From:	C Cochran
To:	AdvancedRxDCComments Resource
Subject:	[External_Sender] Oklo ARDC Comments
Date:	Thursday, June 09, 2016 5:42:59 AM
Attachments:	Oklo Non-Light Water Reactor Design Criteria Letter of Comment.pdf

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Hello,
Please find attached the Oklo letter of comment on the Non-Light Water Reactor Design Criteria.
Thank you for the opportunity to comment.
Best,
Caroline

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June 8, 2016

Ms. Diane Jackson, Branch Chief
Advanced Reactor Policy Branch
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Proposed Advanced Non-Light Water Reactor Design Criteria Comments

References: (1) DRAFT Advanced Non-LWR Design Criteria Table – April 2016

(2) Industry Comments on DRAFT Advanced Non-LWR Design Criteria Table – April 2016, Nuclear Energy Institute

Oklo, Inc. (Oklo) has reviewed the subject draft guidance on advanced reactor design criteria (ARDC), and associated comments from the Nuclear Energy Institute (NEI), in References 1 and 2, respectively. Oklo endorses the NEI comment letter, as expanded or amended below.

Oklo has followed the joint Department of Energy (DOE) – Nuclear Regulatory Commission (NRC) effort to create guidance for prospective applicants to develop principle design criteria (PDC). We applaud the NRC for taking on this initiative and for producing these Non-Light Water Reactor Design Criteria in a timely manner. Oklo has evaluated needed exemptions or possible departures from the existing GDCs over several years, and the advances represented in these new criteria are very helpful in advancing Oklo's PDC development process and should likewise be a significant improvement for many advanced reactors. It is in this respect that Oklo differs significantly from some trade group and non-government organization (NGO) commentary. Although Oklo has worked with the prominent NGOs for a number of years, we do not echo the sentiments that the NRC licensing process cannot be done with private funding, that it is "all or nothing," or that there needs to be significant additional staging processes, or that it is not possible for advanced reactors. We believe the Advanced Non-LWR Design Criteria show a sustained effort by the NRC to safely license a variety of reactor types.

Because the Oklo design is unique and part of a unique type of reactors, it was not expected that the NRC's Advanced Reactor Design Criteria (ARDC), Sodium Fast Reactor Design Criteria (SFR-DC), or Modular High Temperature Gas Reactor Design Criteria (mHTGR-DC) would be perfectly applicable, nor was it anticipated that a specific set of design criteria would be released for this reactor type. However, guidelines outlined in each set of criteria will help lay the groundwork for Oklo's PDC. It is Oklo's understanding and expectation that individual advanced reactor applicants will select PDC based, in part, on the individual criteria from each type as applicable to their own designs, and that the Oklo design may utilize differing aspects of these draft criteria as described below.

The Oklo reactor design is similar in some ways to the SFR due to the liquid metal coolant and materials used. However, our primary coolant operates at 1/15th atmospheric pressure with less than 1% the fluid inventory of an SFR of comparable size and does not have any pumps, valves, or flow loops in the core. Therefore, many of the SFR-DC are not directly applicable. However, for instance, requiring secondary fluids which are chemically compatible with the primary coolant may be readily applicable.

Likewise, Oklo reactor design features are in line with justifications for some of the mHTGR-DC in that it has a very low power density, at nearly two orders of magnitude less than the EBR-II or PRISM, and a completely passive core cooling system. For an example, in mHTGR-DC 34 and 36, the mHTGR design is defined as having "passive heat removal due to a low power density."

In still other respects, the Oklo reactor design is distinct from both the designs associated with the SFR-DC and mHTGR-DC, and in these cases, Oklo expects to use the ARDC or other justification for departure from existing GDC.

These characteristics and other unique aspects, as well as other feedback on specific proposed criteria, are further discussed below.

In response to the request for comments, Oklo provides the following information and encourages further dialogue between the NRC, DOE, and public stakeholders to ensure a positive resolution before issuing ARDC guidance:

- Important to Safety: The term "important to safety" is used throughout the NRC's draft ARDC, SFR-DC, and mHTGR-DC. This is not consistently interpreted, and because the GDC are founded on identifying criteria for structures, systems, and components (SSCs) that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public, it is more appropriate to use the term "safety-related" throughout the ARDC, SFR-DC, and mHTGR-DC. This term is clearly defined in the NRC's regulations.

- Throughout the draft ARDC document, references are made to future guidance documents to be created (i.e., the Regulatory Guide). Multiple rationale statements include detail required by a prospective applicant to fully implement the intent behind certain criterion. Oklo strongly recommends the NRC ensure this guidance is produced in a timely manner and include such detail to support a fully informed PDC development effort.

In response to the NRC staff's specific questions:

1. *Are the ARDC generally applicable to the different types of non-LWRs being developed by different companies? Are there any additional criteria that should be added?*

Response: The overall intent of the ARDC appears to be reasonably applicable to some types of advanced reactor designs, including the Oklo design. Unlike the ARDC proposed by DOE, the NRC draft ARDC in many cases appear to be marginally evolved from the existing GDC. These changes do not reflect the differences between non-LWR designs and the existing LWR fleet, and discourage advanced reactor developers from proposing improvements to safety and security through design. This effect appears to be at odds with the Commission's Policy on Advanced Reactors, reaffirmed in 2008. Oklo strongly encourages the NRC staff to engage with DOE and other stakeholders to ensure the ARDC remain technology-inclusive and allow developers to demonstrate how their designs perform safety functions, rather than specifying the means of accomplishment.

2. *Should the current regulations that an applicant must address be incorporated into the ARDC? If so, which ones?*

Response: Oklo does not believe that establishing regulatory requirements in the ARDC will provide a substantial benefit to developers, and indeed could result in substantive unnecessary confusion.

3. *Are the SFR-DC and mHTGR-DC generally applicable to the different designs of SFRs and mHTGRs being developed by different companies? Are there any additional criteria that should be added?*

Response: While the SFR-DC may be generally suitable for existing SFR designs, such as General Electric's PRISM, the criteria do not reflect many design characteristics of more recent SFR designs. The ARDC proposed by DOE reflected a more technology-inclusive, performance-based approach to ensuring safety functions are identified and protected in a design. As written, many of the SFR-DC prescribe systems, structures, and components without regard for the scale of hazard, nature of proposed passive features, and other design considerations. Oklo's design incorporates several features found in existing SFR, mHTGR, and other conceptual designs that are not recognized by the NRC's draft ARDC (as discussed above). The SFR-DC in particular should be written such that a developer presents the safety functions and how a design accomplishes them, rather than create a series of necessary justifications for why the ARDC are not applicable.

4. *There are several new approaches within the ARDC, SFR-DC, and mHTGR-DC, such as:*

- *use of "functional containment" for mHTGR-DC,*
- *use of "specified acceptable radionuclide release design limits" (SARRDLs) in the mHTGR-DC in place of specified acceptable fuel design limits (SAFDLs),*
- *incorporation of GDC 35, "Emergency core cooling system," with GDC 34, "Residual heat removal," as applicable, and*
- *the role of the SFR residual heat removal system during postulated accidents.*

Are these approaches appropriately addressed in the proposed criteria?

Response: Specific comments associated with specific criteria are provided below. Generally, the criteria proposed by DOE are more suitable for the suite of advanced reactor designs, and tailorable to each design's unique features. The NRC staff should provide a more detailed assessment of why the DOE-proposed design criteria were modified or disregarded.

The introduction of a Specified Acceptable Radionuclide Release Design Limit (SARRDL) is encouraging as a performance-based means of clearly demonstrating how a safety function provides adequate protection of the public, and should be considered for incorporation elsewhere in the ARDC.

Criterion-Specific Comments:

- Criterion 10, Reactor design: The language used in the mHTGR-DC is applicable to many other advanced reactor designs, and provides a useful technology-inclusive criterion that does not specify the reactor systems unnecessarily. This language should be adopted for the ARDC and SFR-DC, with consideration for either "fuel" or "core radionuclide release" as the intended limit.
- Criterion 16, Containment design: Oklo disagrees with the specificity in the ARDC and SFR-DC language. Some designs, such as those with low power density or other design features that mechanistically limit the accident source term, could meet the onsite/offsite dose consequence criteria with active or passive filtration, or other confinement-centric methods. Containment leakage may not be a safety-related criterion to be met in the design. The DOE proposed criterion language should be retained, or aligned with the intent behind the mHTGR-DC language of providing a credible barrier to radionuclide release. This comment would also apply to Criterion 13, Instrumentation and Control, which specifies the systems requiring instrumentation rather than the actual safety functions to be allocated to barriers of the developer's choice. Criteria 38 (Containment heat removal), 39 and 40 (Inspection/Testing of containment heat removal systems) , 41 (Containment atmosphere cleanup), 42 and 43 (Inspection/Testing of containment cleanup systems), 50 (Containment design basis), 51 (Fracture prevention of containment pressure boundary), 52 (Capability for containment leakage rate testing), 53 (Provisions for containment testing and inspection), 54 (Piping systems penetrating containment), 55 (Reactor coolant boundary penetrating

containment), 56 (Containment isolation), and 57 (Closed system isolation) should also be reevaluated with respect to this consideration.

- Criterion 17, Electric power systems: Oklo agrees that SSCs that require electrical power to accomplish their safety function should be provided with sufficient electric power supplies, although the provision of the specific numbers and types of power supplies should be risk-informed, not prescriptive. More importantly, however, if electrical power is not required to perform safety-related functions, then such a requirement should not be imposed. The proposed ARDC removes any incentive for a developer to utilize more effective safety features, such as passive and inherent features, if there is not a complimentary reduction in the need for electric power supplies. Oklo is designing a very small modular reactor, close to research reactor size, with low power density, low source terms, subatmospheric pressure primary coolant, and a fully passive core cooling system and redundant systems. While the safety functions of the reactor can be accomplished without any electrical power, the proposed criterion presumes such power is necessary and immediately creates an unnecessary regulatory burden to justify excluding safety-related power. The responsibility should rest on the applicant to sufficiently demonstrate the safety case for the design, including the roles of electrical power, redundancy, and reliability. We recommend this criterion be reevaluated and require electrical power where necessary to ensure successful safety-related function performance. Evaluating Criterion 17 should also lead to a reevaluation of Criteria 12, 18, 33, 34, 35, 37, 38, 40, 41, 43, 44, and 46.
- Criterion 26, Reactivity control system redundancy and capability: The use of “stuck rods” in the ARDC presumes rods as the preferred reactivity control strategy. Several proposed advanced reactor designs utilize other strategies. Additionally, many advanced reactor designs may rely on one or more inherent feedback phenomena as a method of reactivity control during design basis events. For example, the Experimental Breeder Reactor-II, an early SFR design, successfully demonstrated safety shutdown through testing without the use of control rods, instead relying on the inherent temperature feedback of the metal fuel. Rather than specify combined reactivity control “systems.” Oklo recommends this criterion be reworded to reference simply combined reactivity control and a design limiting reactivity control malfunction. This comment also applies to Criteria 27 (Combined reactivity control systems capability) and 28 (Reactivity limits).
- Criterion 33, Reactor coolant makeup: Allowing for mHTGR justification based on meeting SARRDL and whether or not the criterion applies is a positive step forward.
- Criterion 34, Residual heat removal: With respect to the SFR-DC language, the proposed criterion assumes certain systems and configurations that may not be common to the suite of SFR designs. Primary coolant boundary integrity is addressed in other criteria. Localized sodium boiling may be acceptable while retaining the necessary cooling capability and without compromising boundary integrity. Oklo recommends this criterion be reevaluated to focus on the safety function rather than specific systems and configurations. The proposed DOE SFR-DC provides a reasonable approach for a developer to use.

- Criterion 35, Emergency core cooling: Rather than creating a new ARDC for emergency core cooling, with the associated conditions for applicability, the language proposed by DOE should be retained to allow for the developer's PDC process to use the original GDC if necessary. This resolution would then allow for creation of the necessary Criteria 36 and 37 for an emergency core cooling system when necessary.
- Criteria 38, 39, 40, 41, 42, and 43: As mentioned in the comment for Criterion 16, these criteria should be reevaluated to consider designs that do not require the type of containment identified for ARs and SFRs in the draft NRC SFR-DC.
- Criterion 50, Containment design basis: We recommend all of the examples provided for potential energy sources be removed. The developer can provide the technical basis for what potential energy sources exist inside of the containment.
- Criteria 51, 52, 53, 54, 55, 56, and 57: As mentioned in the comment for Criterion 16, these criteria should be reevaluated to consider designs that do not require the type of containment identified for ARs and SFRs in the draft NRC SFR-DC.
- Criterion 70, Intermediate coolant system: Certain SFR designs may not require a safety-related intermediate cooling system. This may be the case for a non-water-based power conversion system (precluding any sodium-water reactions) or a residual heat removal system coupled directly to the core or primary cooling system. If an intermediate cooling system is required to perform a safety-related function, then this criterion would apply, along with Criteria 75, 76, and 77. The language of each draft SFR-DC should be evaluated to clearly identify that the criteria apply only to intermediate cooling systems that are needed for safety-related functions.

Thank you for the opportunity to comment. If you have any questions or need any additional information, please contact us at regulatory@oklo.com or (650) 550-0127.

Sincerely,

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cc: Dr. Jennifer L. Uhle, NRO, NRC
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