

# Powering the Future: Innovations in Nuclear Fuel and Regulatory Strategy

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- National Priorities
  - Power uprates (Executive Order [EO] 14302), regulatory efficiency (EO 14300), ADVANCE Act
- Enabling Technologies
  - Coated cladding, doped fuel, increased enrichment, higher burnup fuel
- Regulatory Readiness
  - EO 14300 rulemaking; licensing efficiency; fuel fragmentation, relocation, and dispersal (FFRD); dose analyses; future technical topics

## National Priorities

- EO 14300
  - Overall call for the NRC to modernize regulations and licensing processes to facilitate deployment of new technologies and expand American nuclear energy capacity
- EO 14302
  - While directed toward the U.S. Department of Energy, establishes a goal of 5 gigawatts of power uprates to existing nuclear reactors
- ADVANCE Act
  - Strengthen readiness for advanced nuclear fuels by assessing preparedness, deepening coordination with partners, and focusing on key research needs.

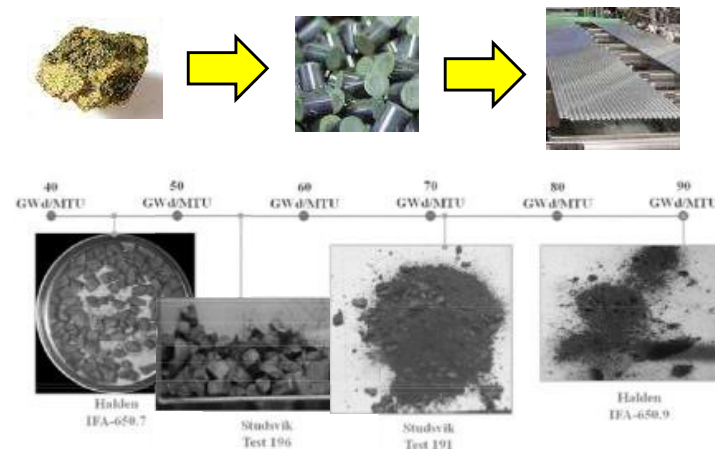
## Enabling Technologies



Coated Cladding



Doped Pellets



Increased Enrichment (> 5 wt% U-235) and Higher Burnup (>62 gigawatt-days per metric ton of uranium [GWd/MTU] rod average)

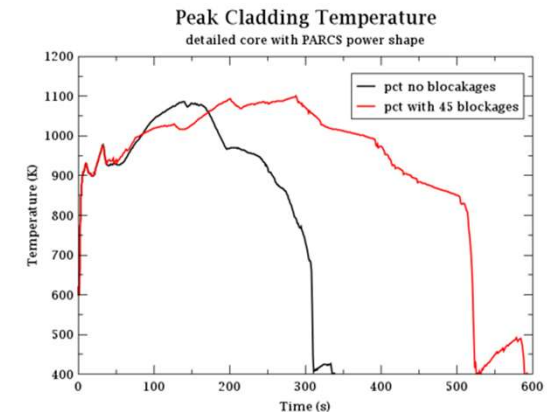
## Regulatory Readiness—Regulatory Framework

- EO 14300 rulemaking (including increased enrichment rule)
  - Revises NRC regulations as needed to remove barriers to increase enrichment
  - Proposes new performance-based, risk-informed emergency core cooling system regulatory requirements
    - Allows flexibility in addressing FFRD and safety margins
- Licensing efficiency
  - Licensing process improvements for efficiency and predictability

## Regulatory Readiness—FFRD Resolution

- Topical report reviews for approaches to disposition FFRD within different regulatory contexts
  - Electric Power Research Institute: Alternative Licensing Strategy
  - Framatome: Increased Burnup for Pressurized-Water Reactors
  
- Office of Nuclear Regulatory Research scoping work

|  | PARCS Power, Offsite Power Available, 2 ECCS Trains | PARCS Power, Offsite Power Available | PARCS Power, Offsite Power Unavailable | Chopped Cosine, Offsite Power Available | Chopped Cosine, Offsite Power Unavailable |
|--|---|--------------------------------------|--|---|---|
| Dispersed Mass (RIL Model A, single grid span) (kg UO <sub>2</sub> ) | 380   | 530                                  | 540                                    | 1400                                    | 1500                                      |



## Regulatory Readiness—Dose

- Regulatory Guide 1.183, Revision 1
  - Added guidance for accident tolerant fuel and increased enrichment source term analyses
  - Supported burnups up to 68 GWd/MTU
  - Added transient release fractions
- Proposed Regulatory Guide 1.183, Revision 2
  - Supports the use of light-water-reactor fuel containing uranium enriched to greater than 5.0 and less than 20.0 weight percent U-235
  - Proposed support for up to 80 GWd/MTU burnups

## Regulatory Readiness—Future Challenges

- Industry considering extended power uprates (EPU) in 2030s, potentially beyond current licensing experience
- Post-EO-14300 rule licensing landscape—how will new regulatory requirements affect core design and operating strategies?
- Potential increases in FFRD
- Time at temperature

## Bottom Line, Not-So-Up-Front

- Resolve technical issues for near-term industry plans
- Identify efficiencies in licensing processes
- Update regulatory framework to align with above *To be completed: 2026*
- Tackle new challenges for (EPU+? Super EPU? EEPU?) submittals in the 2030s and beyond *To be determined—innovation never ends!*