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AREVA's proposal concerning scenario for Accident Tolerant Fuel studies

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Scenario for ATF studies

► Objective

Simplified accident scenario for assessing ATF gain compared to Zry cladding

► Main parameters that should influence temperature increase:

- ◆ Heat transfer between fuel and fluid and natural convection are pressure dependent.
- ◆ Level of decay heat

So two scenarios studies on PWR:

High pressure scenario with medium decay heat (SBO)

Low pressure scenario with high decay heat (LBLOCA)

High pressure scenario (SBO scenario)

► Main characteristics of a SBO scenario

A Station BlackOut (SBO) scenario is a Loss Of Offsite Power (grid) and Onsite Power (all diesels).

Due to postulated unavailability of all diesel generators feedwater to Steam Generators (SG) is unavailable, and safety injection means are unavailable, except the accumulators.

In a real case depressurization of the RCS should be performed by opening the Power Operated Relief Valves (PORV) when maximum Core Outlet gas Temperature ($T_{COT\ max}$) signal 650 °C is reached.

In order to stay at high pressure, it is assumed that the operator fails to open them and consequently water from accumulators is not injected.

High pressure scenario (SBO scenario)

► Detailed assumptions of a SBO scenario

The Station BlackOut leads at time zero to:

- ◆ the Reactor scram,
- ◆ the loss of pressurizer cooling sprays and heaters,
- ◆ the loss of Main FeedWater (MFW),
- ◆ the closure of Main Steam Isolation Valves (MSIV),
- ◆ the loss of Auxiliary Feedwater System (AFWS),
- ◆ the coastdown of Reactor Coolant Pumps (RCP),
- ◆ the loss of Safety Injection (SI) pumps

High pressure scenario (SBO scenario)

► Detailed assumptions of a SBO scenario

Additional assumptions are as follow:

- ◆ Power Operated Relief Valves (PORV) are assumed powered by severe accident dedicated batteries. In a real case, they are opened when maximum outlet gas temperature (TCOT MAX) reaches 650°C. But in order to stay at high pressure it is assumed that the operator fails to open it.
- ◆ Accumulators are assumed available (no injection due to high RCS pressure).
- ◆ Steam Generators isolation on SA criteria: SG Atmospheric Dump Valves is increased to the nominal value before the accident.
- ◆ Reactor coolant pumps seals are assumed undamaged.
- ◆ No primary component creep ruptures except for reactor vessel failure (no induced HL, surge line or SG tubes rupture).

High pressure scenario (SBO scenario)

► End of calculation

The calculation will be done until RPV failure

Low pressure scenario (LBLOCA scenario)

► Main characteristics of a LBLOCA scenario

For this scenario, the rupture of the pressurizer surge line is assumed. The break is large enough to remove all the decay heat and depressurize very quickly the RCS. The RCS voids in about some minutes despite the accumulators injection.

This scenario is characterized as the fastest in terms of core uncover and core degradation with a RCS pressure very low (equal to the containment one).

Low pressure scenario (LBLOCA scenario)

► Detailed assumptions of a LBLOCA scenario

The scenario is initiated by a surge line break.

The main assumptions for this scenario are:

- ◆ The primary system makeup and letdown are not available,
- ◆ The reactor scram is sent when the PZR pressure drops,
- ◆ The high vibration trip signal of the main cool pumps is reached when the average void fraction of the primary system exceeds 10%,
- ◆ SI pumps are not available,
- ◆ Only passive safety injection (accumulators) is available,
- ◆ The SGs are fed by AFWS on low SG level signal,
- ◆ In order to apply SAMG, when maximum core outlet gas temperature (TCOT MAX) exceeds 650 °C, PORV are opened.

Low pressure scenario (LBLOCA scenario)

► End of calculation

The calculation will be done until RPV failure