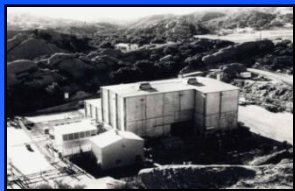
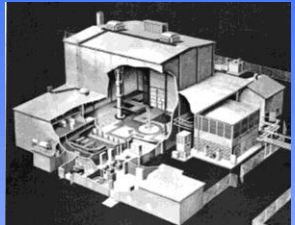


SODIUM REACTOR EXPERIMENT OPERATION



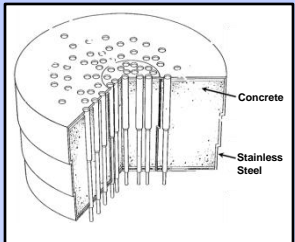
Reactor Building



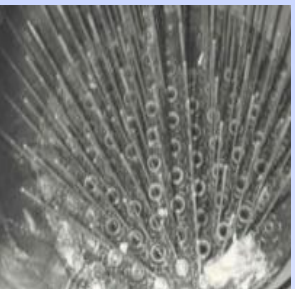
Reactor Building Cutaway



Sodium Reactor Plug



Sodium Reactor Plug Schematic



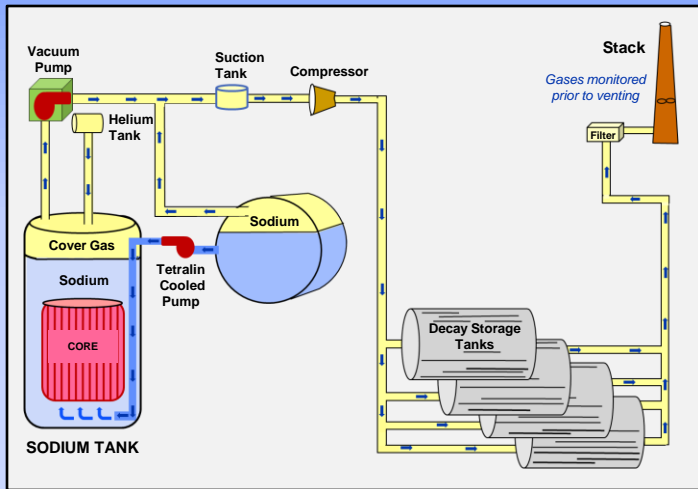
Looking Down on Fuel Bundles of Sodium Reactor



Sodium Reactor Container Prior to Placement in Ground

Operated 1957 – 1964

SRE small low pressure sodium-cooled nuclear reactor used to investigate different nuclear fuel materials

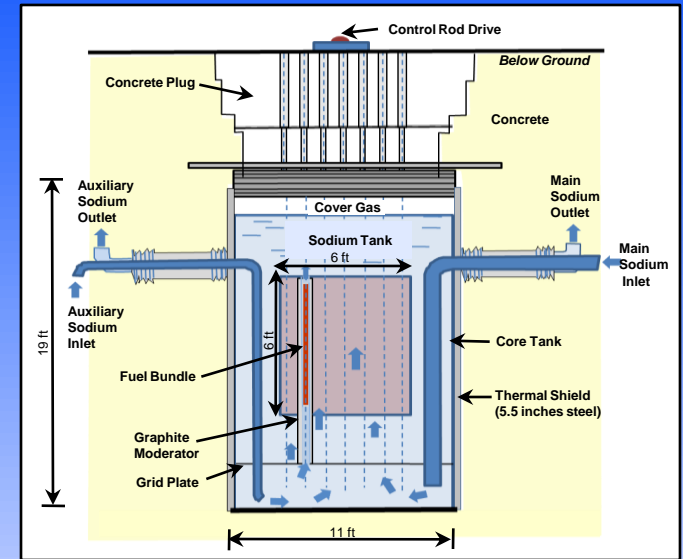


Schematic of Sodium Reactor Operation

Why Use A Sodium Reactor?

Sodium (liquid metal) cooled reactors with graphite moderators were considered promising options for achieving higher efficiencies

Sodium cooled reactors could operate at higher temperatures and higher efficiencies but still operate at lower pressures



Schematic of Sodium Reactor

Features of the SRE

SRE core could produce up to 20 MW_t of power

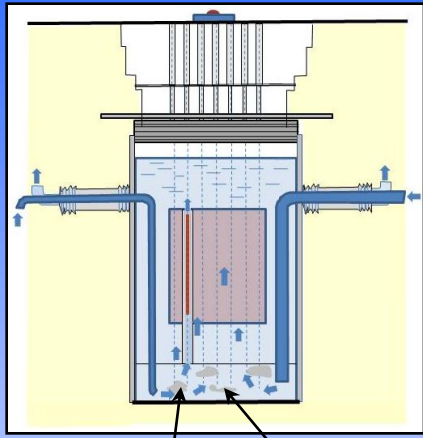
Primary sodium cooling loop removed heat to an intermediate heat exchanger

Secondary sodium loop isolated core and radioactive coolant from power generation system

Numerous other pumps and valves existed to startup and control system operations

SODIUM REACTOR EXPERIMENT ACCIDENT

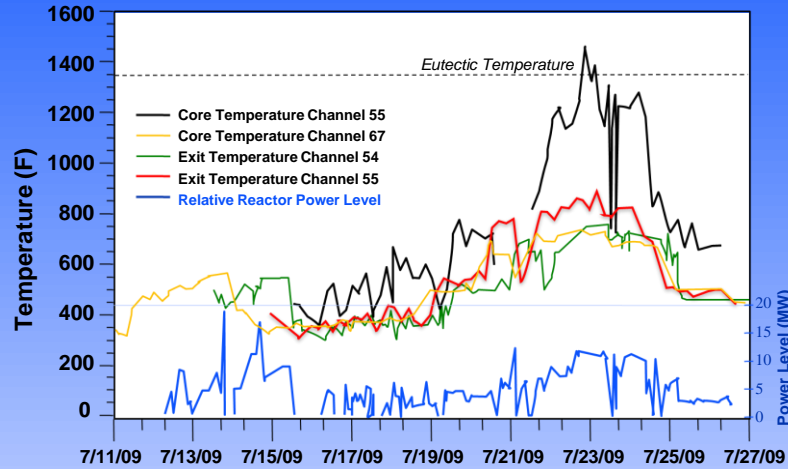
Blockages Formed Within The Sodium Reactor



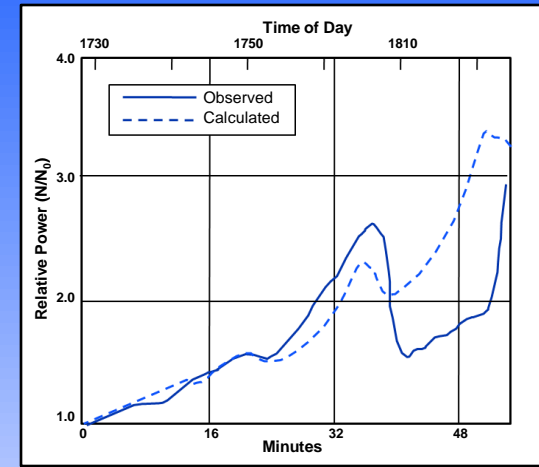
Tetralin (C₁₀H₁₂) coolant formed carbon blockages in inlet channels

Higher fuel temperatures in partially blocked channels

SRE Temperature and Reactor Power



Observed and Calculated Power July 13, 1959



What Happened?

July 12 Initial operation – higher than expected fuel temperatures in some channels; high radiation levels recorded in reactor building due to shield plug leakage

July 13 Power changes not consistent with control rod movements;

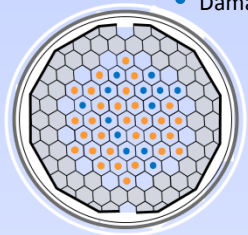
- Reactor was shut down after a rapid power rise
- Power anomalies caused by sodium boiling and re-flooding

July 14-26 Highest fuel temperatures recorded July 22-24

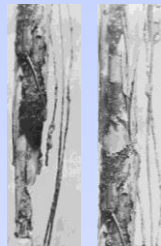
- Operations damaged 13 of 43 of the reactor's fuel
- Fission products released from fuel into reactor's primary sodium coolant
- Primary reactor vessel did not fail, but gaseous radionuclides escaped into reactor building from cover gas
- Subsequent fuel recovery processes, fission products in the cover gas were periodically vented to the environment

13 of the 43 Fuel Bundles Were Damaged

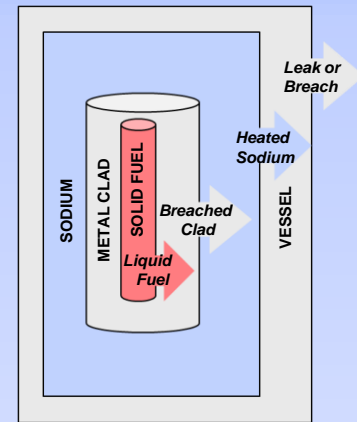
- Fuel Bundles
- Damaged Fuel Bundles



Cross-Section of SRE Showing Damaged Fuel Bundles



Damaged Fuel Bundles showing evidence of local melting and cladding failure



Barriers to Fission Products Release