

ALARA Programs & Occupational Dose Trend in Wolsong Nuclear Power Plant

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Abstract

Over the last two decades, KHNP(Korea Hydro & Nuclear Power Co., Ltd) has made excellent accomplishments in controlling and reducing radiation exposure to workers. For the first time, the main driver for controlling radiation exposure was to ensure legislative compliance. Atomic law in Korea requested implementation of actual ALARA program. KHNP developed the standard ALARA procedure which has lower limitations and stronger members of organization than the previous procedure.

These doses reductions have achieved by ALARA program through a variety of means. As a result of the ALARA program, annual total dose has not increased even if the number of operating NPPs(Nuclear Power Plants) is increased. The number of over-exposure workers exceeded 20m-Sv per year has been also rapidly diminished until 1999 and then there has been no over-exposure worker till now.

Introduction

KHNP has always striven to reduce occupational exposures to levels that are ALARA(As Low As Reasonably Achievable) and has made remarkable strides over the last two decades. These reductions have achieved through a variety of means at a number of levels, even if main driver for controlling radiation exposure was to ensure legislative compliance. In practical, this reduction was achieved through making the legal limits and ensuring these limits even if there were many factors.

Brief history of Korea Regulatory Law related in ALARA is as follows,

- 1958 : Establishment of the Atomic Act
- 1983 : General Revision based on ICRP-9(MPD, MPAD, MPC)
- 1994 : Include the concept of “ALARA”
- 1996 : Apply the Dose Limit concept (No quarterly limit)
- 1998 : Internal dosimetry 100mSv/5yr (50mSv/yr maximum) but 200mSv/5yr (2002)
- 1999 : Require to implement “ALARA program”
- 2001 : Apply the concept of ALI, DAC

Introduce ICRP-60 recommendations to ALARA Program

Korea adopted ICRP-60 recommendations by law stated in Article 98-12 of MOST in 1998. To meet the recommendations, various radiation management techniques were developed. KHNP started to revise its ALARA program and developed the standard ALARA procedure. Table 1 shows main improvement contents of ALARA program.

Table 1 Improvement of ALARA Program

	Previous (before 2000)	Present
ALARA Committee	Expected Dose Above 250man-mSv	Expected Dose Above 200man-mSv
ALARA Practical Committee	Expected Dose 100~250man-mSv	Expected Dose 70~200man-mSv

ALARA Program in KOREA

1. ALARA Organization and responsibility before 2000

Previous ALARA procedures have applied to each plant until developing the standard ALARA procedure for all plants in 2000. Table 2 & 3 briefly shows contents of previous procedures for PWR and PHWR, respectively.

Table 2 ALARA Committee before 2000

		PWR	PHWR
Organi- zation	Chairman	Plant Manager	Plant Manager
	Vice chairman		Vice plant Manager
	Member	Vice plant Manager Plant Section Manager	Plant Section Manager QA Manager
	Secretary	Appointed person Radiation Safety Sect. Manager	Plant Manager(Sub-contractor) Radiation Protection Sect. Manager
Responsibility		- Review ALARA program - Review dose reduction plan for works which expected dose above 250man-mSv	- Review ALARA program - Review dose reduction plan for works which expected dose above 250man-mSv

Table 3 ALARA Practical Committee before 2000

	PWR	PHWR
Organization	Radiation Safety Sect. Manager ALARA staff Radiation Protection Sect. Chief Work planner and Supervisor	Radiation Safety Sect. Manager Radiation Protection Sect. Chief Maintenance Sect. Chief Work Supervisor
Responsibility	- Review dose reduction plan for work which expected dose 100~250man-mSv	- Review ALARA sheet for work which expected dose 100~250man-mSv

Figure 1 shows ALARA committee organization described in the standard ALARA procedure. This

procedure applies to the all NPPs, commonly. Responsibilities of ALARA Committee are as follows,

- (1) General reviews of ALARA program such as
 - RP Policy, Annual Target, Long-term ALARA strategy etc)
- (2) For works above 200 man-mSv(expected dose)
 - Review radiation protection optimization planning
 - Review ALARA results after work if actual dose exceeded by 25% more than expected dose
- (3) Review radiation safety control plan during O/H periods
- (4) Review of optimization plan for radiation protection (whenever requested by chairman)

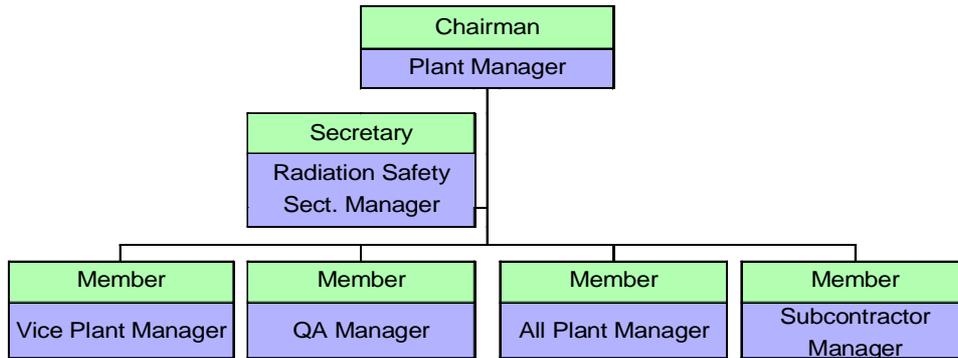


Figure 1 ALARA committee organization after 2000

2. ALARA Organization and responsibility after 2000

Figure 2 shows ALARA practical committee organization described in the standard ALARA procedure.

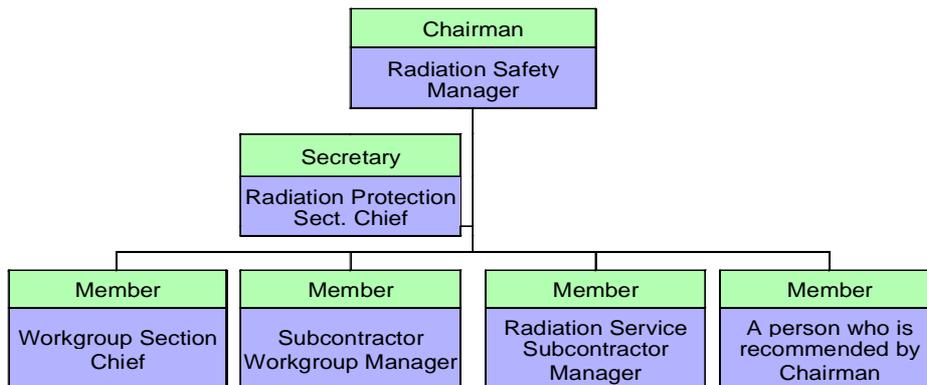


Figure 2 ALARA practical committee organization after 2000

Responsibilities of ALARA practical committee are as follows,

- (1) For works above 70~200 man-mSv(expected dose)
 - Review radiation protection optimization planning
 - Review ALARA results after work if actual dose exceeded by 25% more than expected dose
- (2) Review radiation safety control plan for following workplaces
 - Airborne Tritium concentration exceed 10DAC
 - Expected dose exceed 10 man-mSv

(3) Review of optimization plan for radiation protection (whenever requested by chairman)

3. ALARA Committee Operation

ALARA committee should be operated to keep the occupational radiation exposure (ORE) dose as low as reasonably achievable in Nuclear power plant. The operating methods such as calling ALARA committee and making decision are as follows,

- (1) Minimum 50% of the committee membership should be attended
- (2) Issued meeting agenda should be agreed by two-thirds of the attendee
- (3) Urgent items & imperative cases can be decided in writing by the committee members without the committee meeting

Table 4 ALARA Documentation & Control

Expected Dose (man-mSv)	Retention of records
Radiation work plan (Over 10 under 70 man mSv)	3 years
Doc. reviewed by ALARA practical committee (Over 70 under 200 man mSv)	5 years
Doc. reviewed by ALARA committee (Over 200 man mSv)	Plant life time

Results of ALARA program

1. Decrease in Exposure Dose

As a result of the ALARA program, annual total doses have not increased in contrast to increasing of the number of operating NPPs. And environmental radiation working conditions also have not changed extremely. Furthermore, average dose per person & NPP are diminished continuously. .

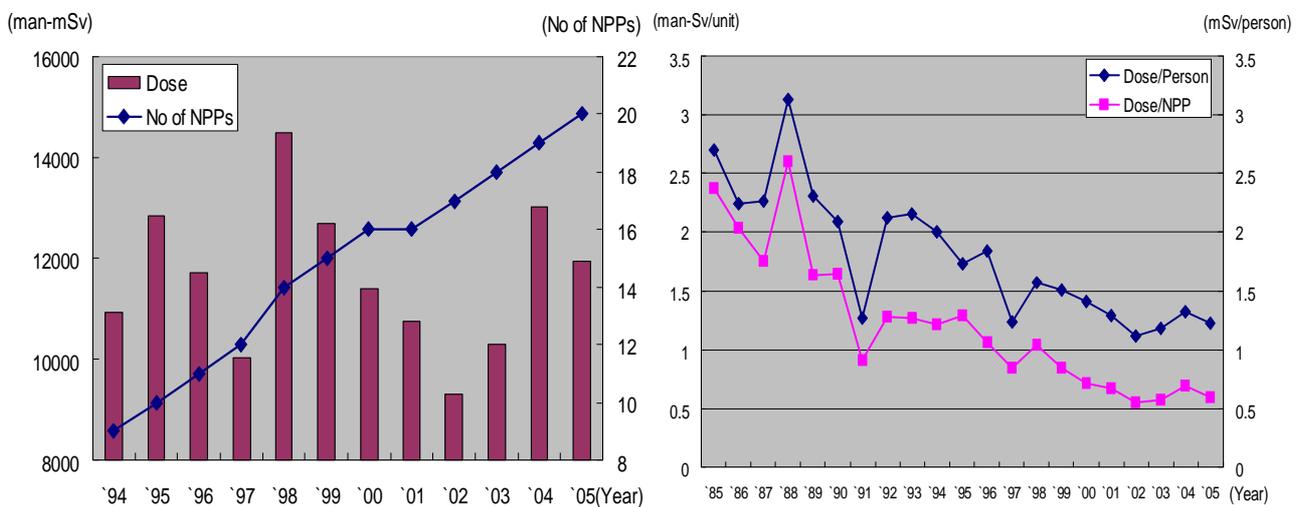


Figure 3 Annual Dose & No. of Operating NPP

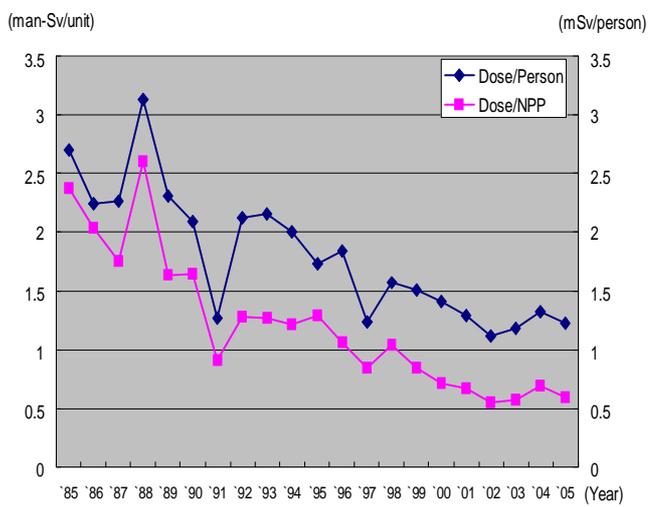


Figure 4 Annual Avg. Dose per NPP & Person

2. Diminishment of Over-Exposure Workers

In status of over-exposure workers exceeded 20m-Sv per year, the trend shows that the number of over-exposure workers has increased before 1990 and rapidly diminished until 1999. Due to good radiation management and ALARA program, there is no over-exposure worker till now.

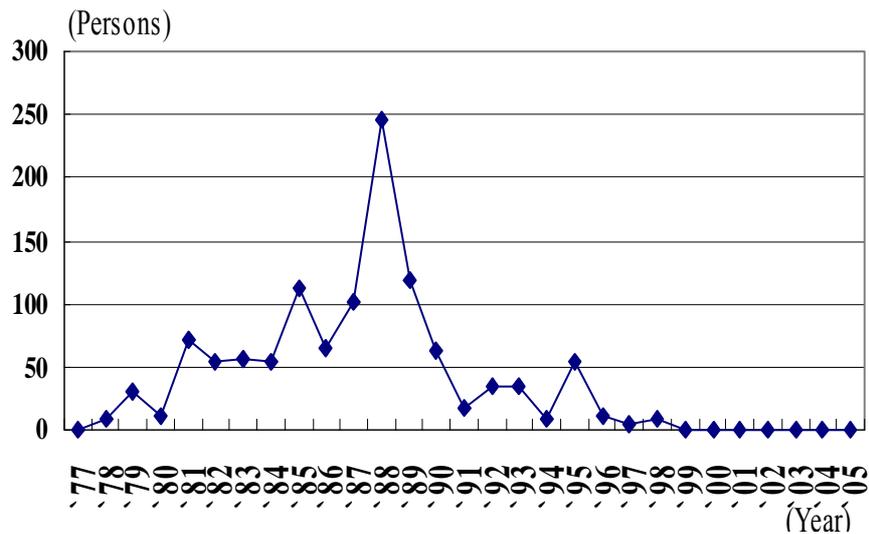


Figure 5 Status of Over-exposure Workers

3. Tendency in Exposure Dose

Based on last 5 year's exposure dose tendency, the dose at all NPPs during normal operation & overhaul period is 22.3% and 77.7%, respectively. And PHWR plant is 31.0% and 69.0%, respectively. It is lower than all NPP's but the figure is still high. It means that the radiation exposure dose should be managed and ALARA activity also should be concentrated during overhaul period.

Table 4 Exposure Dose for All NPP

Year	Dose(man-mSv)			% of O/H Dose
	Normal Operation	O/H	Total	
2000	1,811	9,583	11,394	84
2001	2,181	8,571	10,752	80
2002	2,671	6,644	9,315	71
2003	2,756	7,532	10,288	73
2004	2,627	10,398	13,025	80
2005	2,607	9,323	11,930	78

Table 5 Exposure Dose for PHWR

Year	Dose(man-mSv)			% of O/H Dose
	Normal Operation	O/H	Total	
2000	750	1,463	2,213	66
2001	779	1,898	2,677	71
2002	877	1,661	2,538	65
2003	1,137	2,027	3,164	64
2004	845	2,485	3,330	75
2005	809	2,207	3,016	73

Conclusions

Atomic law in Korea requested implementation of actual ALARA program. To ensure legislative compliance, KHNP developed the standard ALARA procedure which has lower limitations and stronger

members of organization than the previous procedure.

For the first time, management had a duty to ensure doses were ALARA. But these doses reductions have achieved through a variety of means such as ALARA program. As a result of the ALARA program, annual total dose has not increased even if the number of operating NPPs has been increased. The number of over-exposure workers exceeded 20m-Sv per year has been also rapidly diminished until 1999 and there is no over-exposure worker till now.

References

1. Annals of KHNP, "Nuclear power plant annual radiation management report", Korea Hydro & Nuclear Power Co., Ltd, 1991~2005.
2. Annals of ICRP, "1990 Recommendations of the international commission on radiological protection", ICRP publication 60, Vol. 21, 1990.
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