Status Report - Aurora (United States of America)

Published Date : Oct 17, 2024 2:58 PM CET

1. Overview

☐ **In Operation**

☐ **Under Construction**

☐ **Described in**

Link to PRIS	--

☑ **New Concept**

Number of Units	--
Year	--

Reference Plant

Name of Site	--
Link to PRIS	--
Net Power Output (MWe)	15.50
Gross Power Output (MWe)	--

1.1 Introduction

Oklo Inc. (NYSE: OKLO) a fast fission clean power technology and nuclear fuel recycling company developing fast fission power plants to provide clean, reliable, and affordable energy at scale.

The Oklo powerhouse is designed to provide affordable, reliable, emission-free electricity and heat. Oklo's business model is to provide power on a power purchase agreement basis. Oklo is in active discussion with companies across the following sectors: data centers, defense, industrial and manufacturing, real estate, and oil and gas.

Figure 1. Oklo concept

1.2 Development Milestones

2016	Began pre-application interactions with the U.S. NRC and ongoing pre-application process for Aurora powerhouses
2017	Demonstrated prototype fuel fabrication
2018	Conducted thermal testing
2019	Safeguards Information Protection and Handling Plan approved
2019	Granted a site use permit from the U.S. Department of Energy
2019	Awarded recovered fuel material from the Idaho National Laboratory
2020	Combined license application submittal to the U.S. Nuclear Regulatory Commission and acceptance for review (currently being revised)
2020	Quality Assurance Program Document approved
2021	Began pre-application for fuel recycling
2021	Partnership with Centrus announced
2021	Awarded U.S. Department of Energy Technology Commercialization (TCF) Fund award related to fuel recycling
2016-2022	Awarded five awards from the Gateway for Accelerated Innovation in Nuclear for work on fuel data, fuel modeling, fuel fabrication, thermal hydraulic testing, licensing support, and more
2022	Awarded Advanced Research Projects Agency-Energy (ARPA-E) OPEN program award related to fuel recycling

2022	Awarded ARPA-E ONWARDS program award related to fuel recycling
2023	Began pre-application process for fuel fabrication
2024	Safety Design Strategy for the Aurora Fuel Fabrication Facility approved by DOE
2024	Entered into a land rights agreement with the non-profit Southern Ohio Diversification
2024	Initiative to advance the deployment of two powerhouses in Southern Ohio
2024	In partnership with Argonne National Laboratory, Oklo successfully completed the second phase of the high-fidelity testing campaign at the Thermal Hydraulic Experimental Test Article
2024	Signed non-binding letter of intent to supply 50 megawatts to Diamondback Energy, a Texas-based independent oil and natural gas company, over a 20-year power purchase agreement
2024	Began trading on the New York Stock Exchange under the new ticker symbol “OKLO"
2024	Signed non-binding memorandum of understanding with Atomic Alchemy to collaborate on isotope production
2024	Partnered with computer networking company Wyoming Hyperscale to deliver 100 megawatts to its data centers over 1 20-year power purchase agreement
2024	Completed successful end-to-end demonstration of advanced fuel recycling process, advancing commercial-scale recycling facility
2024	Established preferred supplier agreement with Siemens Energy for steam turbine generator products and services

1.3 Design organization or vendor company

1.4 Links to designer/vendor website

1.5 Design Description

Main design features:

Safety is fundamentally accomplished in Oklo's design by its inherent characteristics, including:

- Low decay heat term, removed by inherent and passive means
- Inherent reactivity feedbacks ensure reactor power is controlled during overpower or overtemperature

events

- Multiple barriers to fission product release
- Ambient pressure system removes sources of pressure and minimizes driving forces for release
- Water not required for safety-related cooling
- <18 months installation
- Offsite fabrication
- Operate at atmospheric pressure
- Power output license is 40+ years

1.6 Licensing Application Support Documents

The design is at the detailed design stage. Oklo has completed fuel prototyping activities, heat transport testing programs, and is now developing experimental advanced fuel recycling and fabrication capabilities. Oklo was awarded a Site Use Permit by the U.S. DOE and was awarded fuel material by the Idaho National Lab and the U.S. DOE. Oklo is the only company to have had a custom combined license accepted for review by the U.S. NRC. Oklo has actively engaged the U.S. NRC from 2016 to the present in pre-application activities, as well as application review activities.

1.7 Reactor Unit in PRIS

2. Category Fields

Table 1: ARIS Category Fields

ARIS Category	Value	Units of Examples
Current/Intended Purpose		e.g. Commercial – Electric/Non-electric, Prototype/FOAK, Demonstration, Experimental
Main Intended Application (once commercial)	Baseload	e.g. Baseload, Dispatchable, Off-grid/Remote, Mobile/Propulsion, Non-electric (specify)
Reference Location	Inland	e.g. On Coast, Inland, Below-Ground, Floating-Fixed, Marine-Mobile, Submerged-Fixed (Other-specify)
Reference Site Design (reactor units per site)		e.g. Single Unit, Dual Unit, Multiple Unit (# units)
Core Coolant	liquid metal	H2O, D2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify)

Reactor Core Size (1 core)	30 MWth <= Thermal power < 1000 MWth	e.g. Thermal Power < 30 MWth, 30 MWth ≤ Thermal power < 1000 MWth, 1000 MWth ≤ Thermal power ≤ 3000 MWth, Thermal power > 3000 MWth
Reactor Type	Others	e.g. PWR, BWR, HWR, SCWR, GCR, GFR, SFR, LFR, MSR, ADS
Reactor Size	Microreactor	e.g. PWR, SMR
Neutron Moderator	None	e.g. H_2O, D_2O, He, CO_2, Na, Pb, PbBi, Molten Salts, (Other-specify)
NSSS Layout		e.g. Loop-type (# loops), Direct-cycle, Semi-integral, Integral, Pool-type
Primary Circulation		e.g. Forced (# pumps), Natural
Thermodynamic Cycle		e.g. Rankine, Brayton, Combined-Cycle (direct/indirect)
Secondary Side Fluid		e.g. H_2O, He, CO_2, Na, Pb, PbBi, Molten Salts, (Other-specify)
Fuel Form		e.g. Fuel Assembly/Bundle, Coated Sphere, Plate, Prismatic, Contained Liquid, Liquid Fuel/Coolant
Fuel Lattice Shape		e.g. Square, Hexagonal, Triangular, Cylindrical, Spherical, Other, n/a
Rods/Pins per Fuel Assembly/Bundle		e.g. #, n/a
Fuel Material Type	Metal	e.g. Oxide, Nitride, Carbide, Metal, Molten Salt, (Other-specify)
Design Status	Detailed Design	e.g. Conceptual, Detailed, Final (with secure suppliers)
Licensing Status		e.g. DCR, GDR, PSAR, FSAR, Design Licensed (in Country), Under Construction (# units), In Operation (# units)
Neutron Spectrum	Fast	e.g. Fast, Thermal

3. Parameter Fields

Table 2: ARIS Parameter Fields

ARIS Parameter	Value	Units of Examples
Plant Infrastructure		
Design Life	40	Years
Lifetime Capacity Factor		%, defined as Lifetime MWe-yrs delivered / (MWe capacity * Design Life), incl. outages
Major Planned Outages		# days every # months (specify purpose, including refuelling)
Operation / Maintenance Human Resources		# Staff in Operation / Maintenance Crew during Normal Operation
Reference Site Design		n Units/Modules
Capacity to Electric Grid	15.50	MWe (net to grid)
Non-electric Capacity		e.g. MW(th) heat at x °C, m3/day desalinated water, kg/day hydrogen, etc.
In-House Plant Consumption		MWe
Plant Footprint	8094	m2 (rectangular building envelope)
Site Footprint		m2 (fenced area)
Emergency Planning Zone		km (radius)
Releases during Normal Operation		TBq/yr (Noble Gases / Tritium Gas / Liquids)
Load Following Range and Speed		x – 100%, % per minute
Seismic Design (SSE)		g (Safe-Shutdown Earthquake)
NSSS Operating Pressure (primary side)	0.101325	MPa(abs), i.e. MPa(g)+0.1, at core outlet
NSSS Operating Pressure (secondary side)	0.10325	MPa(abs), i.e. MPa(g)+0.1, at secondary side outlet
Primary Coolant Inventory (incl. pressurizer)		kg

Nominal Coolant Flow Rate (primary)		kg/s
Nominal Coolant Flow Rate (secondary)		kg/s
Core Inlet Coolant Temperature		ºC
Core Outlet Coolant Temperature		ºC
Available Tempeature as Process Heat Source		ºC
NSSS Largest Component		e.g. RPV (empty), SG, Core Module (empty/fuelled), etc.
- NSSS Largest Component Length		mm
- NSSS Largest Component Diameter		mm
- NSSS Largest Component Thickness		mm
- NSSS Largest Component Weight		tonne
Reactor Vessel Material		e.g. SS304, SS316, SA508, 800H, Hastelloy N
Steam Generator Design		e.g. Vertical/Horizontal, U-Tube/ Straight/Helical, cross/counter flow
Secondary Coolant Inventory		kg
Pressurizer Design		e.g. separate vessel, integral, steam or gas pressurised, etc.
Pressurizer Volume		m3 / m3 (total / liquid)
Containment Type		Dry (single/double), Dry/Wet Well, Inerted, etc.
Containment Volume		m3
Spent Fuel Pool Capacity and Total Volume		Years of full-power operation / m3
Non Electric Application		-
Core Delta Temperature		ºC
Fuel/Core		
Single Core Thermal Power	50	MW(th)

Refuelling Cycle	120-240	months or “continuous”
Fuel Material		e.g. UO2, MOX, UF4, UCO
Enrichment (avg./max.)		%
Average Neutron Energy		eV
Fuel Cladding Material		e.g. Zr-4, SS, TRISO, E-110, none
Number of Fuel “Units”		Specify as Assembly, Bundle, Plate, Sphere, or n/a
Weight of one Fuel Unit		kg
Total Fissile Loading (initial)		kg fissile material (specify isotopic and chemical composition)
% of fuel outside core during normal operation		Applicable to online refuelling and molten salt reactors
Fraction of fresh-fuel fissile material used up at discharge		%
Core Discharge Burnup		MWd/kgHM (heavy metal, eg U, Pu, Th)
Pin Burnup (max.)		MWd/kgHM
Breeding/Conversion Ratio		Fraction of fissile material bred in-situ over one fuel cycle or at equilibrium core
Reprocessing		e.g. None, Batch, Continuous (FP polishing/actinide removal), etc.
Main Reactivity Control		e.g. Rods, Boron Solution, Fuel Load, Temperature, Flow Rate, Reflectors
Solid Burnable Absorber		e.g. Gd2O3
Core Volume (active)		m3 (used to calculate power density)
Fast Neutron Flux at Core Pressure Boundary		n/(cm²*s)
Max. Fast Neutron Flux		n/(cm²*s)
Core Control Rod Absorber		-
Core Soluble Neutron Absorber		-
Safety Systems		

Number of Safety Trains	Active / Passive	% capacity of each train to fulfil safety function
- reactor shutdown	Active/Passive	- / - / -
- core injection	Active/Passive	- / - / -
- decay heat removal	Active/Passive	- /- / -
- containment isolation and cooling	Active/Passive	- / - / -
- emergency AC supply (e.g. diesels)	Active/Passive	- / - / -
DC Power Capacity (e.g. batteries)		Hours
Events in which Immediate Operator Action is required		e.g. any internal/external initiating events, none
Limiting (shortest) Subsequent Operator Action Time		Hours (that are assumed when following EOPs)
Severe Accident Core Provisions		e.g. no core melt, IVMR, Core Catcher, Core Dump Tank, MCCI
Core Damage Frequency (CDF)		x/reactor-year (based on reference site and location)
Severe Accident Containment Provisions		e.g., H2 ignitors, PARs, filtered venting etc.
Large Release Frequency (LRF)		x/reactor-year (based on reference site and location)
Overall Build Project Costs Estimate or Range (excluding Licensing, based on the Reference Design Site and Location)		
Construction Time (nth of a kind)		Months from first concrete to criticality
Design, Project Mgmt. and Procurement Effort		Person-years (PY) [DP&P]
Construction and Commissioning Effort		PY [C&C]
Material and Equipment Overnight Capital Cost		Million US$(2015) [M&E], if built in USA
Cost Breakdown	%[C&C]/%[M&E]	
- Site Development before first concrete		

- Nuclear Island (NSSS)		(e.g. 25/10) (30/40) (20/25) (20/10) (5/15) (-----------) (to add up to 100/100)
- Conventional Island (Turbine and Cooling)		
- Balance of Plant (BOP)		
- Commissioning and First Fuel Loading		
Factory / On-Site split in [C&C] effort		%/% of total [C&C] effort in PY (e.g., 60/40)
Nuclear System		
System Steam Flow Rate		kg/s
System Steam Pressure		MPa
System Steam Temperature		ºC
System Feedwater Flow Rate		kg/s
System Feedwater Temperature		ºC
Reactor Core		
Active Core Height		m
Equivalent Core Diameter		m
Average Linear Heat Rate		kW/m
Average Fuel Power Density		kW/kgU
Average Core Power Density		MW/m3
Outer Diameter Of Fuel Rods		mm

4. Plant Layout, Site Environment and Grid Integration

SUMMARY FOR BOOKLET

Plant Layout Arrangement

The Aurora site has a primary building with some supporting structures. The Aurora powerhouse has two floors. The radiators are located external to the Aurora powerhouse. The radiators exchange heat with ambient air as the ultimate heat sink for the power cycle. There is a parking lot for the site as well as landscaping surrounding the site. Due to the inherent safety characteristics, an evacuation zone outside of the site boundary is not generally required.

4.1 Site Requirements during Construction
4.2 Site Considerations during Operation
4.3 Grid Integration

5. Technical NSSS/Power Conversion System Designn

SUMMARY FOR BOOKLET

5.1 Primary Circuit
5.2 Reactor Core and Fuel
5.3 Fuel Handling
5.4 Reactor Protection
5.5 Secondary Side
5.6 Containment/Confinement
5.7 Electrical, I&C and Human Interface
5.8 Unique Technical Design Features (if any)

6. Technology Readiness

SUMMARY FOR BOOKLET

Initial Proposed Site

Oklo is working with a range of customers related to the initial sites. It is anticipated that the first powerhouse will be sited at the Idaho National Laboratory (INL) Site in southeast Idaho, referred to as the "Aurora INL site." The Oklo Inc. site use permit request was evaluated by the Department of Energy Office of Nuclear Energy (DOE-NE), a field office of the DOE, through the site use permit process and received a permit on September 26, 2019. Additionally, the DOE provisionally approved a specific site within the INL Site for the location of the powerhouse in late 2021.

Design and Licensing Status

The design is at the detailed design stage. Oklo has completed fuel prototyping activities, heat transport testing programs, and is now developing experimental advanced fuel recycling and fabrication capabilities. Oklo was awarded a Site Use Permit by the U.S. DOE and was awarded fuel material by the Idaho National Lab and the U.S. DOE. Oklo is the only company to have had a custom combined license accepted for review by the U.S. NRC. Oklo has actively engaged the U.S. NRC from 2016 to the present in pre-application activities, as well as application review activities.

6.1 Deployed Reactors
6.2 Reactors under Licensing Review

6.3 Reactors in the Design Stage

7. Safety Concepts

SUMMARY FOR BOOKLET

7.1 Safety Philosophy and Implementation
7.2 Transient/Accident Behaviour

8. Fuel and Fuel Cycle

SUMMARY FOR BOOKLET

8.1 Fuel Cycle Options
8.2 Resource Use Optimization
8.3 Unique Fuel/Fuel Cycle Design Features

9. Safeguard & Physical Security

SUMMARY FOR BOOKLET

9.1 Safeguards
9.2 Security
9.3 Unique Safeguards and/or Security Features

10. Project Delivery & Economics

SUMMARY FOR BOOKLET

10.1 Project Preparation and Negotiation
10.2 Construction and Commissioning
10.3 Operation and Maintenance