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Activities in Germany related to ICRP 103

W. RASKOB

ABSTRACT **In Germany, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has asked the German Commission on Radiological Protection (SSK) to provide advice on the revision of the German "Radiological Fundamentals for Decisions on Measures for the Protection of the Population against Accidental Releases of Radionuclides" (Radiologische Grundlagen). A working group has been established to guide the preparation of a new version of that document. It was asked that the revision has to consider most relevant publications of international bodies such as ICRP, EC and IAEA. Therefore, the ICRP recommendations 103, 109 and 111 have to be considered together with the draft documents of the European Union and the IAEA Basic Safety Standards. Recommendations of working groups of NEA (WPNEM) as well as the EPAL working group of HERCA (Heads of European Radiological Protection Competent Authorities) will be also taken into account. Within the discussion it turned out that the practical application of the new recommendation for professionals working in the operational community is extremely important. As the current recommendations are widely accepted and operational all over Germany, it was investigated to which extent the current procedures can be taken over with minor modifications.**

Keywords: ICRP recommendation / practical application / operational procedure

1. Introduction

The German Commission on Radiological Protection (SSK) is the highest body that provides advice to the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) in all aspects As the basic guidlines "Radiological Fundamentals for Decisions on Measures for the Protection of the Population against Accidental Releases of Radionuclides" (Radiologische Grundlagen, 2000) on radiation protection in Germany are under revision, the SSK was asked to provide guidance in that revision, taking into account relevant publications of international bodies such as ICRP, EC and IAEA. This includes

KIT, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany.

the ICRP recommendations 103, 109 and 111 (ICRP, 2007; ICRP, 2009a, 2009b), the draft documents of the European Union and the IAEA Basic Safety Standards and recommendations of working groups of NEA (WPNEM) as well as the EPAL working group of HERCA (Heads of European Radiological Protection Competent Authorities).

One key point in the discussion was the question, to which extent the operational procedures at present valid in Germany have to be modified. Therefore, calculations were issued to check whether the residual dose of 100 mSv in the first year would be exceeded when – formally – the existing intervention criteria for sheltering, evacuation and relocation would be applied.

2. Scope of the calculations

Calculations were performed with the RODOS system (Ehrhardt, 2000) for the following scenarios which are part of the RODOS source term data base

- DRSB-F3a (large accident)
- FK2 (very large accident)
- FK5 (long lasting accident)
- FK7 (filtered release)
- CS-137

Two different meteorological conditions were selected; one with and one without rain.

Countermeasures are taken as soon as the criteria are exceeded. The German intervention criteria have been selected for the investigations. The criteria were characterised as:

- ***Sheltering*** (initiated when dose is above 10 mSv); exposure pathways considered: inhalation, external exposure from cloud and ground (integration time 7 days), duration of the measure was set to 24 h; efficiency in dose reduction ~50%.
- ***Evacuation*** (initiated when dose is above 100 mSv), exposure pathways considered: inhalation, external exposure from cloud and ground (integration time 7 days), duration of the measure was set to 30 days, efficiency in dose reduction 100%.
- ***Temporary relocation***, (initiated when dose is above 30 mSv), exposure pathways considered: only external exposure from ground duration (integration time 30 days) Eff. 100% for 30 days, start of measure day 2.
- ***Permanent relocation***, (initiated when dose is above 100 mSv), exposure pathways considered: only external exposure from ground duration (integration time 1 year) Eff. 100% for 1 year, start of measure day 2.
- Iodine blockage and food were not considered in the dose assessments.

3. Results

As mentioned before, 5 different source terms and two weather conditions were applied. These calculations provided dose areas and most important nuclide vectors for the dose assessments. For each of the source terms and weather conditions, one location was selected where the dose for evacuation was exceeded. This location characterised the nuclide vector. In a second step, the source term was varied from very small – dose of 0.1 mSv at that location to very high values exceeding any intervention criteria. In a third step, the various intervention criteria for sheltering, evacuation and relocation have been applied as soon as they have been reached by one of the modified source terms. In other words, the dose has been continuously increased in small steps to check if the application of single intervention criteria keeps the dose in the first year below the 100 mSv residual dose criterion.

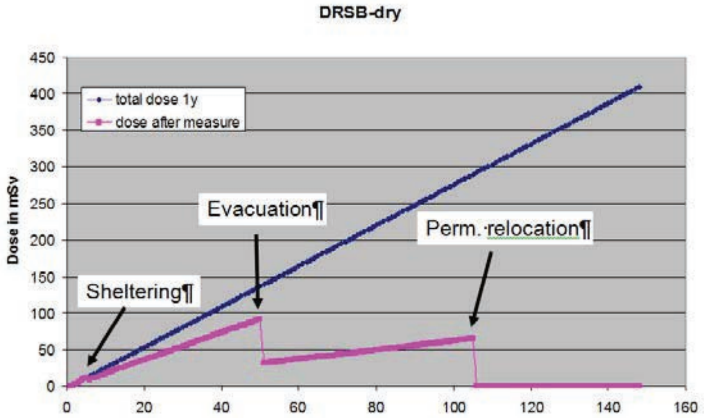

Figure 1 – ***DRSB source term variation (160 steps) resulting in a one year dose from 0.1 mSv up to 450 mSv without any intervention; second line shows the dose with applied countermeasures.***

Figure 1 shows that independent from a projected dose at that point, the application of the existing intervention criteria in Germany would assure that the residual dose of 100 mSv in the first year would not be reached. However, the dose would be close just in the case that the evacuation criterion would not be fully reached and only sheltering is applied. Figures 2 and 3 show results for the source term FK5 with dry (Fig. 2) and wet (Fig. 3) weather conditions.

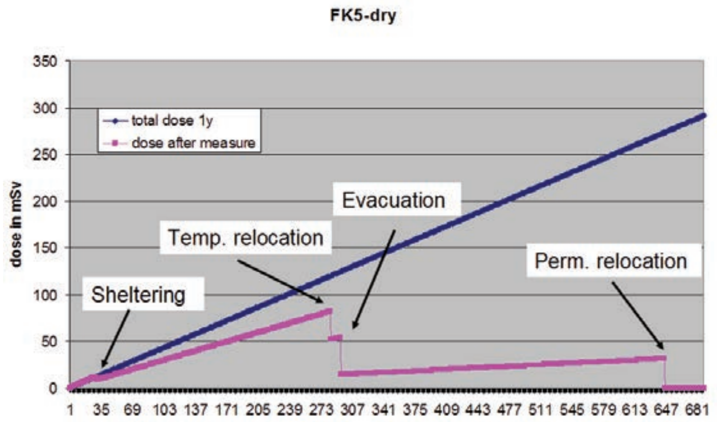

Figure 2 – ***FK5 source term variation (681 steps, dry weather) resulting in a one year dose from 0.1 mSv up to 300 mSv without any intervention; second line shows the dose with applied countermeasures.***

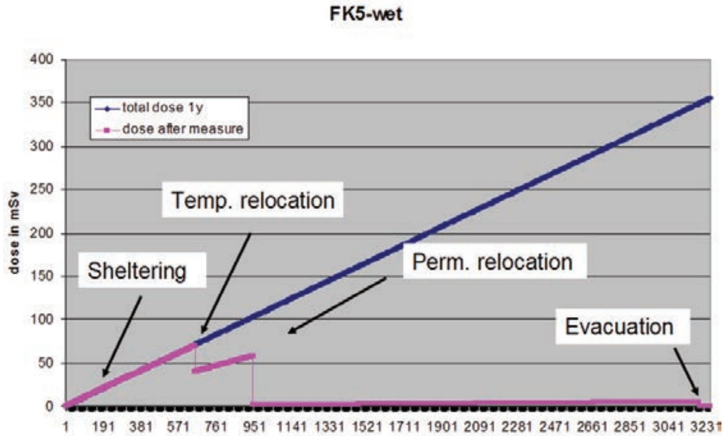

Figure 3 – ***FK5 source term variation (681 steps, rainy weather) resulting in a one year dose from 0.1 mSv up to 350 mSv without any intervention; second line shows the dose with applied countermeasures.***

In both scenarios, first the shelter criterion is reached and later the temporary relocation for 30 days. In case of the dry weather, the evacuation criterion is reached next, whereas for rainy conditions, permanent relocation is reached. The reason for this is the contribution from external ground irradiation which is high in case of rain. In al these scenarios, the reference level of 100 mSv in the first year is not reached.

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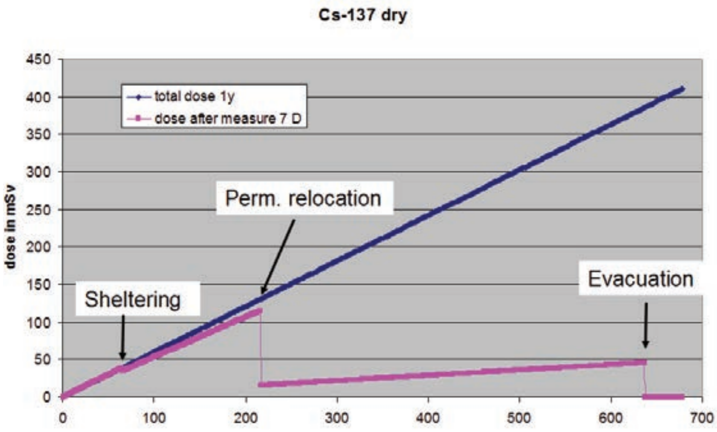

Figure 4 – ***Cs-137 source term variation (700 steps, dry weather) resulting in a one year dose from 0.1 mSv up to 450 mSv without any intervention; second line shows the dose with applied countermeasures.***

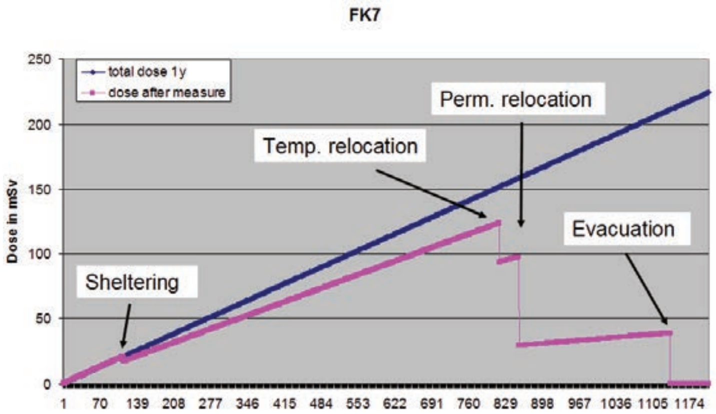

Figure 5 – ***FK7 source term variation (1200 steps, dry weather) resulting in a one year dose from 0.1 mSv up to 230 mSv without any intervention; second line shows the dose with applied countermeasures.***

Figures 4 and 5 show scenarios in which the simple application of intervention criteria fail. In case of a pure Cs-137 release, the criterion permanent relocation is reached too late given a residual dose in the first year of more than 100 mSv. The reason for this is the fact that the relocation criterion only considers exposure from ground. Even worse, the evacuation criterion is reached late, only when the one year dose is about 400 mSv. The reason here is that other pathways do not contribute too much to the criterion dose. In case of the FK7 release, the noble gas release is dominating the dose and thus it takes long until the contribution from ground trigger the initiation of further countermeasures.

4. Summary

In most of the calculations performed, the application of the individual measures assures that the one year dose stays below 100 mSv. However in 2 out of 10, the residual dose limit is exceeded. The main explanation seems to be the nuclide vector of the two releases which is very different to those which have been used to generate the intervention criteria in Germany. This also questions the possible approach to continue using single countermeasures to satisfy the ICRP 103 approach.

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