INL/CON-24-80966-Revision-0

"Source Term Modeling for Advanced Gas Micro-Reactors"

October 2024

Alexandra Camille Raichart, Benjamin Douglas Stoyer, David A Petti

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Source Term Modeling for Advanced Gas Micro-Reactors

Pacific Basin Nuclear Conference

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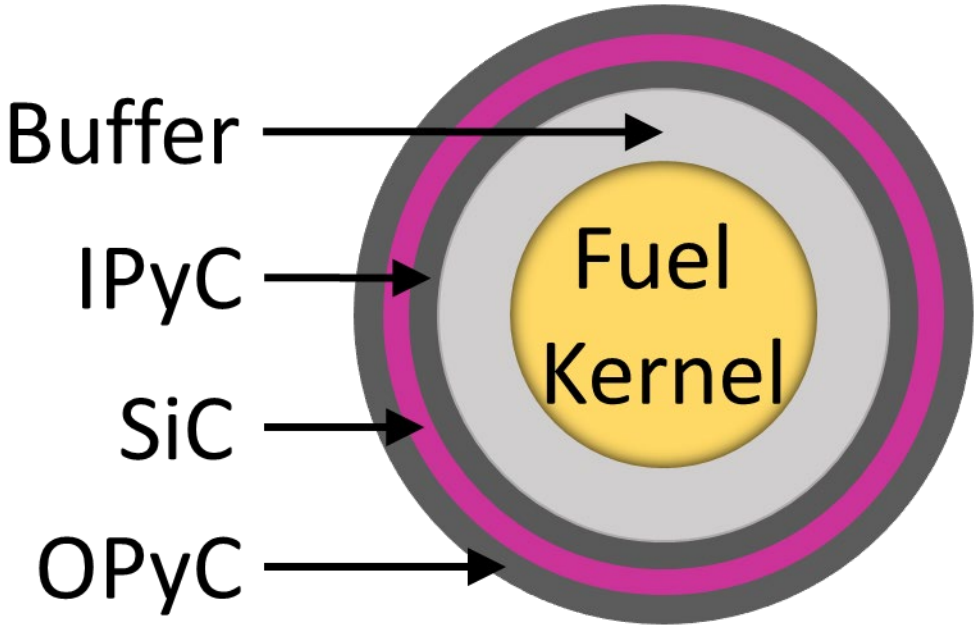
Idaho National Laboratory

TRi-structural ISOtropic (TRISO) fuel to be used in advanced gas micro-reactors.

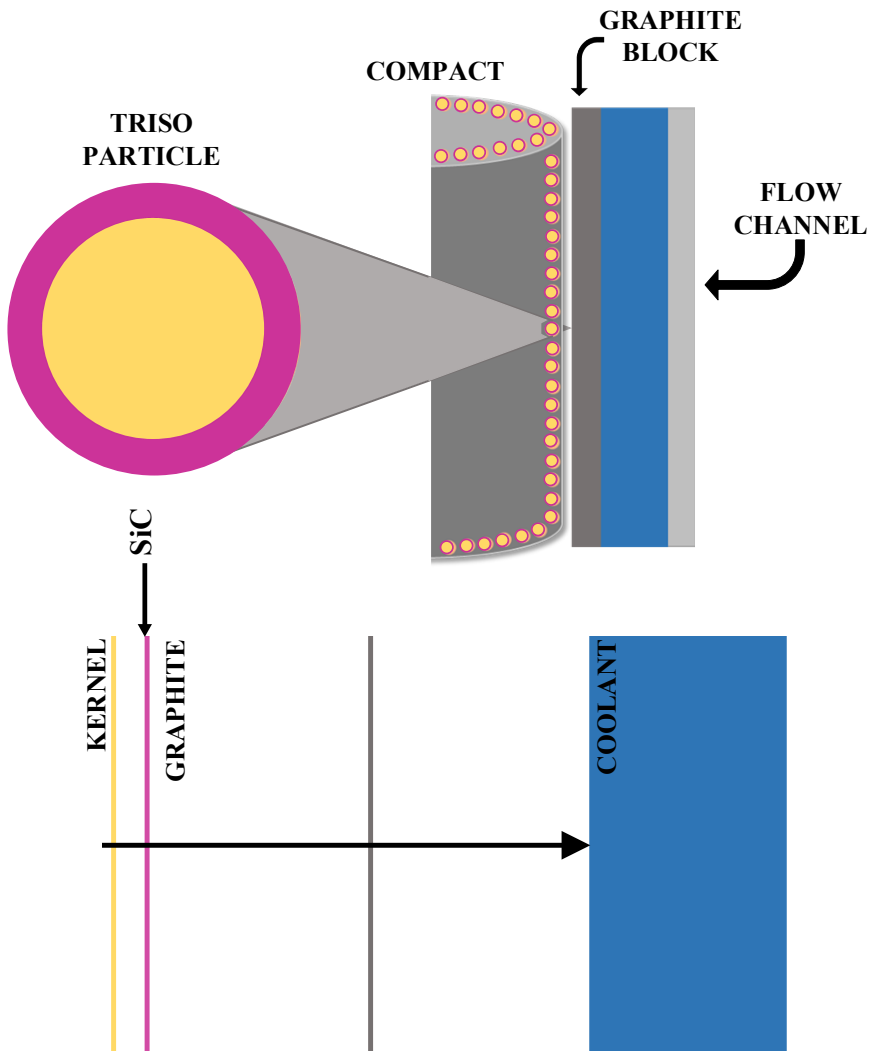
Particle Structure:

- Kernel
- Buffer
- Inner Pyrolytic Carbon (IPyC)
- Silicon Carbide (SiC)
- Outer Pyrolytic Carbon (OPyC)



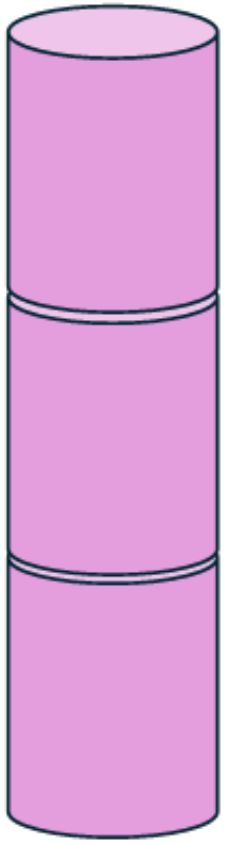
A mechanistic analysis that uses conservative assumptions to predict fission product release.

- Expanding model from 1991 for New Production Reactor – Modular High-Temperature Gas-Cooled Reactor (NPR-MHTGR) program.[1]
  - Multi-Node
  - AGR Release Data
- Uniaxial, radial diffusion.
- Model particle as kernel and SiC layer.
- Assume the broken particles occur on the edge of compact.



1. EGG-NPR-8522, "6.0 Safety and Environmental Assessment," March 1991.

Phenomena Modeled in TRISOATOPS



Multiple nodes in the core, radially and axially

Intact Particle

Only Silver release expected

Exposed Kernel or Heavy Metal Contamination

All fission products can be released. Release determined by retention of UCO kernel

SiC Defect

Metallic fission products release. Noble gases and halogens retained by PyC layers

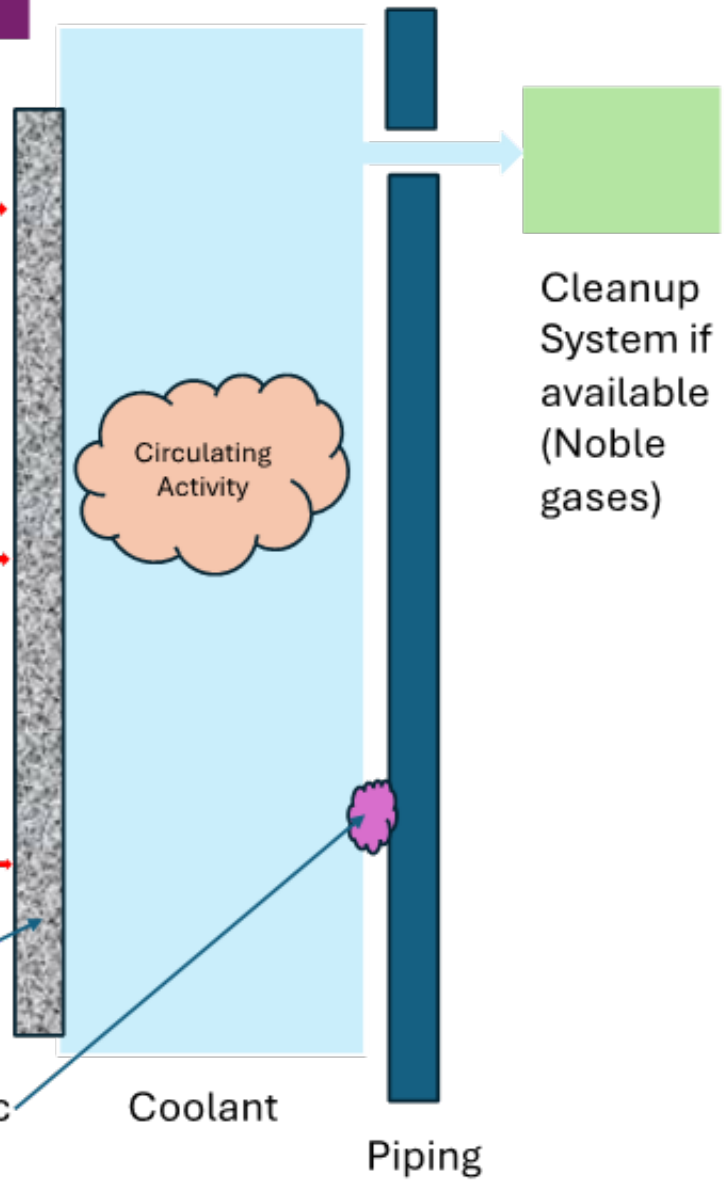


*Figure by David Petti

The model is simple and versatile with a variety of user inputs and optional conditions.

User Inputs:

- Radionuclide Inventories
- Temperature Profiles
- Failure Fractions
- Etc.

Optional Conditions:

- Clean-Up Model
- Accident Model

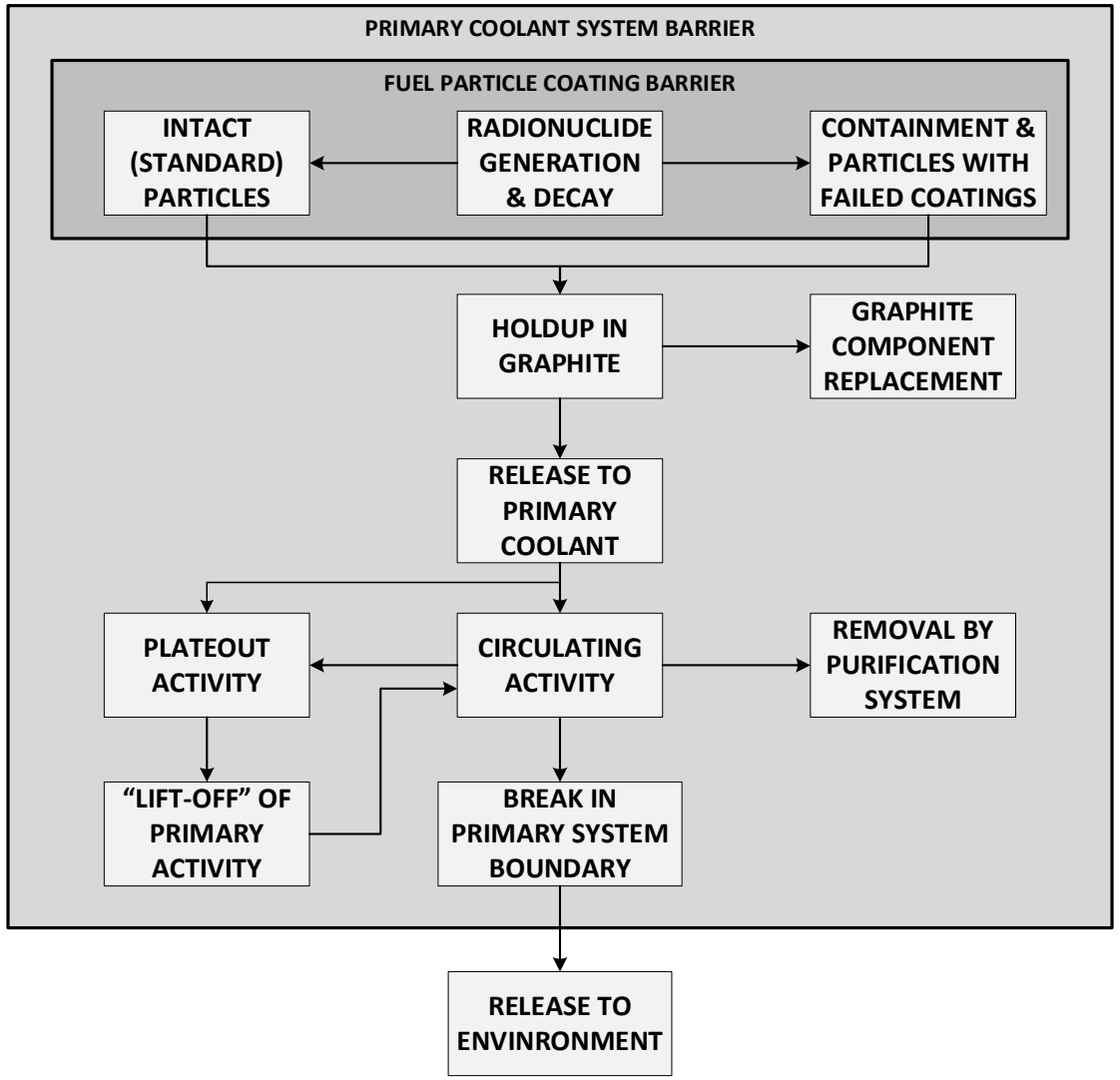


*Figure adapted from EGG-NPR-8522, Rev. B, Section 6[1]

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Reference

1. EGG-NPR-8522, “6.0 Safety and Environmental Assessment,” March 1991.