

**Mazza, Jan**

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**From:** Alex Popova <alex@oklo.com>  
**Sent:** Friday, April 12, 2019 6:03 PM  
**To:** Mazza, Jan; Lynch, Steven  
**Cc:** Joshua Richard; Jacob DeWitte  
**Subject:** [External\_Sender] NRC modeling document -- Oklo concerns  
**Attachments:** Oklo concerns with NRC modeling document.pdf

Hi Jan and Steve,

Please see the attached, as promised, following our discussion yesterday. Unfortunately, I was able to listen in only to the last portion of the call, so please let me know if something does not line up with your expectations. I know Jan is off today, so I will wait to hear back from you on Monday.

Have a good weekend, and we appreciate your time.

Alex

## ATTACHMENT – Oklo Concerns with NRC Modeling Document

### NRC NON-LIGHT WATER REACTOR (NON-LWR) VISION AND STRATEGY, VOLUME 1 – COMPUTER CODE SUITE FOR NON-LWR DESIGN BASIS EVENT ANALYSIS

#### Section 4.4, "Heat Pipe Cooled 'Micro' Reactors"

*Issue #1: Paragraph 2, sentence 4, page 90 of digital PDF (printed page 89) reads as follows, "A supercritical CO2 power cycle has been suggested for the secondary side of both designs."*

Suggestion: Please rewrite as follows, "A supercritical CO2 power cycle is one of the power cycles that have been suggested for both designs."

Reason: Oklo has not publicly stated that supercritical CO2 will be used for the secondary-side coolant. It is understood that the NRC is developing models for supercritical CO2, which is why the rewrite is slight.

*Issue #2: Paragraph 4, sentences 5 and 6, page 91 of digital PDF (printed page 90) state the following, "This would include the sodium bond, the can and the supporting structures including the steel base, upper and lower reflectors, gas plenum, and insulator. Estimating the contact resistance between fuel cells may be a challenge, as will be the thermo-mechanical interaction as the fuel cells expand."*

Suggestion: Remove sentence 5 and rewrite sentence 6 as follows, "Estimating contact resistances between various core components and structures may be a challenge, as will be the thermo-mechanical interactions that arise from thermal expansion of these components and structures."

Reasoning: Sentence 5 contains proprietary information and export-controlled information (ECI), such as the term "can"; the removal of this sentence does not take away from the message in this paragraph as it is extraneous design information. Sentence 6 contains proprietary information and ECI, such as the term "fuel cells." The proposed revision does not utilize this term.

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### NRC NON-LIGHT WATER REACTOR (NON-LWR) VISION AND STRATEGY VOLUME 3: COMPUTER CODE DEVELOPMENT PLANS FOR SEVERE ACCIDENT PROGRESSION, SOURCE TERM, AND CONSEQUENCE ANALYSIS

#### Section B.4, "Design Specific Models - Oklo Heat Pipe Reactor"

*Issue #3: Paragraph 4, page 148 reads as follows:*

*The OKLO fuel cell is designed as an annular fuel region, with a cylindrical core representing the heat pipe. This geometry would require a new fuel component (modification to existing fuel component) since the effective coolant channel is now internal to the fuel cell and the fuel region is not cylindrical and may be interspersed with a sodium bond. The duct surrounding the fuel cell and the heat pipe walls would also need to be represented by a new (or by a modified) COR component.*

Suggestion: Rewrite the paragraph as follows:

The Oklo fuel element geometry would require a new fuel component (modification to existing fuel component) since the effective coolant channels are not similar to the MELCOR code geometry and the fuel region is not cylindrical and may be interspersed with a sodium bond. The structures around the fuel region would also need to be represented by a new (or by a modified) COR component.

Reasoning: This paragraph contains proprietary information and ECI, such as detailed information about Oklo's fuel design.

*Issue #4: Paragraph 1, sentence 2, page 149 reads as follows, "These new fuel cell components could be extended using the existing multi-rod model for assessment of propagation from localized failures."*

Suggestion: Replace "fuel cell" with "fuel element" when discussing Oklo fuel structures.

Reasoning: The term "cell" as it relates to an Oklo fuel structure is considered proprietary information and ECI by Oklo.

*Issue #5: Paragraph 2, sentence 1, page 149 states the following, "The OKLO reactor uses metallic U-10wt%Zr fuel in a steel alloy heat pipe wall and is surrounded by a steel alloy duct."*

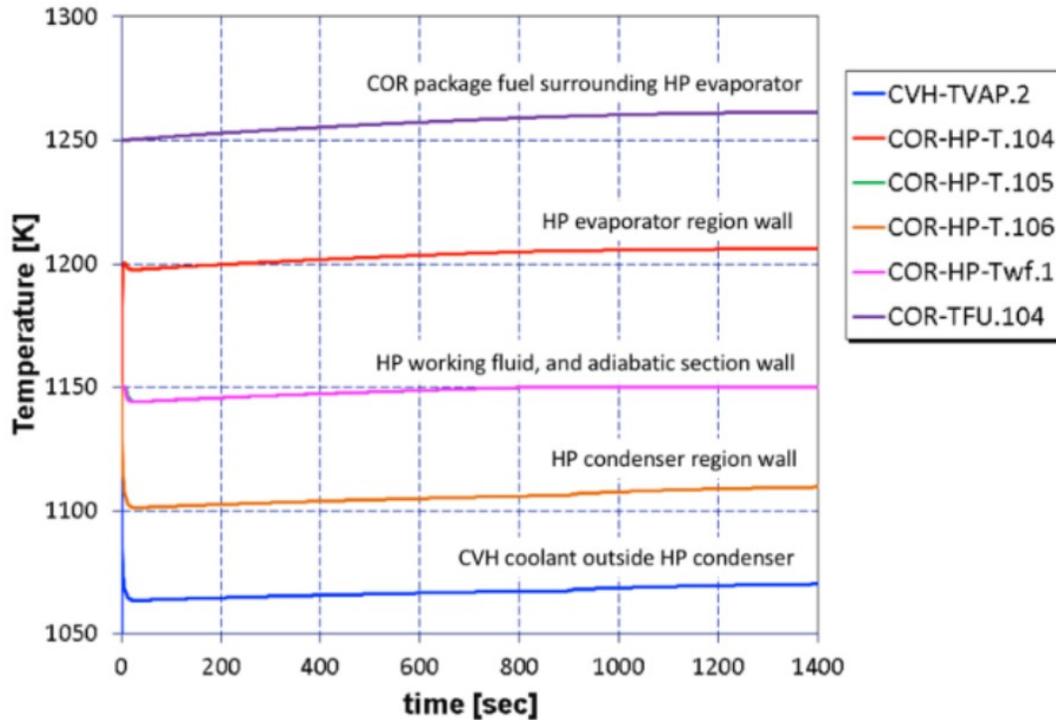
Suggestion: Rewrite as follows, "The Oklo reactor uses metallic U-10wt%Zr fuel and stainless steel structural materials."

Reasoning: This statement is hard to read but is an issue, taken in the context of the preceding paragraphs mentioned above. It could be describing detailed design information about the Oklo

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fuel that is inaccurate. Additionally, this statement taken at face value could be describing a design by a different vendor and could be interpreted as patent infringement.

*Issue #6: Figure B-23, page 150, is replicated below:*



*Figure B-23. MELCOR heat pipe temperatures for a transient-equilibrium test problem*

Suggestion: Delete this figure.

Reasoning: This figure discloses detailed fuel design information that Oklo usually considers proprietary information and ECI. Additionally, the removal of this figure from the report does not take away from the message conveyed in this report.

*Issue #7: Throughout Section B.4 of the document, it is repeatedly stated that the heat pipes will be filled with sodium.*

Suggestion: Modify the wording such that Oklo is using liquid metal heat pipes and that the NRC has specifically selected sodium as the working fluid for their models.

Reasoning: Given that the title of this section is explicitly named as, "Design Specific Models - Oklo Heat Pipe Reactor," it is thus implied that this is the material that Oklo will be using in its heat pipes. Oklo is generally reticent to discuss the specific material employed in its heat pipes, preferring instead to say, "liquid metal." This decision is both for proprietary reasons and because multiple liquid metal working fluids are currently under evaluation.

# ATTACHMENT – Oklo Concerns with NRC Modeling Document

## Section 2, "MELCOR Development Plans for Non-LWRs"

*Issue #8: Table 2-1, row 2, column 3, page 27 is replicated, in part, below:*

*Table 2-1. MELCOR Non-LWR Development Plan Start Dates.*

| Reactor Type/<br>Development Item (DI) | Phenomenological Area (MELCOR) | Description of Tasks (needs)   | FY18 | FY19 | FY20 |
|--|--------------------------------|--|------|------|------|
| SFR (M1.1)                             | Development of core components | 3 new components (fuel region, fuel cell duct, heat pipe walls) need to be added to COR package. Radiation use existing models. (Applies to HPR designs) | ✓    |      |      |

Suggestion: Omit the word “cell” in row 2, column 3, such that it reads as follows, “3 new components (fuel region, fuel duct, heat pipe walls) need to be added to COR package. Radiation use existing models. (Applies to HPR designs)”

Reasoning: Oklo considers the term “fuel cell” both proprietary information and ECI.

*Issue #9: Paragraph 1, sentence 4, page 42 read as follows, “Failure of one or two heat pipes may be tolerable but propagation of failure to adjacent fuel cells must be calculated to adequately calculate source term.”*

Suggestion: Rewrite as follows, “Failure of one or two heat pipes may be tolerable but propagation of failure to adjacent fuel elements must be calculated to adequately calculate source term.”

Reasoning: Oklo considers the term “fuel cell” both proprietary information and ECI.