



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

April 1, 2020

MEMORANDUM TO: Benjamin Beasley, Chief
Advanced Reactor Licensing Branch
Division of Advanced Reactors and Non-Power Production
and Utilization Facilities
Office of Nuclear Reactor Regulation

FROM: Jan Mazza, Project Manager */RA/*
Advanced Reactor Licensing Branch
Division of Advanced Reactors and Non-Power Production
and Utilization Facilities
Office of Nuclear Reactor Regulation

SUBJECT: AUDIT PLAN FOR THE OKLO POWER LLC. AURORA
REACTOR COMBINED LICENSE APPLICATION ACCEPTANCE
REVIEW

On March 11, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML20075A000), Oklo Power LLC, submitted a combined license (COL) application for the Aurora reactor to the U.S. Nuclear Regulatory Commission (NRC). The NRC staff is in the process of reviewing the application for acceptance and docketing.

The purpose of this audit, as part of the NRC staff's acceptance review, is to verify the existence of detailed calculations, analyses and/or bases underlying the application and to confirm the staff's understanding of the application. The audit will also be used to support the staff's insights on the level of effort and resources that will be needed to conduct the review, provide input to the application review schedule, and identify any areas of information insufficiency that may impact the application review. This plan has been coordinated with the Environmental Review New Reactor Branch in the Office of Nuclear Material Safety and Safeguards to support the acceptance review of the environmental report submitted with the application.

Enclosure:
Audit Plan

cc w/encl.: Oklo Power LLC

CONTACT: Jan Mazza, NRR/DANU/UARL
301-415-0498

SUBJECT: AUDIT PLAN FOR THE OKLOPOWER LLC AURORA REACTOR COMBINED
LICENSE APPLICATION ACCEPTANCE REVIEW DATED: APRIL 1 2020

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ADAMS Accession No: ML20079L202

*via email

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**U.S. NUCLEAR REGULATORY COMMISSION
REGULATORY AUDIT OF OKLO POWER LLC AURORA REACTOR
COMBINED LICENSE APPLICATION SUPPORTING DOCUMENTATION**

AUDIT PLAN

APPLICANT: Oklo Power LLC.

APPLICANT CONTACTS: TBD, Oklo Power LLC

DURATION: April 8 – May 22, 2020

LOCATION: Oklo Power LLC
230 E. Caribbean Dr.
Sunnyvale, CA 94089

Electronic Reading Room (eRR)

AUDIT TEAM: Timothy Lupold, Sr. Mechanical Engineer, Audit Team Leader, NRR/DANU/UART
Ian Jung, Sr. Reliability and Risk Analyst, NRR/DANU/UART
Boyce Travis, Reactor Systems Engineer, NRR/DANU/UART
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Ata Istar, Civil Engineer, NRR/DEX/ESEA
David Heeszal, Geophysicist, NRR/DEX/EXHB
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Peyton Doub, Environmental Scientist, NMSS/REFS/ERNRB
Jeff Rikhoff, Sr. Environmental Scientist, NMSS/REFS/ERLRB
Don Palmrose, Sr. Reactor Engineer, NMSS/REFS/ERNRB
Steven Vitto, Security Specialist, NSIR/DPCP/RSB
Dan Barss, Sr. Emergency Preparedness Specialist, NSIR/DPR/RLB
Jesse Seymour, Reactor Operations Engineer Human Factors, NRR/DLO/IOLB
Shawn Harwell, Financial Analyst, NMSS/REFS/FAB
Joseph Kelly, Sr. Reactor Systems Engineer, RES/DSS/CRAB
Jan Mazza, Project Manager, NRR/DANU/UART
William Reckley, Sr. Project Manager, NRR/DANU/UART

Enclosure

I. BACKGROUND

Oklo Power, LLC (Oklo) has submitted a custom combined license (COL)¹ application (“application”) for the Aurora reactor in March 2020. The NRC staff will review the application for acceptance and docketing for detailed review of the Aurora reactor design. Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.79, “Contents of applications; technical information in final safety analysis report [FSAR],” establishes the requirements for the contents of the FSAR to describe the facility, present the design bases and the limits on its operation, and present a safety analysis of the structures, systems, and components of the facility as a whole. The FSAR shall include information at a level sufficient to enable the Commission to reach a final conclusion on all safety matters that must be resolved by the Commission before issuance of a combined license. In 10 CFR 52.80(a), “Contents of Applications; additional technical information,” further states, “The proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will be operated in conformity with the combined license, the provisions of the Act, and the Commission’s rules and regulations.” The acceptance review will include the reactor design aspects since the combined license application will not reference an approved design certification. The acceptance review will also include an assessment of the environmental report required to be contained in the application in accordance with 10 CFR 52.80(b). As required by 10 CFR 51.50(c), the environmental report shall contain the information specified in 10 CFR Section 51.45, 51.51, and 51.52, as modified by 51.50(c).

The NRC staff will review the application to determine if it reasonably appears to contain sufficient technical information, both in scope and depth, for the NRC staff to complete the detailed technical review and render, in an appropriate time frame for the associated action, an independent assessment of the proposed action with regard to applicable regulatory requirements and the protection of public health, safety, security, and the environment. The NRC staff will audit the supporting information for the application to ensure the information that is generally expected to be complete for a custom COL exists and is consistent with the level of detail necessary to review the documents supporting the application. The NRC staff’s audit follows the guidance in NRR Office Instruction (OI) LIC-111, “Regulatory Audits,” Revision 1.

II. PURPOSE

The purpose of this audit, as part of the NRC staff’s acceptance review, is to verify the existence of detailed calculations, analyses and/or bases underlying the application and to confirm the staff’s understanding of the application. The audit will also be used to support the staff’s insights on the level of effort and resources that will be needed to conduct the review, provide input to the application review schedule, and identify any areas of information insufficiency that may impact the application review.

III. REGULATORY AUDIT BASIS

The audit basis is to confirm that there is supporting information that provides the basis for the application to meet the applicable criteria contained in 10 CFR Part 52 Subpart C - Combined Licenses, 52.79, and 10 CFR 52.80, “Contents of Applications; additional technical information.”

¹ The custom COL application would include all the design information provided in a design certification application plus all the site-specific safety and environmental information in a COL application.

IV. REGULATORY AUDIT SCOPE

The primary scope of this audit is to verify that COL application supporting information exists and is generally complete for a custom COL to the level of detail necessary for the application review.

V. DOCUMENTS / INFORMATION NECESSARY FOR THE AUDIT

The following documents are to be made available to the NRC staff, in the Oklo Electronic Reading Room (eRR):

A. DOSE/SOURCE TERM/ACCIDENTS

1. Calculations used to determine the fission product inventory in the core
2. Analyses that provide the assumptions for the fission product release from the fuel considering retention by each fission product barrier credited
3. Calculations supporting the radiological source terms in FSAR Chapter 3
4. Shielding design analyses
5. Documents related to the event evaluation process for determining the maximum credible accident
6. Analyses supporting the following statements:
 - a. "Oklo analysis showed that an assumption of 30 percent degradation in thermal-conductivity for the entire cycle is conservative"
 - b. "Cascade failures [of heat pipes] have been shown in Oklo analysis not to be credible"
7. Probabilistic risk assessment (PRA) information including analyses, calculations, data/ operating experience, assumptions, codes, quality control process, any peer/expert panel reviews, and the use of PRA

B. CORE/FUEL DESIGN

1. Calculations that establish the reactor core design and kinetics behavior (e.g., reactivity balance, power distribution, reactivity coefficients, shutdown margin)
2. Calculations that provide fuel performance characteristics as a function of burnup (e.g., thermal-conductivity, swelling, peak temperature, eutectic formation)
3. Calculations used to determine parasitic heat losses during normal operation and heat removal from the reactor to the environment during plant transients and accidents, including any analysis related to the contact conductance and resistances use
4. Fuel fabrication specifications
5. Documentation on the point kinetics equation solver that was developed by Oklo (e.g., methodology, verification, validation, sensitivity studies, and uncertainty evaluations)

C. STRUCTURES SYSTEMS AND COMPONENTS

1. Analyses which demonstrate the safety functions of structures, systems, and components will be accomplished during and after a seismic event. This should include seismic evaluation of shutdown rods, module shell support to reactor module emplacement, and concrete temperature assessments
2. Design specifications for major components including fuel cans, heat pipes, capsule, and module

3. Design drawings for major components of the reactor. Details of specific interest include: interfaces between reactor internal components, the bill of materials, tolerances of components that are (a) stricter than stock material tolerances and (b) important factors in design calculations
4. Information related to structures, systems, and components including key instrumentation and controls (I&C) and electrical equipment compatibility with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents
5. Failure mode and effects analysis or evaluations on failure mechanisms. Topics of interest include evaluations on creep, irradiation embrittlement and void generation, fabrication issues such as cold cracking, etc

D. SITING

1. Site evaluation documents demonstrating the assumed plant seismic design bounds the site-specific seismic hazard
2. Site evaluation documents demonstrating that site-specific geotechnical parameters (e.g. bearing capacity, settlement calculations, foundation stability evaluations) are adequate compared to the design requirements (e.g. bearing demand, allowable settlements, minimum factor of safeties for foundation stability), and soil-structure interaction evaluation

E. OPERATIONAL PROGRAMS

1. Aurora Fire Protection Program documents.
2. Drawings identifying locations for radiation monitors.
3. Human Factors Program documents including style guide/guidelines.
4. Concept of Operations descriptions for the facility
5. Functional Requirements Analysis for the assignment of responsibilities to personnel, automation, or other design attributes.
6. Descriptions of training and qualification requirements for the Startup Operator position
7. Clarification of access control measures that may preclude monitors actions such as inserting a manual trip

F. ENVIRONMENTAL

1. For the environmental report, information and/or analyses addressing:
 - a. Radiological health impacts of construction and operation (estimated occupational exposures, annual dose to the maximally exposed individual, annual population doses, non-human biota doses, construction worker doses resulting from proximity of the proposed site to the INL Materials and Fuels Complex and planned pre-operational and operational radiological monitoring).
 - b. Radiological waste streams (form, quantities, and activities of radiological waste streams).
 - c. Radiological impacts of postulated accidents (including consideration of severe accident mitigation design alternatives and, due to the location of the proposed site in the jurisdiction of the U.S. Ninth Circuit Court, impacts of postulated acts of terrorism).
 - d. Environmental impacts resulting from the nuclear fuel cycle and the transportation of fuel and wastes.

G. SECURITY

1. Documents that describe how the regulations in 10 CFR Part 73 not exempted in Part V of the application will be met. This consists of technical information establishing the licensing basis for the physical protection program; information addressing the design of security systems; and the plans for implementing operations, management systems, and organization for meeting the performance and prescriptive requirements of 10 CFR Part 73
Examples – Safeguards detailed security design and assessment technical report, safeguards detailed Security Plans, supporting details for probability risk assessment (PRA information that indicates those components that need to be protected in a security event), supporting technical information for final safety analysis, any topical reports, and others supporting engineering evaluations and analyses.
2. Security assessment results and design evaluation of a physical protection system (e.g., providing engineered and administrative controls for detection, assessment, communications, delay, and security response) for meeting the performance requirements of 10 CFR 73.55(b).
3. Access-authorization program including background investigation, psychological assessment, and behavioral observation addressing requirement of 10 CFR 73.56 and 10 CFR 73.57.
4. Technical basis for exemptions requested in Part V
 - a. Information that provides the supporting technical basis that will allow the NRC to conclude the exemptions are appropriate. Information that supports the assertion of no radiological consequences for maximum possible release and maximum credible release following acts of sabotage or terrorism.
 - b. Basis that demonstrates the appropriateness for exemptions from fitness for duty requirements.
 - c. Basis that demonstrates the appropriateness for exemptions from cyber security requirements.
5. Descriptions detailing the fitness for duty programs for personnel relied on for conduct of operations.
6. License and design basis information for a material license under 10 CFR Part 70 for possession of special nuclear material (SNM), to include licensing basis for physical security of SNM in accordance with requirements of 10 CFR Part 73 and MC&A requirements of 10 CFR 74 for quantity, form and enrichment of SNM of low and moderate strategic significance.

H. EMERGENCY PREPAREDNESS

1. Emergency Operating Procedures (EOPs) - The emergency plan refers to actions taken in accordance with EOP.
2. Information pertaining to the signal system to notify responders, both onsite and offsite in the event of an emergency.
3. Maps that identify the site and features related to emergency planning associated with the site.
4. Onsite Monitor Training Program – The emergency plan indicates that the process for determining emergency actions will be in the Onsite Monitor Training Program.
5. Emergency Plan Certifications, Memorandum of Understanding or Letter of Agreement – The emergency plan relies on offsite agencies for many actions

I. OTHER

1. Financial information (qualifications, decommissioning, insurance, etc.)

Other needed documents may be identified during the audit. If so, the NRC core team project manager (PM) will request that the additional documents be placed into the eRR.

VI. SPECIAL REQUESTS

The NRC staff requests that Oklo provide the technical staff with access to the audit documents identified in Section V. The NRC staff will follow terms of the, "Oklo, Inc. – Online Reference Portal Information Access Agreement," dated November 7, 2019, located in NRC's Agencywide Documents Access and Management System (ADAMS) records management system ADAMS Accession No. ML19291B640. Oklo can upload the requested documents into the Oklo eRR for staff's review. It is expected that the staff will have questions and discussion items for the Oklo personnel during the audit. Oklo is requested to provide access to personnel that will have further knowledge on documents within the eRR and that may have additional information that the NRC staff may need to determine whether the application is acceptable to be docketed. This access will be via scheduled meetings coordinated between the NRC core team PM and Oklo. When the staff's review of the documents associated with a specific issue is complete the NRC core team PM will notify Oklo Power LLC that these documents can be removed from eRR thereby minimizing their residence time in eRR.

VII. AUDIT ACTIVITIES AND DELIVERABLES

The NRC audit team review will cover the technical areas identified in Section V of this audit plan. Depending upon the effort needed in a given area, core team members may be reassigned to ensure adequate coverage of important technical elements.

The regulatory audit will be scheduled starting from the date of the audit entrance meeting and ending 45 days later. At the completion of the audit, the audit team will issue an audit summary within 90 days that will be declared and entered as an official agency record in ADAMS.

The NRC core team PM will coordinate with Oklo in advance of audit activities to verify documents and identify any changes to the audit schedule and requested documents. The audit entrance/exit meetings and weekly audit meetings are to be scheduled as followings: Entrance Meeting – April 08, 2020; Exit Meeting: TBD (approximately 45 days after the entrance meeting); weekly NRC Audit Team Meetings as needed: Wednesdays 11:00 AM – 12:00 PM EDT (proposed).

The NRC staff acknowledges the proprietary nature of the information requested. In accordance with the Oklo, Inc. – Online Reference Portal Information Access Agreement, proprietary information will be handled appropriately throughout the audit. While the NRC staff will take notes, the NRC staff will not remove hard copies or electronic files from the audit site.

The NRC will hold routine audit calls and/or meetings with Oklo to discuss the level of completeness of various documents and the other information that may be necessary to gauge acceptability of the application for docketing. In these routine meetings, NRC will also identify any emerging information needs as well as documents that may be removed from eRR. A discussion of status and summary of results will take place during the NRC Audit Team Meetings.

The audit outcome may be used to determine if the Oklo application for the Aurora reactor is acceptable to be docketed for review by the NRC staff, provide insights on the level of effort and resources that will be needed to conduct the review, provide input to the application review schedule for the Oklo Aurora reactor, and identify any areas of information insufficiency in the Oklo application.

If necessary, any circumstances related to the conduct of the audit will be communicated to Jan Mazza (NRC) at 301-415-0498 or email: Jan.Mazza@nrc.gov

VIII. REFERENCES

1. Oklo Inc. Letter dated March 11, 2020, Oklo Inc Project 99902046; Oklo Power Combined Operating License Application for the Aurora at INL; ADAMS Accession No. ML20075A001 (Package ML20075A000).