STUDY OF THE UNAVAILABLE OF ECCS IN THE EVENT OF LB LOCA OF PWR USING KIRAP

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ABSTRACT: This project presents overview about the role of PSA and the levels of PSA, the process of selecting initial event and accident sequence modeling, and system analysis for PSA level 1. The project also study initially data-base development cho PSA. In this part, two method was shown classical method and Bayesian method. The project calculated the uncertainty of ECCS in case of large break LOCA (LB LOCA) of nuclear power EPR 1600 MWe. The results of core damage calculation in case of large break LOCA is 5.9E-8 a year shown that initial large break LOCA has small contribution to core damage. The result also shown that, the accumulator, electric system and low head injection pump have an important role. They are need to concern in the maintenance. Compare with the data, these results are not compatible well.

I. INTRODUCTION

Developing the resources of nuclear safety analysis has an important role in the first of nuclear power in Vietnam. Having a probabilistic safety analysis group is one of the objects of Nuclear Safety Center in the human developing progress. Studying PSA method and applying PSA for a specific problem is performed to improve safety analysis skill.

PSA is helpful in making decision and for the safety of nuclear power plant. Throught the project, young staffs can achive about following:

- Learing about the PSA level 1, the process of analysis such as initial event selection, sequences modeling, system modeling.
- Studying data-base development for PSA.
- Improving capabilities of using the existing computer codes in Nuclear safety center, especially KIRAP code.
- Studying the uncertainty of ECCS of EPR 1600 MWe in the LB LOCA event.

The SIS of EPR consists of four independent trains, designated Trains 1, 2, 3, and 4, one supplying each reactor coolant loop. The four trains are separated into four safety divisions and are functionally identical. Each SIS train has separate MHSI and LHSI pump trains and an accumulator injection train. The MHSI and LHSI pump trains share an isolable suction line from the IRWST. The discharge lines for all three MHSI, LHSI, and accumulator injection trains branch together to share an injection nozzle on their associated RCS cold leg. Each MHSI train consists of a pump, an isolable supply branch from the shared IRWST suction line, and a discharge line that tees into its respective cold-leg LHSI injection line just upstream of the inboard LHSI-to-RCS isolation check valve. Each accumulator injection train has one accumulator whose isolable injection line tees into its respective cold-leg LHSI injection line just upstream of the inboard LHSI-to-RCS isolation check valve. The LHSI train consists of an LHSI pump, LHSI HX. Each SIS has an emergency division of electricity supplying. Simplified of SIS is shown in Figure 1, and emergency electric system is shown in Figure 2.

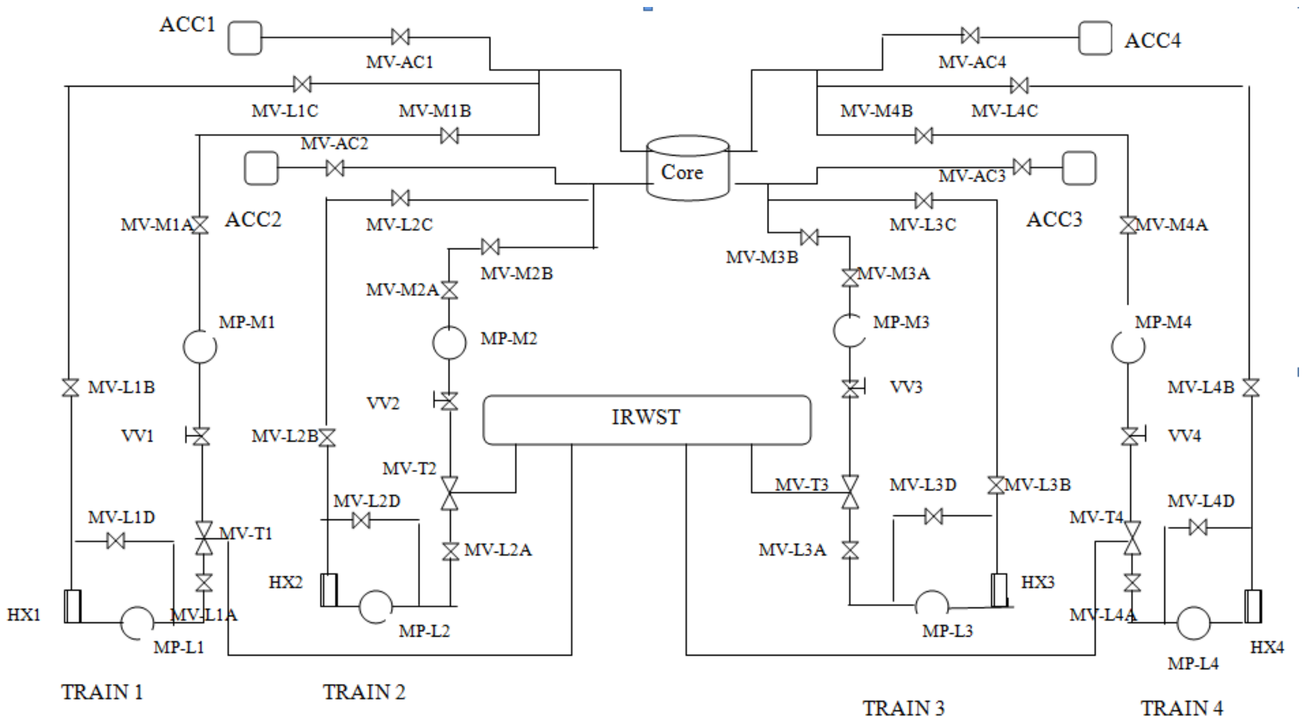


Figure 1: Simplified of SIS.

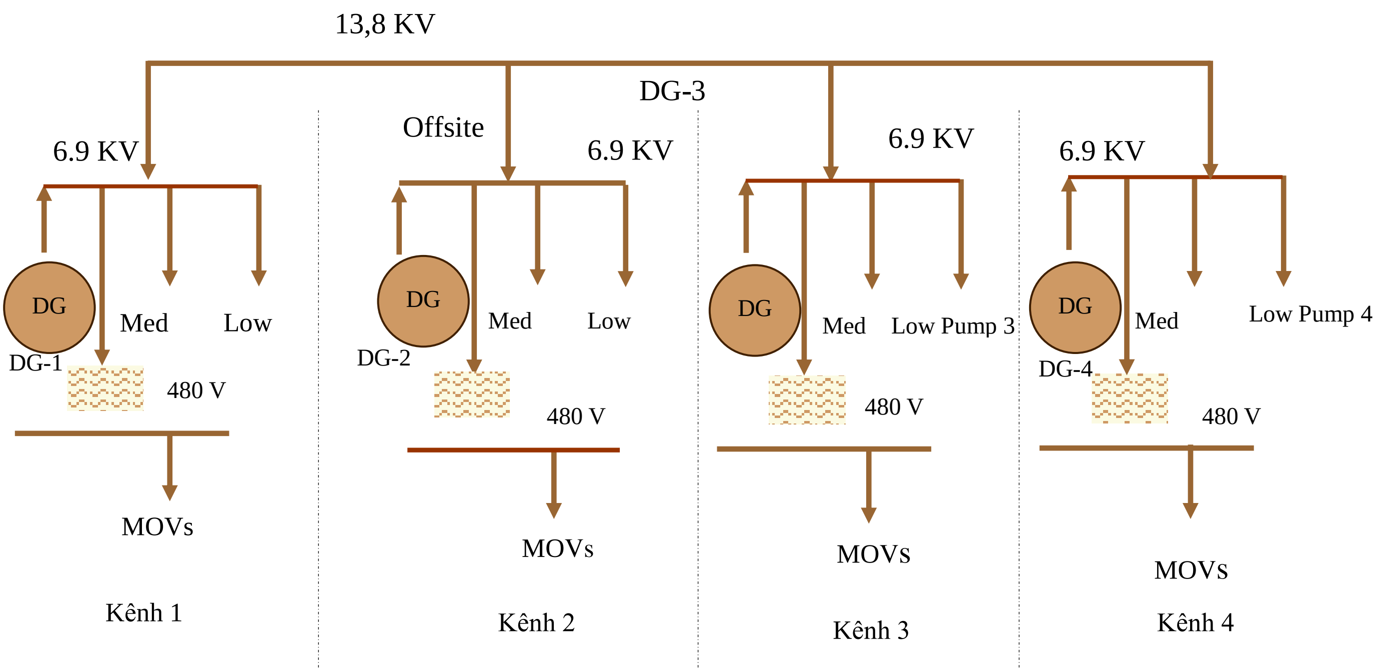


Figure 2: Electric system for SIS.

II. SYSTEM ANALYSIS

When LBLOCA occurs, reactor pressure decrease rapidly. It causes core mass flow rate reduction. Because of this, critical heat flux is over. Safety injection system is initiated to delivery water into the core. The event tree is built as follow:

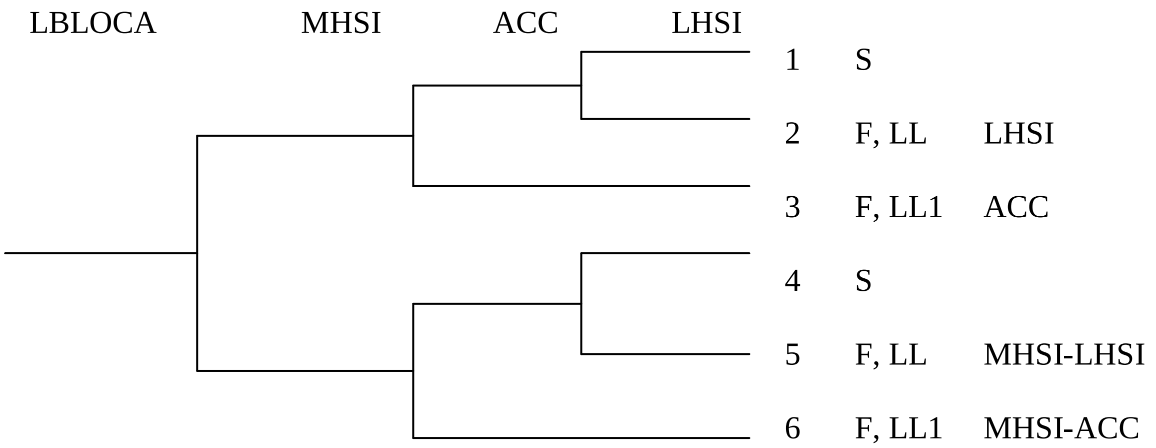


Figure 3: Event tree for LBLOCA initial event.

There are three cases leading to core damage: 3, 4, 5, 6. The fault trees for system MSHI and LSHI and electric are developed (Figure 4, 5, 6).

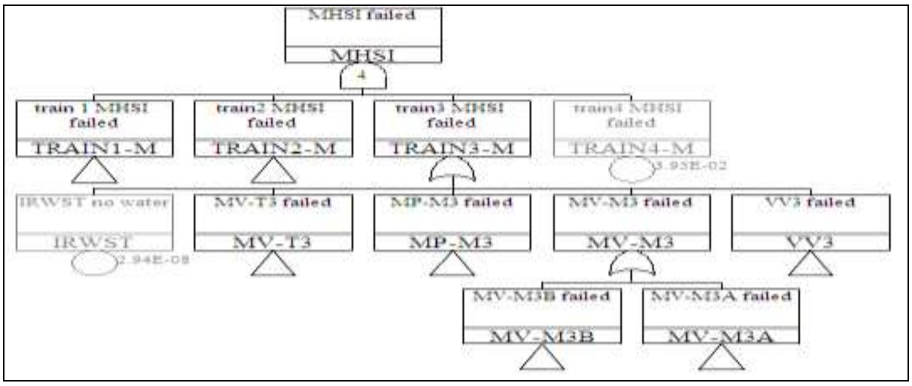


Figure 4: Fault tree for MHSI.

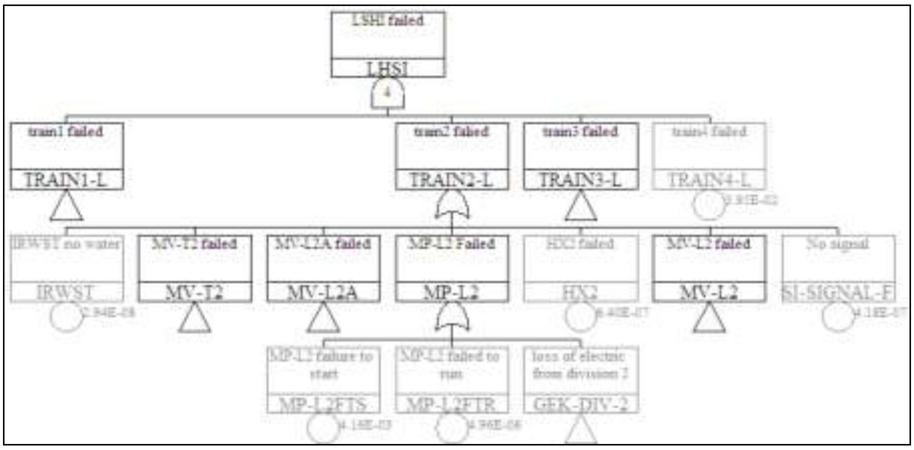


Figure 5: Fault tree for LHSI.

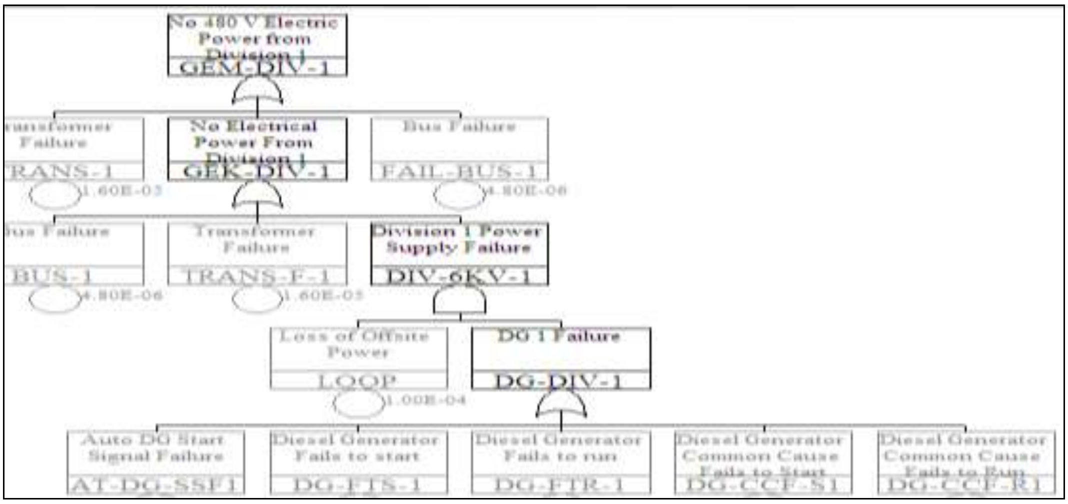


Figure 6: Fault tree for Electricity.

III. RESULTS AND DISCUSSION

The results of core damage frequency for cases 3, 4, 5, 6 are 7.45E-10, 5.83E-08, 7.45E-10, 4.60E-15 respecially (Figure 7). Total core damage for LBLOCA accident is 5.9E-08. Compare with the contribution of LBLOCA event in Figure 8, which is about 2.9E-9, so they are not compatible well. Because in PSA, having all data of all system is very difficult.

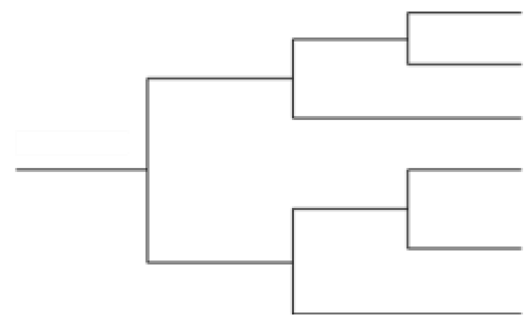
LBLOCA MHSI ACC LHSI			
	S F, LL F,LL1 S F, LL F,LL1	 LHSI ACC MHSI-LHSI MHSI-ACC	 7.45E-10 5.83E-08 7.45E-10 4.60E-15
Tổng			5.90E-08

Figure 7: Results of core damage frequency.

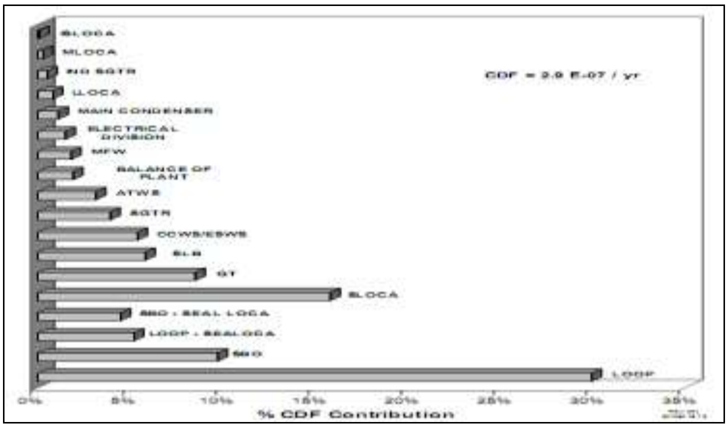


Figure 8: U.S. EPR Initiating Events Contributions – Level 1 Internal Event.

Table 1 shows the important results. It can seen that the failures of accumulator, and HPSI have an important role. So these components are need to concern in testing and maintainace.

Table 1: The important results.

No	Event	Mean	F-V	Rrw	Raw
1	LBLOCA	1.33E-06	1	9999	751879.7
2	ACC	5.00E-06	0.9874	79.186	197474.3
3	TRAIN4	3.95E-03	0.0126	1.0128	4.18
4	MP-L1FTS	4.16E-03	0.0069	1.007	2.66
5	MV-L2A-FTO	1.07E-03	0.0062	1.0062	6.74
6	MV-L2C-FTO	1.07E-03	0.0062	1.0062	6.74
7	MV-L1C-FTO	1.07E-03	0.0018	1.0018	2.67
8	MV-L1A-FTO	1.07E-03	0.0018	1.0018	2.67
9	MV-L1B-FTO	1.07E-03	0.0018	1.0018	2.67
10	SI-SIGNAL-F	4.18E-07	0.0003	1.0003	781.02

IV. CONCLUSION

This project performed studying PSA level 1 and calculating the uncertainty of ECCS of EPR nuclear power plant in case of LBLOCA. The results of core damage frequency with initial LBLOCA help to assess the core safety, and the results of important help to make decision when testing and maintainace. Therefor, the results of PSA contribute to improve the safety of nuclear power plant.

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