

From: [Samuel Cuadrado de Jesus](#)
To: [Bolin, John](#)
Cc: [Stephen Philpott](#); [Greg Oberson \(He/Him/His\)](#)
Subject: Transmittal of Requests for Additional Information - General Atomics-Electromagnetic Systems Fast Modular Reactor Principal Design Criteria Topical Report
Date: Wednesday, October 05, 2022 3:30:00 PM

John,

The Nuclear Regulatory Commission (NRC) staff reviewed General Atomics-Electromagnetic Systems (GA-EMS) Fast Modular Reactor Principal Design Criteria Topical Report and concluded that additional information is needed to complete its review. The NRC staff's Request for Additional Information (RAIs) are below. This email serves as formal transmittal of the RAIs.

A response from GA-EMS is expected by November 7, 2022. This date will support the NRC staff's established review schedule. If you would like to discuss the schedule further or need additional time to provide the responses to the RAIs, please do not hesitate to contact me. This email will be placed in ADAMS and will be declared public.

-
REQUEST FOR ADDITIONAL INFORMATION
OFFICE OF NUCLEAR REACTOR REGULATION
FAST MODULAR REACTOR PRINCIPAL DESIGN CRITERIA TOPICAL REPORT
GENERAL ATOMICS – ELECTROMAGNETIC SYSTEMS
DOCKET NO. 99902098
EPID L-2022-TOP 0033

Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "General Design Criteria for Nuclear Power Plants," also known as the GDC, establishes "minimum requirements for the principal design criteria for watercooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission" (i.e., light-water reactors). While the GDC themselves may not directly apply to non-light water reactor (non-LWR) designs, they 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." To provide guidance on developing principal design criteria (PDC) for non-LWRs, the NRC published Regulatory Guide (RG) 1.232, "Guidance for Developing Principal Design Criteria for Non-Light Water Reactors" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17325A611). This RG provides model advanced reactor design criteria (ARDC), sodium fast reactor design criteria (SFR-DC), and modular high-temperature gas reactor design criteria (MHTGR-DC).

By letter dated June 3, 2022, General Atomics – Electromagnetic Systems (GA-EMS) requested that the NRC review their Fast Modular Reactor (FMR) PDC Topical Report (TR) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22154A555). GA-EMS TR developed a set of PDCs for the FMR (referred to as the fast modular reactor design criteria, or FMR-DC). The TR referred to the GDC and the various advanced reactor PDC in RG 1.232 in developing the FMR-DC.

RAI FMR-DC 12:

GAEMS TR FMR-DC 12 provides a criterion for the suppression of reactor power oscillations largely consistent with GDC 12. Relative to GDC 12, the only substantive change is to remove the word “coolant” from the design criterion. The rationale for this adaptation to the GDC provided in the TR is that the helium coolant in the FMR does not affect the core’s susceptibility to power oscillations. The staff agrees with this point and notes that it is consistent with the adaptations for MHTGR-DC 12. However, ARDC 12 adapted GDC 12 by adding the word “structures”, because “items such as reflectors, which could be considered either outside or not part of the reactor core, may affect susceptibility of the core to power oscillations.” This is particularly true for fast reactors like the FMR. Please explain why it is not necessary to address the role of structures in power oscillations for the FMR.

RAI FMR-DC 34:

GA-EMS TR FMR-DC 34 provides a criterion for the design of the passive residual heat removal (PRHR) system. Overall, this criterion is very similar to MHTGR-DC 34 from RG 1.232, aside from the change to specified acceptable fuel design limits (SAFDLs) from specified acceptable system radionuclide release design limits (SARRDLs), which is consistent with other FMR-DC. However, compared to the design-specific PDC provided in RG 1.232, the words “[f]or normal operations and anticipated operational occurrences” are missing from the FMR-DC. Please provide a justification for removing this language.

RAI FMR-DC 37:

GA-EMS TR FMR-DC 37 provides a criterion for testing of the PRHR system. Some of the language used in this PDC appears to be redundant. Specifically, the last two clauses from the FMR-DC 37 may cover overlapping systems:

- “including operation of associated systems and interfaces with an ultimate heat sink and the transition from the standby normal operation mode to the passive operation mode relied upon during postulated accidents”
- “including the operation of applicable portions of the protection system and the operation of the associated structural and equipment cooling water system.”

Please clarify whether both clauses are needed.

By letter dated June 3, 2022, General Atomics – Electromagnetic Systems (GA-EMS) requested that the NRC review their Fast Modular Reactor (FMR) Principal Design Criteria (PDC) Topical Report (TR)(Agencywide Documents Access and Management System (ADAMS) Accession No. ML22154A555). The proposed design criteria would satisfy the regulatory requirements for PDC of Title 10, “Energy,” of the *Code of Federal Regulations* (10 CFR), Section 50.34, “Contents of Applications; Technical Information,” paragraph (a) (3)(i), that requires applicants for a construction permit include the PDC for the facility.

The requirements of 10 CFR 50.34, “Contents of Applications; technical Information,” state the following in Paragraph (a)(3)(i) :

The principal design criteria for the facility. Appendix A, General Design Criteria [(GDC)] for Nuclear Power Plants, establishes minimum requirements for the principal design criteria for watercooled nuclear power plants similar in design and location to plants for which construction permits have previously been issued by the Commission and provides guidance to

applicants for construction permits in establishing principal design criteria for other types of nuclear power units.

Similarly, NRC regulations in 10 CFR 52.47(a)(3)(i), 10 CFR 52.79(a)(4)(i), 10 CFR 52.137(a)(3)(i), and 10 CFR 52.157(a) require that applications for standard design certifications, combined licenses, standard design approvals, and manufacturing licenses include the PDC for a facility.

Although the regulations noted that the GDC were generally applicable to other types of reactor units and were intended to provide guidance in establishing the PDC for such other units, the NRC and DOE established a joint initiative to address the regulatory framework that could apply to non-LWR technologies and specifically, to address the existing GDC, which may not directly apply to non-LWR power plant designs. This effort resulted in the NRC Regulatory Guide (RG) 1.232, "Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors," (ADAMS Accession No. ML17325A611). This RG provides Advanced Reactor Design Criteria (ARDC) and 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 temperature gas-cooled reactors (MHTGRs).

-
RAI FMR-DC 56:

For ARDC 56, *Containment Isolation*, the RG 1.232 includes the following statement:

Isolation valves outside containment shall be located as close to the containment as practical and upon loss of actuating power, automatic isolation valves shall be designed to take the position that provides greater safety.

Although GA-EMS TR Table 1, "FMR Principal Design Criteria," indicates that FMR-DC 56, *Containment Isolation*, is the same as ARDC 56 in RG 1.232, the above statement was omitted from the column "FMR-DC Title and Content" for FMR-DC 56. Please clarify whether the omission was intentional and, if so, provide the basis for the removal of the statement regarding location and effect of loss of actuating power from FMR-DC 56.

Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "General Design Criteria," establishes "minimum requirements for the principal design criteria for watercooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission" (i.e., light-water reactors). While the general design criteria (GDC) themselves may not directly apply to non-light water reactor (non-LWR) designs, they 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." To provide guidance on developing principal design criteria (PDC) for non-LWRs, the NRC published Regulatory Guide (RG) 1.232, "Guidance for Developing Principal Design Criteria for Non-Light Water Reactors" (Agencywide Documents Access and Management (ADAMS) Accession No. ML17325A611).

By letter dated June 3, 2022 (Agencywide Documents Access management System (ADAMS) Accession No. ML22154A555), General Atomics – Electromagnetic Systems (GA-EMS) requested that the NRC staff review the proposed PDC applicable to the GA-EMS Fast Modular Reactor (FMR) as described in their topical report (TR), “Fast Modular Reactor Principal Design Criteria,” 30599T00005 Revision 1, dated May 31, 2022. The GA-EMS FMR is a Gas-cooled Fast Reactor operating at system temperature range of 500 °C to 800 °C. The GA-EMS fast modular reactor design criteria (FMR-DC) were developed based on RG 1.232.”

The NRC staff reviewed the proposed FMR-DC applicable to the GA-EMS FMR electrical power systems and has the following questions.

RAI FMR-DC 17(A):

Table 1, “FMR Principal Design Criteria,” of the TR provides the FMR-DC content for Criterion 17, “Electric Power Systems.” RG 1.232 states that for Modular High-Temperature Gas-Cooled Reactor (MHTGR) Criterion 17, “[i]f electric power is not needed for anticipated operational occurrences or postulated accidents, the design shall demonstrate that power for important to safety functions is provided.” This is deleted from the GA-EMS FMR-DC 17.

Please explain the deletion and if power to important to safety functions are not required (i.e., Is this not applicable since there will be safety-related onsite power?).

RAI FMR-DC 17(B):

Table 1 of the TR provides the content for GA-EMS FM-DC 17. RG 1.232, MHTGR-DC 17 “Electric power systems,” states in part “[t]he electric power systems shall include an onsite power system and an additional power system. [...] An additional power system shall have sufficient independence and testability to perform its safety function.” Requirements for an additional power system are not provided in the GA-EMS FMR-DC 17. In addition, the rationale for GA-EMS FMR-DC-17 in Table 1 of the TR, states that ‘The GDC text related to “...supplies, including batteries, and the onsite distribution system,” was deleted to allow increased flexibility in the design of offsite power systems for advanced reactor designs.’

Please explain if there are any offsite or other power systems required besides the onsite power system.

Regards,

Samuel Cuadrado de Jesús

Project Manager

Advanced Reactor Licensing Branch (UARL)

Division of Advanced Reactors and Non-Power Production and Utilization Facilities (DANU)

U.S. Nuclear Regulatory Commission

Phone: 301-415-2946

Samuel.CuadradoDeJesus@nrc.gov