Severe Accident Test Station

Description

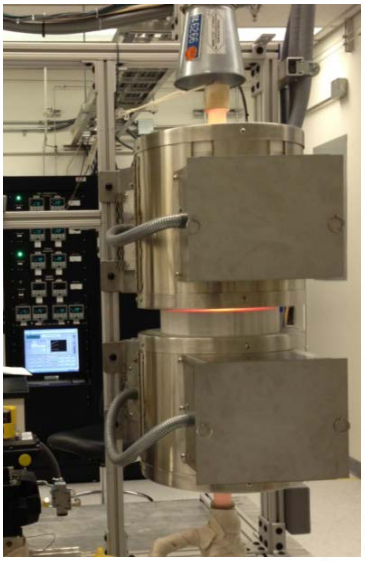
The Severe Accident Test Station (SATS) is a modular facility for examination of light water reactor (LWR) fuel and core constituents under design basis and beyond design basis accident conditions. The SATS modules enable exposure of fuel and core materials to high-temperature steam environments under a wide range of temperatures, pressures, and flow velocities. The SATS is implemented across two buildings: Building 4500S hosts the ex-cell modules, and building 3525 (Irradiated Fuels Examination Laboratory) hosts the in-cell modules, enabling examination of irradiated fuel under severe accident conditions. Currently the SATS mainly serves the mission of the Advanced Fuels Campaign in the Department of Energy Office of Nuclear Energy Fuel Cycle R&D program by examining separate and integral effects on performance of advanced accident tolerant fuel and cladding materials. Deployment of SATS also resurrected the national capability for integral loss-of coolant (LOCA) testing of irradiated fuel rods per US Nuclear Regulatory Commission requirements. This capability was initiated at Argonne National Laboratory (ANL) in the 1990s but was since dismantled. In addition to integral effects and applied testing, SATS modules allow for strict control of the environment and sophisticated instrumentation for direct measurement of kinetics to enhance basic understanding of governing phenomena in fuel and core degradation during severe accidents.

Capabilities

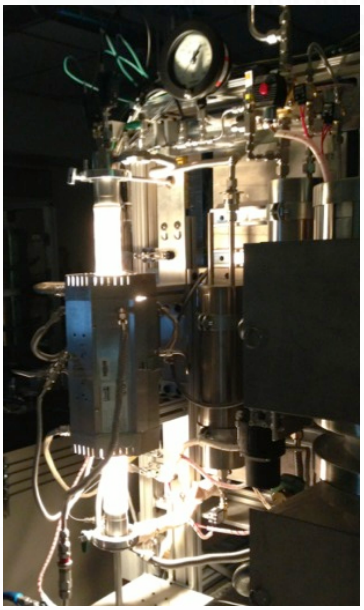
- Integral LOCA testing: rapid temperature ramp (5°C/s) to 1200°C on an internally pressurized rod to simulate burst, followed by cooldown to 800°C and subsequent quench with room-temperature water
- High temperature furnace: exposure of coupons or fuel rod segments to steam or steam-hydrogen mixtures to temperatures and flow velocities up to 1700°C and 2 m/s
- High pressure module (Keiser Rig): exposure of coupons to steam or steam-hydrogen mixtures to temperatures and pressures up to 1400°C and 2 MPa
- Thermogravimetry module: online measurement of oxidation kinetics via an environmentally decoupled magnetic system reaching temperatures up to 1550°C

Date: March 2015

High temperature furnace module

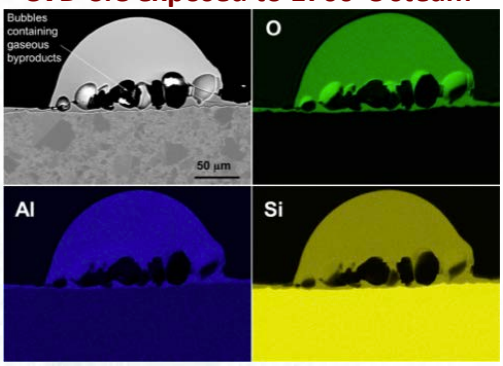


Integral LOCA test module



Zircaloy-4 clad fuel segment after burst

CVD-SiC exposed to 1700°C steam



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	Integral LOCA[a] furnace	High temperature furnace	High pressure furnace	Thermogravimetry
Max temperature (°C)	1200	1700	1400	1550
Max pressure (MPa)	0.1	0.1	2	0.1
Max flow velocity (cm/s)	50	200	2	5
Max ramp rate (°C/min)	300	20	20	20
Capable of 100% steam	✓	✓	✓	✓

[a]LOCA = loss-of-coolant accident