

# Containment Responses and Fission Product Behavior in Loss-of-Reactor-Level Accident of Sodium-Cooled Fast Reactor

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## Abstract

A loss of reactor level accident (LORL) of a sodium cooled fast reactor (SFR) results in core degradation and causes fission products release from the reactor system to the containment. The authors investigate the fission product behavior during the LORL accident of the SFR.

**Keywords:** LORL, containment response, fission product, SFR, severe accident

## Introduction

For seismic induced loss-of-reactor-level accident (LORL) of the SFR, the authors use containment analysis code AZORES<sup>[1]</sup> to analyze the dynamic responses of the containment responses and fission product behavior.

## Event Progression and Fission Product Behavior

The initiating event is a seismic-induced structural failure of the cold-leg pipe of the primary heat transfer system (PHTS). It is assumed that the guard vessel fails as well and the sodium (Na) flows into the PHTS room. Consequently, Na boils in the reactor core at 49.3 minutes and the fuel cladding breaches at 24.1 hours (h) and core starts to melt at 26h. Over-pressurization of the PHTS causes RV head plug seal leakage at 16.9 h and the RV head fails at 42.2h.

Figure 1 shows the time transients of the mass of fission products in the containment vessel. The fission products (FPs) are classified into ten groups.<sup>[1]</sup> As Na leaks into the dome soon after Na boiling, sodium vapor (Na<sub>g</sub>) reacts with oxygen (O<sub>2</sub>) and produces sodium oxide (Na<sub>2</sub>O) and sodium peroxide (Na<sub>2</sub>O<sub>2</sub>). Since the O<sub>2</sub> is used up, the mass of Na<sub>2</sub>O/Na<sub>2</sub>O<sub>2</sub> decreases rapidly at 14.92h, and that of Na<sub>g</sub> increases correspondingly and peaks at 17.33h when the plug seal fails. For noble gases, their mass increase at 26.08h when the core begins to melt. Due to the filter system, their mass fluctuates and peaks at 44.58h when the RV head fails. For other FPs, their mass increase after core melt, but obtain relatively low peak amounts, such as Iodine-134kg, Lanthanides-4.94kg.

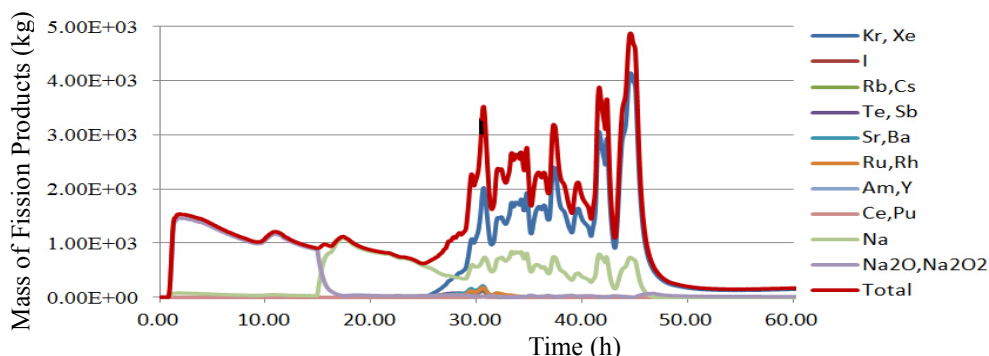


Fig.1 Fission Products in Dome along Time

## Conclusion

We can conclude that: from the Na boiling to plug seal damage, the main FPs in the dome is Na<sub>2</sub>O, Na<sub>2</sub>O<sub>2</sub> and Na<sub>g</sub>; and then before the start of core meltdown, Na<sub>g</sub> is the main FPs; and then before the break of RV head, noble gases and Na<sub>g</sub> are the main FPs, and also Iodine, Cesium and others are also produced, but have relatively low amounts.

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## References

[1] JNES, 高速増殖炉の格納施設応答解析手法の整備, JNES/SAE06-105.