ENVIRONMENTAL SURVEILLANCE : DO LESS AND LEARN MORE

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ABSTRACT

In this paper, we consider the principles that govern the design of environmental surveillance programmes for discharges from various installations under normal conditions of operation. Two opposing objectives bear on the situation: to estimate the doses to the public with acceptable uncertainty and to avoid expenditure on unnecessary or unstructured monitoring. We suggest that it is possible to classify discharges according to their potential for delivering doses to individuals and the community and then to decide on the scale of monitoring. This approach leads to an environmental surveillance programme shorn of surplus elements and to which additions on grounds other than radiological protection are made with awareness. Present surveillance practices not complying with such principles may need to be reformed.

INTRODUCTION

There has been a steady increase, over recent times, in the number of radiation sources that cause exposure of the public and a pronounced increase in public awareness of such exposures with their imputed risks. This enhanced perception finds expression in demands for reduced releases of radionuclides to the environment and generates pressures for increasingly comprehensive and sensitive environmental surveillance. The pressures have been intensified by the emphasis that the International Commission for Radiological Protection places on the ALARA approach(1) and the general assent given to that recommendation. We have noted elsewhere the apprehension(2) among environmental analysts that they will be required to achieve ever lower levels of detection.

These pressures, whether from the public or within the profession of radiation protection, should be resisted. To yield to them would be to misallocate human and material resources with too much effort being expended on unimportant pathways that lead to trivial doses. The pitfall could be avoided if environmental monitoring programmes were designed with clear objectives and on logical lines. Reviews of such programmes in the USA(3,4) have indeed revealed that the elements requiring most attention are rationale and design. In this paper, therefore, we shall concentrate on objectives and design and offer some broad suggestions. We are not speaking for the Board, but exposing some personal proposals.

FUNCTION OF MONITORING

When installations discharge radioactive waste to the environment, it is generally found that the dose to the public is dominated by a few radionuclides in a few media. In general, levels of radioactive contamination are difficult to measure outside the immediate surroundings of installations. Environmental monitoring tends therefore to be concentrated on proximal environments and on critical groups. Measurements may be made further afield, but only to determine so-called background levels. The collective dose from discharges of radionuclides is usually estimated from measurements or calculations of the discharges and mathematical models of environmental transport and transfer.

If we restrict our reasoning to protection, we are forced to the conclusion that the primary purposes of normal environmental monitoring are to

assess doses in the community and to demonstrate compliance with authorised limits. The order of these objectives here deliberately reflects the shift of emphasis from limitation to optimisation. A monitoring programme would be justified only if it could fulfil these objectives and naturally it would be expected to fulfil them. Monitoring programmes may have many secondary objectives, and international organisations have described them(5,6). We shall touch on some of these later, but it is well to dispose of one at this juncture. The need to assure the public of the continuing safety of the installation is seen by some of our colleagues as a prime objective in its own right, and they imply that monitoring programmes should be designed with this in mind. We disagree. Assurance should flow from a programme designed for protection purposes and not vice versa.

CLASSIFICATION OF INSTALLATIONS

There are about twenty nuclear installations and over a thousand other installations in the United Kingdom that routinely produce radioactive waste. Many discharge radioactive material, but few undertake routine environmental monitoring, nor indeed should they. The government departments that authorise waste disposal consider each case on its merits and prescribe or effect the monitoring. As in other countries, the resulting programmes are inspired by wisdom, understanding, counsel and other professional gifts. Previous practice is also an important influence. There is, we know, no substitute for quality of judgment in these matters, but we should like to quantify part, at least, of the process.

We begin with an attempt to classify installations according to the individual and collective doses that they cause in the community. The classification is solely related to routine environmental monitoring: the annual dose refers to the mean effective dose equivalent in the critical group, and the collective dose refers to the collective effective dose equivalent commitment from one year of operation. The doses will have been inferred with varying degress of uncertainty from previous measurements and modelling.

Our colleagues are proposing at this congress(7) that there must be some levels of dose and risk that should be of no concern to regulating authorities. As lawyers manqué, they call them de minimis levels, but we know that they mean negligible. The doses they suggest are 1 μSv a year to individuals and 1 manSv collectively, the collective dose referring to the impact of the extended operation. We adapt their numbers to our purpose, and assert that normal environmental monitoring is never required for installations that do not cause doses in excess of 1 μSv a year to individuals and 0.1 manSv collectively from a year of operation.

We then proceed to delimit a minor class in which installations cause doses above these negligible values but below 10 μSv a year to individuals and below 1 manSv a year collectively. Many non-nuclear installations are in this class - hospitals, universities, factories. At the other extreme, we define major installations that cause annual doses above 100 μSv a year or collective doses above 10 manSv: many of the installations associated with the nuclear fuel cycle would be in this class. We have, by exclusion, identified a medium class, which will have intermediate requirements for normal environmental monitoring.

At this point, the reader may argue that the classification is deficient because it takes no account of the potential need for environmental monitoring in an emergency. We recognise that there may have to be a plan for emergency

monitoring at an installation and that the complexity of a plan should be commensurate with the potential magnitude of the emergency, but we would counter that the objectives of emergency monitoring are quite different from the objectives of normal monitoring and consequently that their designs are quite independent: in blunt terms, normal and emergency schemes should not be confused. But if it so happens that the designs overlap and that some normal monitoring may be regarded as preparation for emergency monitoring, the opportunity should be seized to reduce the cost of emergency preparedness. Although we are not dealing with emergency monitoring on this occasion, it seems to us that a classification related to potential dose to individuals and potential collective dose might also be feasible.

SCALE OF MONITORING

The next step is to devise a monitoring scheme that matches the classification. In doing so, we shall refer to source monitoring, by which we mean an appropriate procedure at an installation to determine the discharge of radioactive material to the environment or the emission of radiation in any other manner. We shall also refer to a scale of frequency with three bands: continual, which implies measurements in fairly close succession; periodic, which means regular but not frequent; occasional, which suggests annual measurements at most. These frequencies will inevitably be affected by the practicability of collection and measurement, the half-life of the radionuclides of interest, and temporal variability such as seasonal changes.

Starting with individual minor installations, we suggest that they are unlikely to require routine environmental monitoring to satisfy the objectives we have laid down: doses can be assessed with adequate certainty from an inventory of the radioactive sources, from a knowledge of the disposal procedures, and from a simple model of exposure in the environment. They are most unlikely to have source monitoring. For the class as a whole, however, it would seem worthwhile for the authorising agencies to monitor the overall impact in the environment occasionally. This environmental monitoring would, in effect, be an economical national scheme.

For major installations, we suggest that continual monitoring is required in the environment for any radionuclide that contributes more than 25% to the critical or collective doses and that periodic monitoring should be considered for contributions exceeding 10% to either. It is likely that installations in this class will carry out source monitoring, a most important function of which is to warn of abnormal releases.

In the intermediate class, we propose that periodic measurements be made in the environment for radionuclides contributing more than 10 μSv to the critical group dose or 1 manSv to the collective dose, and it would be logical to make occasional measurements for other contributors in aggregate. Source monitoring may be encountered in this class.

If there is appreciable uncertainty in an environmental model and the estimated doses are near the boundary of a class, it would be appropriate to verify the estimates experimentally: this advice applies to all classes of installation.

SHIFT OF EMPHASIS

Our prescription is a deliberate attempt to cure our friends of an obsession with the monitoring of critical or near-critical groups. We know that the possibility of legal sanctions, no matter how remote, is a powerful incentive in this matter, but too much attention to limits is a sure sign of

reaction. On a more serious note, one could point to the fact that the doses that delineate our categories imply far greater impact through collective exposure than through critical exposure. To lend extra force to the argument, it is only necessary to remind them that any decision to reduce discharges from an installation would be heavily influenced by the expected saving on collective dose.

What we are advocating therefore is more monitoring for collective dose at the expense of individual dose. Were we pressed to say what the proportion might be, we would have to admit that it is virtually impossible to generalise, but that one should expend effort on each type according to the coordinates of the installation within our classification scheme. Should routine environmental monitoring for collective dose prove impracticable in any circumstance, we would not be in favour of restoring the original lopsided position. The probable consequence would be a reduction in the amount of normal environmental monitoring practised in the United Kingdom. The same would occur, we believe, in other advanced countries.

There are inadequacies in present practices that we would seek to eliminate with the resources thus made available. We should be inclined, first of all, to improve quality assurance to the degree that it is at least acceptable: at present, we pay mere lip-service to it. It would also be desirable to devote some of the savings to a systematic review of the monitoring programme each year. For these tasks, we suggest allocating an amount equal to one tenth each of the restructured budget for routine environmental monitoring. There may even be resources left over for informative special investigations.

We realise that we have not been able to deal, in this short space, with some important but subsidiary problems relating to the design of monitoring programmes - the disposition of sampling locations around an installation, for instance. We intend to turn to these matters in another place and in the light of the reception given to these proposals.

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