Preliminary Thermal-Hydraulic Analysis of Beam Tu Break (BTLOCA) Accident at HANARO

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Abstract

Beam Tube Break (BTLOCA) accident of 30-MW pool type research reactor is analyzed with MELCOR.

- **Thermal-Hydraulic** behavior during BTLOCA was examined with MELCOR
- **Fuel degradation** was shown at the end of the calculation.

Conclusion

The fuel degradation starts after 60 hours from the accident initiation, without the aid of EWSS.

The operation of EWSS can delay the accident progress.

The radiological consequences by the event is under calculation.

BTLOCA Accident in HANARO

■ 30 MW pool type research reactor with finned fuel.

- BTLOCA occurs by the break of seal plate and diaphragm at the same time, resulting in a loss of pool water
- The occurrence probability is very low, but causes long-term fuel damage by an excessive loss of coolant when there's no mitigation measure.

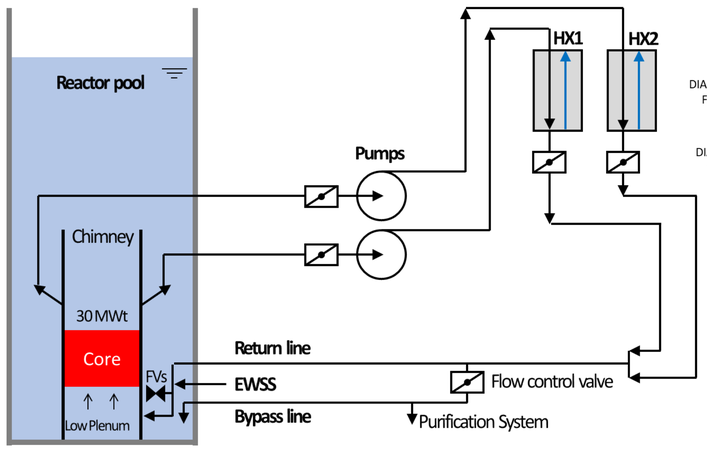

Fig. 1 15-MW pool type research reactor

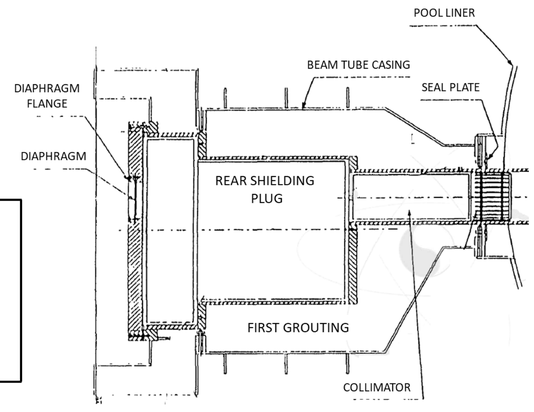

Fig. 2 Standard Beam Tube

Event Sequence

■ Event sequences of BTLOCA

- After the reactor trip by pool level decrease, fuels are cooled by natural convection via the flap valves until the level reaches the chimney top.
- The coolant loss by the break flow stops before the fuels are exposed to air, and then the water slowly evaporates by the decay heat.

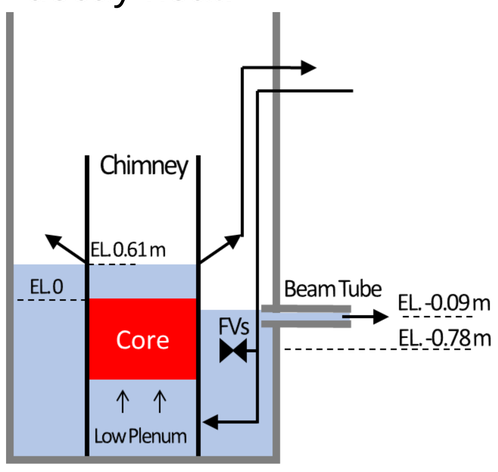

Fig. 3 Schematic of BTLOCA

Tab. 2 Event sequence

Events	hour
Beam tube seals break (BTLOCA)	0
Reactor trip by low-low pool level RCPs trip, HXs trip	1.07
Flap valve open passively	1.25
Level reaches chimney top	9.25
Fuel cooled by natural circulation	~
Core support plates start to fail	47.9

Results

■ Long term behavior of the reactor

- The pool level decreases much slower than the previous results which was calculated by Bernoulli equation, due to the small D_h.
- The fuel is initially cooled by natural convection via the flap valves, and then the flow stops when the pool level reaches the chimney top.
- The coolant evaporates by the decay heat from the fuel, then the fuel degradation starts.
- The fuel seems intact until it is submerged in the coolant, and then the hot steam is generated when the fuel is exposed to the air.
- The fuel starts to relocated after 60 hours from the accident initiation.
- Operation of emergency water cooling system (EWSS) can delay the fuel degradation further. However, the EWSS is not considered in the analyses

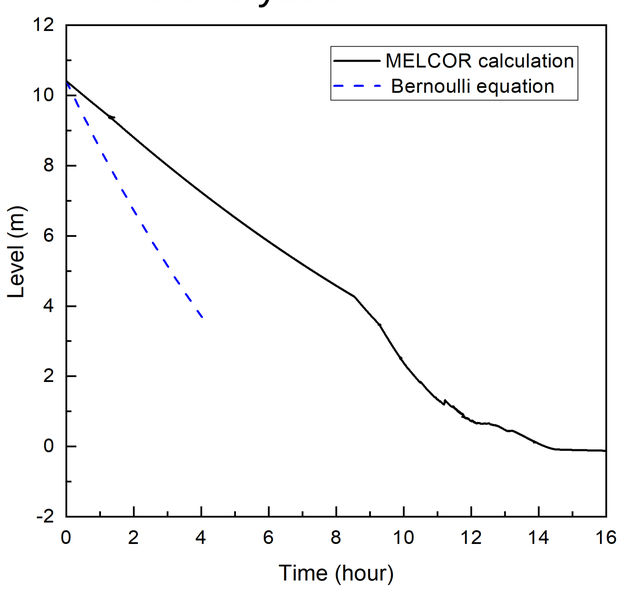

Fig. 4 Pool level decrease

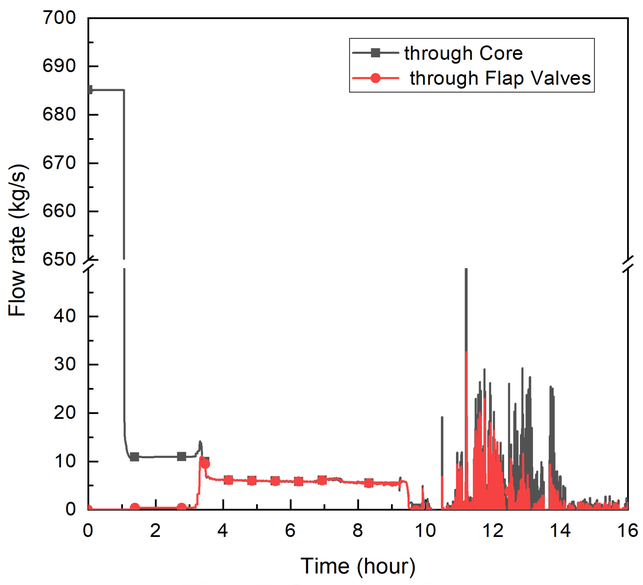

Fig. 5 Coolant flow rate through core and flap valves

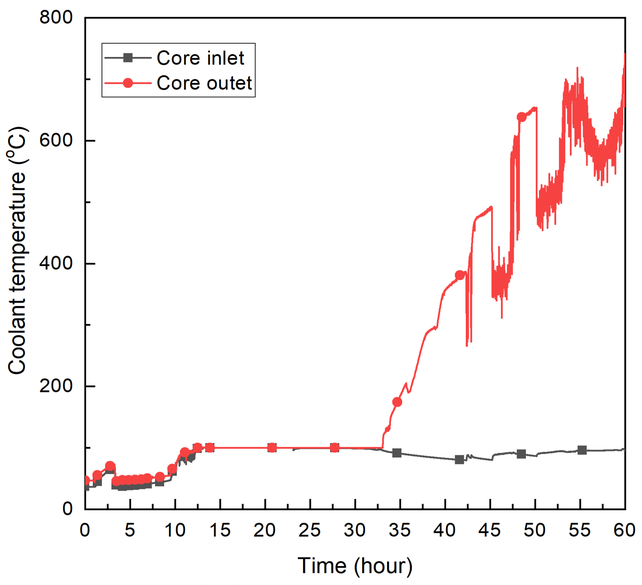

Fig.6 Coolant temperature at the core inlet and at the core outlet

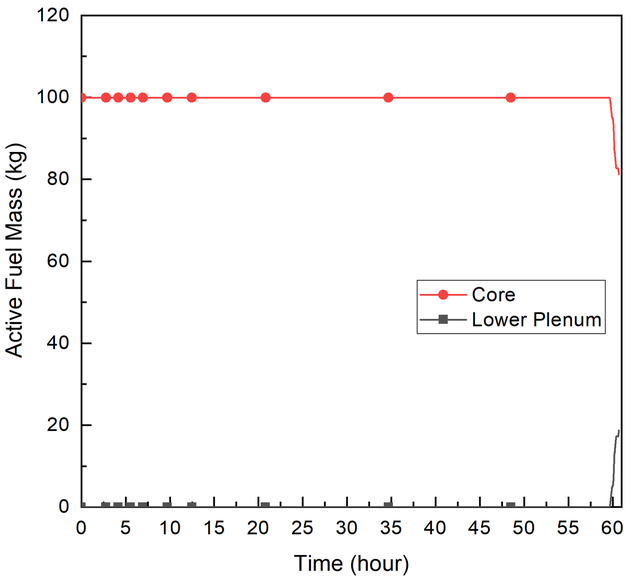

Fig. 7 Active fuel (U_3Si-Al) mass at the core and at the lower plenum