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Mr. John Monninger
Director, Division of Safety Systems, Risk Assessment, and Advanced Reactors
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: NEI Comments on Draft Regulatory Guide DG-1330, "Guidance for Developing Principal Design Criteria for Non-Light Water Reactors"

Project Number: 689

Dear Mr. Monninger:

On behalf of the nuclear energy industry, the Nuclear Energy Institute (NEI)[1] appreciates the opportunity to provide comments on the subject Draft Regulatory Guide DG 1330, "Guidance for Developing Principal Design Criteria for Non-Light Water Reactors." The purpose of this letter is to provide the attached comments which recommend several changes to improve the clarity and completeness of DG-1330.

The design criteria provided in DG-1330 are based on a Department of Energy (DOE) effort and proposal. In addition to the comments attached, the industry recommends that NRC provide the basis for areas in which the guidance deviates from the original DOE proposal.

NRC indicates that the reason for issuing this document is to provide guidance to applicants on developing Principal Design Criteria (PDC) for non-Light Water Reactors (non-LWRs) to support the approval of construction permits, design certifications, combined licenses, standard design approvals, or manufacturing licenses. The industry believes that the proposed regulatory guidance is an important component of improving the clarity of the regulatory process and for enhancing the NRC's readiness for licensing advanced non-light water reactors.

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

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We appreciate the NRC staff's consideration of these comments. If you have any questions concerning this letter or the attached comments, please contact me or Thomas Zachariah (202.739.8058; txz@nei.org).

Sincerely,

Michael D. Tschiltz

Attachment

c: Ms. Vonna L. Ordaz, NRO, NRC
Ms. Deborah A. Jackson, NRO/DEIA, NRC
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Mr. William D. Reckley, NRO/DEIA/ARPB, NRC
NRC Document Control Desk

	Affected Section	Comment/Basis	Recommendation
1.	General	NRC should clarify the language throughout the document regarding the regulatory basis for Principal Design Criteria and the use of the regulatory guide once issued. Principal Design Criteria (PDCs) are required to be included in an application for construction permit, design certification, combined license, design approval, or manufacturing license. (see 10 CFR 50.35, 52.47, 52.79, 52.137, and 52.157). 10CFR50 Appendix A States: The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety; that is, structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. These General Design Criteria establish minimum requirements for the principal design criteria for water-cooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission. The General	Clearly state that the objective is to provide guidance to an applicant develop PDCs and not to meet the GDCs as they are regulatory requirements for non-LWR reactors. This should be clear and consistent through-out the document. For example the purpose section should state: This regulatory guide (RG) describes the NRC's ~~proposed~~ guidance on how ~~the general design criteria (GDC) in Appendix A, "General Design Criteria for Nuclear Power Plants," of Title 10 of the Code of Federal Regulations, Part 50 "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 1) apply to non-light water reactor (non-LWR) designs. This guidance may be used by~~ non-LWR reactor designers, applicants, and licensees ~~to~~ may develop principal design criteria (PDC) for any non-LWR designs, as required by the applicable NRC regulations. LWR general design criteria (GDC) in Appendix A, "General Design Criteria for Nuclear Power Plants," of Title 10 of the Code of Federal Regulations, Part 50 "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 1) are intended to only provide guidance to non-LWR designs. This RG derives Advanced Reactor Design Criteria (ARDC) from the intent of the GDC to provide more specific guidance. The RG also derives additional design-specific criteria ~~describes the NRC's proposed guidance for modifying and supplementing the GDC~~ to develop PDC that address two specific non-LWR design concepts: sodium-cooled fast reactors (SFRs), and modular high

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		Design Criteria are also considered to be generally applicable to other types of nuclear power units and are intended to provide guidance in establishing the principal design criteria for such other units. It is industry's position, based on the above, that the GDC's of Appendix A do not establish regulatory requirements for use with non-LWR designs but provide guidance in developing and submitting PDCs with an application. Industry believes that this RG document will essentially replace Appendix A of 10 CFR Part 50 as <u>guidance</u> for advanced reactors in developing PDC to be included with an application. There are a number of statements in the draft guidance document that appear to presume the GDC in Appendix A are regulatory requirements for advanced reactors. For example, the Purpose Section of the DG states, "this regulatory guide (RG) describes the NRC's proposed guidance on how the general design criteria (GDC) in Appendix A........apply to non-light water reactor (non-LWR) designs." Industry believes it is unnecessary and inappropriate to attempt to make the GDC of Appendix A "apply" to non-LWRs through this guidance document but rather to simply state the objective as guidance to an applicant develop PDCs as is	temperature gas-cooled reactors (mHTGRs). PDCs for other designs can be developed using the more generic ARDC with design-appropriate changes.

	Affected Section	Comment/Basis	Recommendation
		done in the second sentence of the section. This is also consistent with the section entitled Intended Use of This Regulatory Guide in Section C. There are a number of other places in the DG that imply conformance or alignment with Appendix A. It is recommended that a search for reference to Appendix A be performed and language appropriately clarified.	
2.	General	In several cases, the word "reactor" is removed from "reactor containment" in recognition that containment is a barrier between the fission products and the environment, yet "reactor containment" is retained in several other cases. (As an example, ARDC 57 and SFR-DC differ in this regard.)	Consider removing "reactor" for consistency or explain the distinction.

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3.	Discussion General Page 6	As acknowledged in the preliminary draft guidance on non-light water reactor security design (83 FR 13511; March 13, 2017), the Commission's "Policy Statement on the Regulation of Advanced Reactors," (73 FR 60612; October 14, 2008) states that the design of advanced reactors should "include considerations for safety and security requirements together in the design process such that security issues (e.g., newly identified threats of terrorist attacks) can be effectively resolved through facility design and engineered security features, and formulation of mitigation measures, with reduced reliance on human actions." NRC goes on to observe that, as we have previously commented, design considerations and associated regulatory requirements related to security are currently addressed outside of 10 CFR 50 Appendix A. We appreciate the staff's attention to distinguishing security design considerations from general design criteria. This structure should be maintained, and design considerations related to security should not be incorporated into the advanced reactor design criteria.	Without incorporating security design considerations in the advanced reactor design criteria, add a brief discussion of the relationship and expectations for security in design, i.e., advanced reactor design criteria and security design considerations should be addressed by advanced non-light water reactor developers in parallel.
4.	Discussion, Harmonization with International Standards, Page 10	IAEA is also developing safety design criteria and safety design guidelines for mHTGRs.	NRC should coordinate with mHTGR activities at IAEA in addition to SFRs.
5.	Discussion, Key Assumptions and	The draft regulatory guide states *"It is the responsibility of the applicant to demonstrate*	It is recommended that this key assumption be deleted.

	Affected Section	Comment/Basis	Recommendation
	Clarifications Regarding the non-LWR Design Criteria, Page 9	*compliance with applicable severe accident and BDBE regulations and orders, demonstrate why any that are not applicable do not apply, and demonstrate why other design specific severe accidents or BDBE that can occur will be mitigated."* Since ARDC/SFR-DC/mHTGR-DC apply to normal, AOOs, and design-basis events, and do not pertain to BDBE regulations, this sentence is outside the scope of this report.	
6.	Discussion , Key Assumptions and Clarifications Regarding the non-LWR Design Criteria, Page 9	Seventh bullet states: "The NRC intends the ARDC to apply to the six advanced reactor technology types identified in the DOE report; however, in some instances, the SFR-DC or mHTGR-DC may be more applicable to a design or technology than the ARDC." Clarification would be useful that a "mix and match" approach is entirely appropriate – i.e., an entire set of criteria for a given design won't necessarily apply.	Change to: "The NRC intends the ARDC to apply to the six advanced reactor technology types identified in the DOE report; however, in some instances, one or more of the criteria from the SFR-DC or mHTGR-DC may be more applicable to a design or technology than the ARDC."
7.	Discussion, Key Assumptions and Clarifications Regarding the non-LWR Design Criteria, Page 9	Eighth bullet states, in part: "The SFR-DC and mHTGR-DC are intended to apply to all designs of these technologies," which could leave the impression that the criteria in the RG are inviolate, irrespective of specific design attributes.	Caveat with a statement indicating that, as with all criteria, design-specific exceptions may be proposed (and defended) by the applicant.
8.	Appendix A ARDC 16 Page A-4	The draft guidance for ARDC 16, *Containment design*, retains the original GDC language, thereby carrying forward design criteria intended for a pressure-retaining light water	ARDC 16 language should include technology neutral containment requirements which can be subsequently applied to a specific technology. The original DOE/INL language for ARDC 16 is provided below.

	Affected Section	Comment/Basis	Recommendation
		reactor (LWR) containment. This results in limiting the applicability of the functional containment concept to applicable non-LWR designs, and appears to be inconsistent with the Commission's position on alternatives to a leak tight containment, as discussed in SECY 93-092 and the associated SRM. Advanced reactor containment design guidance should flow logically from ARDC 16 to the SFR and mHTGR design criteria. ARDC 16 should be a high-level technology-neutral design criteria from which technology-specific design criteria are derived.	*"Containment design.* *A reactor functional containment consisting of a structure surrounding the reactor and its cooling system or multiple barriers internal and/or external to the reactor and its cooling system, shall be provided to control the release of radioactivity to the environment and to assure that the functional containment design conditions important to safety are not exceeded for as long as postulated accident conditions require."* The concept of a functional containment would be of interest for application to other technologies. Applying this recommendation would provide a high-level technology-neutral ARDC which could be used to obtain Commission approval of containment performance criteria. SFR and mHTGR DC 16 would then serve to illustrate how technology-specific design criteria can be derived from ARDC 16.
9.	Appendix A ARDC 16 Page A-4	Clarify that use of ARDC 16 [per industry comment ##] for non-LWR designs other than mHTGRs may "be subject to a policy decision..." Making a justification, similar to that for research reactors and non-power reactors has basis in NRC policy and should not require a Commission-level policy decision. Discussions of Commission policy decisions on functional containment need to be worded carefully. For the modular HTGR, a policy decision is not needed regarding the general acceptability of applying a functional containment (radionuclide retention) approach	Revise rationale to state, "...However, it is also recognized that characteristics of the coolants, fuels, and containments to be used in other non-LWR designs could share common features with SFRs and mHTGRs...Use of ~~the~~ ARDC 16 for non-LWR designs other than mHTGRs~~-DC 16~~ ~~will~~ may be subject to a policy decision by the Commission. If a reactor is able to demonstrate safety margins and/or consequences on the order of those demonstrated by non-power and research reactors, a functional containment may be justified, and the reactor may be able to use ARDC 16 without a Commission level policy decision. ~~See rationale for mHTGR-DC 16 for further information on the policy decision.~~"

	Affected Section	Comment/Basis	Recommendation
		that differs from a conventional LWR high-pressure, low-leakage structure. However, based on the SRM to SECY-03-0047, a policy decision is needed regarding the performance criteria to be applied to a functional containment. The information located in the mHTGR-DC 16 rationale correctly states that a policy decision regarding functional containment performance requirements and criteria will be needed. It's noted that containment performance criteria for LWRs are provided in 10 CFR 50 Appendix J, rather than in the GDC of Appendix A.	
10	Appendix A, ARDC 17, Page A-4	Clarify "A reliable power system is required for SSCs during postulated accident conditions" to apply to SSCs whose safety performance relies on electric power	Modify to: "A reliable power system is required for SSCs during postulated accident conditions when those SSCs' safety functions require electric power."
11	Appendix A ARDC 17 Page A-4	The following text is confusing: "The existing single switchyard allowance remains available under ARDC 17. If a particular advanced design requires the use of GDC single switchyard allowance wording, the designer should look to GDC 17 for guidance when developing PDC."	Suggest rewording to: "The single switchyard allowance under GDC 17 is not eliminated because of the changes in ARDC 17; if a particular advanced design..."
12	Appendix A ARDC 17 ARDC 26	ARDC 17 states the safety function for the electrical systems "shall be to provide sufficient capacity, capability, and reliability to ensure that...vital functions that rely on electric power are maintained in the event of postulated accidents." The scope of "vital functions" is unclear. For example, it is unclear if the independent and diverse means of	Revise ARDC 17 with respect to the postulated accident safety function, or clarify the scope of "vital functions" with the *Rationale.* Revise the *Rationale* discussion on applicability of ARDC 17 to address the use of electrical power for the performance of the prescribed safety functions.

	Affected Section	Comment/Basis	Recommendation
		shutdown prescribed by ARDC 26 paragraph 2 is considered such a vital function. Further, the *Rationale* for ARDC 17 states "If electrical power is not required to permit functioning of SSCs important to safety, the requirements in the ARDC are not applicable to the design. In this case, the functionality of SSCs important to safety must be fully evaluated and documented in the design bases." The requirements of ARDC 17 are related to performance of the prescribed safety functions (e.g., sufficient redundancy "to perform their safety functions"). Accordingly, it appears the appropriate test for applicability of ARDC 17 is whether electrical power is required to perform the specifically prescribed safety functions, not the functioning of SSCs important to safety more generally.	
13	Appendix A, ARDC 19, Page A-6	This criterion presumes that operator action is required and that operator actions, including monitoring, must be performed from a single location (i.e., a control room).	Consideration should be given to an applicant demonstrating that operator action, including monitoring, is not required for safety, and/or that any necessary actions, including monitoring, could be demonstrated to be feasible from additional and/or redundant and/or remote locations.

	Affected Section	Comment/Basis	Recommendation
14	Appendix A, ARDC 19, Page A-6	The way the text is written still appears to assume some fundamental, legacy needs in a power plant. None of this makes sense if operators have literally zero ability to influence the safety of the plant because it is physically inherent (note: not to be confused with "inherent" safety as defined by the IAEA, which requires no decay heat)	As with some other sections, frame with "As applicable to plant design:"
15	Appendix A, ARDC 25 through 28, Page A-7	It appears assumed that control/protection systems are required for reactivity control. It also assumes that the ultimate reactivity protection mechanism is still an active function. This assumption is not necessarily true for all designs. The term "system" indicates active/designed to us.	As with some other sections, frame with "As applicable to plant design:"
16	Appendix A, ARDC 26, Page A-7	(1) Capability (1) is specific to having a means to shut down the reactor in regularly occurring situations. The move from specified acceptable fuel design limits to fission product barriers is a significant improvement towards technology neutrality, enabling accurate safety assessment of both more conventional fuel forms with more complex fuel forms including liquid fuel forms on the same basis. That being said, there was concern that there are some possible components considered as fission product barriers could fail without significant impact to safety. Therefore words were added to ensure that the focus is on only those fission product barriers that are safety-	Define "Appropriate Margin" AND Change wording to the below (italics indicates changed wording, bold indicates added wording) Reactivity control systems shall include the following capabilities: (1) A means of shutting down the reactor shall be provided to ensure that, under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions, design limits for safety-related fission product barriers are not exceeded. (2) A means of shutting down the reactor and maintaining a safe shutdown in *anticipated operational occurrences and postulated accidents,* with appropriate margin for malfunctions, shall be provided. If the

	Affected Section	Comment/Basis	Recommendation
		related. (2) Many industry comments included reasoning that two independent means for shutting down the reactor and maintaining shutdown may not be needed, especially for reactor types that have natural or passive means for shutdown as the primary means. In addition, the requirement for two fully independent means both capable of achieving and maintaining shutdown does not seem to be the standard for LWRs. This presents the simplest wording that allows for reactors with inherent or passive shutdown fundamental to the physics of the system to make a justification that a second means would be superfluous. It also allows for reactors to make a probability risk assessment to make a similar justification. The wording change from "design basis events" to "anticipated operational occurrences and postulated accidents" is taken from the NRC's Rationale and ensures that what is being referred to is clearly outlined terminology in the regulation. (3) The requirement of subcriticality may not be the most appropriate measure of safe shutdown. For example, it has been demonstrated in various reactor types that	primary means for shutdown is not inherent, passive, or shown to have a probability of failure an order of magnitude less than that of postulated accidents, a second means of reactivity control shall be provided that is independent, diverse, and capable of achieving and maintaining safe shutdown both for anticipated operational occurrences and postulated accidents. (3) A system for holding the reactor subcritical in the long term or in an equilibrium condition naturally achieved by the design under cold conditions shall be provided.

	Affected Section	Comment/Basis	Recommendation
		a safe, long term shutdown could be achieved naturally without rods or coolant even if brief moments of criticality occurred. (see "Secondary shutdown systems of Nuclear Power Plants," ORNL-NSIC-7, January 1966). Wording was taken directly from the NRC Rationale to expand the capability to account for such a capability in certain designs. With the addition of the phrase "appropriate margin for malfunctions," it is important that the subjective phrase be defined by NRC. This wording is an attempt to define "appropriate margin" with options for both deterministic and risk-informed scenarios for malfunction. Depending on the reactor type, it may be preferred to utilize the simplicity of a deterministic approach. There also may or may not be enough data to utilize a risk-informed approach. For others, a risk-informed approach may more accurately determine appropriate margin. The previous metric of maintaining fission product barriers is kept as the primary metric in this measurement of margin. The definition could be: (1) A single active failure must not result in exceeding design limits for safety-related fission product barriers, or	

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		(2) The probability for a malfunction of the means must not be greater than the frequency for AOOs. If the probability is greater than the frequency for postulated accidents by an order magnitude or more, that malfunction must not result in exceeding design limits for safety-related fission product barriers.	
17	Appendix A, ARDC 26, Page A-7	The second to last paragraph of the ARDC 26 rationale states *"The second sentence of ARDC 26(2) refers to a means of achieving and maintaining shutdown that is **important to safety but not necessarily safety related**. The second means of reactivity control serves as a backup to the safety-related means and, as such, margins for malfunctions are not required but the second means shall be highly reliable and robust (e.g., meet ARDC 1 -5)."* The distinction between the terms "important to safety" and "safety-related" is not properly defined. To avoid confusion, the statement should be revised.	Recommend restating the rational to say *"The second sentence of ARDC 26(2) refers to a ~~means of achieving and maintaining shutdown that is important to safety but not necessarily safety related. The second~~ means of reactivity control which serves as a backup to the ~~safety-related~~ primary means and, as such, margins for malfunctions are not required but the second means shall be highly reliable and robust (e.g., meet ARDC 1 -5)."*

	Affected Section	Comment/Basis	Recommendation
18	Appendix A ARDC 35 A-14	ARDC 35 states *"A system to provide sufficient emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core such that effective core cooling is maintained* ***and fuel damage is limited****."* Regarding the addition of the words *"and fuel damage is limited"* to the first paragraph of the criterion, the rationale does not provide guidance for how these new words (which reflect an expansion relative to GDC 35) should be interpreted or why they have been added. The added words are ambiguous when considering (1) to what level should fuel damage be limited? (2) What are the appropriate measures of fuel damage? (3) How would fuel damage be interpreted for a molten salt reactor or for a modular HTGR?	It appears that the cited ARDC 35 text expands the scope of the existing GDC, and is therefore outside of the scope of this ARDC effort. Absent further information regarding the intent of these words, it is recommended that they be deleted from the criterion.
19	Appendix A ARDC 45 A-19	Clarify "important" refers to "important to safety"	Change to "The structural and equipment cooling systems shall be designed to permit appropriate periodic inspection of ~~important~~ safety related components, such as heat exchangers and piping, to ensure the integrity and capability of the systems."
20	Appendix A ARDC 46 A-19	Clarify applicability to SSCs with a safety function	Change to "~~The structural~~ Safety Related structural and equipment cooling systems shall be designed…"
21	Appendix A ARDC 50 A-20	Editorial: "The example at the end of subpart 1 of ~~the ARDC~~ GDC 50 is LWR specific…"	As indicated

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22	Appendix B General	In several cases, SFR-DCs indicate "same as ARDC." Some others do not indicate this, when the only change is from "reactor coolant boundary" to "primary coolant boundary."	Consider indication, where applicable, that only difference from ARDC is coolant boundary designation.
23	Appendix B General	In many cases, the SFR-DC rationale include: "The use of the term "primary" indicates that the SFR-DC are applicable only to the primary cooling system, not the intermediate cooling system." In several instances, however, "indicates" is replaced with "implies," which connotes less certainty as to applicability.	Replace "implies" with "indicates" for consistency.
24	Appendix B SFR-DC 1 and 10	As regard quality standards and records, and reactor design, no specific SFR criteria are proposed	It is suggested to add that *"design codes adapted to SFR specificities (high temperature…) must be defined"*.
25	Appendix B SFR-DC 14	The definition of the primary coolant boundary includes the cover gas boundary. Therefore, the Criterion 14 requiring an extremely low probability of abnormal leakage for cover gas leakage is not necessary. A cover gas leakage would lead to very limited safety consequences (no impact on the fission process, no impact or limited radiological consequences). This allows for safety valves on the cover gas system to limit abnormal pressure on the reactor vessel. On the other hand, the failure of the reactor vessel could have very severe consequences (e.g. reactivity insertion, failure of the core coolability).	It is therefore proposed to state that "*Each part of the primary coolant boundary shall be designed, fabricated, erected, and tested so as to have ~~an extremely low probability~~ a prevention level of abnormal leakage, of rapidly propagating failure, and of gross rupture, commensurate with the consequences of such failures*".
26	Appendix B SFR-DC 16 B-5	It is indicated that the reactor containment is a pressure retaining structure surrounding the reactor and its cooling systems. In case of SFR, it is possible to limit the pressure	It is therefore proposed to modify the first sentence of the criterion as: *"A reactor containment consisting of a high strength, low leakage~~, pressure retaining~~ structure surrounding the reactor ~~and its cooling systems~~ shall be*

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		loadings on the containment structure in accident conditions. For example the rooms with sodium circuits can be designed so that the effect of a sodium leak or fire would not result in significant pressure on the containment structure and the pressure effect could be limited to the room where the leak occurs. Also, the reactor cooling systems could include secondary cooling systems which are partially outside the containment structure where this can be particular concern is cooling systems with air as the heat sink, for which sodium/air heat exchanger must be placed outside of the containment.	*provided to control the release of radioactivity to the environment and to assure that the reactor containment design conditions important to safety are not exceeded for as long as postulated accident conditions require."* Additionally, remove the phrase "and its primary cooling system."
27	Appendix B SFR-DC 16 B-5	Under rationale, statement that "all past, current, and planned SFR designs use a high-strength, low-leakage, pressure-retaining containment concept" seems broader than can be substantiated without knowledge of <u>all</u> planned designs.	Delete "and planned"
28	Appendix B SFR-DC 17 B-6	Editorial: "The existing single switchyard allowance remains available under ~~ARDC~~ SFR-DC 17..."	As indicated. However, also refer to comment on ARDC 17 suggesting rewording of this rationale discussion.
29	Appendix B SFR-DC 26 SFR-DC 27	GDC 26 and GDC 27 requirements are: • Two independent reactivity control systems of different design principles shall be provided. • One of the systems shall use control elements and be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences (AOOs), and	Recommend retaining GDC 26 and 27 unchanged as SFR-DC 26 and SFR-DC 27. GDC 26 and 27 are applicable for currently licensed and operating LWRs. The reactivity control requirements currently in place for LWRs are sufficient for SFRs.

	Affected Section	Comment/Basis	Recommendation
		with appropriate margin for malfunctions such as stuck control elements, specified acceptable fuel design limits are not exceeded. • The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes to assure acceptable fuel design limits are not exceeded. • One of the systems shall be capable of holding the reactor core subcritical under cold conditions. • The reactivity control systems shall be designed to have a combined capability of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck control elements the capability to cool the core is maintained. Current BWRs and PWRs in the US have two independent systems for controlling reactivity through movement and positioning of control rods. To attain the desired core power level and power distribution during normal operation, one reactivity control system is used to position control rods to compensate for reactivity due to changes in temperature and fuel burnup. BWRs also used core flow	

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		and PWRs also use boration to help control reactivity during normal operation. To ensure all safety criteria are met during AOOs and DBAs, a second reactivity control system is used to provide rapid, full insertion of all control rods (scram). The circuitry and hardware used to move the control rods are completely independent for the two reactivity control systems. The reactivity worth of the control rods is sufficient to ensure reactor shutdown when the rods are fully inserted by either control system for BWRs. For PWRs, control rod insertion and boration ensure reactor shutdown. US LWRs have implemented design features to provide an alternate method for reactor shutdown in the event that the reactivity shutdown system (scram) fails. For PWRs, alternate control rod insertion methods in the event of scram failure have been implemented (same control rods as normal scram, but an independent method for inserting the rods). For BWRs, standby liquid boron injection systems are used to provide an alternate method for reactor shutdown. These alternate means to shut down the reactor are required to meet 10CFR50.62 requirements. Note, these alternate means of shutdown are for a beyond design basis event and the	

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		requirements are not addressed in the GDC. Requirement differences with NRC SFR-DC 26: • Item (1) of SFR-DC 26 changes "specified acceptable fuel limits" to "design limits for fission product barriers". Challenges to primary coolant boundary or containment boundary are addressed in other GDCs. Change is not necessary, but does not add new requirement. • Item (2) of SFR-DC 26 changes the requirement to "provide capability to cool the core" during "postulated accidents" to "maintaining a safe shutdown under design basis events". The reactivity control system requirement has been extended from ensuring core damage does not prevent core cooling to including other aspects (e.g. heat removal from primary system) of safe shutdown. Additional requirements to achieve safe shutdown are addressed by other GDCs. The term "design basis events" is not used in the GDCs. • Item (2) of SFR-DC 26 adds the requirement to have a second independent shutdown system for design basis events. 10CFR does not require a second independent shutdown system for design basis events. 10CFR requires an alternate	

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		means of shutdown for beyond design basis events (10CFR50.62). • SFR-DC 26 eliminates the requirement that the reactivity control system for normal operation reactivity control be independent from the reactivity control system used for shutdown (scram).	
30	Appendix B SFR-DC 30	Similar comment as the one for SFR-DC 14. The definition of the primary coolant boundary includes the cover gas boundary. A cover gas leakage would lead to very limited safety consequences (no impact on the fission process, no impact or limited radiological consequences). This allows for safety valves on the cover gas system to limit abnormal pressure on the reactor vessel. On the other hand, the failure of the reactor vessel could have very severe consequences (e.g. reactivity insertion, failure of the core coolability).	It is therefore proposed to state that *"Each component~~s~~ that ~~are~~ is part~~s~~ of the primary coolant boundary shall be designed, fabricated, erected and tested ~~to the highest quality standards practical~~ with high quality standards, consistent with its safety significance".*
31	Appendix B SFR-DC 33	The goal of GDC 33 is that the cooling function of the primary heat removal system shall not be impacted during normal operation by primary coolant inventory loss due to leakage from the primary coolant boundary and rupture of small piping or other small components which are part of the boundary. For SFRs specifically, the primary concern is ensuring primary coolant inventory is sufficient to maintain the cooling function for the primary heat removal system. This ensures specified acceptable fuel design limits are not exceeded.	Replace the phrase "specified acceptable fuel design limits are not exceeded" with the phrase "the cooling functions of the primary heat removal system and the residual heat removal system are not impacted". To eliminate redundancy, delete the phrase "for protection against small breaks in the primary coolant boundary".
32	Appendix B	SFR-DC 34 deleted reference to postulated	Explain the reasoning for SFR-DC 34 being for normal

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	SFR-DC 34	accidents (e.g. DBAs) without an explanation in the rationale section.	operations and AOOs, similar to the explanation provided for SFR-DC 35.
33	Appendix B SFR-DC 35	For SFRs, the residual heat removal system may be all that is required to provide adequate heat removal during postulated accidents. SFR-DC 34 is specified as being applicable for normal and AOO conditions. However, residual heat removal will also be necessary for postulated accident conditions and should be addressed in SFR-DC 35. The draft SFR-DC 35 added "and fuel damage is limited". Other than maintaining effective core cooling, the meaning of this statement is not clear – what is being prevented by limiting the fuel damage? Suggest using wording similar to that used in GDC 35; that is use ".... such that fuel and clad damage that could interfere with continued effective core cooling is prevented...." instead of ".... such that effective core cooling is maintained and fuel damage is limited ...". SFR-DC 35 does not address protection of the primary coolant system boundary. Add "...and the design conditions of the primary system boundary are not exceeded."	Replace the first paragraph of SFR-DC 35 with the following paragraph: • "A system to assure sufficient core cooling during postulated accidents and to remove residual heat following postulated accidents shall be provided. The system safety function shall be to transfer heat from the reactor core during and following postulated accidents such that fuel and clad damage that could interfere with continued effective core cooling is prevented and the design conditions of the primary system boundary are not exceeded."
34	Appendix B SFR-DC 36 & 37	The title of these SFR-DC refers to the "residual heat removal system". The text that follows refers to the emergency core cooling	Revise title of SFR-DC 36 to Inspection of emergency core cooling system.

	Affected Section	Comment/Basis	Recommendation
		system. While a single system may be provided to perform both residual heat removal and emergency core cooling functions, it would be logical for the title and the text to use the same nomenclature to describe the system.	Revise title of SFR-DC 37 to Inspection of emergency core cooling system.
35	Appendix B SFR-DC 44	The opening sentence is confusing.	The opening sentence needs to be revised to make its meaning clearer.
36	Appendix B SFR-DC 52	SFR structures are sensitive to pressure and it may be chosen to avoid high pressure elevation in the containment design during leakage rate testing, in order to preserve the facility and prevent undesirable over or under pressurization risks during those tests. It may be chosen to perform those tests at a pressure below the containment design pressure, in order to extrapolate them at the containment design pressure (in this case the relevance of the extrapolation will of course have to be justified).	We propose to state that *"the reactor containment structure and other equipment that may be subjected to containment test conditions shall be designed so that periodic integrated leakage rate testing can be conducted to demonstrate resistance at containment design pressure".*
37	Appendix B SFR-DC 54	As indicated in criterion 57, an isolation of lines penetrating the reactor containment structure may not be required in some cases. This could for example could apply to the intermediate heat transport system penetrating the reactor containment (provided adequate justification is given).	To ensure coherency of the text, this could be reflected in the Criterion 54: *"Piping systems penetrating the reactor containment structure shall be provided with leak detection, isolation if necessary and containment capabilities (...)"*
38	Appendix B SFR-DC 56	Why is "Isolation valves outside containment..." deleted? It's not deleted in 55. It appears from the wording that the intent was that this phrase NOT be deleted from SFR-DC 56. Deletion may have been	Add the wording to SFR-DC 56.

	Affected Section	Comment/Basis	Recommendation
		unintentional.	
39	Appendix B SFR-DC 70	The first sentence, "If an intermediate coolant system is provided, then the system shall be designed to transport heat from the primary coolant system to the energy conversion system as required," is not required.	Rewrite the DC to state "If an intermediate cooling system is provided, then the system shall be designed with sufficient margin ..."
40	Appendix B SFR-DC 72	Sodium freezing may not impact the safety function of all systems.	Add phrase "....if necessary to ensure that the safety function of the system is accomplished" to the beginning of the first sentence.
41	Appendix B SFR-DC 72	"Heating systems shall be provided for systems and components important to safety, which contain or could be required to contain sodium." could be inferred to mean that all systems and components important to safety contain or could be required to contain sodium.	To minimize confusion, restate as: "Heating systems shall be provided for systems and components that are important to safety~~, which~~ and that contain or could be required to contain sodium."
42	Appendix B SFR-DC 73	Is the intent of the last sentence to ensure that all sodium systems be in inerted enclosures or guard vessels? Not all plant systems containing sodium need to be in inerted spaces.	Recommend deleting the last sentence.
43	Appendix B SFR-DC 73	"Special features, such as inerted enclosures or guard vessels, shall be provided for systems containing sodium." implies a significant hazard exists for any system containing sodium.	Replace this sentence in its entirety with: "Systems from which sodium leakage constitutes a significant safety hazard shall include measures for protection, such as inerted enclosures or guard vessels."
44	Appendix B SFR-DC 74	Fire protection and mitigation due to sodium-water interaction is covered by SFR-DC 3 and SFR-DC 73.	Delete phase "..., including mitigation of the effects of any resulting fire involving sodium."
45	Appendix B SFR-DC 75 SFR-DC 76	SFR-DC 70 states *"The intermediate coolant system to be designed with sufficient margin to assure that (1) the design conditions of its*	Recommend deletion of SFR-DC 75, 76, and 77.

	Affected Section	Comment/Basis	Recommendation
	SFR-DC 77	*boundary are not exceeded during normal operations and anticipated operational occurrences, and (2) the integrity of the primary coolant boundary is maintained during intermediate coolant system accidents."* SFR-DC 75, 76, and 77 are superfluous when evaluated in combination with the cited text from SFR-DC 70. SFR-DC 75, 76, and 77 appear to be applicable when the role of the intermediate coolant system is commensurate with a safety function. However, other than the case when it could serve as a path for decay heat removal, the intermediate coolant system does not have any safety function. If the intermediate cooling system provides a safety-related heat removal capability, then SFR-DC 34-37 and SFR-DC 78 specify its requirements. The quality and fracture prevention requirements specified in SFR-DC 75 and 76 are supplementary requirements that are not consistent with the requirements for the decay heat removal and emergency core cooling systems specified in SFR-DC 34 and 35. Likewise, the inspection and testing	If SFR-DC 76 is not deleted, it should include wording such as "commensurate with their importance to safety."

	Affected Section	Comment/Basis	Recommendation
		requirements specified in SFR-DC 77 for the intermediate cooling system are contained in SFR-DC 36 and 37. Therefore, for the case where the intermediate cooling system provides safety-related heat removal capability, SFR-DC 75, 76, and 77 are redundant and unnecessary. If the intermediate cooling system does not provide safety-related heat removal capability, then only the requirements of SFR-DC 70 are necessary to specify the system design with appropriate margin to assure the design conditions of its boundary and the integrity of the primary coolant boundary. Therefore, for the case where the intermediate cooling system does not provide safety-related heat removal capability, SFR-DC 75, 76, and 77 are also redundant and unnecessary.	
46	Appendix B SFR-DC 78	It is possible that there either be such a configuration or that there be not be enough liquid metal to cause a severe consequence or even a significant consequence due to reactions with either air or water or both, both in terms of the reaction itself as well as	Move the first sentence to the end with added wording described below. After "compatible" in the second sentence, add "or

	Affected Section	Comment/Basis	Recommendation
		consequence to the reactor and safety system functions. Instead of being prescriptive, there needs to be a mechanistic method to determine whether multiple boundaries are necessary. Ultimately, the prescriptive condition for two boundaries is redundant; for both fluids and coolants which are compatible or incompatible, the required conditions should be the same, which are the conditions (1) and (2). So long as there is no failure of the intended safety functions of structures, systems or components important to safety or result in exceeding the fuel design limits, then the size of the reaction is small enough to justify not needing redundant boundaries.	incompatible". Add wording to the end to read: "If the primary coolant system interfaces with a structure, system, or component containing fluid that is chemically incompatible with the primary coolant, *and cannot meet condition (1) and condition (2)*, the interface location shall be designed to ensure that the primary coolant is separated from the chemically incompatible fluid by two redundant, passive barriers.
47	Appendix B SFR-DC 79	The requirement to ensure that "primary coolant sodium limits" are not exceeded as a result of cover gas leakage are already addressed in SFR-DC 71, item (4).	Delete SFR-DC 79
48	Appendix C General	Many of the proposed mHTGR GDC retain the statement "assuming a single failure". This inclusion makes no reference to SECY-03-0047 and the Commission SRM that described the replacement of the single failure criterion with	The single failure requirement should be replaced with a probabilistic (reliability) criterion.

	Affected Section	Comment/Basis	Recommendation
		a probabilistic (reliability) criterion.	
49	Appendix C mHTGR-DC 14, 30, 31, 32	The requirements as written imply the primary helium pressure retention is a safety function similar to LWRs. However, it is important to note that although the leak tightness and high quality of the helium pressure boundary is necessary for commercial operation of mHTGRs, the pressure retaining function of the helium pressure boundary <u>is not a required safety function</u>. The safety function of the reactor vessel and its support system is to maintain core coolable geometry and provide sufficient conduction and convection heat transfer properties in the core region.	De-emphasize the pressure retention function of the helium pressure boundary. mHTGR-DC 70 correctly emphasizes seismic stability and geometric stability of the reactor vessel system. However, emphasis on T/H properties of the reactor vessel at uninsulated the core region is lacking.
50	Appendix C mHTGR-DC 15	The addition of "heat removal systems" appears to be limited solely to connected systems, i.e., the steam generator. Clarification is needed as to the role of the RCCS for heat removal under normal operations and AOOs.	Clarify the role of the RCCS for heat removal under normal operations and AOOs.
51	Appendix C mHTGR-DC 17	Editorial: "The existing single switchyard allowance remains available under ~~ARDC~~ mHTGR-DC 17..."	As indicated. However, also refer to comment on ARDC 17 suggesting rewording of this rationale discussion.
52	Appendix C mHTGR-DC 19	Delete "as defined in § 50.2" as this is implicit in all of the GDC statements.	Delete "as defined in § 50.2"
53	Appendix C mHTGR-DC 26	The existing GDC includes the wording "specified acceptable fuel design limits", while the proposed mHTGR-DC does not include the	Recommend establishing consistency between mHTGR-DC 26 and other design criteria mentioned.

	Affected Section	Comment/Basis	Recommendation
		replacement "specified acceptable system radionuclide release design limits" wording. The wording that "design limits for fission product barriers are not exceeded" is imprecise and moves the intent from maintaining fuel design limits to fission product barriers. The rationale desribes: "Additionally, "specified acceptable fuel design limits" is replaced with "design limits for fission product barriers" to be consistent with the AOO acceptance criteria." This appears to be inconsistent with other design criteria which include SARRDLs. See proposed mHTGR-DC 10, 17, 20, and 25.	
54	Appendix C mHTGR-DC 29	With the inclusion of AOOs within mHTGR GDC 20, 25, and 26, it is recommended that this GDC is duplicative and can be deleted.	Delete mHTGR-DC 29
55	Appendix C mHTGR-DC 34 mHTGR-DC 71 mHTGR-DC 72	The word "passive" implies that only a passive system is to be provided. Maintaining geometry is needed for both active and passive means of heat removal. Note that proposed new mHTGR-DC 72 does not mention passive (while the rationale does).	Remove the word "passive"
56	Appendix C mHTGR-DC 36	Add the word "system" after residual heat removal.	Add the word "system" after residual heat removal.