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REGULATORY CONTROL AND *NORM* – THE UK POSITION

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1 Introduction

The history of regulatory control of the use of radioactive substances in the United Kingdom (UK) closely follows international developments in the understanding of the deterministic and stochastic effects of ionising radiations. Special regulations were introduced in 1947 to control the use of luminising materials in factories. In the 1960's, further regulatory controls were introduced covering the use of unsealed and sealed sources. The scope of these regulations in the workplace was limited to industrial applications carried out in factories, along with a parallel system of control for nuclear installations. The structure of the factories based regulations was very prescriptive in nature and they were superseded in 1985 by broadly based regulations implementing the 1980 Basic Safety Standards Directive (see below).

2 The UK Approach

The use of radioactive materials is regulated by the Health & Safety Executive (HSE), as part of its wide ranging remit under the Health & Safety at Work etc. Act, 1974 (HSWA) to ensure that risks to the health and safety of employees and other persons who may be affected by work activities are reduced so far as is reasonably practicable. The emphasis in the HSWA is on workplace health and safety, and the potential impact on members of the public arising from these work-place activities. Regulations made under the HSWA address the control of specific risks, such as ionising radiations. The ownership of radioactive material is regulated by the Environment Agency; it is mainly concerned with protecting the environment against discharges of radio-activity, using its powers granted under the Radioactive Substances Act (RSA). In this way, the UK regulatory approach makes a distinction between ownership and use of radioactive materials. The HSE and Environment Agency work together closely on issues of mutual interest, such as the development of legislation, and practical advice and inspection and enforcement of legislation in the workplace.

3 Basis of legislation

3.1 Current position.

Whilst the recommendations of the International Commission on Radiological Protection (ICRP) form the basis of radiological protection, and represent the starting point for European and UK legislation, they are not in a suitable form to translate directly into national legislation.

The Euratom treaty provides for the making of Directives laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiations.

In joining the European Union, the UK became subject to the provisions of the Euratom treaty and was obliged to implement the 1980 Basic Safety Standards Directive (BSS80) which reflected the then current (published) recommendations in ICRP Publication 26 (ICRP26). There is no explicit treatment of NORM in ICRP26 nor in BSS80. The 1980 Directive was amended in 1984 to take account of the latest figures on annual limits of intake published in ICRP Publication 30 (ICRP30).

The UK regulatory approach described in section 2 required the introduction of specific legisla-tion under HSWA covering the use of radioactive materials (and radiation generators) (Ionising

Radiations Regulations 1985) (IRR85), alongside the existing legislation covering the ownership of radioactive materials (Radioactive Substances Act 1960) (RSA60), to satisfy the amended 1980 Directive.

3.2 Implications of ICRP60 for IRR85 and RSA.

The 1990 recommendations of the ICRP (ICRP60) have significant implications for the existing UK workplace legislation covering the uses of ionising radiations.

ICRP has considered the conceptual framework in terms of the divide between natural and artificial sources of radiation, and the conundrum of risks and perceptions between the two types of sources. As a result, it has recommended a single framework of protection, taking into account the differences between "practices" and "interventions". It has recommended that exposure to NORM in the workplace be specifically addressed as part of occupational exposures.

The European Union was committed to bringing the 1980 Directive in line with ICRP60 recommendations, and was determined to include explicitly natural radiation sources (NRS) (including NORM). There followed a protracted period of consultation with member states of the EU over the introduction of these NRS related issues. A particularly contentious issue was the inclusion of public exposure from NORM.

The revised Directive was adopted in May 1996; a four year period is allowed for implementation. A major change from the previous Directive is the explicit arrangements for treatment of NRS's, including NORM. When NORM is processed for it's radioactive properties, then standard controls will have to be applied. However, in the vast majority of the remaining cases of the use of NORM (i.e. for it's non-radioactive properties), there will be a separate regime of control measures, covering both worker and public exposures.

An extensive review of the existing IRR85 has taken place to decide what will be required for the UK to demonstrate compliance with the revised Euratom Directive by May 2000. The HSE has published a draft set of revised regulations (IRRrev), and is engaged in extensive consultation with user groups on issues including controls for NORM in the workplace. It is anticipated that revised UK legislation and associated guidance will be in place by 1999, and come into operation at the beginning of the year 2000. However, the existing UK RSA93 will also need to be carefully assessed to ensure that it covers all required aspects of public exposure to NRS's, including NORM.

The relevance of UK legislation to NORM will now be described, with emphasis on the use of NORM in the workplace.

4 Ionising Radiation Regulations

4.1 What is a radioactive substance?

4.1.1 Current position.

In accord with ICRP26 and 1980 BSS, the IRR85 did not specifically address NORM in the workplace. Indeed, ICRP26 and 1980 BSS seemed to deliberately avoid any references to NORM! Hence IRR85 included in its definitions of "Work with ionising radiation" as "any work involving the production, processing, handling, use, storage, moving, transport or disposal of any radioactive substance." Critical to this definition, in the case of NORM, is the interpretation of the meaning of the term "radioactive substance", namely "any substance having an activity concentration of more than 100 Bqg^{-1} and any other substance which contains one or more radionuclides whose activity cannot be disregarded for the purposes of radiation protection,...."

The IRR85 is supported by an Approved Code of Practice (ACOP), which gives extensive guidance on the Regulations (Part 1), and more specific advice on compliance with ALARA for particular processes (Part 2), but this does not address work with NORM . There is a separate third part to the ACOP, covering exposure to radon, mainly in below ground workplaces; it is interesting to note that with one exception (see next section), this is the closest that the ACOP approaches the provision of explicit guidance on exposure to NORM in the workplace.

The ACOP states that the definition of a "radioactive substance" extends to some substances which, although having an activity concentration equal to or less than 100 Bqg^{-1}, may nevertheless present a radiological hazard. Such substances include NORM such as zircon, baddeleyite and monazite sands, zirconia, and similar rare earth ores etc.. These examples have low activity concentrations but are often involved in dusty processes and may create an internal radiation hazard from inhalation. Equally, there may be an external radiation hazard from bulk storage of such materials.

In order to assist employers involved in the handling of NORM, the HSE commissioned research to further identify the activity concentration at which the IRR85 would be triggered. The research modelled the internal and external radiation pathways, using parameters appropriate to typical industrial exposures to dusts and bulk storage situations. The resulting guidance in the ACOP states that for substances which include the radionuclides thorium-232 or uranium-238, or any nuclides in their particular decay series, activity concentrations of the parent radionuclide exceeding 0.3 Bqg^{-1} or 1.0 Bqg^{-1} respectively for dusty operations, and 5 Bqg^{-1} or 9 Bqg^{-1} for bulk storage, would bring them within the definition of work with ionising radiation.

4.1.2 BSS96 Interpretation & IRRrev

The BSS96 Directive followed the ICRP lead with Title VII devoted to NRS, including specific reference to NORM in Article 40. The main duty in Title VII on member states is to establish a national picture, through surveys or other means, and decide which work activities should be subject to control.

The UK has retained its definition of what constitutes a radioactive substance for regulatory purposes, but it now qualifies the phrase "..whose activity cannot be disregarded for the purposes of radiation protection" in specific guidance. This indicates that if a dose of ionising radiations to employees or other persons in excess of 1 mSv in a year is likely to arise as a result of use of NORM, then it will be considered that the activity of the NORM cannot be disregarded for the purposes of radiation protection and this will be sufficient to trigger the application of the IRRrev.

4.2 ALARA principles and advice on risk assessment

Regulation 6 of IRR85 requires employers to restrict exposure to ionising radiation so far as is reasonably practicable. This implies that the employer needs to assess the risk to employees working with NORM to see whether it would be regarded as a "radioactive substance" as described in the previous section.

Such a risk assessment is far from straightforward in the case of internal radiation arising from exposure to dust from using or handling NORM. The experience of HSE has been that few employers have access to the required radiation protection advice within their immediate organisation. Hence, in most cases, the employer will need to seek advice from a competent qualified expert (QE).

Where the use of NORM in the workplace will trigger the IRRrev, the employer will be required to carry out a prior risk assessment before commencing work with ionising radiation

In the case of work with ionising radiation solely involving the handling or use of NORM, there is currently no requirement for the employer to formally appoint a QE, or notify the HSE of any such appointment, however complex the radiation protection issues. However, the IRRrev will explicitly require the appointment of a QE to advise the employer about the need for controlled or supervised areas (see below).

In the case of potential exposure to NORM dust, the provision and use of local ventilation systems to extract airborne dusts from the workplace may be justified. In addition, protection of the individual employee may be enhanced by the provision and (correct!) use of suitable respiratory protective equipment. Systems of work designed to minimise exposure to airborne dusts may also be required.

4.3 Designation of work areas

The assessment of risks associated with the work with NORM will have identified likely doses to employees (and others) in various workplace activities. If such doses are likely to exceed 15 mSv, then the employer will need to designate a "controlled area". If doses are likely to exceed 5 mSv then a "supervised area" must be designated. Entry into controlled areas is limited to designated radiation workers or persons operating under a written system of work. Due account must be taken of access for maintenance purposes, for example servicing of dust or fume extraction equipment. Experience has shown that this can have considerable potential for exposure, particularly where higher activity material may be concentrated as a result of the characteristics of the process in use.

IRRrev, while being less prescriptive about the criteria for designating such areas, will in most practical situations reduce these trigger points to 6 mSv and 1 mSv respectively.

4.4 Assessment of doses

If the employer has designated controlled areas that persons enter, then actual doses will need to be assessed when persons enter such areas. In the case of external radiation, such an assessment is reasonably straightforward (e.g. by the use of TLD or film dosemeters). However, in the case of internal radiation, assessments are far more complex, and will need to be designed to cover all work activities in the area. The employer will probably need to discuss such a programme of assessments with a QE.

4.5 Other management issues

An employer carrying out "work with ionising radiation" by virtue of handling or use of NORM will need to prepare "local rules" for this work. The local rules are the general principles and description of the means of complying with the IRR85. The local rules would normally take account of any particular engineering controls or systems of work which need to be followed in order to achieve exposures which are ALARA.

Employees (and other persons) will need to be provided with information, instruction and training to enable them to carry out their work in compliance with the IRR85. The employer will need to ensure that the work involving the handling and use of NORM in the workplace is properly supervised.

These requirements will carry through to IRRrev.

5 Supplier's Responsibilities

Suppliers of NORM which may, in the course of reasonably foreseeable circumstances, result in such materials being considered radioactive substances for the regulatory purposes , need to provide adequate information about radiological (and other hazards) to the user. This is a requirement of the HSWA.

In order to comply with the HSWA, the supplier will need to carry out an analysis of the material in order to determine the potential risk to users. This analysis and associated information to users will need to be reviewed periodically, in the light of changing circumstances (e.g. changes in the sourcing of raw materials).

6 UK Experiences

In the 13 year period of application of the IRR85 in the UK, the HSE has found that users are not always aware of the potential for risk of radiation exposure as a result of exposure to NORM, since the materials are being used in industries that have had no previous experience, and hence awareness, of radiation protection issues. However, certain industries (e.g. oil & extraction) have quickly developed expertise to effectively manage NORM in the workplace in compliance with UK legislation.

Another common conceptual problem is the conundrum of perception of risk for natural versus artificial sources of radiation; the former is nearly always thought to be less harmful because it is natural!

Therefore, it is nearly always the case that the user will need to obtain the assistance of a QE (plus other specialists e.g. occupational hygienist) in order to manage the risk associated with NORM

External radiation arising from exposure to bulk storage of NORM is not normally a priority for attention; distances from bulk stores and occupancy times around hoppers etc. mean that radiation doses are rarely going to exceed 1 mSv per annum.

However, internal radiation arising from prolonged exposure to dusty conditions; experience has shown that doses in excess of 5 mSv might arise. If engineering controls have failed to reduce the dust levels to acceptable levels, then a controlled area may have to be designated, and respiratory protective equipment may need to be provided.

Another problem that has been encountered is the preferential concentration of radioactivity in certain process streams during heating, smelting, refining, extraction etc. of NORM. A typical example of this effect is the more volatile products in the uranium and thorium decay series being driven off and concentrated in furnace fume. Under certain conditions, enhancement of radioactivity by a factor of 50x to 100x has been observed. The resultant product stream has the potential to deliver a highly significant internal radiation dose of radiation to employees, if not properly managed by engineering controls and systems of work for entry into hazardous areas. Scales in pipework etc. can also trap and concentrate uranium, thorium and their decay products.

7 Conclusions

UK (and other European member states) legislation has not to date specifically addressed control of exposure to NORM in the workplace. Chronic exposure to low activity sources may have the potential to become significant; there is particular potential for internal doses of radiation. Awareness of risks amongst users of NORM tends to be low. This contrasts with the well developed systems for control of exposure to artificial sources, where risks from acute exposures to high activity sources are closely controlled, in part due to a high awareness of the associated hazards.

ICRP60 has addressed the specific problems associated with NRS's, including NORM. National legislation in the EU is in the process of being revised to take account of these changes. It is envisaged that the legislative position with respect to the use of NORM will become clearer, and thus promote safer use of NORM in the workplace.

REFERENCES

ACOP (1985) Approved Code of Practice "The protection of persons against ionising radiation arising from any work activity" H.M.S.O. London ISBN 0 7176 0508 6

BSS80 (1980) 80/836/Euratom - Council Directive, amending the Directives laying down basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation.

BSS96 (1996) 96/29/Euratom - Council Directive, laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

HSWA (1974) Health and Safety at Work etc 1974 H.M.S.O., London

ICRP26 (1980) Publication 26 Recommendations of the ICRP Annals of the ICRP 1(3)

ICRP60 (1990) Publication 60 Annals of the ICRP 2(3/4)

IRR85 (1985) The Ionising Radiations Regulations 1985 S.I.1333 H.M.S.O. London ISBN 0 11 057333 1