TRISO Fuel Performance Topical Report

EPRI-Led Collaboration to Enable a New Generation of High-Temperature Reactors (HTRs)

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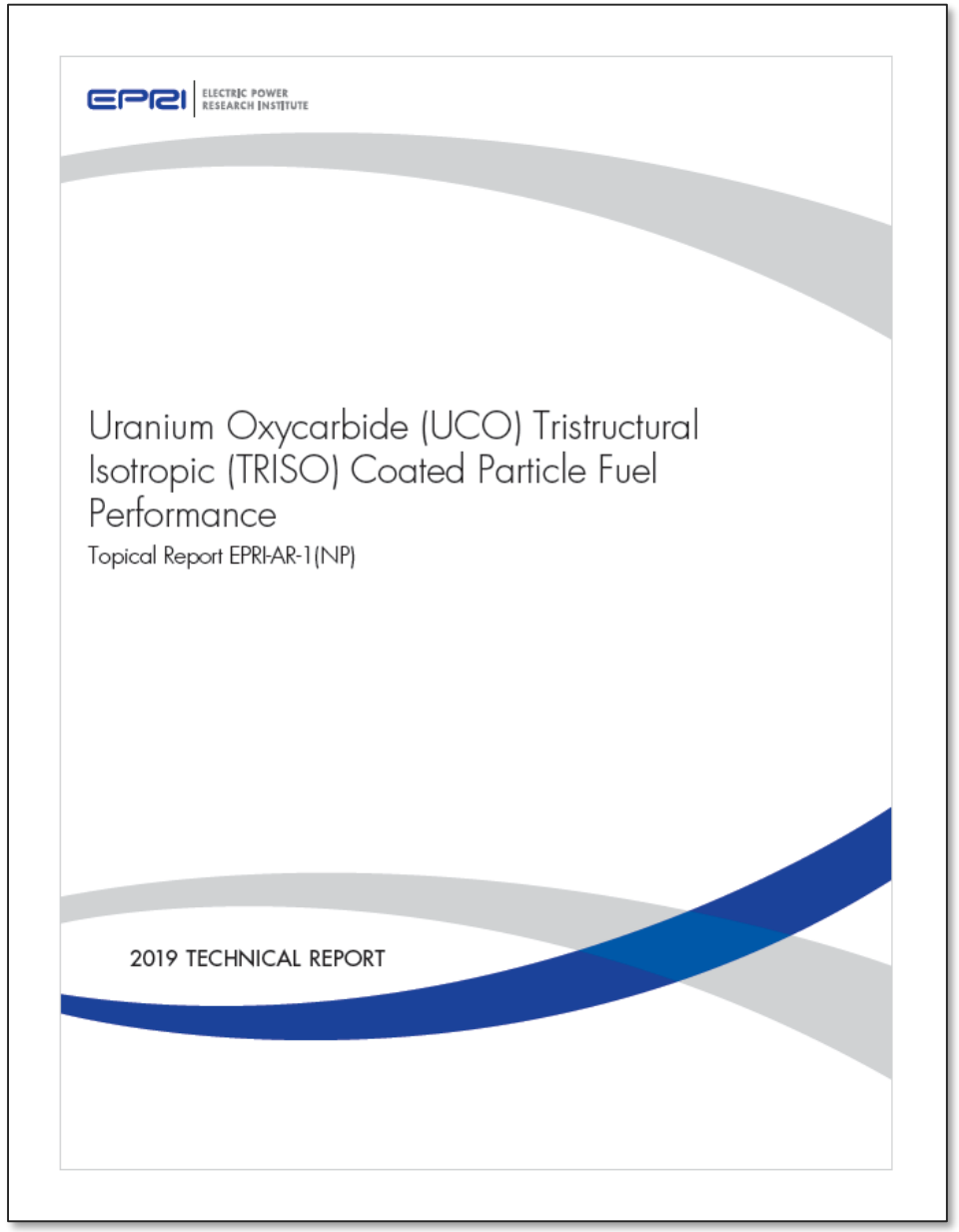
Nuclear Regulatory Commission (NRC) Meeting
December 9, 2019

TRISO Fuel Topical Report

- Objective: Support commercialization of mature advanced nuclear designs to maintain nuclear as a future energy generation option
- Scope:
  - U.S. Department of Energy (DOE)-sponsored AGR-1 and AGR-2 fuel campaigns
  - Global context, history, and experience
  - Uranium oxycarbide (UCO) fuel performance demonstration
  - Irradiation, post-irradiation examination, and available post-irradiation safety testing data
- Approach:
  - Collaborative public-private partnership
  - DOE and EPRI co-funding
  - Industry in-kind support
  - NRC off-fee review



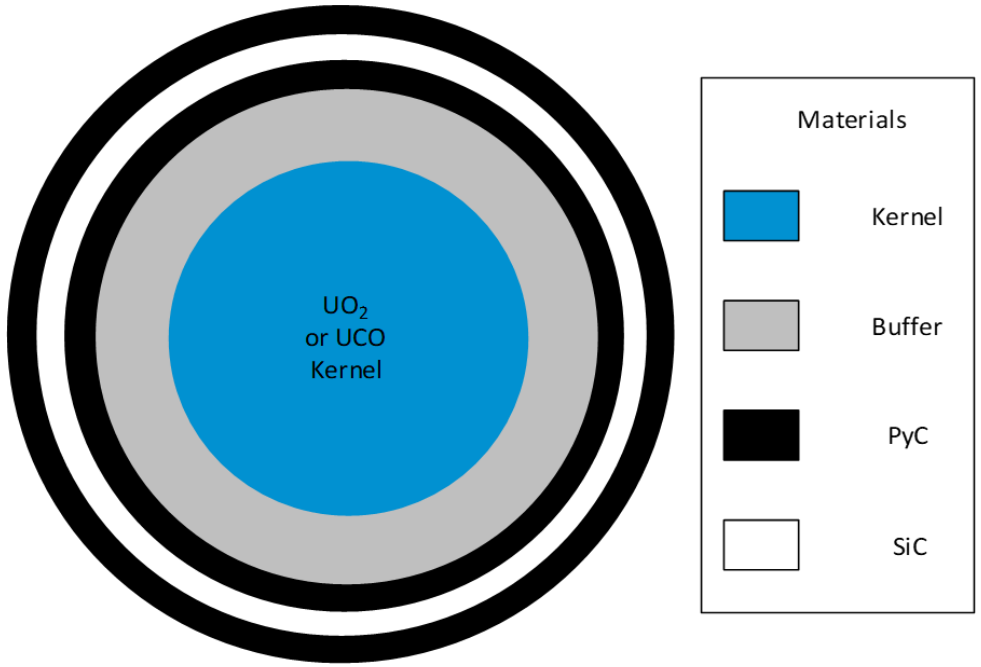
EPRI Report 3002015750, Published May 31, 2019

Schedule to Date

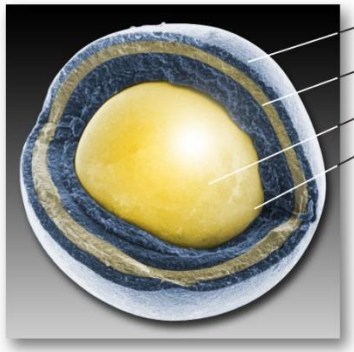
- May 31, 2019: Topical report submitted
- August 5, 2019: Accepted for review by NRC
- October 8-9, 2019: Regulatory audit by NRC at the Idaho National Laboratory
- November 2019: Draft requests for additional information (RAIs) from NRC
- December 9, 2019: Meeting with NRC to discuss RAIs

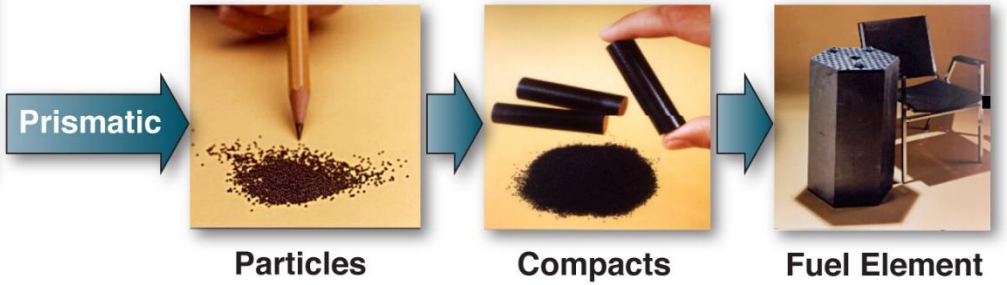
Goal is NRC Safety Evaluation by May 2020

HTR Fuel: Tristructural Isotropic (TRISO) Coated Particles



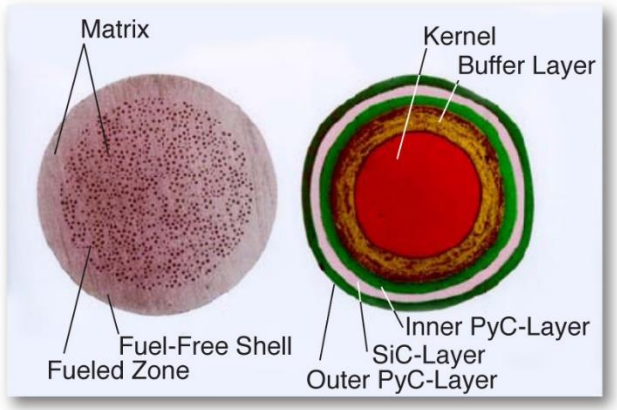
- **International development and use of TRISO fuel has occurred over 60 years**
- **U.S. DOE Advanced Gas Reactor Fuel Development and Qualification (AGR) Program launched in 2002**



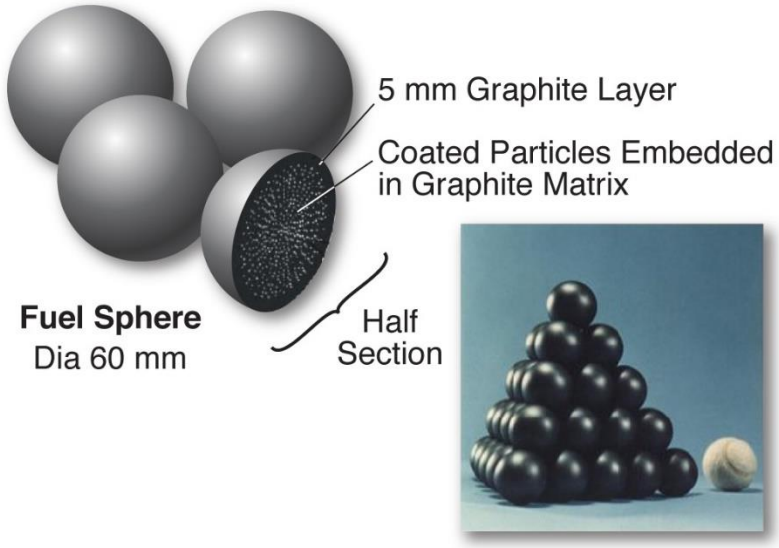


TRISO-coated fuel particles (left) are formed into fuel compacts (center) and inserted into graphite fuel elements (right) for the prismatic reactor

Pebble



TRISO-coated fuel particles are formed into fuel spheres for pebble bed reactor

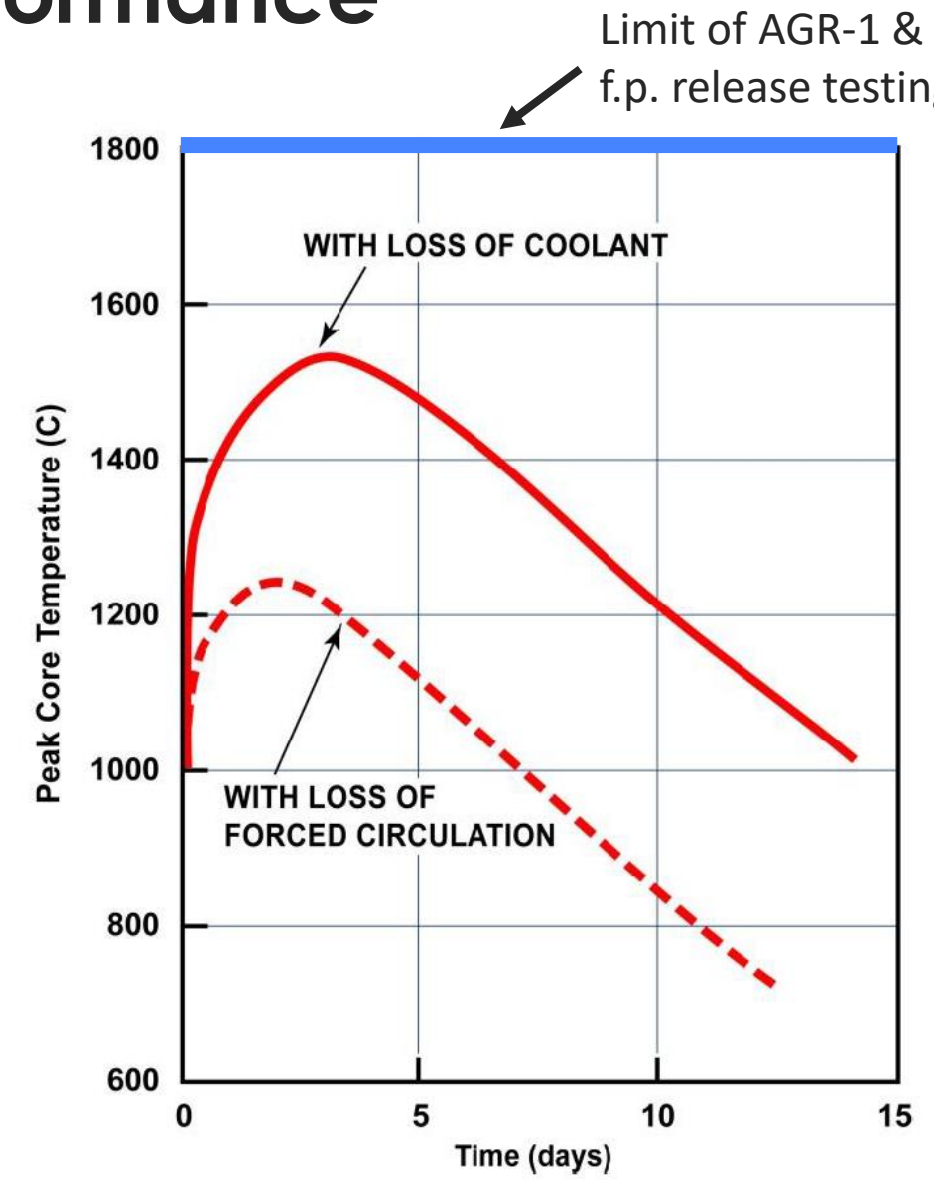


Figures courtesy of Idaho National Laboratory

08-GA50711-01-R1

Inherent Safety from TRISO Fuel Performance

- Refractory TRISO fuel tolerates temperature excursions for the most extreme events (~1600°C)
- Reactivity and power decrease with increasing temperature
- Reactor designs can provide fully passive heat removal via conduction to environment



Source: IAEA ARIS database, GA Prismatic HTGR design

Three Conclusions for NRC Approval

1. AGR-1 and AGR-2 testing provides a foundational basis for use of UCO TRISO particle designs in the fuel elements of HTR designs (i.e., designs with pebble or prismatic fuel and helium or salt coolant).

2. UCO TRISO-coated fuel particles that satisfy the parameter envelope defined by measured particle layer properties can be relied on to provide satisfactory performance.

3. AGR-1 and AGR-2 fission product release data and fuel failure fractions can be used for licensing of reactors employing UCO TRISO-coated fuel particles.

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