Fuel Burnup and Enrichment Appendix

NRC Project Plan

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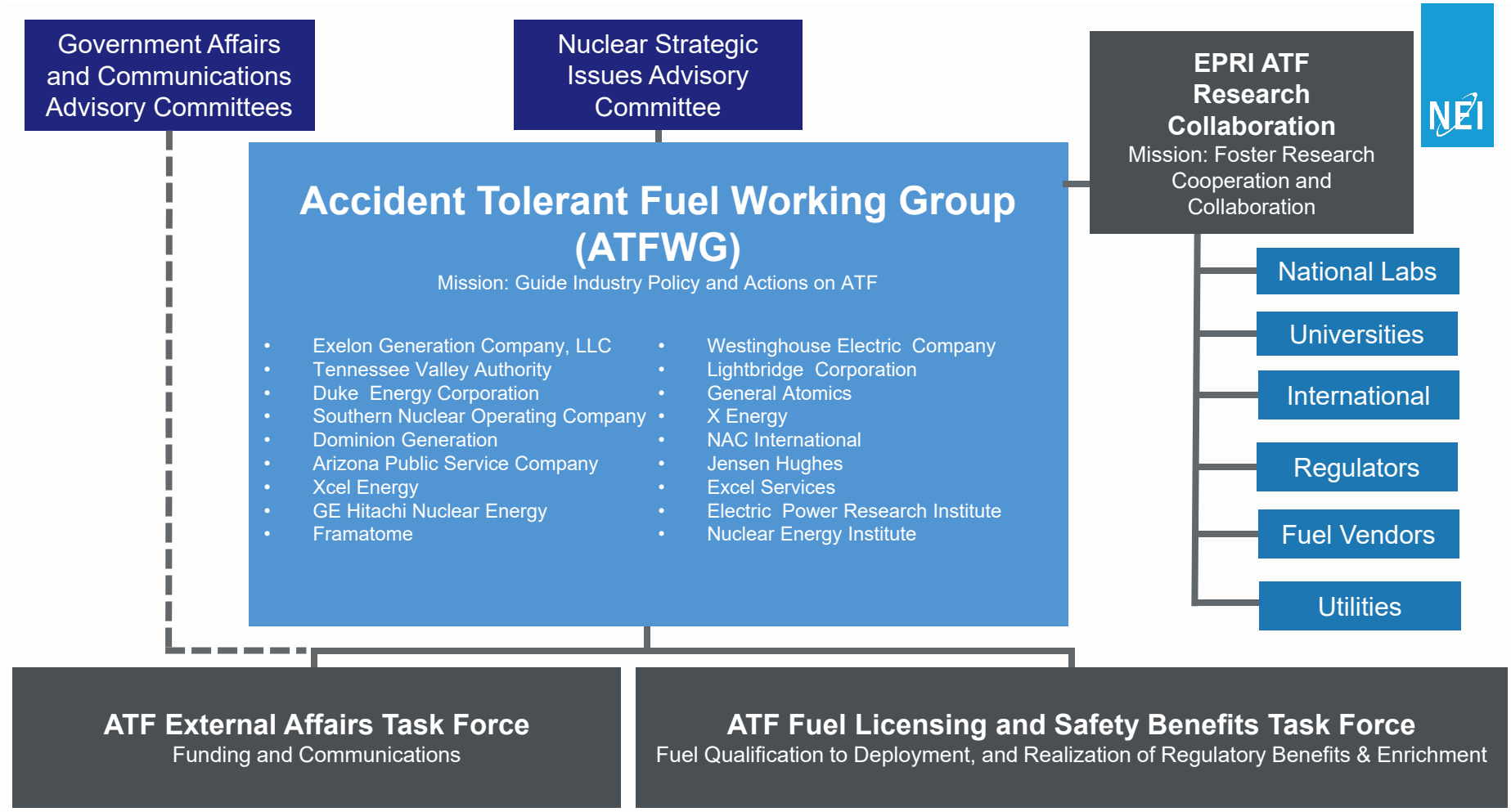
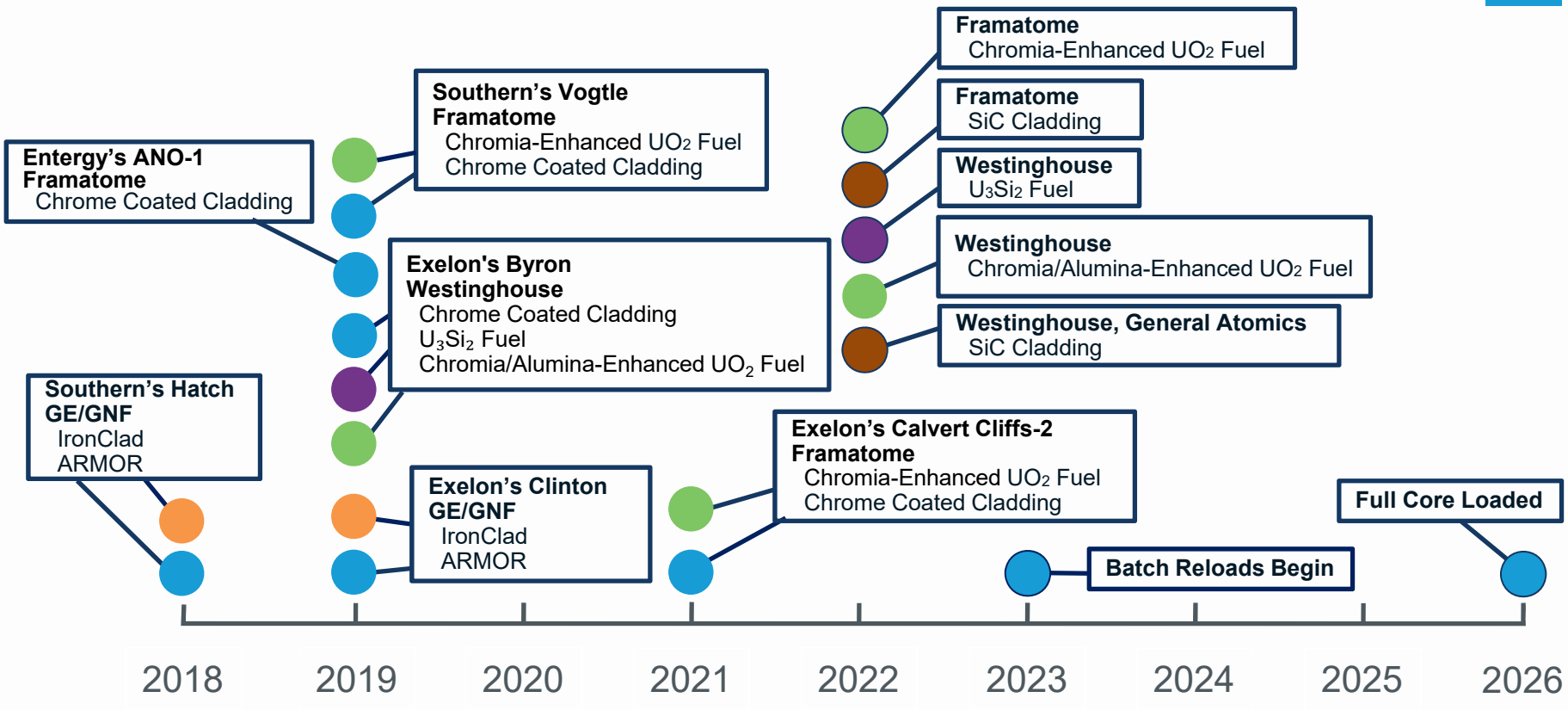
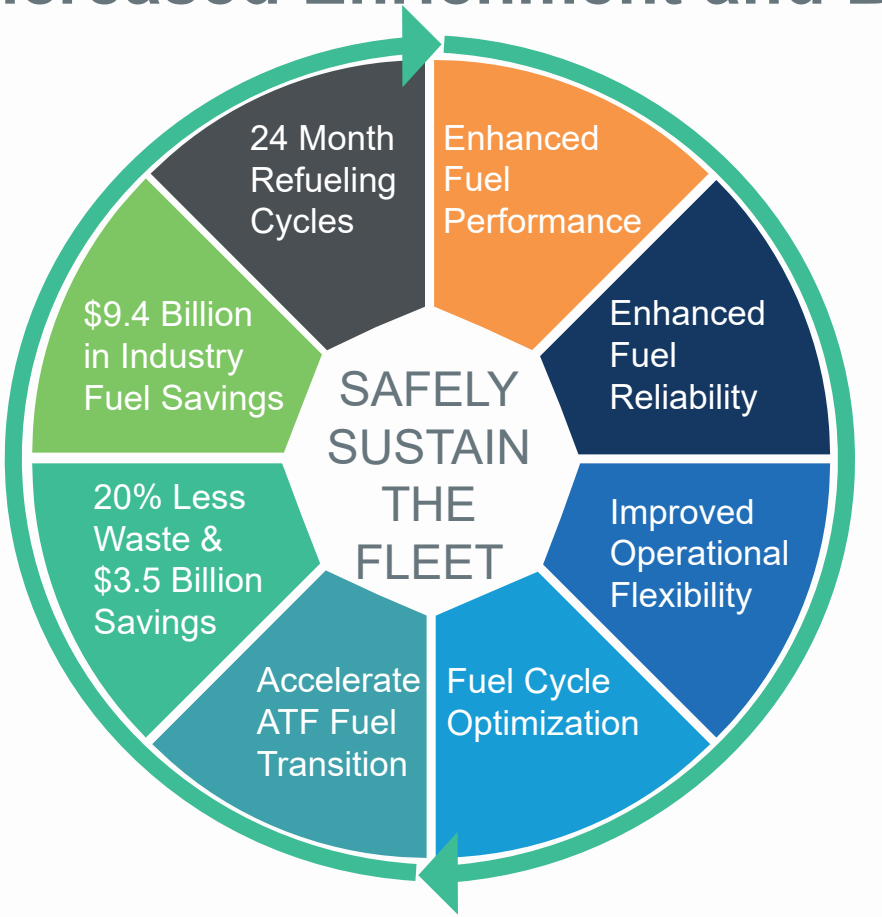


Key ATF Fuel Milestones



Accelerating ATF Deployment with Increased Enrichment and Burnup

IMPROVED PLANT ECONOMICS



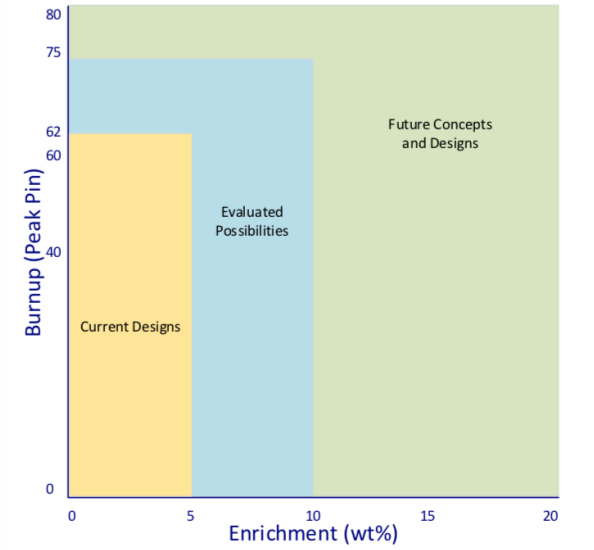
ENHANCED SAFETY

Realizing Increased Burnup

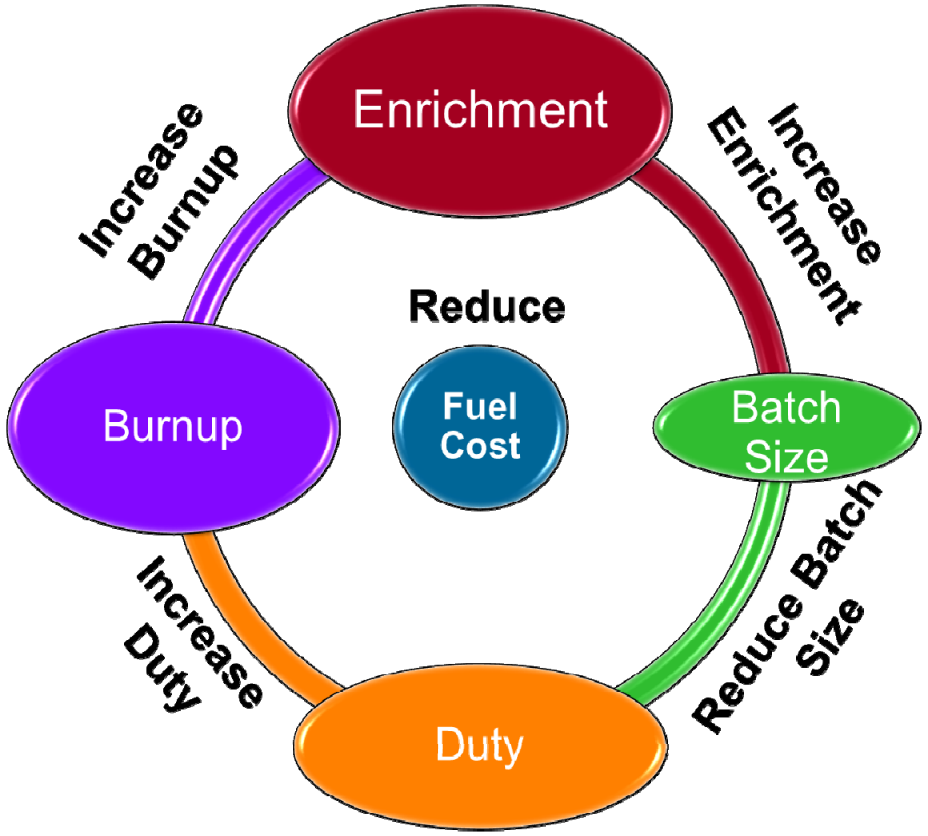
- Utilities and Vendors are engaged in discussions to accelerate the licensing of batch loads of ATF with increased enrichment by 2023
  - Pilot Plants to demonstrate licensing pathway

Pilot Plant Program

	Today	2023	2026
Enrichment (wt.%)	<5%	>5%	~6-7.5%
Burnup (GWD/MTU)	62	~66-68	~66-68 (non-ATF) ~75 (ATF)



Fuel Burnup/Enrichment and ATF Impact



Coated Clad

- Fuel chemistry limits
  - Lower Corrosion
  - CRUD impact uncertain
- Cladding Balloon/Burst Size Improved

Doped Pellets

- Fission Product distribution
  - Fuel Fragmentation, Redistribution and Dispersion

Improved Thermal Margins

- Support higher duty operation to higher burnup

Increased Burnup and Enrichment Value Overview [1]

60-year Operating Life

- Potential Fuel Savings
  - $2.5B industry, $1.46 M/year/reactor
- Potential Dry Cask Savings up to $1B
  - 500 fewer dry casks

80-year Operating Life

- Potential Fuel Savings
  - $9.4B industry, $2.28 M/year/reactor
- Potential Dry Cask Savings up to $3.5B
  - 1770 fewer dry casks

Other Benefits

- Longer fuel cycles for high power PWRs
  - Currently 20% can operate on 24 month fuel cycles
  - Viable for all PWRs
- All BWR can currently operate on 24 month fuel cycles
- Reduce fuel cycle environmental impact
- Pave the way for advanced reactor which typically require higher enrichment

1- 2018 Feasibility Study and Evaluation for informing Fuel Enrichment and Burnup Limits, 3002014625

Infrastructure Changes

- Fuel enrichment and fabrication facility upgrades
- New UF_6 shipping canister system
- Fuel Assembly and UO_2 shipping container upgrades
- Site new fuel and spent fuel pool re-analysis
- New BWR fuel design (optional)
- New fuel mechanical design topicals
- New dry storage canister system

Multi-phase Implementation

- Pilot Plant Program – Initial Reloads 2023
  - Infrastructure Changes to support 2-3 plants
    - Enrichment Limit
  - No Burst Burnup Limit
    - Modified assembly designs and licensing
    - Vendor specific submittals
- Full Burnup Credit by 2026
  - Infrastructure Changes to support fleet
  - Technical Challenges
    - Fuel Fragmentation Relocation and Dispersal
    - Decay Heat Models
    - Accident Source Term
    - Severe Accident Models

Key Technical Challenges

- Moderate Burnup Extension
  - Increase from 62 GWD/MTU to 67 GWD/MTU
    - No-burst criteria
- High Burnup Extension
  - Collaborations between EPRI, USNRC and USDOE as well as through OECD-NEA
  - Increase from 62 GWD/MTU to 75 GWD/MTU
  - Fuel fragmentation/relocation/dispersal issue (particularly, during LOCA)
    - Advanced Modeling and Simulation
      - Support Treat testing and extension to other conditions
    - ATR preconditioning/TREAT LOCA Test using nuclear heat source
    - Impact of partial dispersal
    - Testing for ATF coated cladding, additive pellets under consideration

Industry Initial Thoughts on Appendix

- Burnup and Enrichment have Distinct and Unique challenges
  - Clarity of topic
- Intent, Scope, and Schedule of PIRTs
  - In-reactor phenomena and transportation mentioned in appendix
  - Industry has suggestions for improvement on the PIRT process
- Industry expects to qualify for the categorical exclusion for the Generic Environmental Impact Statement

Technical Concerns on Appendix

- Challenges for Transportation and Storage of Spent Fuel
  - The text indicates that there is a need for experimental confirmation for whether an unknown age-related phenomena impact the spent fuel during storage and transport after storage.
- The NRC appendix proposes changes to the criticality acceptance criteria.
  - Industry believes that the criticality uncertainty can accommodate the uncertainty associated with the benchmark size.
- There is inconsistency in the appendix for how to treat PRA updates.
  - Industry believes that any update associated from increased burnup and enrichment would be addressed through the normal PRA update process
- Task 1 does not specifically discuss options for no-burst or limited dispersal.

Questions