

Preparation of technical support material for radioactively contaminated land

The UK Government is considering the introduction of a regulatory regime to address the legacy of sites that are radioactively contaminated due to historical activities. The Department of the Environment, Transport and the Regions (DETR) consulted on the principles of this regime in 1998, although no specific plans are yet in place to introduce the regime. The consultation paper envisaged that the Environment Agencies would have a major role in regulating the investigation and assessment of potentially contaminated sites and, where appropriate, their remediation.

This work was commissioned by the Environment Agency, with support from DETR and SNIFFER (Scottish and Northern Ireland Forum for Environmental Research) to provide information on the techniques available allow the Environment Agencies to fulfil their envisaged regulatory requirements, and to assist DETR in the preparation of Statutory Guidance. The work was carried out by Entec UK Ltd, in conjunction with the NRPB.

Radioactive land contamination in the UK

The occurrence of radioactively contaminated land and UK experience in its remediation were reviewed. Radioactive contamination in the UK has primarily arisen from historical industrial practices such as luminising using radium, gas mantle manufacture, phosphate manufacture and use, metal ore refining and processing and various other industrial and medical uses of radioisotopes. The UK situation is dissimilar to other major international occurrences of contamination, as large-scale contamination problems associated with uranium extraction, under regulated nuclear activities and weapons testing do not exist. Radioactive contamination in the majority of cases is of natural origin that has been enhanced for a particular product use (e.g. radium luminising paint) or inadvertently created as a by-product (e.g. tin slag). Radium, uranium, thorium, strontium, promethium and their decay products are most commonly recorded. Contamination has most usually occurred as a result of historically uncontrolled waste disposal practices.

Identifying potentially contaminated sites

A simple desk based approach has been proposed to assist regulatory bodies in identifying potentially radioactively contaminated sites of concern in their geographical area. This is based on a two tier approach. Firstly, a simple qualitative approach to ranking potentially contaminated sites in order to rapidly and cost effectively focus on sites of prime concern. This is based on the potential occurrence of radioisotopes identified for the various land uses and takes into account the probability of occurrence of radioactive contamination and the possible severity of the radiological hazard. Secondly a site specific desk study drawing on established methodologies from the DETR contaminated land research programme.

Characterisation techniques

A review of field and laboratory methods for the assessment of radioactive contamination has been undertaken. The review has considered both direct monitoring techniques, for example when assessing gamma emitters and conventional sampling and analysis methods for other circumstances. A broad range of detector based technologies have been investigated for direct monitoring ranging from simple hand-held, off-the-shelf, health physics instrumentation to aerial surveys. The advantages and limitation of each technique are discussed and the techniques most appropriate for the principal radioisotopes of concern are identified. Sampling and analysis protocols are described with consideration of appropriate sampling density, distribution of sampling points and analytical techniques being considered.

Assessing and categorising the significance of radionuclides on land

A practical methodology has been proposed to enable the assessment of unacceptable risks to health from radioactively contaminated land and assist the determination of appropriate remediation. Contaminated land problems may arise either as a result of land redevelopment (change of use) or during ongoing use of the land. These have been considered under the ICRP system of protection as 'practice' or 'intervention' situations. In general terms, land redevelopment is considered to be a 'practice' whereas land that is already in use when the contamination is identified is an 'intervention'.

An NRPB methodology for assessment of radiological risks from contaminated land has been compared to the method used to develop UK guideline values for chemically contaminated land (CLEA). The two approaches are in many respects very similar but some significant differences in scenarios considered and parameters used were identified that may require further assessment if comparability is to be achieved.

Dose criteria are proposed for intervention situations where no change of use is envisaged. If radioactively contaminated land gives rise to an individual dose of in excess of 10 mSv/year remedial measures are always justifiable, for doses below 0.3 mSv/year remedial measures are rarely justifiable. For doses in between these values intervention will require justification on a site specific basis. For each of the radioisotopes of concern, risk based 'screening' levels in Bq/g have been established that would result in the above dose levels for two situations: uniform surface contamination, and buried or heterogeneous contamination.

A two tier methodology for assessing land is proposed. Firstly, an initial 'screening assessment' that would involve a desk study and initial site survey followed by categorisation against the 'screening' levels. Secondly, a site specific assessment for sites not cleared on screening including a detailed radiological assessment of current dose levels and projected dose levels and an assessment of the benefits/disbenefits of remediation (intervention).

Remediation technologies and experience in the UK

Within the UK, there is limited experience in the remediation of radioactively contaminated sites. Most of this experience has been obtained on MOD sites where contamination has resulted from *ad hoc* disposal of radium luminised items; luminising works; rare-earth ore processing operations; and contamination arising from uncontrolled disposal of radioactively contaminated wastes. Experience is most common for sites contaminated with radium-226, thorium-232, caesium-137 and uranium. Remediation schemes have generally involved the use of simple methodologies such as excavation and off-site disposal, using standard health physics instrumentation for the identification and segregation of contamination.

The applicability to radioactively contaminated sites of using other remediation technologies commonly employed on chemically contaminated land has been reviewed. These are categorised according to standard civil engineering technologies including excavation, covering systems and barriers, and process based technologies including physical treatment, biological, chemical, thermal and solidification treatment methods. Of the more innovative techniques, only soil washing and phytoremediation have seen limited application at pilot scale in the UK.

Regulatory issues

The principal current legislation and regulatory instruments of relevance to the assessment and remediation of radioactively contaminated land have been reviewed and potential conflicts with respect to the proposed regulatory regime have been considered.

One potential conflict is that, under the proposed risk based regime, situations may arise where sites will be classified as not being radioactively contaminated when, under the definition of RSA93, radioactive materials may still be present. The implications of this on public and site user confidence will need to be considered. An important concern in the UK is the availability of disposal routes for low level radioactive wastes; the BNFL Drigg facility has a limited capacity. Therefore, it may be necessary to consider the greater use of landfill sites for wastes that represent a low radiological hazard. The implications of this for site licensing and for the safe handling of wastes at landfill sites that may not be designated as radioactive waste but nevertheless contain discrete radioactive sources needs to be considered.

Recommendation

The report makes a number of recommendations concerning further work to be carried out prior to the development of technical guidance, including the trialling of the site identification screening methodologies.

This R&D Technical Summary relates to information from R&D Project P3-055 in the following output:

R&D Technical Summary PS282

Preparation of technical support material for radioactively contaminated land, R&D Technical Report P307.

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