



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

X-ENERGY LLC – AUDIT PLAN XE-100 TOPICAL REPORTS:

**GOTHIC AND FLOWNEX ANALYSIS CODES QUALIFICATION TOPICAL REPORT
(CAC / EPID NO. 00431 / L-2024-TOP-0021)**

**REACTOR CORE DESIGN METHODS AND ANALYSIS TOPICAL REPORT
(CAC / EPID NO. 00431 / L-2024-TOP-0012)**

**TRANSIENT AND SAFETY ANALYSIS METHODOLOGY TOPICAL REPORT
(CAC / EPID NO. 00431 / L-2024-TOP-0017)**

**MECHANISTIC SOURCE TERM APPROACH TOPICAL REPORT
(CAC / EPID NO. 00431 / L-2024-TOP-0019)**

APPLICANT INFORMATION

Applicant: X Energy, LLC

Applicant Address: 801 Thompson Avenue, Rockville, MD, 20852

Design Name: Xe-100

Project No(s): 99902071

Background:

By letter dated March 27, 2024, X Energy, LLC (X-energy) submitted topical report (TR) 2024-XE-NRC-012, "Xe-100 Licensing Topical Report GOTHIC and Flownex Analysis Codes Qualification, Revision 2" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML2424143A192). This TR describes the GOTHIC and Flownex models and computer codes that represent the thermal-hydraulic phenomena associated with the transient and safety analysis evaluation model for the Xe-100 reactor.

By letter dated April 8, 2024, X Energy, LLC (X-energy) submitted TR 2024-XE-NRC-009, "Xe-100 Licensing Topical Report Core Design Methods and Analysis," (ML24099A183). This TR provides the methods and computer codes used to support the Xe-100 reactor core design and analysis.

By letter dated April 30, 2024, X Energy, LLC (X-energy) submitted TR 2024-XE-NRC-010, "Xe-100 Licensing Topical Report, Licensing Topical Report Transient and Safety Analysis Methodology" (ML24121A285). This TR describes the approach to develop an evaluation model and analysis methods used for transient and safety analyses for the Xe-100 reactor.

By letter dated May 10, 2024, X Energy, LLC (X-energy) submitted TR 2024-XE-NRC-011, "Xe-100 Licensing Topical Report Mechanistic Source Term Approach," (ML24131A146). This TR describes the functional containment and mechanistic source term methodology used in Xe-100 design and safety analysis and the plans to verify and validate the computer code that model these physical phenomena.

These four TRs represent approaches or methodologies to analyze the safety of the Xe-100 design required by the applicable regulations under Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 50 and 52. They are also elements of the licensing basis event (LBE) analyses being implemented by X-energy under the Licensing Modernization Project (LMP) consistent with Nuclear Energy Institute (NEI) 18-04, Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," which was reviewed and endorsed by the NRC staff in RG 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors," Revision 0. The topical reports are interrelated and dependent on each other in various ways; thus, the NRC staff determined that it is more efficient and effective to conduct a combined regulatory audit, versus four separate ones, for these topical reports under one combined audit plan. This audit is in support of the U.S. Nuclear Regulatory Commission (NRC) staff's safety review of the TRs submitted by X-energy.

Purpose:

The purpose of the audit is for the NRC staff to gain a more detailed understanding of X-energy's four TRs discussed above that are expected to be referenced in future licensing applications for the X-energy's Xe-100 reactor design. In addition, this audit will support identification of any information that would be required to be submitted on the docket to support the NRC staff's safety evaluations of the subject TRs. Therefore, the NRC staff is requesting access to X-energy documents associated with the topics discussed in the TRs.

Regulatory Audit Basis:

The regulatory basis for this audit includes the following regulatory requirements: Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34(a)(4) and (b)(4) apply to applicants for construction permits and operating licenses, respectively. In part, these sections require an 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 and including 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. Similar regulatory requirements exist for design certification applications, combined license applications, standard design approvals, and manufacturing licenses (10 CFR 52.47(a)(4), 10 CFR 52.79(a)(5), 10 CFR 52.137(a)(4), and 10 CFR 52.157(f)(1) respectively.

Regulatory Audit Scope:

The audit will follow the guidance in NRR Office Instruction LIC-111 (ML19226A274), "Regulatory Audits." The audit team will examine supporting documentation provided by X-energy in the on-line portal and hold discussions during virtual meetings.

Information and Other Material Necessary for the Regulatory Audit:

The NRC staff will identify and share with X-energy the needed information, questions, and other material needed during the audit in a timely manner. Additional documents may be requested as needed.

Team Assignments:

Ian Jung	Senior Reliability and Risk Analyst
Pravin Sawant	Senior Nuclear Engineer
Jason Schaperow	Senior Reactor Systems Engineer
Dan Beacon	Nuclear Engineer
Inseok Baek	Nuclear Engineer
Tracy Radel	Nuclear Engineer
Michael Salay	Senior Reactor Systems Engineer
Ondra Dukes	Project Manager
Adrian Muñiz	Senior Project Manager
Denise McGovern	Senior Project Manager

Members of the audit team may change during the audit. Contract personnel of ERI will also participate in the audit and the specific names will be identified and shared with X-energy.

Logistics:

Entrance Meeting	1:00 PM ET, September 3, 2024
Exit Meeting	9:00 AM ET, November 15, 2024

Audit meetings will take place in a virtual format, using Microsoft Teams or another similar platform. Audit meetings will be scheduled as needed after the entrance meeting. The audit will begin on September 3, 2024, and continue as necessary, with activities occurring intermittently during the audit period. The audit period may be reduced or extended, depending on the progress made by the NRC staff and X-energy in addressing audit questions.

Special Requests:

The NRC staff requests that X-energy ensure that their technical staff are available to answer questions during the audit. The NRC staff also request that X-energy provides access to supporting documents via the X-energy electronic reading room.

Deliverables:

At the completion of the audit, the audit team will issue an audit summary within 90 days after the exit meeting. The audit summary will be made publicly available in ADAMS.

References:

- Title 10 of the *Code of Federal Regulations*
- NEI 18-04, Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," (ML19241A336)
- RG 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors," Revision 0 (ML20091L698)
- NRR Office Instruction LIC-111, "Regulatory Audits," (ML19226A274)

If you have questions about this audit, please contact me at 301-415-0681 or via email at denise.mcgovern@nrc.gov or Ondra Dukes at 301-415-0537 or via email at ondra.dukes@nrc.gov.

Date: August 29, 2024

Denise McGovern, Senior Project Manager
Advanced Reactors Licensing Branch 2
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No.: 99902071

cc: X-energy via GovDelivery

SUBJECT: X ENERGY LLC – AUDIT PLAN FOR XE-100 GOTHIC AND FLOWNEX ANALYSIS CODES QUALIFICATION TOPICAL REPORT, REACTOR CORE DESIGN METHODS AND ANALYSIS TOPICAL REPORT, TRANSIENT AND SAFETY ANALYSIS METHODOLOGY TOPICAL REPORT, AND MECHANISTIC SOURCE TERM APPROACH TOPICAL REPORTS (CAC / EPID NO. 00431 / L-2024-TOP-0021, 0012, 0017, and 0019) DATED AUGUST 29, 2024

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NRR-106

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DATE	8/21/2024	8/26/2024	8/29/2024	8/29/2024

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