



DOE Advanced Gas Reactor Fuel Development and Qualification Program Overview

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Changing the World's Energy Future

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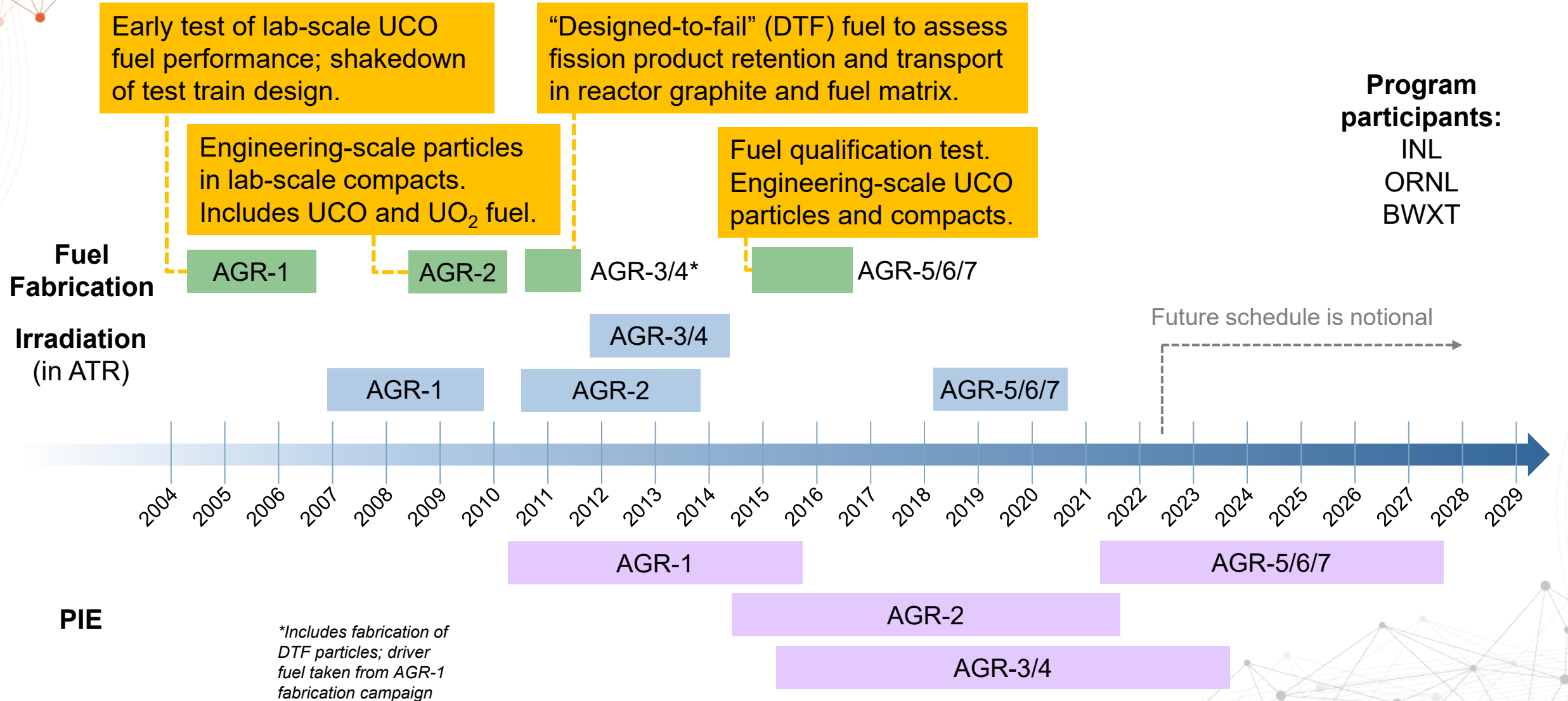
July 12, 2022

Paul Demkowicz

AGR Program Technical Director

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AGR Program Timeline



Program Activities

- AGR-3/4 post-irradiation examination and data analysis
 - AGR-5/6/7 PIE and safety testing
 - Supplemental fuel microanalysis and method development
 - Fuel oxidation testing
 - Air/moisture Ingress Experiment (AMIX) system development (deployed in FY23)
 - Single particle testing in FITT
 - Data management and analysis
 - Fuel performance modeling
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- Fuel fabrication completed
 - Fuel irradiation testing complete (continue to support fuel performance evaluation with irradiation data analysis)

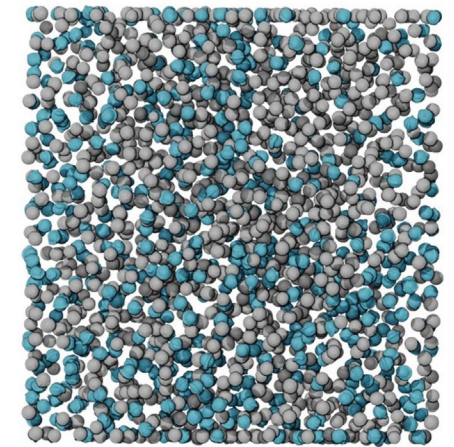
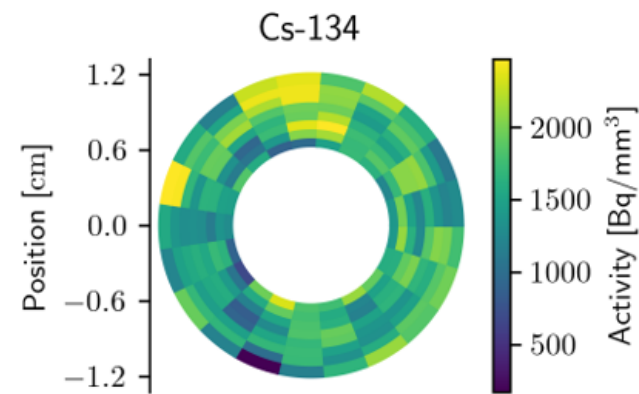
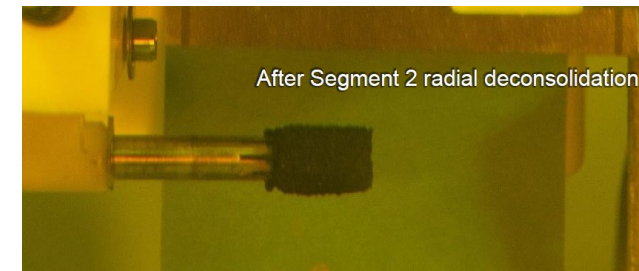
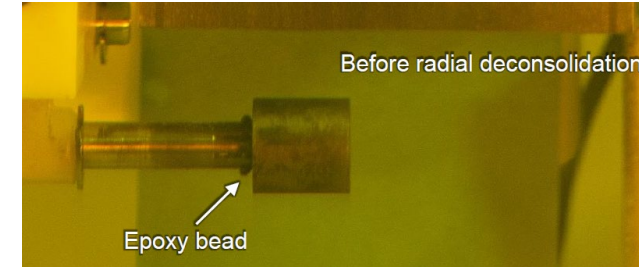
Major Accomplishments – Last 12 Months

AGR-2 PIE

- Issued AGR-2 Final PIE Report (*INL/EXT-21-64279, Sep 2021*)

AGR-3/4 PIE

- Completed 2 fuel compact reirradiation+heating tests (used to assess ^{131}I release)
- Completed 10 fuel compact radial deconsolidation-leach-burn-leach procedures
- X-ray tomography of unirradiated and irradiated AGR-3/4 fuel compacts
- Updated approach to data analysis for fission product distribution in the rings from gamma spectrometry (*INL/RPT-22-67635, Jun 2022*)





Major Accomplishments – Last 12 Months

AGR-5/6/7 Irradiation

- AGR-5/6/7 Final Irradiation As-Run Report (INL/EXT-21-64221)
- Four additional irradiation data analysis reports

AGR-5/6/7 PIE and Safety Testing

- Completed initial inspection and analysis of Capsule 1 fuel behavior (INL/RPT-22-66720)
- Completed dimensional measurements of all graphite holders and fuel compacts
- Completed gamma scanning of ~90 fuel compacts
- Initiated destructive examination of irradiated compacts (DLBL)
- Initiated compact safety testing at ORNL and INL



Major Accomplishments – Last 12 Months

Fuel performance modeling

- Bison As-Run AGR-3/4 Irradiation Test Predictions (INL/EXT-21-65160, Nov 2021)
- AGR-5/6/7 as-run fuel performance predictions using PARFUME (INL/EXT-21-64576, Sep 2021)

2022 Program Review Presentation Topics

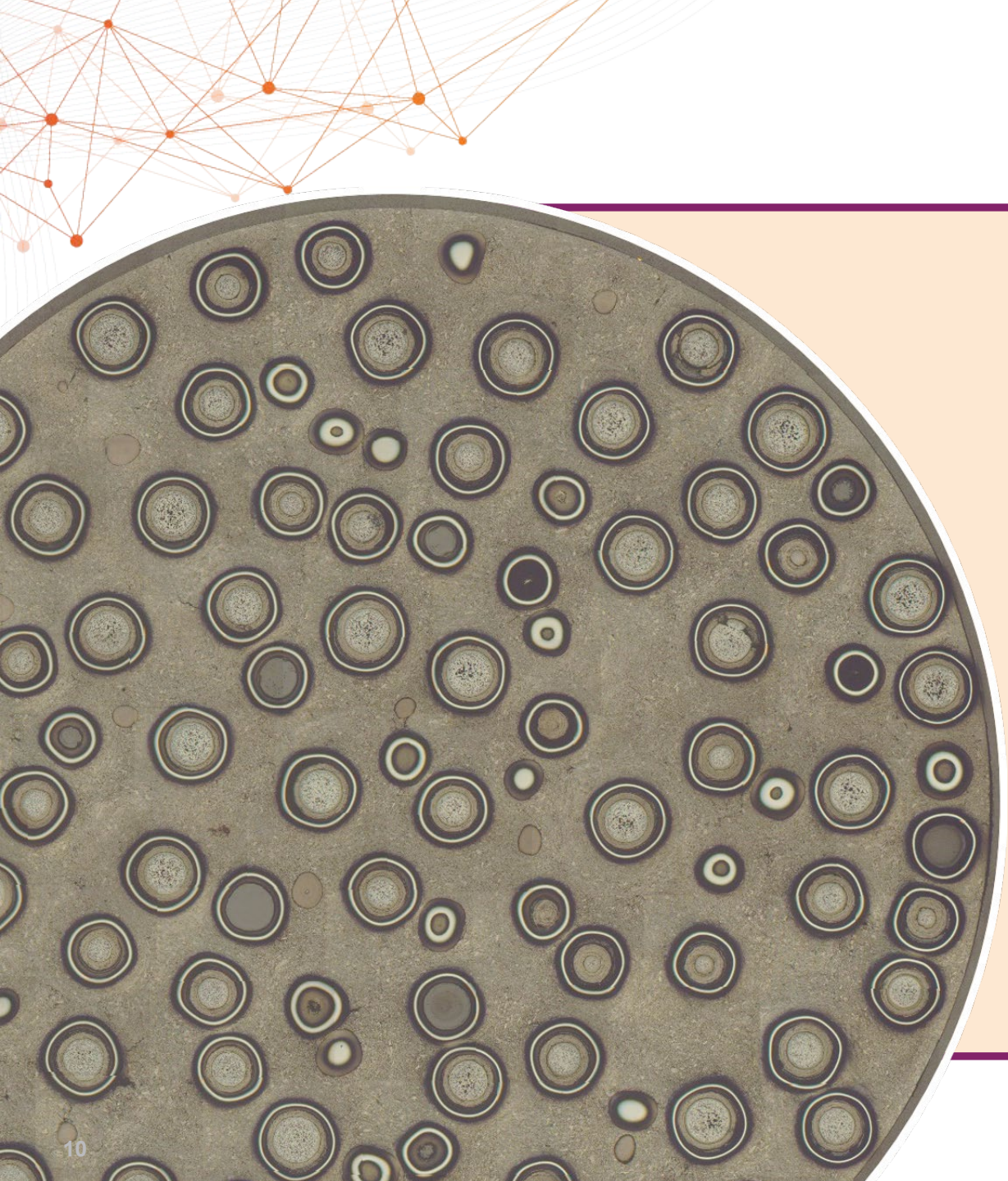
- AGR-3/4 PIE results update
- AGR-3/4 fission product transport modeling
- Exposed fuel kernel heating tests
- 3D analysis of buffer porosity
- Results of loose particle oxidation studies
- X-ray tomography of fuel compacts
- TRISO fuel performance modeling (PARFUME and BISON)
- AGR-5/6/7 Capsule 1 investigation results
- AGR-5/6/7 irradiation temperature uncertainty analysis
- AGR-5/6/7 PIE results update

Major Program Activities – FY23 and Beyond

- **Complete AGR-3/4 PIE and data analysis**
 - Determine key takeaways in terms of fission product transport
- **Continue/complete AGR-5/6/7 PIE and safety testing**
 - Confirm cause of Capsule 1 particle failures
 - Confirm performance of pilot-scale fuel, including performance at extreme high and low temperature regimes
- **Fuel oxidation tests**
 - Determine fuel performance under oxidizing conditions
- **Compile AGR datasets for use by reactor designers, e.g.:**
 - Fission product retention characteristics of the fuel
 - Fuel failure analyses under all tested conditions
 - Oxidation kinetics and impact on fission product retention
- **Support vendors' interaction with the regulator during licensing activities**

DOE-Funded TRISO-Fuel-Related Research Projects

Project ID	Lead Institution	Title
21-24111	Texas A&M University	Experimental Investigations of HTGR Fission Product Transport in Separate-effect Test Facilities Under Prototypical Conditions for Depressurization and Water-ingress Accidents
20-19556	University of Wisconsin-Madison	Statistical modeling of the effect of microstructural heterogeneity on the irradiation behavior of TRISO fuel buffer layer
20-19205	Missouri University of Science and Technology	Robust bullet-time tagging and tracking system based on computer vision for individual ex-core TRISO-fueled pebble identification
19-17251	Idaho State University	Measuring Mechanical Properties of Select Layers and Layer Interfaces of TRISO Particles via Micromachining and In-Microscope Tensile Testing
18-15171	Missouri University of Science and Technology	Oxidation behavior of silicon carbide and graphitic materials
18-15039	The University of Texas at San Antonio	Oxidation of Tristructural Isotropic fuel forms in low oxygen and steam partial pressures and the role of matrix burn off in the oxidation rate at high temperature
18-15097	Virginia Tech	Oxidation Study of High Temperature Gas-Cooled Reactor TRISO Fuels at Accidental Conditions
17-12710	University of Central Florida	Mechanisms of Retention and Transport of Fission Products in Virgin and Irradiated Nuclear Graphite
17-12830	University of Missouri-Columbia	Radioisotope Retention in Graphite and Graphitic Materials



Thank you for your attention

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