

Fast Breeder Test Reactor

Description

The Fast Breeder Test Reactor is in operation since 1985. It was built with French collaboration, and the design closely follows that of Rapsodie-Fortissimo, with the major difference that its tertiary loop is a steam-water system with four steam generator modules, as against the sodium-air heat exchanger in Rapsodie. FBTR uses a unique, high Pu mono-carbide fuel as the driver fuel.

The reactor went critical with a small core of 23 fuel subassemblies rated for 10.6 MWt. The excellent performance of the carbide fuel resulted in the extension of the burn-up limit of this fuel to 155 GWd/t from an initial conservative design limit of 25 GWd/t. This extension was possible through PIE of the fuel at 25, 50 & 100 GWd/t and modelling by the fuel designers. The current limit of 155 GWd/t is based on the residual ductility of the wrapper. The extension of the burn-up limit resulted in progressive expansion of the core to compensate for the reactivity loss due to burn-up. The current core has 50 fuel subassemblies of different compositions-viz. 70%PuC+30%UC, 55%PuC+45%UC and MOX with 44% PuO₂. The current core has a power rating of 18.6 MWt.

The current major mission of FBTR is to test irradiate MOX fuel of power reactor composition (29%PuO₂) to a target burn-up of 100 GWd/t at a LHR of 450 W/cm. Operating experience with the sodium systems has been excellent, and the four sodium pumps have cumulatively logged 600,000 h of trouble-free operation. The steam generators have operated without any leak.

In addition to routine measurements of control rod worths and reactivity coefficients of inlet temperature and power after every core configuration change, physics experiments carried out are: reactor kinetics experiments, void coefficient measurements, response of delayed neutron detection system to detect clad failure and flux mapping in sodium above core. A series of safety related engineering tests was conducted in 1994-95, basically to validate the codes used in incident analysis. Normal plant incidents like off-site power failure and tripping of one pump in the primary, secondary or tertiary

loops were studied and the sequence of events confirmed to be as per safety logic, and the temperature transients in components were recorded. Primary pump coast down characteristics, take over by the batteries and low speed running of the pumps were studied. As a precursor to the station black out test, natural convection tests in the secondary and primary loops were separately carried out. In order to validate the performance of the Delayed Neutron Detection System and verify the capability to identify any failed fuel, a series of experiments was conducted with a special subassembly with 19 perforated pins of natural uranium. The results of the experiments were satisfactory, and confirmed that the failed fuel could be easily detected by the DND system and the failed fuel location could be easily inferred from the contrast ratio of the counts from both the loops.

Inside reactor/Outside Reactor:

This is the reactor facility.

Instrumentation:

Peak Flux : $2.65 * 10^6$ n/cm²/s

Irradiation in capsules within steel reflector & Nickel reflector subassemblies (capsules of size 19 mm to 25 mm) or special fuel subassemblies with seven pins removed

Capsule size: 10 mm ID, 550 mm long

Sample Temperature: 380°C to 490°C

Current status and availability:

Presently the reactor is operated in campaign mode. Depending upon the irradiation needs and program, operation is planned. Reactor is currently available. available.

Uniqueness:

This facility has employed a unique plutonium rich carbide fuel which has reached a burnup of 165 GWd/t without any fuel pin failure so far. It has played a key role in the finalization of India's 500 MWe PFBR design.