Specific Safety Issues in SFR

- Seismic Design Criteria
- Sodium Related Safety Issues
- Reliability of Passive Safety Systems
- In Service Inspection Requirements
- Design Criteria Against CDA

Seismic Design Requirements

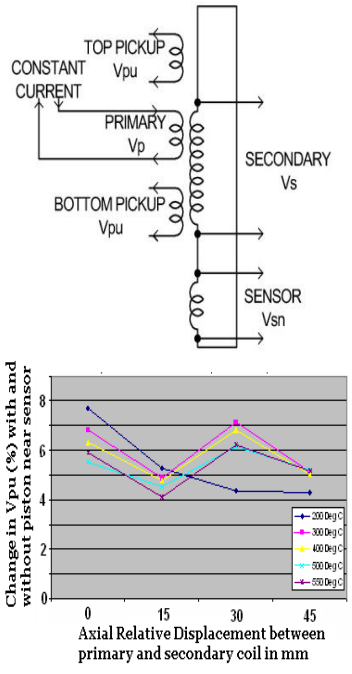
- The reactivity insertion because of core compaction due to horizontal displacements and relative vertical displacements between the absorber rod and fuel subassembly < 0.5 $)
- It should be possible to insert control rods during EQ.
- The drop time of absorber rods should be less than 1 s
- Primary pumps should not seize (at lower speeds)
- Sodium ejection to the reactor containment building (RCB) through the top shield penetrations is to be prevented.
- The stresses at the components should be less than the allowable values as per the RCC-MR to ensure that there is no risk of buckling and loss of structural integrity
- Seismic margin assessment to prevent cliff edge effects

All sodium circuit components are designed for both for SSE and OBE

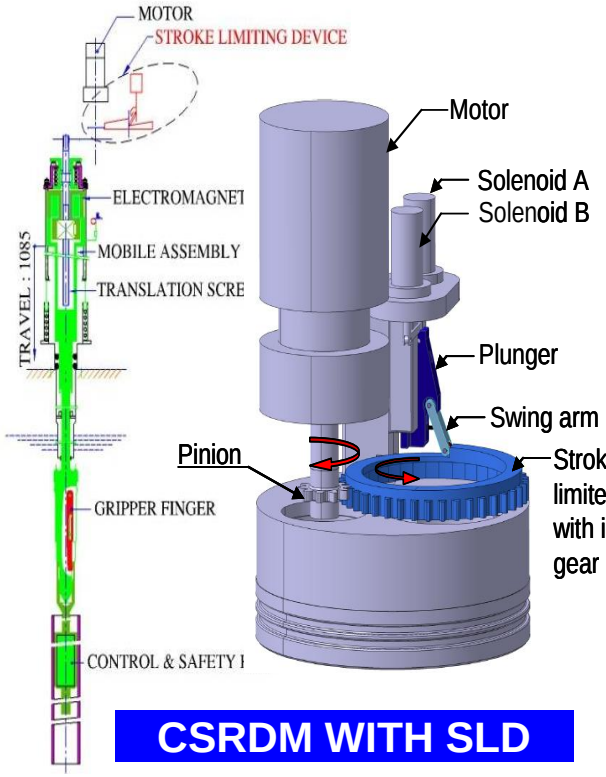
Specific Safety Issues Related to Sodium

- Structural integrity of components subjected to temperature fluctuations (thermal striping and thermal stratifications)
- Challenges in LBB Justification (detectability of small leaks, effects of small leaks, such as corrosion of stailess steel pipes due to chemical reaction between sodium and insulation material)
- Effective Functioning of systems mitigating the effect of sodium fires, e.g Leak Collection Trays
- Large number of tube leaks in steam generators and their consequences on core safety
- Integrity of safety systems (safety grade decay heat removal circuits) due to sodium fire followed by secondary fires (cables and insulation materials) on the above top shield, consequent to a CDA

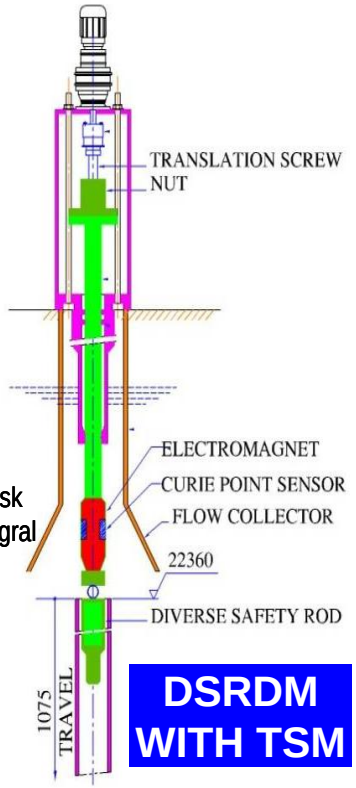
Reliability Assessment of Passive Safety Systems



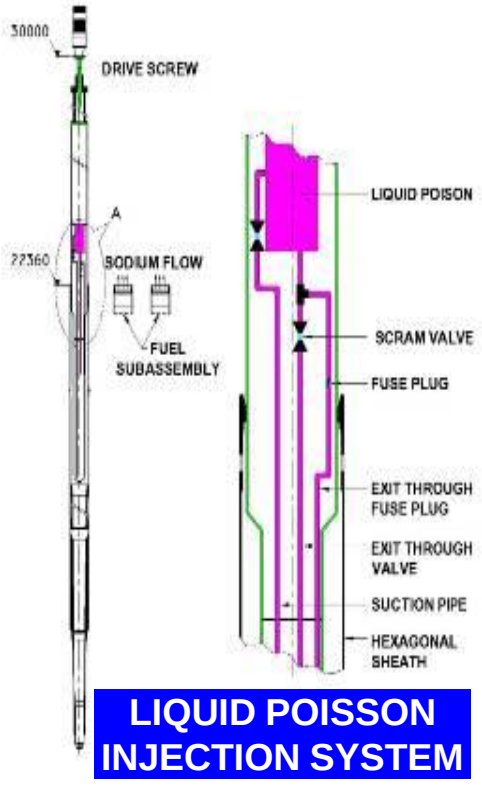
DROP TIME USING ECPS



CSRDM WITH SLD



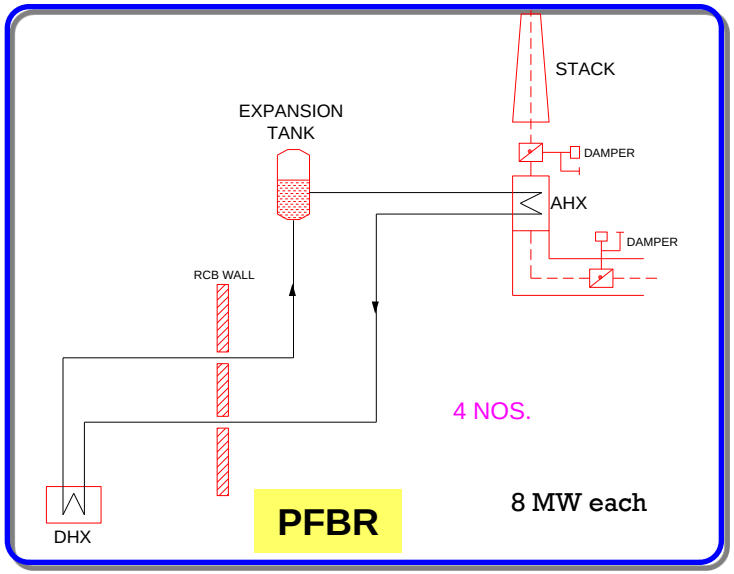
DSRDM WITH TSM



LIQUID POISSON INJECTION SYSTEM

Passive Shutdown Systems conceived for Future SFRs

Active and Passive Decay Heat Removal Systems



PFBR:

4 independent SGDHR loop each with 8 MW heat removal capacity

The SGDHRS is completely passive except for the dampers at the inlet and outlet of Air Heat Exchangers

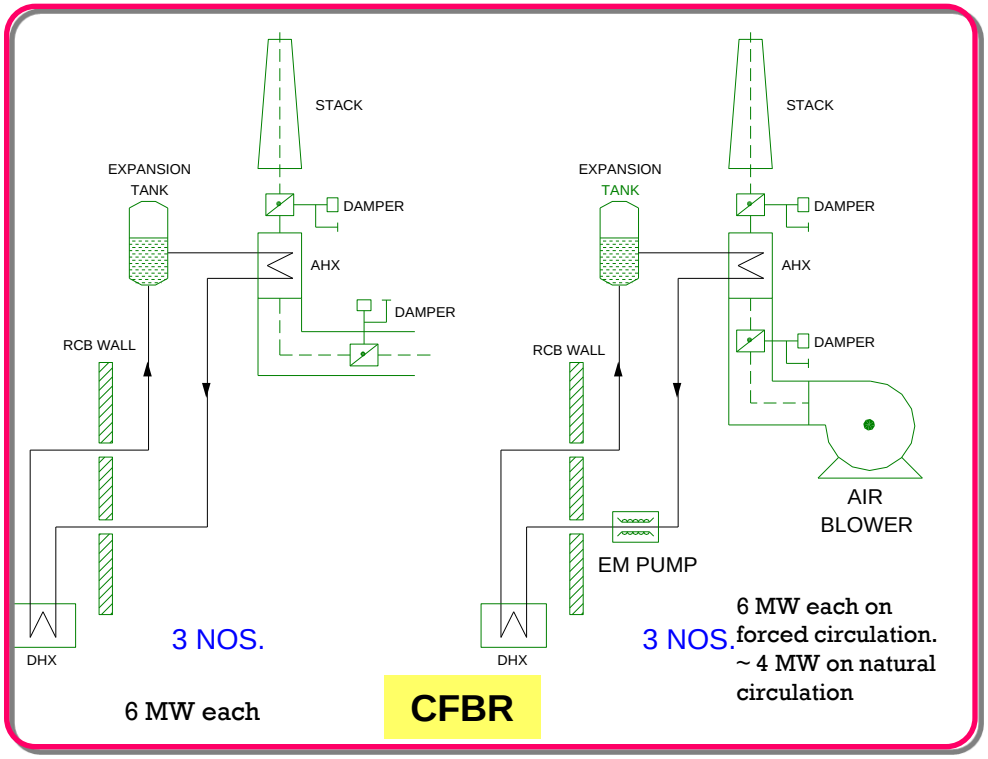
Reliability target – 10^{-7}/Ry

CFBR:

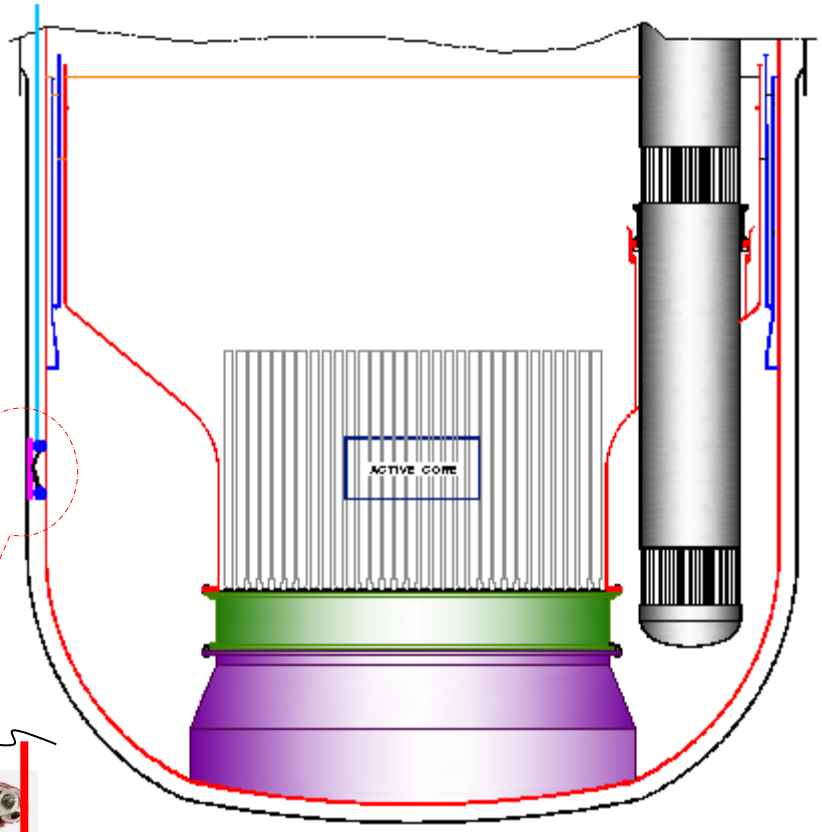
3 SGDHR circuits with forced cooling (2/3 of heat removal under natural convection)

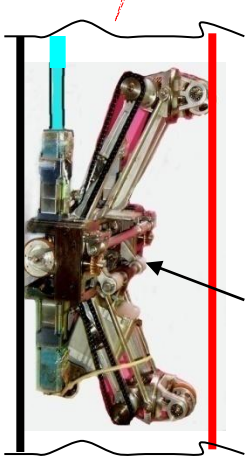
&

3 SGDHR circuits with natural convection cooling each with a power removal capacity of 6 MWt



In-service Inspection of Main Vessel





ISI
VEHICLE

GAP MV – SV 250 40 mm

Design Criteria against Core Disruptive Accident

- Core Disruptive Accident (CDA) is considered as beyond design basis accident.
- (CDA+SSE) as well as (CDA + OBE) - not combined BDBE
- Nevertheless following design basis has been followed:

- ✓ Main vessel along with top shield is designed for CDA.
- ✓ Decay heat removal exchangers in reactor pool and core catcher are designed for CDA for long term coolability
- ✓ RCB is designed for pressure resulting from expulsion of sodium burning in air of RCB.
- ✓ Site boundary dose meets the limits specifiedfor basis accident (Category-4) on best estimate analysis .

Core Design Features for preventing recriticality