

WESTINGHOUSE UPDATE FOR DOE ATF HIGH BURNUP PROGRAM

Jeffrey L. Bradfute

Senior Vice President, Americas PWR Fuel

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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 Zirconium – increases safety and operational margin, and may enable high burnup

Silicon Carbide Cladding – safety and operational benefits

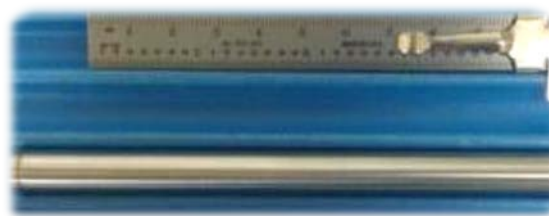


Advanced Fuel

ADOPT fuel pellets – higher density, can support higher burn up

Advanced Pellet (UN) - benefits to fuel cycle costs, and may support high burnup improved fuel cycle economics, thermal properties, and lower operating temperatures

Chromium-Coated Zr Cladding



SiGA[®] Silicon Carbide (SiC) Composite Cladding

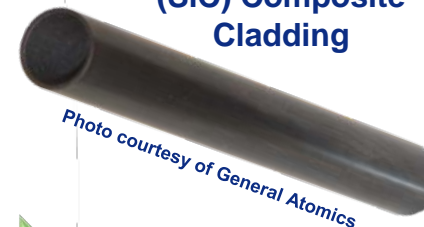


Photo courtesy of General Atomics

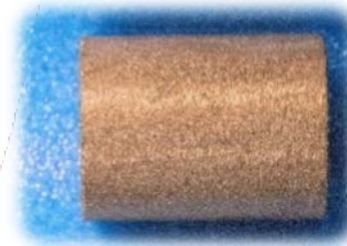
ATF Products

Enables HB Fuel

ADOPT Fuel Pellets



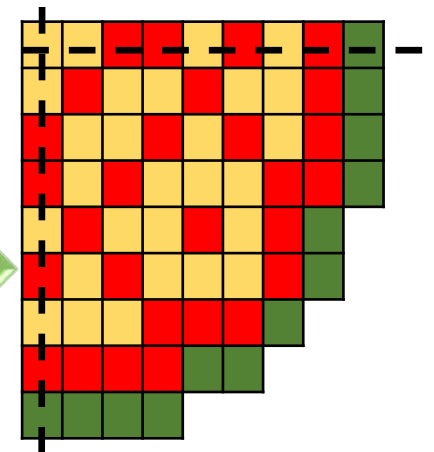
Uranium Nitride (UN) Pellets



U¹⁵N Fuel

Photo courtesy of Los Alamos National Lab

Higher Burnup Fuel

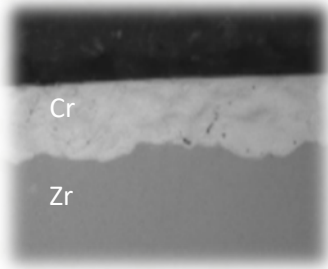


- Enables 24-month cycles
- Improves fuel cycle economics
- Power uprates
- Supported through higher enrichment and ATF technologies

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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



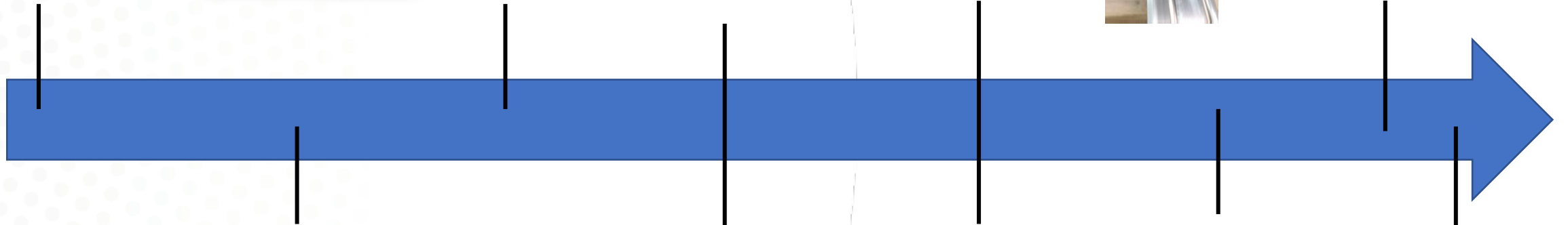
July 2022: Cold spray chosen as **EnCore** ATF Cr coating technology

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

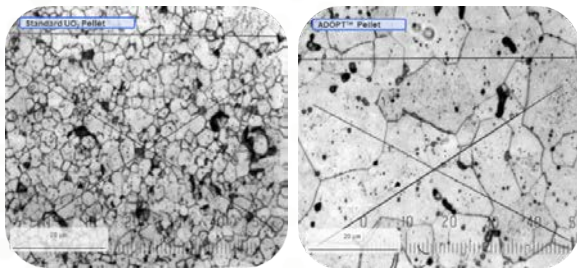
Continuing into 2023: Develop in-rod sensors for model validation



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

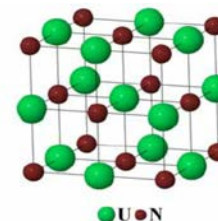


June 2022: ADOPT Pellet Final SERs issued, full region to be inserted in mid 2020s



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

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

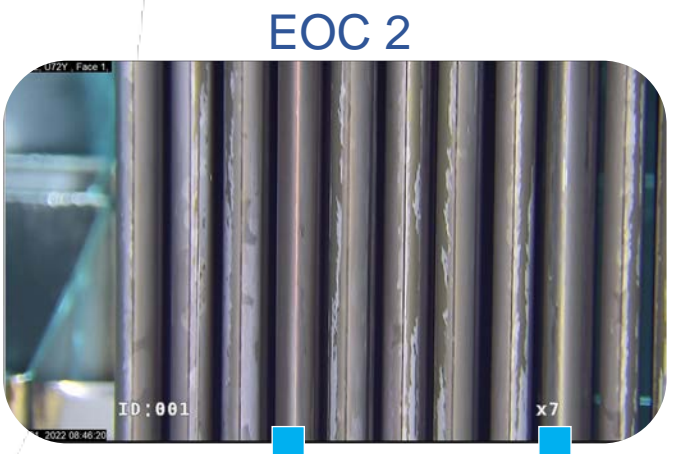
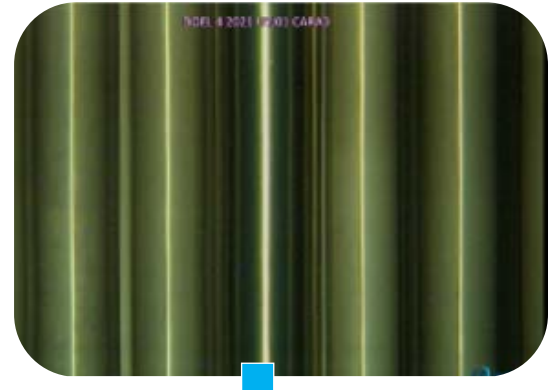
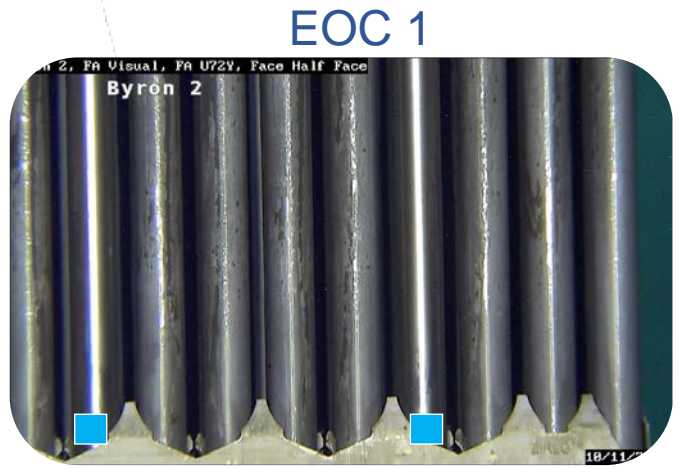
Commercial reactor testing continues to confirm excellent performance of Westinghouse ATF products

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

	Cr Coated Cladding	ADOPT Pellets	High Density Pellets	High Enriched Pellets
Byron Unit 2 (2019)	✓	✓	✓	
Doel Unit 4 (2020)	✓		✓	
Vogtle Unit 2 (2023)	✓	✓		✓
EDF LTRs (2023)	✓	✓		

Byron Unit 2 LTRs

Doel Unit 4 LTRs



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

4 Cr Coated Rods

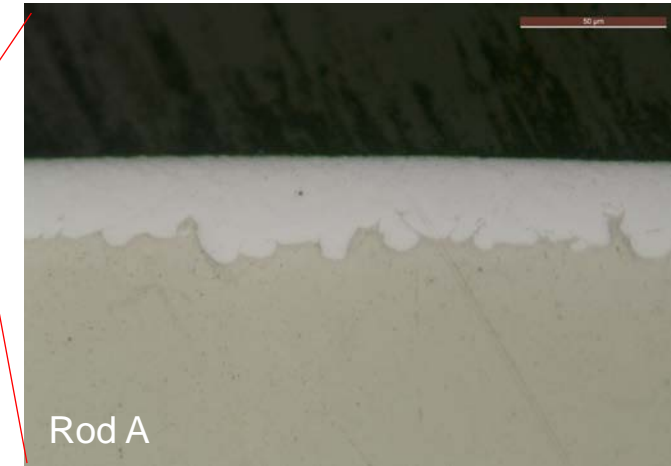
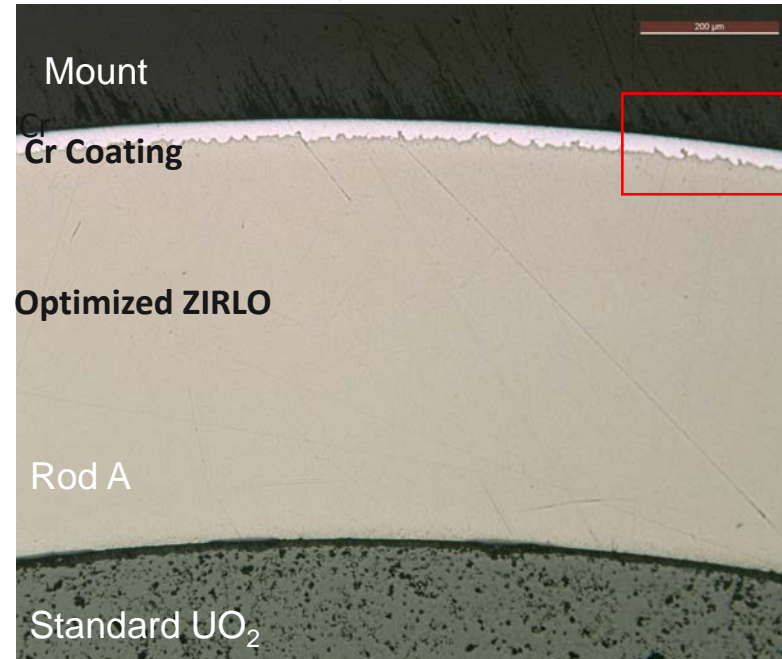
LTR: Lead Test Rod
LTA: Lead Test Assembly
EOC: End of Cycle

Post irradiation examinations of Byron-2 fuel shipments confirm excellent **EnCore** fuel performance

3 ATF and 4 high burnup rods received mid-2021



Credit: ORNL Photographer Carlos Jones



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

Excellent cold sprayed Cr coating integrity with complete protection of substrate

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}U enrichments up to 10%
- **Traveller™** fuel shipping container package approved by NRC for ^{235}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}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

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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
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