Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 27-28, 2011

Estimation of the initiating event frequencies from Korean domestic operational data for Regulatory PSA model

Park, Jin-Hee, Han, Sang-Hoon
P.O. Box 105, Yusong, Taejon, 305-600, Korea
Tel : +82(42)868-8297, Fax: +82(42)868-8256
Email:jhpark6@kaeri.re.kr

I. INTRODUCTION

It is recognized that operating experience data is essential for an accident analysis (including Probabilistic Safety Assessment) and other quantitative activities such as a Risk or Performance informed application for a nuclear power plant. The data for a PSA or other quantitative activities have to use specific data to respect domestic operation characteristic, because they are considered important contributors to the total risk at a nuclear power plant.

The main purpose of this study is to estimate transient initiating event frequencies from Korean domestic operational data to utilize them to MPAS(Regulatory PSA model). For the objectives, Korean specific nuclear power plants transient data gathered and analyzed to estimate initiating event frequency.

II. Data gathering and Database program development

For this study, unplanned plant transient data has been gathered from all the commercial nuclear power plants in Korea during April 1978 in which the first nuclear power plant started its commercial operation through the end of 2010. During this duration, about 572 plant transient events were gathered from 20 commercial operating nuclear power plants and the cumulative operating experience has been about 306 reactor operating years. After the data were collected each transient was reviewed and categorized to apply it to a PSA or other quantitative activities. Table 1 summarizes operating year and the number of unplanned transient events collected from each plant.

In order to analyze the data, the computer-based database program was developed to display information from the data collected. After the data was collected and inserted into to the database program, each transient was analyzed.[1]

III. Analysis.

Transient initiating event frequencies are an essential input to the analysis process of a nuclear power plant PSA or quantitative activities. To evaluate the initiating event frequencies, all the events except for the events which occurred in CANDU Type plants(4 plants are CANDU type in Korea) are inserted into the computer program. [1, 2]

Table 1. Summary on the operating year & number of events for each units

Unit	Cal. Year	Rx. Year	# of events
1	32.7	26.18	122
2	27.45	23.9	62
3	25.27	21.94	44
4	24.69	21.79	37
5	24.37	21.48	35
6	23.58	20.51	35
7	15.76	14.08	17
8	15.01	13.52	15
9	8.62	7.63	9
10	8.02	7.19	6
11	22.32	19.3	35
12	21.27	18.81	29
13	12.4	11.42	11
14	11.01	10.09	15
15	6.43	5.15	4
16	5.69	5.31	4
17*	27.71	23.51	58
18*	13.51	12.36	17
19*	12.51	11.57	12
20*	11.26	10.56	5
total	349.58	306.3	572

* CANDU type plant

In this study, to estimate the initiating events frequencies for the MPAS PSA model, the transient events are classified according to the PWR Transient Category.[4] Table 2 summarizes the result of the PWR transient Category classification.

Table 2. The results of the PWR Transient category classification

PWR Transient Category		# of Events
B1	Loss of Offsite Power	8
C2	Loss of Vital Low Voltage ac Bus	1

D1	Loss of Instrument or Control Air System	4
E1	Total Loss of Service Water	1
E2	Partial Loss of Service Water	2
F1	Steam Generator Tube Rupture	1
G1	Very Small LOCA/Leak	1
G5	Stuck Open: 2 or more Safety/Relief Valves	2
G8	Reactor Coolant Pump Seal LOCA: PWR	1
H1	Fire	2
J1	Flood	1
L1	Inadvertent Closure of All MSIVs	5
L2	Loss of Condenser Vacuum	28
P1	Total Loss of Feedwater Flow	10
QC4	Loss of ac Instrumentation and Control Bus	12
QC5	Loss of Nonsafety-Related Bus	27
QG10	Inadvertent Open/Close: 1 Safety/Relief Valve	2
QG9	Primary System Leak	28
QK4	Steam or Feed Leakage	14
QL5	Partial Closure of MSIVs	14
QL6	Condenser Leakage	4
QP2	Partial Loss of Feedwater Flow	40
QP3	Total Loss of Condensate Flow	3
QP4	Partial Loss of Condensate Flow	2
QP5	Excessive Feedwater Flow	23
QR0	RCS High Pressure (RPS Trip)	1
QR1	RCS Low Pressure (RPS Trip): PWR	1
QR2	Loss of Primary Flow (RPS Trip):PWR	16
QR5	Turbine Trip	162
QR6	Manual Reactor Trip	73
QR7	Other Reactor Trip (Valid RPS Trip)	13
QR8	Spurious Reactor Trip	65
QR9	Spurious Engineered Safety Feature Actuation	3

Most of the transient category cases, for an arithmetic average of the Korean specific data is higher than that of the U.S experience because the Korean operating experience is too short when compare to the U.S operating experience during the Bayesian updating process.

IV. CONCLUSIONS

In this study, unplanned plant transient events are gathered and analyzed to obtain an insight from the Korean domestic data. The initiating event frequency for 5 MPAS model updated by this domestic transient event data.

ACKNOWLEDGMENTS

This work has been carried out under the Nuclear long term R&D Program sponsored by the Korea Ministry of Education, Science and Technology.

REFERENCES

1. Development of a database system for shutdown events of nuclear power plants in Korea", KAERI/TR-2131/2002, 2002.
2. Development of transient initiating event frequencies for use in Probabilistic Risk Assessments, NUREG/CR-3862, 1985.
3. Updating of initiating events frequencies in the UCN 3,4 PSA", KAERI/TR-2957/2005, 2005.
4. Rates of Initiating Events at U.S Nuclear Power Plants:1987 -1995, NUREG/CR-5750, 2002.