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Abstract. This work discusses the behavior of Angra 2 nuclear power plant core, for a postulate Loss of Coolant Accident (LOCA) in the primary circuit for Small Break Loss Of Coolant Accident (SBLOCA). A pipe break of the hot leg Emergency Core Cooling System (ECCS) was simulated with RELAP 5 code. The considered rupture area is 380 cm^2, which represents 100% of the ECCS pipe flow area. Results showed that the cooling is enough to guarantee the integrity of the reactor core.

Keywords: Small break LOCA, RELAP5, ANGRA 2.
PACS: 28.41-Fr

INTRODUTION

The objective of this work is to present the RELAP5/MOD3.2 gamma code [1] behavior calculations of Angra 2 nuclear reactor core for a postulate loss of coolant accident in the primary circuit, Small Break Loss of Coolant Accident (SBLOCA). This accident and boundary conditions are described in detail in Chapter 15 of the Final Safety Analysis Report of Angra 2 – FSAR [2]. The accident consists basically of the total break of a pipe of the hot leg Emergency Core Cooling System (ECCS) of Angra 2, which is a PWR reactor with four primary loops (10/20/30/40), **FIGURE 1**, and power of 1,400MW(e). The rupture area is 380 cm^2, which represents 100% of the ECCS pipe flow area [3].

In this simulation, failure and repair criteria are adopted for the ECCS components, in order to verify the system operation, in carrying out its function as expected by the project to preserve the integrity of the reactor core and to guarantee its cooling, as presented in the **TABLE 1**. SBLOCA accidents are characterized by a slow blowdown in the primary circuit to values that the high pressure injection system is activated. The thermal-hydraulic processes inherent to the accident phenomenon, such as hot leg of ECCS vaporization and consequently core vaporization causing an inappropriate flow distribution in the reactor core, can lead to a reduction in the core liquid level, until the ECCS is capable to refill it.

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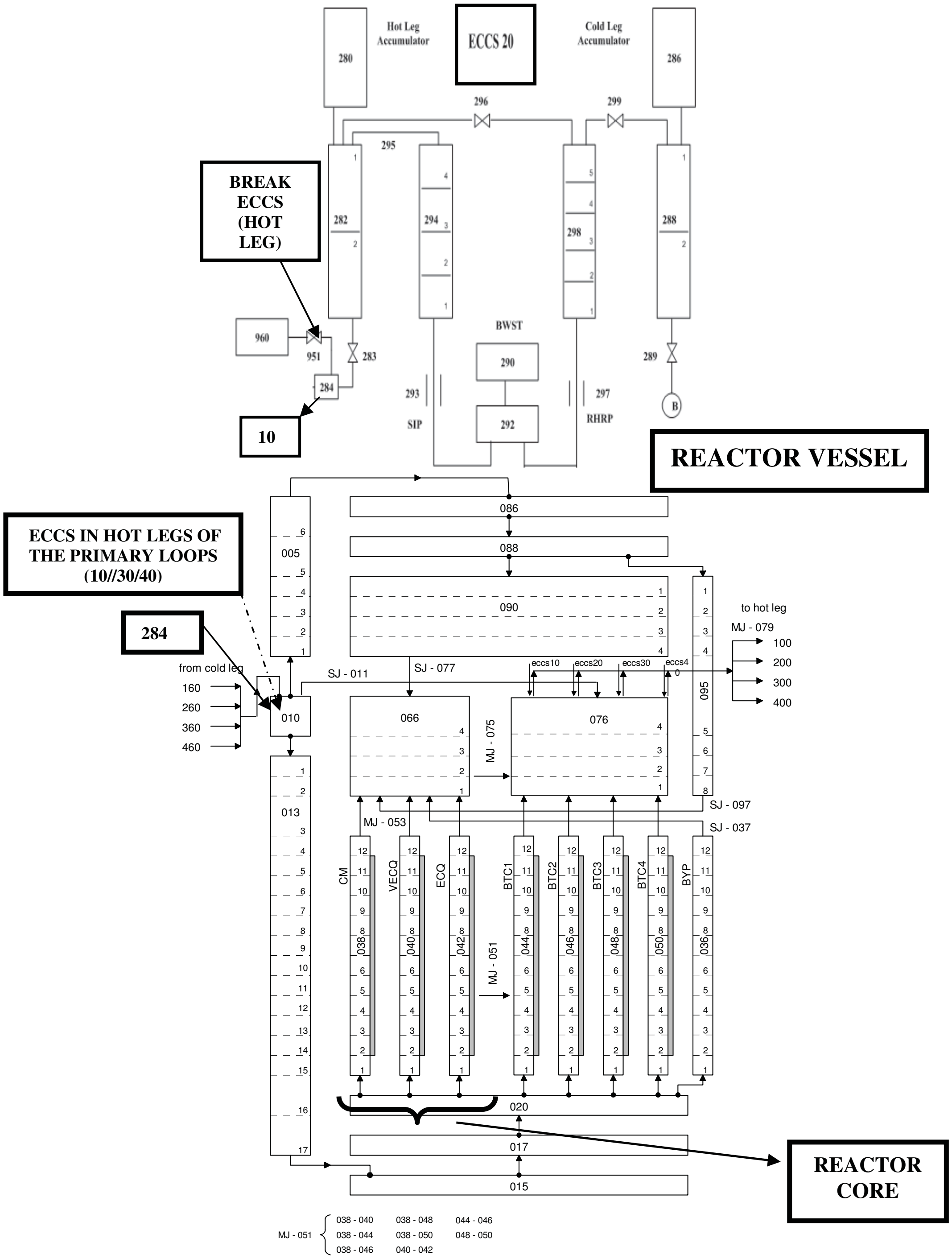

FIGURE 1. ANGRA 2 vessel RELAP5 code nodalization.

TABLE 1. Injection by the ECCs for rupture of the Loop 20 hot-leg injection line

ECCs Components	Injection							
	Loop 10		Loop 20		Loop 30		Loop 40	
	hot	cold	hot	cold	hot	cold	hot	cold
Safety Injection Pumps	1	_	Break	_	SF	_	RC	_
Accumulators	1	1	Break	1	1	1	1	1
Residual Heat Removal Pumps	1		Break		SF		RC	

Break: Injected coolant lost via the break
SF: Single failure of diesel engine
RC: Diesel engine down for repairs

RESULTS AND CONCLUSIONS

Results obtained with RELAP5 to the core of ANGRA2, for the considered SBLOCA, are presented in the FIGURES 2, 3, 4 and 5:

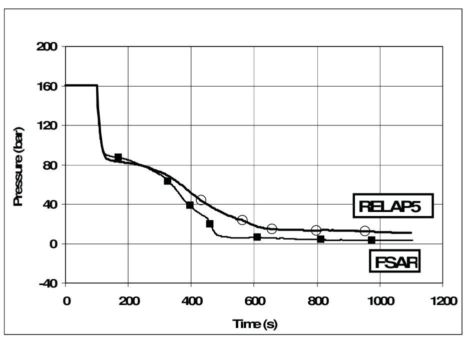

FIGURE 2. Pressure in the reactor core (RELAP5 and FSAR)

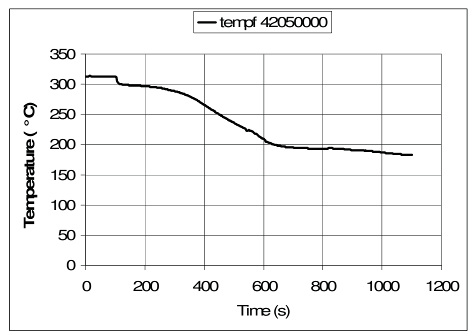

FIGURE 3. Temperature in the reactor core RELAP5

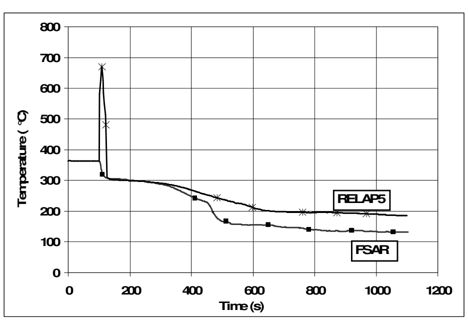

FIGURE 4. Maximum Temperature in the hot fuel rod (RELAP5 and FSAR)

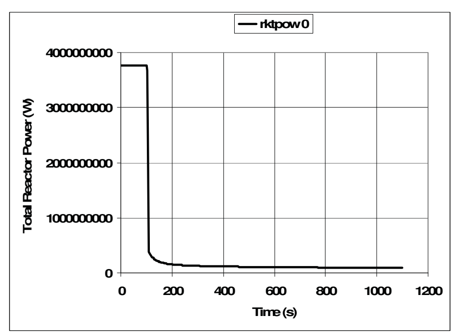

FIGURE 5. Total reactor power - RELAP5

FIGURES 2 and 3 show the pressure and the temperature in the core cooling channels obtained with RELAP5 code. FIGURE 2 also compares the pressures obtained from the simulation with RELAP5 and FSAR that showed to be in a reasonable agreement.

FIGURE 4 shows that the core cooling by ECCS was enough to keep the fuel cladding below its melting temperature (1200 ^{0}C). Although the results were not as expected when compared to the FSAR, the ECCS efficiency was verified for this accident.

The reactor control system simulated in this work was able to shutdown the reactor in the safety set point of ANGRA 2, FIGURE 5.

Results presented in this paper showed the correct actuation of the ECCS guaranteeing the integrity of the reactor core.

Further work will be developed to better understand the FSAR differences and guide us to improve the RELAP5 model.

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