INL/EXT-20-59627

Evaluation of Proposed Oklo Aurora Microreactor Sites at Idaho National Laboratory

September 2020

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SUMMARY

In response to a request from the Department of Energy Idaho Operations Office (DOE-ID), members of the Land Use Committee met on August 26, 2020, to review and rank the Oklo Aurora microreactor demonstration sites that were presented to DOE-ID by Oklo for comment.

Based on this evaluation, and subject to further consideration of the cross-cutting challenges identified during the evaluation, it is recommended at this time that the most suitable locations for the Aurora microreactor from the list of proposed sites are Oklo 1 and 3.

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CONTENTS

FIGURES

TABLES

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ACRONYMS

DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EIS	Environment Impact Statement
EPZ	emergency planning zone
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
N&HS	National and Homeland Security
NRC	Nuclear Regulatory Commission
NRIC	National Reactor Innovation Center
SNM	special nuclear material
TREAT	Transient Reactor Test Facility

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1. OVERVIEW

In response to a request from the Department of Energy Idaho Operations Office (DOE-ID), members of the Land Use Committee met on August 26, 2020, to review and rank the Oklo Aurora microreactor demonstration sites that were presented to DOE-ID by Oklo for comment. Refer to Appendix A for the agenda and roster of meeting participants. Table 1 describes the proposed sites and Figure 1 illustrates their locations.

Table 1. Oklo proposed site descriptions.

Site	Description
1	Site at the "Y" turnoff between the Materials and Fuels Complex (MFC) and Transient Reactor Test (TREAT) Facility
2	Site near the MFC transmission station
3	Site at the southwest corner of the dirt road around MFC
4	Site of the MFC badging and inspection facility
5	Site to the northeast of the TREAT operation building

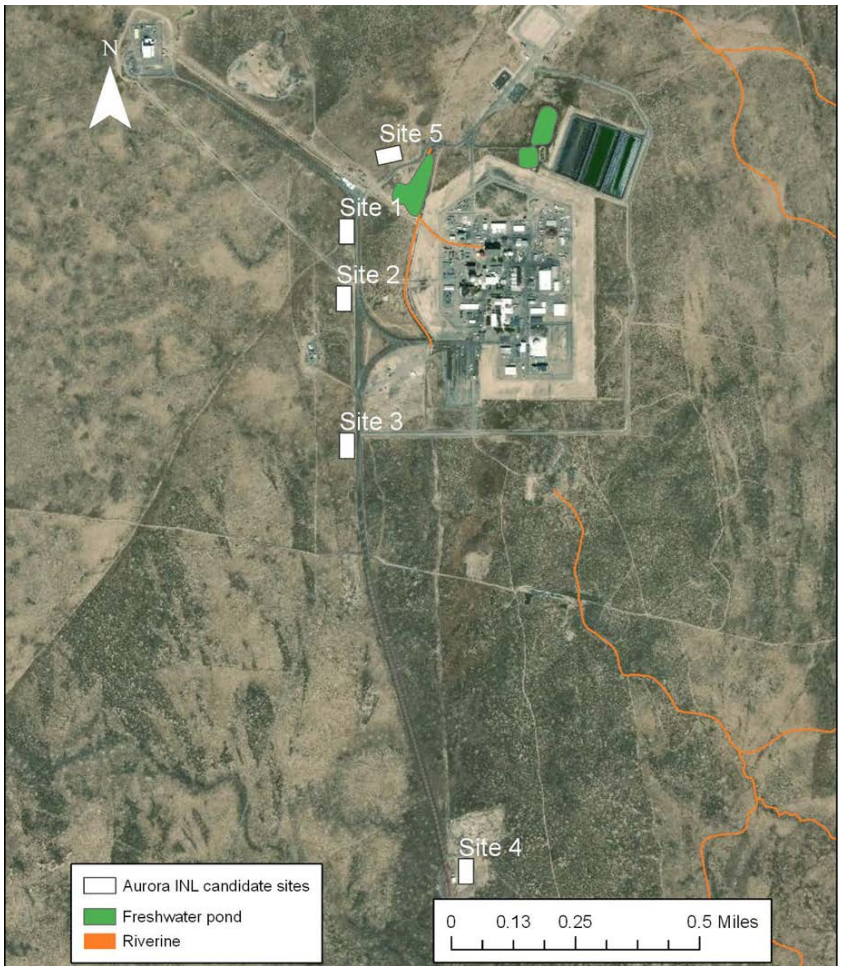

Figure 1. Oklo Aurora microreactor proposed siting locations.

1.1 Site Evaluation Process

To ensure an objective and consistent evaluation process, the team followed the process described in INL/EXT-20-57821, "Evaluation of Sites for Advanced Reactor Demonstrations at Idaho National Laboratory," and utilized the criteria established in that siting evaluation. Based on the Idaho National Laboratory (INL) mission, the five proposed sites from Oklo were ranked from most to least suitable location.

1.2 Assumptions

Key assumptions applied during the siting evaluation include the following:

1. Regarding physical security authority, property located within the Oklo Aurora site boundary fence (refer to Figure 2) is assumed to be Oklo's responsibility. Everything outside that site boundary fence is INL's responsibility.
2. The emergency planning zone (EPZ) for Oklo is assumed to be the Aurora powerhouse.

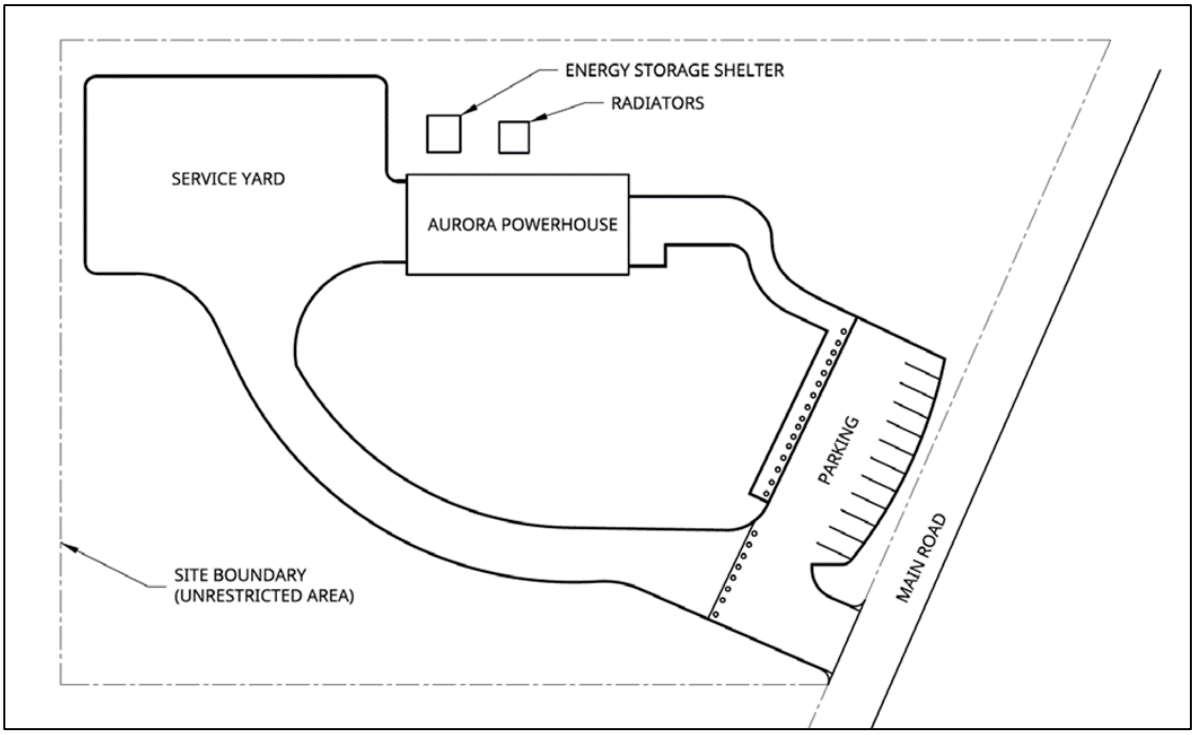

Figure 2. Oklo schematic of an Aurora site.

3. Regarding interim storage of special nuclear material (SNM) and fuel assembly, it is assumed that the Oklo facility will include areas to support these functions. Oklo will need to coordinate with INL security to bring SNM into the site.

2. EVALUATION RESULTS SUMMARY

The table below summarizes the results of the evaluation and identifies the preferred ranking of the Oklo sites. The left portion of the table identifies the various criteria (A-K) used to evaluate the sites, the scoring definitions, and the weight applied to each criterion. The first column for each proposed site provides the scoring for each criterion, while the second column provides the weighted scoring. Finally, the bottom of each column of the table identifies the total scoring for each of the proposed sites. Appendix B includes the site scoring explanations.

Table 2. Summary evaluation matrix of preferred ranking of the Oklo sites.

EVALUATION MATRIX		PROPOSED SITES									
WANT CRITERIA	**WEIGHTS**	Oklo 1		Oklo 3		Oklo 5		Oklo 2		Oklo 4	
A - Avoid areas of surface water flooding/ponding	7.3	10	73	10	73	5	36	10	73	10	73
B - Maximize proximity to suitable sources of cooling water	4.0	Not Applicable									
C - Minimize disturbance of critical habitat of protected species	11.9	10	119	10	119	10	119	10	119	5	60
D - Avoid areas of high predictive archaeology zones	13.2	10	132	10	132	10	132	10	132	5	66
E - Minimize potential adverse interactions with existing programs	10.6	5	53	5	53	5	53	1	11	5	53
F - Ensure appropriate security controls are available	15.2	5	76	5	76	5	76	5	76	5	76
G - Minimize distance from public transportation routes	3.3	10	33	10	33	10	33	10	33	10	33
H - Minimize distance to transmission lines	2.6	10	26	10	26	10	26	10	26	5	13
I - Optimize use of Land Use planning zones	0.7	10	7	10	7	10	7	10	7	10	7
J - Maximize use of updated seismic hazard analysis and site-specific characterization data	19.9	10	199	10	199	10	199	10	199	0	0
K - Minimize proximity to faults and building on soil sites	11.3	10	113	10	113	10	113	10	113	10	113
TOTALS	100.0		**831**		**831**		**795**		**789**		**493**

Scoring Definitions for A to I and K:
10 = Candidate site meets criterion with minimal to no difficulty
5 = Candidate site meets criterion with some difficulty
1 = High degree of uncertainty as to whether the candidate site can meet criterion
0 = Candidate site cannot meet criterion

Scoring Definitions for J:
10 = Candidate site meets criterion with minimal to no difficulty
5 = N/A
1 = N/A
0 = Candidate site cannot meet criterion

As identified in Table 1, the team recognized that the criterion, "Maximize proximity to suitable sources of cooling water," was not applicable in the evaluation of the Aurora microreactor siting. The Aurora does not use water for cooling; therefore, this criterion was not included in the evaluation.

Also, regarding distance to transmission lines, Oklo sites 1, 3, 5, and 2 scored a "10" when considering their proximity to INL transmission lines. When considering their closeness to commercial transmission lines, they would all score a "5."

3. NOTED SITING CHALLENGES

Below are potential challenges or issues relevant to the five proposed sites that will need to be addressed prior to selecting the final location of the Aurora. We also understand that DOE-ID is working with the National Reactor Innovation Center (NRIC) to more closely evaluate some of the regulatory and permitting issues with co-locating a Nuclear Regulatory Commission (NRC) licensed facility (such as Oklo) adjacent to existing INL facilities authorized by DOE.

3.1 Cross-Cutting Challenges

- Additional analysis is required to determine the impacts a total evacuation of MFC due to an emergency would have on Oklo's power generation. The impacts of an evacuation of the Aurora site on MFC operations due to an emergency also require further analysis.
- Potential impacts on the environment and current INL air permit due to emissions from the Aurora site require analysis. A determination of whether Oklo operations is considered part of the public may affect the air emission calculations in the current air permit.

- Anyone coming onto INL will have to have an INL badge. Resolution of required security requirements are necessary prior to selecting the final Aurora site.
- A challenge identified during the advanced reactor siting evaluation and discussed at the Aurora siting evaluation was the need for clarification on what determines the "nearest public member" and definition of a collocated worker. DOE regulations specify a general employee can be someone working in conjunction with DOE. NRC specifies, when receiving an occupational dose, that member is not a member of the public. The Defense Nuclear Facilities Safety Board (DNFSB) specifically includes a description of workers as being traditionally inside the boundary of a potential release, and a collocated worker as being at 100 meters from the potential release. This may need the Department of Energy Idaho Operations Office (DOE-ID) to make an official determination (INL 2020).
- All siting locations of planned NRC-licensed advanced reactors may be affected by the results of the next volcanic hazard assessment at INL; planning for this study is currently underway.
- Additional analysis is necessary to understand the potential impacts of selecting Oklo sites 1, 2, 3, or 5 might have on the current MFC safety basis.
- The bridge on Taylor Boulevard is good for all legal loads. Any load that is over the legal weight limit coming into INL from off site will require an Idaho Transportation Department permit. That permit information (number of axles, axle spacing, axle loads, and route information) must be sent to INL Facility Engineering for evaluation prior to initiating the shipment.

3.2 Site Specific Challenges

Oklo Site 1:

- No specific notable challenges with Oklo site 1.

Oklo Site 2:

- Oklo site 2 is located directly beneath two existing 138kV power lines. There are plans to bring in a third 138kV power line in that same area. Additional analysis is needed to determine the potential impacts regarding operation, safety, and maintenance of placing a reactor beneath power lines and potentially within the path of the new construction for the third power line.
- Also, relatively close to this site is the National and Homeland Security (N&HS) MFC Power Test Pad. Concerns with potential foreign national visitors to this area need to be evaluated.

Oklo Site 3:

- No specific notable challenges with Oklo site 3.

Oklo Site 4:

- Oklo 4 appears on the map provided to be in the same location as the newly renovated INL security badging and inspection facility. If this location is selected, additional analysis will be required to locate the Aurora at an adequate distance from the badging facility to not impact operations of that facility
- This location is not currently included in the site characterization surveys that are planned in support of the site-wide Environment Impact Statement (EIS). If this location is selected, additional planning and resources will be required to survey for potential cultural, ecological, and wildlife impacts. If items of significance are found, mitigation planning will be required.
- Oklo 4 is located outside of existing seismic evaluations. If this location is selected additional resources will be required to adequately characterize this site for seismic hazards in compliance with NRC regulations.

- The area south of MFC historically has been prone to flooding (INL 2020). Construction of additional engineered barriers may be required to ensure proper mitigation of potential surface flooding.

Oklo Site 5:

- The area south of MFC historically has been prone to flooding (INL 2020). Construction of additional engineered barriers may be required to ensure proper mitigation of potential surface flooding.

4. RECOMMENDATIONS

Based on this evaluation, and subject to further consideration of the cross-cutting challenges identified above, it is recommended at this time that the most suitable locations for the Aurora microreactor from the list of proposed sites are sites 1 and 3. When evaluated against the established criteria, these sites scored the highest, equally. The five evaluated sites are listed below from most to least suitable:

- Oklo sites 1 and 3
- Oklo site 5
- Oklo site 2
- Oklo site 4.

5. REFERENCES

INL. 2020. “Evaluation of Sites for Advanced Reactor Demonstrations at Idaho National Laboratory.” INL/EXT-20-57821.

Appendix A
Meeting Agenda and List of Participants

Microreactors Siting – Oklo Proposed Sites Evaluation

Objective: Create ranked list of proposed Oklo sites with notes of significant reasons/differences, as applicable.

Agenda, August 26, 2020:

8:30	Welcome	Randy
8:35	Review Oklo Proposed Sites	George
9:00	Compare Proposed Sites Against Previously Scored Sites and Capture Technical Input on New Data Received, as applicable	Alison with Team
10:00	Review Ranked List of Candidate Sites and Discuss, as needed	Alison with Team
10:10	Capture Final Comments and Wrap Up	Randy
10:15	Adjourn	All

Meeting Participants:

8/26/20	NAME	EMAIL ADDRESS	ORGANIZATION
x	Jason Andrus	jason.andrus@inl.gov	Adv Nuclear Facility Safety Engineering
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Appendix B
Scoring Explanations

SCORING EXPLANATIONS	PROPOSED SITES									
WANT CRITERIA	Oklo 1		Oklo 3		Oklo 5		Oklo 2		Oklo 4	
A - Avoid areas of surface water flooding/ponding	10	Outside of flooding area	10	Outside of flooding area	5	drainage area, high degree of flooding	10	Outside of flooding area	10	No flooding issues
B - Maximize proximity to suitable sources of cooling water	Not applicable									
C - Minimize disturbance of critical habitat of protected species	10	Outside of conservation areas and away from active leks	10	Outside of conservation areas and away from active leks	10	Outside of conservation areas and away from active leks	10	Outside of conservation areas and away from active leks	5	Sagebrush Habitat
D - Avoid areas of high predictive archaeology zones	10	Low probability of unearthing unknown cultural artifacts	10	Low probability of unearthing unknown cultural artifacts	10	Low probability of unearthing unknown cultural artifacts	10	Low probability of unearthing unknown cultural artifacts	5	Potential significant cultural issues; need to survey
E - Minimize potential adverse interactions with existing programs	5	Additional analysis is necessary to understand potential impact to current MFC safety basis	5	Additional analysis is necessary to understand potential impact to current MFC safety basis	5	Need to ensure to locate site out of TREAT boundary/buffer zone and analyze for potential impact to current MFC safety basis	1	Addition of new line coming in and proximity to N&HS battery test pad	5	Additional analysis needed to ensure no adverse interactions with newly refurbished INL security badging and inspection facility
F - Ensure appropriate security controls are available	5	Outside MFC facility PIDAS	5	Outside MFC facility PIDAS	5	Outside MFC facility PIDAS	5	Outside MFC facility PIDAS	5	Outside MFC facility PIDAS
G - Minimize distance from public transportation routes	10	Near existing high quality roads	10	Near existing high quality roads	10	Near existing high quality roads	10	Near existing high quality roads	10	Near existing high quality roads
H - Minimize distance to transmission lines	10	Near transmission lines and existing infrastructure	10	Near transmission lines and existing infrastructure	10	Near transmission lines and existing infrastructure	10	Near transmission lines and existing infrastructure	5	Relatively close to transmission line
I - Optimize use of Land Use planning zones	10	Within appropriate planning zones	10	Within appropriate planning zones	10	Within appropriate planning zones	10	Within appropriate planning zones	10	Within appropriate planning zones
J - Maximize use of updated seismic hazard analysis and site-specific characterization data	10	Seismic Hazard Analysis and Site-Characterization Data available for MFC facility; data is applicable withing 500 yards outside of fence	10	Seismic Hazard Analysis and Site-Characterization Data available for MFC facility; data is applicable withing 500 yards outside of fence	10	Seismic Hazard Analysis and Site-Characterization Data available for MFC facility; data is applicable withing 500 yards outside of fence	10	Seismic Hazard Analysis and Site-Characterization Data available for MFC facility; data is applicable withing 500 yards outside of fence	0	No data available
K - Minimize proximity to faults and building on soil sites	10	Not near faults	10	Not near faults	10	Not near faults	10	Not near faults	10	Not near faults