

RADIOACTIVE CONTAMINATION ON PRIVATE CLOTHING

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Introduction

In 1999 during the annual outage of a German nuclear power plant (NPP) radioactive contamination up to 5 KBq (Co-60) was found on private clothing of arriving contractor personnel. The contamination on private clothing was found by check-in measurements at the reception, before entering the controlled area. This contamination could only be found as a new type of sensitive Fast-Scan-Monitor (whole body incorporation and contamination monitor) with high efficiency was used.

The Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) was informed about this incident through correspondence by the State Ministry of Environment of Lower Saxony, that itself was informed by the plant operator. The BMU demanded from the state authorities for further information, clarification and a statement.

To evaluate how this kind of contamination spread is possible to gain out of radiation controlled areas (RCA) of nuclear power plants, VGB (Technical Association of Large Power plants Operators/Essen) established a working group called "Contaminated Clothing".

By using a review program the working group investigated on a selected number of German nuclear power plants, through a review, the possibilities of contamination spread beyond the boundaries of radiation control areas (RCA's). The review team was given a mandate to identify existing program deficiencies and recommend corrective measures.

The results of the reviews in substance were completed by the statements from different independent Technical Surveillance Agencies (TÜV), and exist as recommendations.

For all German NPP's the review experience and additional statements of TÜV resulted in improvement measures, which were introduced and discussed with the state authority. The implementation of measures is specific to each plant, because there is no uniform administrative, organizational and technical standard in German NPP's on this item.

To assure the review results and to look for radiological consequences for personnel or civilian population, an independent study was given by contract to "Brenk Systemplanung" company. The intention was to make a radiological evaluation of contamination on private clothing with deterministic and probabilistic methods, and to show that there is no significant radiological consequence.

Paths of contamination spread

Although there is no standardized procedure in German NPP's to avoid spread of contamination by personnel, the administration, organisation and technical preconditions are comparable in all German nuclear power plants. The essential barriers to avoid contamination spread in NPP's by leaving the radiation controlled area are noted below as:

- whole body contamination monitors for personnel
- gamma monitors (release measurement device/chamber) for all personal materials/small objects
- radiation and contamination control in lorry and materials locks only by personnel from radiological protection department
- release of residual materials only by beta and gamma monitoring (release measurement device)

The essential barriers for contamination spread in nuclear power plants by leaving the surveillance (not installed in all German NPP's) area are the following:

- whole body gamma check at the entrance and exit for personnel
- contamination gamma scan monitors for vehicles

Only through these paths spread of contamination is possible.

In spite of good technical and administration preconditions to survey contamination spread, contamination was found on private clothing of contractor personnel by check-in measurements, before entering the controlled area.

Contamination form of appearance

Basically one has to consider two contamination scenarios for spread of contamination.

Surface contamination, which is widely a homogeneous contamination and the hot particle contamination. Hot particles are small, loose, highly radioactive particles. These particles are highly transportable due to their small size and electrostatic charge.

Up to now detected and documented incidents of surface contamination outside of radiation controlled areas indicate a good consistence to all available data sources, which shows, that contamination on private clothing or skin is generally in a total height in the range of 100 to 1000 Bq. The surface which was recognised by this incidents was always less 1000 cm², a typical value is about 200 cm².

For hot particle contamination outside of radiation controlled areas only a few incidents are noted. Today's standard of knowledge shows one single incident where a hot particle contamination was found on a cardigan (jacket) with 5000 Bq Co-60. Some other cases, but only few, with hot particle contamination are noted in front of vehicles and material locks with the same height of contamination.

Review Team methods and goals

The explosiveness of this subject and the information of BMU disposed VGB to establish a team of German health physics experts, with the mandate, to investigate by Peer Review - on selected German nuclear power plants - the technical and administration realities (preconditions) of radiation protection.

On the basis of the Peer Reviews a catalogue of recommendations was issued to reduce the potentiality of contamination spread. For recommendation this catalogue was given to all German nuclear power plants to check their own procedures, standards and programs.

During the Peer Review the team acts on always the same criterions, as noted below.

Achievement of the following goals

- Improvement of standards for the supervision of contamination, open exchange of experience, mutual comparison and examination of individual selected procedures
- Review of contamination prevention concepts in RCA's
- Analysis of selected, particular contamination control processes
- Identification of good practices and weaknesses
- Identification of organisational and administrative improvement possibilities
- Elaboration of proposals and recommendations
- Identification of contamination paths (sources, material flow, personnel flow)

Composition of the Review Team

- 1 Teamleader (no staff member of the plant)
- 1 Keeper of the minutes
- 2 Health physics experts

Review Preparation

Elaboration of a list of places and items (working places, hot workshop, storage depots, decontamination areas, vehicle locks, material locks, personnel and material flow) should be checked by the team experts. Based on this list a quick familiarisation to preconditions and comparability of findings in different plants should be ensured. During preparation the catalogue could be adjusted to plant specific conditions.

Review Performance

For evaluation of procedures the review team applies 5 methods:

- inspection of documents
- discussion with operational staff on site
- discussion amongst the procedure experts
- observation of procedures in practise
- discussion of findings with operational staff on site

Review duration is 3 days

Considerations and exchange of experience

Good practices and weaknesses will be discussed. In case the majority of team members agrees to individual findings, these have to be considered in more detail. Therefore the teamleader nominates a keeper of the minutes. He is responsible to draft a short report describing the weak points identified, possible reasons and practical proposals for improvement.

The head of radiation protection has to be informed daily and the plant manager has to be informed by final report.

Final report

During the last day the final report has to be elaborated under the guidance of the teamleader. The report contains a short description of all items considered, description of good practices and the presentation of weak points including reasons (if possible).

Referrals of the review team

Administrative measures

The responsibility for the keys that lock the rooms adjacent to the RCA (i.e. RCA entree, and the various locks) should be excessively limited to radiation protection personnel.

The lobby area adjacent to the RCA must be kept free of contamination. This includes that contaminated material which was used in the RCA, must be denoted with the appropriate signs available.

A routine measurement of the contamination level is necessary. It is excessively important to use cleaning devices free of any contamination to clean the area adjacent outside to the RCA (i.e. RCA entrees and locks) These cleaning devices should be likewise checked on a routine basis for any source of contamination.

This also includes rigging loops, slips, ropes and traverses that are in use in the locks adjacent to RCA. These machines, materials etc, should be denoted after the routine check.

Private clothing should absolutely not be permitted inside the RCA

The area around the RCA exit should be kept under constant surveillance by radiation protection staff, by personnel flow or materials brought out of the RCA

It is necessary to ensure contamination prevention measures on the wheels of transportation cars that are used in and outside of contamination zones. (i.e. decontamination, covering the wheels with tape or adhesion foil)

Monitoring measures

The background level on contamination monitors for measuring personnel and objects should be kept under an adequate level. This is achieved with a dose rate ≤ 100 nSv/h.

The contamination monitors should be calibrated with the “guide/dominant nuclide”, to determine the efficiency and detection limit.

The necessary contamination control on tools, paper etc. must additionally be monitored with an integral gamma measurement.

Additional control measures

Occasional contamination monitoring should be carried out to recognize any possible contamination spread in the areas adjacent to the RCA (i.e. airlocks, dressing rooms) by random tests.

The materials that have left the RCA should be occasionally monitored by random tests.

The radiation protection clothing that is used outside the RCA (i.e. spent fuel cask processing) should be checked on radioactivity. This also applies to vehicles leaving the plant vicinity.

The tools and rigging loops used in the workshop inside the RCA, are to be monitored routinely with contamination control checks.

Procedures in event of contamination findings

If any contamination is discovered on private clothing, the following measures should be taken:

- detection of α/γ contamination by monitoring
- initiate an inquiry for clarification reasons
- induce further measures according to the findings

Summary

The organisational and administrative measures for contamination prevention and the technical methods for contamination control, stated in the review for the different plants are comparable, and results, in accordance to the German standards, indicate a high state of administrative, organisational and technical precaution.

A fundamental modifications of the procedures are not necessary. The measures performed are for optimational reasons.

It should be pointed out, that undiscovered contamination (i.e. unrepresentative skin surfaces, contamination spread over a small area) in relation to radiation monitoring, over geometrical unfavourable spots, can never eliminate the problem to 100%. The probability can be further minimised through the supplementary installed measures.