WESTINGHOUSE UPDATE FOR DOE ATF
HIGH BURNUP PROGRAM

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NRC Commission Briefing – January 24, 2023
Westinghouse EnCore® fuel program enables 24-month cycles and significant uprates for PWRs with advanced cladding and pellets

**ACCIDENT TOLERANT FUEL PRODUCTS**

**Advanced Cladding**
- Chromium-Coated Zr Cladding
- Silicon Carbide Cladding

**Advanced Fuel**
- ADOPT Fuel Pellets
- Advanced Pellet (UN)

**ATF Products**
- Chromium-Coated Zr Cladding
- SiGA® Silicon Carbide (SiC) Composite Cladding

**Higher Burnup Fuel**
- Enables 24-month cycles
- Improves fuel cycle economics
- Power uprates
- Supported through higher enrichment and ATF technologies

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Westinghouse rapidly progressed all facets of ATF program in 2022/2023

Dec 2021:
Submitted topical report burnup extensions to 68 MWd/kgU

June 2022:
ADOPT Pellet Final SERs issued, full region to be inserted in mid 2020s

July 2022:
Cold spray chosen as EnCore ATF Cr coating technology

Aug 2022:
Vogtle LAR submittal for ATF >5 w/o $^{235}$U LTAs

Continuing into 2023:
Develop in-rod sensors for model validation

Spring 2023:
Submit topical report for higher enrichments > 5 w/o 235U

Continuing into 2023:
UN fuel property atomic scale model development

Early 2023:
General Atomics work on SiGA(R) for ATR

Fall 2023:
Complete fabrication of Vogtle ATF LTAs and insert Byron 2 LTA for 3rd burn

Aug 2022:
Byron 2 LAR submittal for reinsertion of ATF LTRs to exceed 75 MWd/kgU

Spring 2023:
Submit topical report burnup extensions to 68 MWd/kgU

Continuing into 2023:
Develop in-rod sensors for model validation

Fall 2023:
Complete fabrication of Vogtle ATF LTAs and insert Byron 2 LTA for 3rd burn

ATF: Accident Tolerant Fuel
ATR: Advanced Test Reactor
LAR: License Amendment Request
LTR: Lead Test Rod
SER: Safety Evaluation Report
Commercial reactor testing continues to confirm excellent performance of Westinghouse ATF products

LTR/LTA Campaigns with Utility Partners provide critical data to support fuel qualification

- Byron Unit 2 LTRs (2019)
  - Cr Coated Cladding
  - ADOPT Pellets
  - High Density Pellets
  - High Enriched Pellets

- Doel Unit 4 LTRs (2020)
  - Cr Coated Cladding
  - ADOPT Pellets
  - High Density Pellets
  - High Enriched Pellets

- Vogtle Unit 2 LTRs (2023)
  - Cr Coated Cladding
  - ADOPT Pellets
  - High Density Pellets

- EDF LTRs (2023)
  - Cr Coated Cladding
  - ADOPT Pellets

ATF rods appear "pristine" with excellent coating adherence and little indication of crud.

EOC 1

EOC 2

Vogtle Unit 2 (2023)

Byron Unit 2 (2019)

Doel Unit 4 (2020)

EDF LTRs (2023)

Cr Coated Rods
Post irradiation examinations of Byron-2 fuel shipments confirm excellent EnCore fuel performance.

Additional Byron 2 ATF and high burnup fuel shipments to INL and ORNL planned.

3 ATF and 4 high burnup rods received mid-2021.

Excellent cold sprayed Cr coating integrity with complete protection of substrate.

Credit: ORNL Photographer Carlos Jones
Codes and methods and fuel transportation updates support deployment of ATF and high energy fuel

- **PARAGON2™** two-dimensional fuel energy transport code approved by NRC for modeling of $^{235}\text{U}$ enrichments up to 10%

- **Traveller™** fuel shipping container package approved by NRC for $^{235}\text{U}$ enrichments exceeding 5%

- Fuel fragmentation, relocation, and dispersal (FFRD) is at the center of the Westinghouse HBHE fuel program, fully support Industry efforts

- Topical reports under development to be submitted for approval between 2023 and 2025
  - High enrichment topical to exceed the current 5% $^{235}\text{U}$ enrichment limit
  - Chromium coated cladding topical report
  - **PAD5™** supplement for burnups: up to ~75 MWd/kgU
  - **FSLOCA™** supplement for burnups: up to ~75 MWd/kgU
  - High burnup topical for burnups: up to ~75 MWd/kgU
Summary

• Good progress being made on all fronts for ADOPT pellets and Coated Cladding with respect to development, fabrication scale-up, and licensing

• Poolside and Hotcell Post Irradiation Exam (PIE) support excellent fuel performance of ATF features

• Expect to insert first ATF feature (ADOPT pellets) in full region mid 2020s

• Good progress being made to fabricate UN pellets for test reactor testing and working with General Atomics to develop and qualify the SiC composite cladding

• ATF features provide enhanced safety, improved fuel cycle economics, support uprates and enable higher burnup / 24-month cycles

Westinghouse very appreciative for all DOE, NRC, National Lab, Utility and NEI/EPRI Support
The following material is based upon work supported by the United Stated Department of Energy under Award Number DE-NE0009033

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