Risk Assessment for ILRT Interval Extension of Ulchin Unit 1&2

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 1 per 5 years to 1 per 10 year 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 (Westinghouse Type) and YGN Unit 3&4 (CE Type KSNP) was already endorsed to once per 10 years.

Ulchin Nuclear (UCN) Unit 1&2 were the Framatome type PWR and their original design basis ILRT intervals were 1 per 10 years. But, in 1992, when the ILRT interval of domestic PWR was extended from 3 per 10 years to 1 per 5 years, ILRT interval of UCN 1&2 was reduced instead.

2. Site Specific Conditions

2.1. Weather Condition

In general, the risk in associated with ILRT interval extension was affected by the site specific conditions. The weather data measured from the observation tower around the UCN site from 2000 to 2004 was collected and analyzed.

Fig 1. shows the amount of rain measured from observation tower from 2000 to 2004. The base case data for risk assessment was that measured in 2004, though the amount of rain in 2002 and 2003 was more than that in 2004 because of local heavy rain by abnormal weather condition.

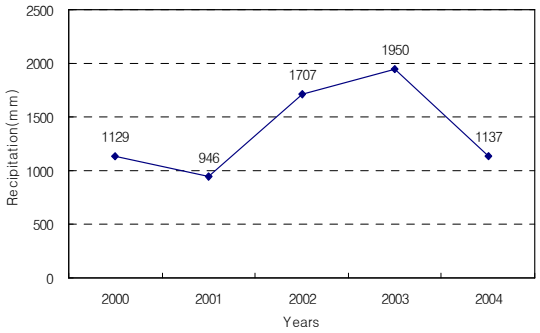

Fig 1. The amount of rain measured by UCN site

The Fig 2 shows the annual average wind direction in 2004, and the north wind is shown to be dominant.

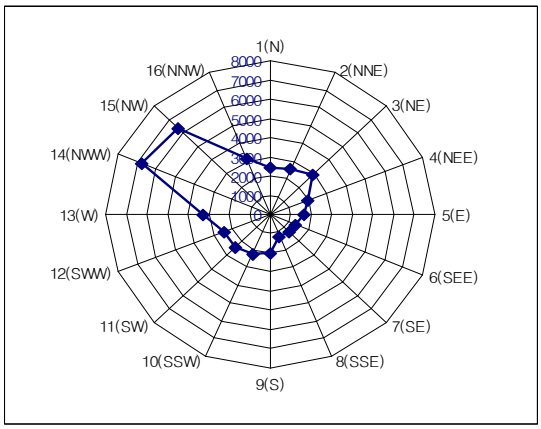

Fig 2. The wind direction distribution around UCN site

2.2. Population Distribution

The population distribution within 80 km around the UCN site was calculated using annual statistical report of local autonomous entity published in 2004 and shown in Fig 3. According to analysis results, the total number of population within 80 km for risk assessment was 643,234.

Distance (km)	Population
0-16	39,809
16-32	39,217
32-48	134,989
48-64	174,851
64-80	254,367
Sum	643,234

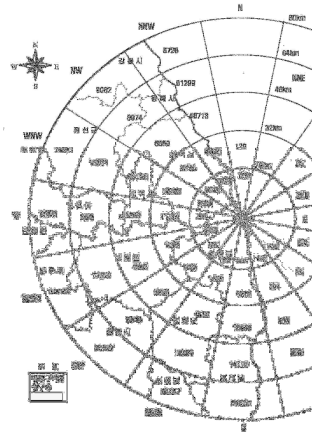

Fig 3. The population distribution around UCN site

3. Risk Assessment

The first step for risk assessment for ILRT interval extension is to perform the off-site consequence analysis which calculates the population risk due to the release of radioactivity material.

Table 1. The off-site consequence analysis results

STC	Frequency	Early Effect Probabilistic Population Risk (person·rem/year)	
		Mean	99.5%
1,2 (No CF)	3.92E-06	5.84E-04	1.17E-02
3 ~13 (CF)	4.15E-06	1.43E+00	2.85E+01
SUM	8.07E-06	1.43E+00	2.85E+01

The second step is to estimate the change of population risk due to the ILRT interval extension based on the methodology described in NUREG-1493 and NEI interim report (using 5% undetectable leakage rate)

Table 2. 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 %

Table 3. The risk assessment results by NEI

Risk Index	UCN 1,2	KOR 3,4	YGN 3,4	YGN 1,2
Risk Increase (%)	0.005	0.015	0.018	0.01
LERF Change	3.63E-08	3.91E-08	2.17E-8	3.37E-8

Table 2 & 3 shows the comparison results of risk assessment for the extension of ILRT surveillance intervals of UCN 1&2 and those of other PWR evaluated previously. In case the ILRT surveillance interval of UCN 1&2 is extended from 1 per 5 years to 1 per 10 years, the increase rates of risk are very low. Moreover, the amount of changes for LERF also satisfies the criteria of RG-1.174 of US NRC.

4. Risk Insight

The risk in associated with ILRT interval extension was affected by the site specific conditions, such as climate and population. In the previous paper, the risk associated with two site specific conditions, Yonggwang and Kori were compared. Since the population density of Ulchin site was very lower than that of Yonggwang and Kori site, it was expected that the risk associated with ILRT interval extension of UCN 1&2, especially the population risk, is much lower than that of YGN or KOR.

But, as shown in Table 2, the population risk of Ulchin site is not much lower than that was expected. The main reason for these 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 YGN or KOR.

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.

4. Conclusion

The risk assessment for the extension of ILRT surveillance intervals of UCN 1&2 is performed based on the methodology described in NUREG-1493 and NEI interim report. Based on the results of Level I & II PSA for UCN 1&2, off-site consequence analysis is performed using MACCS II code. And, with these results, risk impact due to the extension of ILRT interval is evaluated and the risk increase rates are quantified.

The assessment results show that risk levels for UCN 1&2 are lower than that of YGN 1&2, 3&4 and KOR 3&4 previously evaluated. Therefore, in case the ILRT surveillance interval of UCN 1&2 is extended from 1 per 5 years to 1 per 10 years, the increase rates of risk are very low. Moreover, the amount of changes for LERF also satisfies the criteria of RG-1.174 of US NRC.

REFERENCES

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