

## **The Development of Occupational, Public and Environmental Radiation Protection Legislation in Great Britain**

W P Bines<sup>1</sup> and S D Chandler<sup>2</sup>

<sup>1</sup>Health and Safety Executive, Rose Court, 2 Southwark Bridge, London SE1 9HS, England

<sup>2</sup>Environment Agency, Rivers House, East Quay, Bridgwater, Somerset TA6 4YS, England

### **INTRODUCTION**

Following the discovery of radioactivity by Becquerel in 1896 radium began to be used in medicine and scientific research, and subsequently in the manufacture of luminous paints. Although the first harmful effects of radiation on the human body were realised soon after these early applications of radioactive substances, the full extent of the risks involved was not appreciated until much later. Few countries took legislative action aimed at controlling exposure to radioactive substances before the Second World War.

### **EARLY LEGISLATION**

In Great Britain (GB), the first legislation introduced to control exposure to radioactive substances was the Factories (Luminising) Special Regulations 1947, made under the Factories Acts and concerned with the protection of industrial luminisers. It contained provisions restricting employment in luminising processes and provided for the wearing of film badges, for medical examinations and for record-keeping. The Regulations were prompted in part by considerable evidence from the United States of America of injury to radium dial painters and detailed recommendations from the US Advisory Committee on X-ray and Radium Protection. As with other Regulations made under the Factories Acts they were enforced by the Factories Inspectorate, then a free-standing entity and now part of the GB Health and Safety Executive (HSE).

The first recognition of the need for public protection from the use of radioactive materials came with the introduction of the Radioactive Substances Act 1948. This Act was largely intended to control medical uses of radioactive substances. Although it was the first legislation to mention radioactive waste specifically, it proved ineffective as a regulatory tool for two main reasons. Firstly, the definitions of radioactive substance and of waste were very wide, so that it was impractical to make regulations to control radioactive waste disposal. Secondly, it did not give any exemption from other legislation which might restrict disposals of radioactive waste, such as the Rivers (Prevention of Pollution) Act 1951. Arguably the most important contribution of the Act was to provide for the setting up of the Radioactive Substances Advisory Committee. This was to play a key role in framing later and more effective legislation.

The most significant discharges of radioactivity and the greatest potential for public exposure during this early period came not from medical practices but from the fledgling nuclear industry. These were the atomic weapon research and manufacturing plants run by the Ministry of Supply, including Windscale, Aldermaston, Harwell and Capenhurst. For the first years of their operation the discharges from these major plants were controlled only by informal agreements with the Ministry of Housing and Local Government.

The first important milestone in effective regulation of radioactive waste disposals was the 1954 Act setting up the Atomic Energy Authority (AEA). This required any radioactive waste disposals from AEA premises to be authorised by the Minister of Housing and Local Government and the Minister of Agriculture and Fisheries. The Act also recognised the importance of the local impact of discharges and disposals by requiring local authorities and water undertakings to be consulted before authorisations were granted. Unfortunately the Act had two major limitations, it only applied to AEA premises and there was no offence committed if a discharge authorisation was breached.

The Ionising Radiations (Sealed Sources) Regulations, made in 1961, were the next important step in control of occupational exposure. However, they were solely concerned with the protection of factory workers against ionising radiations from sealed sources and machines or apparatus generating X-rays. They did not cover work with unsealed radioactive substances or nuclear fuel elements, nor work at nuclear installations, educational and research establishments or hospitals. These Regulations provided for a fairly comprehensive system of control for factories, with quite detailed provisions for certain processes. Factory occupiers were required to do all that was reasonably practicable to restrict the extent of exposure of employees and maximum permissible doses were specified. For classified workers there were maximum permissible doses both for the calendar quarter and for cumulative, age dependent, occupational exposure. The 1961 Regulations reflected many of the scientific developments up to 1959, as covered in ICRP publication 1. At that time, the maximum permissible dose was seen as a dose accumulated over a long period of time or resulting from a single exposure. In the light of the then current knowledge, such a dose was seen as carrying a negligible probability of severe somatic or genetic injuries.

Even if such a dose might be received more frequently, the effects were thought likely to be minor and not unacceptable.

A few years earlier the fire at the Windscale number 1 Pile, in 1957, had caused considerable concern about the control of the developing nuclear industry. The subsequent public inquiry led to the making of the Nuclear Installations (Licensing and Insurance) Act 1959, to "ensure, by a system of licensing and inspection, that nuclear reactors on land are made effectively subject to control in the interest of public safety", and extended regulation to nuclear sites not operated by the AEA. The radioactive waste controls in this Act remedied the limitations of the 1954 Act, making non-compliance with an authorisation an offence. The 1959 Act was subsequently amended by the Nuclear Installations Act 1965 (NIA65) to comply with international Conventions relating to liability and compensation. The Nuclear Installations Regulations 1971 brought fuel production and reprocessing operations within the scope of NIA65.

Although a large part of NIA65 deals with insurance and international liabilities, its key provision relating to safety is the requirement for operators of a civil nuclear installation to have a nuclear site licence. The Act places an absolute responsibility for safety on the licensees. The Nuclear Installations Inspectorate (NII) was set up in 1960 shortly after the 1959 Act came into force. It began under the Ministry of Power and moved to several Government Departments until it became part of the then newly formed HSE in January 1974. NIA65 allowed for the site licence to contain Conditions for the purposes of ensuring that the site was operated safely. These conditions typically numbered over fifty and covered such things as operating rules, maintenance, recording of incidents, keeping of records etc. Prior to the introduction of the Ionising Radiations Regulations in 1985, site licence conditions also specified dose limits and radiation protection requirements.

The Ionising Radiations (Unsealed Radioactive Substances) Regulations 1968 and the Ionising Radiations (Sealed Sources) Regulations 1969 represented a further significant advance but were still limited in scope to industrial applications carried out in factories; as already mentioned, equivalent provisions for nuclear installations were contained in site licence conditions under NIA65. The concept of maximum permissible dose (other than from intakes) was retained, supplemented in the case of unsealed radioactive substances by maximum permissible levels of surface contamination. The Regulations were still quite prescriptive in nature, covering both the basic principles of protection and radiological and medical supervision together with particular arrangements for specific types of plant or processes.

## DEVELOPMENT OF PRINCIPLES FOR THE REGULATION OF RADIOACTIVE WASTE

During the 1950s, the disposal of waste from the burgeoning use of radioactive materials in industry and medicine was essentially unregulated and was causing increasing problems, particularly from the radium luminising business. This unsatisfactory situation was eventually addressed in 1956, when the Radioactive Substances Advisory Committee convened a Panel to "ascertain the nature and quality of radioactive waste likely to arise in the foreseeable future; to advise on the best methods of securing that the waste is disposed of safely; and to advise whether any new legal provision or amendments to existing legislation are necessary to ensure safe disposal and, if so, to advise on the form which the new provision or amendments should take".

The final report of the Panel on Radioactive Wastes was published as a Government White Paper, Cmnd 884. As well as recommending a new legislative provision, this paper set out a number of key principles for regulation of radioactive waste that have stood the test of time:

- v discharges of waste should be controlled to ensure, irrespective of cost, that they will not release an amount of radioactivity which would directly endanger the health of any number of the public living in the neighbourhood;
- v in considering whether a given discharge should or should not be permitted, it is necessary to decide whether the radiation from the discharge, when added to that from all other sources of radiation, is likely to result in a genetic hazard to the nation as a whole;
- v the number of people who have sufficient scientific knowledge to evaluate these problems is so limited that it would not be practicable to set up a large number of local controls. Therefore control should be organised on a national basis as a Government responsibility;
- v local disposal of wastes by conventional means is desirable where practicable;
- v the authority responsible for control should have in reserve means of disposing of wastes which are too active to permit safe local disposal.

These principles were not finally implemented for all radioactive waste disposals until December 1963, when the Radioactive Substances Act 1960 (RSA60) replaced the earlier controls under the Atomic Energy Authority Act 1954 and the Nuclear Installations (Licensing and Insurance) Act 1959. The 1960 Act introduced two levels of control: registration of radioactive material holding and use; and authorisation of radioactive waste accumulation and disposal. It provided for exemption of certain types of work and low levels of radioactivity and continued the practice, established in the earlier legislation, of consulting local authorities on disposals from nuclear licensed sites.

The framework of control established by RSA60 has continued largely unchanged to the present day. However, there have been two significant sets of amendments to bring it up to date. In 1991 the Act was amended to include a requirement for information on registration and authorisations be placed on public registers, held by the enforcing authority (then Her Majesty's Inspectorate of Pollution) and the relevant local authority. There was also a provision for charging the applicant fees, in accordance with the 'polluter pays' principle. These amendments were consolidated in the Radioactive Substances Act 1993. Subsequently in the 1995 Environment Act, which established the Environment Agency, the opportunity was taken to make further important changes to the Radioactive Substances Act 1993. The Environment Agency became the enforcing authority, rather than the Secretary of State for the Environment, although the Secretary of State was given powers to direct the Agency on whether or not to grant authorisation in any particular case. The Minister of Agriculture, Fisheries and Food was also given power of direction, but lost the joint authorisation role for nuclear site discharges which he had held since 1954.

Authorisation for radioactive waste disposal under the Radioactive Substances Act 1993 may be granted subject to such conditions as the Environment Agency sees fit. In general authorisations contain monthly and/or annual limits on the amounts of specific radionuclides that may be disposed of. Nuclear site authorisations also have an overriding requirement that "best practicable means" shall be used to minimise the radioactive content of discharges. There are further conditions requiring adequate supervision, training, maintenance and record keeping.

## RADIOACTIVE WASTE POLICY

The legislative framework is very flexible and might be applied to many situations in many different ways. Therefore, the development of radioactive waste policy has been very important in determining exactly how effective regulation of radioactive waste has proved in practice. As previously mentioned, the first major statement of the Government's policy was set out in Cmnd 884 published in 1959. These principles have underpinned radioactive waste regulation ever since. Nevertheless, this White Paper appeared well before there was a clear commitment to a major nuclear programme in the United Kingdom. By the early 1970s there were several first generation Magnox power reactors in operation and the second generation AGRs were being built. The atomic weapon facilities were also over twenty years old and considerable radioactive waste had accumulated. The Royal Commission on Environmental Pollution believed that a more co-ordinated approach to managing the waste arising from the nuclear programme was needed, and said so in their sixth report published in 1976. The report drew attention particularly to the divided responsibility for radioactive waste policy and the lack of a clear policy for solid radioactive waste that was unsuitable for local disposal.

The Government's response to this criticism was published in 1977 in the White Paper, Cmnd 6820. This accepted that a long-term strategy was needed and announced that the Secretary of State for the Environment would in future be responsible for nuclear waste management policy. The main components of the new policy were set out, extending the principles established in Cmnd 884 twenty years earlier:

- v ensure that the creation of wastes from nuclear activity are minimised;
- v ensure that waste management problems are dealt with before any large nuclear programme is undertaken;
- v ensure that the handling and treatment of wastes is carried out with due regard to environmental considerations;
- v secure the programmed disposal of wastes accumulated at nuclear sites;
- v ensure that there is adequate research and development on methods of disposal;
- v secure the disposal of wastes in appropriate ways, at appropriate times and in appropriate places.

These principles became the foundation for radioactive waste management policy for the next twenty years, although there were further developments of policy at a more detailed level. In the late 1970s an Expert Group reviewed the Cmnd 884 principles to take account of the developments in radiological protection in ICRP 26. The ICRP hierarchy for radiological protection (justification, optimisation and limitation) was specifically introduced into Government radioactive waste policy by a further White Paper published in 1982, Cmnd 8607. The White Paper also dealt with an issue raised by the Royal Commission in 1976 that had not been addressed in Cmnd 6820, the urgent need for a repository for intermediate level waste (ILW) in the United Kingdom. It was now stated that the Government's objective was to have new facilities in operation soon. This proved to be unrealistically optimistic and in the approach to the 1987 General Election the Government announced a series of decisions restricting investigation of potential disposal sites for low level waste (LLW) and ILW that put the timescale for a new repository back many years.

No further significant review of policy took place until 1994, when the Government published a consultation document (Green Paper) on radioactive waste management policy. The final policy resulting from this review and consultation was published in 1995 as a White Paper, Cmnd 2919. Although there were some developments in specific policies (eg controlled burial and decommissioning) the overall conclusion was that the policy framework in Cmnd 6820 had worked well. The policy was therefore simply redrafted to take into account

the concept of sustainable development, to recognise the partial privatisation of the nuclear industry and to clarify the different responsibilities of the Government, the regulators and the industry. From the strict radiological protection perspective perhaps the most significant innovation was to introduce a dose threshold of 0.02 mSv/year, corresponding to an annual risk of death of  $10^{-6}$ , as a lower band for optimisation, below which the regulators should not seek further reductions in public exposure.

## CHANGE OF LEGISLATIVE FRAMEWORK FOR OCCUPATIONAL HEALTH AND SAFETY

The Health and Safety at Work Etc. Act 1974 (HSWA) introduced a radically new framework for legislation on health and safety. The purpose of this Act was to provide one comprehensive and integrated system of law concerning the health, safety and welfare of people at work (including the self employed) and also public safety, insofar as it was affected by the work activities. The general objective included the progressive replacement of outdated legislation by modern flexible regulations on specific hazards and by Approved Codes of Practice (ACOPs). It represented a change of philosophy towards health and safety. Importantly, it adopted an across-the-board approach covering all work activities, not merely factories or nuclear installations. The underlying philosophy was one of restricting risks so far as reasonably practicable; it was flexible, goal-setting legislation rather than the prescriptive approach seen previously.

HSWA provided for the establishment of the Health and Safety Commission (HSC), a tripartite body with members representing employers, trades unions and local authorities whose duties included developing and recommending regulations to Ministers, and the Health and Safety Executive (HSE), which would direct the work of inspectors brought together from various inspectorates. Arrangements for the enforcement of the Act and relevant statutory provisions were enhanced by provisions enabling Health and Safety inspectors to serve "improvement" and "prohibition" notices. An improvement notice could require an employer to undertake certain improvements by a specified date, while permitting work to continue, and would be used to tackle significant safety problems that nevertheless were not life-threatening. A prohibition notice could be used when a work activity was seen as being too dangerous to be allowed to continue until safety improvements had been made.

## DEVELOPMENT OF RADIATION PROTECTION LEGISLATION

When the UK joined the European Community (now the European Union) in 1973, like other member States it became subject to the provisions of the Euratom Treaty and related Community legislation. This included a duty to transpose the provisions of the 1976 Basic Safety Standards (BSS) Directive (76/579/Euratom), which reflected the recommendations in ICRP Publication 9, into national legislation. Although the United Kingdom (UK) is the member State, Great Britain (GB) and Northern Ireland make separate, albeit virtually identical, implementing legislation. This paper specifically relates to the legislation made by GB. Before implementation could be achieved, however, ICRP revised its recommendations (published as ICRP 26 in 1977) and the European Council consequently negotiated and then adopted a revised BSS Directive (80/836/Euratom), subsequently amending it in 1984 (84/467/Euratom).

These developments at European level resulted in HSC publishing two formal Consultative Documents, containing draft Regulations and supporting ACOP advice to implement the bulk of the Directive provisions, first in 1979 and then, to take account of the revised Directive, an amended version in 1982. The Ionising Radiations Regulations 1985 (IRR85) were made on 23rd August 1985 and, for the first time in GB, all work activities involving exposure to ionising radiations, including natural radiation sources (principally radon), were covered by the same comprehensive legislation. The Regulations were supported by a two-part Approved Code of Practice and, subsequently, by a third part relating to exposure to radon. The purpose of an ACOP is to provide practical guidance. The provisions of an ACOP represent, in the opinion of the HSC, the most appropriate methods of complying with legal requirements. An ACOP has a special legal status and may be used in legal proceedings as evidence that a person has contravened a regulation, while allowing the employer some flexibility to show that the standards had in fact been met by different means.

In 1987 it became clear that scientific knowledge, mainly based on the survivors of the Japanese atomic bombings, was pointing to higher estimates of risk of cancer induction from exposure to ionising radiation than those reflected in ICRP 26 and the 1980 BSS Directive (as amended in 1984). ICRP therefore issued its 'Como' Statement. In response to this and to formal advice from the UK's National Radiological Protection Board HSC introduced a further part to the ACOP supporting IRR85, in order to strengthen the requirement that doses should be kept as low as reasonably practicable, pending revised recommendations from ICRP and their reflection in a revised BSS Directive. ACOP Part 4 advised that employers might need to review decisions on what it was reasonably practicable to do to restrict exposure. Also, it introduced an additional investigation level for employees whose recorded cumulative dose reached or exceeded 75 mSv within any five consecutive years. The purpose of this investigation was to focus attention on the individual, considering the recent past and looking into

the future to decide what action might be necessary to restrict future exposure.

## LATEST DEVELOPMENTS IN LEGISLATION FOR OCCUPATIONAL RADIATION PROTECTION

In 1990 ICRP adopted substantially revised and updated recommendations, published in 1991 as ICRP 60(1). These in turn led to a revised European Basic Safety Standards Directive, adopted in 1996 (96/29/Euratom) (2). The UK took the opportunity created by the need to produce revised Ionising Radiations Regulations to review the overall regulatory structure, the layout and grouping of regulations, the balance between material in an Approved Code of Practice and HSE-issued non-statutory guidance, and the scope for simplifying and clarifying amendments arising from experience of IRR85.

Consultation, both formal and informal, provided the basis for revision of IRR85 to implement the majority of the provisions of the 1996 BSS Directive, for which the due date for implementation is 13 May 2000. Firstly, HSE issued a Consultation Paper in 1996 which discussed and sought views on strategic issues, such as the structure of revised regulations and broad proposals for a more transparent approach to the recognition of the capacity of qualified experts ('radiation protection advisers' in UK legislation) (3). Responses to this document helped to direct the broad approach to preparing revised regulations. The work of twelve Topic Groups also fed into the preparation of a formal Consultative Document, published by HSC in February 1998, which contained draft regulations as well as ACOP and regulatory guidance and was freely available to anyone, employer, employee, organisation or member of the public, who was interested (4). After the responses to the Consultative Document had been analysed, further informal consultation was undertaken on those issues where it was needed. Throughout, HSC/E received advice from the HSC's Ionising Radiations Advisory Committee, which comprises members nominated by employers' and employees' organisations, professional bodies, local authorities, government departments, consumer associations and the National Radiological Protection Board. This work has culminated in the Ionising Radiations Regulations 1999, which came into force on 1 January 2000 (5).

The emergency preparedness aspects of the 1996 BSS Directive will be implemented through different regulations which will require a managed process for radiation protection during intervention. These regulations will deal with 'top level' incidents, and will complement the requirements for contingency planning in the Ionising Radiations Regulations 1999 which apply to everyone.

## RECENT DEVELOPMENTS IN ENVIRONMENTAL PROTECTION LEGISLATION AND POLICY

Several recent developments indicate the way legislation and policy may evolve, but no significant new radioactive waste legislation or White Paper has been published since 1995. In summary, the main current issues are:-

- v while the bulk of the provisions of the 1996 BSS Directive have now been implemented by the Ionising Radiations Regulations 1999, amendments to radioactive waste legislation are also necessary to reflect the changes in clearance levels. The Government is expected to issue a Consultation Document shortly which will describe proposed changes to the Radioactive Substances Act 1993 (RSA93). These are likely to amend only the exemption for holding luminised clocks and watches, although a review of all the Exemption Orders made under the Act is planned. There may also be a Secretary of State's direction to make the Environment Agency legally responsible for taking account of ALARA, also the dose limits and dose constraints in the 1996 Directive, when granting RSA93 authorisations;
- v the Oslo and Paris (OSPAR) Convention meeting at Sintra, Portugal in 1998 agreed a statement that the contracting parties would aim to achieve concentrations in the marine environment close to zero for artificial radioactive substances (technical feasibility and radiological impact being taken into account), reducing discharges by 2020 to levels where they make no significant addition to historic concentrations. Nuclear operators are currently discussing with Government and the regulators their strategies to achieve this target;
- v the Government carried out a consultation in 1998 on a regulatory regime for radioactively contaminated land and plans to introduce legislation later in 2000;
- v the House of Lords Science and Technology Select Committee produced a report on nuclear waste management in 1999. Their conclusions are that decisions on stored radioactive waste must not be delayed further and that phased disposal in a deep repository is feasible and desirable. They recommended that a new "Nuclear Waste Management Commission" should be charged with the development of a comprehensive strategy, through public consultation. Additionally they recommended that the Environment Agency should be given new powers to regulate waste treatment and storage on nuclear sites.

## THE FUTURE?

The concept of 'controllable dose', currently under discussion, plus further results from research studies

and the knowledge of continuing public interest fuelled by campaigners, will ensure that the radiation protection community does not become complacent and continues to keep matters under review. Regulators and regulated may be permitted a wish for a degree of stability, however, to allow time for the latest standards to be assimilated and achieved across the world and for their effect to be evaluated before further change is considered.

## CONCLUSION

UK legislation on occupational radiation protection has developed from a fairly narrow base to a comprehensive package covering all work with ionising radiation. To a large extent this has mirrored developments in scientific knowledge. Analysis of occupational dose information on HSE's Central Index of Dose Information, which receives annual summaries of doses to individual classified workers ('category A workers' in the BSS Directive), demonstrates the general success of the Ionising Radiations Regulations, as well as highlighting sectors where inspection efforts could usefully be targeted (6). The development of UK policy and legislation for protection of the public and environment from radioactive waste discharges has perhaps been less timely, particularly for the disposal of solid radioactive wastes. Despite the absence of a clear policy or progress on the disposal of such waste being highlighted in 1976 by the Royal Commission on Environmental Pollution, a House of Lords Committee felt called to make almost the same criticism in 1999. The evidence indicates that the public and the environment have been well protected from the effects of radioactive discharges for the past 50 years. Nevertheless, there is likely to be increasing public concern over the future until there is a clear solution for the disposal of accumulated radioactive wastes, within a transparent regulatory framework. However, the current discussions on a potentially new concept of radiological protection, 'controllable dose', could have significant implications for both regulator and regulated alike.

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