

The Honorable Christopher T. Hanson

Chairman

U.S. Nuclear Regulatory Commission

Washington, D.C., 20555-0001

September 9th, 2022

Dear Chairman Hanson:

First, we would like to acknowledge and thank the Nuclear Regulatory Commission (NRC) for establishing this Fusion Working Group, which has allowed over the last 48 months Fusion Industry Association (FIA) members to provide contextual and technical information on our respective technologies and common challenges. It was an excellent public forum to exchange constructive ideas with the NRC on how best to enable the licensing and advancement of fusion technologies in a commercial setting in the United States.

The purpose of this letter is to reiterate General Fusion's support for all of FIA's general positions regarding the need to adopt regulatory approaches commensurate with the low radiological risks of the fusion technologies represented by the FIA group and to share with the NRC additional and iterative considerations to FIA's stated positions that we hope useful as you and your team are implementing the directive to evaluate regulatory frameworks for fusion energy systems.

As discussed in previous public meetings with the NRC staff, General Fusion believes that the materials licensing program in Part 30 (in conjunction with Part 20, which comprehensively regulates low-level waste to be generated by fusion power plants) of the Commission's regulations is the most appropriate for commercial fusion all other options in the current framework considered. Some key consideration in this regard:

- The Fusion energy machines cannot easily fall under Parts 50 and 52 given the definitions and conceptual approaches inherently focused on fission reactors. This is supported by the fact that fusion uses a fundamentally different atomic process from fission. Fusion machines present a completely different risk profile. Fusion does not use special nuclear material or source material and does not create risk for criticality accidents, decay heat removal or high-level radioactive wastes.

- Tritium fits within the byproduct material that Part 30, and agreement States regulate. Provisions of Part 30 calibrate regulatory oversight to hazards that byproduct material used or created by fusion energy machines, all in accordance with the Nuclear Energy Innovation and Modernization Act's (NEIMA) mandate.
- Part 30 should be used as a basis for safety analyses of the first fusion machines to enter the commercial market in the U.S. and should be reviewed when years of operational experience allow for an informed review and optimal adjustments if necessary.

We would like to add that all the fundamental, technologically neutral conceptual and methodological approaches (e.g., hierarchical structure of safety goalsⁱ, defense in depthⁱⁱ, the fundamental principles of justification and optimization for radiation protection) are provided in current regulations that allow the various regulatory authorities to properly assess the safety case for fusion technologies without making hasty changes in their respective regulatory framework. Developing new fusion-specific regulations would be a perilous and unsustainable journey in the absence of the operational experience (OPEX) that is necessary to determine how such regulations could best facilitate fusion facility licensing and regulation. As pointed out in one of FIA members presentation (<https://www.nrc.gov/docs/ML2215/ML22159A269.pdf>) during the June 7th 2022 Virtual Public Meeting on "Developing Options for a Regulatory Framework for Fusion Energy Systems", this approach has already been used by the NRC with Part 36 for irradiators, which was developed after decades of irradiator operation around the world to gain the operational experience necessary for a robust regulatory framework, and it took two years after that time to finalize this part of 10 CFR.

While keeping the focus on Part 30 and avoiding the development of new regulatory content or expansion of existing content (which would be counterproductive, costly, and time consuming given the lack of sufficient OPEX with fusion technologies), General Fusion believes it is to the advantage of the industry and the regulator to open the lines of communication earlier than usual for pre-licensing initiatives for fusion technologies ready to engage in the safety case discussions. This would allow an integrated exchange between industry and regulators on conceptual designs so that the capability of this interface evolves and matures quickly and allows for the inclusion of safety feature considerations early in the process paving the way for a more performing formal licensing process. As the design of the commercial fusion plants are still in development and the

operating procedures (start-up, shutdown, and maintenance) will follow, the safety approach must include appropriate methods, usable despite the lack of operational experience on components, systems, and procedures. Such approaches existⁱⁱⁱ and can be used in early (pre-licensing) discussion with the NRC to confirm that fundamental safety principles are integrated in the finalization of the design.

General Fusion strongly believes that the approach that will be the most efficient to optimize rapid emergence of commercial fusion plants in the USA is early industry-regulator interface for performing safety case analysis on conceptual design elements. This approach influences the direction of the concept and ultimately the design development from its earliest stages by giving useful feedback and guidance to the designer to achieve a safety that is “built in” rather than “added on”.

One topic of discussion on this front (early industry – regulator interface for pre-licensing efforts) is the optimal Tritium Breeding Ratio (TBR) which greatly depends on the performance of many structures, systems and components of the fusion machine and the tritium extraction/removal systems. Some margins may be required during early stages of operations to account for a series of factors^{iv} and associated uncertainties due to the lack of OPEX. This is a topic of interest to General Fusion with a potential impact on the size and tritium inventories mobilization and we would certainly welcome cooperation with the NRC on this angle of our safety case in early pre-licensing discussions.

To optimize waste reduction for the decommissioning phase, General Fusion will be prepared to discuss optimal alloy choices so that all activated materials meet the standards for low-level waste under Part 61 of the Commission's regulations. We anticipate that the activated materials will be classified as Class A low-level waste. No waste will be classified as high-level waste since no special nuclear materials or source materials are used.

10 CFR Parts 20 and 30 of the Commission's regulations present a good basis for adequately addressing the risks that fusion energy systems would present in a commercial setting in the United States. General Fusion believes that it is time to begin preliminary safety case discussions on a technology-by-technology basis to pave the way for licensing fusion machines over the next decade. This regulator-applicant interface must evolve in a dynamic and synergistic manner to be effective in these exciting new fields in the energy sector.

We look forward to continuing the dialogue with the NRC and its Commissioners.

Sincerely,



Pascal Dumont, M.Sc.

Vice President, Regulatory Affairs

General Fusion

CC:

Commissioner Jeff Baran, U.S. NRC;

Commissioner David Wright, U.S. NRC;

Commissioner Annie Caputo, U.S. NRC;

Commissioner Bradley R. Crowell, U.S. NRC.

ⁱ IAEA-TECDOC-1874 *Hierarchical Structure of Safety Goals for Nuclear Installations* published in 2019 presents technology neutral high level safety goals enabling the assessment of advanced and novel technologies safety cases with specific inputs about how far this general concept is currently applied in Canada, Germany, Sweden, UK, and USA.

ⁱⁱ INSAG 10 *Defence in Depth in Nuclear Safety*, IAEA, International Nuclear Safety Advisory Group, 1997. DiD saves us from what we don't know from operational experiences by making paramount the importance of preventing and controlling abnormal operation and failures.

ⁱⁱⁱ Master Logic Diagram (MLD) a top-down approach and the Functional Failure Mode Effect Analysis (FFMEA) a functional bottom-up approach can be used in conjunction to develop a list or postulated initiating events and pave the way for lower tier safety goal through deterministic and probabilistic safety analysis at formal design stage to evaluate the adequacy of existing or proposed designs of safety related Structures Systems and Components (SSCs).

^{iv} Optimal T burn-up fraction in plasma; Means for maintaining low T inventories achieved in all subsystems; Considerations related to high reliability and short repair time of Tritium processing systems so one day of T reserve storage for malfunction in T processing system is sufficient; Minimal losses to environment; Net TBR variation during operation due to uncertainties in design elements; On line adjustment for tritium breeding to control TBR; Consideration related to redundancy of tritium processing systems; etc.

Chairman Resource

From: Pascal Dumont <pascal.dumont@generalfusion.com>
Sent: Thursday, September 8, 2022 8:16 PM
To: Chairman Resource
Cc: Blake, Kathleen; Greg Twinney; Megan Wilson; Andrew Holland; Ryan Guerrero; Michael Cappello; Jay Brister; Matt Miles
Subject: [External_Sender] RE: General Fusion's letter of support for FIA's positions with the USNRC
Attachments: Letter to Chairman Hanson from General Fusion_Sept 2022_Final.pdf

From: Pascal Dumont
Sent: Thursday, September 8, 2022 5:12 PM
To: Chairman@nrc.gov
Cc: Kathleen.Blake@nrc.gov; Greg Twinney <greg.twinney@generalfusion.com>; Megan Wilson <megan.wilson@generalfusion.com>; Andrew Holland <aholland@fusionindustryassociation.org>; Ryan Guerrero <ryan.guerrero@generalfusion.com>; Michael Cappello <michael.cappello@generalfusion.com>; Jay Brister <jay.brister@generalfusion.com>; Matt Miles <matt.miles@generalfusion.com>
Subject: General Fusion's letter of support for FIA's positions with the USNRC

Dear Chairman Hanson

Please find attached General Fusion's letter of support for the FIA positions that have been exchanged over the past two years at the public meetings organized by the USNRC entitled "Developing Options for a Regulatory Framework for Fusion Energy Systems". General Fusion is a Canadian FIA member with our US offices based in Oak Ridge, TN.

We are grateful for the opportunities we have had over the past 24 months to interact with the USNRC in these dynamic and open forum. We are pleased and excited about what lies ahead and hope that our work together will lead to promising cooperation in the near future to advance the emergence of fusion commercial plants in the United States.

Best regards,

Pascal Dumont
Vice President, Regulatory Affairs

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