



# High-fidelity multiscale model development for accelerated fuel qualification for high discharge burnup

August 2023

*Changing the World's Energy Future*

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**Prepared for the  
U.S. Department of Energy  
Under DOE Idaho Operations Office  
Contract DE-AC07-05ID14517**



# High-fidelity multiscale model development for accelerated fuel qualification for high discharge burnup

## Finite element-informed, discrete element modeling of fuel fragmentation, relocation, and dispersal (FFRD) phenomena during a simulated loss of coolant accident (LOCA)



PRESENTER:

**Ahmed Hamed**

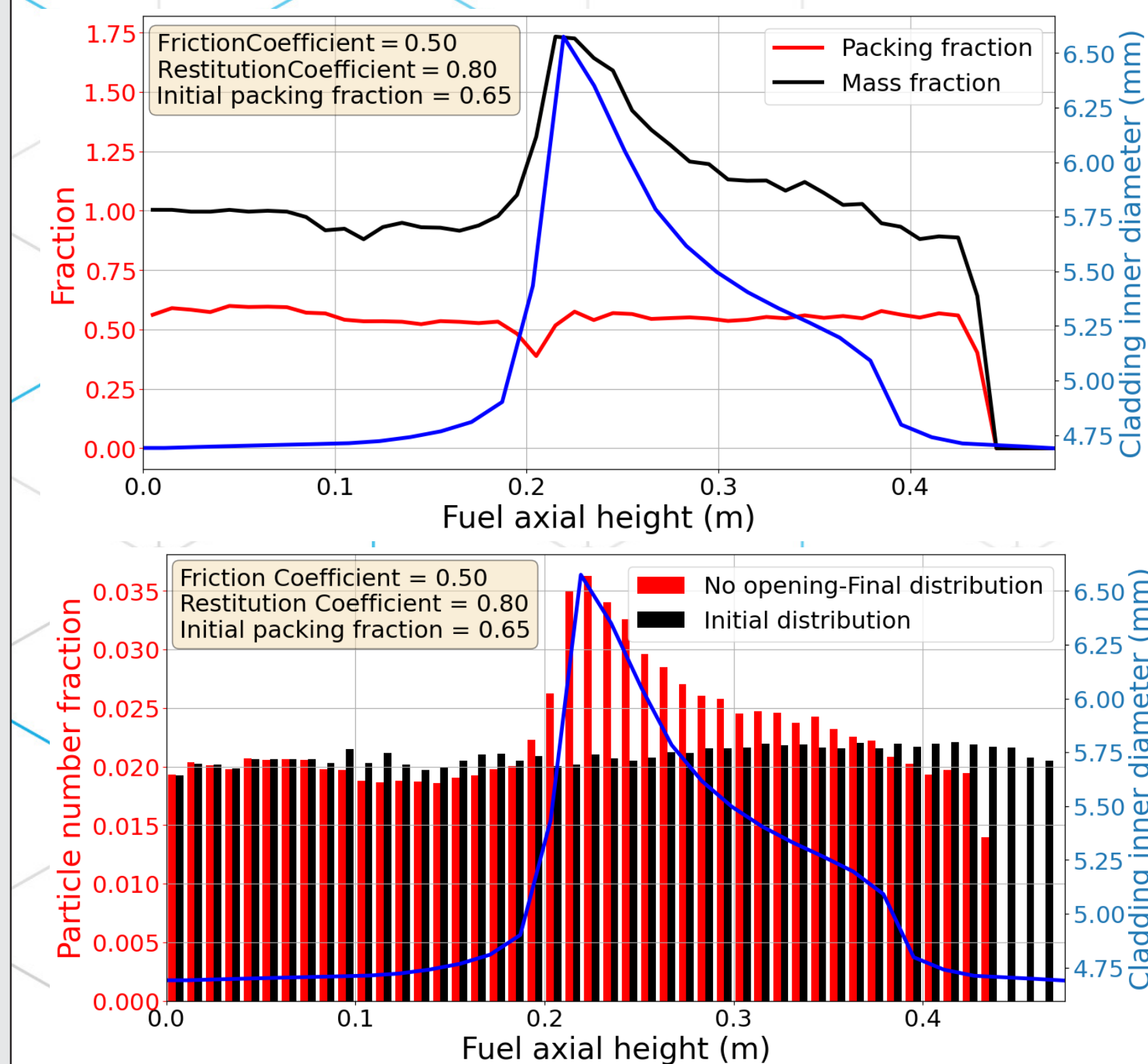
### BACKGROUND:

Reactor vendors seek economic benefits associated with increasing nuclear fuel service lifetime in the existing light-water reactors fleet. FFRD phenomena represent a major safety concern which still needs to be addressed. Formation of high burnup structure (HBS) in conjunction with LOCA can lead to relocating fuel to escape the fuel pin and get dispersed into the primary coolant system.

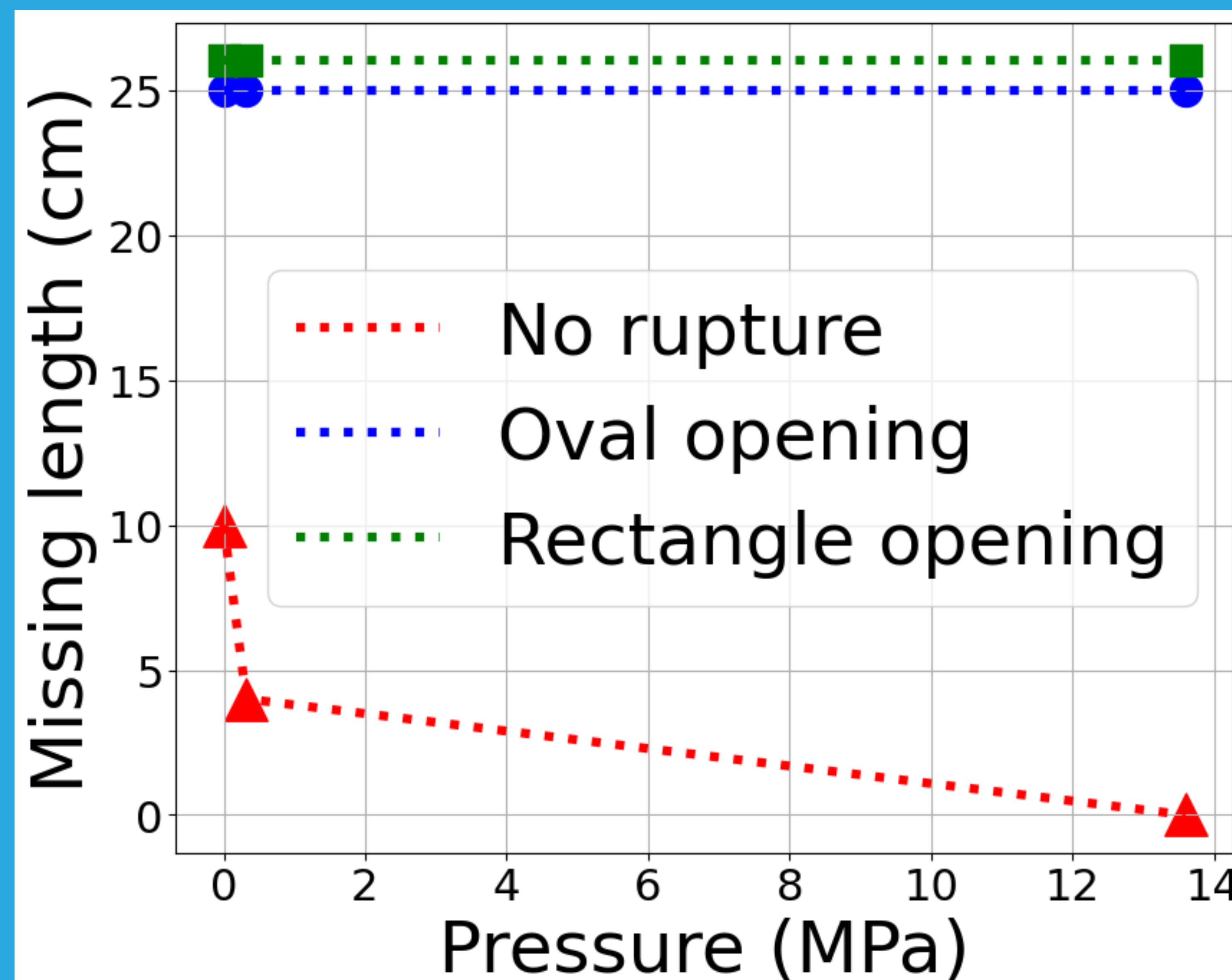
### METHODS

1. BISON is used to simulate experimentally observed scenarios leading to FFRD.
2. BISON-informed Discrete Element Method is used to simulate FFRD dynamics and analyze controlling parameters.

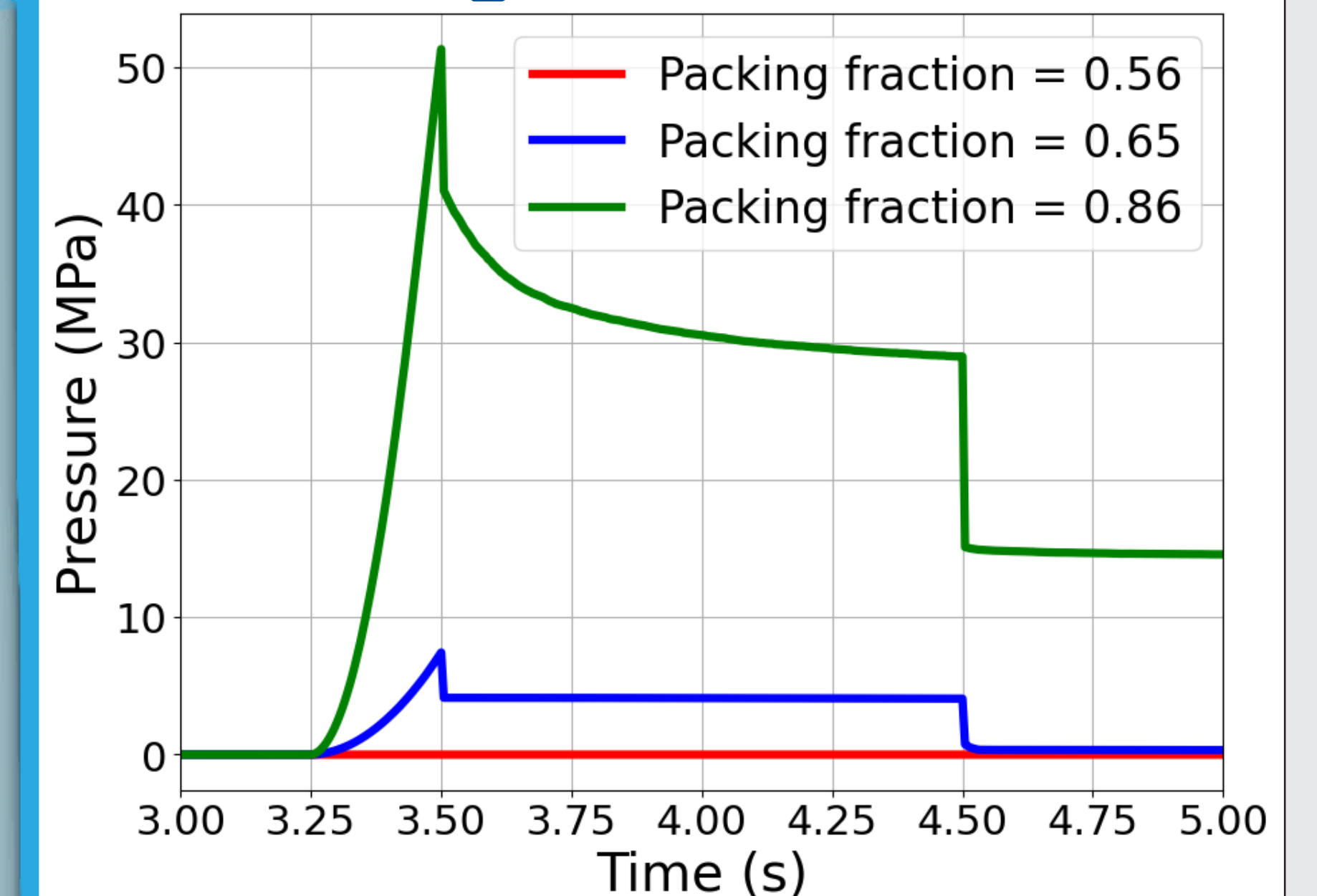
### RESULTS



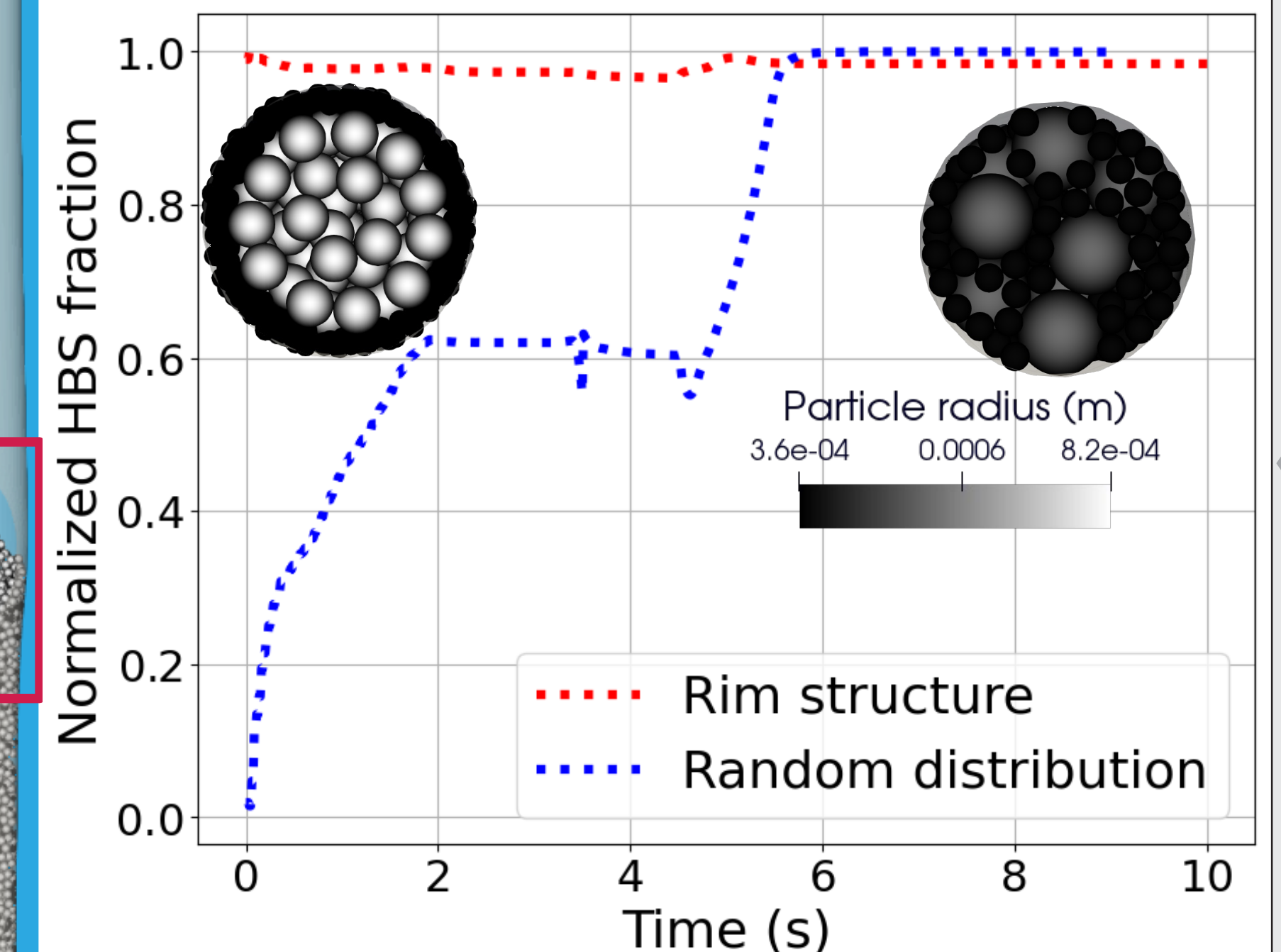
**FFRD dynamics are very sensitive to particle features, stress level, and burst opening geometry. High pressure suppresses the axial fuel relocation until the onset of clad rupture.**



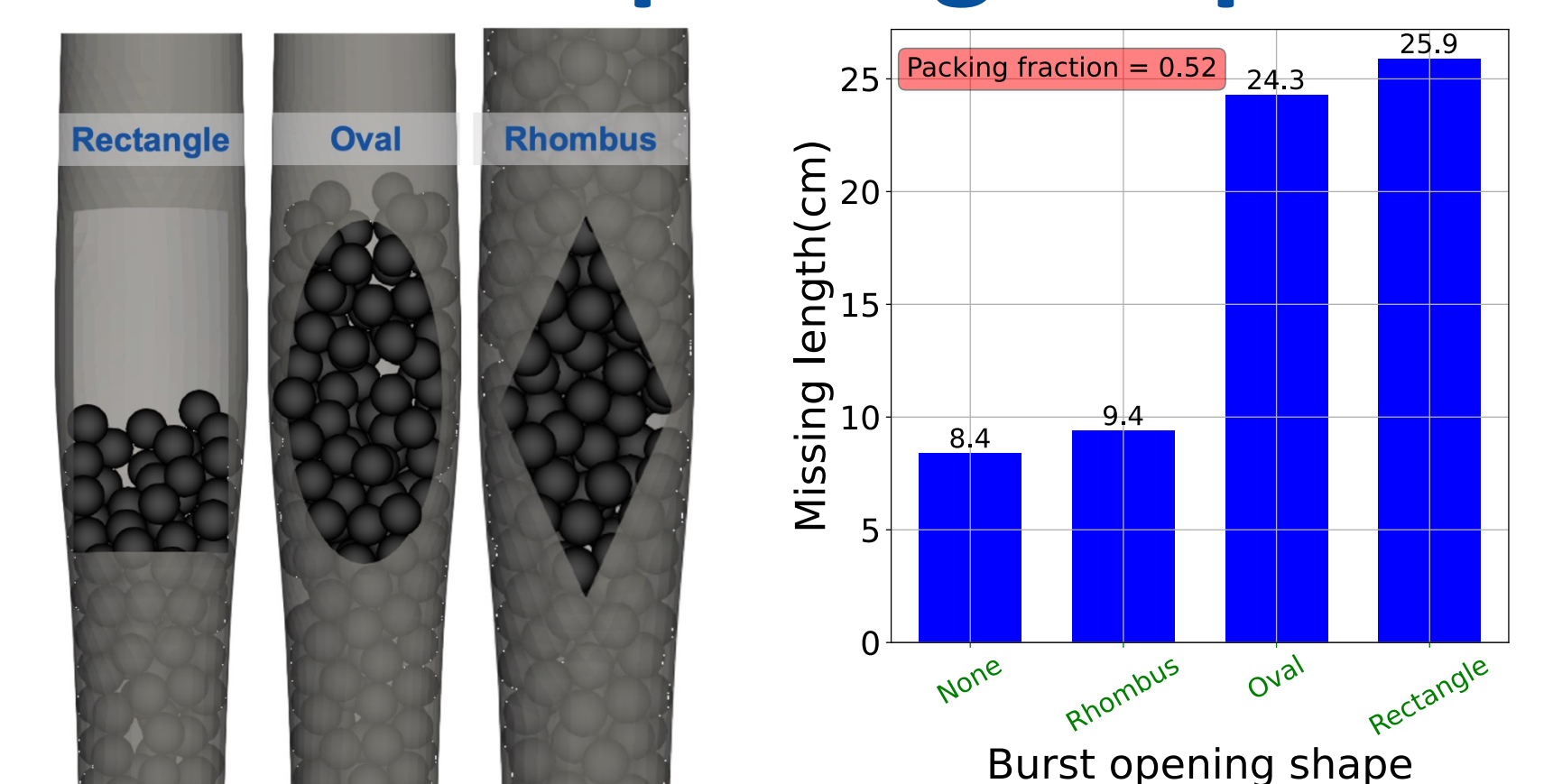
### Packing fraction effect



### Radial structure effect



### Burst opening shape



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Project Number: 22P1074-009FP

LRS Number: INL/MIS-23-74169

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Work supported through the INL Laboratory Directed Research & Development (LDRD) Program under DOE Idaho Operations Office Contract DE-AC07-05ID14517."

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\* FFRD schematic is adopted from Siefken, Int. Conf. on Structural Mechanics in Reactor Technology, 1983