

ACCIDENT TOLERANT AND HIGH BURNUP/HIGH ENRICHMENT FUELS THE FRONT AND BACK END OF THE FUEL CYCLE

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ITEMS TO DISCUSS

Background

NMSS Activities and Updates

ATF Regulatory Actions

NMSS Accomplishments

Licensing & Technical Challenges

Conclusion

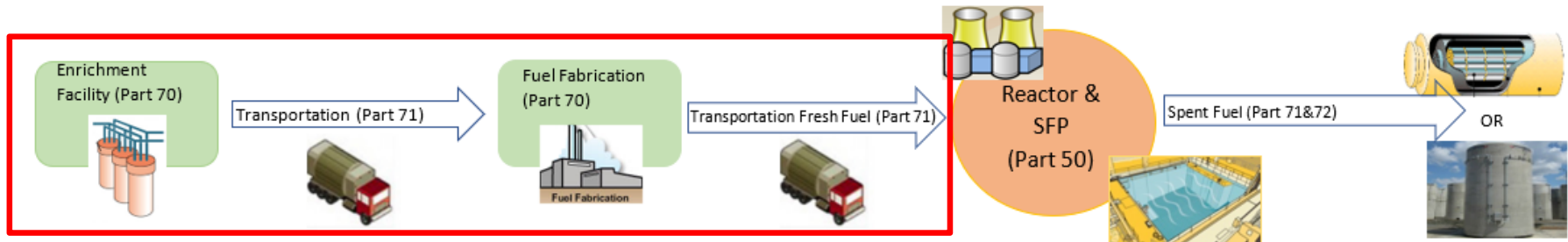
BACKGROUND

- Accident Tolerant Fuel (ATF) is a set of new technologies that have the potential to enhance safety at U.S. nuclear power plants by offering better performance during normal operation, transient conditions, and accident scenarios.
- The nuclear industry is working to deploy batch loads of accident tolerant fuel designs in the operating nuclear reactors by late 2023.
- The NRC staff is taking steps to make agency licensing processes more efficient and effective to enable timely licensing/certification.
- ATF Project Plan - Document available in ADAMS (ML18261A414).
- Office of Nuclear Reactor Regulation is leading the agency efforts for ATF.
- Office of Nuclear Material Safety and Safeguards (NMSS) is responsible for the oversight of the front-end and back-end of the fuel cycle.

ATF NMSS UPDATES

- Nuclear industry is now considering the development of ATF and conventional fuel concepts with higher enrichment.
 - High assay low enriched uranium (HALEU) = $5\% < E < 20\%$
- NRC developed the high burnup and increased enrichment (HBU+IE) project plan.
 - Document made available in ADAMS (ML19242E192).
 - Public Meeting on September 12, 2019.
 - NRC's revised ATF project plan which includes HBU+IE issued on 11/01/2019 (ML19297F703).
- In early September, NMSS sent a letter to the Nuclear Energy Institute that identifies NMSS licensing critical path to support industry's goal of ATF deployment in 2023.
 - Document available in ADAMS (ML19235A265).
- Currently reviewing an application from GE-Hitachi for transport of irradiated ATF in the GE-2000 package. The review is expected to be completed by February 2020.

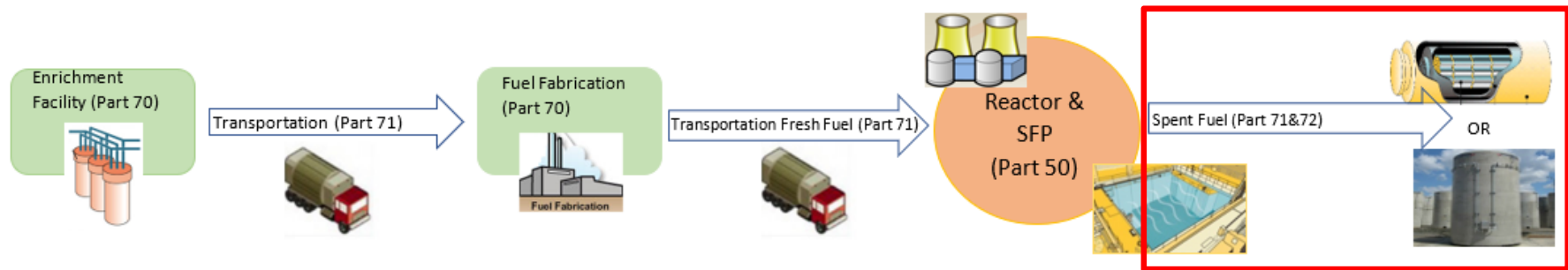
ATF REGULATORY ACTIONS — FRONT END



○ LWR Fuel Types

- ATF – UO_2 fuel with different cladding
- ATF – UO_2 fuel with different cladding (up to 8%)
- ATF – Non- UO_2 fuel with different cladding
- ATF – Non- UO_2 fuel with different cladding (up to 8%)

ATF REGULATORY ACTIONS — BACK END



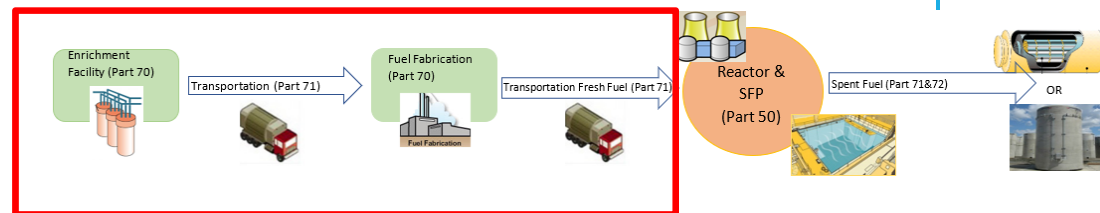
○ LWR Fuel Types

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- ATF – Non- UO_2 fuel with different cladding
- ATF – Non- UO_2 fuel with different cladding (up to 8%)
- ATF – UO_2 and non- UO_2 with/without different cladding and Higher burnup (up to 75 GWd/MTU)

NMSS MAJOR ACCOMPLISHMENTS - LICENSING

- Issued a letter of authorization to Global Nuclear Fuels for shipment of lead test assemblies in the RAJ II package.
- Issued a letter of authorization to Westinghouse for one shipment of two types of ATF pellet designs, each in different lead test assemblies in the Traveller package.
- Issued a certificate of compliance to Framatome authorizing transport of ATF assemblies in the MAP-12/MAP-13 packages.
- Approved a license amendment to URENCO Louisiana Energy Services (LES) to modify their validation report to allow the use of MCNP 6 to perform criticality safety calculations in August 2019.

CHALLENGES



○ Fuel Cycle Facilities

- All commercial fuel cycle facilities are licensed to produce up to 5% enriched material.

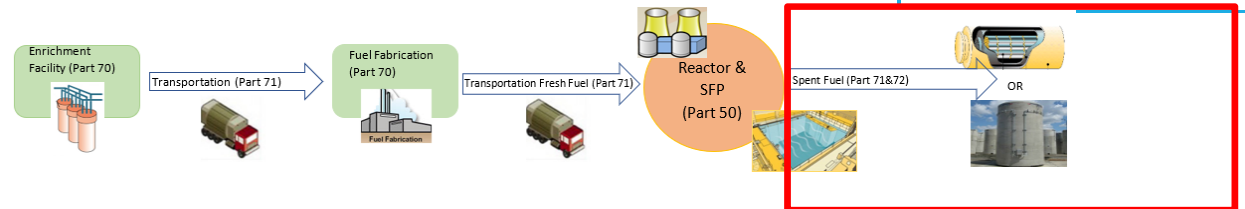
○ UF₆ Transportation

- Existing UF₆ transportation packages are approved for up to 5% enrichment.
- 10 CFR 71.55(g)(4) limit to 5% enrichment without water intrusion analysis.

○ Fresh Fuel Transportation

- Fuel integrity – mechanical properties of the cladding
- Benchmarking – criticality safety

CHALLENGES (CONT.)



- Spent Fuel Transportation and Storage
 - Cladding material integrity especially at higher burnup
 - Creep
 - Hydrogen absorption
 - Oxidation
 - Delayed Hydride cracking
 - Irradiation Hardening
 - End-of-life rod internal pressure
 - Pellet swelling
- Neutronic benchmarking for higher enrichment/higher burnup
 - Isotopic depletion
 - Neutron-absorbing fission product and actinide isotopes inventory
 - Source term for shielding
 - Heat source for thermal
 - Critical benchmarks

CONCLUSION

- NRC staff believes the current regulatory framework is adequate for the licensing of ATF and ATF with high burn up and increased enrichment fuel designs.
- NRC has identified regulatory actions critical path based on available information for ATF deployment in reactors in CY 2023.
 - Letter sent to NEI requesting feedback on critical path.
- To improve the efficiency of regulatory efforts, the NRC encourages NMSS licensees, certificate holders and applicants to engage in pre-application discussions and/or share any plans for submittals or licensing strategy.