exemptions," of this commentary for comment on exemptions.

Section 3.2, "SECURITY BY DESIGN"

Describe how the definition of vital areas will be changed for the Xe-100.

Section 3.3, "CONSEQUENCE-BASED PERFORMANCE OBJECTIVE"

Section 4, "XE-100 PLANT SECURITY STRATEGY"

- (1) In the second paragraph, identify if the NEI 03-12, "Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan, [and Independent Spent Fuel Storage Installation Security Program]," security plan template will be used to develop the site security plan. If so, identify if it will be NEI 03-12, Revision 7, or NEI 03-12, Revision 7.1 (with alternate compensatory measures). Otherwise, state if X-energy has developed their own security plan template design based on NRC regulations, orders, etc. Additionally, state if NEI 11-08, "Guidance on Submitting Security Plan Changes," will be utilized for any security plan updates submitted under 10 CFR 50.54(p)(2).
- (2) Confirm if a recommended testing option and/or any other recommendation in the most current revision of Regulatory Guide 5.44, "Perimeter Intrusion Alarm Systems," will be utilized.
- (3) The executive summary states that certain computer modeling applications have been considered for X-energy's security planning approach. For the proposed TR, consider the use of computer modeling software that can help identify target sets. Additionally, consider benchmarking with new reactor licensees on their experiences and successes using these tools regarding target sets.
- (4) In the second paragraph, the last sentence mentions "early adversary detection", commonly known as an early warning system (EWS). As per the May 26, 2016, NRC letter, "The U.S. Nuclear Regulatory Commission Inspection Approach Related to Industry Implementation of Early Warning Systems," (letter is Official Use Only - Security Related Information, therefore is not publicly available) consider if the EWS will be a requirement for the success of your protective strategy or as an enhancement to the protective strategy (voluntary). If determined to be a requirement for a reactor site, consider the following (not all-inclusive):
 - EWS must satisfy the requirements of 10 CFR 73.55(b).
 - EWS barriers in the OCA are subject to the requirements of 10 CFR 73.55(e)(1), through (e)(4); and (e)(6).
 - EWS is subject to the requirements of 10 CFR 73.55(e)(10) where vehicle control measures are performed as a "function" of the EWS.
 - EWS intrusion detection and assessment system is subject to the requirements of 10 CFR 73.55(i).
 - EWS is subject to the Maintenance, Testing, and Calibration requirements of 73.55(n).
 - EWS is subject to the Compensatory Measure requirements of 73.55(o).
- (5) Ensure that all available information on new technologies to be used in the PPS is available for NRC staff review and audit. Ensure that cyber security considerations are included in the review of digital systems (e.g., artificial intelligence, robotics, etc.).

- (6) The second paragraph indicates that the principal security objective for the Xe-100 plant is the protection of the plant personnel and facility and the prevention of sabotage that could result in offsite doses above 25 rem total effective dose equivalent (TEDE) in 2 hours at the site boundary. Later in the document, it is stated that the program will be designed to prevent core damage. Are these objectives considered the same by X-energy (i.e., core damage that could cause offsite release) or two different objectives?

Section 4.1, "PHYSICAL PROTECTION PROGRAM"

- (1) Page 20, Section 4.1 discusses that Xe-100 plants will establish and maintain a Physical Protection Program which will include a security organization and agreements with Local Law Enforcement Agencies (LLEA) for support as needed, but no other details are discussed on the role of LLEA. Consider being more specific within your proposed TR on the type of support and duties that LLEA will be expected to fulfill.
- (2) Are there any other areas at the site that might have inventories of radionuclides that may cause a significant release (>25 rem)? If so, will the program be designed to protect these areas?

Section 4.4, "SECURITY PROGRAM PERFORMANCE EVALUATION"

Page 21, Section 4.4 describes in part, the drill and exercise program. Identify if this program will include force-on-force drills.

Section 4.5, "PHYSICAL PROTECTION SYSTEM DESIGN PRINCIPLES"

Section 4.5.1, "Owner Controlled Area Design"

Consider referencing all applicable Regulatory Guides applicable to materials and plant protection (i.e., Division 5) when designing the PPS.

Section 4.5.2, "Protected Area Design"

- (1) Regarding tethered drones or any drone/unmanned aerial system that may be considered for the site protective strategy, ensure all applicable Federal Agencies' rule(s)/proposed rule(s) have been reviewed and adhered to prior to implementation.
- (2) Consider a compensatory measure(s) in case of bad weather, which could inhibit the intended function of a tethered drone.

Section 5, "LICENSING APPROACH"

Section 5.1.1, Anticipated Exemptions

- (1) For exemptions proposed under 10 CFR Part 73, be sure to provide sufficient documentation to allow the staff to determine that they meet all 10 CFR 73.5 requirements (i.e., are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest). Insufficient application information will result in delays in and/or complications to the review.

Section 6, "CONCLUSION"

No Comment

Section 7, "BACKGROUND RESEARCH"

No Comment

Section 8, "APPENDIX A (§73.55 COMPARISON MATRIX)"

- (1) The beginning of Section 8 states, in part, "The Proposed Rule Language" column lists changes (in red text) that is currently under review by the industry and the NRC as it pertains to advance reactors." However, no red text was found in this section.
- (2) Page 35, Appendix A, Comparison Matrix (b)(3) "Preliminary Xe-101 Analysis" block, states, in part, that the Xe-100 is designed to operate so that material is protected against potential radiological theft. For power reactors, protection against theft is addressed by protecting against radiological sabotage and no extra measures are required. Once irradiated, the special nuclear material is considered radiologically resistant to theft (10 CFR 73.67). Is this statement in the block referring to fresh, unirradiated fuel?
- (3) Page 35/36, Appendix A Comparison Matrix (b)(3) "Preliminary Xe-101 Analysis" block provides the definition of small modular reactor, which is a type of light water reactor. The Xe-100 is not a light water reactor. Provide a discussion within the future TR on why this definition is included or consider removing it.
- (4) Page 36, Appendix A Comparison Matrix "Preliminary Xe-101 Analysis" block for (b)(3)(ii), clarify if the physical protection program will be designed to protect against radiological sabotage, offsite dose release, or both. Define significant core damage.
- (5) Page 59, Appendix A Comparison Matrix (f) "Preliminary Xe-101 Analysis" block, clarify if the protection strategy is to prevent off-site dose above part 100.11(a)(1), why are target sets identified by significant core damage? Could there be a release from somewhere other than the core and should that be considered in the target set identification process?
- (6) Pages 117-124, Appendix A Comparison Matrix (r) "Preliminary Xe-101 Analysis" blocks, what criterion will be used in the technical basis to support the use of alternatives? Will the criterion be based on the function of the alternative being equal to the original, or will it be based on the ability to maintain protection against significant core damage, or will it be based on protecting against offsite release, etc.?

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