

Reduction of personal contamination by keeping score

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Abstract

To increase safety and reduce the number of personal external contaminations we have started a programme where we follow up every alarm in the whole body monitors. The contaminated person is interviewed on which type of job he or she was doing, where the job was done and which protective clothing was used. By doing this we are made aware of inadequate workmanship, contaminated locations and insufficient protective gear, which we can correct promptly by adequate jobplanning. To get to terms with contamination emanating from the reactor hall we have installed mandatory whole body monitoring on exiting the hall. By taking these measures we have been able to reduce the number of alarms in whole body monitors from 2 % of monitored exits to below 0,5%.

Introduction

Important aspects for the radiological protection (RP) staff is to make sure that no contamination leaves the plant and, of course, to ensure that the staff is well protected. Keeping down the number of personal contaminations reduces the risk that a person brings out contamination from the RCA/CCA, it reduces the risk for internal contaminations and it also reduces doses, especially if the contaminations are reduced by cleaner workplaces and improved workmanship.

At Forsmark NPP each worker is whole-body monitored to check for contamination at least twice before exit (figure 1). First, while leaving the RCA/CCA work area and entering the changing room (pre-monitoring), second, after having removed the personal protective gear and passing the shoe-barrier (exit-monitoring). We have approximately 200 000 exits through final monitors per year adding all 3 units. We have also introduced mandatory walk-through whole-body monitoring at exiting the reactor hall since the hall is a known source of contamination.

If a person is contaminated the monitoring system gives an alarm and the contaminated body part is pointed out. Utilizing this information we have developed a routine where all alarms in the pre- and exit-monitoring is registered and followed up. By doing this we have been able to significantly reduce the number of contaminated persons in the exit-monitoring.

Method

If a person receives an alarm in the pre-monitors the RP staff is notified. If the contamination takes place during office hours or during outages the RP office adjacent to the pre-monitors is constantly staffed. The contaminated person is assisted during cleanup and the contaminated body part and the location where contamination likely took place is noted on a log-paper and then transferred to an excel spreadsheet for statistical analysis. During non-office hours at operation periods, when the RP office is not staffed, there is a binder that clearly states what should be done if a person is contaminated which always includes filling in the log- paper.

Monitoring of external contamination at Forsmark NPP

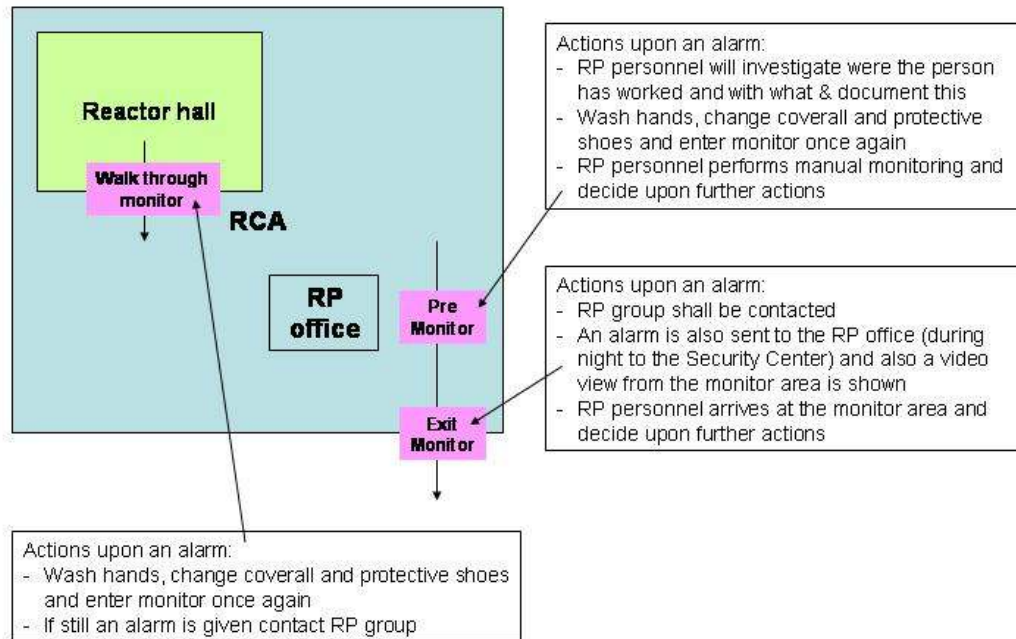


Figure 1, schematic on how external contaminations are monitored at Forsmark NPP

During normal operation follow-up of alarm data is done weekly and during outages data is processed daily (table 1). If any person is contaminated more than twice in one day, follow-up is done regarding the causes. First it is checked if the RP staff have performed their duties regarding information, job-planning, contamination checks and supply of protective gear. If all these duties are found to have been performed satisfactory the management of the contaminated person is notified. The RP staff indicate on the notice if, in their opinion the person has failed to follow instructions, voluntarily or involuntarily, or lacks the knowledge on how to behave in the RCA/CCA. It is the work management's obligation to take action, if needed.

	Pre				Exit				Workplace							
Date	Coverall	Shoes	Hands	Other	Face	Hands	Feet	Other	Reactor hall	U.containment	L.containment	Reactor build.	Turbine	Workshop	Waste dep.	Other
Monday	9	3	2	0	0	0	1	0	2	1	5	2	1	0	0	0
Tuesday	13	2	2	2	1	1	1	3	2	3	8	1	1	0	0	0
Wednesday	15	3	3	0	0	1	0	2	0	7	5	1	5	3	0	0
Thursday	13	10	3	0	0	1	2	3	1	2	7	0	9	9	0	1
Friday	10	1	0	0	0	1	0	2	1	7	3	0	2	0	0	0
Saturday	17	1	1	0	1	1	0	1	2	14	3	0	0	0	0	0
Sunday	12	0	1	1	2	0	2	2	1	9	1	0	0	3	0	2
Sum	89	20	12	3	4	5	6	13	9	43	32	4	18	15	0	3
	Pre				Exit											
Sum	124				28											

Table 1. Example of the contamination follow-up, first week of outage at Forsmark 3

Follow-up is also done if any specific workplace results in contamination more than twice in one day. The RP-technician responsible for that location is notified and extra cleaning performed. This procedure is a great help making sure that locations where contamination is spread are kept as clean as possible.

Results

The routines to follow up alarms in the pre-monitoring started in 2005 and since then the number of alarms in the exit-monitoring have been reduced to about one fourth (figure 2). The new routines have been very well accepted and adapted; despite the interrogative approach very few negative comments from the workers have been noted.

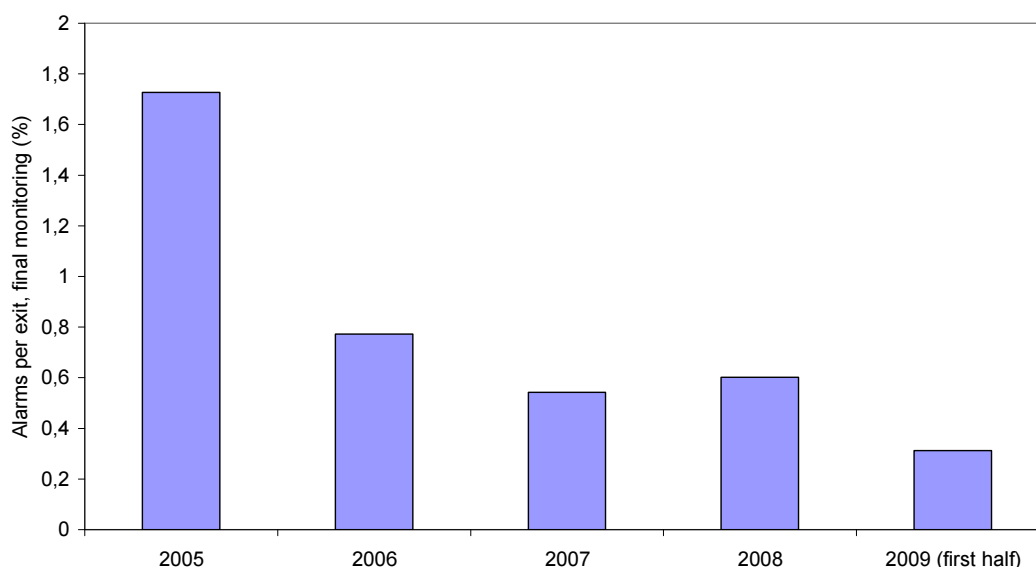


Figure 2, Alarms per monitored exit, all Forsmark units.

To further emphasize the importance of keeping down contaminations we have set goals in our ALARA-programmes. In 2006 and 2007 the goal in our ALARA-programme was to have alarm in less than 2 % of exits through the exit-monitors. In 2008 the goal was lowered to 1 % and for 2009, the goal is set even lower, to 0.5 %.

	F1	F2	F3	Alara goal
2005	1,76	1,28	1,80	n.a
2006	0,75	0,71	0,91	2
2007	0,46	0,35	0,68	2
2008	0,38	0,32	1,03	1
2009 (first half)	0,21	0,13	0,57	0,5

Table 2, Percentage of alarms per monitored exits for each Forsmark unit compared to the goal set in the ALARA-programme.

In table 2 the outcome can be seen for the different units. It is shown that both unit 1 and 2 have been significantly below the goal since start and unit 3 is below the goal or just at it. As for the values for 2009, only a short refuelling outage at unit 2 has taken place during the first 6 months therefore the values might change, but they are promising so far.

By introducing mandatory contamination control upon exiting the reactor hall the number of contaminations emanating from the hall is kept relatively small. From the hall being a dominant source of contamination there is now a larger spread of different locations from where contamination occurs, depending on the jobs currently taking place, as can be seen in figure 3.

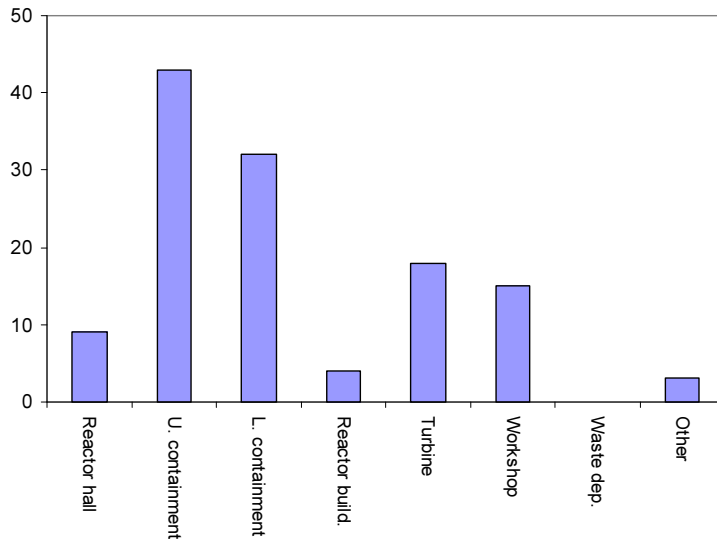


Figure 3. Number of contaminations emanating from different workplaces, first week of outage at F3.

Conclusions

To conclude we have managed to reduce the number of alarms in the final monitors simply by keeping score. By doing this we are made aware of inadequate workmanship, we can faster and more accurately react on contamination spread in areas or in connection with specific jobs and perform countermeasures regarding cleaning and protective equipment. The data also serves as a great help in the pre-job planning helping us make the safety instructions more adequate for the job planned. This also prevents internal contaminations to occur.

As a result we have also obtained a cleaner workplace, since contaminated locations have been made more visible. It has improved not only the workmanship of the personnel in the plant, giving them even more confidence in that we care for their safety and work environment, the RP-staff also gets a push to do their job correctly, increasing their knowledge on how and where contaminations usually occur, which in the long end will reduce the doses throughout the plant, making it a safer place.