NATIONAL DOSE ASSESSMENT WORKING GROUP

PAPER 9-04: METHODOLOGY FOR ASSESSING DOSES FROM SHORT-TERM PLANNED DISCHARGES TO ATMOSPHERE

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1 Introduction

Impact of routine discharges from sites are assessed it is normally assumed that discharges occur continuously and uniformly over a year. However, during normal operations at sites which discharge radionuclides to the atmosphere, it is possible to have short-term enhanced releases due to routine maintenance operations or particular features of the operations undertaken. It is possible that such short-term discharges may lead to doses that are higher, or indeed lower, than would be expected if it were assumed that the site discharges are continuous over a year. The report NRPB-W54 presents a generic assessment methodology for short-term planned discharges which can be applied to a variety of release conditions. It addresses the issues of variability in model input parameters and discusses how these may influence the dose received by the critical group. The aim of the methodology is to provide realistically cautious, rather than exceedingly cautious, predictions of the dose to members of the critical group.

2 Data and methods

The methodology makes recommendations regarding the use of data and methods which include those for meteorological data, atmospheric dispersion, foodchain modelling, the modelling appropriate for other exposure pathways (external dose, inhalation) and critical group habits. In particular, key assumptions regarding the source of food consumed by the critical group are addressed. The methodology uses assessment tools that are well established but also includes some new models. Assumptions made are generally based on established ideas but where these are inappropriate for short-term releases new ideas have been developed.

The key features of the methodology for estimating the critical group dose from a single short duration release are summarised below.

- The wind is assumed to blow directly towards the critical group.

- The range of possible meteorological conditions is represented by atmospheric stability category D, wind speed 3 m s^{-1}, boundary layer height 800 m and a continuous rainfall rate of 0.1 mm hr^{-1}. Adoption of these meteorological conditions is shown to result in critical group doses at 1 km downwind of the release point in the upper part of the overall distribution, generally around the 70^{th} percentile.

- Two example release durations are considered in the methodology: 30 minutes and 12 hours. To account for the variation in mean wind direction during the 12 hour release an angular variation of 60 degrees is assumed.

- It is assumed that members of the critical group spend all their time at a distance of 1 km downwind of the discharge point and that they obtain 50% of their food from this location. The remaining food in their diet is assumed to be uncontaminated.

- The “Top Two” approach is used to calculate ingestion doses, where the two foods that make the greatest contribution to this dose are assumed to be consumed at critical rates with the remaining foods consumed at average rates. These rates are based on national food surveys. The foods considered are green vegetables, root vegetables, potatoes, fruit, cow meat, cow liver, cow milk, sheep meat and sheep liver. Grain, pork, chicken, eggs and milk products are not considered in the default case for reasons discussed in the report.

- Habit data have been reviewed and recommendations made. It is cautiously assumed that individuals will be outside during the entire passage of the plume.

A limited exploration of modifications to be made to this methodology for multiple short releases is reported and a number of areas where further research could usefully be carried out are highlighted.

3 Results

Dose calculations using the methodology have been carried out for theoretical short duration releases from two nuclear sites: BNFL Sellafield, Cumbria and Amersham plc, Buckinghamshire. The calculations have assumed discharges, in a single release, of all the radionuclides for which short-term limits or advisory levels have been recommended by Environment Agency. Dose estimates arising from this methodology have been compared with those derived from methodologies currently adopted for regulatory purposes and found to be less by a factor of 1.5 to 5 for the two example sites considered (Tables 1 to 3). The main factors that contribute to this difference, for these two sites, are the location of the critical group, the exclusion of milk products as an ingestion pathway, the fraction of food that is locally produced and the choice of meteorological conditions.

Table 1 Summary of doses from Amersham site (30 minute release)

		Dose to critical group (μSv)		
		Environment Agency [1]	Environment Agency/FSA [1,2]	NRPB-W54 [2]
Adult	100 m	66.6	114	
	300 m	79.2	127	
	1000 m			25.8
Child	100 m	103	116	
	300 m	115	129	
	1000 m			31.8
Infant	100 m	251	152	
	300 m	263	165	
	1000 m			55.5

1 Food is derived from a location 500m downwind.

2 Ingestion of milk products not considered.

Table 2 Summary of doses from Sellafield (30 minute release)

		Dose to critical group (μSv)		
		Environment Agency	Environment Agency/FSA [1,2]	NRPB-W54 [1]
Adult	500 m	281	319	
	1000 m			103
Child	500 m	414	266	
	1000 m			149
Infant	500 m	840	268	
	1000 m			222

1 Ingestion of milk products not considered.

2 Assessment does not include ^{14}C in the ingestion pathway. This might contribute between 20% and 30% to the dose.

Table 3 Summary of doses from Sellafield (12 hour release)

		Dose to critical group (μSv)		
		Environment Agency	Environment Agency/FSA [1,2]	NRPB-W54 [1]
Adult	500 m	104	108	
	1000 m			30.2
Child	500 m	153	91.4	
	1000 m			46.5
Infant	500 m	297	96.6	
	1000 m			71.8

1 Ingestion of milk products not considered.

2 Assessment does not include ^{14}C in the ingestion pathway. This might contribute between 20% and 30% to the dose.

4 Conclusions

A methodology for the assessment of short-term planned releases has been developed. Dose estimates made using this methodology and that representing the current Environment Agency approach for short-term releases have been compared. It is felt that some of the assumptions made in the Environment Agency approach are overly cautious; the methodology developed here is intended to be more realistic while still ensuring public safety.

An important point to note is that the choice of atmospheric dispersion model may have a significant effect on the dose estimates. From the brief comparison study carried out in this report it is estimated that doses would have been greater by up to a factor of about five if the model NRPB-R91 (Clarke, 1979) had been used instead of ADMS (CERC, 2002).

The results presented in this report do not identify the point at which the frequency of multiple short-term releases is so great that the continuous release assessment methodology can be used. This transitional region would require investigation using a probabilistic approach, for which full data are currently unavailable.

This methodology presents a straightforward, robust and realistic assessment of dose that can be carried out without resorting to complex probabilistic methodologies with the associated difficulties of data presentation.

5 References

CERC (2002). ADMS Version 3.1. Cambridge Environmental Research Consultants.

Clarke RH (1979). The first report of a Working Group on Atmospheric Dispersion: A Model for Short and Medium Range Dispersion of Radionuclides Released to the Atmosphere. Chilton, NRPB-R91.

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