Additional Considerations for NRC Evaluation and Agreement State Case Study

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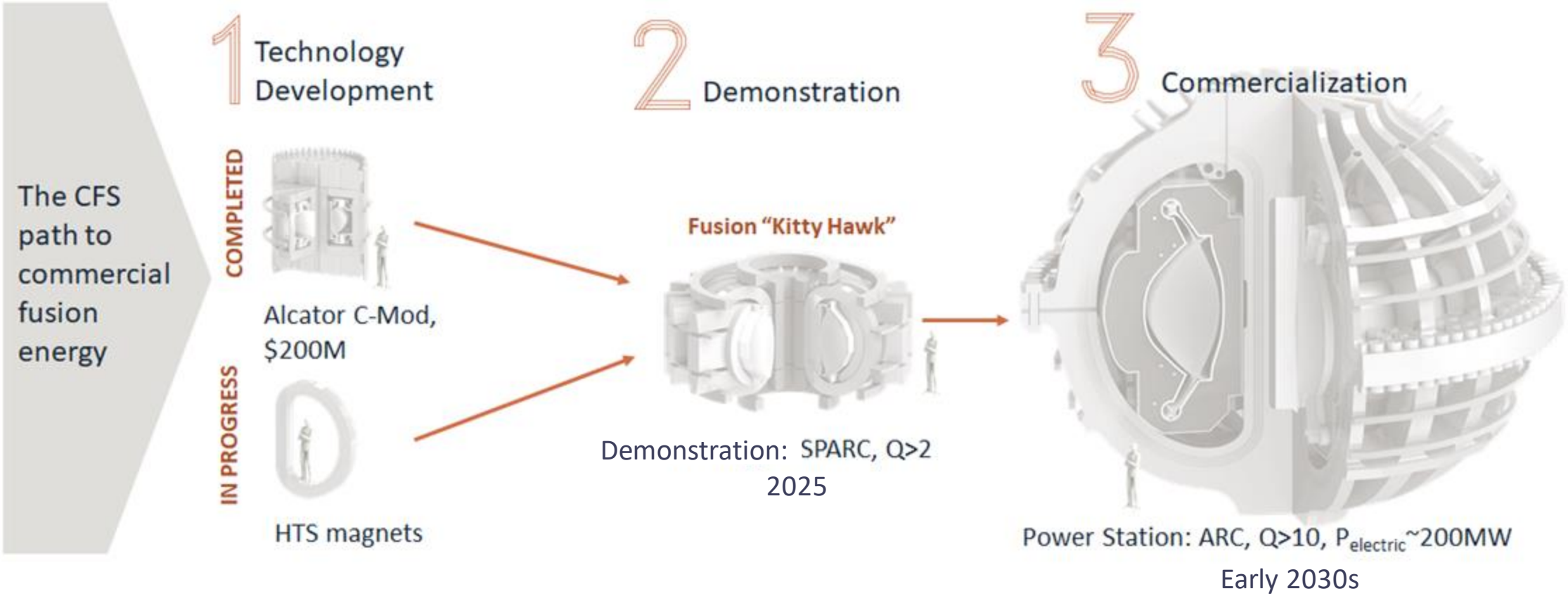
Commonwealth Fusion Systems

CFS Approach

- Extensively studied (since the 1950s), traditional tokamak design which incorporates new magnets utilizing high-temperature superconductors
- If power is cut or vacuum chamber fails, facility simply shuts down, no decay heat to deal with
- No possibility of a melt-down nor production of long-lived nuclear waste due to the lack of source or special nuclear material
- Solid technical basis described in the Journal of Plasma Physics special issue on [Status of the SPARC Physics Basis]

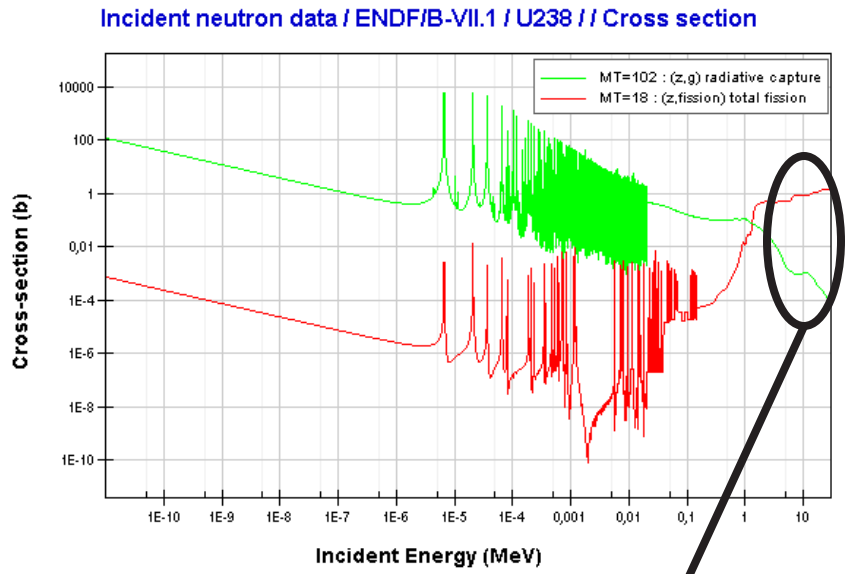


Additional Considerations for NRC Evaluation

- The 2009 NRC Memo stated "the Commission may be able to exercise regulatory jurisdiction over fusion devices by treating such devices as utilization facilities…"
- To do this, the NRC would have to find in a rulemaking both that:
  - (1) fusion constitutes "atomic energy" within the meaning of the AEA, and
  - (2) the fusion process is of such quantity as to be 'of significance to the common defense and security, or in such manner as to affect the health and safety of the public'"
- Fusion processes may fall within the definition of "atomic energy" since atomic energy is defined to mean "all means of energy released in the course of nuclear fission or nuclear transformation"
- However, commercial fusion facilities should **not** be utilization facilities because they will **not** be of significance to the common defense and security and their health/safety impact only falls within 10 C.F.R. Parts 20 and 30
- Special nuclear materials (SNM), which have defense and public safety implications, are defined as only plutonium and enriched uranium; neither of which are used in fusion
- To treat fusion as a utilization facility, NRC would have to reclassify many benign materials (e.g. boron, deuterium, and tritium) as SNM which is highly unlikely
- Therefore, the only way the NRC could treat commercial fusion energy devices as "utilization facilities" is if they use "atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public"

Additional Considerations for NRC Evaluation

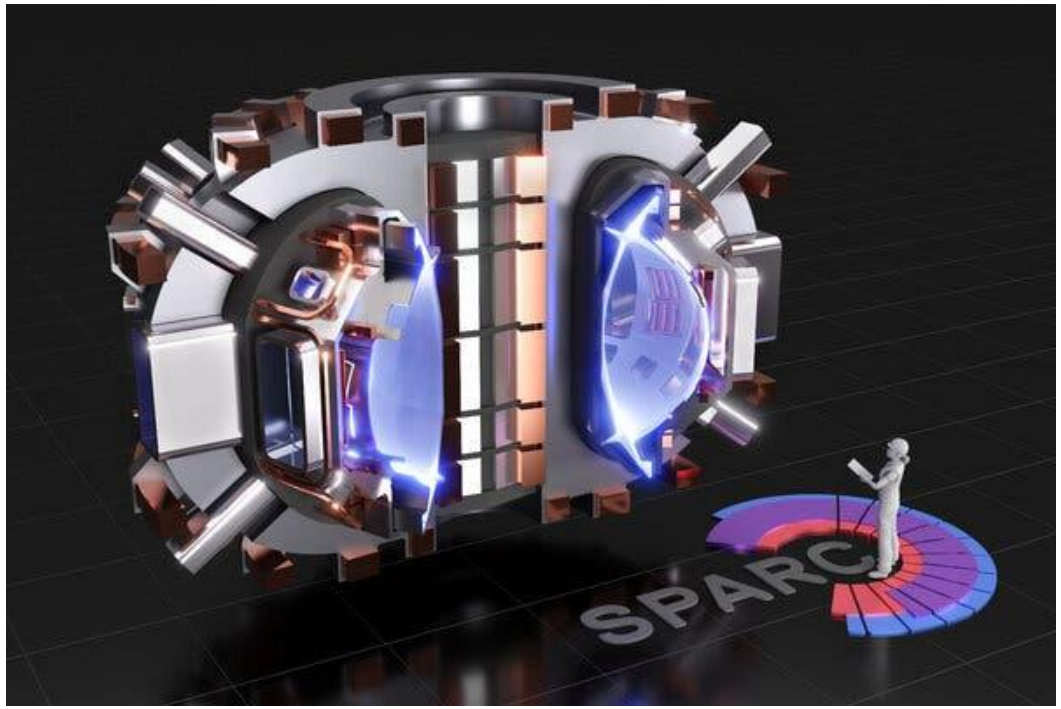
- Fusion energy facilities will **not** be of significance to the common defense
  - Commercial fusion facilities will not be capable of producing the fissionable materials because there is no source material nor special nuclear material on site
  - Even though neutrons are produced, using them to produce fissionable materials would be an extremely complex endeavor requiring immense effort and is unlikely to be a credible threat
  - To the extent that fusion facilities use tritium fuel to start, it's possible to secure tritium on the civilian market so there is no diversion of any material resource from U.S. defense needs
  - Fusion energy facilities are also capable of producing all the tritium fuel that they need on-site
  - Once commercialized, fusion energy facilities will join a mixed electricity grid so it is highly unlikely that any U.S. defense facility or activity will rely solely on fusion for power generation in the foreseeable future



Fusion neutrons are born at this energy, where capture is hundreds to thousands of times less likely, so proliferation concerns are not likely to be a credible threat

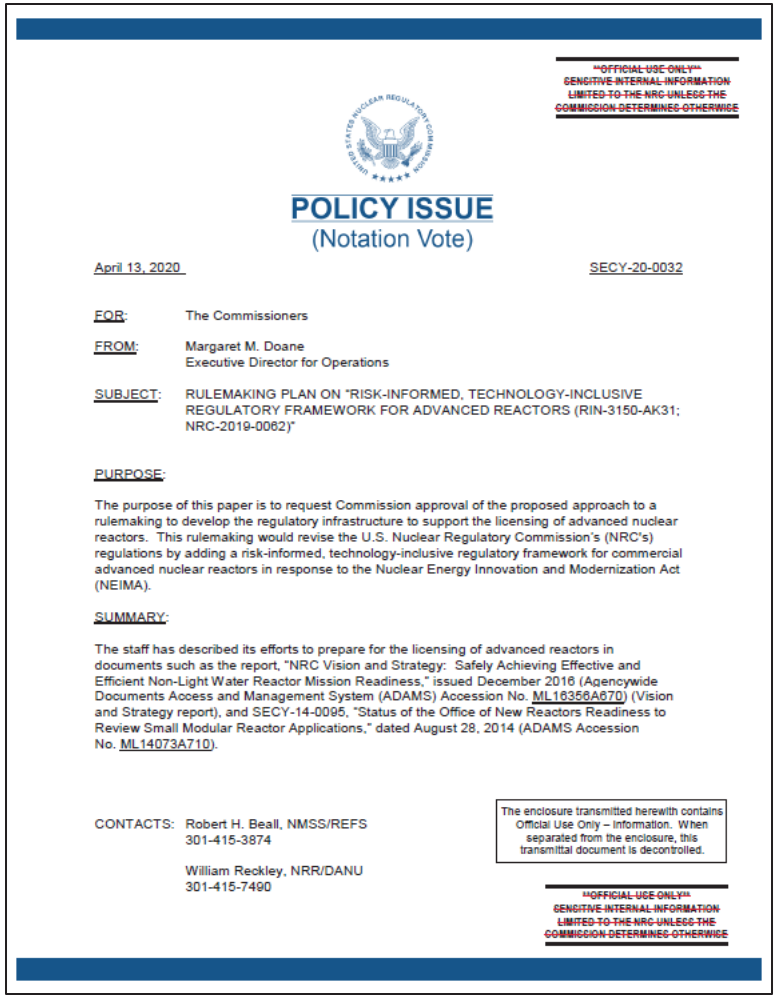
Additional Considerations for NRC Evaluation

- Fusion energy facilities will **not** affect the health and safety of the public in a negative way
  - All effects from abnormal operation of a fusion energy facility would be confined to the plant site and would not have a negative impact on the public
  - Fusion energy facilities would be constructed to comply with applicable standards for radioactive materials, rendering residual risks comparable to risks from existing hydrocarbon power plants or other industrial facilities
  - Fusion energy facilities will not produce high-level radioactive waste and would comply with existing rules for handling radioactive materials like tritium
  - By providing an emissions-free and inherently safe source of electricity, fusion will improve the health and safety of the general public



Additional Considerations for NRC Evaluation

- The 2009 NRC Memo suggested that an "additional consideration involves the potential benefits of the NRC establishing a national regulatory framework for fusion devices instead of requiring various State and local agencies to develop programs to address this new technology"
- States already handle radioactive sources under Parts 20 and 30 through the Agreement State Program (with 39 states participating) and the NRC exerts oversight through regular audits, so national consistency is already maintained
- The success of the Agreement State Program demonstrates that states are fully capable of exercising regulatory oversight for radioactive sources and this program is applicable to the tritium needed for future fusion systems
- NRC Staff suggested in SECY-20-0032 that "development of requirements for fusion reactors potentially include regulatory approaches similar to those for the regulation of [particle] accelerators, which may include Agreement State considerations"
- Imposing the same fission standards on the fusion sector would create a costly regulatory requirement developed to address risks that will not be present at a fusion energy facility



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POLICY ISSUE
(Notation Vote)

April 13, 2020 SECY-20-0032

FOR: The Commissioners

FROM: Margaret M. Doane
Executive Director for Operations

SUBJECT: RULEMAKING PLAN ON "RISK-INFORMED, TECHNOLOGY-INCLUSIVE REGULATORY FRAMEWORK FOR ADVANCED REACTORS (RIN-3150-AK31; NRC-2019-0062)"

PURPOSE:

The purpose of this paper is to request Commission approval of the proposed approach to a rulemaking to develop the regulatory infrastructure to support the licensing of advanced nuclear reactors. This rulemaking would revise the U.S. Nuclear Regulatory Commission's (NRC's) regulations by adding a risk-informed, technology-inclusive regulatory framework for commercial advanced nuclear reactors in response to the Nuclear Energy Innovation and Modernization Act (NEIMA).

SUMMARY:

The staff has described its efforts to prepare for the licensing of advanced reactors in documents such as the report, "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness," issued December 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16356A670) (Vision and Strategy report), and SECY-14-0095, "Status of the Office of New Reactors Readiness to Review Small Modular Reactor Applications," dated August 28, 2014 (ADAMS Accession No. ML14073A710).

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Environmental Review

- In addition to the proposed Part 53, NRC is also considering a “one size fits all” approach to environmental reviews for advanced fission systems in SECY-20-0020
- NUREG-1748 allows ONMSS to dial in an environmental review proportional to the potential impacts of the project to be licensed
- Requiring all fusion facilities to complete the proposed generic EIS is not appropriate since that is designed for advanced fission systems
- Instead the guidance of NUREG-1748 should be maintained so that the appropriate level of evaluation can be conducted for fusion facilities

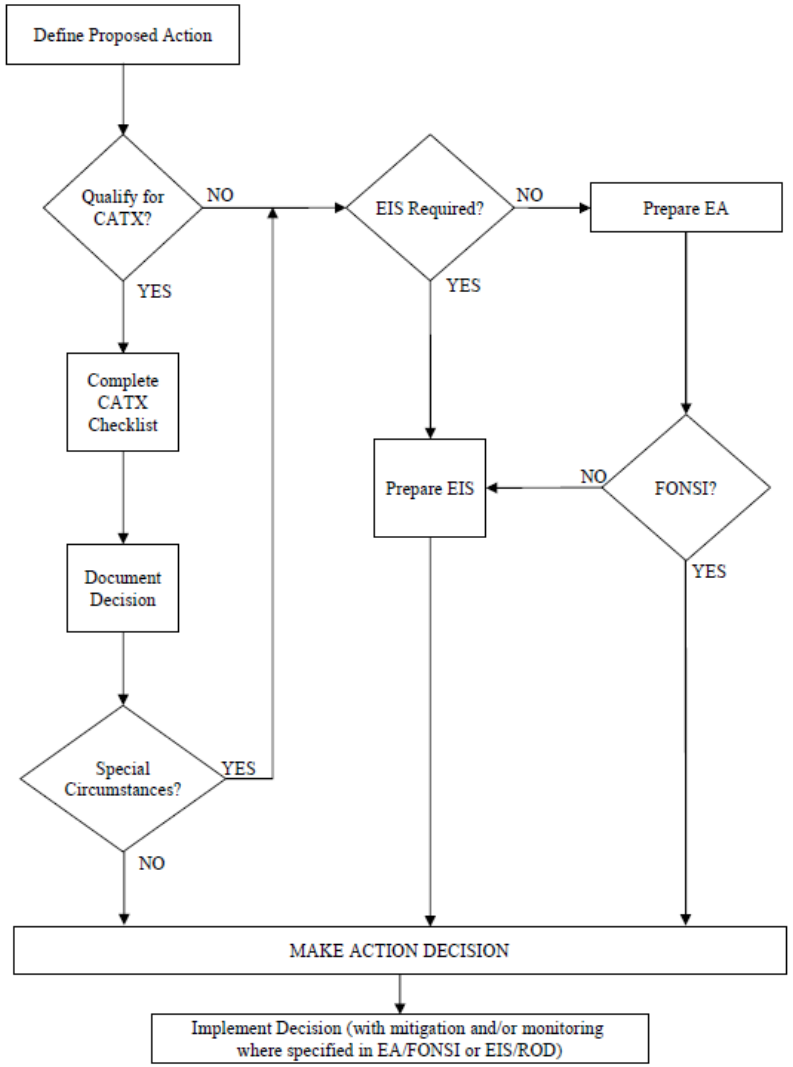

Figure 1: Flow chart showing NEPA screening process.

Agreement State Program already regulates a fusion facility under 10 CFR Part 20/30

- Wisconsin's oversight of a deuterium-tritium fusion device offers a clear example of an agreement state's capacity to regulate fusion energy facilities and can provide an important precedent for NRC rulemaking actions
- 39 states regulate ~17,000 radioactive material licenses under this agreement which is ~86% of all US licenses and NRC oversight assures compliance with federal standards
- In 2003, NRC and Wisconsin agreed that NRC would discontinue its regulatory authority over byproduct materials, source materials, and special nuclear materials in quantities too small to form a critical mass in favor of Wisconsin state authority
- Wisconsin has regulatory jurisdiction over Phoenix, LLC's neutron generators, which use a deuterium-tritium fusion reaction to produce neutrons for industrial applications and medical treatment
- This reaction is the same as that proposed in many commercial fusion energy facilities, using the same reactants and demanding the same level of safeguards and regulatory compliance
- Because fusion energy devices will be similar to the Phoenix fusion device, Congress and the NRC can look to WI's oversight of Phoenix as an example of an agreement state's capacity to regulate fusion devices under 10 C.F.R. Part 20/30

Phoenix Neutron Generator. Source: https://phoenixwi.com/