Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

Issues from the Study of ILRT Interval Extension

M. R. Seo, S. Y. Hong, M. K. Kim, B. S. Chung, H. C. Oh, J. h. Ha
KEPRI, Nuclear Power Laboratory, 103-16 Munji-Dong Yuseong-Gu, Daejeon, 305-380, Korea, mrseo@kepri.re.kr

1. Introduction

In Korea, the containment Integrated Leakage Rate Test (ILRT) was performed with 5 year interval. But, in MOST(Ministry of Science and Technology) Notice 2004-15 "Technical Standards of Primary Reactor Containment Leak-Tightness Tests", the extension of the ILRT interval from once per 5 years to once per 10 years can be allowed if some conditions are met. So, the safety analysis for ILRT interval extension was performed and the ILRT interval extension of Yonggwang Nuclear (YGN) Unit 1&2, Kori Nuclear (KOR) Unit 3&4 (Westinghouse Type) and YGN Unit 3&4 (KSNP) was already endorsed to once per 10 years. In addition, the study of ILRT extension for Ulchin Nuclear (UCN) Unit 1&2 (Framatome Type), UCN Unit 3&4 (KSNP) and KOR 2 (Westinghouse Type) is going ahead.

The safety analysis for ILRT interval extension was composed of two parts, off-site consequence evaluation and evaluation of risk increase rate due to test interval extension. In this study, some issues founded by safety analysis were introduced and discussed.

2. Off-Site Consequence Evaluation

2.1. Weather Data Acquisition System

In general, the risk in associated with ILRT interval extension was affected by the site specific conditions, especially weather condition and population distribution. During the safety analysis, we gathered the weather data from all Korean NPP site, but the weather data acquisition systems and procedures are differed form each site. In the situation of severe accident, if the radionuclides are escaped from containment, the weather condition is very important to evacuation planning, especially in the case of small country such as Korea. So, it is necessary to establish the standardized on-line weather data acquisition system and procedures and to be totally managed.

2.2. Source Term Tracking

Until recently, since the requirement for PSA is limited to Level 1 & 2 analysis world widely, the source term evaluation is only treated in Level 2 analysis although the public risk is directly affected by the source term. In the first stage in Level 2 analysis, the initial core inventory was calculated by ORIGEN code and the mass of each radionuclide was inputted in MAAP code for severe accident analysis. In the final stage in Level 2 PSA, all the accident sequences were classified into source term categories (STC), and the release mass and fraction of each STC was calculated using MAAP code. At this stage, since the release mass is calculated as the product of release fraction and initial mass, the mass of radionuclide produced during severe accident, such as core melting, was not calculated. These results were regrouped and inputted to MACCS code for Off-site consequence evaluation and directly affected the calculation results for population risk. So, in order to reduce uncertainty and increase the credibility of risk analysis results, it is necessary to track the source term from initial mass inventory to final release mass including the mass of new radionuclide produced.

2.3. MACCS Model Applicability

It is appropriate to use the MACCS code for mid and long range (100km~1000km) in Off-site consequence evaluation. But, the credibility of this result for small range (~ 100km) is limited. And, the risk to public by radioactive material released from containment during severe accident is affected by weather condition such as wind direction and precipitation which is related to configuration of ground. So, it is necessary to develop the more realistic atmospheric dispersion model that is more appropriate for Korean site characteristics such as meteorological and geometrical property instead of current recommended model.

2.4. Evacuation Planning

In the previous paper, the risk associated with 3 site specific conditions, YGN, KOR, and UCN was compared. Since the population density of UCN site was very lower than that of YGN and KOR site, it was expected that the risk associated with ILRT interval extension of UCN, especially the population risk, is much lower than that of YGN or KOR.

But, as shown in Table 1, the population risk of Ulchin site is not much lower than that was expected.

Table 1. The risk assessment results by NUREG-1493

Risk Index	UCN 1,2	KOR 3,4	YGN 3,4	YGN 1,2
Population Risk (person·rem/yr)	1.43	18.1	0.72	2.05
Risk Increase	0.049 %	0.131 %	0.142 %	0.061 %

The main reason is that the wind around UCN site is blown to the main population residence area. In other words, 30% among the total population within the 80km radius area from the YGN plant was inhabited under the main wind direction. But, in the case of UCN site, more than 70% was inhabited under the main wind direction. This insight is not significant in ILRT interval extension

of UCN 1&2 since the amount of risk increase of UCN 1&2 is still much lower than that of other plant

But, it is judged that this insight will be considered some more importantly from the view point of the radioactive protection and evacuation planning because of site characteristics around Ulchin. So, it is necessary to represent the probability concept to deterministic evacuation planning for more effective and realistic planning

3. Utilization of Expert Panel

The main risk contribution factor in risk assessment due to ILRT interval extension is the undetectable leakage rate. The meaning of the undetectable leakage rate is the fraction of leakage pathways that are detected only by ILRT. In other words, the undetectable leakage rate is the performance indicator of containment integrity and the usefulness of ILRT itself. In U.S, through the review of real plant database and the statistical analysis, 3% undetectable leakage rate is used in risk assessment.

But, since the U.S database was created based on 3 per 10 years test interval, the Korean regulatory body pointed that application of 3% undetectable leakage rate to Korean NPP is not appropriate. At present, since ILRT interval in Korea is 1 per 5 years, they insist that the probability of pre-existing leak is bigger than that in the case of U.S. So, 5% undetectable leakage rate was used in the risk assessment, although the basis for that is not the statistics but engineering judgments.

In the recent study for Risk-Informed ILRT interval extension program in U.S, the role of expert panel is greatly emphasized. The role of expert panel is the review of containment leak event database and determination of proper leak probability and size, and the impact to risk. Every step of expert elicitation process was formulated and documented. Through this process, the more reasonable risk impact can be evaluated.

4. Performance Monitoring Plan

According to the "Principle of Risk-Informed Regulation" in RG 1.174, it is required that the impact of the proposed change should be monitored using performance measurement strategies. But, in the case of ILRT test interval extension, it is difficult problem to set up the performance monitoring plan because the target is containment itself.

As a first step to strength the performance, the test standard is upgraded from ANSI/ANS 56.8-1987ed. to 1994ed. by the requirement of the regulatory body. And the second step, the interval of visual inspection is strengthened and clearly stated in the ILRT procedure.

In addition, the management method and program for the containment penetrations and the related valves in connection with Maintenance Rule is being discussed.

5. Periodic Risk Management

New ILRT interval is once per 10 years and it is some long time period. During this period, it is expected that so many changes maybe happen in site condition such as weather condition and population distribution that is the major factor for public risk. In addition, it is also expected that the plant PSA model which is the base for risk assessment will be updated. So, it is judged that the plans for periodic risk assessment and management must be established. These plans are essential for Risk-Informed Application program and the detailed plan may depend on the characteristics of program. In general as in U.S, it is appropriate for the interval of periodic re-assessment to meet that of Maintenance Rule program because the data such as reliability and availability should be reviewed and updated during this period. And also the major upgrade in PSA model should be happened in accordance with the revision of data. In Korea, the interval of Maintenance Rule re-assessment is once per 3 years (2 refueling stage), this interval is adequate for tracking the change of weather trend and population distribution.

6. Conclusion

At this study, some issues founded through the study of ILRT interval extension in Korea were discussed. Issues related to the off-site consequence evaluation are not the easy problems and it may take a long time to solve the issues technically, especially the MACCS model applicability. On the other hand, the remaining issues, the utilization of expert panel, performance monitoring plan, and periodic risk management, are the systematic problem of the Plant (KHNP) to be solved spontaneously with a long term view.

REFERENCES

[1] "Performance-Based Containment Leak-Test Program," NUREG-1493, January 1995.
[2] "Interim Guidance for Performing Risk Impact Assessments In Support of One-Time Extensions for Containment Integrated Leakage Rate Test Surveillance Intervals," NEI Memo, September, 2001
[3] "Risk assessment of Ulchin Unit 1&2 according to ILRT interval extension," KEPRI, TM.S01.P2006.337, June, 2006.
[4] "Risk Assessment for the Containment ILRT Interval Extension of Yonggwang Unit 1&2", ICAPP05, May, 2005.
[5] "Study on the Outside Risk Contribution Factor for ILRT Interval Extension", 2006 Spring KNS Meeting, May, 2006.
[6] "Risk Assessment for ILRT Interval Extension of Ulchin Unit 1&2", 2006 Fall KNS Meeting, November, 2006.