



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

**X ENERGY LLC – AUDIT PLAN FOR XE-100 LICENSING TOPICAL REPORT TRANSIENT AND SAFETY ANALYSIS METHODOLOGIES FRAMEWORK  
(CAC/EPID NO.00431/L-2021-TOP-0023)**

**SPONSOR INFORMATION**

**Sponsor:** X Energy, LLC

**Sponsor Address:** 801 Thompson Avenue  
Rockville, MD, 20852

**Plant Name(s) and Unit(s):** Xe-100 HTGR 4-unit module

**Project No(s):** 99902071

**Background:**

X Energy LLC (X-energy) began pre-application discussions with the U.S. Nuclear Regulatory Commission (NRC) staff regarding its Xe-100 pebble-bed high temperature gas cooled reactor design in September 2018. As part of its pre-application activities, X-energy has submitted various topical reports and white papers. On October 8, 2021, X-energy submitted to the NRC staff, "Xe-100 Licensing Topical Report: Transient and Safety Analysis Methodologies Framework" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21288A173). The topical report describes the approach taken by X-energy to develop evaluation models and analysis methods for transient and safety analyses for the Xe-100 reactor. The NRC staff requested this audit as part of its review of the topical report and development of the safety evaluation report.

**Purpose:**

The purpose of the audit is to allow the NRC staff to (1) efficiently gain an understanding of detailed calculations, analyses, and bases; (2) verify information; and (3) identify information that will require docketing to support the safety evaluation report.

## **Regulatory Audit Basis:**

The basis for the audit is the regulations in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 50.34, "Contents of applications; technical information." Specifically, 10 CFR 50.34(a)(4) and (b)(4) require that applicants for a construction permit (CP) and an operating license (OL), respectively, provide analysis and evaluation of the design and performance of structures, systems, and components (SSCs) of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility. In addition, an applicant has to include the determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of SSCs provided for the prevention of accidents and the mitigation of the consequences of accidents. The NRC staff anticipates that the information provided in the topical report subject to this audit will be a primary basis for the analyses and evaluations to be provided in a license application for the Xe-100 design.

## **Regulatory Audit Scope**

The regulatory audit will follow guidance in NRR Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML19226A274). This audit will focus on information provided by X-energy on the online reference portal.

## **Information and Other Material Necessary for the Regulatory Audit**

Throughout the topical report, the sponsor states that, as the Xe-100 methodologies and evaluation models mature, relevant information will be provided to the NRC through supplemental documents, revisions to the report, and continued engagement. The sponsor states that information that will be made available during the audit includes V&V documents, code manuals, code base decks, modeling details, analyses, and special methods required by analyses.

In particular, the sponsor will make available documents associated with aspects of the report that are under development, as the topical report states the content is not yet finalized in many cases. These documents will include, but may not be limited to, the following:

- X-energy, "Xe-100 Technical Report, Technology Description," XE00-P-G1ZZ-RDZZ-D001118
- X-energy, "Xe-100 Licensing Topical Report Risk-Informed Performance-Based Licensing Basis Development," XE00-R-R1ZZ-RDZZ-L-001522
- X-energy, "Xe-100 Safety Analysis Summary Report," XE00-R-R1ZZ-RDZZ-X-000850
- X-energy, "Xe-100 200MWth Steady-State Core Design Report," XE00-N-RZZ-NSZZ-D-000288
- X-energy, "Xe-100 Mass & Heat Balance Report", XE00-P-DZZ-GLZZ-A-000311
- X-energy, "VSOP-A Theoretical Description Baseline Report," XE00-T-S3ZZ-SWZZ-N-000232
- X-energy, "XGAS: Gaseous Fission Product Transport Code Manual" XE-S2-GL-G0-N11-100432
- X-energy, "Mechanistic Source Term Approach and XSTERM Code Verification and Validation," XE00-R-R1ZZ-RDZZ-L-000632
- DIN 25485, Reference 32 of topical report Section 7 "References"

Please provide English translations (if available) of DIN 25485 and topical report references 36, 37, and 42 of topical report Section 7, "References."

## **Team Members**

Boyce Travis	Technical Reviewer
Ben Adams	Technical Reviewer
Lucieann Vechioli	Project Manager

Additional audit team members may be added as needed.

## **Logistics**

Entrance Meeting	May 23, 2022
Exit Meeting	June 3, 2022

Audit meetings will take place in a virtual format, using Microsoft Teams, or via other, similar platform. Audit meetings will be scheduled on an as needed basis after the entrance meeting and once the NRC staff has had the opportunity to read any documents placed in the online reference portal. The audit will begin May 23, 2022, and continue as necessary, with activities occurring intermittently during the audit period.

To improve the efficiency of the audit, X-energy and the NRC staff discussed the use of the online reference portal (i.e., Certrec), established by X-energy, that would allow the NRC staff limited read-only access to the material and other technical information placed in the portal by X-energy. Use of the online reference portal is acceptable provided that X-energy establishes measures to limit access to specific NRC staff (e.g., based on NRC e-mail addresses or the use of passwords which will only be assigned to the NRC staff directly involved in the audit on a need-to-know basis), and to make the documents view-only (i.e., prevent NRC staff from saving, copying, downloading, or printing any documents). The conditions associated with the online reference portal must be maintained throughout the audit process. The NRC staff who should initially be granted access to the portal are those listed in the "Audit Team" section above. As needed, the NRC Project Manager may provide X-energy with the names of additional NRC staff who are added to the audit team and should subsequently be granted access.

## **Special Requests**

The NRC staff requests that X-energy ensure that their technical staff are available to answer questions during the audit.

## **Deliverables**

At the completion of the audit, the audit team will issue an audit summary within 90 days after the exit meeting but will strive for a shorter duration. The audit summary will be declared and entered as an official agency record in ADAMS and be made available for public viewing.

## **References**

Title 10 of the *Code of Federal Regulations*.

Please contact Lucieann Vechioli at (301) 415-6035 or via e-mail at [Lucieann.VechioliFeliciano@nrc.gov](mailto:Lucieann.VechioliFeliciano@nrc.gov) with any questions related to the conduct of the audit.

Date: May 9, 2022

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Lucieann Vechioli Feliciano, Project Manager  
Advanced Reactor Licensing Branch 1  
Division of Advanced Reactors and Non-Power  
Production and Utilization Facilities  
Office of Nuclear Reactor Regulation

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TRANSIENT AND SAFETY ANALYSIS METHODOLOGIES FRAMEWORK  
(CAC/EPID NO.00431/L-2021-TOP-0023) DATED: MAY 9, 2022

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LVechioli, NRR  
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DGreene, NRR  
BTravis, NRR  
MHayes, NRR

**ADAMS Accession Number: ML22119A129**

OFFICE	NRR/DANU/UAL1/PM	NRR/DANU/UAL1/LA	NRR/DANU/UTB1
NAME	LVechioli	DGreene	BTravis
DATE	4/29/2022	5/3/2022	5/3/2022
OFFICE	NRR/DANU/UART1/BC	NRR/DANU/UAL1/BC	NRR/DANU/UARL/PM
NAME	MHayes	WKennedy	LVechioli
DATE	5/8/2022	5/5/2022	5/9/2022

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