A COPA Fission Product Release Analysis for a Gen-IV Numerical Calculation Case

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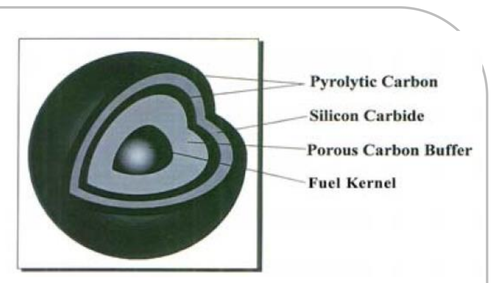
Objectives

- Another accident condtion (AC) benchmarking task on the fission product (FP) releases from a coated fuel particle (CFP) has been performed in the frame of Gen-IV (INL/EXT-20-60147), as a follow-on of the CRP-6 AC benchmark (IAEA-TECDOC-1674).
- This study treats the calculations of the FP releases from a CFP using the COPA FPRC (KAERI/TR-7945/2019) module for a Gen-IV numerical calculation case (NCC) problem and the comparison them with other countries' results.



Numerical Calculation Case

- To calculate the release of the fission products Ag, Cs, Sr, Kr from a CFP during irradiation and heating

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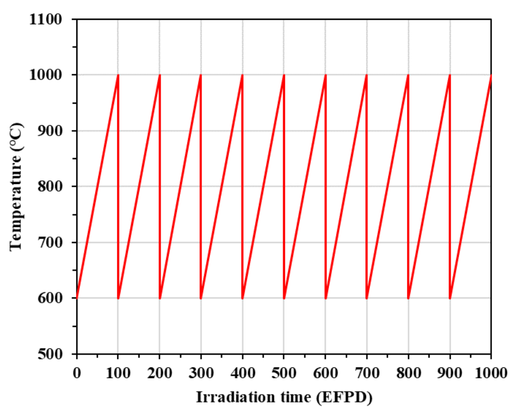
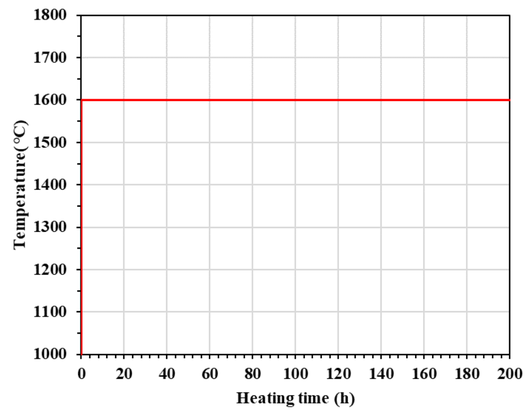
Category	Parameter	Mean Value
Fuel properties	U-235 enrichment (wt%)	10
	Oxygen/uranium (atomic ratio)	2
	Carbon/uranium (atomic ratio)	0
	Uranium contamination fraction	0
Particle properties	Kernel diameter (μm)	350
	Buffer thickness (μm)	100
	IPyC thickness (μm)	40
	SiC thickness (μm)	35
	OPyC thickness (μm)	40
	Kernel density (g/cm^3)	10.8
	Kernel theoretical density (g/cm^3)	10.96
	Buffer density (g/cm^3)	0.95
	Buffer theoretical density (g/cm^3)	2.25
	IPyC density (g/cm^3)	1.9
	SiC density (g/cm^3)	3.20
	OPyC density (g/cm^3)	1.9
	IPyC anisotropy (BAF)	1.03
	OPyC anisotropy (BAF)	1.03
	Particle asphericity (SiC level)	1.0
Boundary conditions	Ambient pressure (MPa)	0.1

Irradiation

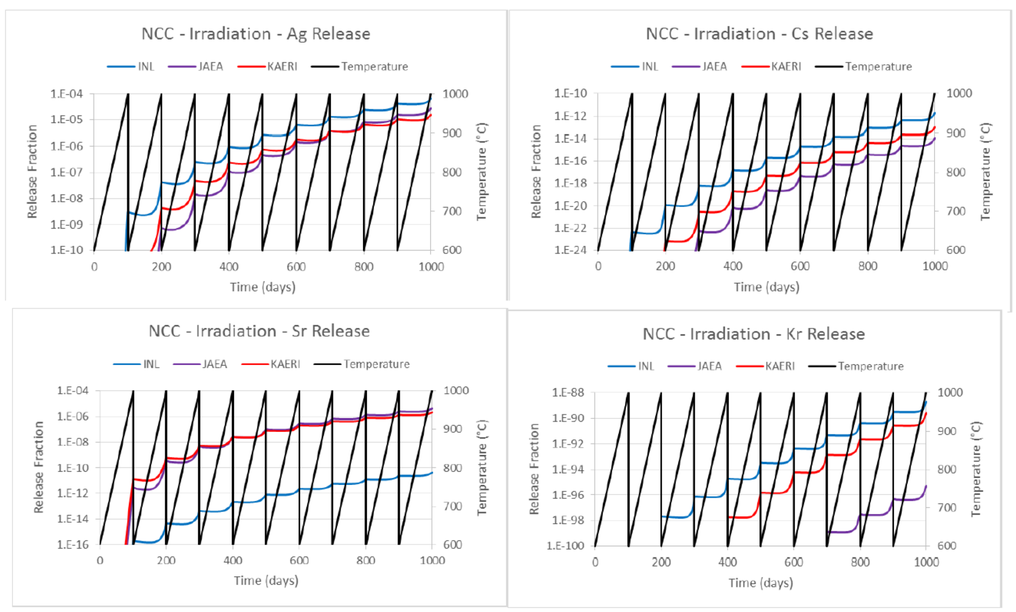


Heating

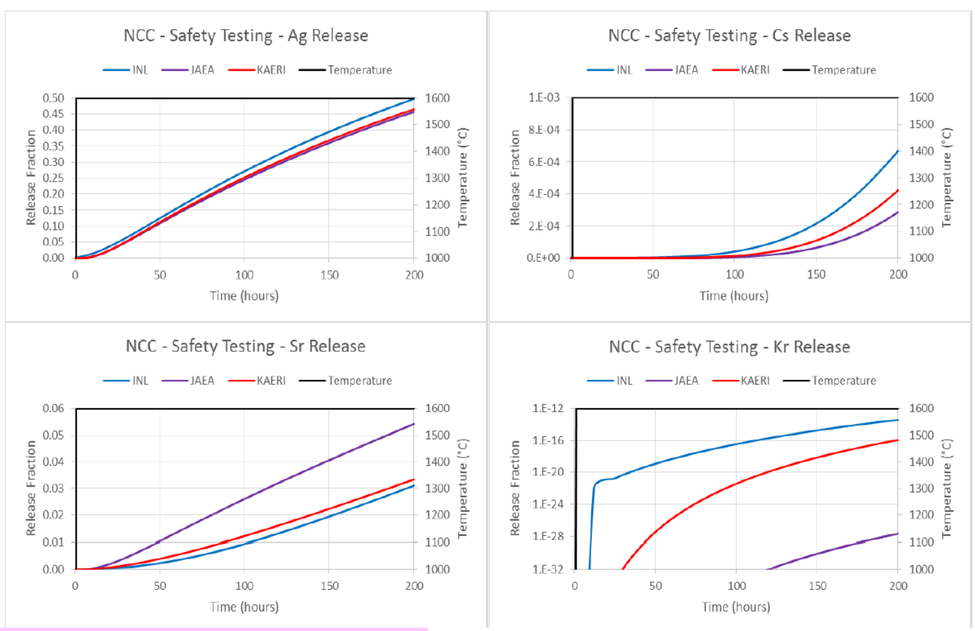


Calculation Results and Summary

FP releases during irradiation



FP releases during heating



Calculated Ag, Cs, Sr, and Kr release fractions for the NCC

	After irradiation				After 200h heating			
	Ag	Cs	Sr	Kr	Ag	Cs	Sr	Kr
INL	6.7×10^{-5}	1.8×10^{-12}	4.3×10^{-11}	2.1×10^{-89}	5.0×10^{-1}	6.7×10^{-4}	3.1×10^{-2}	4.0×10^{-14}
JAEA	2.8×10^{-5}	1.2×10^{-14}	4.2×10^{-6}	7×10^{-122}	4.6×10^{-1}	2.9×10^{-4}	5.5×10^{-2}	1.2×10^{-17}
KAERI	1.6×10^{-5}	9.8×10^{-14}	2.2×10^{-6}	2.6×10^{-90}	4.6×10^{-1}	4.2×10^{-4}	3.3×10^{-2}	1.3×10^{-16}

- After irradiation and heating, silver release fractions are in very good agreement, but there are large discrepancies between the release fractions of cesium, strontium, and krypton.
- It has been concluded through the comparison of the three codes' physical models that the discrepancies resulted from a numerical calculation accuracy, not from differences in the physical model (INL/EXT-20-60147),