

From: [Dimitri Lutchenkov](#)
To: [Mazza, Jan](#)
Subject: [External_Sender] Comments on proposed ARDCs
Date: Thursday, June 09, 2016 12:09:01 PM
Attachments: [XE-X1-LD-G0-L06-100367_1_Comments_to_NRC_on_Draft_ARDC.PDF](#)
[Undeliverable X Energy LLC Comments on ARDC and mHTGR-DC.msg](#)

Jan,

X-energy's submission (attached) of comments to the ARDCs failed yesterday. I sent the cover letter and attached comment table to the e-mail address identified on the NRC site (AdvancedRxDCComments.Resource@nrc.gov) but it got kicked back as undeliverable. Can you please provide assistance/guidance on how to proceed?

Regards,

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Forwarded via e-mail to:
advancedRxDCComments.Resource@nrc.gov

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June 8, 2016

XE-X1-LD-G0-L06-100367

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: X ENERGY, LLC COMMENTS ON DRAFT ADVANCED NON-LIGHT WATER REACTOR DESIGN CRITERIA

The purpose of this letter is to forward X Energy, LLC (X-energy) comments on the NRC's draft modular high temperature gas reactor design criteria (mHTGR-DC). We recognize that the overall draft package issued by the NRC for comment also consisted of the generic advanced non-light water reactor design criteria (ARDC) and draft sodium fast reactor design criteria (SFR-DC) but have focused our response to our design technology only, the mHTGR-DC. Our responses to NRC questions and detailed comments are provided in the attached table.

We also note that X-energy has read the comments issued by NEI and is aligned with them. In that regard, when applicable, we have referred to the NEI rational as the basis for our comment on the mHTGR-DC. We concur with NEI in regard to risk-informing the mHTGR-DC and will work with NRC towards that end as we continue to mature our design.

X-energy appreciates the opportunity to provide input at this stage and looks forward to future interactions with the NRC staff in the process of finalizing the ARDCs. Please do not hesitate to contact me if you have any questions or concerning regarding our comments at 410-370-9090 or by e-mail at DLutchenkov@x-energy.com.

Sincerely,

A handwritten signature in black ink, appearing to read 'Dutchenpa', written over a horizontal line.

Dimitri Lutchenkov
Vice President, Licensing
X Energy, LLC

Attachment

X-energy Comments on Advanced Non-Light Water Reactor Design Criteria
Modular High Temperature Gas Reactor (mHTGR)

General Questions	Reply
Should the current regulations that an applicant must address be incorporated into the ARDC? If so, which ones?	Incorporation of current regulations into the ARDC or mHTGR-DC is outside the scope of the current initiative and should not be pursued.
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 criterion that should be added?	The mHTGRs will be generally applicable once the changes presented below are incorporated. No additional criterion besides those already added for mHTGR-DC (70-72) are needed.
General, Other Advanced Non-LWR Activities	Design considerations and associated regulatory requirements related to security are currently addressed outside of 10 CFR 50 Appendix A. This structure should be maintained, and design considerations related to security should not be incorporated into the advanced reactor design criteria.
General, NRC should review and provide feedback on DOE proposed definitions.	The DOE proposed definitions should be addressed and confirmed in the pending Regulatory Guide.

I. Overall Requirements	
Current GDC Language	Comments
3 <u>Fire protection.</u>	Agree with NEI comments
4 <u>Environmental and dynamic effects design bases.</u>	Concur with NEI and its rationale to revise ARDC 4 (and the associated mHTGR-DC) to include brackets around “[pipe whipping]” to identify a portion of the original GDC language where advanced designs that operate at low pressure may provide alternative descriptions to address underlying criterion requirements and that gasses be considered as a fluid for clarity.

II. Multiple Barriers	
GDC No. and Title	Comments
10 <u>Reactor design.</u>	Concur with NEI and its rationale to revise ARDC 10 to the DOE-proposed mHTGR-DC language to make it applicable to all designs and change the mHTGR-DC column to “same as ARDC”.
13 <u>Instrumentation and control.</u>	Concur with NEI and its rationale to delete “...reactor core, and reactor helium

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II. Multiple Barriers	
GDC No. and Title	Comments
	pressure boundary...” from mHTGR-DC 13.
16 <u>Containment design.</u>	The mHTGR DC is the same as the ARDC and, as such, concur with NEI and its rational that the NRC should adopt the DOE-proposed ARDC 16 language without modification and to allow a designer to show that there is no significant risk of uncontrolled release of radioactivity to the environment.
17 <u>Electric power systems.</u>	<p>Concur with NEI and its rational that GDC 17 is not applicable to modular HTGRs.</p> <p>Recommend deleting mHTGR-DC 17 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language</p> <p>Basis: mHTGRs are passive plants and as such they do not rely on external DC or AC power to remove decay heat. Decay heat is removed by a redundant and fully passive reactor cavity cooling system (RCCS). Furthermore, there is no action required (passive or active) to start the RCCS. This system is always operating in a non-safety mode during both normal operation and AOOs. As a DID measure, in a total loss of RCCS, i.e., a beyond design bases scenario, decay heat is passively rejected to the ground surrounding the reactor cavity as long as the functional containment is maintained. There is no important to safety electrical equipment that relies on AC power for accident mitigation functions. Specific to the X-energy design, DID power supply for safety related systems are already supplied with requirement to have two interdependent connections to the transmission network. Third defense in depth are the house load provided by the turbine-generator set. Fourth defense in depth are provided by non-safety related diesel generators charging the batteries powering the buss-bars powering the RPS and PEMS that monitors reactor conditions before, during and after an event. In summary, this requirement does not apply to the mHTGR because none of the SSCs that are needed to mitigate Design Basis Accidents and thus classified as safety related rely on offsite or onsite AC power.</p>
18 <u>Inspection and testing of electric power systems.</u>	The mHTGR DC is the same as the ARDC and, as such, concur with NEI and its rational that to ensure consistency with resolution of comments on ARDC 17 the NRC should adopt the DOE-proposed ARDC 18 language without modification.

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III. Reactivity Control	
GDC No. and Title	Comments
21 <u>Protection system reliability and testability.</u>	The mHTGR GDC is the same as the ARDC and, as such, concur with NEI and its rational that the ARDC should be changed to eliminate the “single failure” requirement and rely on systematic risk-informing and performance-based methodology to provide the required level of safety.
23 <u>Protection system failure modes.</u>	The mHTGR GDC is the same as the ARDC and, as such, concur with NEI and its rational that the ARDC should be changed to include in the list of “postulated adverse environments,” a mention of “chemicals eventually generated during postulated events that can result in an adverse environment.”
24 <u>Separation of protection and control systems.</u>	The mHTGR GDC is the same as the ARDC and, as such, concur with NEI and its rational that the ARDC should be changed to to eliminate the “single failure and redundancy” requirement and rely on systematic risk-informing and performance-based methodology to provide the required level of safety.
26 <u>Reactivity control system redundancy and capability.</u>	Concur with NEI and its rational that the NRC should remove the requirement for one of the reactivity control systems to necessarily consist of control rods.
27 <u>Combined reactivity control systems capability.</u>	Concur with NEI and its rational that GDC 27 is not applicable to modular HTGRs. Recommend deleting mHTGR-DC 29 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language
29 <u>Protection against anticipated operational occurrences.</u>	Concur with NEI and its rational that GDC 29 is not applicable to modular HTGRs. Recommend deleting mHTGR-DC 29 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language

IV. Fluid Systems	
GDC No. and Title	Comments
33 <u>Reactor coolant makeup.</u>	Concur with NRC that GDC-33 is not applicable to modular HTGRs.
34 <u>Residual heat removal.</u>	Concur with NEI and its rational that the NRC should adopt the DOE-proposed modular HTGR-DC language and ensure consistency with resolution of comments on ARDC 17. For the mHTGR-DC, eliminate the following sentence, “For normal operations and anticipated operational occurrences, the...” to the end of the paragraph. ARDC 34 and 35 should be merged in a single criterion. Remove the any reference to electrical power or offsite power in the last paragraph. Change ARDC 34 to ensure consistency with resolution of

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IV. Fluid Systems	
GDC No. and Title	Comments
	<p>comments on ARDC 17. Basis Agree with NEI comment (21) on criterion 34 especially with the NEI comment to combine criterion 34 & criterion 35 (The system safety function shall be to transfer fission product decay heat) Fred Silidy- Use of the term residual heat is a better term that includes the decay heat. Revise rationale to be clear that the mHTGR design has passive heat removal and a low power density.</p>
35 <u>Emergency core cooling.</u>	<p>Concur with NEI and its rational that the NRC should adopt the DOE-proposed modular HTGR-DC language and ensure consistency with resolution of comments on ARDC 17. rename mHTGR-DC 35 as Residual Heat Removal System System and remove “reactor coolant boundary” from the first sentence ----- Rational ----- Agree with NEI comment (22) on criterion 35. mHTGR do not need a Emergency Core Cooling System. Consider combining this criterion & criterion 34. Fred Silidy- mHTGRs are designed so that heat is removed with forced cooling or failing that with passive heat removal whether primary helium is pressurized or depressurized so that an ECCS would be superfluous. The RCCS under mHTGR-DC 34 is a passive system that removes decay and residual heat and does not rely on the pressure retention integrity function of the reactor coolant boundary. mHTGRs do not have and do not need an Emergency Core Cooling System.</p>
36 <u>Inspection of emergency core cooling system.</u>	<p>Concur with the NEI comments regarding the modular HTGR-DC. Revise rationale to be clear that the mHTGR design has passive heat removal and a low power density. Basis In the NRC’s mHTGR-DC rationale for modification it states, “the mHTGR design is defined as having passive heat removal due to a low power density.” [emphasis added] To be clear, the mHTGR design has passive heat removal and a low power density.</p>
37 <u>Testing of emergency core cooling system.</u>	<p>Concur with NEI and its rational that the NRC should adopt the DOE-proposed</p>

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IV. Fluid Systems	
GDC No. and Title	Comments
	<p>modular HTGR-DC language and ensure consistency with resolution of comments on ARDC 17.</p> <p>Basis The Residual Heat Removal System for mHTGRs, i.e., the RCCS, is a passive system. It does not require AC power to be switched on or off for it to function. The operation of the associated cooling water system is also gravity driven and passive in water-based RCCS configurations</p>
38 <u>Containment heat removal.</u>	<p>Concur that GDC-38 is not applicable to modular HTGRs.</p> <p>Basis In the mHTGR there is no need for a containment building heat removal system; the functional containment assures that radionuclides are retained within the independent, nested barriers over the wide range of licensing basis events without active systems</p>
39 <u>Inspection of containment heat removal system.</u>	Concur that GDC-39 is not applicable to modular HTGRs.
40 <u>Testing of containment heat removal system.</u>	Concur that GDC-40 is not applicable to modular HTGRs.
41 <u>Containment atmosphere cleanup.</u>	Concur that GDC-41 is not applicable to modular HTGRs.
42 <u>Inspection of containment atmosphere cleanup systems.</u>	Concur that GDC 42 is not applicable to modular HTGRs.
43 <u>Testing of containment atmosphere cleanup systems.</u>	Concur that GDC 43 is not applicable to modular HTGRs.
44 <u>Cooling water.</u>	<p>Concur with NEI and its rationale that GDC 44 is not applicable to modular HTGRs.</p> <p>Recommend deleting mHTGR-DC 44 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language.</p> <p>Basis There are no "important to safety" systems that require cooling water in a modular HTGR.</p>

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IV. Fluid Systems	
GDC No. and Title	Comments
45 <u>Inspection of cooling water system.</u>	<p>Concur with NEI and its rational that GDC 45 is not applicable to modular HTGRs.</p> <p>Recommend deleting mHTGR-DC 45 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language.</p> <p>Basis</p> <p>There are no "important to safety" systems that require cooling water in a modular HTGR.</p>
46 <u>Testing of cooling water system.</u>	<p>Concur with NEI and its rational that GDC 46 is not applicable to modular HTGRs.</p> <p>Recommend deleting mHTGR-DC 46 and replacing it with “not applicable to modular HTGRs.” as in DOE-proposed language.</p> <p>Bais</p> <p>There are no "important to safety" systems that require cooling water in a modular HTGR.</p>

V. Reactor Containment	
GDC No. and Title	Comments
50 <u>Containment design basis.</u>	Concur that GDC 50 is not applicable to modular HTGRs.
51 <u>Fracture prevention of containment pressure boundary.</u>	Concur that GDC 51 is not applicable to modular HTGRs.
52 <u>Capability for containment leakage rate testing.</u>	Concur that GDC 52 is not applicable to modular HTGRs.
53 <u>Provisions for containment testing and inspection.</u>	Concur that GDC 53 is not applicable to modular HTGRs.
54 <u>Piping systems penetrating containment.</u>	<p>Concur with NEI and its rational that GDC 54 is not applicable to modular HTGRs.</p> <p>Recommend deleting mHTGR-DC 54 and replacing it with “not applicable to modular HTGRs.”</p> <p>Basis</p> <p>In light of mHTGR-DC 16, the modular HTGRs have functional containments instead of a fixed containment. This makes the reactor building a non-pressure retaining structure and pressure retention of any piping penetration unnecessary.</p>

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V. Reactor Containment	
GDC No. and Title	Comments
55 <i>Reactor coolant pressure boundary penetrating containment.</i>	Concur that GDC 55 is not applicable to modular HTGRs.
56 <i>Primary containment isolation.</i>	Concur that GDC 56 is not applicable to modular HTGRs.
57 <i>Closed system isolation valves.</i>	Concur that GDC 57 is not applicable to modular HTGRs.