



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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February 15, 2022

MEMORANDUM TO: Jacob I. Zimmerman, Chief
Fuel Facility Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

FROM: Jason M. Piotter, Project Manager
Fuel Facility Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Jason M. Piotter
2/15/2022

SUBJECT: SUMMARY OF DECEMBER 14, 2021 PRE-APPLICATION MEETING
FOR THE KAIROS POWER ATLAS FUEL FABRICATION FACILITY
(OPEN PORTION)

The staff of the U.S. Nuclear Regulatory Commission (NRC) conducted a partially closed virtual Microsoft Teams meeting with representatives from Kairos and members of the public on December 14, 2021. The purpose of this meeting was to discuss a proposed High Assay Low Enriched Uranium (HALEU) fuel fabrication facility for TRISO fuel particles and fuel pebbles.

The public meeting notice with the agenda topics is available in the Agencywide Documents Access and Management System (ADAMS) under ADAMS Accession No. ML21335A185. No regulatory decisions or commitments were made during the meeting.

Summary of Meeting's Discussions

Shana Helton, Director of the Division of Fuel management gave opening remarks which stressed the need for a high-quality application and common understanding between parties to support an aggressive schedule noting that this approach will help streamline the licensing review.

Kairos provided a presentation that included a company overview, a discussion of the proposed fuel design, scope of the envisioned fabrication facility, and overview of the fuel fabrication

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processes, overview of the proposed facility layout, and a discussion on the regulatory approach. The presentation was followed by a questions and comment period for both the NRC staff and the public.

Fuel Design

- Kairos identified their reactor design as a fluoride salt-cooled high temperature reactor, which would use HALEU TRISO [tri-structural, isotropic] pebbles as the fuel. The HALEU TRISO particle is the primary barrier with four total barriers, and is encapsulated in a fuel pebble with a low-density core.
- The NRC staff asked how many of the 11 topical reports mentioned were focused on the reactor and how many Kairos plans to leverage for the fuel fabrication facility. Kairos responded that possibly the regulatory analysis (Part 70) and quality assurance topical reports. Kairos stated that overall, elements of each could be used, but the intent of the topical reports was not for the fuel facility. They [Hermes topical reports] would not directly apply to the Atlas fuel fabrication facility.
- The NRC staff indicated that It would be helpful to explore applicability of previous topical reports in future pre application meetings.

Scope of Envisioned Fabrication Facility

- The fuel facility will manufacture HALEU (Category II facility) TRISO particles and pebbles and will be located in Oak Ridge TN. There will be no enrichment at this site.
- The NRC staff asked who the supplier of feedstock would be and if there were certain aspects of the manufacturing process that have been confirmed. Kairos responded that they had not yet fully defined the source material. Kairos further noted that the process for TRISO particle production is well defined and Kairos will use that process. Kairos is also working on equipment design, but one area of difference they are working on is our pebble design, which is 4 cm in diameter vs a 6 cm solid pebble.
- The NRC staff clarified that they are currently interested in the process and control mechanisms rather than fuel composition, and further asked how far along Kairos is on their equipment design. Kairos responded that their overall strategy is to use critically safe geometry (tanks and vessels) for manufacturing processes and storage, and that this is the general approach to maintain criticality safety. Kairos noted that they will need future criticality pre application meetings.

Fuel Fabrication Processes

- The fuel fabrication process consists of kernel manufacturing, coated particle manufacturing, pebble manufacturing, waste management, and balance of plant.

Kernel Manufacturing – See presentation slides (no questions/comments)

Coated Particle Manufacturing

- The NRC staff noted that there are several batch steps identified, and asked how much material is in each batch [of particle manufacturing]. Kairos responded that each batch is a total of 3kg of uranium.
- The NRC staff followed up asking if the previous step of calcining and sintering was also 3kg. Kairos confirmed that value.

Pebble Manufacturing

- The NRC staff noted that for the overcoating process, the diagram indicated that air would be used. The NRC asked if Kairos had some sort of direct or indirect control over moisture content over process gasses or the air that they are using. Kairos responded that they are still working on the over-coater design, so they have no detailed response on that topic at this time. Kairos noted that the process air is dry.
- The NRC staff asked what the plans were for the treatment of off-spec [specification] fuel. Kairos responded that they would have a process for recovery of heavy metal material, and it is the step that Kairos will work on last as part of the process development. The NRC staff further commented that Kairos should consider this with respect to creating certain specific accident scenarios which will affect the integrated safety analysis (ISA).

Waste Management – See presentation slides (no questions/comments)

Balance of Plant

- NRC asked that the geometry considerations for criticality control be extended to auxiliary systems, and they noted past issues with uranium build up in those systems. Kairos responded that they are very aware of those issues and they will be considered.

Overview of Proposed Facility Layout

- Kairos provided a very brief conceptual layout of the facility.

Regulatory Approach

- Kairos plans on using 10 CFR Part 70 for the facility and 10 CFR Part 51 for the environmental review. They also plan to leverage work done on the Hermes reactor application.
- Kairos plans on submitting the application in two parts: (1) the environmental review and (2) the Part 70 application and ISA summary to follow. This regulatory approach will require an exemption.
- Kairos is currently creating annotated outlines and following the structure identified in NUREG 1520.

NRC and Kairos Comment and Question Period

- The NRC staff noted that for a Category II facility, guidance for material control and accounting is still being developed and is in a comment period. Kairos inquired when the guidance will be issued, and the NRC staff responded that completion was expected in Spring 2022.
- The NRC staff commented that a new application should consider 10 CFR 70.64.
- Kairos asked if the NRC staff had any reaction or concern with bifurcating the application (environmental review and safety review) and processing an exemption. The NRC staff responded by noting that they were aware of two reviews where that approach was taken, but we would need to discuss further internally to see if that is a possibility.
- Kairos asked about the timing for other guidance for Category II facilities (e.g., physical security). The NRC staff noted that the staff looked at creating an interim staff guidance for Category II physical security which may be several months away. The NRC deferred additional discussion on timing of a safeguard information program and timing on the physical security plan.
- Kairos referenced a statement in NUREG 1520 which stated that there is no guidance for Category II facilities, but they would look at these items. This issue was deferred to another pre-submittal meeting discussion.
- The NRC staff mentioned Regulatory Guide 5.59 for physical protection, which is the current NRC guidance for Cat II and Cat III facilities.
- Kairos asked if the NRC staff has any concerns with maintaining alignment with the environmental report (ER) submitted for the Hermes application. The NRC staff deferred additional discussion to future interactions and would focus on a roadmap or crosswalk between the Hermes ER and the Atlas fuel facility ER provided by Kairos. The NRC staff noted that they did not see any showstoppers.

Public Questions or Comments

- Kalene Walker asked what the burnup would be in the reactor. The NRC staff responded that this meeting was not focused on the reactor operation and will check with the Office of Nuclear Reactor Regulation to see if they can respond to this question.
- Kalene Walker asked if the NRC staff will consider a comprehensive carbon footprint evaluation during the environmental review. The NRC staff noted that as part of the National Environmental Policy Act, the NRC staff does look at the greenhouse gasses that result from the construction and operation of facilities, and that an overall view of climate change is considered.
- Kalene Walker noted that a main concern is radioactive waste. Further, Kaylene Walker asked if the NRC staff will do a 'cradle to grave' analysis of the fuel involved. The NRC staff responded that the responsibility for the regulations in 10 CFR Part 70, Part 71, and Part 72 are all within the same division at the NRC, and there will be coordination between each NRC team responsible for each of those regulations.

- Kalene Walker commented that the NRC should have a comprehensive back-end plan for this new fuel and waste stream.

Adjourn

The NRC staff concluded the meeting with closing remarks by Jake Zimmerman, Branch Chief of the Fuel Facility Licensing Branch and by Ms. Shana Helton, Director, Division of Fuel Management.

Action Items

Kairos and NRC to schedule follow on pre application interactions

Enclosures:

1. List of Attendees
2. Meeting Presentation
(ADAMS Accession No. ML21342A239)

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NAME	JPiotter	ELee	JZimmerman	JPiotter
DATE	1/25/2022	2/4/2022	2/11/1022	2/15/2022

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LIST OF ATTENDEES

DECEMBER 14, 2021 PRE APPLICATION MEETING FOR THE KAIROS POWER ATLAS

FUEL FABRICATION FACILITY (OPEN PORTION)

Name	Affiliation
Shana Helton	U.S. Nuclear Regulatory Commission (NRC)
Jacob Zimmerman	NRC
Jason Piotter	NRC
Suzanne Ani	NRC
Tison Campbell	NRC
Lindsey Cooke	NRC
Diana Diaz Toro	NRC
Peyton Doub	NRC
Tami Dozier	NRC
Yawar Faraz	NRC
James Hammelman	NRC
Rick Harper	NRC
Tim Harris	NRC
Jeremy Munson	NRC
John Pelchat	NRC
Jessie Quintero	NRC
Kevin Roach	NRC
James Rubenstone	NRC
David Tiktinsky	NRC
Glenn Tuttle	NRC
Jenny Weil	NRC
James Tomkins	Kairos
Edward Blanford	Kairos
David Boyes	Kairos
Martin Bryan	Kairos
Margaret Ellenson	Kairos
Darrell Gardner	Kairos
Dyrk Grenhalgh	Kairos
Micah Hackett	Kairos
Peter Hastings	Kairos

Jordan Hagaman	Kairos
Danie Jacobs	Kairos
Ashley Lewis	Kairos
Lou Martinez	Kairos
Drew Peebles	Kairos
Zackary Rad	Kairos
Kalene Walker	Public