THE UNITED KINGDOM'S NATIONAL REPORT

ON COMPLIANCE WITH THE OBLIGATIONS

OF THE INTERNATIONAL CONVENTION ON

NUCLEAR SAFETY

Revision 2, September 2001

URN 01/292

dti

Department of Trade and Industry

Contributors to the UK 's National Report

The Health and Safety Executive prepared this report in consultation with and incorporating contributions from:

- British Energy plc
- British Nuclear Fuels plc
- Department for Environment, Food and Rural Affairs
- Department of Trade and Industry
- Environment Agency
- Food Standards Agency
- Home Office
- Magnox Electric plc
- National Assembly for Wales
- Scottish Environment Protection Agency
- Scottish Executive

FOREWORD

This report has been prepared by the United Kingdom (UK) to meet the requirement of Article 5 of the Convention on Nuclear Safety. It considers each of the Convention's obligations and explains how the UK addresses them.

The report only covers land based civil nuclear power plant, that is, nuclear installations as defined within Article 2 of the Convention. The safety of other UK nuclear facilities outside the scope of the Convention are also regulated and operated in a manner that maintains a high level of safety.

The UK has no nuclear installations where significant corrective actions were necessary to comply with the Convention. This is because for many years the UK has been monitoring and improving the safety of its nuclear installations. This activity will continue in the future.

Table of contents

Table of contents cont. **Page**

Table of contents cont. **Page**

Table of contents cont. **Page**

UK REPORT FOR THE CONVENTION ON NUCLEAR SAFETY

EXECUTIVE SUMMARY

Purpose and structure of the Report

This report is the UK's submission to the second review meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS). It considers each of the Convention's obligations and explains how the UK meets them. The report only considers nuclear installations that are within the scope of Article 2 of the CNS (that is, land based civil nuclear power plant). As a result, the UK's report does not consider Northern Ireland, the Isle of Man or the Channel Islands since the nuclear installations are all sited in England, Scotland and Wales. However, to avoid confusion this report uses 'the UK' where strictly speaking 'Great Britain' would be more accurate. The safety of other UK nuclear facilities outside the scope of the CNS are also regulated and operated in a manner that maintains a high level of safety.

In preparing this second report the following approach has been taken:

- The introduction includes the main nuclear issues that have been considered in the UK since the first report was prepared and addresses the issues that were raised at the first Review Meeting on the UK's report and Contracting Parties' reports in general.

- The other chapters in the report on the articles of the CNS are mostly the same as those in the first report, but have been updated as necessary. Significant changes are shown by underlining new text or lines through deleted text. Minor changes to the text of a grammatical nature are not highlighted.

- The introduction includes an indication of the above changes in general terms.

- Questions on the UK's first report raised in writing before the first review meeting and their answers are included at the end of the appropriate chapter.

- Oral questions on the UK's report raised during the first Review Meeting and their answers are included as Annex 11.

- Where further information is available on the internet relevant to the UK's submission to the second Review Meeting, the web sites are referenced.

The report demonstrates how the UK Government meets the objectives of the CNS (Article 1) namely:

(i) to achieve and maintain a high level of nuclear safety world-wide through the enhancement of national measures and international co-operation including, where appropriate, safety related technical co-operation;

(ii) to establish and maintain effective defences in nuclear installations against potential radiological hazards in order to protect individuals, society and the environment from harmful effects of ionising radiation from such installations;

(iii) to prevent accidents with radiological consequences and to mitigate such consequences should they occur.

It explains how the UK responds to these objectives to maintain a high level of nuclear safety at nuclear installations. It also explains how the nuclear industry responds to these objectives and the principles for achieving the high safety standards required by the UK's relevant Acts and Regulations.

The UK's approach to nuclear safety is explained with, where appropriate, more detailed information and data in Annexes and references to sources of information. Obligations under the CNS are contained in Articles 6 to 19 inclusively. Each obligation Article is treated as a separate chapter and the paragraphs in the chapters are numbered to reflect the Article under consideration. For example, paragraph 7.1 is on Article 7. **Articles that do not contain obligations are not discussed in this document, hence there are no paragraphs numbered 2.x to 5.x.**

INTRODUCTION

This section describes:

- **the UK's national policy towards nuclear activities (paragraphs 1.1 to 1.4);**
- **main nuclear safety issues considered in the UK (paragraphs 1.5 to 1.29);**
- **nuclear installations in the UK (paragraph 1.30 to 1.32);**
- **information requested by first Review Meeting (paragraphs 1.33 to 1.57);**
- **information requested by first Review Meeting relevant to Articles 6 to 19 (paragraphs 1.57 to 1.94);**
- **answers to written questions on the first report introduction.**

National policy towards nuclear activities

1.1 The Government's Department of Trade and Industry (DTI) sponsors the nuclear industry in the UK. Commercial nuclear power generation is carried out by three companies: one private sector company British Energy plc (BE), and British Nuclear Fuels Limited (BNFL) (wholly government owned) and Magnox Electric plc (ME, wholly owned by BNFL) in the public sector. BE, the larger of the two, is a holding company with two subsidiaries, British Energy Generation Ltd. (BEGL) that operates the Pressurised Water Reactor (PWR) and five Advanced Gas Reactor (AGR) stations in England, and British Energy Generation (UK) Ltd (BEG(UK)L) that operates two AGR stations in Scotland. BNFL and ME own and operate seven Magnox stations in England, Wales and Scotland. The Health and Safety Executive (HSE) (see paragraph 7.1) is the UK's nuclear installation licensing authority and within HSE, HM Nuclear Installations Inspectorate (NII) regulates safety at all nuclear installations in the UK.

1.2 The UK Government's energy policy is to ensure secure, diverse and sustainable energy at competitive prices. The Government frequently reviews a number of policy areas (for example, energy sources for power generation, utility regulation) to ensure that these contribute to that broader objective.

1.3 During 1999, (the latest date for which a figure is available) nuclear installations represented about 18% of the installed electricity generating capacity in the UK. In terms of electricity supplied, nuclear installations accounted for about 26% of the UK's electricity output. Provided that stations maintain their existing high standards of safety and environmental protection, the Government believes that nuclear power should continue to contribute to the UK's electricity supply industry.

Review of Energy Objectives

1.4 The Prime Minister announced on 27 June 2001, in response to a question in Parliament, that he has asked for a review of the longer term, strategic issues surrounding energy policy for Great Britain. The review is to be within the context of meeting the challenge of global warming, while ensuring reliable and competitive energy supplies. The aim of the review will be to set out the objectives of energy policy and develop a strategy that ensures cur-

rent policy commitments are consistent with longer-term goals. The Minister for Industry and Energy will chair the advisory group for the Project. Other Ministers on the Advisory Group include the Minister for the Environment and the Chief Secretary to the Treasury. The Performance and Innovation Unit will be responsible for the management of the project. The Unit will work closely with the DTI, the Department of Environment, Food and Rural Affairs (DEFRA), the Treasury and other Government Departments who have a responsibility for or an interest in energy policy. The Unit aims to complete its work by the end of the year when the Minister for Industry and Energy will deliver the report to the Prime Minister.

Main Nuclear Safety Issues recently considered or being considered in the UK

1.5 The UK has no nuclear installations where significant corrective actions were necessary to comply with this Convention. This is because for many years the UK has been monitoring and improving the safety of the installations (further details are given under Article 6). To demonstrate this a number of topics have been included below to show the UK approach to the anticipation and handling of safety issues and dealing with unanticipated issues.

Periodic Safety Reviews

1.6 In addition to requirements to produce safety cases before operations are commenced and maintain adequate safety cases during operation, the licensing regime requires licensees to review and re-assess the safety of their plants periodically and systematically. Periodic Safety Reviews (PSRs) meet this requirement and the regulator makes its findings on the PSRs available to the public. The PSR programme has been successful in identifying the necessary plant safety improvements, some of which have been generic to the whole of the gas cooled reactor programme. Although the PSR may conclude that the safety case will remain valid for a further ten years, this will depend upon continuing satisfactory results from both in-service and periodic shutdown inspections. Thus PSRs provide confidence in, but are not the only guarantee of, continued safe operation. Should any safety-related factors emerge in the interim that may raise questions on the continuing validity of the safety case, the regulator would require the licensee to resolve the issue. If the regulator is not satisfied with the licensee's response, it has extensive powers under the licence and under the Health and Safety at Work etc (see paragraphs 7.12 and 7.13) Act to require any necessary changes, and can shut down the plant until it is satisfied that the plant can be operated safely. This process gives confidence that relevant safety issues will be identified and resolved as plants age. PSRs are dealt with in more detail under Articles 6 and 14.

Contractorisation

1.7 The use of contractors in the UK's nuclear power industry for specific activities is relatively common and has not so far caused major difficulties to licence compliance at nuclear power stations. In terms of published guidance {ref. 1} 'the user' is interpreted as being the company 'which is in day to day control of the site, process and activities and whose staff manage the operation of the plant'. Hence, the licensee must have the competence to oversee and take responsibility for its activities. The use of contractors or consultants should not

compromise either the licensee's chain of command or its ability to control activities on its site on a day to day basis.

1.8 Contractorisation can be a factor in loss of corporate expertise. It involves the displacement of knowledge and experience from the licensee to a third party. Recent licensee reorganisations have involved a reduction in persons directly employed by the licensee, but an increase in the use of contractors. If the contractor is working specifically in the nuclear domain, and has entered a long-term relationship with the licensee, this should not be problematical. However, the regulator must have confidence that the licensee possesses sufficient skills and resource to be able to make a knowledgeable assessment of the contractor's performance. As a result, the licensee must be able to set appropriate standards for the contractor's work, to monitor performance, to judge the consequences of departures from any standards, to determine the impact of the work if it is inadequately conceived or executed, and to act accordingly. The regulator also seeks reassurance that where key skills are vested in a contractor, decisions on the continued employment of that contractor are subject to the same considerations as decisions affecting employees.

Magnox Issues

1.9 There have been operating problems at several of the Magnox stations that have resulted in reduced output from BNFL's Magnox fleet. The reactors at Hinkley A (prior to final closure) and at Bradwell were out of service for most of the 1999/2000 financial year and reactor one at Sizewell A was off-line for a substantial period from November 1999. Also, the reactors at Wylfa have been shutdown since early in 2000.

1.10 At Hinkley A there was a need to revise the safety case and reinforce it in light of additional information concerning the materials used for the reactor pressure boundary and their performance. At Bradwell concrete beam reinforcements have had to be carried out to meet the requirements of the seismic safety case. Again, at Sizewell A safety case revisions have had to be made to take account of the results of inspections of the plant. The Wylfa reactors have been shut down for several months following the detection, using new enhanced inspection techniques, of cracks in part of the reactor pressure boundary while a revised safety case is developed and plant modifications completed.

1.11 More recently, one of the Bradwell reactors was delayed in coming back from its normal statutory outage while enhancements to the reactor pressure vessel safety case where made. Also, the other reactor at Bradwell was shut down for a period to ensure that adequate back up electrical supplies remained available under fault conditions.

1.12 In addition to these abnormal outages the Magnox reactors have been subject to their normal statutory outages for maintenance and inspections. Additional information on Sizewell A, Chapelcross and Wylfa power stations is given below.

Sizewell A Reactor 2 Shutdown

1.13 In the first report, the UK reported on the follow up work from the Long Term Safety Review (see paragraph 6.18) of Sizewell A, which revealed significant defects in seam welds in three of reactor 2's boilers. A programme of work was undertaken by BNFL Magnox to address the safety issues associated with these weld defects. The repairs were accepted by HSE and the reactor brought back to power.

Chapelcross Fuel Route Incidents

~~1.13~~1.14 During refuelling operations on Reactor 2 in March 2001, an irradiated fuel element failed to release from the grab holding the element while it was withdrawn from the reactor. Routine methods were used to release the grab. However, the irradiated fuel element snagged during the operation and was lifted out of its shielding. Personnel responded quickly and the radiological dose received by them was small. The HSE investigated the event and judged that it was due to inadequate design and operation of the equipment. The licensee modified the equipment and procedures in accordance with the nuclear site licence requirements and HSE agreed to fuelling operations continuing.

1.15 In July 2001, a carousel containing 24 irradiated fuel elements from reactor 3 fell a short distance from a fuelling machine grab at Chapelcross Nuclear Power Station. Subsequent investigation established that at least 12 of the fuel elements had been dislodged and had fallen approximately 25 metres down the heavily shielded fuel route shaft. At the time of writing this report, indications were that a number of the elements had fallen into a water-filled transfer flask, which was situated at the bottom of the fuel route shaft. HSE ensured that all necessary measures were taken by BNFL Magnox to safeguard the public near, and employees on, the Chapelcross site while actions were undertaken to recover the fuel safely. HSE is investigating the incident.

Wylfa Power Station Superheater Headers

1.16 A planned periodic shutdown of Reactor 2 at the Wylfa power station was made in April 2000 to carry out a programme of inspection and maintenance, during which there were a number of unexpected findings. This caused BNFL Magnox to shut down Reactor 1 to see if similar features were present. This was the case. The main findings were that there were indications of defects in the closure welds on the superheater header penetrations.

1.17 Investigations by BNFL Magnox of the superheater header closure welds indicated that the defects were consistent with lack of fusion during the original welding, with no evidence that in-service growth of the defects had taken place. Based on these findings, BNFL Magnox developed a strategy for addressing the issue, which was accepted in principle by HSE. HSE progressively regulated the implementation of the BNFL Magnox strategy using a series of regulatory hold points.

1.18 The strategy was based on two approaches. First, the use of structural integrity analysis to robustly demonstrate that each superheater header were fit for purpose without weld re-

pairs and were unlikely to fail under normal or fault loading conditions. Second, defence in depth was to be provided by fitting external restraints to each of the 64 headers, unless there was a detriment to safety in doing so. These restraints will be capable of limiting the amount of header movement in the unlikely event of weld failure. The welds concerned were to be monitored for any signs of incipient failure and will also be subject to an ongoing inspection programme.

1.19 BNFL Magnox progressed the work with the two reactors shutdown until the work was completed to HSE's satisfaction. Other safety-related findings, arising from the initial inspection, were satisfactorily addressed during the outage by BNFL Magnox.

Advanced Gas-cooled Reactor Issues

Dungeness B

1.20 Each reactor at Dungeness B has eight boiler units inside the shell of the reactor pressure vessel. These include eight superheater headers that operate at high steam pressure. In November 1999 inspection work discovered a defective weld joining a superheater header and a tube plate on Reactor 21. [This event was rated INES (International Nuclear Event Scale) level 2 because of the severity of the defect and the fact that it was found in an unexpected place.] Both reactors at Dungeness B were shut down for further inspection and repair. After a very extensive inspection programme no defects were found on reactor 22. On reactor 21, a second defect was found. BEG's weld inspection and repair programme was closely monitored by a team of HSE nuclear Inspectors. Both units have been returned to service after HSE consent to do so.

1.21 A programme of significant safety enhancements for both of the Dungeness B reactors has been completed. It included installation of dividing walls in the circulator halls and an additional high-pressure boiler feedwater system, as well as an electrical overlay system and a carbon dioxide supply system with greater capacity.

1.22 During recommissioning of the fuelling machine in April 2001 after an extensive fuel route outage a 'link' was identified that defeated a key protection system. Investigations by the company led to the conclusion that the link had only been put on the machine a few days before its discovery and that no irradiated fuel had been handled while it was present. HSE's investigations confirmed the conclusion. The licensee also demonstrated to HSE that routine tests would always show anomalous results if links were applied across the protection system.

Hunterston B loss of grid connections

1.23 In December 1998, all grid connections were lost to Hunterston B because of bad weather. Both reactors were tripped manually and automatic protection systems operated normally. The site was reconnected to the grid within two hours. A little later, with both reactors still shut down, the grid connection was lost again. The automatic protection system had not been re-set after the first incident and a fault with a diesel back-up generator meant

that problems were encountered in maintaining electrical supplies. The recovery plan restored forced cooling to both reactors.

1.24 The regulatory investigation found that the cause of the incident was a combination of procedural deficiencies, a plant fault and operational weaknesses. It confirmed that the reactor conditions were stable during the incident. It also concluded that the incident had demonstrated the defence in depth of the safety case, which had provided tolerance to plant faults and human error.

1.25 While there were no radiological consequences, the incident was judged important in safety terms as it identified a number of issues to be addressed that were either site specific or generic. The latter covered the availability of protection systems relevant to the safety case, a review of manual shutdown operations and the comprehensiveness of the safety case for shutdown operations.

1.26 The HSE required action plans to address both the site-specific and generic issues.

Hunterston B Boiler Tube erosion / corrosion

1.27 The licensee removed Hunterston B reactor 4 from service in November 2000 to allow inspection of its boiler tubes following a moisture ingress event in May 2000. The inspections resulted in a decision to replace a proportion of the tubes exhibiting signs of service related degradation. The remedial work required internal access to the reactor concrete pressure vessel, which was undertaken by station and contract staff. The extent of the work required some workers to receive radiation doses above the company dose restriction level of 10 mSv for the year 2000; this step was monitored both within the company and by the HSE. In no case was a dose reported to have exceeded the statutory investigation level of 15.0 mSv, which is below the annual dose limit of 20 mSv. The boiler remedial work was completed early in 2001 and the reactor returned to service.

1.28 Inspections of Hunterston B reactor 3 and Hinkley Point B reactor 3 boilers, during their statutory outages in the summer of 2000, revealed no evidence of damage. Hunterston B and Hinkley Point B are nominally identical stations. Similarly inspection of Hinkley Point B reactor 4 in December 2000 showed no evidence of erosion or corrosion. Prior to the inspections the boiler pressure and flow were reduced as a prudent measure (there had been no evidence of leaking boiler tubes). The cause of the damage at Hunterston B reactor 4 has not been established.

Change in shift patterns at Hinkley Point B

1.29 In the summer of 2000, BEGL proposed a major change in the shift pattern for the operators at Hinkley Point B involving a change from a 3 shift to a 2 shift pattern, each shift being 12 hours long. HSE is currently assessing the proposed change, which has both safety benefits and some safety issues associated with it. The advantages are that it is forward rotating (from days to nights followed by a rest period) and it minimises the shift changes, particularly important during normal day hours to allow day teams, for example maintenance staff, to return completed tasks to the same shift team that initiated them. The principal concern is that

it is based on 12-hour shifts, which, though consistent with some international practices, take workers closer to the length of working period that fatigue is known to be a concern. An extended trial has been agreed with HSE, together with rules to minimise excessive hours and to control rest periods and with the direct monitoring of potential fatigue effects on the workers concerned. A report will be produced later in the year that addresses these and other issues. HSE will assess the report.

Nuclear Installations in the UK

1.30 Annex 1 contains a list of the UK's nuclear installations with nuclear power plant. The UK has no current plans to build any new nuclear installations. The power station at Hinkley Point A has closed since the first report was written and is undergoing defuelling.

Magnox management of ageing

1.31 BNFL announced on 23 May 2000 a lifetime strategy for its Magnox nuclear power stations. The strategy provides a phased programme for the cessation of electricity generation at the eight stations, most of which began operating in the 1950s and 1960s. The reactors are licensed to operate for between 33 and 50 years and this early announcement of the Company's strategy for the lifetimes of the stations allowed operational plans to be optimised. For business reasons, Hinkley Point A was not brought back into service from its shutdown at the time.

1.32 With the announcement the Magnox station lifetimes will be planned as follows:

Station	Licensed lifetime	Age at Cessation of Generation	Published Lifetime
Calder Hall	50	50	2006/2008
Chapelcross	50	50	2008/2010
Bradwell	40	40	2002
Hinkley Point A			Defuelling
Dungeness A	40	40	2006
Sizewell A	40	40	2006
Oldbury*	40	40	2008
Wylfa*	33	38	2009

Market conditions, safety or technical issues could result in earlier closure.

* At the time of the May 2000 announcement, BNFL were considering the option of converting Oldbury and Wylfa to run on a new type of ceramic oxide fuel called Magrox, which would not need to be reprocessed in the same way as Magnox fuel. However, BNFL have decided recently not to pursue trials of Magrox fuel for these stations, due to a significant risk that there would be insufficient return for the high capital investment required.

Information requested by First Review Meeting

1.33 The CNS first Review Meeting held in April 1999 raised a number of specific and general issues to be addressed in countries' second reports. Where they are applicable to the UK, they are considered in turn below. In addition, an indication is given of how the remainder of the report has required updating since the first report was issued.

Deregulation of electricity markets and associated ownership changes and increased competition

British Energy plc

1.34 As stated in paragraph 1.1, BE is the parent company for the two licensees which operate the 7 Advanced Gas-cooled Reactor (AGR) power stations and the one commercial Pressurised Water Reactor (PWR) in the UK. The two licensees are:

- **British Energy Generation (UK) Ltd** (BEG(UK)L) is the main generator of electricity in Scotland. It owns power stations on two licensed sites, one at Hunterston B on the Ayrshire coast north of Irvine and the other Torness on the East Lothian coast south of Dunbar. Its headquarters are at Peel Park in East Kilbride. BEG(UK)L was the nuclear power business of the South of Scotland Electricity Board (SSEB). When SSEB was being prepared for privatisation in 1995 the AGR nuclear power stations at Hunterston B and Torness were formed into Scottish Nuclear Ltd. (SNL). In 1996, SNL became a wholly owned subsidiary of BE. In 1999, SNL was re-named British Energy (UK) Ltd., but remained as a wholly owned subsidiary of BE. The power stations were relicensed in 1996 prior to privatisation following a review by HSE. The change of name in 1999 did not require a change in the licence.

- **British Energy Generation Ltd (**BEGL) is one of the main electricity generators in England. It owns and operates 6 nuclear power stations in England - 5 twin AGRs and one PWR. The AGR stations are Dungeness B, Hinkley Point B, Hartlepool, Heysham 1 and Heysham 2. The PWR is at Sizewell B. BEGL headquarters are at Gloucester. BEGL was part of the nuclear power business of the State owned Central Electricity Generating Board (CEGB). When the CEGB was being prepared for privatisation in 1995, all its nuclear power stations were placed in Nuclear Electric and divisionalised as the Magnox and AGR divisions, the latter including the PWR at Sizewell B. In 1996, the AGR and PWR power stations were transferred to BE, as Nuclear Electric and were privatised with the sale of BE. The Magnox stations remained in the public sector as Magnox Electric, and were subsequently transferred to BNFL. Nuclear Electric was re-named British Energy Generation Ltd. (BEGL) in 1999. The stations were re-licensed on privatisation in 1996, but there was no requirement for relicensing on the change of name in 1999.

New Electricity Trading Arrangements

1.35 The wholesale electricity market in England and Wales has recently been reformed. On 27 March 2001, the Electricity Pool was replaced by New Electricity Trading Arrangements (NETA). The Electricity Pool was the trading arrangement in England and Wales by which electricity suppliers and large industrial users purchased electricity from the electricity generators. It was established in 1990 when the electricity industry was privatised, and operated under the Pooling and Settlement Agreement, a commercial arrangement between the generators and public suppliers of electricity. The Pool was used to determine which generating sets were called on to satisfy demand, and the price for wholesale electricity (the Pool price) was set for each half hour by the most expensive generator used during that period. All generators called to run received this price.

1.36 Among the long-standing criticisms of the Pool were that it was not open to electricity consumers. Also its operation was not transparent, it was a price setting mechanism rather than a true market, it facilitated the exercise of market power by generators owning large amounts of capacity, and it distorted the market to the disadvantage of flexible plant. These concerns led to a programme to replace the Pool with more competitive trading arrangements and this came to fruition in March 2001. The new trading arrangements are much more like those in other commodity markets. They comprise a series of bilateral markets (i.e. genuine two-side markets unlike the Pool) designed to encourage competition and liquidity and to remove distortions in the market.

1.37 The key features of NETA are:

- It provides a 'forwards' market where generators can contract with suppliers and large customers for the physical delivery of electricity. Such contracts can be struck close to the time of delivery or a year or more ahead.

- It works using screen-based short-term power exchanges which enable participants to refine their contract positions at close to real time in the light of current information (e.g. the weather). Five power exchanges have either been set up or are in the process of being set up.

- It has a balancing mechanism, managed by the National Grid Company (NGC), which operates from 3½ hours ahead of real time up to real time. As electricity cannot be stored, NGC needs to manage the grid system on a second-by-second basis. The balancing mechanism is the facility under the new arrangements which allows this to happen. However, the vast majority of trading takes place in the forward markets rather than in the balancing mechanism.

- It has associated derivatives markets to enable market participants to manage commercial risks.

- It has a settlement process to deal with the financial settlement of balancing mechanism trades and to deal with those whose generation or consumption of electricity is out of balance with their contracted position.

BE's work management project

1.38 BE's Work Management Project is designed to control all the work activities of BE through a uniform computorised system. This was piloted at Heysham 2 AGR Power station. HSE is closely monitoring this as it has the potential to impact on safety through maintenance activities on site and through the control of plant modifications and the management of station safety cases.

Update of experience of privatisation of the nuclear power generation

Privatisation

1.39 In 1996, the nuclear power industry in the UK was restructured and the more modern installations were privatised. As part of the restructuring and privatisation process, all the affected sites were re-licensed. The prospective licensees produced Safety Management Prospectuses describing how they would discharge their responsibilities as nuclear site licensees. After a substantial programme of assessment and inspection, HSE satisfied itself that safety was, and would be, maintained in the new nuclear power industry structure, and granted new licences for the affected sites. In addition, the privatised sites were granted new authorisations for radioactive waste disposal. Before granting the authorisations, the environmental regulators considered the implications of privatisation on the ability to comply with the authorisations. They concluded that the operators would be properly regulated whether or not they were privatised. The ability of the UK to deal with changes of this magnitude demonstrates the robustness of its regulatory system.

Staff Reductions

1.40 Like other UK industry sectors, the nuclear industry is under commercial pressures to cut costs and is undertaking many changes. If changes in staffing levels are inadequately conceived or executed they have the potential to adversely affect the way in which safety is achieved and managed. On the other hand, changes have the potential to improve safety. The UK would not wish to draw a predetermined line at the limit of staffing that would be acceptable. This will vary with circumstances, for example: the balance of skills retained; the needs of safe operation of the site; and the amount of control of bought-in expertise. Nor would it be appropriate for the regulator to draw such a line, as this would be incompatible with the UK's non-prescriptive regulatory regime. Licensees are responsible for safety. It is for licensees to justify such proposed changes to the regulator, demonstrating no adverse affects on safety, and for the regulator to judge the adequacy of such changes by assessment and inspection. There are sufficient powers under the licence to regulate such changes (see paragraphs 1.44 to 1.53 and 7.5 to 7.7).

Safety Management Audit of British Energy

1.41 Following privatisation, the two licensees embarked on programmes of staff reductions known as 'Route 21' for BEG(UK)L in Scotland and 'Vision 2000' for BEGL in England. In late 1998, BE announced its intention to fully integrate the two licensees into a single licensee. As a prerequisite to that, and to fulfill an earlier intention to revisit the "Management of Change" process used for downsizing since privatisation, HSE undertook a safety management audit of the two licensees in 1999. The findings from the audit were published in January 2000 {Ref. 2}.

1.42 The audit findings focused on the action needed to ensure that BEGL and BEG(UK)L maintained or improved their capability to discharge their duties as licensees in the medium to longer term. HSE identified no significant short-term problems and a number of good points were noted. The principal findings were:

- Downsizing should be halted until BEGL and BEG(UK)L could show that the projected workload for their staff matched the staff resources, and demonstrate that the Management of Change process to be applied will not adversely affect nuclear safety.

- Both licensees should formalise, record and resource the skills base necessary to underpin their duties as licensees and to retain control and ownership of their operation.

- Both licensees should develop and apply policies on why, when and how contractors should be used, including consideration of 'intelligent customer' requirements.

- Both licensees should investigate the reasons for high levels of hours being worked and take steps to prevent excessive hours being worked by staff handling nuclear safety issues.

- Both licensees should critically review and revise their Management of Change processes to incorporate the lessons learned from experience of it to date and the lessons learned from the audit.

1.43 BEGL and BEG(UK)L accepted the principal audit findings and have produced an action plan to address its 103 detailed recommendations. The licensees have set up teams to take forward the recommendations, working with counterparts in HSE to ensure effective and long lasting improvements rather than just to produce short term responses. The licensees and HSE are monitoring progress.

Organisational change: Licence Condition 36

1.44 From around the time of the privatisation of the AGR and PWR power stations, licensees have had arrangements to control organisational change. HSE regulated organisational and staff changes through voluntary agreements with the licensees and by reference to licence conditions covering quality assurance and modifications to plant and equipment. However, there were signs of increasing resistance to regulatory involvement where this might run

counter to the early delivery of commercial objectives. Taken together with the increasing pace and scope of the proposed changes, HSE concluded in 1999 that the existing licence conditions needed to be augmented by the introduction of a new condition specifically addressing changes to licensees' organisation and resources.

1.45 As part of the requirement that licensees manage safety, it is appropriate for the regulator to examine licensees' approaches to managing and controlling changes to resource levels and to judge whether this is being done in such a way as to promote or, at least, not to compromise nuclear safety. To enable HSE to make such a judgement, HSE considered it necessary for licensees to document their organisational structure and resources and provide evidence that proposed changes were systematically reviewed and carefully planned so as not to compromise safety.

1.46 The new licence condition (LC), number 36 (LC36) was attached to all nuclear site licences at the end of July 1999. The wording of the new licence condition, LC36, is reproduced in Annex 4. LC36 sections (1) to (4) did not come into effect until April 2000, giving the licensees time to develop their arrangements for compliance. LC36 requires that, before a licensee makes an organisational change, it must consider the safety implications. The new condition enables HSE to require the licensee to submit a safety case for changes that could have a significant effect on safety if they were inadequately conceived or executed. HSE can, if necessary, prevent the change from taking place until satisfied that the safety implications are understood and that there will be no lowering of safety standards.

1.47 HSE's NII formed, under the leadership of its Strategy Unit, a Project Group of site Inspectors and management of safety specialist Inspectors to manage the implementation and to produce guidance for Inspectors on what would constitute adequate arrangements. NII also held seminars with Licensees to explain its guidance.

1.48 The project group met regularly to consider licensees' progress in forming their arrangements and importantly, to provide consistent advice and guidance internally. Individual management of safety specialist Inspectors met Licensees regularly during the six-month period up to April 2000, to monitor their progress (so that they could assess the outcomes quickly, once the arrangements were submitted), to give advice and to negotiate.

1.49 HSE does not seek to define a level of staffing or changes to other resources, or their organisation or disposition, which would be acceptable. This will vary with circumstances: the balance of skills retained; the needs of safe operation of the site; and the amount of control of bought-in expertise. Nor would it be appropriate for HSE to define such a level, as this would be incompatible with the UK's non-prescriptive nuclear safety regulation. Rather, it is for licensees to justify such proposed changes, demonstrating no adverse affects on safety, and for the regulator to judge the adequacy of such changes by assessment and inspection.

1.50 A brief indication of the important features expected of LC36 arrangements is given below:

- **Regulatory control by HSE** - approval of licensees' arrangements; submission of proposals most significant to safety to HSE for agreement. Licensees must keep a change register for inspection by HSE. Complex changes must be divided into stages requiring HSE

agreement to move from stage to stage. HSE also has the power to 'Direct' a licensee to cease a change.

- **Policy** - licensees to have a policy statement on management of change.

- **Baseline** - licensees to provide a substantiation of right size, structure and experience. In the baseline no presumption of the adequacy of existing structure may be claimed; the baseline should be that from which proposed changes can be judged. For some licensees the production of complete and fully rigorous baselines will take time. HSE accepted preliminary versions for April 2000, with plans to strengthen baseline analysis over about a year.

- **Scope** - to cover sites and headquarters support; to consider contractors support; staffing and organisational changes; the test to be used for establishing the safety impact if inadequately conceived or executed.

- **Classification** - each proposed change to be classified by its potential safety impact; to facilitate appropriate licensee processes that are proportionate; to facilitate HSE regulatory intervention.

- **Planning and making change** - set out roles and responsibilities; proper assessment and review of implications of changes; proper planning; records; change register.

- **Transparency** – Quality Assurance (QA) arrangements used to produce transparency through procedures, records and audit/review.

- **Review** - performance measures; establish that procedures are being followed; periodic review of baseline (including incorporation into Periodic Safety Review); review should promote continuous improvement.

1.51 The new LC is not an impediment to legitimate business practice, it seeks to ensure that licensees make proper consideration of safety when organisational changes are planned.

1.52 Following attachment of LC36 to all site licences in 1999, licensees developed their arrangements for compliance and this work is completed. All licensees submitted arrangements under LC36 by April 2000 and the arrangements have been approved by HSE. The introduction of LC36 has heightened the regulatory focus on the implications of organisational change. Indications of the changes processed since April 2000 are satisfactory. For their part, the licensees accepted the legitimacy of the regulator's interest in this area and understand that any material change must be properly justified.

1.53 The project group is now considering inspection guidance and will be coordinating the next phase of the operation, which is to carry out inspections by specialist management of safety Inspectors, at major licensees, of the actual process of managing change.

Year 2000 Computer Issues

1.54 The safety case for any nuclear installation has to consider the effects of failures of computers important to safety. Thus any computer failure should be covered by existing fault sequence analyses. Also, current protection systems used in nuclear installations in the UK do not rely entirely on computer systems. Even Sizewell B, the newest reactor, has a non-computer based secondary protection system and simple programmable logic controllers, which contain embedded chips that often do not use date or time in their logic. Nonetheless, the UK believed that the nuclear industry should adopt a cautious stance towards 'Y2K' Year 2000 computer issues, and carry out careful reviews.

1.55 The UK ensured that each operator had an adequate strategy and action plan in place to deal with the Y2K safety issues. The operators identified all safety-critical systems on their sites that contain software plus any off-site systems that may have safety implications and tested them. HSE monitored the implementation of the operators' action plans; reviewed safety submissions arising from the investigations and subsequent modifications; and ensured that the arrangements each operator had in place at the key times were adequate.

1.56 HSE also carried out an examination of its own emergency functions. This involved the examination of the vulnerability of both equipment and infrastructure. This resulted in various changes to its own Y2K preparedness, and strengthened its capabilities in the future when dealing with emergencies.

1.57 During the actual millennium period 12 HSE inspectors operated a three-shift system that commenced at midday on New Year's Eve, when licensees faxed HSE reports updating the operating status of their plants. These were used as the basis for a brief for the DTI, Scottish Office and Cabinet Office. HSE's communication protocol was the same as it would use in an emergency and this worked well. HSE also monitored activities around the world using a special website set up by the Organisation for Economic Co-operation and Development Nuclear Energy Agency (OECD NEA). In all, two installations in the UK reported Y2K faults. Neither of the UK faults was serious.

Information requested by First Review Meeting Relevant to Articles 6 to 19.

1.58 Some of the specific and general issues raised by the first Review Meeting are relevant to Articles 6 to 19. The remainder of the Introduction addresses these issues where applicable to the UK, identifying each Article in turn. An indication is also given of how the information on each Article has been updated.

Article 6

The first review meeting asked for further information on the status of safety improvement programmes with a demonstration of progress achieved by safety assessments of the improved installations

Periodic Safety Reviews of Power Stations

1.59 An update on the periodic safety reviews of the AGR power stations can be found at paragraphs 6.23 to 6.29. Magnox power stations were addressed at paragraphs 1.31 and 1.32.

Technical Specifications

1.60 Technical Specifications to control operations at all AGRs are being introduced in a similar way to those used for PWRs. Technical Specifications have already been introduced to augment the established operating rules at Hinkley Point B and Torness. The other AGRs will follow shortly, subject to regulatory agreement.

Article 7

Updates to legislation

Ionising Radiations Regulations 1999 (IRR99) {ref. 3}

1.61 These Regulations replace the Ionising Radiations Regulations 1985 (IRR85), implementing, in part, the latest Euratom Basic Safety Standards Directive that incorporated International Commission on Radiological Protection (ICRP) Publication 60 into European Union law. Further information on IRR99 can be found at paragraph 7.16 to 7.17.

Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIAD99) {ref. 4}

1.62 The EIAD99 regulations make the dismantling or decommissioning of Nuclear Power Stations and most nuclear reactors subject to environmental impact assessment and various procedural requirements. In brief this means that the licensee must carry out an environmental impact assessment, resulting in the submission to HSE of an Environmental Statement (ES) and an application for consent. HSE has to consult on the ES with expert bodies such as envi-

ronmental agencies, nature conservation bodies, local authorities, and other relevant organisations and consider submissions from members of the public, etc., before coming to a conclusion on whether or not to grant consent to decommission. HSE may attach conditions to any consent that appear desirable in the interests of limiting the impact of a project on the environment. No decommissioning work on any part of a reactor or nuclear power station, even non-nuclear work, on turbine halls for example, can begin until HSE has granted a Consent. However, defuelling the reactor is treated as an operational activity and excluded from EIAD99 requirements.

Utilities Act 2000 {ref.5}

1.63 The Utilities Act 2000 redefined the ways in which the markets in gas and electricity supply are regulated for economic purposes. It amends the relevant parts of the Electricity Act 1989. The Act established the Gas and Electricity Markets Authority (GEMA) made up of five executive members and six non-executive members. GEMA's principal duty is to protect the interests of consumers of gas and electricity wherever appropriate by promoting effective competition in the shipping, transportation or supply of gas and the generation, transmission, distribution or supply of electricity. GEMA has a duty to consult the Health and Safety Commission (HSC) on all electricity safety issues and to take account of advice offered whether or not in response to such consultation.

1.64 GEMA is required to carry out its functions in a manner that it considers is best calculated to: protect the public from the dangers arising from the generation, transmission, distribution or supply of electricity; ensures the efficient use of electricity; and secures a diverse and viable long-term energy supply. GEMA must ensure all reasonable demands for electricity are met; licence holders are able to finance their activities; and have regard to the effect on the environment of activities connected with the generation of electricity.

1.65 The Utilities Act created the Gas and Electricity Consumer Council to protect the interests of consumers of gas and electricity by providing advice and information; investigating consumer complaints; obtaining information about consumer matters along with consumer views on such matters; and developing proposals to improve industry service levels.

Article 8

Maintaining competence in regulators in an industry that has stopped expanding and future assurance of human and financial resources;

Nuclear Safety Directorate - Staffing

1.66 The Nuclear Safety Directorate (NSD) is that part of HSE that has been delegated the responsibility of regulating the UK's nuclear industry. The Nuclear Installations Inspectorate (NII) is the major part of NSD. NSD employed 233 staff in the period 1999/2000. This included 144 inspectors and technical staff and 89 administrative staff. All are based at Bootle in Merseyside except a small administrative team in HSE's Head Office in London. Nearly two-thirds of NSD's staff are technically qualified, educated to degree level and had at least 10 years experience in industry before joining HSE. They carry out site inspection, specialist or safety case assessment roles, delivering the regulatory functions required by nuclear legislation

and the Health and Safety at Work Act (see Article 7). HSE has recently provided an increase in its staff budget allocations for NSD and recruitment of new nuclear inspectors is underway, with the aim of increasing the number of inspectors to 179. To complement this increase in inspectors additional administrative staff have also been recruited.

Training and Development of regulatory staff

1.67 NSD understands and is committed to the business and personal benefits of investing in well targeted, quality training and development. This supports its programme of continuous improvement. The commitment is underpinned each year by the review and allocation of resources, both financial and people, which enable its training and development priorities to be planned, met and evaluated. Further evidence of NSD's commitment was its achievement of the Investors in People (IiP) Standard: independent confirmation that NSD arrangements for training and development met a national standard.

1.68 All new NSD staff receive a range of induction training. For inspectors it includes, within 12-18 months of their appointment, specific training to develop the skills and attitudes necessary to become an effective regulator. Linked activity includes several mandatory courses, including:

- completion of some modules of the post graduate Diploma in Occupational Health and Safety;
- familiarisation with the IRR99;
- an introduction to health and safety law, relevant nuclear regulation and nuclear licence compliance;
- understanding the assessment of safety cases;
- awareness of radiological protection;
- pursuit of the Health & Safety Regulator's National Vocational Qualification (NVQ);
- awareness of personal safety on site.

1.69 In addition to the mandatory courses identified above, most new inspectors receive on-job support. Many shadow experienced staff to benefit from the practical, on-the-job guidance that they can offer. Examples include participating in emergency exercises and being part of team audit/inspections at nuclear sites.

1.70 Once through the 12-18 month induction period, Continuous Professional Development (CPD) provides for the on-going training and development of NSD staff, especially for the technical training of its regulators. Opportunities are provided to help regulatory staff develop in their discipline/specialist area; or to acquire new skills after a change of duties. As examples: NSD runs its own Site Inspection Course for all regulators new to, or returning to, site inspection duties, and arranges for full-scale reactor simulator training to refresh the skills of reactor inspectors and assessors. Inspectors can also attend externally organised courses and conferences both in the UK and abroad. Such events are usually designed to keep delegates abreast of the latest technological developments and ways of working in the nuclear and other high hazard industries.

1.71 A range of non-technical training is also provided for management and personal development. Examples include leadership training; effective management, team-working; effective communication, and stress awareness workshops.

1.72 As a further strand of CPD, each year the Director of NSD leads a strategic overview of staffing and positioning of expertise in the Directorate in relation to delivery of its short-medium term business objectives. This is known as the Career Development Review process. Its aim is to ensure that NSD continues to have the right expertise, in the right place, at the right time to enable NSD to sustain delivery of its mission; and wherever possible, to achieve this by meeting individuals' development goals.

1.73 The Chief Inspector and the other Senior Management Group members also review the Directorate's Training and Development Plan and associated Budget twice a year; they are particularly concerned to see the impact that their investment in training and development has had on the delivery of NSD's business. On average, that budget runs at around £300k per annum for the direct cost of off-job training activity; and when on-job activity is added the cost increases to about £750k per annum, with a significant proportion invested in the technical training and development of inspectors.

Explanation of how regulatory independence is achieved ('de jure' and 'de facto' status of regulatory bodies

1.74 In order to explain how regulatory independence is achieved in the UK, this report follows the model prepared by the IAEA. Hence the subject is described under six elements: political, legislative, financial, competence, information to the public and international. Where appropriate reference is made to text that can be found elsewhere in the report.

- Political Independence: Article 8 describes the mandate and duties of HSE and its authority and responsibilities. HSE has no responsibility for the development of nuclear technologies. Paragraph 8.14 describes how HSE reports through ministers to Parliament on nuclear safety regulation.

- Legislative Independence: Article 7 describes the UK's legislative and regulatory framework relevant to nuclear safety.

- Financial Independence: paragraph 8.10 describes how HSE recovers expenses incurred through its regulation of nuclear installations. The regulator is sponsored with respect to its budget by a government department with no responsibilities for exploiting or promoting nuclear technologies.

- Competence: HSE's NSD has independent technical expertise in the areas relevant to its safety mission. The management within the regulatory body has the responsibility and authority to recruit staff with skills and technical expertise necessary to carry out its regulatory functions. This is described in paragraphs 8.11 to 8.13, updated by paragraphs 1.66 to 1.73 above.

- Information to the public: HSE provides information to the public by publishing documents, providing press releases and posting information on its web site {Ref.6}.

In addition, the regulator and relevant government ministers has set up independent advisor committees to provide them with independent advice. Paragraphs 8.20 to 8.23 provide further information on the advisory committees. In addition, information from the advisory committees is published on the regulator's web site {Ref. 6}.

- International: the regulators international activities are described in paragraphs 8.24 to 8.28.

Implementation of modern quality assurance systems for regulatory activities;

1.75 HSE's goal is continuous improvement in the quality and consistency of its regulatory activities. This is achieved by providing all nuclear regulatory staff in NSD with clear guidance of what is expected of them to ensure that best practices are adopted by all. NSD applies the EFQM EM (European Foundation for Quality Management Excellence Model). This covers the following areas: Leadership, Policy and Strategy, People, Partnerships and Resources, Processes, Customer Results, People Results, Society Results, Key Performance Results. NSD is using the EFQM EM to assess where it are going, its plans for getting there and seeing what it has achieved. Improvements are being achieved through reassessment, audit, feedback and projects (such as knowledge management, stakeholder analysis and communications). NSD has set up a Continuous Improvement Programme Board to oversee this work, but the key to its success is the involvement of all of NSD.

1.76 This year NSD launched the Business Management System (BMS). This is concerned with the "Processes" part of the EFQM EM which represent about 14% of the model. The BMS documents how NSD does its business. There are six Key Business Activities, these being: Assessment; Business Support; Licensing; Research; Site Inspection and Enforcement; and Standards and Advice.

1.77 NSD's initial EFQM EM assessment was carried out in April 1999 and a re-assessment took place in May 2001.

International co-operation on a bilateral and multilateral basis among regulatory bodies;

1.78 This is discussed at paragraphs 8.24 to 8.28.

Article 9

1.79 Information in the report on Article 9 has required no updating since the first report was issued.

Article 10

1.80 Information on the licensees' priority to safety has been updated.

Article 11

The first Review Meeting asked for information on maintaining competence in industry and research institutions in an industry that has stopped expanding and future assurance of human and financial resources.

1.81 In order to maintain competence BE has:

- defined the minimum acceptable breadth of skills;
- prepared a formal record of the current levels of skilled resources, and carried out an assessment of their adequacy;
- defined a baseline for the development of the skilled resource against future work requirements.

1.82 An improved and uniform process for formally recording staff skills underpins all three aspects. This innovative and rigorous process has been developed for use and implemented in the Central Support Functions, building on the previous process developed by BE and specifically identified by the HSE as a good practice.

1.83 The categories against which the skills have been recorded are termed "Suitably Qualified and Experienced Persons" (SQEP) roles. Such roles may be divided into sub-roles where appropriate. These SQEP roles and sub-roles form a record of the relevant skills vested in the existing staff. The process involves assessment, against a set of well-defined criteria, of the qualifications and experience of individual staff members, using a uniform procedure to produce an auditable record. The criteria for assessment include formal qualifications, experience, specific technical training and core safety and quality skills (for example, knowledge of the relevant Company processes).

1.84 The HSE "Intelligent Customer" model has been divided into "Technical Expertise" and "Informed Customer" to define the skills requirements for the Central Support Functions. This allows a clear distinction between the in-house requirements (technical expertise) and the appropriate means of dealing with contractor support. Technical expertise requires:

- sufficient expertise to understand and support the safety basis on which the Licensee operates;
- knowledge of the limitations and boundaries of the safety cases and of how these may change over time, or as circumstances change;
- the capability to oversee and, where necessary, develop and determine relevant safety and engineering standards, and to ensure the standards are met.

1.85 The SQEP roles of BE and BNFL cover the breadth of the technical expertise required in the Central Support Functions to provide appropriate nuclear safety related support to the Stations.

1.86 With respect to the changes in the text of Article 11, the main change has been the reference to licensees' web sites for up-to-date information on their financial resources.

Article 12

1.87 Information in the report on Article 12 has required little updating since the first report was issued. The main change has been to reference the use of Technical Specifications in place of Operating Rules at some nuclear installations.

Article 13

1.88 Information in the report on Article 13 has required updating of the standards used in relation to Quality Assurance.

Article 14

1.89 Information on graphite core oxidation at paragraph 14.40 has been updated.

Article 15

1.90 This Article has been updated to reflect the change in regulation from IRR85 to IRR99 noted at paragraph 1.61 above. In addition, Table 7 has been updated to reflect trends in occupational radiation doses up to 1999, the latest date for published information.

Article 16

1.91 This Article has been updated to reflect changes in Government structure and to include information on extendibility at paragraphs 16.86 and .87. Figures 5-7 have been developed to present some of the interactions between different bodies involved in emergency arrangements pictorially, as suggested at the first review meeting.

Article 17

1.92 Information in the report on Article 17 has required no updating since the first report was issued.

Article 18

1.93 Information in the report on Article 18 has required no updating since the first report was issued.

Article 19(viii)

1.94 New information on radioactive waste has been added at paragraphs 19.32 and 19.33. Paragraphs 19.36 to 19.40 provide additional information on radioactive discharges.

ANSWERS TO THE WRITTEN QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT

QG1. What kind of safety performance indicators are used by the regulatory body to assess the licensees' activities in operating NPPs?

Currently the NII is reviewing the use of numerical criteria for judging aspects of NPP safety performance. There are pros and cons in the use of safety performance indicators (SPIs) but the NII recognises the need to systematically capture the knowledge gained on each site from the regulatory process to help prioritise NII's regulatory activities. NII recognises that such systems are always to some degree subjective and tend to draw attention to negative aspects, rather than encourage positive ones. Care also needs to be taken when the information is being used to compare plants.

The licensees themselves use SPIs to monitor their own performance: these are largely based on WANO or other international measures. NII and the licensees are closely following the work of the IAEA in its attempts to develop meaningful SPIs.

QG2. Are there any conclusions, either positive or negative, of privatisation and deregulation that may be beneficial for other countries?

The privatisation of the AGRs and PWR took place relatively recently and changes within the Licensees' organisation and management are still evolving. Thus the full impact of the changes have yet to emerge. As a result of privatisation and deregulation there has been a move on the part of the licensees to cut costs in a very competitive market. This has been counterbalanced by the close scrutiny by the regulators, who are paying particular attention to organisational downsizing and an increasing use of contractors in partnering arrangements.

The increased commercial pressures have led the licensee to focus on just operating existing plant, downsizing its "in-house" support teams and by the extensive use of contractors. Regulatory concerns have been expressed to the licensees about the retention and maintenance of "in-house" expertise and the implications of high reliance on contractors. Scrutiny in relation to these concerns has been and continues to be significant. The NII is especially vigilant for signs of fall off in safety performance. Generally it is essential that the regulatory body intervenes at a very early stage in any privatisation/deregulation discussions and that any lessons learned from other country's experience are shared.

QG3. The privatisation of the nuclear industry in the UK may have an impact on operation cost and manpower.
(a) How does the operating organisation plan to deal with large-scale improvements if the need arises (given that no special funding provisions are available aside from the operating budgets)?
(b) Has any bench marking been done to determine acceptable staffing levels?

(a) All operators - publicly owned as well as the privately owned British Energy - have to make a balanced judgement as to whether the investment that a large scale improvement represents will bring an appropriate return on the capital invested or whether an alternative route of closure and decommissioning is better.

(b) British Energy has benchmarked their PWR operations against American experience. They are also in process of reducing their shift team sizes and relying on call in. It is not easy to directly benchmark the staffing levels for the majority of the reactor types in the UK because they are of unique designs not duplicated elsewhere in the world. Also, the sizes and organisations of the licensees allow much of the higher technical development work to be done by central support staff. However, it is for the licence holder to prove that its compliance with its licence conditions will not be impaired by staffing changes whether at the reactor sites themselves or in a central technical or administrative capacity. Benchmarking is one technique for doing so. The HSE's Nuclear Installations Inspectorate has and will continue to assess whether staff reductions and/or organisational changes might impair the safe and effective operation of each site.

QG4. With no new plants being built in the UK, are there any design activities being performed? How are the design basis, and the implicit assumptions that go with it, being preserved?

At present there are no new NPP being built in the UK so, consequently, there are no major design activities. However, the application of the nuclear site licence forces the licensee to maintain a detailed understanding of the safety design basis. In particular the programme of periodic safety reviews on the UK NPPs has identified many areas where it is reasonably practicable to carry out safety upgrading work. This requires comprehensive design work in a range of specific plant areas such as reactor shutdown systems and providing additional reactor post-trip cooling capability. It should be noted that, for the UK gas reactors, much of the original design information is held by the licensees themselves or by UK organisations, which have worked closely with the licensees for many years. The periodic review process ensures that this information is re-evaluated and that safety standards continue to be acceptable and enhanced, where appropriate.

ARTICLE 6 - EXISTING NUCLEAR INSTALLATION

Text of Article 6:

'Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.'

This section includes:

- ***a list of the UK's nuclear installations (paragraph 6.1)***;
- ***a history of nuclear power generation in the UK (paragraphs 6.2 to 6.9)***
- ***regulatory inspection of nuclear installations (paragraph 6.10 to 6.12);***
- ***nuclear installations' safety reviews (paragraphs 6.13 to 6.30 ~~26~~);***
- ***further operation of the UK's nuclear installation (paragraphs 6.31 ~~27~~ to 6.34 ~~29~~).***

Nuclear installations in the UK

6.1 The following nuclear licensed sites are the locations of nuclear power stations in the UK. (Not all of them are nuclear installations as defined by the CNS as their reactors are being decommissioned.) The sites have either Magnox reactors, AGRs or a PWR as indicated. Descriptions of the different reactors follow.

(i) for BNFL plc and Magnox Electric plc. [undergoing reorganisation]

Berkeley	- 2 Reactors (Magnox)	decommissioning
Hunterston A	- 2 Reactors (Magnox)	decommissioning
Trawsfynydd	- 2 Reactors (Magnox)	decommissioning
Calder Hall	- 4 Reactors (Magnox)	
Chapelcross	- 4 Reactors (Magnox)	
Bradwell	- 2 Reactors (Magnox)	
Dungeness A	- 2 Reactors (Magnox)	
Hinkley Point A	- 2 Reactors (Magnox)	defuelling
Oldbury	- 2 Reactors (Magnox)	
Sizewell A	- 2 Reactors (Magnox)	
Wylfa	- 2 Reactors (Magnox)	

(ii) for BE (BEGL in England and Wales, and BEG(UK)L in Scotland)

Dungeness B	- 2 Reactors (AGR)
Hartlepool	- 2 Reactors (AGR)
Heysham 1	- 2 Reactors (AGR)
Heysham 2	- 2 Reactors (AGR)
Hinkley Point B	- 2 Reactors (AGR)

Hunterston B	- 2 Reactors (AGR)
Torness	- 2 Reactors (AGR)
Sizewell B	- 1 Reactor (PWR)

Further details and key parameters for the operating nuclear installations are given in Annex 1.

History of nuclear power generation in the UK

6.2 The UK's first nuclear installations, opened between 1956 and 1971, were carbon dioxide gas cooled Magnox reactors. These reactors use natural Uranium as the fuel, contained in a Magnesium alloy can. The first nine installations used steel reactor pressure vessels. The last two stations at Oldbury and Wylfa use prestressed concrete reactor pressure vessels.

6.3 A major change in the design of the gas cooled reactors came with the development of AGRs. This type of reactor was opened between 1976 and 1988. They use enriched Uranium Oxide fuel clad in stainless steel. Both AGRs and Magnox use carbon dioxide as the reactor coolant. All the AGRs have prestressed concrete reactor pressure vessels.

6.4 The latest nuclear installation to operate in the UK is a PWR at Sizewell B. It became operational in 1995. This reactor uses enriched uranium oxide fuel clad in Zircalloy and pressurised water as the coolant.

Magnox Reactors

6.5 As successive Magnox reactors were designed, the carbon dioxide coolant pressure in the primary circuit increased from around 7 Bar for the first Calder Hall and Chapelcross reactors up to about 27 Bar for the last Magnox installation at Wylfa. The increases were initially made possible by the developing technology for the design and construction of steel pressure vessels up to about 19 metres in diameter at Dungeness A and Sizewell A. However for the last two Magnox reactors at Wylfa and Oldbury, prestressed concrete pressure vessels were used. Not only did this allow higher operating pressures, but the new designs were also seen to have significant safety advantages over the steel pressure vessels since a sudden and unexpected failure was deemed to be virtually impossible. The operating coolant temperature of Magnox reactors at the inlet to the reactor core was gradually increased as the Magnox design developed. It was at around 140^{o}C for Calder Hall to around 230-240^{o}C for Oldbury and Wylfa. Similarly, the temperature at their reactors outlets rose from around 340^{o}C to a design figure of over 400^{o}C.

6.6 An issue of major safety significance for the Magnox reactors arose towards the end of the 1960s when it was discovered that certain generally low silicon steels were showing signs of breakaway and rapid oxidation. These steels had been used in fixings such as nuts, bolts and washers and, because the oxide was of greater volume than the original steel, large additional strains were induced in such components, particularly in the bolts. They often failed at unusually low strains (of less than 2%). These effects led to a major investigation, analysis and inspection of the operating Magnox reactors. As a result two actions were taken. Firstly, reactor gas outlet temperatures were reduced to below 370^{o}C (the oxidation effect was temperature dependent). Secondly, an annual inspection and assessment on all stations was instigated. These annual reappraisals and the more moderate temperature conditions enabled oxi-

dation to be properly controlled. Since these steps were taken this oxidation mechanism has not been a significant safety issue.

Advanced Gas-Cooled Reactors

6.7 Magnesium alloys can oxidise in air. AGRs using enriched Uranium Oxide in stainless steel cans overcame this disadvantage and also allowed considerably higher gas temperatures at the reactor outlet (over 600^{o}C). This, together with the development of the concrete pressure vessel allowing gas pressures of over 30 Bar, gave an important improvement in overall efficiency and fuel utilisation.

Gas-Cooled reactor containment

6.8 The UK's gas cooled reactors are designed such that they do not need a secondary containment building. This is because, under design basis loss of coolant accidents, the reactor transient does not precipitate large scale fuel failure. The plant is designed to be capable of retaining the bulk of the radioactive material that might be released from the fuel for the entire range of accidents considered in the design. In contrast, containment buildings are required for Pressurised Water Reactors and Boiling Water Reactors because a design basis loss of coolant accident results in significant fuel failure and release of radioactive fission products.

Pressurised Water Reactor

6.9 The newest nuclear installation to operate in the UK is Sizewell B. It has a single pressurised water reactor developed from an established reactor plant design from the USA. This is the first pressurised water reactor constructed in the UK for commercial power generation.

Regulatory inspection of nuclear installations

6.10 Each nuclear installation is required as a Licence Condition (see paragraph 19.10) to shut down for inspection and maintenance on a regular basis every two or three years depending upon the particular nuclear installation. This Licence Condition requires the licensee to apply for a Consent (see Annex 2) to restart the reactor after these shutdowns. The Consents are granted on the basis of a review by HSE nuclear installation inspectors of the licensee's inspection and maintenance programme, the operational performance of the station since the previous start-up Consent and a satisfactory review of the safety case. These start-up reviews give the HSE the opportunity to review specific aspects known to have safety significance. In addition, Consent for start up is not granted until HSE is sufficiently confident that the reactor is safe to operate for the period up to the next shut down for inspection and maintenance.

6.11 Any safety concern on one reactor may have implications for other reactors on the site or indeed for the family of reactors with similar features. If such concerns are raised either during a maintenance outage or during normal operation, the HSE has powers to require the operators of the reactor, or similarly affected reactors, to take remedial action including shutting down if this is appropriate. In this latter situation the operator must again apply to HSE for Consent to restart. Further information concerning the statutory requirements and the operation of HSE are given under Articles 7 and 8. The Licensee meets the cost of safety improvements. (Further information on financial considerations for the nuclear installations is given under Article 11.)

6.12 In addition to the continual day to day regulatory inspection and assessment of Licensees' activities and the shutdowns described in paragraph 6.10, there are PSRs (see paragraph 6.18) where reappraisals are done not only to confirm continual operation but also to anticipate operation for the foreseeable future.

Nuclear Installations' Safety Reviews

6.13 The UK has been undertaking safety reviews for many years as part of the HSE's regulatory process.

Major Safety Reviews of Magnox Stations

6.14 Whilst the continuous day to day monitoring and inspection of nuclear installations fulfils the important function of maintaining safety, an additional review is also necessary that periodically considers the safety of the whole installation against modern safety standards and requirements. This review aims to:

(i) confirm that the plant is adequately safe for continued operation;

(ii) identify and evaluate any factors which might limit the safe operation of the plant in the foreseeable future; and

(iii) assess the plants' safety standards and practices and introduce any improvements which are reasonably practicable.

6.15 The first two aims are fulfilled by a re-examination of the safety case for the plant to confirm that it is still valid and will remain so up to the next review. As part of this examination, any life limiting features are identified and their safe remaining lives either conservatively predicted (particularly where they may ultimately dictate the safe working life of the station) or found by HSE to be acceptable for the remaining period of operation.

6.16 The third aim is achieved by a comparison with current standards and re-analysis using up to date methodologies where appropriate. This is the most demanding requirement. The modern standards are those detailed in the HSE's Safety Assessment Principles (SAPs) {Ref. 7 } (see paragraph 7.36). In addition, the safety standards used by the licensees are included in scope documents, which set down the coverage of their analysis and may be more extensive than required under the SAPs.

6.17 HSE decided it was not reasonable to expect older designs of nuclear power plants to be capable of full compliance with the safety standards applied to more modern designs, even after completion of a wide ranging safety evaluation and subsequent reasonably practicable improvements. Instead the licensees demonstrate to HSE's satisfaction that an acceptable safety case exists and all reasonably practicable plant improvements have been made. However, comparison with modern standards is an important discipline to show where existing designs need reinforcement or where back up systems could be introduced to improve safety.

6.18 The licensees reviewed the safety of each Magnox station at about 25 years of operational life. These reviews were called Long Term Safety Reviews (LTSRs) and were all completed between 1987 and 1995. For operation beyond 30 years and up to 40 years each sta-

tion had to have a further review, known as a Periodic Safety Review (PSR) and obtain HSE's agreement to continued operation. The current status of PSRs is given in Table 1. For further operation beyond 40 years and up to 50 years each station ~~will carry out~~ requires another ~~further~~ PSR and ~~have to~~ obtains HSE's agreement to further operation. This third round of safety reviews has already been completed for the oldest Magnox reactors, Calder Hall and Chapelcross. These stations and Bradwell, Dungeness A and Sizewell A will be closed before they require another PSR (see paragraph 1.31). Wylfa will require a PSR in 2004.

6.19 Early in the LTSR programme it was realised that, while there are many detailed design differences between the stations, the basic principles of their operation were the same. It was recognised that each Station would need to carry out a Review involving a considerable amount of work. For example, for each plant, over 40 detailed reports with supporting references were submitted to HSE for consideration. HSE noted that there were a number of key topics (called Generic Issues) common to all Magnox reactors that were treated on a generic basis, streamlining the review process and enabling identified improvements to be made on the younger installations as soon as practicable. It also helped identify plant differences in the installation by installation review.

6.20 The Generic Issues programme of work was completed in 1994 and the result of HSE's review was published {Ref. 8 ~~3~~}. The Generic Issues were grouped under the following headings:

1. Reactor pressure vessel safety case.
2. Biological Shield.
3. Shut-down systems.
4. Post-trip cooling.
5. Fire Hazards.
6. Resistance to earthquakes.
7. Operator action following faults.
8. Reactor control room.
9. Ageing.
10. Reactor refuelling machines.
11. Cranes and lifting equipment.
12. Radiological protection.

The topics considered under each of these headings are given in Annex 3.

6.21 The findings on each of these Generic Issues were formulated and discussed with the Licensee. Where the need for improvements was identified, a programme of work was put forward by the licensee and agreed by the HSE. By way of example, the assessment work and resulting corrective actions for some of the generic issues are briefly described in Annex 3 (i.e. on: material properties; in-service-inspection; shutdown systems; emergency indications centres; and segregation and protection of boiler water supplies).

6.22 The HSE's assessment findings of the individual station LTSRs were published {Refs. 9 to 17 ~~4 to 12~~}. However, the findings for Trawsfynydd nuclear power station were not published because the Station was shut down for decommissioning in 1993 before the report had been completed. The subsequent PSR findings have been announced in press releases with a summary of the key safety issues.

Major safety reviews of Advanced Gas Cooled Reactors

6.23 Like the Magnox stations, the AGR Stations are subject to PSRs as part of the Licence requirements. A programme of submissions for each station has been agreed and reports of the Licensee's assessment are being received and assessed by the HSE. The programme for all the UK's nuclear installations' PSRs is given in Table 1.

6.24 The AGR Stations' ~~Hinkley Point B and Hunterston B~~ PSR findings have been published {Ref. 18 to 21 ~~13~~}. As with the Magnox LTSRs these findings have indicated areas where the safety cases for longer-term operation could be reinforced. As a result, the operators are undertaking programmes of work involving modifications, procedural changes, inspections and further analysis. The PSRs identified some reasonably practicable safety improvements for all the reactors, which included:

- improved diversity of boiler feed for post trip cooling;
- improvements in the pressure vessel cooling system safety case;
- enhanced safety case for the seismic qualification of some safety systems; and
- improved and extended safety analyses.

6.25 The licensees are making efforts to complete the programmes of work resulting form the PSRs that are scheduled for completion as follows:

Hunterston B	all findings closed out, some emergent work issues being undertaken as routine licensing business.
Hinkley Point B	as for Hunterston B
Dungeness B	June 2002
Heysham 1	December 2002
Hartlepool	December 2002
Torness	April 2002
Heysham2	April 2002

6.26 Subject to the continuing satisfactory results from this work HSE has concluded that it expects all AGR ~~both~~ stations to be able to operate safely for at least 30 years.

6.2~~7~~5 The results of the PSRs have produced, and continue to produce, worthwhile improvements to safety. So far they have revealed no factors seriously prejudicial to the continued operation in the foreseeable future of any operating station. The continuing programme of reviews is however a vital part of HSE's monitoring of an operator's performance, and an essential input to any agreement by the HSE to the continued operation of any nuclear installation.

6.28 All AGRs were originally operated for a period of two years between routine shutdowns for inspection and maintenance. After agreement to the safety case by HSE, this period has been extended to three years at Hunterston B, Hinkley Point B, Torness and Heysham 2.

6.29 Hunterston B and Hinkley Point B have the highest integrated core burn-up of the AGRs. This means that data on the physical properties of the blocks of graphite moderator in

the cores of these reactors are particularly important to supporting the future core safety cases. Samples are being taken routinely from the reactors at these stations and the other AGR reactors to provide accurate data on graphite properties as a function of burn-up, to augment the early data used from materials test reactors.

The PWR at Sizewell B

6.30 Sizewell B will be the subject of a PSR after 10 years of operation in 2005.

Further operation of the UK's installations

6.31 Magnox electric has declared the latest date for end of power generation for all of its operational power stations (see paragraph 1.31). If an operator has not declared a closure date for its station, the operating lifetime of each nuclear installation is limited principally by the lifetime of items and systems that are uneconomic to replace (e.g. the graphite core, boilers and components within the reactor pressure vessel of Magnox or AGR reactors). Account also has to be taken of the additional costs and worker radiation doses arising from increased inspection and maintenance associated with confirming the adequacy of the safety case for ageing structures.

6.32 For accountancy purposes, BE ~~set a~~ has established a range of plant lifetimes, currently between 30 and 40 ~~of about 25~~ years. This is then kept under close review ~~adjusted at any time~~ to take account of both the known life-limiting issues ~~(such as investigations into technical, operational or engineering issues)~~ and any unforeseen ~~real~~ plant events, which would threaten these assumptions. Equally, regular opportunity is taken to examine the prospects for lifetime extension, where this can be underpinned by appropriate safety cases and be shown to be financially prudent.

6.33 BE would cease generation of electricity and take steps to start the decommissioning of the plant when either plant refurbishment costs or the cost of establishing the safety case for re-starting the reactor ~~is~~ are greater than the income that would be generated by operating the plant over the next operating period. Thus the decision to cease generation is determined by safety issues which can be reasonably foreseen and economic factors which are variable between nuclear installations and with time. Economic factors also include the extent to which the original cost of the plant has been depreciated in the financial accounts.

6.34 When the closure date of a reactor is known well in advance, the operator provides HSE with a safety case that addresses the post closure phase. This report provides safety information on the defuelling of the reactor and final clean-up of operational waste. The operator must also produce an Environmental Impact Statement and Assessment before decommissioning as required by the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 {Ref. 4}, see paragraph 1.62.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 6

Q6.1 Why are improvements as a result of the generic issue programme only envisaged for 'younger plants'?

The report states the Generic Issues (GI) are common to all plants and as such none are exempt from implementing plant safety upgrades as a result of consideration of these issues. The original identification and objective of the GIs was to ensure an earlier implementation of safety upgrades at the "younger" plants precisely because of the recognition that these issues were equally applicable to all Magnox plants. All Magnox plants have made reasonably practicable improvements to upgrade their levels safety as a result of both the GI identification and the LTSR/PSRs that have subsequently been carried out. The GIs have also been taken into account in the PSRs for the AGR stations.

Q6.2 LTSRs for Magnox Stations Generic Issues are described and do not include aeroplane crashes. Did the United Kingdom examine the potential safety problem of aeroplane crashes on Magnox plants without containment equipped with steel vessels?

For Magnox Nuclear Power Plants (NPPs) the licensees have examined the potential safety implications of aircraft crash. They have undertaken analyses of the risk to the various stations from aircraft crashes using the latest statistics and have concluded that the probability of a significant crash is very low, at less than one in a million per year and hence the risk to the population from an aircraft crash is judged to be acceptably low.

Q6.3 One of the generic issue concerns the resistance to earthquakes, for which the licensee has to demonstrate what level of earthquake the plant can withstand without unacceptable damage. What are the criteria used to decide if this level is acceptable?

The licensees have undertaken a detailed seismic assessment on a station-by-station basis and have concluded that all plants can be safely shut down, cooled and monitored following an earthquake with a peak horizontal ground acceleration of 0.1g (as recommended by IAEA safety standards), expected to occur about once in 1000 years for UK average seismicity areas. The licensee has also demonstrated that the Magnox NPPs have a margin above the 0.1g level. The extent of the margin is dependent on the characteristic seismic hazard level at a particular site. The acceptability is judged on a site-specific basis.

For less frequently predicted, more severe seismic events, tertiary feedwater systems, diverse shutdown systems and emergency indication centres, which have been installed at all UK reactors, are designed to withstand a minimum 0.2g peak ground acceleration event.

Q6.4 In the periodic safety reviews, is it required to perform probabilistic safety studies, in particular for the Magnox reactors? Could the United Kingdom give the main conclusions drawn from these studies, if they have been performed?

The scope of the PSRs for the Magnox reactors include a requirement to carry out a probabilistic safety analysis (PSA) and PSAs have been completed for all the operating Magnox reactors. As a result of the PSRs, improvements were made to the design and operation of these

reactors to allow continued operation. The PSAs demonstrate that the risks from the plants are acceptable against the accident frequency principles defined in the SAPs and are as low as reasonably practicable (ALARP).

Q6.5 To what extent do the old gas cooled stations meet modern safety criteria, equivalent to those of the light and heavy water reactors?

In the UK modern safety criteria are established in the HSE's Safety Assessment Principles (SAPs, see paragraphs 14.48 to 14.52), they do not differentiate between reactor types but represent the NII's view of good engineering practice. The SAPs are primarily intended for the assessment of new plants and they are consistent with IAEA standards. The older gas cooled stations do not and could not fully comply with the modern SAPs. However, a major part of the legally established PSR process is that the licensees must assess compliance of their installations' with current standards. In practice this means that the licensees must identify any shortfalls, evaluate them and where reasonably practicable make improvements to plant safety. The 10 yearly PSR iteration, as well as the routine regulatory regime, ensures that safety is maintained or gradually enhanced. The SAPs also set out numerical accident frequency criteria, the Basic Safety Limits (BSLs) and Basic Safety Objectives (BSOs); these set the upper limits of tolerable risk and also the lower limits that are being aimed for, these two levels define the ALARP region (see Fig 4) within which the licensees safety improvements are focused. The ALARP principle underpins all health and safety legislation in the UK. The main concerns regarding the safety enhancement programme for Magnox reactors are identified in Annex 3 to the UK report. These issues were resolved by additional inspections or other verification work (e.g. reactor pressure vessels), hardware changes (e.g. additional post-trip cooling capability, diverse shutdown systems), or by changes to procedures (e.g. ageing management systems). (See also response to Q18.2)

The IAEA's International Nuclear Safety Advisory Group (INSAG) have suggested as a technical safety objective for existing plants a severe core damage frequency less than 10^{-4} per plant operating year, and an improved goal of 10^{-5} per plant operating year for new plant. For the six steel RPV Magnox reactors the results of the licensees Level 1 PSAs claim that the core damage frequency (which is taken to equate to the frequency of a large release of radioactivity) is in the range $2x10^{-6}$ - $9x10^{-6}$ per reactor year.

Q6.6 The report does not list the Fast Reactors at Dounreay. Can it be confirmed that these reactors are considered to be outside the scope of the Convention?

Yes. The Convention (Article 2) defines a "nuclear installation" as "Any land based civil nuclear power plant ... such a plant ceases to be a nuclear installation when all nuclear fuel elements have been removed permanently from the reactor core and has been stored safely in accordance with approved procedures and the decommissioning programme has been agreed to by the regulatory body." Neither of the two fast reactors at Dounreay was primarily designed for the purposes of power generation. Both reactors have been defuelled for a number of years and have approved decommissioning programmes, which are at different stages.

Q6.7 Only one problem of Magnox operation is indicated in item 6.6. At the same time other important problems, such as pressure vessel steel properties change under radiation, the problem, which has caused the shutdown of one of the reactors as mentioned in Sec-

tion 1.13 (page 5), is omitted. It seems that other problems have been revealed in the course of operation since 60-ies. It is desirable to know how they have been solved and what was the utility's ground to justify the NPP life extension.

NPP life extension is justified through the UK regulatory regime and is station specific. The first LTSRs and now the PSRs address ageing as one of their main objectives. Specific problems arising between PSR intervals are dealt with under the arrangements made to comply with the site licence including the reviews carried out before each start up after a statutory NPP outage. Steel oxidation on the Magnox plant was specifically mentioned in Article 6 because it was a problem which was not anticipated at the design stage and it resulted in major changes to operating parameters of all Magnox plant. On the other hand the UK did anticipate that there would be changes to the properties of pressure vessel steel due to the effects of neutron irradiation and a monitoring programme was initiated at the start of life for each reactor. As a result schemes were developed during design where samples of vessel materials were located inside the reactor vessels in representative locations. The samples are removed periodically for testing to determine vessel ageing. The results of these tests are taken into account during regular reviews of the pressure vessel safety cases.

For all the steel vessel stations the effect of irradiation embrittlement is considered as an important part of their safety cases. These safety cases are required to justify continued operation. In the LTSR and PSR programmes HSE concluded that some degradation processes, such as irradiation embrittlement, would require more regular reviews than that afforded by the ten year PSR periodicity. The licensees have established generic arrangements to undertake this important work at all installations and the outcome is taken into consideration by HSE when making regulatory decisions such as issuing a Consent for a reactor to return to routine operation after its statutory shutdown. The licensee developed a long-term strategy to demonstrate the safety of the steel RPVs. The strategy is underpinned by a detailed work programme, which is updated annually, and regularly discussed with HSE at review meetings. An example of the work being undertaken by Magnox Electric is the sampling and testing of irradiated steel removed from the RPVs at Trawsfynydd which is being used to underpin the safety cases for the other steel vessel stations.

Another example of an emerging issue is given in paragraph 1.13 which refers to the detection of defects in boiler shell seam welds in Reactor 2 of the power station at Sizewell A. Following the discovery of these defects the licensee developed a strategy to return the boilers to power. The licensee proposed the development of an in-situ post weld heat-treated repair. Before commencement NII required a number of key safety issues to be addressed. The licensee undertook a comprehensive development programme to optimise the repair procedures to minimise the risk of recracking of the boilers and mitigate the risk of cracking elsewhere. The basis of continued plant operation, following these repairs, included a complete understanding of the crack mechanism formation; an extensive materials testing programme; a comprehensive inspection procedure to exclude possibility of defects and all work undertaken to nuclear codes and rigorous QA procedures.

Q6.8 It is indicated that additional analysis and the report are required to extend the licence after 30 years of operation, and it enables obtaining license for 10 more years. Bearing in mind that old NPPs cannot completely meet the modern safety requirements nevertheless the period of 10 years seems to be too long as NPP features and performance variation prediction for 10 years after its design life is expired, implies great uncertainty. Rather difficult is to prove that the NPP safety would not suffer considerable degradation within 10 years and would be maintained at current rather high level. Perhaps 5 years period would be more justified.

For all nuclear power stations in the UK, HSE and the licensees have agreed that major fundamental reviews of the safety cases should be carried out at 10-year intervals, which is in line with international "best practice".

In between these major PSR reviews, as part of the normal regulatory process, the safety case, including the most recent information from in service inspections, results from operational experience feedback analyses and from surveillance programmes for ageing and degradation effects is considered prior to HSE consenting to the return of a reactor to service following its periodic shutdown. Consequently in between the major PSR reviews the safety cases are re-evaluated every year in the case of Magnox steel reactor pressure vessel stations and a maximum of every three years for concrete pressure vessel stations (both Magnox and AGRs).

Q6.9 A diverse means of shutting down the reactor shall actuate not only upon the command from the main control room, but automatically also. Its initiation by operator may be acceptable only in case the well-defined information on the main trip system failure and time available for operator's diagnostics of the plant state as well as reliable decision-making (no less than 30 minutes) is available.

All UK reactors are provided with a diverse means of reactor shutdown, which is actuated automatically. In addition, to the secondary shutdown system the option is available to manually actuate the shutdown of the reactor.

Q6.10 All the NPPs shall be equipped with standby control room to ensure reactor shutdown, cooling down and basic parameters monitoring in case personnel presence at the main control room is impossible.

The statement in Annex 3 (item 8) is in itself not complete and may give the misleading impression that there was an option available to the licensee to choose not to install standby indication centres. Annex 3 simply records the wording of a requirement, which the regulator gave to the licensees. This was followed by extensive discussions and the outcome was that standby centres have been installed in all UK Magnox plant. These alternative indication centres (AICs) do not include reactor control capability. They are for emergency use in the event of loss of use of the main control room. They provide a range of monitoring data on the state of the reactors and essential plant, allowing informed decision making on action required to achieve a safe condition. Magnox and AGR reactors have a significant degree of local control of plant which allows the control of safety systems even with the loss of the main control room.

6.11 Availability of emergency operation procedures describing operator's actions under design-basis accidents and abnormal operation conditions and measures of Beyond Design Based Accidents (BDBA) management and mitigation should be demonstrated. NPP operators shall be trained to use the said procedures and shall be requalified periodically using simulators. This information is missing in the report.

The comment is duly noted and the next version of the UK report will cover this area in more detail. This comment is similar to other comments and questions received (see response to Q12.3 & Q19.1 where these points have been addressed. The use of simulators for training and re-training purposes is universally adopted; symptom based emergency guidelines and severe accident management guidelines are also available to plant operators.

Q6.12 Magnox reactor pressure vessels in-service monitoring sufficiently justification is based on limited monitoring in accessible points and thorough manufacturing inspection. However, considering high probability of local stresses and defects the mentioned problem can not be considered finally substantiated. Additional measures of substantiation of Magnox pressure vessels long-term safe operation are required.

Substantiation of the long-term [continued] safe operation of Magnox pressure vessels is achieved by various means including in-service inspection. Inspections of Magnox pressure vessels are targeted to locations where the defect tolerance is lower; it is not simply targeted on where the welds are most accessible. The locations targeted for inspection, e.g. the Bradwell and Hinkley Point A outlet duct nozzles, are not the easiest places to inspect; but the licensee has developed ways of carrying out remote inspections in difficult areas. The licensees have also been doing a lot of work to determine the capability of the manufacturing inspections to detect defects of structural significance; this was complemented by detailed reviews of the construction records to confirm the effectiveness of these inspections to give [high] confidence in the quality of manufacture.

The licensees analyse the structural integrity of the reactor pressure vessels (RPVs) in great detail annually for normal operating conditions and for potential faults and hazards. This, together with the quality of original manufacture, their robust and simple design, low stresses, defect tolerance and the targeted inspections gives substantiation of the long-term [continued] safe operation of Magnox pressure vessels.

If at any time the HSE judge that there is not an adequate safety case for a station’s RPV it will not be allowed to operate - for example Trawsfynydd which ceased operation on 1991 and shut down [started decommissioning] in 1993.

ARTICLE 7 - LEGISLATIVE AND REGULATORY FRAMEWORK

Text of Article 7:

'1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:

(i) the establishment of applicable national safety requirements and regulations;

(ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

(iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

(iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.'

This section includes:

- **a description of the UK's legislative and regulatory framework (paragraphs 7.1 to 7.11);**
- **a summary of the UK's:**
  laws, regulations and requirements (paragraphs 7.12 to 7.26);
  licensing system (paragraphs 7.27 to 7.34);
  framework for regulatory judgement (paragraphs 7.35 to 7.36).

Legislative and Regulatory Framework

Main legislation

7.1 In the UK, the main legislation governing the safety of nuclear installations is the Health and Safety at Work etc. Act 1974 {Ref. 22 ~~14~~} ("the HSW Act") and the associated relevant statutory provisions of the Nuclear Installations Act 1965 {Ref. 23 ~~15~~} ("the NI Act"). There has been no need for major changes to these Acts, but amendments have been made whenever necessary. In particular, the Nuclear Installations Act 1965 etc. (Repeals and Modifications) Regulations 1974 {Ref. 24 ~~16~~} made HSE the nuclear licensing Authority for nuclear sites. The mandate and duties of HSE are explained under Article 8 of this report.

7.2 Under the HSW Act, employers are responsible for ensuring the safety of their workers and the public from dangers arising from that work. This responsibility is reinforced for nuclear installations by the NI Act under which no site can be used for the purpose of installing or operating a nuclear installation unless ~~a site cannot have a nuclear installation on it unless the user has been granted~~ a nuclear site licence is currently in force, granted by the HSE. Only a corporate body, such as a registered company or a public body, can hold such a licence and the licence is not transferable. HSE's Nuclear Safety Directorate (NSD) administers this licensing function on its behalf. The licensing regime is complemented by the Ionising Radiations Regulations 19~~85~~99 (IRRs) {Ref. 3 ~~17~~} which provide for the protection of all workers

and members of the public, whether on licensed sites or elsewhere, from ionising radiations (discussed further under Article 15).

UK framework

7.3 Before a site can be licensed, a prospective operator must show that the plant to be used will be safe and that the operator can manage the site and deal with any liabilities remaining when the nuclear installation is finally shut down. The onus is on the applicant to prove the safety of the site and their own viability before HSE will grant a licence: without a licence they cannot build or operate a nuclear installation.

7.4 HSE makes it clear that safety law holds licensees responsible for safety. The HSE sets safety goals and it is for licensees to set out how they will meet them. This policy ensures that the licensees accept that responsibility, whilst allowing them to find their own ways of meeting the needs. Therefore, a balance has to be struck in how far HSE becomes involved in the design and assessment process. This calls for careful choice of the key safety issues and what to examine. Licence applicants or licensees must carry out their own detailed assessment and audit of the design and of the design process from the point of view of safety. HSE satisfies itself that licensees have the organisation for this and that they are carrying out their functions effectively.

Enforcement powers

7.5 HSE may grant a nuclear site licence if it accepts the licence applicant's proposals and if they have obtained all other relevant consents (see paragraph 7.8 and Article 17). HSE's powers allow it to draw up this licence with any Licence Conditions (LCs) attached to it that may have a bearing on safety on the site. Annex 4 gives the wording of the standard set of LCs. In addition, HSE may vary or revoke the licence and can amend, add or revoke LCs at any time. The LCs also give HSE powers (see Annex 2).

7.6 When HSE appoints its nuclear inspectors, it gives them powers to enforce relevant legislation at nuclear installations. This enables them to issue Improvement and Prohibition Notices (see Annex 2) and to initiate prosecutions under the HSW Act. They have additional powers under the NI Act and the nuclear site licence (see Article 8). HSE's nuclear installations inspectors also carry out inspections at nuclear installations to ensure licensees are complying with other health and safety regulations.

7.7 HSE's action, if it considers the law has been broken, will depend on the circumstances and on the licensee's safety record. HSE may revoke a nuclear site licence at any time, but it has not exercised this power to date. However, inspectors have initiated prosecutions and issued Improvement Notices under the HSW Act at several sites. In practice, HSE's main enforcement activity consists of withholding its formal consent to start up or to restart an installation until it is satisfied that all necessary safety related work has been completed.

Other legislation

7.8 As well as satisfying HSE that a proposed site will be safe, licence applicants must also meet the legal planning requirements. Before building or extending nuclear installations, consent under the procedure set out in the Electricity Act 1989 {Ref. 25 ~~18~~} is necessary (see Ar-

ticle 17). An applicant granted planning consent to use the site will still need a licence from HSE to install and operate the nuclear installation.

7.9 The operator must also meet requirements under the Radioactive Substances Act 1993 {Ref. 26 ~~19~~} (see paragraph 7.22).

Other inspectorates

7.10 HSE deals with health and safety matters only so far as they arise from work activities on the nuclear licensed site. Other regulatory bodies deal with other aspects (see paragraph 8.3).

Powers of Secretaries of State

7.11 The Secretaries of State for Scotland, Wales, the Department ~~of~~ for ~~the~~ Environment, Food and Rural Affairs, ~~Transport and the Regions~~ and the ~~Ministry of Agriculture, Fisheries and Food~~ Department of Health hold joint powers to call in applications for **authorisations** for their own determination, in which case a local inquiry may be held. The Secretaries of State can also issue directions to the environment agencies.

Laws, regulations and requirements

The Health and Safety at Work etc. Act {Ref. 22 ~~14~~}

7.12 Under the HSW Act, a general duty is placed on employers to conduct their undertaking in such a way as to ensure, so far as is reasonably practicable, the health and safety at work of their employees and also of persons not in their employment who may be affected by their work activities. This means that the risk of harm has to be balanced against the cost of preventive measures, and the latter need not be taken if the cost is grossly disproportionate to the reduction in risks. Some risks are so large that preventive measures would be taken whatever the cost, or the risk not run. In the case of nuclear installations, the potential effects of accidents could be widespread and long lasting, and thus very large sums of money must be spent if necessary to make the chance of an accident very remote, and to reduce harm from radiation in normal operation to very low levels.

7.13 The HSW Act places duties on employees, established the Health and Safety Commission (HSC) and HSE and enables HSE to appoint inspectors and give them regulatory powers (see Article 8). Extracts of the HSW Act relevant to the CNS are contained in Annex 5.

Nuclear Installations Act 1965 (as amended) {Ref.23 ~~15~~}

7.14 Under the NI Act, no site may be used for the purpose of installing or operating a nuclear installation unless a licence has been granted by the HSE. Sections 1, 3 to 6, 22 and 24A of the NI Act are relevant statutory provisions of the HSW Act (i.e. these sections of pre-existing law are subject to HSW Act arrangements for regulation and enforcement). The parts of each of these sections relevant to the CNS are contained in Annex 6.

Electricity Act 1989 {Ref. 25 ~~18~~}

7.15 A generating station with a capacity greater than 50 megawatts requires a consent granted by the Secretary of State for Trade and Industry (for England and Wales) or the Secretary of State for Scotland under section 36 of the Electricity Act 1989 before being constructed, extended or operated (see also paragraph 17.2).

Ionising Radiations Regulations ~~1985~~ 1999 {Ref. 3 ~~17~~}

7.16 Specific requirements for the radiological protection of employees and the public are contained in the Ionising Radiation Regulations ~~1985~~ 1999 (IRR~~85~~99) made under the HSW Act. These Regulations implement aspects of the European Council Directive establishing Basic Safety Standards and include the setting of limits for all activities involving ionising radiations. These limits are upper limits of radiation doses and are subject to the overall principle that an employer should take all necessary steps to restrict so far as reasonably practicable the extent to which people are exposed to ionising radiation. Further information on the IRR~~85~~99 is contained in the report on Article 15 on radiation protection.

7.17 IRR99 also implement Council Directive 90/641/Euratom of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas. Outside workers are persons undertaking activities in controlled areas designated by an employer other than their own. The regulations require:

- an exchange of information between the outside undertaking and the operator before the activities start;
- the provision to the operator of information contained in a radiation passbook carrying identification details of the outside workers and information on the assessed and estimated doses received by those workers;
- an estimate of the dose received by the outside workers during their activities for the operator (entered in the passbook).

The Nuclear Installations (Dangerous Occurrences) Regulations 1965 {Ref. 27 ~~20~~}

7.18 These require the Licensee to report specified types of Dangerous Occurrences. For nuclear installations these are any:

- occurrence on a licensed site involving the emission of ionising radiations or the release of radioactive or toxic substances in such circumstances as to cause or be likely to cause the death of, or serious injury to the health of, persons on or outside the site at the time of the occurrence;
- explosion or outbreak of fire on a licensed site which affects or is likely to affect the safe working or safe condition of the nuclear installation;
- occurrences involving the breaking open of any outside container in which nuclear matter is being carried; and
- uncontrolled criticality excursion.

The reports of these occurrences are made to the relevant Government Minister, the Local Authority and Chief Police Officer in whose area the nuclear installation is sited. The reports contain specified information concerning time, nature and effects of the occurrence.

Public Information for Radiation Emergencies Regulations 1992 {Ref. 28 ~~21~~}

7.19 These implement European Council Directive 89/618/Euratom and require employers to provide specified information on arrangements for emergencies to members of the public (see paragraph 16.66). These Regulations (in so far as they apply to nuclear installations) will be subsumed into the Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR) due to be enacted later this year. REPPIR will implement relevant parts of European Council Directive 96/29/Euratom {Ref. 29}.

~~***Ionising Radiations (Outside Workers) Regulations 1993 {Ref. 22}***~~

~~7.19 These regulations implement Council Directive 90/641/Euratom of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas. Outside workers are persons undertaking activities in controlled areas designated by an employer other than their own. These Regulations require:~~

~~{ an exchange of information between the outside undertaking and the operator before the activities start;~~

~~{ the provision to the operator of a radiation passbook carrying identification details of the outside workers and information on the assessed and estimated doses received by those workers;~~

~~{ an estimate of the dose received by the outside workers during their activities for the operator (entered in the passbook).~~

Management of Health and Safety at Work Regulations ~~1992~~ 1999 {Ref.30 ~~23~~}

7.20 This includes requirements that employers must:

i) make assessments of the health and safety risks of their activities;
ii) make, give effect to and record the appropriate health and safety arrangements;
iii) ensure that their employees are provided with appropriate health surveillance;
iv) appoint an adequate number of competent persons to assist them in complying with health and safety legislation;
v) establish and give effect to procedures to be followed in the event of serious or imminent danger arising;
vi) provide employees with information concerning the:-
- risks to their health and safety;
- preventive and protective measures;
- procedures necessary in the event of serious or imminent danger;
- persons nominated to implement evacuation procedures;

vii) co-operate with other employers to enable statutory health and safety obligations to be met, including the provision of health and safety information;

viii) ensure that employees, taking into account their capabilities, have adequate health and safety training which is repeated periodically as appropriate.

7.21 The Regulations are of a wide-ranging nature. Where the requirements overlap with other Health and Safety Regulations then compliance with the more specific Regulations is normally sufficient for compliance with the Management of Health and Safety at Work Regulations.

The Radioactive Substances Act 1993 (RSA) {Ref. 26 ~~19~~}

7.22 For nuclear installations, this Act requires the prior authorisation to dispose of radioactive waste. RSA also requires ~~On nuclear sites as defined in the Act (which includes nuclear installations), the~~ registration ~~requirements~~ for the keeping and use of radioactive material and ~~the~~ authorisation ~~requirements~~ for the accumulation of radioactive waste. However, these do not apply to nuclear sites as defined in RSA (which includes nuclear installations). These requirements are instead met by specific provisions in the Licence Conditions attached to a nuclear site licence and the statutory requirements for consultation between regulators on licences and authorisations.

~~7.23 The disposal of radioactive waste includes its transfer or shipment from one site to another. Where persons carrying on a business receive waste for disposal, they must be separately authorised to dispose of it, except where the waste is being disposed of under the terms of an authorisation already given to the owner of the waste. Hence, the operators of nuclear installations must have an authorisation before disposing of radioactive waste.~~

7.23 Disposal includes the discharge of radioactive effluent to the environment, incineration of solid or liquid waste, burial of solid waste ~~in landfills~~ or waste transfer to another site. Where persons carrying on a business receive waste for disposal, they must be separately authorised to dispose of it. ~~Limitations and c~~ Conditions in authorisations control the wastes that may be disposed of and the disposal routes that may be used. The authorisations set limits on the quantities of waste that may be disposed of, place requirements on monitoring and require records to be kept. The Act was amended by the Environment Act 1995 {Ref. 31 ~~24~~} so that the Environment Agency (EA) is the regulatory body for authorisations in respect of premises in England and Wales and the Scottish Environment Protection Agency (SEPA) is the regulatory body for Scotland. As part of the implementation of the Basic Safety Standards Directive 96/29/Euratom {Ref. 29} ~~-~~a number of the Agencies' existing administrative practices under the Act have been put into legally binding obligations. Inspectors from these Agencies check compliance and have a range of enforcement powers.

Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 {Ref. 4 }

7.24 These implement the requirement for an environmental impact assessment for decommissioning nuclear power stations and nuclear reactors arising from Council Directive 85/337/EEC (as amended by Council Directive 97/11/EC) on the assessment of the effects of certain public and private projects on the environment. Before decommissioning or dismantling of a nuclear reactor or power station can take place, a licensee must apply to HSE for consent, undertake an environmental impact assessment and provide an environmental state-

ment. The information to be included in an environmental statement is referred to and specified in Schedule 1 to the regulations.

Utilities Act 2000 {Ref. 32 }

7.25 The Act applies to the gas and electricity sectors in England, Scotland and Wales and it established a single Gas and Electricity Markets Authority. It aims to achieve a fair balance between the interests of consumers and shareholders by setting new duties and powers for the Authority and established an independent Gas and Electricity Consumer Council. It contains provisions to enable the gas and electricity sectors to make an appropriate contribution to the Government's social and environmental objectives. It contains provisions to make regulation more transparent and predictable. The Act also updates the financial regulatory regime for the gas and electricity sectors to take account of, and to facilitate further, competition, and to reflect increasing convergence between the two sectors. It provided the powers needed to bring in the new electricity trading arrangements (see paragraph 1.35).

Notification of incidents

7.26 The Secretary of State for Trade and Industry has identified classes of incidents on sites which the licensee is required to notify so that Parliament may be fully informed on matters of public interest. These requirements are in addition to the statutory and site licence condition requirements.

Licensing system

7.27 The Nuclear Installation licensing system applies throughout the lifetime of a civil nuclear site including installation, commissioning and operation to eventual decommissioning. The NI and HSW Acts {Refs. 2315 and 22 14} allow the HSE to:

(i) attach Conditions to the Nuclear Site Licence;

(ii) have certain powers in relation to the Conditions; and

(iii) take enforcement action in the event of non compliance with statutory requirements.

7.28 There are no formal rules or procedures for the processes that lead to and follow the granting of a Nuclear Site Licence. However, the HSE has issued 'Nuclear Site Licences - Notes for Applicants' {Ref. 1 }. The following is a typical sequence of events for a new site for a power reactor.

7.29 Safety guidelines for the station design prepared by the licence applicant must be acceptable to HSE before a safety case for the design can be considered. The licence applicant usually maintains discussions with the HSE during the development of the safety case. As aspects of the design reach the point where their safety can be assessed submissions are made to the HSE. These submissions may be discussed and further analysis or design modifications may be necessary before the HSE's acceptance. This is considered further under Article 14.

The Nuclear Site Licence

7.30 The form and structure of the site licence is the same for all nuclear installations. The licence is granted to the user of the site for the purposes of installing and operating an installation. Schedules attached to it provide a:

(1) brief definition of the site (with reference to a site map) and a description of the licensable aspects of the installation or definition of the processes; and

(2) series of Licence Conditions.

7.31 A licence may be revoked by HSE or surrendered by the licensee. However, in either event, the licensee will remain responsible for the safety of activities on the site. This "period of responsibility" can end only when a new licence has been granted for the site or the HSE has given written notice that in its opinion there has ceased to be any danger from ionising radiations from anything on the site. Before a notice is issued the HSE needs to be satisfied that the site has been decontaminated to a high standard.

7.32 Once granted, the nuclear site licence is the principal and immediate method of statutory control over a licensee's operations. The associated LCs are a standard set that have evolved with the aim of providing consistent safety requirements which are non-prescriptive and flexible. The text of the LCs is given in Annex 4. In the main they require the licensee to make and implement adequate arrangements to address the particular issues identified. LC 1 makes it clear that these arrangements must be in writing and LC 6 requires the licensee to make records to demonstrate compliance with these arrangements. Each licensee can develop arrangements which best suit its business whilst demonstrating that safety is being managed adequately. The arrangements and their implementation are inspected regularly by HSE's nuclear installations inspectors.

7.33 Some LCs require permission from HSE (a Consent) before the licensee can proceed with certain activities. Similarly, the content of the arrangements may be approved by the HSE (an Approval) and if this is the case they cannot be changed without the HSE's agreement. Failure to comply with a Consent or Approval is a failure by the licensee to comply with the LC and is a statutory offence. The scope and intent of Consents and Approvals are described in Annex 2 along with HSE's other powers under a nuclear site licence.

7.34 A great deal of HSE's activity involves exerting influence at a less formal level by gaining an understanding of safety issues, how they are managed and how best any necessary changes may be effected. When the formal instruments are required, they are supported by reports that present a justification for the issue of the instrument. Where necessary, these reports make full use of internal HSE expertise as well as expertise from other agencies when it is required. Arrangements are in place to ensure that the authorisation of Consents and Approvals takes place at the appropriate management level.

Framework for Regulatory Judgement

7.35 A licensee carries out its activities to its own health and safety standards and criteria. HSE assesses the licensee's activities to the principles set out in two of HSE's documents, 'The Tolerability of Risk from Nuclear Power Stations' (TOR) {Ref. 33 ~~25~~} and the 'Safety Assessment Principles for Nuclear Plants' (SAPs) {Ref. 7 ~~2~~}. TOR and the SAPs are described in Annex 7 and Annex 8 respectively. Article 14 describes enforcement, safety cases, assessment and inspection.

7.36 Public Inquiries in the UK have examined HSE's regulatory methods in depth and their findings have had a major impact on the development and evolution of its standards. TOR itself was first published in 1988 as a public consultation document, in response to Sir Frank Layfield's report on the Sizewell B Public Inquiry {Ref. 34 ~~26~~}. Layfield proposed that HSE should formulate and publish guidance on the tolerable levels of individual and societal risk to workers and the public from nuclear power stations. TOR was revised and re-published in 1992 to take account of public comments and the findings of the Barnes report into the proposed Hinkley Point C PWR {Ref. 35 ~~27~~}.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 7

Q7.1 The NI Act and the HSW Act were issued after the commissioning of all MAGNOX reactors. What are the legal fundamentals for their operation?

The NI Act came into force in 1960 before any of the civil Magnox reactors were commissioned. The Act was modified in August 1965. The HSW Act, which came into force in 1974, made the licensing and inspection parts of the NI Act relevant statutory provisions within the meaning of the HSW Act. Calder Hall and Chapelcross were commissioned in 1956 and 1959 subject to UKAEA regulation. Berkeley and Bradwell were commissioned in 1962. Hunterston A was commissioned in 1964, Dungeness A, Hinkley Point A, and Trawsfynydd in 1965. After the NI Act became law the licensing process was enforced. Although still exempt from licensing at the time the NI Act came into force, Calder Hall and Chapelcross were brought under the full UK licensing regime in 1971.

Q7.2 Are Health and Safety Executive inspections periodic and, if yes, what are the time periods for these inspections?

Yes, routine inspections at nuclear licensed sites are carried out by nominated site inspectors, who spend 30% of their working time on site. They are based at HSE headquarters in Liverpool for the rest of their time. Site inspectors adopt a planned inspection programme to ensure that the requirements under the licence are thoroughly covered. Site inspectors plan their own visits to site, but typically visit at least once every month for three to five days.

Q7.3 Part 1) Please indicate what is meant by 'key safety issues' and give some clarification about how far the HSE is involved in these issues. Is there any written guidance or do procedures exist about this point? Not only for the design of a new plant, but also and especially for subjects such as modifications of safety systems and organisation.

No nuclear installations in the UK can operate without a licence from HSE, and HSE attaches conditions to the site licence in the interests of safety. HSE "samples" the work of the licensees to ensure that they are fulfilling their safety responsibilities. Sampling can be carried out using the regulatory body's own judgement and experience but there are also more formal procedures. For example, one site licence condition requires that the licensee must "make and implement" adequate arrangements to control plant modifications. These arrangements will include a means of safety classification of plant modification. The highest category is broadly defined as a proposal that if inadequately conceived or implemented would have a serious effect on nuclear safety. Such modifications must be formally agreed with HSE before implementation. In these cases HSE will carry out its own assessment of the proposals. One function of the HSE site inspector is to ensure that modifications have been correctly categorised and that the HSE's assessment of the safety case has been properly managed.

Q7.3 Part 2) Which points are to be clarified before the HSE gives an approval for the start-up of a NPP after an outage? Is there any written regulation/guidance?

Prior to the start of a statutory outage, as part of the normal regulatory process, the HSE agrees with the licensee the "outage intent" which details the requirements for in service inspections to be undertaken and the ageing and degradation surveillance reviews which are re-

quired to be completed and updated before the reactor may be returned to service. The detail of these outage intent documents are plant/reactor specific and are required to take into account the particular plant/reactor safety case requirements and limitations, previous operating history and relevant information from previous inspection/surveillance activities.

Outages take place every two or three years, during which major inspections of internal reactor components take place (very little refuelling is required, because this is done throughout the operating period). In addition, major external structural components that cannot be inspected while the plant is operating are examined and some of the key plant is stripped down for maintenance. In particular, the pressure vessel, tendons, external pressure parts and safety-related post-trip cooling plant systems will be worked on. The results of all these examinations and refurbishments will need to be reported to NII's satisfaction. The results of any outage-related tests will also need to be reported, and the satisfactory completion of any plant modifications. If any modifications have not been completed, assurance will be required that they need not be, even if they have no direct nuclear safety significance.

A pre-start-up meeting is always held with the licensee and action lists are drawn up for completion. At this meeting, a review of the previous two/three years' operation is considered together with results of inspections etc referred to above and the licensee is required to justify operation to the next proposed outage. The process described above is not specified in regulations or publicly available guidance but represents the working arrangements agreed between the HSE and licensees at statutory outage intervals.

Q7.3 Part 3) Is the HSE authorised to suspend, modify or revoke the licence and if, yes, under which conditions?

Yes, HSE is empowered to revoke a site licence, although such action would only be taken after very careful consideration of the implications. HSE also has the power to modify or add to the conditions attached to the licence in the interests of safety. HSE does not suspend licences, there is a power of Direction under the licence which can in effect suspend all operations in the event of a serious safety concern.

ARTICLE 8 - REGULATORY BODY

Text of Article 8:

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.

This section of the report covers:

- **a description of the mandate and duties of the regulatory body (paragraph 8.1);**
- **a description of the authority and responsibilities of the regulatory body (paragraphs 8.2 to 8.6);**
- **the structure of the regulatory body and its human and financial resources (paragraphs 8.7 to 8.13);**
- **the position of the regulatory body in the governmental structure (paragraphs 8.14 to 8.17);**
- **the relationship of the regulatory body to bodies responsible for the promotion and utilisation of nuclear energy (paragraph 8.18 to 8.19);**
- **the UK's Nuclear Safety Advisory Committee (paragraphs 8.20 to 8.22);**
- **Ionising Radiations Advisory Committee (paragraph 8.23);**
- **international activities (paragraph 8.24 to 8.28).**

Mandate and Duties of the Regulatory Body

8.1 In the UK the Government bodies with responsibilities for the regulation of nuclear safety are the Health and Safety Commission (HSC) and Health and Safety Executive (the Executive). The HSC is responsible to the appropriate Minister for the administration of the HSW Act and hence the relevant statutory provisions of the NI Act (see paragraphs 7.12 to 7.14). It also reviews health and safety legislation and submits proposals for new or revised regulations. Commissioners are appointed by the Minister with special responsibility for health and safety within the Department of Transport, Local Government and the Regions (DTLR) ~~the Environment, Transport and the Regions (DETR)~~ after consultation with representatives of employers, local authorities and other professional and interest groups. The HSC appoints the three Members of the Executive (a body corporate) that, together with its civil servants (HSE, see paragraphs 8.7 to 8.9), is responsible for implementing the provisions of the HSW Act and the relevant statutory provisions of the NI Act. As a result, HSE is the licensing authority for nuclear installations in the UK. HSE reports to the HSC.

Regulatory Authority and Responsibilities

8.2 The HSC and the Executive were established by section 10 of the HSW Act to make arrangements for securing the health, safety and welfare of people at work, as well as the health and safety of the public resulting from work activities. In preparing proposals for health and safety law and standards, the HSC is advised by the Executive. The HSC also receives advice on nuclear policy matters from its independent Nuclear Safety Advisory Committee (NuSAC) (see paragraphs 8.20 to 8.22).

8.3 Requirements for the protection of the environment and the authorisation of discharges and disposal of radioactive waste from nuclear installations are regulated by the two environment agencies, the Environment Agency (EA) in England and Wales (which is sponsored by the Minister responsible for the Environment) and the Scottish Environment Protection Agency (SEPA) in Scotland (which is sponsored by the Scottish Executive~~Secretary of State for Scotland~~) (see also paragraph 8.15). The Food Standards Agency has responsibility for food safety in the UK and is responsible to Parliament via the Department of Health.

8.4 The HSW Act places the responsibility to take care upon those directly engaged in industrial activity: mainly employers, but also the self-employed and suppliers, etc.

8.5 The HSC and the Executive's business is to see that risks from economic activity are controlled effectively, in ways that allow for technological progress and pay due regard to cost as well as benefits. They act in close consultation with all whom their work affects; and in all that they do, seek to promote better management of health and safety, through a systematic approach to identifying hazards and assessing and controlling risks.

8.6 The HSC can direct the Executive to carry out the health and safety functions for which the HSC is responsible. It cannot however give the Executive any direction as to the enforcement of any of the relevant statutory provisions in a particular case.

Structure of the Regulatory Body

8.7 The body commonly referred to as 'HSE' is the 4000 or so civil servants who deal with almost all aspects of industrial safety under the authority of the Executive. The structure of HSE is shown in Figure 1.

8.8 HSE's Safety Policy Directorate (SPD) is responsible for advising the HSC and HSE on safety policy matters. In particular, SPD's Division E includes responsibility for policy aspects of the regulation of nuclear safety at nuclear installations. The structure of SPD relevant to nuclear matters is shown in Figure 2. HSE's Health Directorate is responsible for advising the HSC and HSE on radiological protection matters.

8.9 The HSE's Nuclear Safety Directorate (NSD) is one of HSE's operational directorates. The Nuclear Installations Inspectorate (NII) is that part of NSD to which the day to day exercise of the Executive's nuclear licensing function is delegated. In particular, the Executive has delegated to the Chief Inspector of Nuclear Installations and to his Deputy Chief Inspectors its authority to carry out on their behalf certain functions under the HSW and NI Acts which are relevant to the regulation of nuclear safety at nuclear installations. Thus the Chief Inspector

and Deputy Chief Inspectors have power to grant or vary Nuclear Site Licences, to attach, vary or revoke Conditions of the Licence and other powers. The structure of NSD is shown in Figure 3.

Financial Resources

8.10 Section 24A of the NI Act enables HSE to impose a financial charge on the nuclear licensees to recover the expenses incurred through its regulation of nuclear installations. In addition further expenses are recovered from the largest licensees in respect of a programme of generic safety research agreed between HSE and the industry (see paragraph 19.16). HSE uses a work recording system to identify the effort and expenses of its staff attributable to each licensee.

Human Resources

8.11 HSE appoints suitably qualified and experienced inspectors under Section 19 of the HSW Act. Inspectors have letters of authorisation specifying the powers conferred on them under:

(i) sections 20, 21, 22, 25 and, in England and Wales, 39 of the HSW Act (see Annex 5);

(ii) any health and safety regulation; and

(iii) the provisions of the Acts mentioned in Schedule 1 to the HSW Act.

Nuclear Installation Inspectors' Qualifications

8.12 As required by section 19 of the HSW Act, the engineers and scientists employed as nuclear installations inspectors have suitable experience in appropriate fields and are professionally qualified, generally with a minimum of a good honours degree. Inspectors' qualifications include a range of engineering and scientific disciplines and specialist areas of expertise include pressure vessel technology, control and instrumentation, ergonomics, heat transfer, fluid flow, metallurgy and chemical engineering and the management of safety. Many Inspectors have experience of working in the nuclear industry before joining HSE. However, there are also inspectors who are from non-nuclear backgrounds, but with appropriate skills.

Nuclear Installation Inspectors' Training

8.13 Staff who join NSD receive job-specific training to develop their knowledge of regulation and its application for HSE's regulatory needs. For new nuclear installation inspectors, this initial training is spread over about one year and consists mainly of general courses run by HSE and more specialised ones run by NSD. The courses are designed to ensure that all staff understand their role as regulators. It is HSE's and NSD's policy to continue staff training throughout their career and, where appropriate, to transfer staff to other posts to give them wider experience and knowledge. This may include the transfer of staff not only between

NSD's assessment and inspection functions but also to and from other Directorates and Divisions within HSE and secondments to other regulators, IAEA, etc.

Relationship of HSE with government departments and other regulators

8.14 HSE is sponsored by the ~~DETR~~ DTLR. However, the Secretary of State for Trade and Industry ~~and the Secretary of State for Scotland are~~is responsible to Parliament for nuclear safety in England~~, and~~ Wales~~,~~ and Scotland ~~respectively~~. The Executive reports to this~~ese~~ minister~~s~~ on matters of nuclear safety regulation. In addition, HSE maintains good lines of communication with the Department for Environment, Food and Rural Affairs (DEFRA)~~DETR~~, notably the Radioactive Substances Division, to ensure that the nuclear safety implications of environmental policy and vice versa are properly considered.

8.15 The regulatory role of the EA and SEPA was discussed in paragraph 8.3. HSE, the EA and SEPA work closely with one another to ensure the effective co-ordination of their respective regulatory activities at nuclear installations. They have agreed Memoranda of Understanding whose objective is to facilitate the minimisation of the overall detriment due to radioactive waste management on licensed sites, from generation to disposal. Under the NI Act, HSE consults the EA or SEPA before:

{ granting a nuclear site licence; or

{ varying a nuclear site licence if the variation relates to or affects the creation, accumulation or disposal of radioactive waste.

8.16 Similarly the EA or SEPA consult HSE under the Radioactive Substances Act 1993 {Ref. 26 ~~19~~} (as amended by the Environment Act 1995, {Ref. 31 ~~24~~}) on proposed authorisations for disposals of radioactive waste including discharges to the environment.

8.17 In addition to their own routine inspection activities on nuclear licensed sites, the EA and SEPA carry out planned joint inspections and co-operate in investigations of incidents where appropriate.

Relationship of HSE to bodies responsible for promotion and utilisation of nuclear energy

8.18 The ~~Office of Electricity Supply (OFFER)~~Gas and Electricity Markets Authority (GEMA) is the commercial regulatory body for the gas and electricity supply industries~~y~~ in England, Wales and Scotland. Its ~~functions include~~principal duty is to protect the interests of consumers of gas and electricity wherever appropriate by promoting competition in the shipping, transportation or supply of gas and the ~~electricity~~ generation, transmission, distribution or ~~and~~ supply or electricity. ~~, ensuring all reasonable demands for electricity are met, promoting efficient use of electricity, and protecting customers interests in relation to prices, security of supply and quality of services.~~ GEMA has a duty to consult HSC on '… all electricity safety issues …' and to take account of the advice offered whether or not in response to such consultation. An 'electricity safety issue' is '…. Anything concerning the generation, trans-

mission, distribution or supply of electricity which may affect the health and safety of members of the public, or persons employed in connection with any of those activities'. A Memorandum of Understanding has been drawn up between ~~OFFER~~GEMA and HSE to provide a mechanism for consultation between the two parties where there is, or could be, an overlap of interests and particularly to ensure nuclear safety.

8.19 The DTI has a number of policy roles in respect of the nuclear industry. These include responsibility for energy policy generally (including the role of nuclear power), prescribing the activities that should be subject to the nuclear licensing regime, nuclear emergency planning, nuclear security and safeguards and the international nuclear liability regime. It is also responsible for those parts of the UK civil nuclear industry still owned by the Government (this includes BNFL/Magnox). In carrying out its responsibilities, DTI will, when appropriate, seek technical advice on safety related matters from HSE. Under the HSW Act, HSE's independence as regulator of nuclear safety is ensured as HSE is given direct responsibility for the enforcement of the nuclear safety regulatory system.

The Nuclear Safety Advisory Committee

8.20 The HSC and Government Ministers are able to draw on independent expert technical advice on nuclear safety issues from an independent committee: the Nuclear Safety Advisory Committee (NuSAC). NuSAC comprises experts from industry, academia and elsewhere. It provides a technical forum in which nuclear safety issues and any proposals which might impact on nuclear safety can be considered in an open and independent a manner as possible. Its terms of reference are:

> 'To advise the HSC, and when appropriate Secretaries of State, on major issues affecting the safety of nuclear installations including design, siting, operation, maintenance and decommissioning which are referred to them or which they consider require attention.
>
> To advise the HSC on the adequacy and balance of its nuclear safety research programme.'

8.21 The Chair and the 20 members of NuSAC are appointed by the HSC, normally for a period of three years, and are drawn from a wide field of specialisms and expertise. They include representatives from industry and the unions who may nominate up to four members each. It discharges its responsibilities mainly through formal meetings of the whole committee and through sub-committees that report to the main Committee on particular subjects. On certain topics NuSAC calls upon HSE and the nuclear licensees to give it appropriate information and considered opinions.

8.22 Topics which have been addressed and which are kept under review include siting, design, operation, decommissioning and emergency preparedness. NuSAC is not directly involved in regulatory processes. HSE's SPD provides an independent Secretariat for NuSAC.

The Ionising Radiations Advisory Committee

8.23 HSC has established the Ionising Radiations Advisory Committee (IRAC) to consider all matters concerning protection against ionising radiations that are relevant to HSC's remit. IRAC consists of a wide cross-section of organisations including representatives from industry and the unions, local authorities, government departments and professional bodies. IRAC's work includes consideration of the standards of protection for workers and others from work activities involving ionising radiations, monitoring the effectiveness of legislation and monitoring developments in technology.

International activities

8.24 HSE has a number of bi-lateral arrangements with regulatory bodies in other countries to ensure the smooth flow of information relevant to nuclear safety. In addition, HSE's nuclear installations inspectors attend and contribute to international discussions and initiatives on nuclear safety. This includes working with the International Atomic Energy Agency (IAEA) and Organisation for Economic Co-operation and Development's Nuclear Energy Agency (OECD's NEA).

The Western European Regulators Association

8.25 The Western European Regulators Association (WENRA) is a small group of senior regulators from Western Europe whose countries have a nuclear power programme. WENRA members are the chief nuclear regulators of the UK, Belgium, France, Germany, Spain, Finland, Italy and Sweden. The Chairman is elected by the group, and is presently the French Chief Inspector. WENRA meets biannually, at which time the HSE's Chief Inspector of Nuclear Installations is supported by a senior SPD(E) staff member.

8.26 A significant piece of WENRA work, in which SPD(E) and NSD are involved, will "benchmark" regulatory practices in the WENRA countries.

The International Nuclear Regulators Association

8.27 The International Nuclear Regulators Association (INRA) provides a forum for a small group of senior regulators from the most developed nuclear nations to discuss issues of mutual interest. INRA members are the chief nuclear regulators of the UK, Canada, France, Germany, Japan, Spain, Sweden, and the United States. Again the group elects the Chairman, with the current Chairman (June 2001) being Mr Williams from NII who is supported by a senior SPD(E) staff member.

8.28 Limiting membership to a small group, INRA meetings aim to promote frank, open exchanges of information and views. This allows lessons to be learned from one another's experiences, and seeks international consensus on approaches to nuclear safety regulation. The INRA network complements other international information exchange arrangements between regulators and has proved useful in learning from nuclear events in various countries. INRA meets biannually. The agenda in 2000 included discussion about developing an INRA statement on fundamental regulatory concepts, as follows:

- Effective Independence;
- Regulatory process;

- Regulatory effectiveness;
- Powers and Sanctions; and
- Internal Quality Assurance.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 8

Q8.1 Since HSE reports to DTI, which is responsible to Parliament for nuclear safety, how it is assured the independence of regulatory policies from Government policies supporting or opposing the use of nuclear energy? Is that reflected in the appointment and removal of the Chief Inspector?

HSE does not report to the Department of Trade and Industry. DTI ministers answer to parliament on nuclear safety matters but they have no direct control over nuclear safety regulation. This is a matter for HSE who report to the Health and Safety Commission which is an independent non-departmental public body. The Chief Inspector is appointed by the HSE.

ARTICLE 9 - RESPONSIBILITY OF THE LICENCE HOLDER

Text of Article 9:

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

This section of the report covers:

- **the main responsibilities of the licence holder (paragraphs 9.1 to 9.3);**
- **the mechanism by which the regulatory body ensures that the licence holder meets its primary responsibility for safety (paragraphs 9.4 to 9.8).**

Responsibilities of the licence holder

9.1 The HSW Act requires every employer so far as is reasonably practicable to:-

i) ensure the health, safety and welfare at work of all their employees (HSW Act s.2); and

ii) conduct their undertakings in such a way as to ensure that persons not in their employment who may be affected thereby are not exposed to risks to their health and safety (HSW Act s.3).

9.2 In addition, the NI Act requires that in the case of nuclear installations, prospective operators must have a licence from HSE before the installation can be constructed or operated. Section 7 of the NI Act places duties on the licensee in respect of nuclear occurrences.

9.3 In the UK, therefore, the holder of a nuclear site licence is responsible for the safety of its nuclear installations and also for the health and safety of its employees and members of the public that may be affected by the installations' operations. This ensures that the licensees recognise and accept their responsibilities whilst allowing them to determine their own methods for meeting the law. The way in which this responsibility is carried out is monitored and, if necessary, safety improvements are enforced by the HSE as described below.

Ensuring operators meet their primary responsibility for safety

9.4 Once a specific reactor design has been accepted for licensing at a specific site, HSE determines after discussion with the licence applicant during the licensing process those topics to be dealt with in the applicant's safety submissions. These safety submissions describe the safety case for the nuclear installation. They typically cover the licensee's management and organisation structure, engineering design safety principles and criteria (and a safety report showing how these are met), safety analysis principles and criteria and quality management. This safety case is assessed by HSE as described in paragraphs 14.44 to 14.52. During construction and commissioning a number of hold points are agreed at which the licensee must receive HSE's Consent to proceed (see Annex 2). This would only be granted when HSE is sure that the licensee's responsibilities for safety are being met satisfactorily, and that an adequate safety case has been made for the next stage to commence.

9.5 Once a nuclear site licence has been granted, the NI Act enables HSE to attach any conditions to the licence that may have a bearing on safety (paragraph 7.5). Currently, HSE attaches 365 Conditions to a nuclear site licence which ensure that the licensee meets its responsibilities for nuclear safety. These Licence Conditions (LCs, listed in Annex 4) cover matters such as the need to set operating limits, use suitably qualified and experienced persons, to draw up operating, test and maintenance activities, to manage radioactive waste, to report and investigate incidents and to implement adequate arrangements for dealing with accidents or emergencies.

9.6 Any change to the plant or its operation that impinges upon the plant's safety case requires that change to be justified with submission of significant changes to HSE prior to agreement. HSE ensures that the licensee meets its responsibilities by assessment of these safety cases (paragraph 14.44) and inspection by its nuclear installation inspectors (paragraph 14.53). The enforcement powers described in Annex 2 ensure that HSE must be satisfied from a safety viewpoint before any significant change takes place.

9.7 In addition to its assessment of safety cases and its licence conditions HSE also implements regular programmes of inspection of licensed sites. This includes nominating an inspector to each site (paragraph 14.53). This process provides HSE with additional assurance that the licensee meets its responsibilities with respect to the licence conditions and safety case.

9.8 A particularly important aspect of a licensee's safety case is its management and safety organisation. HSE requires that the licensee's safety policy and organisational structure are documented as part of the licensing process. This document sets out the senior management structure, the health and safety responsibilities of key staff and, in particular, how health and safety performance is monitored and reviewed.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 9

Q9.1 How does domestic legislation implement the international obligations entered into by the United Kingdom in the Paris and Brussels Conventions on third party liability in the nuclear field?

The Nuclear Installations (Amendment) Act 1965 amended the Nuclear Installations (Licensing and Insurance) Act 1959 so that the UK could ratify the three International Conventions regulating liability for damage due to nuclear accidents.

Q9.2 Has a licensee in the United Kingdom a right of recourse against his employee (in particular those in operational control) if they cause a nuclear damage either by their negligent behaviour or with the intent to cause such damage? If this is the case is this right of recourse granted on the basis of the labour contracts entered into between the licence holder and its employees or otherwise?

Under UK law licensees and employers are always responsible for safety on their sites, which means they are responsible also for the acts and omissions of their employees, contractors and subcontractors. In addition, most licensees encourage open reporting on their sites by operating a justice-based no-blame culture. This means that they would only seek to discipline staff if they were extremely negligent or had acted maliciously. They would be entitled to do this under the company's normal employment terms, which set out the procedures to be followed under such circumstances. These powers are used relatively rarely, but can involve measures such as loss of an individual's certificate of authorisation to undertake safety duties, up to and including dismissal. Although it is not usual for HSE to prosecute individuals, in an extreme case, where safety had been violated, HSE might also take action against an individual employee.

Q9.3 Does the HSWA or other legal provisions give inspectors the power to enforce relevant legislation at nuclear installations by imposing administrative sanctions against the licence holder or its employees, such as fines?

The Chief Inspector has the power to revoke a licence; Deputy Chief Inspectors have the power to Direct a nuclear installation to shut down. Superintending Inspectors have the power to control; for example plant modifications. Inspectors can issue Prohibition Notices on any work activity that they consider unsafe. They also have the power to issue Improvement Notices. However, Inspectors do not have the power to issue fines. These are a matter for the Courts but Inspectors can initiate criminal proceedings in England and Wales and provide evidence for the Procurator Fiscal in Scotland.

Q9.4 What are the relevant statutory provisions referred to in the United Kingdom's National Report and what are the offences established therein? Do they establish a criminal responsibility of the licensee or of its employees? What are the sanctions that can be imposed against the licensee or these employees?

The Health and Safety at Work Act 1974 (HSW Act) brought together, under one self consistent framework, large amounts of existing Health and Safety legislation and made provision for future legislation. This was done by making existing laws or parts of Laws "Relevant

Statutory Provisions" (RSPs) of HSW Act. Many Laws made since have also been created as RSPs of HSW Act. By so doing, amongst other things, the jurisdiction of HSE, the powers of inspectors and the enforcement provisions, which were created by HSW Act became applicable to its RSPs. Sections 1, 3-6, 22, 24A and Schedule 2 of the Nuclear Installations Act (NI Act) are RSPs of the HSW Act. Other parts of the NI Act are not under the jurisdiction of HSE as they deal, for example, with insurance liabilities under the Paris and Brussels Conventions. Those parts are not RSPs of HSW Act and are regulated under the jurisdiction of the Department of Trade and Industry.

Section 3 of the NI Act specifies that a licence can be granted only to a corporate body; thus the licensee must be a company.

Section 4 of the NI Act (which is an RSP) gives HSE powers to attach conditions to nuclear site licences, "as may appear to HSE to be necessary or desirable in the interests of safety …". Section 4(6) provides a number of criminal offences (for which HSE does have enforcing powers); the most significant of which is contravention of licence conditions. This offence may be committed by: "the licensee and *any person having duties on the site*."

In addition to the NI Act, nuclear licensed sites are subject to all the relevant general safety legislation of the HSW Act and its RSPs. These acts deal with other, conventional, safety aspects, many of which establish duties of a criminal nature. Offences committed under an RSP are offences under section 33 of HSW Act.

Who would be prosecuted for an offence would depend on the nature of the offence, but it is not HSE's normal practice to prosecute employees. In general Licensees are prosecuted. In cases tried in Crown Court the licensee (the body corporate) is liable to a fine of unlimited extent for contravening licence conditions.

Q9.5 The HSW Act gives an inspector the power to prosecute before a magistrates' court for an offence under any of the relevant statutory provisions in England and Wales. How can such proceedings be instituted in Scotland for the same offences?

The same health and safety requirement must be met, but under Scottish Law only the Crown can bring a case to court. This is done through an individual known as a procurator fiscal for the equivalent of a magistrates' court in England and Wales: a sheriff court in Scotland is equivalent to a crown court. Whereas in England and Wales inspectors can act as the prosecuting counsel or as expert witnesses in court, in Scotland they can only be expert witnesses.

Q9.6 Nothing is mentioned under the responsibilities of the licence holder, regarding the financial responsibilities of the operator for potential damages to the public or the environment. How are they guaranteed? Has the HSE any review responsibilities before granting the licence?

Licensees are insured against their liabilities and the Government has its financial responsibilities as a contracting party to the Paris and Brussels Conventions. HSE seeks assurance from DTI on the issue of liability before issuing a nuclear site licence but does not have any review responsibilities. (Also see response to Q9.1)

ARTICLE 10 - PRIORITY TO SAFETY

Text of Article 10:

'Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.'

This section of the report covers:

- **the principles used in the UK to emphasise the overriding priority of safety and its implementation for: the regulatory body (paragraph 10.1);**
- **the licence holders (paragraphs 10.2 to 10.3);**
- **principles related to safety (paragraphs 10.4 to 10.6);**
- **feedback of experience (paragraph 10.7);**
- **allocation of responsibilities (paragraphs 10.8 to 10.11);**
- **contractors (paragraphs 10.12 to 10.16);**
- **regulatory control (paragraph 10.17).**

HSC's and the Executive's priority to safety

10.1 The HSC's and the Executive's business is to ensure that risks to people's health and safety from work activity are properly controlled, in ways that are proportionate to risk, allow for technological progress and pay due regard to cost as well as benefits. They act in close consultation with those whom they regulate or who are affected by work activities; and in all that they do, seek to promote better management of health and safety, through systematic approaches to identifying hazards and assessing and controlling risks. The system of nuclear installation regulation in the UK has been vindicated by public inquiries {Refs. 34 ~~26~~ and 35 ~~27~~}.

Licensees' priority to safety

10.2 The UK's nuclear installation licensees are committed to giving due priority to nuclear safety. This commitment is reflected in the companies' annual reports. BNFL states in ~~page 40 of its Annual Report for 1997 {ref. 28}:~~its Environment, Health and Safety Report 1999-2000 {Ref. 36} that "safety remains [its] number one priority and there have been significant improvements in many aspects of [its] performance over the last several years. However, the process of improvement is continuous and [it] is implementing a comprehensive overhaul of its safety management systems across the company. It goes on to state that any organisation that does not operate safely will have high and unpredictable costs. Safety and operational excellence go hand in hand in an efficient and profitable business."

~~"Overall, 1996 was an excellent year for BNFL's Safety, Health and Environmental (SHE) performance, although a number of minor incidents served to underline that there is always room for further improvement in this crucial aspect of the company's operations.~~

~~BNFL is committed to achieving world-class levels of safety, health and environmental performance. This is a key goal following a top-level review of how SHE is managed in the company. ....~~

~~A number of behavioural safety programmes, involving the workforce at all levels, have also been introduced across the sites. New approaches to creating a 'safety culture' are now paying dividends with a measurable improvement in the company's performance. ....~~

~~Control of radiation exposure to the workforce continued to improve during 1996. The number of BNFL radiation workers at the higher dose levels decreased significantly compared to 1995. At the same time, the additional average radiation dose received by BNFL radiation workers was once again well below the average exposure that UK residents receive from natural background radiation."~~

~~In addition, BNFL's Safety, Health and Environment Report also of 1997 contains the company's health and safety policy which states:~~

~~"The company considers that none of its activities is more important than the health and safety of its employees, its contractors, the general public, and the protection of the environment"~~

10.3 Similarly, British Energy states in ~~page 7 of its Annual Report 1997 {ref. 29}:~~its Safety, Health and Environment Report 1999-2000 {Ref. 37} that, "In British Energy, we firmly believe that good management of safety, health and the environment is as vital to the business as good commercial management and both go hand in hand."

~~"Safety is, and always will be, British Energy's top priority. Our commercial future depends on our safety record and safety culture. Throughout the year we produced excellent safety results against challenging targets.~~

~~All our power stations aim to beat stringent targets for safety performance and measure their performance against international benchmarks. During the year there was no incident at any British Energy power station rated above Level 1 (procedural variations) on the seven point International Nuclear Event Scale, used to measure the significance of incidents at nuclear plants. ....~~

~~Safety dictates our whole approach to managing our plant at all times. It is reflected in meticulous attention to detail in planning and implementation by all our staff and contractors.~~

~~*Safety will always be our number one priority*."~~

Principles related to safety

10.4 The general principles adopted by the nuclear industry in the management of health and safety are:

i) The responsibility for ensuring health and safety within a Company is at Company Board level. To meet this responsibility the Board ensures a comprehensive set of arrangements is implemented to manage all aspects of health and safety and in this way establishes effective self regulation so that the Company is not reliant on Government or its Regulators to ensure health and safety.

ii) The responsibility for ensuring health and safety policies are put into effect lies with the line managers at each company owned nuclear installation and is not the responsibility of health and safety specialists or the health and safety function.

iii) The industry recognises that a good safety culture is critical to ensuring health and safety within a company. This includes the promotion of staff commitment, competence and awareness of health and safety issues at all levels. [Safety culture is considered in greater detail at paragraphs 12.21 to 12.35.]

iv) The arrangements within a company for ensuring health and safety are not fixed for all time. They evolve in response: to changes in statutory requirements; to a continuing programme of review and assessment of experiences gained within the organisation; and to national and international developments.

10.5 A company's health and safety requirements are set out in company policy statements and supporting documentation. These define the arrangements required to satisfy statutory requirements and to achieve the company's aims and values. A company's health and safety policy statement is issued by the company's Board and defines the management and organisational arrangements for ensuring, so far as reasonably practicable, the health and safety of staff and the public. The policy statement describes the health and safety responsibilities within the company. The duties arising from these responsibilities are then exercised by an unbroken delegation through the managerial chain. The policy statement also defines the role and responsibilities of a company's health and safety function. Local managers at defined levels are required to issue local health and safety arrangements which set out their health and safety management system.

10.6 These management systems are used to build the achievement of health and safety directly into the activities of each management unit. They define the activities needed to meet company health and safety requirements and control these activities to ensure that the required performance standards are achieved. The activities controlled by management systems include selection and training of staff, identification of critical tasks and the system of working and work control (including preparation, issue and review of safety rules and written task instructions).

Feedback of experience

10.7 An important component of the management system is the provision of feedback on the effectiveness of the system and the adequacy of company requirements. In addition to peer review, the main methods of providing feedback are these:

i) **Quality management audits and independent assessments** assess in a planned and systematic manner whether key activities (including proposals for plant modifications) have been carried out to the required performance standards.

ii) **Performance monitoring** is carried out which includes consideration of performance reports such as independent surveillance information and key performance indicators such as those provided for the World Association of Nuclear Operators (WANO).

iii) **Event feedback systems** review events in which health and safety objectives have been challenged in order to identify potential failings in the management system or inadequacies in company requirements and integrate experience from other plants and operators.

iv) **Proactive evaluation and reviews** assess current activities against international best practices.

v) **Review and advisory committees** review selected aspects of the company's current activities or health and safety requirements and advise on making improvements where appropriate.

Allocation of responsibilities

10.8 A typical nuclear power generating company's arrangements provide an effective allocation of responsibility between corporate functions and the local managers. Reporting to the Board of Directors there are a number of Divisional Directors or senior managers that run divisions responsible for certain aspects of the company's activities. Divisional Directors also report to a Chief Executive with the responsibility for the day to day running of the company. A company includes divisions having responsibilities for Operations, Technology and Engineering aspects and Health and Safety. The Health and Safety Division has a special status as it reports directly to the Chairman of the Board or Chief Executive. In this way it has **authority and independence** from the company's commercial activities.

10.9 The **Operations Division** provides a co-ordinated management system for the operation of the nuclear installation. For example, the Station manager can be responsible for: a nuclear installation or group of nuclear installations situated at one site; implementing the company's safety policy; and ensuring that safety responsibilities are effectively discharged. Where this is the case, the Station manager reports to the Divisional Director and is also responsible for maintaining operational standards, improving safety performance and managing any safety assessments to ensure that they are effectively carried out and that relevant requirements are implemented.

10.10 The central Divisions that provide services to all sites include **Technology and Engineering Divisions** responsible for providing technical support to Station managers for the preparation, development and assessment of the nuclear installation safety cases. These or other Divisions include specialist functions covering such aspects as fuel performance, fault studies, structural integrity, human factors, operational experience feedback, quality assurance and support for technical training standards.

10.11 The **Health and Safety Division** seeks to ensure that appropriate health and safety policies and standards are formulated and promulgated throughout the company. It provides advice and monitors independently the effectiveness of and compliance with the company's health and safety policy. The monitoring programme includes independent on-site inspections and reviews of the various health and safety performance indicators. The Division has responsibilities for all health and safety issues that include: safety standards and independent assessment of nuclear installation safety cases; radiation protection; independent audit, surveillance and review. It also forms a view on the adequacy of quality assurance arrangements.

Use of contractors

10.12 The licensee takes measures that seek to ensure that an understanding of the safety significance of any expertise bought in from outside the organisation and is in a position to take responsibility for its effect on the site's safety. In addition, the licensee oversees and takes responsibility for its contractors' or consultants' activities to ensure that the use of such resources does not compromise the licensee's chain of command nor the licensee's ability to control activities on the nuclear licensed site.

BNFL Vision and Principles (from 1999/2000 Environment, Health and Safety (EH&S) report {Ref. 36}

10.13 BNFL's vision and principles aim to address the key EH&S issues affecting the company:

- It aims to achieve and maintain world class environmental, health and safety, and operational performance.
- It believes that nothing is more important than the health and safety of its employees, contractors, the general public and the protection of the environment.
- Its primary goal is to be respected and trusted by stakeholders in managing its environmental responsibilities and caring for its people.
- Excellence in EH&S performance is an integral part of its business and is essential to the commercial success of the BNFL Group.
- Working in partnership at all levels within the BNFL Group, it strives for continual improvement in its performance.

British Energy Health and Safety Policy and Principles (from 1999/2000 Annual Health, Safety & Environment Report) {Ref. 37}

Health and Safety Policy

10.14 British Energy will :-

- comply with all relevant health and safety legislation;
- provide safe working conditions to ensure, as far as is reasonably practicable, the health, safety and welfare of its employees at work, visitors to its sites and the general public;
- monitor the arrangements in place to implement health and safety objectives;
- pursue continuous improvement of its health and safety performance.

Health & Safety Principles

10.15 The following Health and Safety Principles must be followed in the Company health and safety arrangements and by those responsible for implementing the policy:

- all reasonably practicable steps will be taken to ensure safe plant operation and working practices, to prevent accidents and risks to health at work;
- all reasonably practicable steps will be taken to minimise the consequences of any accident including radiological consequences;
- no person will receive doses of ionising radiation in excess of the statutory dose limits as a result of normal operation;
- the exposure of any person to ionising radiation and the collective effective dose to staff and the general public will be kept as low as is reasonably practicable (ALARP);
- all activities which may affect safety, including those undertaken by contractors, will be carried out by, and under the control and supervision of, suitably qualified and experienced persons within an effective management system ; and

- operating experience, both within and external to BEGL, will be utilised as important learning opportunities.

10.16 Recognising that safety is everybody's business, we must all:

- Take reasonable care for the health and safety of ourselves and others affected by our activities;
- Ensure that our activities are carried out safely, in accordance with the training and instructions received;
- Report any incident affecting health or safety, or any matter that may affect health or safety; and
- Approach our line managers (or our contact person at other than our base location) if we are unsure about any health and safety matter affecting our work.

Regulatory Control

10.17 In granting a licence to operate a nuclear installation the HSE must be satisfied that the corporate body is the 'user' of the installation and that it has an adequate management structure and the resources to discharge the obligations and liabilities connected with the design, construction, commissioning, operation and decommissioning of the plant. The HSE has powers to inspect the operator's arrangements and to enforce legal requirements (see report on Article 7 and Article 8, and Annex 2). Its regulatory activities are described under Article 14.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 10

Q10.1 The report mainly describes the way in which the licensees demonstrate that there is priority to safety. The British regulatory system is well known for a high degree of self regulation: the licensee is obliged to develop arrangements which are subject to approval by the regulatory body. Is this also the case with the "Priority to Safety" aspect? In other words, is there an obligation for licensees to submit their Safety Policy Statement?

The non-prescriptive, goal setting regulatory system in the UK is not 'self-regulation'. All employers must have a Safety Policy Statement. However, in relation to nuclear licensed sites the Conditions attached to the Nuclear Site Licence are designed to encompass the overall management of nuclear safety at the site. Licensees are required to submit a licence compliance statement to show how they comply with the requirements of the licence. NII, when satisfied will require the licensee to comply with the Licence Condition arrangements.

Q10.2 Although a public inquiry is not a legal requirement in the UK, the system of nuclear installation regulation in the UK has been vindicated by public inquiries which were an introduction to construction of new plants, the Sizewell B and the Hinkley Point.

Who was in charge of organising the public inquiry?
What were the objectives of such inquiries?
Which were the target groups included in these inquiries?
How were the results evaluated?

1. Although there are no requirements under health and safety legislation, applicants for nuclear site licences for new NPPs must comply with the current planning requirements and provisions of the Electricity Act 1989 s.36. The construction, extension and operation of any electricity generating station (nuclear or otherwise) with a capacity of greater than 50 MW requires the consent of the Secretary of State for Trade and Industry.

~~1.~~2. The Sizewell B and Hinkley C public Inquiries were set up on behalf of the relevant Secretary of State under the legislation at the time (Electric Lighting Act 1909 and Electricity Act 1957).

3. The Secretary of State appointed eminent legal Counsels as "Inspectors" to preside over the two inquiries mentioned. The Inspectors were assisted in technical matters by a number of eminent experts [also appointed by the Secretary of State].

~~3.~~4. There were no invited target groups: any person or organisation [, UK or foreign,] could volunteer evidence.

~~3.~~5. The Inspectors were free to choose the methodology and the way of evaluating evidence, within broad terms of reference chosen by the Secretary of State. The findings were made available in published reports.

~~3.~~6. The Sizewell Inspector passed judgement on the total safety process so that the whole process need not be subject to similar degree of public scrutiny within a future Inquiry.

Q10.3 It is stated that Health and Safety Department enjoys authority and independence of the company commercial activity. It is not clear how this independence is attained as the Department is subordinated to Executive Director, whose one if the main tasks being efficient commercial activity of the company.

This is correct; the Chief Executive (CE) is responsible for safety and operation. However, the Health and Safety Department within a licensee's organisation is independent of operational responsibilities and is designed to give the CE independent health and safety advice within the company context.

ARTICLE 11 - FINANCIAL AND HUMAN RESOURCES

Text of Article 11:

'1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.'

This section of the report covers:

- **financial resources of the licensee available to support the nuclear installation throughout its life (paragraphs 11.1 to 11.3);**
- **financing safety improvements during operational life (paragraphs 11.4 to 11.5);**
- **financial provisions for radioactive waste management (paragraphs 11.6 to 11.8);**
- **financial provisions for decommissioning (paragraphs 11.9 to 11.15);**
- **human resources for safety related activities (paragraphs 11.16 to 11.30);**
- **technical support resources (paragraph 11.17 to 11.20);**
- **resources for plant operation and modification (paragraphs 11.21 to 11.23);**
- **arrangements for staff qualification, training and retraining (paragraphs 11.24 to 11.27);**
- **work carried out by contractors (paragraph 11.28);**
- **human provisions for decommissioning programme (paragraphs 11.29 to 11.30);**
- **Regulatory Requirements (paragraphs 11.31 to 11. 34).**

Financial resources

11.1 Under UK law, a registered company must have sufficient assets to meet all of its liabilities if it wishes to continue in business. A balance sheet of assets and liabilities is a required element of the annual accounts, which under UK law must also be audited and made available to the public. ~~Extracts from t~~ The published accounts for the UK's nuclear installation operators are on their web sites {Refs. 36 and 37}. ~~are at Annex 9.~~

11.2 The cost of operating a nuclear installation is determined taking into account three principal factors: the repayment of the capital costs; the operating costs; and liabilities, particularly from fuel reprocessing and decommissioning. To determine the capital cost each nuclear installation was assigned at the start of its life an accounting period. The nuclear installations operated by BNFL are beyond their accounting period and it has an arrangement with the UK Government, its owner, to account for the operating and liabilities costs. For British Energy, AGR stations lives of 25-35~~0~~ years and for the PWR a life of 40 years are currently adopted. Achievement of a station's life is subject to ongoing satisfactory periodic safety assessment. The charge for depreciation of these assets is based on the 'straight line' method to write off the initial cost over their estimated useful lives.

11.3 However, the actual lifetimes of the plants may be different from their assumed accounting lifetime depending upon such things as economic, technical and safety factors~~the lifetime of particular components, the economics of replacing them and any safety consideration that may arise~~. Special financial provision is made for the particular liabilities relating to the reprocessing and storage of spent fuel, the storage and disposal of nuclear waste and the nuclear installation's decommissioning costs. In particular, BE's decommissioning costs are to be met from a segregated fund, established for this purpose when the company was created.

Financing safety improvements during operational life

11.4 Nuclear operators must demonstrate to the satisfaction of HSE that they have in place adequate resources and management arrangements to discharge both day-to-day and long term obligations, and liabilities connected with being the holder of a nuclear site licence. This includes having the capability to meet the costs of making any necessary safety improvements during the operating life of a nuclear installation. Such improvements are treated as part of the installation's normal operating costs. There is no separate fund specifically dedicated to meeting the costs of safety improvements; they are treated as an element in the operating costs identified in paragraph 11.2. The principal elements of operating costs comprise:

- fuel (including both the cost of supply of new fuel and treatment of irradiated fuel);
- materials and services (the cost of engineering , including contractors, and consumable spares for maintaining the stations and other miscellaneous charges such as insurance);
- staff costs (salaries and pension provisions);
- depreciation (representing the proportion of the fixed assets written off in relation to the accounting life).

11.5 As with any other expenditure, the operators' internal financial control processes determine the necessary authority required before commitments are made to make safety or any other improvements. These processes will examine the impact on the operators' financial accounts of any proposal for improvement work using discounted cash flow and cost-benefit analyses. Such analyses will take into account both the immediate costs of carrying out the improvements and future income through continued electricity generation.

Financing radioactive waste management at nuclear installations

11.6 The published audited accounts of UK nuclear installation operators ~~(Annex 9)~~ {Refs. 36 and 37} include details of waste management costs and of the provisions made in order to meet them.

11.7 There is currently no disposal route for intermediate and high level radioactive waste (ILW and HLW) in the UK. The ~~resultant storage~~ costs of ~~radioactive waste management~~ storing these wastes comprise:

{ costs actually incurred during the operational phase; and

{ liabilities associated with the management of ILW and HLW before ultimate disposal during the decommissioning phase.

11.8 The cost of managing ement of radioactive waste during the operational phase is an operational cost spread across the materials and services and staff costs in the reported accounts. The materials and services costs in the accounts include costs associated with disposals of low level radioactive waste (LLW) where the operator of the LLW facility sets a price that reflects all operational and liability cost considerations. (All disposals of radioactive waste during the operational phase, including those to the environment, are undertaken in accordance with regulatory authorisations. The regulator (either the EA or SEPA) recovers its costs in granting, monitoring and enforcing the authorisations from the operator).

Financing decommissioning programmes

11.9 The costs of decommissioning nuclear installations in the future are estimated on the basis of technical assessments of the processes and methods likely to be used for decommissioning under the current regulatory regime. The estimates are designed to reflect the costs of making the sites of the nuclear installations available for alternative use.

11.10 Having established the current cost of decommissioning, the provision for funding the future work is determined by the timing of the work within the decommissioning programme and the discount rate applied. UK Government policy recognises that decommissioning should proceed as soon as reasonably practicable, taking into account all relevant factors, such as: the benefits in radioactive dose optimisation to the public, workers and the environment of delayed action; the availability of disposal routes for the radioactive wastes; and (subject to ensuring public safety) the financial implications of deferring or delaying work and costs.

11.11 As experience is gained on decommissioning and dismantling nuclear installations and other facilities, the technical assessments and cost estimates are refined. Since 1995 the decommissioning strategies of nuclear installation operators require review by the regulators every five years. There is therefore an incentive, from both the financial and regulatory requirements, for decommissioning strategies to be maintained and developed in line with current knowledge. To date, the actual costs for initial dismantling and preparation for storage have been considerably below estimates, demonstrating that the estimates used were cautious.

11.12 The costs of the initial stage of decommissioning of nuclear installations by removing al of fuel and loose radioactive materials from a reactor and the related waste management costs are treated as part of the plant's normal operating costs.

11.13 For nuclear installations in the public sector, provisions are made in BNFL's makes provisions in its financial accounts for the costs of decommissioning and may include Government undertakings to make payment of such parts of the decommissioning costs as are needed to enable the licensee to meet its financial obligations as they fall due. There is a separate dedicated liabilities fund within BNFL to cover the costs of meeting the nuclear liabilities of BNFL and Magnox nuclear installations as they fall due. The cash and realisable assets of the fund may not be used for any other purpose.

11.14 For the private company BE owned nuclear installations there is a segregated fund for decommissioning costs. This has been established to ensure public confidence in the ability of privatised licensees being able to meet their obligations and hence that the costs of meeting

~~long term decommissioning liabilities will not fall on taxpayers by default. Contributions to the segregated fund are made during the operational life of nuclear installations that will, with accumulated interest, meet the costs of making safe, surveillance and ultimate dismantling of facilities on the licensed sites, and the costs of the clearing, decontamination and reinstatement of the licensed sites, and related costs of waste management.~~

11.14 The~~BE's~~ Nuclear Decommissioning Agreement provides for a fund ~~company governed~~run by trustees which is tasked with meeting all the costs of decommissioning BE's UK nuclear stations. ~~whose task is to ensure that the company meets its obligations.~~ The ~~moneys for the~~fund receives predetermined contributions ~~are received~~ from BEG(UK)L and BEGL~~NE and SN~~, which are reassessed quinquennially~~with the amounts being reconsidered and determined from time to time~~ to ensure that there are adequate assets to meet the liabilities. The arrangements ~~for the segregated fund for decommissioning British Energy owned nuclear installations~~ were set out in full in the British Energy Share Prospectus {Ref. 38} (see also Annex 10):

> "Nuclear Generation Decommissioning Fund Limited was incorporated on 28 March 1996 for the purpose of providing arrangements for funding certain long term costs of decommissioning British Energy's power stations. It is owned by the trustees of an independent trust ("The Nuclear Trust"). Three of the trustees are appointed by HM Government and two appointed by British Energy. The ratio of independent directors of the fund company to those appointed by British Energy is the same. "
>
> "In the Nuclear Review, HM Government concluded that segregated funds were the best way of ensuring public confidence that Nuclear Electric and Scottish Nuclear would meet their decommissioning obligations and that the costs of meeting these long term nuclear liabilities did not fall to taxpayers by default. In connection with the privatisation of British Energy arrangements have been made for a segregated fund. The structure and scope of the fund have been agreed by the NII [HSE], which is also satisfied that the arrangements are sufficiently flexible to accommodate changes to the companies' decommissioning strategies."

11.15 Financial details of the BNFL dedicated liabilities fund are set out in the annual accounts (~~copy attached at Annex 9~~ Refs. 36 and 37). The British Energy report includes contributions in the financial year; the basis for the contributions was in the BE Share Prospectus {Ref. 38 ~~30~~}.

Human resource arrangements of licensees for safety related activities

11.16 A typical breakdown of the human resources of a licensee with a capacity of approximately 10000 MW of modern plant would involve in the region of 6500 employees. Their role is divided into the following headings:

Managerial	02%
Engineering	40%
Industrial	39%
Administrative	17%
Trainees	02%

Technical support resources

11.17 The prime engineering and technical capability of the licensee comprises staff at operating and central locations. These staff provide the in-house resource available to respond to requirements for technical analysis and informed action which are immediate, plant-specific or require specialist knowledge not readily available elsewhere. Where it is economic and practicable, technical services may be procured from suitably qualified and experienced specialists in other utilities or organisations under appropriate contractual arrangements. Similarly the technical services of the licensee may be contracted to external organisations where it does not compromise the support of the licensee's operating locations. In these areas there may be technical support from, and collaboration with, other licensees.

11.18 Each licensed nuclear site has engineering and technical support staff who know and understand the nuclear safety case and its relationship to the plant and its operational characteristics. These staff are responsible, on behalf of the Station manager, for ensuring that nuclear safety cases are prepared at the location, in the central organisation, or externally. These staff are also responsible for the preparation, review and development of the written instructions that implement the limits and conditions of the nuclear safety case and the assessment of work for radiological significance.

11.19 The central engineering and technical organisation provides technical support to all locations. This includes a broadly based capability and specialists in key technical and safety areas which are recognised as specific to the licensee's reactors and which are not readily and securely available in the external market. These staff understand the design of the stations and the nuclear safety cases that underpin their operation and prepare and modify nuclear safety cases. The central engineering and technical organisation also has access to specialist facilities and support staff to enable it to maintain and develop the necessary knowledge base.

11.20 The Licensee's health and safety function has its own technical capability and access to other technical capability. It is therefore able to carry out independent nuclear safety assessments and peer reviews of new safety cases and modification, experiment and decommissioning proposals.

Plant operation and modification

11.21 Each operational location also has engineering and technical staff who are suitably qualified, experienced and, where appropriate, authorised to operate, maintain, improve and modify the plant in accordance with its nuclear safety case and after getting the agreement of the regulator (see Article 14). These staff assess work for operational safety significance to establish suitable and sufficient preventive and protective measures and provide the first-line control and supervision of activities which may affect safety.

11.22 Plant improvements and modifications requiring more extensive project management or technical capabilities are carried out by the central organisation on behalf of the Station manager. Where it is economic and practicable, maintenance services are procured from suitably qualified and experienced specialists in other utilities or organisations under appropriate contractual arrangements.

11.23 Project management capabilities are available to support new plants and major modifications on existing plants. These capabilities include the specification of items and services,

supervision of contractors and the management of construction, installation and commissioning of plant.

Qualification, training and re-training of personnel

11.24 Competence to undertake a specific task is achieved by a combination of:

{ knowledge, academic and practical qualifications, assessed training and experience of the person;

{ the instructions and information provided to the person; and

{ the degree of control and supervision exercised in carrying out the task.

11.25 For all tasks undertaken on site, licensee's and contractors' staff receive training: to make them aware of the safety hazards on the site; and in the use of preventive and protective measures established to reduce risks to health and safety. Licensees ensure, for each post or role with a responsibility for safety, that the duties and responsibilities and competencies are identified and that the training needs of an individual are met.

11.26 The performance of employees is assessed continually by their line management. In addition, periodic formal appraisals are undertaken and recorded. In either case, corrective and development actions are identified and taken as necessary.

11.27 Nuclear installation Central Control Room Supervisors are individually authorised by the licensee after assessment on simulator and, under direct supervision, on real plant to carry out the control and operation of the reactor and its supporting safety systems. [The HSE has the power to object to an individual's authorisation if it considers the person is not able to exercise that authority.]

Work carried out by contractors

11.28 When licensees use contractors for safety related work, they satisfy themselves that the contractors' staff have the appropriate qualifications and training to undertake the tasks safely.

Human resource provisions for decommissioning programme

11.29 Human resources for the decommissioning programme are not a matter for the CNS as this period in the life of a nuclear installation is outside the scope of the Convention. However, this is a matter for the Joint Convention on the Safety of Spent Fuel Management and of the Safety of Radioactive Waste Management to which the UK is a ~~signatory~~ Contracting Party.

11.30 During the operational phases of the life of a nuclear installation, the operators are required to preserve records or information that will be significant to the eventual decommissioning of the installation. These records include the designer's and the operator's outline methods for implementing their decommissioning strategy and any special staff qualification requirements, data on the accumulated radioactive waste and the licensee's arrangements for

the content and delivery of training to staff on the site with responsibilities for safety-related operations.

Regulatory requirements

11.31 A licensee must demonstrate to HSE's satisfaction that it has:

{ lines of authority leading to adequate control of the activities whether by the licensee's own staff or contractors;

{ adequate staff resources;

{ precise definition and documentation of duties;

{ integration of health and safety responsibilities into job functions;

{ appropriately trained experienced staff ensuring adequate in-house expertise;

{ the provision of, or access to, a high level of health and safety expertise used in an active role for the peer review of the safety case, audit and review.

11.32 LC 10 (see Annex 4) on training requires the licensee to make and implement adequate arrangements for suitable training of all those on site who have responsibility for any operations which may affect safety. Other LCs, including those relating to the appointment of suitably qualified and experienced staff (LC 12), and to emergency arrangements (LC 11), also have clear implications for the provision of training.

11.33 Training requirements are identified in a number of the SAPs {Ref. 7}. The requirement is that provisions are made for training staff who will have responsibility for the safety of the plant. These include a management system for training on the site, analysis of jobs and tasks, development of training methods, assessment of trainees, revision training as required and regular evaluation of training. Thus, licensees have in place a systematic approach to training and assessment of personnel with safety roles. Analysis of tasks provides an input to the specification of personnel training. Emphasis is placed on training which enables staff to implement accident management strategies, utilising appropriate instrumentation and items of plant that are qualified for operation in severe accident environments.

11.34 The licensee makes a case demonstrating the availability of sufficient numbers of qualified staff during: the initial licensing process; at periodic safety reviews and at other appropriate times. This is checked by HSE and its nuclear installation inspectors regularly inspect and assess the licensees' training arrangements. This is also carried out during targeted inspections by human factors specialist inspectors.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 11

Q11.1 The HSE has the power to object a licence for Control Room Supervisors. May be this capacity also applied to other control room operators or the heads of radiation protection service at the NPPs?

The HSE/NII has the power(s) to ensure that no person it deems to be unfit can control and supervise operations, which may affect safety. Such persons are appointed by the licensee as "duly authorised persons" and include amongst others reactor operators, control room supervisors, persons carrying out particular types of test and/or maintenance e.g. on reactor protection systems).

No individuals in the UK are formally licensed to undertake nuclear work. Licensees are required to ensure that all people who carry out safety related functions are suitably qualified and experienced. NII monitors compliance through its routine inspection. All senior operations staff, including desk operators and those managing operations outside the control room, undergo such assessments and are provided with a certificate by the licensee that permits them to undertake the corresponding duties. (Also see response to Q12.2).

Separate provisions and regulations implementing the requirements of the European Council Directive laying down the basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation control the appointment of persons supervising or advising on radiation protection services.

Q11.2 Who is responsible for estimating the costs of decommissioning programmes? Are the yearly Group Financial Statements sufficient to demonstrate that such programs could be supported?

A licensee is responsible for establishing the costs of decommissioning as part of its decommissioning strategy. BNFL for example determine these either from:

- actual detailed costs of current decommissioning activities based on real plant data;
- cost modelling of detailed activities based, where practicable, on real experience; or
- by comparison with costs of decommissioning plants of a similar nature for which a better cost estimates are available.
- A contingency is usually applied to the base cost estimates to cover uncertainties. Other licensees adopt a similar procedure.

For nuclear installations in the public sector, in addition to the examination by auditors of annual accounts there is oversight by the UK Government department responsible for BNFL's affairs. It obtains independent advice from auditors on the provisions for nuclear liabilities.

For privately owned nuclear installations the provisions for decommissioning are monitored by the Trustees of the decommissioning fund company. The Chairman and a majority of trustees are independent of the licensees. The fund company's independent technical expert audits the cost estimates to confirm whether the costs and expenditure profile estimated by the licensees are reasonable. The fund company's independent actuary will audit the performance of the fund and agree changes in the investment portfolio and degree of discretion exercisable by the investment manager.

For licensees in the public and private sector HSE/NII at each 5 year review will satisfy itself that the process for calculating decommissioning and waste disposal costs is robust and that the licensees' current forecasts and underlying assumptions reasonably show that adequate funding will be available when required.

Q11.3 Is the licensee obliged to make contributions to the "Nuclear Generation Decommissioning Fund on the yearly basis, or within a different time frame?

Is the contribution for each licensee identified as a lump sum or as a percentage of the yearly turnover?

Contributions by each BE licensee are paid quarterly and are based on the costs of meeting the licensees decommissioning strategy. The Trustees of the decommissioning fund determine the periodic payments required taking full account of the findings of their technical and actuarial experts. Contributions are currently in the order of £16m (pounds sterling) in aggregate per annum. The contributions are adjusted in accordance with an inflation index.

Contributions will be revised 5 yearly following the regulators' review of the licensees decommissioning strategy. Contributions may be revised more frequently if there has been a material change in circumstances, e.g. early closure of an installation affecting the decommissioning programme.

Q11.4. Safety enhancement within the service life is financed as part of the normal operating costs together with costs for fuel, materials, staff etc. It seems that the costs of safety enhancement should prevail over routine operating costs of NPP and should be financed the same way as the decommissioning form different funds.

The licensees need special funds for decommissioning because it is a major expenditure required at a time when the plant does not have revenue from generating electricity. In the UK the responsibility for safety rests with the licensees and this includes the funding of all safety activities. When granting a licence, the regulatory body needs to be satisfied that the prospective licensee has the financial resources to manage safety. However, there have been some cases where the licensees have chosen not to fund, for example, major backfitting work to enhance safety. In such cases the regulatory body will not permit operation and this effectively marks the end of plant life.

Q11.5 One should specially point out the great attention paid to the matter of decommissioning financial support. At the same time it is expedient to indicate clearly the sources of dedicated reserve funds for the decommissioning.

The UK agrees the importance that should be paid to the financing of decommissioning. Indeed it is one of the UK Government's key priorities to ensure that long term nuclear liabilities, particularly those relating to decommissioning, are met.

The UK National Report (paragraphs 11.9 to 11.16 and Annexes 9 and 10 of first report) describes the way in which licensees, both in the public and private sector, have established dedicated liabilities funds to cover the costs of meeting nuclear liabilities as they fall due. These funds are separately managed, are distinct from other funds available to licensees and may only be used for decommissioning activities.

Q11.6 When using contractors it seems that one should follow the availability of proper licences with the contractors' staff for execution of the required work, as the utility may be insufficiently competent in the specific field of knowledge to evaluate the contractors' qualification by him.

The licensee has absolute responsibility for nuclear safety, and this includes activities undertaken on its behalf by contractors. This means that the licensee must be competent to act as the 'intelligent customer' when procuring and deploying support from contractors. The Licence Conditions require the licensee to '.... make and implement adequate arrangements to ensure that only suitably qualified and experienced persons perform any duties which may affect the safety of operations on the site.' The licensee's arrangements are subject to assessment and inspection by NII, and NII would resist any proposed organisational change, which threatened the licensee's competence in this area. (Also see response to Q13.1)

ARTICLE 12 - HUMAN FACTORS

Text of Article 12:

'Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.'

This section of the report covers:

- **human performance (paragraphs 12.1 to 12.2);**
- **methods to prevent, detect and correct human errors (paragraphs 12.3 to 12.17);**
- **managerial and organisational issues (paragraphs 12.18 to 12.35);**
- **role of the regulatory body (paragraphs 12.36 to 12.42);**

Human performance

12.1 The UK recognises that human performance plays an important role in ensuring the safety of a nuclear installation throughout every stage of its life cycle - from design, construction, commissioning and operation through to decommissioning. Human factors are concerned with all aspects of human performance, and the factors affecting this performance, which can impact on the safe operation of a nuclear installation. Therefore human factors analysis is applied as appropriate to all activities and functions related to nuclear safety.

12.2 The HSE's SAPs {Ref. 7} form a basis against which the regulatory assessment of human factors is carried out. They identify explicitly the need for a nuclear licensee to consider a comprehensive set of influences on human performance.

Methods to prevent, detect and correct human errors

12.3 The licensee carries out fault analysis to identify initiating events that may occur due to human error and to identify operator safety actions. In general, where a plant failure or incorrect operation leads to a need for safety system operation, the plant is designed so that it is rendered safe by the action of passive or engineered features. These, in general, offer greater reliability than the human operator especially where rapid safety system operation is needed.

Analysis of Operator Safety Actions

12.4 Analysis of the safety functions and actions required of the operators demonstrates that tasks are feasible, and that they can be performed safely and reliably in the time available. Where appropriate, task analysis is carried out to identify the operator actions required to monitor the plant, diagnose plant state, make decisions and implement actions. It takes account of the physical, physiological and cognitive demands, which may be placed on the operator and on teams of operators. It addresses the potential consequences of failure to perform the safety actions successfully, and the potential for recovery from error.

12.5 Task analysis provides a primary input to inform decisions on plant staffing, and on the equipment and other facilities which are provided to support the operator. In particular, it is

important to the design of the user interface, and also provides a basis for developing procedures and the content of personnel training. It influences the way in which the job is organised, as well as being used to determine the feasibility of individual tasks.

Probabilistic Safety Assessment and Human Reliability Analysis

12.6 The probabilistic safety assessment (PSA) provides quantitative assessments of the risk to safety arising from plant designs and operations. The PSAs highlight significant contributors to risk, and take into account the impact of human activities and operations on safety. The licensees ensure that all relevant operator actions are identified in the PSAs, and suitable methods are used to assess the potential errors associated with these actions and to determine human error probabilities.

12.7 The initial stage of the human reliability analysis identifies potential human errors that can impact on safety. The error identification process is rigorous and thorough. It enables the specification of all human errors that could reduce the reliability of the system being examined.

12.8 Quantitative estimates of human error probability are produced for the significant human errors defined during the error identification process. The probabilities reflect influences on performance arising from psychological factors and other task-specific factors (e.g. stress, the physical environment, training, working practices, time constraints, adequacy of procedures and User Interface, etc).

12.9 The potential for dependencies between separate operator actions (either by the same or by different operators) is assessed and the results are factored into the PSA. The potential for recovery from previous errors is also examined - this is especially pertinent where long timescales are available to take corrective action.

12.10 The licensee identifies potential improvements as part of this analysis and uses this information to ensure that risk is reduced so that it is as low as reasonably practicable (ALARP).

User Interface Design

12.11 The design of the User Interface should follow good human factors practice, to ensure that it is compatible with human psychological and physical characteristics and to enable the required tasks to be performed reliably and efficiently. For any new design, a structured User Interface design process is adopted and relevant standards are applied. In particular, the User Interface for the Main Control Room (MCR) is based on a comprehensive and systematic task analysis, which identifies the operational requirements during normal, transient and fault conditions. The User Interfaces of existing nuclear installations have been subject to scrutiny during the PSR processes (see Article 14) in order to ensure that they are fit for purpose.

12.12 The MCR enables the operator to carry out safety functions and tasks during normal operations, postulated fault conditions and, where practicable, severe accidents. Adequate provisions are available in the MCR and at emergency locations to enable the monitoring of plant state in relation to safety, and the taking of any necessary safety actions. Due attention is given to the specification and design of local control stations and to equipment employed during other activities which have the potential to impact upon plant safety (for example, maintenance and testing equipment and computer-based systems used to present operating instructions).

Operating and Maintenance Instructions

12.13 Operations are controlled and carried out in accordance with Operating Rules (ORs) or Technical Specifications (Tech Specs). ORs and Tech Specs define, or refer to lower tier documents, which define the limits and conditions necessary for the plant to remain within a safe operating envelope. Instructions are provided in order to implement the OR and Tech Spec limits and conditions and to support examination, inspection, maintenance, testing activities and plant operations. Written instructions support correct operator performance and ensure that operations are performed in a well-defined and controlled manner.

12.14 The licensee must ensure that the technical content of the instructions is correct, and that the design and presentation of instructions enables users to follow them accurately and reliably. The instructions are subject to a process of verification and validation to ensure that they accurately represent operational requirements and are compatible with the design of plant and equipment. The licensee provides suitable arrangements to implement the ORs, Tech Specs and instructions.

Working environment

12.15 The working environment can impact upon human performance, and the licensee considers environmental factors in its analyses of operator actions including noise, thermal and lighting conditions, communications facilities and the design of the workplace.

12.16 Adequate means of access to, and escape from, areas of plant which may be affected by any internal, external or radiological hazard are provided. Also, personnel are physically protected from direct or indirect effects of an incident. Safety-related structures, systems and components are designed and laid out to facilitate inspection, maintenance, modification, repair and replacement. The licensee ensures that such protection (which may include personal protective clothing, instrumentation indicating radiation and airborne activity levels etc) is compatible with the demands of the tasks the person may be required to perform.

Training

12.17 Training is considered under paragraphs 11.24 to 11.27.

Managerial and Organisational issues

12.18 The safe operation of the plant depends on the technological systems and on the people who interact with those systems. Both of these factors can be affected by the safety management systems and safety culture at the installation. In recognition of this, licensees have formal management systems and procedures, which seek to ensure safe operation. In addition HSE had introduced a specific licence condition (LC36).

12.19 The importance of appropriate management systems is recognised in the UK's Health and Safety legislation. The Management of Health and Safety at Work Regulations (19929) {Ref. 30} are of general application to any work activity (see paragraph 7.20). HSE has issued guidance on 'successful health and safety management' to industry concerning the elements of a successful health and safety management system that are appropriate to meet these statutory requirements (HSG65) {Ref. 39}. These include:

- clear health and safety policies
- good organising and planning functions
- provisions to monitor and measure performance
- an auditing, review and feedback process.

12.20 The HSE's SAPs {Ref. 7} include a section concerned with management systems. Formal provisions for the investigation and reporting of events are also an explicit requirement. The UK licensees have a system for reporting receipt and assessment of reports of nuclear plant events and are members of World Association of Nuclear Organisations (WANO), and as such share operating experience internationally. In addition, the HSE operates the IAEA's Incident Reporting System (IRS) on behalf of the UK. This provides another forum for international exchange of operating experience.

Safety Culture

12.21 NuSAC (see paragraph 8.20) has produced documents on 'Training' and 'Organising for Safety {Refs. 40 and 41} which have informed the UK awareness of, and approach to, safety culture - the attitudes, values and practices which emphasise and maintain safety as the overriding priority.

12.22 While licensees have formal management systems and procedures to assure safe operation, they also recognise the importance of having a positive safety culture. The nuclear licensees know that developing a good safety culture involves gaining the commitment and enthusiasm of staff involved in plant safety, as well as instituting good management procedures. A range of initiatives to enhance safety culture have been implemented. The suitability of a particular type of initiative will vary from licensee to licensee and on the prevailing culture within and between that company's sites. Safety culture is being enhanced through organisational approaches, such as the involvement of staff in TQM (total quality management), regular safety communications (newsletters, seminars etc.), safety performance monitoring, audits and reviews, safety awareness training, provision of adequate resourcing for operational feedback etc.

12.23 The licensees' work in relation to safety culture is considered below under four broad headings: leadership; communications; individual awareness and involvement; and learning.

Leadership

12.24 All the UK licensees have clear positions on the importance of safety in their 'Company vision' statements and the goals of their corporate business plans. Placing the maintenance and improvement of safety alongside other business goals has brought benefits in terms of wider staff involvement. In particular, monitoring the safety improvement activities through the same 'accountability review' process as other business activities ensures that they are given appropriate priority. It also reinforces the message that they are part of the core business.

12.25 One company has set improvement of leadership as a particular business goal. Each business unit is performing a self-assessment using the European Foundation for Quality Management business excellence model to identify the most important areas for improvement.

Another technique being applied is the use of Safety Enhancement Plans for developing, communicating, understanding and monitoring the strategy at each site to improve safety and safety culture. These form part of each location's business plan and outline the activities that will be undertaken to improve safety in the plan year. A mechanism is also provided for staff to contribute ideas for improving safety. Specific safety enhancement 'enablers' and 'results' are in each of another licensee's station business plans.

12.26 Yet another technique being used is the International Safety Rating System (ISRS) to set improvement targets across the full range of safety management activities. Managers are accountable for improvements in each area.

Communications

12.27 Each licensee is striving to achieve a more open approach to event reporting, for example, by encouraging the reporting of abnormal conditions or 'near-miss' events. A wide range of improvements to the communication process are encouraged by the use of ISRS within each company. Particular examples are: greater coverage by team briefing and other corporate information services; regular Group Safety Meetings; involvement of supervisors and mangers in face to face informal discussions with staff on topics chosen by the staff.

12.28 To gauge company culture all the licensees have conducted general staff attitude surveys and specialist safety culture surveys. The lessons learned from these surveys are fed into the business planning process to inform the location's safety enhancement activities.

12.29 At many nuclear installations pocket booklets have been developed in specific areas explaining management's expectations of standards and bridging the gap between training and procedures. Some, for example, promote better understanding, with responsible station and contractor personnel being clearly identified and photographed; other pamphlets apply to individual departments.

12.30 One operator has established a Contractor Safety Forum at each nuclear installation that enables station management to involve contractors' management in agreeing safety objectives and measures. These forums have helped improve communications both between the licensee and individual contractors and between different contractor companies.

Individual awareness and involvement

12.31 All the operators have continuing programmes of safety awareness training to ensure that all staff appreciate the potential impact of their work on safety. Additionally, all the companies have used training programmes based around the STAR (Stop, Think, Act, Review) concept to provide a tool for individual safety improvement.

12.32 One operator has developed a special safety awareness training pack for first line supervisors and is looking at training covering strategic safety matters for senior managers. Another operator uses the STAR concept as an integral part of investigations as to why something happened. These investigations sometimes highlight non-application of the STAR principles and the resultant consequences. Likewise, correct application of STAR techniques, that result in avoiding potential safety incidents, are identified. The lessons to be learned are communicated to staff at Team Talks and Group Meetings as part of the continuing process of emphasising the advantages of the STAR techniques.

12.33 The licensees seek to involve staff in a range of improvement initiatives, to promote personal development and awareness. All staff have taken part in Safety Culture seminars, and, following significant human performance events, all personnel involved participate in the preparation of a report for the Station Incident Panel and the Company Safety Supervisory Board.

Learning

12.34 In the UK the nuclear utilities co-operate in programmes of Peer Evaluation and Operational Experience Feedback. Additionally, they participate in the programmes of WANO, the IAEA and the Institute of Nuclear Power Operations (INPO) which give a wider perspective on performance. As well as the professional, focused critique which a station gains from an Evaluation or an IAEA Operational Safety Review Team (OSART) mission, the many staff who help conduct such reviews bring home valuable insights and ideas, which can be applied at their own stations.

12.35 A continuing concern with feedback and review processes is the potential for new activities and corrective actions to be spawned more quickly than the existing ones are completed. All the companies are aware of weaknesses in this area and, for example, one has recently increased focus in this area by requiring stations to set targets on completion of actions arising from Peer Evaluation and event investigation. Another operator has also made the completion of actions a specific objective. A third has long established Incident Panels which place and track all actions associated with events.

Role of HSE in Human Factors Assessment & Inspection

12.36 Human factors analysis requires scrutiny of design processes in order to confirm that due consideration has been taken of human factors issues. It also requires an examination of the way in which human factors principles have been implemented in practice throughout the life cycle of the nuclear installation. HSE therefore adopts an integrated approach to human factors analysis, which combines assessment and inspection.

HSE Human Factors Assessment

12.37 Assessment of the licensee's treatment of human factors is made throughout the life cycle of a nuclear installation. When a safety case is submitted to HSE, nuclear site inspectors, project managers and human factors specialists agree on the scope of any human factors assessment work which is appropriate to the case in question. HSE places considerable emphasis on the inclusion of human factors analysis in the early stages of plant design in order to ensure that the design properly reflects the capabilities and limitations of human performance.

12.38 Some aspects of human factors are specifically addressed by the nuclear site Licence Conditions (e.g. LC 10 - Training, LC 12 - Suitably Qualified and Experienced Persons), and compliance with these LCs is monitored as part of the nuclear site inspectors' normal duties. Hence HSE's nuclear installation inspectors are trained to identify human factors concerns which they discuss with the licensee or raise with HSE's specialist human factors inspectors.

12.39 The HSE's human factors inspectors proactively identify areas for examination based on their awareness of issues which have been raised from a variety of sources, including national and international operating experience, developments in human factors techniques and research and discussions with HSE and licensee personnel. HSE also maintains exchange arrangements on human factors, and other technical areas, with regulatory bodies and research establishments in other countries.

Methods of Regulatory Assessment

12.40 HSE human factors assessment methods take two principal forms: examination and discussion of the licensee's human factors analysis; or inspection. Considerable emphasis is placed on ensuring that the licensee has carried out appropriate analysis and that the results of this analysis are factored into the plant design process and the way in which the plant is subsequently operated.

12.41 The HSE also carries out targeted inspections of human factors-related issues. Such inspections provide confidence that the licensee's human factors analyses have been implemented in practice. All areas of human factors can be examined in this way, but particular emphasis is given to targeted inspection of the licensee's management of safety and training arrangements. This reflects not only the significance of these areas, but also the fact that they can be subject to more regular change than other factors such as the User Interface.

12.42 With regard to assessment of safety culture, HSE considers it important that the licensees 'own' their safety culture. It is considered neither practicable nor desirable to compel a licensee to adopt a culture advocated by the regulator. The regulatory approach to this issue, therefore, is to seek information that allows HSE to make judgements about the licensee's safety culture, by reviewing indicators of plant and personnel performance, and to use these observations to encourage and support licensee initiatives to promote improvements.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM 'S FIRST NATIONAL REPORT ON ARTICLE 12

Q12.1 What are the criteria applied by HSE to assess the safety culture level of licensees in the four headings included: leadership, communications, individual awareness and learning?

HSE does not apply hard and fast criteria when judging the adequacy of a licensee's safety culture. We do not consider that valid and reliable criteria are available for this multi-faceted concept. Rather HSE seeks to judge the more tangible aspects of how the licensees are managing safety, extensively using Ref. 7 as a guide. As part of this approach HSE seeks confirmation that the licensee is aware of the need to monitor and support its safety culture and then monitors the efforts which the licensee has made to carry out this work effectively, and compare these efforts against current good practice. As stated in under Article 12, HSE does not prescribe a safety culture for its licensees, but instead seeks to gain confidence that the culture is appropriate and that it is being sustained. Information is gained through constant monitoring by HSE's Site Inspectors and targeted inspections by human factors specialists.

Q12.2 Training requirements are identified in a number of SAPs. HSE inspects the training arrangements. Does HSE formally approve operator qualification?

HSE does not formally approve, or certify, the qualification of individual operators. The Site Licence requires the licensee to develop and implement adequate arrangements to ensure that personnel with duties, which may affect the safety of operations on the site, are suitably qualified and experienced or in some cases duly authorised. This includes the training and assessment of operators. HSE may elect to approve the licensee's arrangements, but we do not formally approve each individual operator's qualification. (Also see response to Q11.1 and Q19.6)

Q12.3 Are there simulators for all plant designs?

Simulators are available for all power reactors, although the degree of physical fidelity varies. For example, high fidelity full-scope simulators are provided for all the AGR's and for Sizewell B (PWR). For most of the older Magnox plants, a generic simulator is in use. This has the capability to provide a close functional simulation of the different Magnox designs, but does not provide the same level of physical fidelity. Two of the older Magnox plants have recently implemented simulators, which provide a "high fidelity" presentation of the plant (which has a conventional hard-wired control room) via computer-based displays.

Q12.4 Methods to prevent, detect and correct human errors are task analysis and PSA. The level of automatism is not described: are there general principles concerning automation?

PSA and task analysis are not the only methods to prevent, detect and correct human errors. Although they are important methods of analysis, we would emphasise that they are but two tools in a suite of techniques, which can be drawn upon to minimise the likelihood or consequences of human error. Other tools include paying attention to human capabilities and limitations, and good practice in the design of procedures, the user interface, the working environment, training etc.

With regard to automation, HSE has produced two SAPs, which set out general principles. SAP P117 states that, where reliable and rapid protective action is required, engineered safety features should be provided. Where the safety consequences are less significant, or longer timescales are available, then operator actions may be acceptable to complement the engineered systems. SAP P77 extends P117 by requiring that no human actions should be necessary for approximately 30 minutes after the start of the requirement for protective action. However, it should be possible for the operator to initiate correct safety system functions, but not negate correct safety system action, at any time.

The general principle underlying these SAPs is to minimise dependence on human action to maintain a safe plant state, especially where timescales for action are short. However, where it is reasonable to claim operator action (i.e., where longer timescales for action are available and the safety consequences of error are less severe), then HSE still expects the licensee to ensure that operator action is properly supported through giving attention to human factors considerations.

Q12.5 Organisation and responsibilities, safety culture, communication and use of experience feedback are implemented by the licensees and assessed by HSE. Emergency procedures are set by the licensees: is there a formal approval by HSE?

The top-level emergency procedures relating to each nuclear site are produced by the licensees and following their assessment by HSE, are formally approved by HSE. Other documentation, which gives more detail, is produced by the licensees and can also be formally approved if HSE so wishes.

Q12.6 What is the organisation in the control room for normal and emergency situations?

The normal staffing of Central Control Rooms (CCRs) consists of one engineer per reactor plus a control room supervisor. For most dual-reactor stations, this means that three professional engineers are present in the CCR at all times. Furthermore, some have additional staff in the CCRs - for example, Sizewell B and some of the Magnox reactors have staff who have dedicated responsibilities for the secondary side of plant.

During emergency conditions, the main operational decisions in the CCR continue to rest with the professional CCR engineers. For an emergency, the control room staff would be supplemented by the Shift Charge Engineer (SCE), the most senior person on site when there are no day staff, and the plant engineer. During silent hours the SCE takes on the role of initial

Emergency Controller until the duty EC and the emergency support staff have been called in and taken up their emergency duties. Depending upon the nature of the disturbance, other specialist staff may be called into the CCR. The licensees are required to demonstrate through task analysis that their minimum staffing levels in the CCR and on plant are sufficient to cope with emergency conditions.

In addition each shift carries out a training emergency exercise and HSE witness's at least one of these exercises every year.

Q12.7 Shutdown situations have particular features concerning human factors: are there specific measures (procedures) relating to shutdown situations?

During shutdown conditions, decay heat levels are lower and there is usually more time available to respond to plant transients. However, plant safety systems may be removed for maintenance or configured in unusual ways. This can therefore result in greater reliance being placed on administrative controls and operator action to prevent or mitigate transients.

In the UK, licensees place emphasis on ensuring that tight configuration management systems are in place. This can involve the use of features such as plant walkdowns, valve locking schemes etc. Also, station documentation such as the Operating Rules and Station Operating Instructions (SOIs) are provided for managing shutdown conditions. In recent periodic safety reviews, licensees have assessed the adequacy of alarms and indications supporting timely fault detection during shutdown conditions.

Q12.8 The report states that one operator has developed a special safety awareness training pack for first line supervisors. Please explain contents of the training pack, and effects made by use of the training pack.

The contents of this pack are commercial in confidence and as such are currently not publicly available. Training of operators as far as the obligations under the CNS is covered in the report and in the response to other questions.

ARTICLE 13 - QUALITY ASSURANCE

Text of Article 13:

'Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation'.

This section of the report covers:

- **regulatory policy and requirements (paragraphs 13.1 to 13.2);**
- **operators' Quality Assurance programmes (paragraphs 13.3 to 13.4);**
- **operators' implementation (paragraph 13.5 to 13.9);**
- **operators' assessment (paragraphs 13.10 to 13.11);**
- **regulatory control activities (paragraphs 13.12 to 13.15).**

Regulatory Policy and Requirements

13.1 In the UK, Quality Assurance (QA) is an essential part of a licensee's safety management system. It provides a disciplined approach, which ensures that arrangements are in place covering all safety-related activities throughout the life of the plant. In order to give further confidence, it is important that the part of the organisation responsible for monitoring the implementation of QA arrangements has sufficient authority and independence from commercial pressures. HSE monitors ~~T~~ the QA functions within the licensees' organisation for evidence of ~~are given~~ this authority and independence.

13.2 LC 17 on QA (see Annex 4) requires licensees to set out the managerial and procedural arrangements that they use to control and monitor actions necessary in the interests of safety, and to demonstrate compliance with other LCs (and in particular, the arrangements made under them) and any other relevant legislation. LC 17 applies throughout the life-cycle of a nuclear installation - siting, design, construction, commissioning, operation (including maintenance and modification), and decommissioning - and to all activities associated with the safe operation of the installation. Each phase in the life of a nuclear installation is covered by a document, usually called a QA Programme, which describes the commitment to the adoption of QA principles. The documented arrangements are prepared by the licensee prior to the commencement of any of the phases of the plant. QA is addressed by the SAPs {Ref. 7}.

Operator's QA programme

13.3 A licensee's QA arrangements include:

(i) A QA programme (which may form part of an integrated business programme) that describes the overall management and procedures to provide quality assurance for execution of a specific contract or project for a nuclear installation at any stage in its life-cycle. (QA programmes identify lower level documents and procedures for implementing the various activities. These include the methods for assuring that items and services are in accordance with their safety requirements and the plant or equipment is operated in accordance with the appropriate procedures. QA programmes identify arrangements which, when implemented, assure compliance with appropriate

standards and the associated documentation. The training and qualifications of persons involved in ensuring the appropriate quality are also addressed**.)**

(ii) Organisational requirements for the programme referred to in (i) are specified. This includes the functional responsibilities, levels of authority and lines of communication for the management and the direction and execution of the programme. The organisational structure and responsibilities cover, when appropriate, all stages in the life-cycle of the plant. The purpose of this is to ensure that the work reaches the required standard and can be verified.

(iii) Inspection and surveillance requirements defined for any activity affecting quality (including the quality of safety related products, such as fuel and waste packages). This verifies that instructions, procedures and drawing requirements are followed.

(iv) There is a tiered approach to carrying out audits, which ensure that there is an overall periodic check on arrangements. Self audit and layers of independent audit are used to ensure sufficient and effective use of resources.

13.4 The formal arrangements for QA are based on national and international standards. These arrangements identify those activities and systems that are important to safety. A graded approach to the application of management controls, appropriate to the level of safety required, is applied. The documented system is designed to allow systematic monitoring, which gives confidence that intended actions have been completed to defined requirements and that the cause of any deviation from such requirements, including managerial control, is identified and corrected.

Operator's Implementation

13.5 Each licensee's approach to QA arrangements is in line with the IAEA's Nuclear Safety Standards Code no. 50-C-Q " Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations" {Ref. 42} and International Standards for Quality Management Systems (ISO 9000:2000 ~~series~~) {Ref. 43}. ~~Also, t~~ The UK ~~has a~~ standard explicitly addressing the responsibilities of the owner of a nuclear installation (BS 5882 'Specification for a Total Quality Assurance Programme for Nuclear Installations) has been withdrawn.

13.6 Each licensee has a QA programme document describing the overall management and procedures for operation of nuclear installations. The QA programme includes a:

{ policy commitment that all activities significant to the overall management and procedures for operation of the nuclear installation will be carried out in accordance with the Quality Management System;

{ description of the organisation and allocation of responsibility;

{ description of the procedures and instructions that implement requirements.

13.7 Typically within each nuclear installation, QA documentation is organised using a tiered approach. At the highest level (level 1) is the QA programme. Below that at level 2 are

the management procedures, which describe how arrangements affecting safety are developed, implemented and reviewed. The lowest level (level 3) comprises the task instructions, quality plans and records.

13.8 All activities within the licensee's organisations, which are significant to safety, are carried out in accordance with ~~written~~ formalised instructions. A 'graded' approach is normally taken to ensure that instructions and other 'controls' are established commensurate with the safety significance of the activity. Instructions are generally written for use by a “suitably qualified and experienced person”. Instructions also identify the information to be generated and retained to demonstrate the satisfactory completion of a task.

13.9 Procurement of items and services is closely controlled to ensure that the specification is complete and adequate with respect to safety requirements. Records, inspections, audits and feedback from usage demonstrate that the specification of the item delivered for use, or the service provided, is met.

Operator's Assessment

13.10 The adequacy and effectiveness of the QA system in each nuclear installation is assessed by the licensee using a programme of management reviews and audits. Each system is examined over a defined period and the corrective action taken when a need for change is identified.

13.11 Records are preserved to demonstrate compliance with regulatory requirements and for the commercial and safe operation or decommissioning of the plant. ~~Preservation~~ Records media and conditions of storage are commensurate with the safety significance and period of storage. Some records are required to be preserved for well over 30 years .

HSE's regulatory control activities

13.12 The HSE assesses the adequacy of the licensee's QA arrangements to ensure that these fully address the requirements of the nuclear site licence. In doing so it is expected that these arrangements will be consistent with the requirements of current national and international standards on quality management and HSE's Safety Assessment Principles (SAPs). The national and international standards include, as appropriate, the IAEA Nuclear Safety Standards Code of Practice 50-C-Q "Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations" {Ref. 42}~~,~~ and applicable requirements of ISO 9001:2000 “Quality Management Systems – Requirements {Ref. 43}. ~~BS 5882: 1996 "Specification for a total quality assurance programme for nuclear installations" {Ref. 36} and applicable requirements of ISO 9000 "Quality Systems: Model for quality assurance in design, development, production, installation and servicing" {Ref. 37}.~~

13.13 Monitoring against LC 17, referred to in paragraph 13.2, is conducted as part of programmed inspection by ~~the nominated~~ a site or project inspector to confirm the continued adequacy of arrangements and compliance with them. ~~Site or project inspectors will request appropriate assistance from a QA or management system specialist from within HSE as required. The assessment work carried out by the specialist may consist of a review of documentation provided by the licensee as part of a safety case proposal. This documentation will be assessed~~

~~against appropriate requirements in the standards identified in the last paragraph.~~ Arrangements may also be made to conduct a targeted inspection on site, which will involve a structured programme using auditing techniques. ~~HSE QA specialists also hold regular meetings with their counterparts in the licensees' corporate organisations or site QA departments to monitor and discuss changes and developments to the licensees' arrangements. Actions arising from these meetings are reported to the site inspector (if not in attendance) and are closed out by the QA specialist or site inspector, as appropriate.~~ Meetings are held periodically with licensees, including at the corporate centre, to discuss plans, programmes and changes to QA related activities and documentation. Particular emphasis is placed on monitoring the effectiveness of licensees own auditing with some audits being observed by HSE inspectors.

13.14 Inspections of safety management systems are also carried out by specialists in QA and safety management systems. These inspections are used to monitor arrangements to meet requirements laid down in HSE-developed guidance (HSG65) {Ref. 39} which has been adopted as one of the models in BS 8800:1996 "Guide to Occupational Health and Safety Management Systems" {Ref. 44}. The information gathered during these inspections is relevant to the general topic of management systems since the quality management system provides the basis on which the safety management system is built.

13.15 The HSE's NSD is developing, using quality principles, a Business Management System ~~using applicable requirements of BS EN ISO 9001:1994 {Ref. 37} as a framework~~ to ensure the quality and consistency of its own work.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM 'S FIRST NATIONAL REPORT ON ARTICLE 13

Q13.1 How are suppliers involved in the quality assurance programme?

The licensees are required under Licence Condition 17 to establish QA requirements for all safety-related plant, systems and activities. This requirement extends to suppliers or contractors that the licensee employs. All suppliers of safety related equipment and services must comply with the specifications provided by the licensees. These require some form of QA programme. As indicated in the report a graded approach to QA is adopted, thus the levels of quality assurance provided by the supplier are related to the safety significance of the product or service. Proven suppliers operating to systems in compliance with and certified to ISO 9000 series are predominantly used with additional requirements placed upon them should the safety significance warrant it. Suppliers are included in a listing compiled by the licensees, which is used to control where services and equipment are procured. As the prime responsibility for safety rests with the licensees in the UK, HSE are not involved in supplier selection or evaluation this is clearly the work of the licensees. (Also see response to Q11.6)

Q13.2 Could the United Kingdom indicate if the QA programme used during the design and construction of the older plants allows to have a sufficient knowledge of the initial state of the plant?

The earliest Magnox NPPs were built before the development of the first national and international QA standards. The UK has been at the forefront of the development of QA standards (ISO 9000 series having its roots almost completely in British Standard 5750).

However, irrespective of the requirement of formal QA requirements, authorisations for the early stations required that the plants be constructed to established plans and drawings and that these could not be altered without prior approval of the relevant government ministry. Furthermore it was a requirement of the early licences that certain parts and materials of the nuclear power plant (including all pressure systems) had to be subjected to independent inspection and test over and above that carried out by the manufacturer and constructor. Additional assurance of quality comes from them being designed and built to conservative standards and to a high quality, with considerable efforts being made to avoid the occurrence of significant defects. For example for the steel RPVs the choice of materials and welding processes, including third party surveillance and control, ensure that the design intent and quality were achieved. This is supported by the applied radiography, which identified any defects of a size of structural concern. The licensee has recently reviewed the construction records to confirm the effectiveness of the radiographic weld examination and interpretation. These records indicate that very stringent defect acceptance criteria were used and all but the smallest volumetric defects found were removed. Recent research has given a much clearer and semi-quantitative understanding of the capability of the procedures used at the time to detect defects, which would be of concern. This example typifies the approach taken at the time and good "as built" records are available to demonstrate the level of quality attained. With subsequent periodic reviews of nuclear operating plant safety cases and the application of very well established and comprehensive modification control arrangements the HSE has confidence in the licensee's records of the current state of the NPPs.

Q13.3 The report states (page 49) that HSE's NSD is developing a management system using applicable requirements of ISO 9001 as a framework to ensure the quality of its own work. Has the significance to safety of the absence hitherto of such a management system been assessed and has this influenced the timescale for implementing the NSD QA program?

The short answer is no, but HSE like any other organisation has been evolving through continuous improvement; the goal is to achieve regulatory excellence. In 1998 HSE decided to align its management processes with both ISO 9001 and the Business Excellence Model (BEM). HSE have already gained the UK award Investors in People (IiP) which harnesses the human development aspects of any quality standard. Most of the other elements of a quality management system have existed in HSE for many years (including policies, responsibilities, interfaces, standards and guidance) and have undergone periodic updating. The decision to increase the formalisation of the systems has been taken because of a recognition of the need to continuously monitor and improve the way HSE does its regulatory business added to the fact that HSE requires this of its licensees. HSE has a central audit function. This carried out an internal audit of the QA arrangements for NII's assessment process in 2000, and found them satisfactory.

Q13.4 Paragraph 13.15 reports that the HSE's NSD is developing a quality management programme for use within the NSD. When will this be completed and does the UK see QM programmes within regulatory authorities as being an obligation of the Convention?

The response to Q 13.3 above explains in detail about the current developments in QA/QM programmes within the HSE's Nuclear Safety Directorate. The UK does not see formal QA programmes within regulatory authorities as an obligation under the Convention: they are not currently so recommended by any international standards nor do many regulatory bodies in the world seek the full formality of independent third party evaluation. However, HSE's NSD is actively engaged in the continuous improvement of its QA systems for its regulatory work.

ARTICLE 14: ASSESSMENT AND VERIFICATION OF SAFETY

Text of Article 14:

'Each Contracting Party shall take the appropriate steps to ensure that:

(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.'

This section of the report covers:

- **description of the UK's safety case regime (paragraphs 14.1 to 14.24);**
- **a summary of generic results of monitoring and periodic safety assessments (paragraphs 14.25 to 14.27);**
- **verification programmes - preventive maintenance, In-Service Inspection, ageing processes evaluation (paragraphs 14.28 to 14.41);**
- **regulatory validation activities (paragraphs 14.42 to 14.54).**

The UK's safety case regime

14.1 Licensing UK nuclear installations is described in paragraphs 7.27 to 7.34. In addition, the way that HSE sets safety standards using the TOR principle and SAPs is described in Annexes 7 and 8.

14.2 The assessment and justification of the safety of a nuclear installation starts before construction commences by the production and development of safety analysis reports by the licensee. The safety case consists of a tiered set of these safety analysis reports covering a range of topics, from general safety principles through to detailed aspects of design and operation. This set of documents provides a written justification of the safety of the installation (e.g. evidence to support the selection of the concepts and processes, detailed data used in calculations for specific components calling, as necessary, on specific research and development programmes).

14.3 The safety case is continually developed and updated as the installation progresses through the stages of its life, for example, during design, construction, commissioning, operation, and finally for decommissioning.

14.4 At all stages in the life of the nuclear installation, its safety case technical content is reviewed by HSE. In addition, HSE's nuclear installation inspectors verify, by direct site inspection, that the installation and its operation remain in accordance with its current safety case.

Licence Requirements including Review Periodicity

14.5 Licence Conditions (LCs) (see paragraphs 7.30 to 7.34 and Annex 4) attached to the nuclear site licence require the licensee to put in place arrangements to ensure that adequate safety documentation is produced. In particular:

{ LC 14 "Safety Documentation" requires the licensee to make arrangements for the production and assessment of safety cases consisting of documentation to justify safety during the life of the nuclear installation.

{ LC 15 "Periodic Review" gives HSE the power to require a safety justification on anything it specifies.

{ LC 16 "Site Plans, Designs and Specifications" requires a reference set of documents for buildings and plant relevant to safety. Declared functions cannot be changed without a formal amendment procedure.

{ LC 19 "Construction or Installation of New Plant" requires the provision of adequate documentation to justify the safety of new plant.

{ LC 20 "Modification to Design of Plant Under Construction" requires the provision of adequate documentation to justify the safety of any modification.

{ LC 21 "Commissioning" requires the provision of adequate documentation to justify the safety of the proposed commissioning activity.

{ LC 22 "Modification or Experiment on Existing Plant" requires the provision of adequate documentation to justify the safety of a modification or experiment on the plant.

{ LC 23 "Operating Rules" requires the licensee to demonstrate that there is an adequate safety case for any operation that may affect safety.

{ LC 28 "Examination, inspection, maintenance and testing" requires the licensee to verify limits and conditions by examination and testing.

14.6 These LCs ensure that the licensee produces and maintains a safety case of adequate standard throughout the life of the installation.

14.7 There are formal requirements for other reviews arising from the following LCs:

{ LC 30 requires periodic shutdowns of nuclear installations. These shutdowns are for the purpose of examination, inspection, maintenance and testing of any plant or process. Before re-commencement of operation, the safety case is reviewed in the light of any findings arising during the previous operational period and during the shutdown and the plant must be shown to be safe to operate until the next statutory outage. Periods between outages on nuclear in-

stallations vary from 2 to 3 years and must be explicitly defined in the Plant Maintenance Schedule (see paragraph 14.32).

{ LC 15 requires a periodic review of the nuclear installation during which there is a systematic review and reassessment of all of the safety case. This currently takes place on a 10 year cycle, unless there is a specific requirement for an earlier review.

Purpose of a Safety Case

14.8 The nuclear installation licensees establish systems for the management of safety to ensure that they operate their installations with adequate safety. These systems include the production of safety cases. The licensee "owns", understands, endorses and makes use of the safety case at all stages of the installation's life. It defines the processes being undertaken within a nuclear installation, the hazards associated with these and the components and procedures necessary to protect against or mitigate these hazards. The safety case shows: that the plant and process are, and will remain, fit for purpose by identifying limits and conditions on plant operation and maintenance; that the risks are adequately controlled; and how safety significant issues have been and will be addressed.

Contents of a Safety Case

14.9 The safety case is the licensee's compilation of safety documents, including a summary document called a safety report. This report and the safety documentation make reference to supporting arguments and evidence, as well as to existing or proposed instructions, procedures, arrangements and standards. The references may range from national or international codes to corporate standards, criteria and procedures that provide requirements for safety and the means to ensure that the process of producing the safety case is properly controlled. The safety case also demonstrates compliance with appropriate legislation, for example, the IRR 99 ~~85~~ {Ref. 3 ~~17~~} and the Management of Safety at Work Regulations {Ref. 30 ~~23~~}. The safety case contains:

{ **A demonstration that the nuclear installation conforms to good nuclear engineering practices and sound safety principles.** A nuclear installation is designed against a set of deterministic engineering rules, such as design codes and standards. It uses the concepts of "defence in depth" and "adequate safety margins". The safety case provides sufficient information to demonstrate that the engineering rules have been applied in an appropriate manner. In particular, there should be a clear demonstration that all equipment important to safety has been designed, constructed, operated, and maintained in such a way as to enable it to fulfil its safety function for its projected life.

{ **An analysis of normal operating conditions** to show that resultant doses of ionising radiation, to both members of the work force and the public are, and will continue to be, below regulatory limits and, furthermore, are ALARP (see paragraph 15.7).

- **An analysis of possible accidents.** The analysis includes the two complementary approaches of deterministic and probabilistic assessment. The deterministic approach is used in the analysis of design basis accidents (DBAs) to demonstrate the capability of the safety systems. Deterministic arguments may also be used in demonstrating that certain fault conditions do have negligible frequencies and hence do not require further analysis. PSA provides a comprehensive, systematic and numerical analysis of the plant and the role of its safety provisions, and demonstrates that the risk arising from the plant is acceptable. The PSA requires engineering knowledge and judgement, and it is important therefore to have adequate referencing to establish a clear link with supporting documentation.

- **The basis for the management of safety for people, plant and procedures** by addressing: management and staffing levels; training requirements; maintenance requirements; operating and maintenance instructions, rules and contingency and emergency instructions.

Safety Case Evolution

14.10 A safety case evolves as a plant or activity moves from one phase of its lifecycle to another. It is updated or amended to take into account changing circumstances. This can include: consideration of developments in safety standards; changes in engineering approach; commissioning or operational experience feedback; and the implications of modifications and non-conformances arising from work in the previous phase. It is important that the safety significance of these aspects is examined and that the safety case is updated, as appropriate, to reflect the current situation.

14.11 If changes are not properly managed to ensure the safety case does accurately reflect the as-built, as commissioned or as operated plant, there can be safety implications. Thus the documentation which forms the safety case is subject to appropriate quality assurance procedures discussed under Article 13 and changes to the safety case are regulated as modifications.

14.12 Supplementary documents may also be used to justify an activity at a point in time. For example, a method statement may be prepared to demonstrate that the integrity of plant will be maintained and quality ensured during installation work. Similarly, a temporary plant modification may require definition to justify operations that are necessary, but outside the normal operating envelope described by existing rules and instructions.

14.13 The principal stages in the lifecycle of nuclear installation, the associated safety reports, and their main purpose are shown in Table 2. Tables 3 to 6 give examples of the purpose, use and content of safety cases at these stages. Many features are repeated from report to report. However, the extent to which they are addressed in a particular report may be different. For example, a more detailed description of a plant and its location may be provided in a Pre-Operational Safety Report rather than for a Pre-Construction Safety Report.

14.14 Additional stages may sometimes be included within a particular phase. For example, construction may be sub-divided into stages such as laying foundations, building and civil works, mechanical plant installation and electrical and control and instrumentation installation. In these circumstances the safety case justifies the path proposed, taking into account the constraints imposed on subsequent stages by the requirements of an earlier stage. It is important that the safety case for the plant for one phase or stage is complete to ensure that the case has been made to proceed to the next and difficult issues are not being ignored.

14.15 Changes in the purpose and use of a safety case at each stage can involve changes in those responsible for preparing it. At the design stage, a design team who eventually hands over responsibility to the operator may develop the safety case. In these circumstances, QA documentation is required to address these issues in response to LC 17. This documentation defines how information will be transferred, demonstrates that there are mechanisms in place to ensure that responsibilities are clear, and ensures that the case is fully adopted and implemented.

Modifications to the safety case

14.16 Modifications to either the design intent of a new plant or the upgrading of facilities in an old plant represent a change that affects the validity of the existing safety case. Other modifications that could have an implication for safety will also prompt a re-examination of the safety case. They include: transitory operations (perhaps the replacement of an item of plant that could lead to short term radiological hazards); changes to operations which require minor reinterpretation; ~~or~~ a major change to the way the plant is operated which may require the case to be completely rewritten; or end-of-life defuelling.

14.17 In all these situations, consideration of safety must be full and complete, including any necessary amendment of rules, instructions, plant procedures and training requirements to be undertaken prior to instituting the proposed change. Consideration of such changes is an essential element in the justification of the proposed modification. In order to maintain the integrity and consistency of the safety case during this period, it is important that methodologies and standards used widely within the safety case continue to be adopted. This will allow, for example, the meaningful consideration of risk.

Reviews required by Licence Conditions

14.18 The licensee carries out reviews and re-assessments associated with the periodic shutdowns required by LC 15 and LC 30. Each review will cover the operating period since the previous review and will anticipate changes at the nuclear installation up to the next similar review.

14.19 The topics covered by each type of review include such aspects as:

i) operating experience
ii) maintenance, inspection and test results for reactor and auxiliary safety related equipment
iii) modifications affecting safety of the plant
iv) fuel route history
v) the history of incidents and abnormal events
vi) radiation doses to people on site

vii) the accumulation and monitoring of radioactive waste
viii) discharge of radioactivity and radiation and contamination levels in and around the plant
ix) plant structural changes due to operation and ageing
x) the management of safety at the plant.

Outage Reviews

14.20 Outage Reviews take place every 2 or 3 years for each reactor. They are directed mainly towards demonstrating that adequate safety margins exist for the next period of operation within current safety standards. At this point, confirmation is given to HSE by the licensees that the nuclear installation and procedures are still in accordance with the safety case and that future operations are therefore justified by the current safety case. HSE's Consent to restart the reactor takes account of the findings of the outage review.

14.21 In years where there is no requirement for an outage, a meeting is held by HSE at the nuclear licensed site to review the plant and safety case status to maintain a regular overview of the position.

Periodic Safety Reviews (PSRs)

14.22 PSRs were discussed under paragraphs 6.18 to 6.30 ~~26~~. They are retrospective (learning from experience) and prospective, in reviewing the impact of changes in safety standards, expected lifetimes, uses, requirements, interaction with other plant and possible contingency measures which may be required. The PSRs are designed to ensure that a thorough and comprehensive review is made of the safety case at regular intervals throughout a nuclear installation's life. The reviews have become a well-established feature in the licensing requirements for nuclear installations, and are intended to be more wide ranging than a restatement of the safety case. The objectives of the PSRs are:

i) to review the total current safety case for the nuclear installation and confirm that it is adequate;
ii) to compare the safety case with modern standards, evaluate any deficiencies and implement any reasonably practicable improvements to enhance plant safety;
iii) to identify any ageing process which may limit the life of the installation;
iv) to revalidate the safety case until the next PSR, subject to the outcome of routine regulation.

14.23 In reviewing the total current safety case, the licensee reaffirms the validity of the original safety case, reflecting on factors such as:

{ the original safety standards to which the plant was built;

{ the various engineering improvements introduced during the operational lifetime which have enhanced safety;

{ the numerous safety assessments undertaken during the installations life.

14.24 Although the PSR may conclude that the safety case is adequate for another ten years, this will be dependent upon the continuing satisfactory results from routine inspections. Should any safety-related factor emerge in the interim period that might throw doubt upon the continuing validity of the safety case, HSE would require the licensee to resolve the issue to HSE's satisfaction.

Summary of generic results

14.25 In all the PSRs reported to date, the HSE has concluded, after its assessment of the licensee's review of the existing safety case that the licensee has:

{ identified and is implementing reasonably practicable improvements to plant and procedures;

{ carried out a systematic review of age-related degradation phenomena;

{ ensured that suitable monitoring and surveillance schemes are in place.

14.26 In reaching these conclusions, the HSE recognises that it is difficult to make long term (that is, 10 year) predictions in some areas and these will therefore be subject to a programme of regular reviews throughout future operation. Similarly, further work has been identified in the PSRs that will enhance the current safety justification, which is additional to the plant and procedural improvements, and will continue the programme agreed between HSE and the licensee. HSE's agreement to continued operation is subject to satisfactory completion of this follow-up programme as well as demonstration of continuing satisfactory results for the regular test and inspection programmes that underpin the normal regulatory controls.

14.27 Specific areas where further work was identified included:

- steel Reactor Pressure Vessel structural analysis;
- additional seismic hazard analysis;
- additional fire hazard analysis;
- probabilistic safety analysis and human factors analysis;
- graphite core properties;
- reheat cracking of stainless steel steam pipework;
- consolidation of fuel handling safety case;
- radioactive waste safety cases; and
- control and instrumentation (including the Millennium Bug).

The list indicates the types of work identified from the findings of all the PSRs. The work varied between the nuclear installations.

Verification programmes undertaken by licensees

14.28 All licensees categorise safety cases and proposals to modify the safety cases, to ensure that the degree of assessment and verification and the clearance route (through independent peer review and a nuclear safety committee) are commensurate with the safety significance.

Proposals to change the safety case for a plant are managed by the same process as proposals to modify the plant physically.

14.29 Typically these require (at the highest level of safety significance) a proposal to be:

{ verified in depth by suitable qualified and experienced persons who have not been involved in preparing the proposal (but may be from the same organisation or working group);

{ assessed as satisfactory as to category and content through an independent nuclear safety assessment by, or to the standards established by, the licensee's health and safety function;

{ considered by the nuclear safety committee (required by LC 13) which includes suitably qualified and experienced persons from outside the licensee's organisation, with the licensee taking due notice of the advice given by the committee;

{ formally agreed by HSE.

14.30 At the lowest level of safety significance, the Station manager can authorise and implement the proposal but must have sufficient documentary evidence to justify the category allocated and this evidence is available to HSE inspectors.

Preventive maintenance

14.31 Maintenance activities compensate for time-dependent deterioration and maintain the plant in a condition that meets design safety assumptions and optimum commercial output. Preparation of the overall nuclear installation maintenance and testing programme requires consideration of the nuclear safety case; requirements of safety legislation (such as the regulations for safe operation of pressure vessels); requirements of the insurers of plant items; and the recommendations of the manufacturers of the equipment. The programme defines (within the work control system) the activities, who is responsible for their specification and implementation and the intervals between maintenance activities.

14.32 That part of the programme that is related to meeting the nuclear safety case, and in respect of plant integrity and reliability, is called the Plant Maintenance Schedule, prepared in accordance with the requirements of LC 28. The categories normally used to place items on the Plant Maintenance Schedule are:

1. support of safety arguments where component failure results directly in a beyond design basis accident or inability to achieve safe reactor shut down;
2. support of safety arguments where component failure could result in a consequential failure as defined in 1.;
3. routine performance tests to generate data supporting safety case assumptions;
4. maintenance or replacement of safety related items to sustain reliability claims in the safety case;
5. regular surveillance of plant operation and condition for unforeseen events.

14.33 In the design phase, diverse and redundant systems and plant are provided to ensure that safety-related systems meet the safety performance criteria, making due allowance for ac-

tive and passive failures and realistic maintenance requirements. These include issues such as the time taken to perform preventive maintenance and the time taken to correct defects. A key operational issue is that additional plant surveillance and operational constraints are imposed when an 'urgent maintenance state' arises due to limited plant availability (for testing, preventive maintenance or as the result of plant defects).

14.34 The testing, maintenance and inspection strategy ensures that the plant is kept in accord with overall requirements for the design. The safety objectives of the strategy are to ensure:

1. the integrity of all safety related plant to meet plant operating conditions;
2. sufficient safety related plant is always available to meet the safety case;
3. the reliability of plant remains within safety case assumptions;
4. plant operation within safety case assumptions can be demonstrated.

14.35 Testing, maintenance and inspection complement one another as:

Testing ensures that the plant that is required to perform a safety-related function is capable of carrying out that function. It is particularly important as a routine activity when applied to plant that is not normally running or after maintenance work has been carried out.

Maintenance is carried out to restore plant to its design condition. It may arise as a result of:

{ testing which has revealed a failed or failing state;

{ engineering judgement that a time or running-hours dependent failure mode exists where testing is inappropriate;

{ failure in service.

Inspection is carried out to check the integrity of plant by visual, non-destructive or destructive examinations.

14.36 Preventive maintenance covers testing and re-calibration of instrumentation systems, overhaul of items in situ and the replacement by new or serviced items and components at outages. The results of testing and maintenance of safety-related items and components are reviewed by persons who are aware of the safety case assumptions and preserved in a plant history. This data enables reviews of the appropriateness of the intervals and activities to be undertaken to optimise maintenance work to minimise interference with the plant, operator radiation dose and cost.

In-Service Inspection (ISI)

14.37 In-service Inspection is normally carried out when plant is shut down but consideration of accessibility, cost, operator dose and time to complete the cycle of testing may lead to the development of on-load techniques. Some of the types of inspection carried out on reactor plant are:

{ inspection of pressure-retaining mechanical components against the requirements of design codes involving visual, surface and volumetric non-destructive examinations;

{ inspection of components whose failure has been deemed to be incredible in the safety analysis. These inspections use the same techniques as above and the results are generally linked to specific structural integrity analysis to confirm that the plant is fit for continued operation;

{ destructive examination of components and samples. As part of the design, sufficient redundancy may have been introduced into the plant to allow the withdrawal of components for destructive examination, for example, the stressing tendons within a pre-stressed concrete pressure vessel. A proportion of nuclear fuel is subjected to post irradiation examination to confirm design assumptions and support safety cases for increased irradiation. The designer will also introduce material samples that can be withdrawn and analysed for data on degradation mechanisms, such as neutron embrittlement of steel and graphite core weight loss due to oxidation by the carbon dioxide coolant.

14.38 The interval between in-service inspections is often linked to the operational period between statutory shutdowns of the reactors. For reactors with pressurised or on-load refuelling, the inspection and maintenance requirements will determine the operating period. For the PWR, the refuelling cycle determines the period of operation at power.

Ageing process evaluation

14.39 As noted above, the inspection requirements from the safety case will include those plant deteriorations of which the designer is aware, such as instrumentation drift, fatigue failure and bearing wear and longer term mechanisms such as embrittlement and graphite oxidation which may be termed ageing processes. However, potential failure or wear mechanisms may exist outside the designers' knowledge and the later in the design life of an installation, the more probable that such unexpected phenomena will become apparent as a result of the maintenance, testing and inspection part of the Plant Maintenance Schedule. For this reason, the importance of the Maintenance Schedule, and the necessary research, analysis and assessment to support continued operation increases with the age of the plant.

14.40 The graphite reactor cores and elements of the associated steel support structures are examples of components susceptible to changes induced by ageing mechanisms in gas-cooled reactors (for example, by oxidation, corrosion and erosion) and which cannot be renewed should they become affected to an unacceptable degree. Monitoring, inspection testing and regular safety assessment of these components are consequently of great importance in demonstrating their fitness for purpose. Examples of the reactor internal ageing process evaluation are:

Graphite Core Oxidation - graphite specimens ~~were tested in experimental reactors and installed in reactors prior to operation at power. These can be withdrawn at intervals for analysis. In addition, further specimens can be taken from the graphite core during shutdowns and channel flux shape can be measured with the reactor at power.~~ were originally irradiated in Materials Test Reactors (MTR) to determine the change in material properties with neutron irradiation and the degree of weight loss from radiolytic oxidation. Pre-characterised samples installed in the power reactors prior to operation, and specimens taken from the graphite core, can be removed during shutdowns. These are analysed to determine if the graphite is behaving as predicted from the MTR data and theoretical models. Selected graphite brick bore shapes and whole channel bowing are also measured during shutdown.

Steel Structures - steel is subject to embrittlement from neutron irradiation, oxidation, fatigue, fretting and creep. Where the design does not allow for access to carry out remote visual or non-destructive inspections, predictive analysis and limited inspections are used to confirm that this mechanism is not life limiting. The nearer a reactor gets to, or goes beyond, its original design life, more rigorous and extensive examinations and inspections are necessary to provide this assurance before the reactor is returned to power.

14.41 Other ageing processes that have been recognised and are the subject of specific plant programmes or routine inspections relate to civil engineering structures, electrical cabling insulation and specific components and mechanisms.

Regulatory validation activities

14.42 HSE's nuclear installations inspectors check that appropriate standards are developed, achieved and maintained by the licensees. HSE also takes the following actions:

- it confirms that licensees establish, manage and maintain safety requirements for the protection of employees and members of the public;
- it assesses the safety of proposed and existing sites and nuclear installation designs; and
- it inspects nuclear installations for compliance with these requirements at all stages from construction to operation and eventual decommissioning.

14.43 In the course of its nuclear regulatory work HSE scrutinises the activities of licensees both at their licensed nuclear sites and through assessment of the licensees' written safety submissions. Inspectors examine the licensees' safety cases to satisfy themselves that the safety claims of the licensees are justified or demonstrated. For site inspections HSE uses the safety case to help prepare inspections and to determine parameters and values against which to judge the safety of plants. Both general and specific targeted inspections are undertaken.

Assessment

14.44 HSE's NSD has staff with a wide range of nuclear installation expertise, the majority of whom have direct experience of working in the nuclear industry. Assessment of safety cases is

undertaken by nuclear installations inspectors, with the necessary technical specialism, sampling the key aspects of a safety case using the SAPs {Ref. 7 ~~2~~} as the standard against which to judge them. The technical expertise of the staff is used to select the issues to be pursued in depth. HSE's nuclear project or site inspectors bring together and integrate the findings from assessment of the different technical areas, and provide an overview of a safety case.

14.45 Extensive discussion between the different technical assessors and their project or site colleagues, together with face to face discussion with the technical experts of the licensee, is used to clarify and test the claims made in the cases. The overall judgement of acceptability is based on the full range of assessment advice. The assessors make recommendations, if appropriate, on where safety can be improved. These recommendations are discussed with the licensee and a programme to implement improvements is usually agreed. If agreement cannot be reached with the licensee, and the issue is considered to be of sufficient importance by HSE, enforcement action to achieve compliance can be undertaken, using the powers discussed in Annex 2.

14.46 The contents of safety cases may vary due to differences in design between different nuclear installations, but HSE looks for certain characteristics in the licensees' safety case submissions. They are:

Completeness:	All significant threats to safety must be identified and the plant must incorporate adequate protection against these. Any additional risks from threats to safety, foreseen but not specifically analysed or protected against must be shown to be negligible.
Clarity:	There must be a logical presentation of the plant, system and processes and the safety justification that applies, with clear referencing of supporting information and clear identification of conclusions and recommendations.
Objectivity:	The claims in the safety case must be supported as far as reasonably practicable with factual evidence. The necessary understanding of the behaviour of novel systems or processes should be established from appropriate research and development.
Correctness:	Methods and codes used to demonstrate safety must be fit for purpose.

14.47 If a safety issue is judged to be of sufficient importance then HSE will commission parallel analyses and research to allow additional input into the regulatory judgement process. In addition, if insufficient in-house expertise is available to validate a key safety case claim or if additional views are required, HSE uses external recognised independent experts in the appropriate technical field to help to inform its judgement.

14.48 HSE's SAPs {Ref. 7 ~~2~~} (see Annex 8) form a framework that is used as a reference for technical judgements on the adequacy of licensees' safety cases. They also assist HSE in applying a consistent and uniform approach to its assessment process. In carrying out an assessment, the HSE assessors judge the extent to which the safety submission shows that the design of the plant is in conformity with the relevant SAPs, noting that not all of the principles are applicable to every licensed site. Some of the SAPs embody specific statutory limits.

Apart from these, the SAPs should be met, so far as is reasonably practicable, which is a requirement of the HSW Act. There can, therefore, only be a rigid interpretation of the principles that reflect statutory limits.

14.49 The SAPs are aimed primarily at the safety assessment of proposed (new) nuclear plants. They are also used in assessing existing plants. In this case the SAPs are augmented by LCs which require arrangements to be made, procedures written, etc. that take some of the requirements of the SAPs into a form more appropriate to an existing plant.

14.50 For the assessment of existing plants, there is a further point to be considered: the safety standards used in their design and construction may differ from those used in plants designed and built more recently. The existence of such differences is recognised by HSE's nuclear installations inspectors when applying the SAPs in the assessment of modifications to old plants. The ALARP principle is of particular importance to such assessments, and the age of the nuclear installation and its projected life are important factors taken into account when making regulatory judgements on the reasonable practicability of making improvements.

14.51 To judge the adequacy of the safety case HSE uses both quantitative comparisons of the safety case numerical elements against criteria, and non-quantitative judgement. PSA is part of a methodical accident analysis process that produces numerical estimates of the risk from the plant. It provides a comprehensive logical analysis of the potential for things to go wrong on the plant and the role played by the safety provisions. PSA enables weaknesses in the design to be identified, anticipated and remedied at an early stage. In addition, it can be used to reconcile the calculated risks against the licensee's criteria and against the relevant SAPs. It provides evidence that confirms the plant is balanced, that is, that no particular class of accident or feature of the plant makes a disproportionate contribution to the overall risk.

14.52 The majority of the SAPs are engineering (or deterministic) principles. In creating a design there are many choices to be made. Each choice involves to a greater or lesser extent the use of judgement in technical, scientific or commercial issues. Not all of these judgements are concerned directly with safety, but most will influence its achievement. The deterministic SAPs provide inspectors with guidance on what to look for when judging the ALARP arguments in a safety case. They represent HSE's view of good nuclear engineering practice. They point to the provisions that in HSE's view would lead to a safe plant. PSA acts as a cross-check on the level of safety ~~achieved~~provision, so that the PSA and deterministic SAPs are complementary.

Inspection

14.53 HSE carries out planned inspections of nuclear licensed sites to monitor licensees' compliance with the LCs and the general requirements of the HSW Act. An inspector is allocated to the nuclear installation site from the start of construction. This means that frequent inspections and discussions take place, key tests are witnessed and the test reports are checked. In addition, the specialist nuclear installation inspectors who assess the safety case often visit the site and key manufacturers' works. They use their expertise to monitor the construction of components important to safety and witness quality assurance procedures.

14.54 Once the reactor is operational, the nuclear site inspectors spend about 30% of their time on their site. In particular they check that the licensee is meeting the licence conditions.

Other nuclear installation inspectors who carry out specialist assessments or inspections as necessary support the site inspector. Safety audits or team inspections are also carried out at nuclear installations on an aspect of their safety. For such actions, a multi-disciplinary group of inspectors will visit the site. They make their findings known to the operator, so that improvements are made, where appropriate.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 14

Q14.1 Have probabilistic safety analyses been performed for the individual nuclear power plants?

PSAs have been carried out for all operating nuclear power plants. These were carried out as part of the Periodic Safety Reviews for the gas cooled reactors (Magnox and AGR). For the pressurised water reactor at Sizewell B, PSA was used as part of the design process.

Q14.2 The flexibility of UK regulations is larger when compared to other practices and thus there is a lower level of detail of technical standards and guides. Does this fact represent a larger effort for the regulator and the potential for different interpretations of the regulations for specific licensees?

The basis of the UK regulatory system is the site licence and the conditions attached thereto. Licence Conditions set safety goals but do not tell the licensee how these are to be achieved. In many cases, licence conditions require the licensees to "make and implement" arrangements to achieve a specific goal. HSE can at anytime require these arrangements to be amended or improved - in fact the regulator has the ultimate veto regarding the adequacy of the arrangements. The philosophy behind this system is that the licensees have "ownership" of their own safety management systems and that they become an integral part of the overall management regime. It should be noted that it is mandatory for the licensees to comply with their own arrangements. Potentially this system could lead to the licensees developing different ways of achieving the same objective. This could of course mean that the regulator may need to examine a range of differing arrangements. However, the resources needed to do this are more than compensated for by the fact that the licensees carry out the work to develop the arrangements.

Q14.3 Is there a systematic programme, agreed with the HSE, for the management of ageing and plant life extension?

Yes, the licensees as an integral part of the PSR process manage ageing and plant life extension. As indicated in para 6.14 the identification of ageing and life limiting phenomena are one of the main aims of these reviews. HSE concluded that some degradation processes will require more regular reviews than that afforded by the ten year PSR periodicity. The Licensees have established generic arrangements to undertake this important work at all installations and the outcome is taken into consideration by HSE when making regulatory decisions such as issuing a Consent for a reactor to return to routine operation after its statutory shutdown.

As an example, for the Magnox steel Reactor Pressure Vessel (RPV) stations, following the closure of Trawsfynydd Power Station, the Licensee developed a strategy to sustain the safety cases for the primary circuit, including the RPV. The key objective is management of ageing and plant life extension. The strategy is underpinned by a detailed work programme, which is updated annually, and discussed with HSE at frequent meetings to review progress. Whilst we have not formally agreed the work programme we influence the work and key safety issues to

be addressed through the regulatory process. For the RPVs, in response to the LTSR and PSRs, the safety case is updated each year to take account of new data and ageing processes. An example of the work being undertaken by Magnox Electric is the sampling and testing of material removed from the RPVs at Trawsfynydd which is being used to underpin irradiated materials properties.

Oxidation of some steel components is a safety concern for the Magnox reactors. In this area long-term safety cases were developed by the Licensee based on knowledge of ageing effects. Inspections are carried out at each statutory outage to underpin the safety case.

In addition to the Licensee's directly funded programme of work, research is undertaken under the auspices of the Health and Safety Commission co-ordinated nuclear safety research programme. Applicable areas of research are plant life management of steel components and graphite cores. The HSE, and the industry, contribute to the identification of research issues and an extensive research programme is funded each year to investigate ageing and safety issues for plant life extension. (Note: this also responds to Q18.1)

Q14.4 The report states (page 55) that "Should any safety related factor emerge in the interim period .....HSE would require the licensee to resolve the issue to HSE's satisfaction." Please explain some issues which resulted in design change or operational change.

The modern international practice of 10 yearly intervals between PSRs is now well established in the UK. The normal regulatory process remains in place at all times and indeed during the "interim period" there have been occasions when significant safety related factors have emerged, both technical and organisational, which did not form part of the PSR considerations. Some of these are related to structural integrity issues like the re-heat cracking of AGR boiler components. As a result of the discovery of these cracks additional engineered restraints have been installed at a few installations; extra ISI has been instigated and operating temperatures and pressures adjusted. Research has also been undertaken by the licensee to more fully understand the cracking mechanism. Another example of a significant issue was that of the amount of changes being made to the organisation and management systems of the licensees as a result of deregulation and privatisation and the potential effect this could have on safety. HSE carried out a number of audits of the proposals to ensure that the licensees have robust management of change arrangements in place. The effect on safety of de-manning and contractorisation are uppermost in the mind of HSE and the licensees must provide adequate justification that safety will not be compromised.

ARTICLE 15 - RADIATION PROTECTION

Text of Article 15:

'Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.'

This section of the report covers:

- **a summary of laws, regulations and requirements (paragraphs 15.1 to 15.7);**
- **implementation measures (paragraphs 15.8 to 15.20);**
- **regulatory activities (paragraphs 15.21 to 15.27).**

Summary of laws, regulations and requirements

15.1 Under the HSW Act {Ref. 22 ~~14~~} there are specific regulations for the radiological protection of persons against ionising radiations arising from work activities. These are the Ionising Radiations Regulations ~~1985~~ 1999 (~~IRR85~~ IRR99) {Ref. 3} and they arise from the European Council Directive ~~80/836~~ 96/29/Euratom {Ref. 29} ~~(as amended by 84/467 Euratom)~~ laying down the basic safety standards for the health protection of the general public and workers against the dangers of ionising radiations. This Directive replaced Directives 80/836 and 84/467 Euratom on which the previous Ionising Radiations Regulations 1985 were based. ~~IRR85~~ IRR99 implement most of the provisions of ~~this~~ Directive 96/29/Euratom, in as far as they relate to those working on nuclear installations. Dose limitation under ~~IRR 85~~ IRR99 is based on the restriction of exposure to ionising radiation, so far as reasonably practicable (usually referred to as the ALARP principle in the UK, see paragraph 15.7), supported by dose limits for workers and for members of the public. An Approved Code of Practice (ACoP) and non-statutory guidance {Ref. 45} gives practical advice on the most appropriate methods of complying with the regulatory requirements.

15.2 The requirements of the Directive and of IRR99 are consistent with the recommendations of the International Commission on Radiological Protection (ICRP). ICRP recommendations, while not mandatory, are highly influential internationally. In accordance with its statutory role under the Radiological Protection Act 1970, the National Radiological Protection Board (NRPB) advises the UK Government on the acceptability of those recommendations. Following reappraisal during the 1980s of radiation doses and health effects, ICRP recognised that the risks of exposure to ionising radiation were greater than had previously been thought. ICRP published new general recommendations in 1991, known as ICRP 60 {Ref. 46}, which updated the standards in ICRP 26 of 1977 and further developed the conceptual framework. In particular, ICRP 60 draws a clear distinction between practices (activities that increase human exposure) and intervention (actions taken to decrease human exposure in an actual situation). Practices cover the normal activities associated with the use of radiation sources, such as power generation. The most obvious example of intervention is in actions taken to protect the public during and following a nuclear emergency (discussed further under Article 16). The principles applying to practices, where controls can be exercised over the exposure situation, are different from those applying to intervention. In the latter case, a balance

has to be struck between risks arising from the existing exposure situation and the risks involved in intervention measures taken to reduce that exposure.

15.3 In 1993 the European Commission published proposals for a revised Basic Safety Standards Directive to reflect the latest recommendations of the ICRP (ICRP 60). The revised Directive 96/29/Euratom {Ref. 29} was adopted on 13 May 1996 and gave Member States four years for implementation through domestic legislation. In the UK, again in so far as it relates to those working on nuclear installations, implementation ~~will be~~ has been achieved mainly through ~~revised~~ the IRR99, which came into force on 1 January 2000.

15.4 A separate European Community development, in response to concern about exposure of itinerant workers to radiations, was the adoption by Member States in December 1990 of the Outside Workers Directive, 90/641/Euratom. This was implemented in the UK by free standing regulations made under the HSW Act and the European Communities Act 1972, namely the Ionising Radiations (Outside Workers) Regulations 1993. These provisions, simplified in the light of operational experience, have been subsumed into IRR99.

15.5 The 'Outside Workers' Directive, and thus the UK implementing Regulations, aim to ensure that workers classified for radiation work who go to work in controlled areas of another employer receive the same level of protection as the workers on the site that they are visiting. Thus the outside worker's employer and the site operator must exchange information about the work to be done before the worker arrives, so that the worker can be suitably experienced and properly trained. The employer must also provide the outside worker with a radiation passbook, which contains the worker's medical classification and assessed dose information. The site operator should check this radiation passbook when the outside worker arrives on the site. The site operator must then ensure that an estimate of the dose received on that site is made and that the estimate is entered in the passbook as soon as reasonably practicable after the job is finished. These procedures mean that the outside worker's employer can keep a running check on the doses the worker is receiving without having to wait for the end of an assessment period or for a dosemeter to be analysed and can take action quickly if unexpected doses are received. It also allows site operators to check that the work will not expose the outside worker to an unacceptable cumulative dose.

15.6 The Directive applies within the European Union and so the 'Outside Workers' provisions of IRR99 therefore require an employer to continue to assess the worker's dose while the worker is carrying out work in other Member States.

ALARP and ALARA

15.7 The duty to take action to reduce risks, "as low as reasonably practicable" (the ALARP principle) is fundamental to all UK health and safety legislation. The principle requires any nuclear site operator to follow relevant good practice. Where relevant good practice in particular cases is not clearly established the operator has to assess the significance of the risks (both their extent and likelihood) to determine what action needs to be taken. Some irreducible risks may be so serious that they cannot be permitted. At the other extreme, some risks may be so trivial that it is not worth spending more to reduce them. In general, risk-reducing measures should be weighed against the associated costs (in time, trouble and money). The licensee must take the measures unless the costs of taking particular actions are clearly excessive compared with the benefit of the risk reduction. The widely used ICRP con-

cept ALARA (as low as reasonably achievable, economic and social factors being taken into consideration) is equivalent to ALARP, but does not have the legal precedent in the UK, which has been established in the ALARP case.

Implementation

ALARA steps

15.8 The licensees use the following criteria in ensuring that nuclear installations are operated safely:

- all reasonably practicable steps are taken to ensure safe plant operation and to prevent accidents and risks to health at work;
- all reasonably practicable steps are taken to minimise the consequences of any accident involving radiological consequences;
- no person shall receive doses of ionising radiation in excess of the statutory dose limits as a result of normal operation;
- the exposure of any person to radiation and the collective effective dose to staff and the general public, is kept as low as is reasonably practicable;
- all activities which may affect safety, including those undertaken by contractors, are carried out by, and under the control and supervision of, suitably qualified and experienced persons within an effective management system.

Dose Limitation

15.9 IRR99 lay down dose limits for persons engaged in work with ionising radiation. For adult employees the dose limit for whole body exposure is currently ~~50~~ 20 millisieverts (mSv) per year. In practice, all doses recorded for employees at nuclear installations are well below dose limits for normal operations. IRR99 also allow for dose limitation for an individual worker in specified circumstances to be based on a dose of 100 mSv averaged over a period of five consecutive calendar years, with a maximum of 50 mSv in any one year, but only if the licensee can demonstrate to HSE's satisfaction that an annual limit of 20 mSv is impracticable for that person.

15.10 Notwithstanding dose limits, the employer who is responsible for the work must restrict exposure so far as is reasonably practicable. The employer is obliged to restrict exposure by means of engineering controls such as shielding, physical separation, containment, ventilation and warning devices where these are reasonably practicable, rather than relying solely on systems of work or personal protective equipment. At nuclear installations, whether or not the work is undertaken by licensees' employees, the licensees are responsible for controlling work and ensuring doses to individuals are ALARP.

15.11 The ACoP {Ref. 45} supporting IRR99 gives practical guidance on the most appropriate methods of complying with the regulatory requirements. HSE has also published advice on establishing management procedures to restrict exposure {Ref. 50}. It is still available but

needs updating and may be replaced by ALARP case studies, as plenty of general advice has been published on ALARP, particularly the management aspects since its publication.

15.12 An employer who makes local rules for work with ionising radiations is required to appoint radiation protection supervisors (RPS) for the purposes of securing compliance with IRR99. However, the legal responsibility for ensuring compliance remains with the employer and cannot be delegated to the RPS. In most cases the employer is also required to consult and appoint a radiation protection adviser (RPA) under IRR99 to provide expert advice on measures to restrict exposure and related matters. The HSE has published a statement on RPAs setting out criteria of basic core competences required by individuals and bodies intending to give advice as RPAs. The employer then needs to select suitable RPAs who have experience that is appropriate to the employer's business.

Investigations

15.13 If an employee has a recorded whole-body dose greater than 15 mSv (or a lower level established by the employer) for the year the employer must carry out an investigation (under IRR99 regulation 8), usually in conjunction with the RPA. The purpose of this investigation is to establish whether or not sufficient is being done to restrict exposure so far as is reasonably practicable.

~~15.14 In 1991 a fourth part to the ACoP {Ref. 44} was published in response to new evidence that the risks from exposure to ionising radiation were two or three times as great as previously thought. It introduced an investigation (centred on the past and future work of the individual) which is triggered if an employee has a recorded dose of 75 mSv or more in any period of five calendar years starting from 1 January 1988.~~

15.14 IRR99 regulation 25 requires HSE to be informed if an exposure in excess of a dose limit occurs or is suspected, whether this arises from a single incident or through an accumulated dose. The employer undertaking work with ionising radiation must carry out a thorough investigation.

15.15 Similarly, regulation 30 requires incidents like accidental spillage of radioactive substances to be investigated. LC 34 requires the leakage or escape of radioactive material or radioactive waste to be notified, recorded, investigated and reported in accordance with LC 7 arrangements.

Dose monitoring and record keeping

15.16 If an employee is likely to receive a radiation dose greater than three-tenths of a relevant dose limit in a year (6 mSv in the case of whole-body exposure) the employer has to designate that employee as a classified person. The employer then has to arrange for any significant doses (internal or external) received by that person to be assessed by a dosimetry service approved by HSE for the measurement and assessment of doses for the relevant type of radiation. Such services are referred to as Approved Dosimetry Services (ADS) (assessment). HSE also approves dosimetry services to co-ordinate individual doses received from different ADS (assessment) and to produce and maintain dose records for classified persons. These services are referred to as ADS (records).

15.17 To help the employer assess the effectiveness of the dose control measures, the ADS (records) provide a written summary of the doses recorded for each classified employee at least once every three months. Many ADS (records) provide monthly dose summaries. By the end of March each year the ADS must also send HSE summaries of all recorded doses relating to classified persons for the previous year.

15.18 Reflecting concern expressed at the Public Inquiry {Ref. 34} into the construction of Sizewell B, an additional licence condition (LC 18) was attached to all nuclear site licences requiring licensees to monitor the average effective dose equivalent and notify the HSE if this figure exceeds the level specified by the HSE (currently 5mSv) for any specified class of persons. The classes of persons enable differentiation between the dose received by employees and contractors and by classified and non-classified persons.

Central Index of Dose Information

15.19 On 1 January 1987, HSE established a computerised Central Index of Dose Information (CIDI) in order to receive and process these annual dose summaries. All dose summaries and personal data provided to HSE by ADS (records) under IRR99 (or previously under IRR85) are treated as confidential. Various safeguards protect the computer files and the information presented in published reports maintains that confidentiality.

15.20 One of the purposes of CIDI is to generate statistical information from the dose summaries provided to HSE by ADS (records). Detailed information relating to annual dose statistics has been published for each year from 1986 to 1999. In 1998, HSE published an analysis of the statistics for annual whole-body doses reported for classified persons in the UK during the period 1990 to 1996 {Ref. 47}. This report includes information on classified persons involved in nuclear reactor operations or maintenance. Table 7 shows trends in occupational doses over the 1986 to 1999 period for such workers. Whole-body doses given comprise the sum of effective dose equivalent (from external exposure to ionising radiation) and, where assessed, committed effective dose equivalent (from exposure to radionuclides in the body). Data are presented on collective dose, mean doses and numbers of persons who had a reported dose in excess of 5 mSv, 10 mSv, 15 mSv or 20 mSv a year.

Regulatory Activities

15.21 The provisions of IRR99 at nuclear installations are enforced through inspection by HSE's nuclear installations inspectors. The regulatory control over exposures to the public resulting from discharges of radioactive materials into the environment is a matter for the Environment Agency (England and Wales) and for the Scottish Environment Protection Agency (Scotland) who enforce the conditions attached to waste disposal authorisations issued by them under RSA 93 {Ref. 26}, (see also 15.26 below).

Licensing requirements

15.22 In addition to the application of IRR99, the regulation of radiological hazards is also achieved through the licensing regime in place in the UK. Under LC 14 on safety documentation the licensee is required to submit to HSE written safety cases demonstrating that safety will be maintained during design through to the decommissioning of the installation.

15.23 The adequacy of the licensee's safety submissions is assessed by HSE against its SAPs (see Annex 8 on fundamental principles, and Basic Safety Limits and Basic Safety Objectives). The principles relating to radiological protection are consistent with the latest recommendations of the ICRP (ICRP publication 60) {Ref. 46} and ensure that the licensee makes a strenuous pursuit of the objective to keep exposures ALARP.

15.24 Owing to the nature of the radiological hazard presented by large nuclear installations there is, additional to the provisions of IRR99, the requirement for licensees to make and implement adequate arrangements for the assessment of the average effective dose equivalent (including any committed effective dose equivalent) to specified classes of person (LC 18 on radiological protection). Again, enforcement of this requirement is carried out by the HSE.

Co-operation between other regulatory bodies

15.25 The joint responsibility for regulating doses to the public (paragraph 15.21) requires close co-operation between the HSE and the environment agencies. Memoranda of Understanding are in place to ensure that regulatory activities are consistent, co-ordinated and comprehensive.

Radioactive Waste Disposal Authorisations under RSA 93

15.26 Nuclear installations require disposal authorisations for discharge of radioactivity to the environment, burial, incineration or transfer of waste off-site. Authorisations:

{ specify the disposal routes to be used and place limits and ~~The limitations and~~ conditions on disposal. ~~in authorisation will address the control over the waste disposal routes,~~;
{ place a requirement to use ~~the~~ "best practicable means" (BPM) to ~~limit~~ minimise the volume and activity ~~amount~~ of radioactivity discharged to the environment and to minimise the radiological effects on the environment and on members of the public.~~,~~;
{ require sampling and analysis to determine compliance with authorisation conditions ~~of waste~~, reporting of ~~non-compliance, and~~ the quantities of radioactive waste disposed of ~~discharged~~, non-compliance with limits; and
{ may specify ~~on the radioactivity of individual and groups of radionuclides and as a option, requirements for~~ improvements in waste management arrangements.

The limits on radioactive discharges are set on the basis of the 'justified needs' of the licensees, i.e. they must make a case that the proposed limits are necessary to allow safe and continued ~~accommodate the~~ operation of the plant. In setting limits, the environment agencies use monitoring, discharge and plant performance data to ensure that the radiation exposure of the public as a consequence of the discharges would be less than the dose constraints and limits set by the UK Government. Currently these are:

- a source constraint of 0.3 mSv per annum for an individual nuclear installation which can be optimised as an integral whole in terms of radioactive waste disposals;
- a site constraint of 0.5 mSv per annum for a site comprising more than one source, e.g. where 2 or more nuclear installations are located together;

- a dose limit of 1.0 mSv per annum from all sources of man-made radioactivity including the effects of past discharges but excluding medical exposure.

Regulatory Environmental Radiological Surveillance

15.27 In addition to the requirements placed on operators to monitor environmental radioactivity around their sites, the environment agencies undertake their own independent monitoring programmes. Radioactivity in surface and ground water, radiation dose rates on beaches and public occupancy areas, radioactivity in sediments and environmental material etc. is sampled and analysed. The results of the monitoring are published annually. The Food Standards Agency is responsible for the safety of radiation levels in foods. The SEPA publishes the results of its monitoring programme {Ref. 49} in Scotland for radioactivity in food and the environment jointly with the Food Standards Agency. The EA publishes the results of its monitoring programme in England and Wales separately {Ref. 50}. Monitoring over the last three years has confirmed that, in terms of radioactive contamination, terrestrial foodstuffs and seafood produced in and around the UK are safe to eat. Exposure of consumers to artificially produced radioactivity via the food chain remained below the UK public dose limit of 1mSv for all artificial sources of radiation (except medical sources).

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 15

Q15.1 Which dose reductions have been achieved during the past ten years in the individual nuclear power plants?

The HSE Central Index of Dose Information (CIDI) receives annual summaries of radiation doses recorded for all employees designated as classified persons under UK regulations, including those employed in nuclear power plants. One of CIDI's functions is to generate statistical information, which is done on the basis of occupational categories rather than individual employers or sites. The summary of statistics is publicly available. The licensees collate information on individual installations. It is classified as confidential and thus not publicly available. However, over the last decade considerable dose reductions have been effected in UK installations. As a typical example of the improvements made at one of the oldest Magnox stations the mean annual dose in 1986 was 12.2 mSv and in 1998 was 4.7 mSv. The corresponding collective dose figures are 5.1 Sv and 1.55 Sv, respectively. [See also Table 7]

Q15.2 The information on the regulatory environmental radiological surveillance, on effluent release and on radioactive waste disposal is very limited. How is adequate co-ordination ensured between the different agencies involved?

Information on environmental radiological surveillance, effluent release and radioactive waste disposal is published annually in monitoring reports issued by the Environment Agency, and by Ministry of Agriculture, Fisheries and Food (MAFF) and Scottish Environment Protection Agency. A compilation of year on year discharges of radioactivity from the UK's nuclear installations, together with considerable other information on radioactive wastes and public radiation exposure is given in the annual Digest of Environmental Statistics which is published by the Department of the Environment, Transport and the Regions.

(REFERENCES. Radioactivity in Food and the Environment 1997, MAFF, SEPA, 1998; Radioactivity in the Environment, A summary and radiological assessment of the Environment Agency's Monitoring Programmes, Report for 1998 ~~7~~, Environment Agency~~, 1999~~; Digest of Environmental Statistics, No 20, Department of the Environment, Transport and the Regions, 1998). This information can also be found on these organisations' Internet sites at:

www.environment-agency.gov.uk , www.defra.gov.uk , www.sepa.org.uk .

The operators of the nuclear power stations also publish, annually, reports of their safety and environmental performance including details of their radioactive discharges and solid waste disposals (see, for example, www.british-energy.co.uk)

The Environment Agency and MAFF have agreed a Memorandum of Understanding (MoU) which aims to ensure, *inter alia* that information is exchanged on environmental monitoring, radiological assessments and compliance with standards of protection of the public. Regular meetings of the organisations involved help to prevent duplication of work. EA and SEPA also have MoU with HSE in relation to the regulatory co-ordination of the interface with licensed activities.

Please note that since the above reply was written, there has been a reorganisation of DETR and MAFF, so that the relevant Government department is now the Department for Environment, Food and Rural Affairs (DEFRA). In addition responsibility for food

safety has been moved to the Food Standards Agency, web site
www.foodstandards.gov.uk

Q15.3 Could the United Kingdom indicate the atmospheric (rare gas, aerosols, iodine) and liquid releases for each reactor (authorised limits and effective releases)?

This information is published annually in the Environment Agency and MAFF/Scottish Environment Protection Agency monitoring reports of radioactivity in food and the environment. The Department of the Environment, Transport and the Regions, in its annual Digest of Environmental Statistics, publishes a year on year compilation of radioactive discharges from UK nuclear installations. (Also see response to Q15.2)

Please note the information above on DEFRA and the Food Standards Agency.

Q15.4 ALARP principle (page 65) seems to be a requirement at nuclear installations in the United Kingdom. What are the licensee's procedures and measures to ensure that the doses to individuals are ALARP? And how does the regulatory body confirm whether the licensees keep the ALARP principle or not?

As explained in para 15.10, the licensee is responsible for ensuring that work with ionising radiations is properly controlled and for ensuring that doses are as low as reasonably practicable (ALARP). All activities are carried out by, and under the control and supervision of, suitably qualified persons within an effective management system (para 15.8 refers). A variety of measures are adopted to keep occupational doses to a minimum, these include engineered controls and operational safety features. Engineered controls include physical separation, containment, shielding, and remotely operated equipment. Examples of operational safety features are physical barriers, warning devices/notices to control access and radiation monitoring arrangements. These measures are supplemented by operational controls such as pre-planning and prior assessment of exposures, written systems of work and the provision and use of personal protective equipment.

Currently statutory upper dose limits are set out in the IRR 85 which are in line with ICRP recommendations, these are currently being revised to reflect ICRP 60 and the latest EC Directive. [**Note IRR 85 has been revised and is now IRR99**]. In practice the licensees have their own limits which are well within statutory or international limits. In its SAPs the HSE/NII set safety objectives which represent limits within which it would not expend undue effort in pressing for a further reduction, bearing in mind that ALARP is a fundamental tenet of the law. The basic objectives for individual annual doses to workers and to members of the public are set at 2mSv and 0.02mSv respectively. Where these objectives are not satisfied the NII looks very closely, through inspection and assessment of the licensee's operations to consider whether the right balance has been achieved between the costs and the benefits of dose reduction (see Para 15.7).

Q15.5 It is stated that "radiation exposure of the public as a consequence of discharges would be less than the dose constraints and limits set by the UK Government". Can it be confirmed that the word "public" is not limited to UK public?

Radiation exposure to the public living adjacent to a nuclear power plant in the UK must be less than the dose limits laid down in the international Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources (jointly sponsored by the FAO, IAEA, ILO, OECD/NEA, PAHO, and WHO). It therefore follows that the radiation exposure to the public in other countries, as a consequence of UK power plant discharges in operational states will also be less than these dose limits.

ARTICLE 16 - EMERGENCY PREPAREDNESS

Text of Article 16:

'1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency.

For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.'

This section of the report covers:

- **laws and regulatory requirements (paragraphs 16.1 to 16.9);**
- **implementation (paragraphs 16.10 to 16.12);**
- **classification of emergencies (paragraph 16.13);**
- **emergency response (paragraphs 16.14 to 16.30);**
- **roles of organisations dealing with nuclear emergencies (paragraphs 16.31 to 16.63);**
- **radioactivity monitoring (paragraphs 16.64 to 16.66);**
- **public information (paragraphs 16.67 to 16.75);**
- **longer term actions (paragraph 16.76);**
- **emergency exercises (paragraphs 16.77 to 16.81);**
- **international arrangements (paragraphs 16.82 to 16.85);**
- **extendability (paragraphs 16.86 to 16.87.**

Laws and Regulatory Requirements

16.1 The safety standards used in the design, construction, operation and maintenance of nuclear installations in the UK reduce to very low levels the risk of accidents that could have consequences for the general public. Nonetheless, the UK recognised the importance of emergency preparedness in its first Nuclear Installations Act of 1959, which specifically referred to emergency planning as an aspect for inclusion in the Conditions attached to a nuclear site licence. This has been carried through to the current the NI Act {Ref. 23 ~~15~~}. The IRR99 ~~85~~ also require the preparation of contingency plans (Regulation 12 ~~27~~) {Ref. 3 ~~17~~}.

Licence Condition 11

16.2 LC 11 (see Annex 4), on emergency arrangements, is to ensure that the licensee has adequate arrangements in place to respond effectively to any incident ranging from a minor on-site event to a significant release of radioactive material. The Condition requires employees to be properly trained and that the emergency arrangements are exercised. There is also a requirement for the licensee to consult with any person not in their employ who may be required to participate in emergency arrangements. The licensee must submit to HSE for approval such parts of the arrangements as HSE may specify. Once approved by HSE no alteration or amendment can be made to the approved arrangements unless HSE has approved the alteration or amendment. LC 11 requires the arrangements to be rehearsed to ensure their effectiveness. In addition to licensee training exercises, HSE agrees the programme of demonstration emergency exercises which HSE nuclear installations inspectors formally observe. HSE can specify that exercises of all or part of the arrangements must be undertaken. This power would be used if HSE is not satisfied with an aspect of the licensee's performance and the licensee did no agree or volunteer to repeat the exercise.

16.3 The consent of HSE is required to bring nuclear fuel onto a site for the first time. As part of the assurances that HSE requires prior to granting this Consent, the establishment of appropriate emergency and evacuation arrangements have to be demonstrated including the approval of an Emergency Plan which is in the public domain and cannot be changed without the approval of HSE. The relevant considerations are that there are sufficient trained personnel and suitable available equipment to deal with the risks from hazards on the site. Similarly, the consent of HSE is required at stages specified by HSE relating to key increases in hazard on the site in the process of bringing the plant from initial criticality to achievement of full reactor rating. At any of these stages, HSE may require a demonstration of enhanced emergency arrangements prior to the granting of Consent to proceed to the next stage. This demonstration may be by training records for all staff affected or a demonstration exercise against a testing scenario. Throughout the life of the nuclear installation, the emergency arrangements are subject to review and, with HSE's approval as described above, revision as appropriate.

PIRER Regulations 1992

16.4 The UK learnt some important lessons from the accidents at Three Mile Island and Chernobyl. One of these was the need to avoid public uncertainty about an accident and any immediate action that should be taken. This lesson reaffirmed the importance of maintaining a flow of accurate and up-to-date information. The Public Information for Radiation Emergencies Regulations 1992 (PIRER) {Ref. 28 ~~21~~} arose from the EC Post-Chernobyl Review and provide a legal basis for the supply of information by licensees to members of the public in the vicinity of a nuclear installation who may be affected by a nuclear emergency.

REPPIR Regulations 2001

16.5 From summer 2001, new regulations, the Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR) will come into force. These will subsume aspects of PIRER and also places on a statutory basis the arrangements whereby a local authority with a nuclear site or sites in its area prepares an off-site emergency plan. Licensees will also have to comply with additional requirements on the public availability of certain information. REPPIR is needed to implement the emergency preparedness aspects of the revised Euratom Basic Safety Standards Directive.

Radiation Protection Standards

16.6 Actions in an emergency situation should be based on well considered pre-determined and accepted principles. A key element of this for a nuclear emergency is the response necessary for likely levels of radiation doses for those persons on the site, those dealing with the emergency and the members of the public. In the UK the NRPB is the independent body with the responsibility for specifying and giving advice on emergency reference levels (ERLs) for the public. The NRPB also give other guidance for return and relocation.

16.7 The ERLs are levels of 'dose saved' at which it is justifiable to introduce countermeasures. In recommending any ERL, the NRPB balances the risk from potential radiation exposures against the risks that may be associated with the counter measure. The ERLs are formulated in a two-tier system of dose levels of dose saved for the public. The lower levels of dose saved have been recommended as being levels below which countermeasures should not, in general, be taken because the conventional risks and social disruption resulting from the countermeasures are likely to outweigh the benefits. The upper levels of dose saved have been recommended as being those at which action should almost certainly be taken. At values between these upper and lower bounds of ERL the implementation of countermeasures is desirable but not essential and must be considered in the light of the situation at the time. The application of the ERL is aimed at ensuring that risks to the health of individuals are minimised. If the response is based on the ERLs, any resulting health effects would be small and would not subsequently be distinguished from the normal incidence of such effects. The ERLs are subject to a continuing review to reflect developments in the understanding of radiation risks.

16.8 In drawing up and developing emergency plans the ERLs together with the predictions of the course of the accident and the likely effectiveness of the countermeasures are used to define site-specific intervention levels of dose saved. The intervention levels of dose saved expressed in directly measurable quantities are used to provide advice on possible protective actions. The advice is given to the Police who carry the final responsibility for instigating the necessary measures taking account of the local situation at the time.

16.9 The recommendations and advice provided by the NRPB cover the following counter-measures and actions (Figures taken from NRPB Statement on ERLs {Ref. 52}):

i) **Sheltering** - the public would be advised to stay indoors, close doors and windows and follow advice given by local radio and television stations or other agreed notifying arrangements. Sheltering reduces the risk of exposure to direct radiation and the inhalation of radioactive material. The NRPB has specified the following radiation effective dose levels of dose saved for this counter measure:

Lower ERL	3	mSv
Upper ERL	30	mSv

ii) **Taking of stable iodine tablets** - potential consequences from postulated accidents at nuclear installations are often dominated by the effects of radioactive iodine because of its relatively high volatility. The taking of stable iodine tablets can significantly reduce the iodine uptake by the body and thus reduce the likely radiation dose. NRPB has specified the following radiation equivalent dose levels of dose saved to the thyroid for the introduction of this counter measure:

Lower ERL	30	mSv
Upper ERL	300	mSv

iii) **Evacuation** - this is an important counter measure as it removes the person from further exposure. It is however socially disruptive and incurs other risks. The NRPB have specified the following radiation dose levels of dose saved:

Lower ERL	30	mSv
Upper ERL	300	mSv

iv) **Control of contaminated or potentially contaminated food supplies** (defined in the European Council Regulation on maximum permitted radionuclide concentrations in foods) {Ref. 51} - statutory authority for food safety rests with the Food Standards Agency, which will give advice and recommendations to protect the food chain. NRPB advice is also available on this subject. ~~an appropriate Government Department depending on which area has been contaminated. For England there is the Ministry of Agriculture, Fisheries and Food, in Wales the Welsh Office Agricultural Department, in Northern Ireland the Department of Agriculture and in Scotland the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD).~~

v) **Control of contaminated or potentially contaminated water supplies** - In England and Wales, the responsibility for ensuring a wholesome supply of drinking water rests with the relevant water company (for public supplies) or local authority (for private supplies). DEFRA discharges its regulatory responsibility through its Drinking Water Inspectorate and obtains radiological advice from the Environment Agency. For Scotland, the responsibility for taking action to restrict or stop the supply of water rests with the local water undertaking. The appropriate Government Department is the ~~SOAEFD~~ Scottish Executive Environment and Rural Affairs Department (SEERAD). In addition, for Scotland SEPA would give advice to the Water Authorities on moni-

toring of contaminated waters and on appropriate restrictive actions to take if necessary.

Implementation

16.10 The statutory requirements and guidance outlined above are the basis for making emergency arrangements ranging from managing incidents or accidents which might only affect those on the site to those which might have off site consequences. Four aspects of emergency response are required. They are:

a) the control of the incident or accident at the site;

b) the assessment of actual and potential accident consequences and alerting the relevant authorities and the public;

c) the introduction of counter measures to mitigate the consequences regarding:
   i) individuals who could be affected in the short term; and
   ii) longer term effects such as the contamination of food supplies, land and adjoining waters;

d) the return to normal conditions.

16.11 The principal concern is to avoid any exposure of the public to radiation and minimise the exposure to site personnel, and therefore to rectify any fault before there is any danger to people outside the site. However as soon as a fault occurs the question of emergency action has to be considered and, if necessary, the initiation of the predetermined actions which might lead to the notification of off-site agencies and the public. Emergency actions to protect the public may therefore be put in hand in circumstances where the accident does not develop to a stage which has significant off-site consequences.

16.12 Emergency actions described here for nuclear installations are based upon the following principles:

a) There is a 'detailed emergency planning zone' around each nuclear installation within which arrangements to protect the public are planned in detail. The boundary of this zone is defined in relation to the most significant release of radiation from an accident which can reasonably be foreseen.

b) Emergency planning for the nuclear installation needs to be capable of responding to accidents which although being extremely unlikely, could have consequences beyond the boundaries of the detailed emergency planning zone. The measures that are required to extend the detailed arrangements cannot be precisely planned because the nature and potential of accidents may vary and the exact response would be based upon assessments made at the time. The response can make use of local and national plans prepared to deal with a range of emergencies of a non-nuclear nature.

Classification of Emergencies

16.13 The operator's emergency plans require the first decision to be whether there are, or could be, off-site consequences of the incident. If the answer is yes then the external organisations are informed and take the necessary actions. The UK uses the International Nuclear Event Scale (INES) to communicate to the public, and the media, the safety significance of events reported at nuclear installations in consistent terms. Paragraph 16.19 ~~8~~ specifies how operators define 'levels of warning'.

Emergency Response

16.14 In drawing up the emergency arrangements two basic assumptions are adopted. Firstly the initial response will be at the local level where the control of the incident or accident and its most immediate effects can be dealt with most effectively by the operator. Secondly there is a single lead Government Department which is responsible for co-ordinating the Government response at the national level. This will involve a number of Government Departments each responsible for various aspects of the emergency. The lead Department for nuclear emergencies at a nuclear power station in the UK will depend upon where the station is sited. If the site is in England or Wales the DTI will lead; if in Scotland it will be the Scottish Executive (SE). The lead Department is also responsible for briefing Ministers and keeping Parliament and the public fully informed.

16.15 As actions required to safeguard the public for a nuclear emergency have features in common for dealing with other types of emergency, the planning for a nuclear emergency is seen as one element of the overall system of emergency planning involving Local Authorities and the emergency services together with Central Government and other Agencies.

16.16 The emergency plans for nuclear installations define the circumstances under which a range of actions would be put into effect to protect people on and off the site. The plans set down who is responsible for taking actions including the making of assessments, the provision of advice, the taking of decisions and the implementing of any actions. There are a number of emergency plans specific to a particular site. Firstly there is the site operator's plan. This is integrated into an overall plan for the district which is drawn up by the Local Authority which will encompass all emergencies including nuclear emergencies and will give the responsibilities for all the organisations which might take part in dealing with an emergency. Each of these organisations will then have their own plan. A range of instructions and to be followed procedures support each plan.

16.17 The DTI also has an ongoing lead department role in bringing together organisations involved in off-site nuclear emergency planning through the Nuclear Emergency Planning Liaison Group (NEPLG). Members include representatives of the nuclear operators, the police, fire service, local authority emergency planning officers and government departments and agencies that would be involved in the response to an emergency. The NEPLG provides a forum for discussing common problems, exchanging information and experience and agreeing improvements in planning, procedures and organisation. The NEPLG has issued a number of guidance documents aimed at all those involved in the development of site-specific emergency plans at local level. These have recently been reviewed and will be re-issued as one set of con-

solidated guidance. The NEPLG also reviews the results of Level 2 and 3 exercises (see paragraphs 16.77 ~~6~~ to 16.81 ~~0~~) to ensure that important lessons learned from those exercises are put into practice. Figure 5 shows the Emergency Arrangements' Structure in the UK and references relevant paragraphs in the text.

Site operator's plans

16.18 The site operator's emergency plan covers the operator's emergency planning arrangements both on and off the site and the procedures for their initiation. The plan is supported by detailed instructions on the actions to be carried out by the operating staff. Copies of the site plans are held by local and central Government with copies available in the public libraries local to the Site.

16.19 For all nuclear installations in the UK there are a number of common elements in their emergency plans. These are:

i) The plan would be invoked by a senior manager of the plant present on the site at the time of the emergency.

ii) The nature and likely development of the event, together with possible consequences for the safety of people on and off the site, determine the level of warning that would be declared. The plans specify the level of warning to be declared for a range of conditions. This generally covers the following two situations:

{ a hazardous condition which is confined in its effect within the site security fence (a hazard to site personnel only);

{ a hazardous condition which results, or is likely to result, in the need to consider urgent counter measures to protect the public outside the site security fence from a radiological hazard.

iii) The senior manager invoking the emergency plan is nominated as the Site Emergency Controller. Only designated site staff can act in this capacity and they are identified in the plan and associated handbooks. Only the Site Emergency Controller can declare, upgrade or cancel the emergency state declared in ii) above.

iv) The Site Emergency Controller would be located in the emergency control centre on the site (supported by a team of engineers, scientists and administrative staff) and be responsible for directing the Operator's emergency response organisation. This would include, in the initial stages of an emergency, notifying relevant off-site organisations and recommending actions for the protection of site personnel and members of the public, as appropriate.

Off-site emergency plans

16.20 In addition to emergency control centres on the sites, all off-site emergency plans make use of additional facilities available at some distance from the Site. These off-site emergency

facilities are part of the emergency arrangements for dealing with emergencies that have or might have off-site radiological consequences. The facilities are sited at a sufficient distance from the site to make it highly unlikely that they would be subject to any direct threat from a radiological release during the emergency, but have local knowledge and expertise.

16.21 The declaration of a nuclear emergency will initiate procedures for setting up the off-site facility that will become operational a short time after the declaration of the emergency. Once the facility is operational it takes on the responsibilities for communicating and co-ordinating with the off-site agencies thus leaving the Site Emergency Controller and site staff to concentrate on the control of the accident on the Site.

16.22 The prime function of the off-site facility is to decide on the actions to be taken off-site to protect the public, to ensure that those actions are implemented effectively and to ensure that authoritative information and advice on these issues is passed to the public (the facility includes media briefing centres). Decisions would generally be made through regular co-ordinating group meetings. These are usually chaired by the Police, who are responsible for taking decisions to protect the public, and would involve all the principal organisations represented at the facility.

16.23 The declaration of a nuclear emergency at a Site would be followed immediately by the notification of the emergency services and local and national authorities. Each organisation with responsibilities for dealing with the emergency would be represented at the off-site facility. These would generally include the Operator, the Police, the Local Authority, the Health Authority, Local Water Company and the Fire and Ambulance services. In addition Government Departments and Agencies would also be represented. These would include the ~~MAFF~~ DEFRA, (or Scottish or Welsh equivalents), the DTI, ~~the DETR,~~ NRPB and the HSE. As the regulators for disposal of radioactive waste, SEPA in Scotland, and EA in England and Wales, would also be represented, as would the Food Standards Agency to issue advice and restrictions (if it feels it necessary) on fresh food in the area of the emergency (see paragraph 16.49). The representatives would provide links with their organisations and be responsible for ensuring that adequate information and advice were available both at the off-site and at the emergency control centres of their respective organisations. The representatives would liaise closely to ensure that a proper assessment was being made of the situation, that appropriate actions were being taken and that the public was being kept informed. Figure 6 shows the off-site facility representatives diagrammatically and references relevant paragraphs where further information is available.

16.24 The technical information regarding plant prognosis and radiological assessments by the Operator is an important aspect in the response to an emergency. The off-site facility will receive this information from the Operator's organisation. The Operator's representatives at the facility will have a prime function in ensuring that adequate information is available to those at the facility and to ensure that their own organisations are aware of what assistance the facility requires.

NEBR and SEER

16.25 In addition to the local off-site facility, the lead Government Department would set up a Nuclear Emergency Briefing Room (NEBR) in London for emergencies in England and Wales or a Scottish ~~Office~~ Executive Emergency Room (SEER) in Edinburgh for emergen-

cies in Scotland. Representatives of the principal Government Departments and Agencies would attend the NEBR (or SEER) with communication links to the off-site facility. Any national response to an emergency and the briefing for central Government and Parliament would be co-ordinated at the NEBR or SEER.

16.26 The central Government Departments and Agencies represented at the NEBR would include the DTI, DEFRA ~~TR, MAFF~~, the Department of Health, or appropriate departments for Wales, and the EA. The equivalent departments for Scotland and SEPA would attend the SEER. Representatives of the HSE, including its Chief Inspector of Nuclear Installations, and the NRPB would be present at either the NEBR or SEER. Representations at either the NEBR or SEER are shown diagrammatically at Figure 7.

16.27 The NEBR or SEER would be the focal point within central Government for preparing information for the media and the general public on the course of the emergency, on measures to protect people in the affected area and on any consequences for the public outside the affected area. Press or media enquiries not dealt with by the media briefing centre at the off-site facility could be handled by the lead Department's press office on the basis of material prepared by the NEBR or SEER.

16.28 Although the main source of information to the public would be the media, the lead Department would also be ready to deal with telephone queries put to it by the public; these would be referred to a public enquiry room which would quickly be established in London or Edinburgh. The public enquiry room would attempt to deal with as many calls as possible and would act in concert with other agencies, including the police, local authorities and NRPB, who would also expect to receive calls from the public.

16.29 The NEBR or SEER would also be the focus for briefing Government Ministers and departments and for co-ordination of departmental action, including the co-ordination of any additional resources that might be required.

16.30 The NEBR or SEER would take information from the Radiation Incident Monitoring Network (RIMNET) system operated by DEFRA. This provides a nation-wide system for detecting and monitoring radioactivity together with communications facilities which enable information dissemination between central and local government and other official bodies (see paragraphs 16.82 ~~1~~ to 16.84 ~~3~~). SEPA manages the Scottish end of RIMNET from its Head Office, and would staff the resource as necessary. Access to the RIMNET system would also be available at the SEER.

Roles of Organisations and Agencies responsible for dealing with Nuclear Emergencies

Operators' response to an emergency

16.31 The control of the nuclear installation involved in an accident begins and remains with the operator who is responsible throughout for bringing the plant under control and thus reducing any off site consequences. At the outset the operator is responsible for notifying the appropriate authorities. In the initial stages it is only the operator who can assess the position and give guidance on any counter measure required to protect the public. The operator also maintains a system that can monitor any release of radioactive material from the plant.

Governmental Response to an emergency

Government Technical Advisor

16.32 On the notification of an off-site emergency at a nuclear power station the DTI (for stations in England and Wales) or the SE (for stations in Scotland) will arrange for the appointment of a Government Technical Adviser (GTA), following advice from the HSE's Chief Inspector of Nuclear Installations. The GTA would normally be one of HSE's Deputy Chief Inspectors of Nuclear Installations and would be responsible during the course of the emergency to the lead Minister. The GTA would represent the primary source of technical advice and information to all the relevant off-site agencies. In preparing this advice, the GTA would have the benefit of up-to-date information and close contact with the local agencies and operator of the nuclear installation.

16.33 The appointed GTA will be sent to the local off-site facility and would assume the following responsibilities:

a) to provide independent and authoritative advice to the Police and other Authorities handling the off-site response to the emergency on all matters relating to:

   i) the appropriate counter measures off-site to protect the public and the personnel of the various agencies involved;
   ii) the cause of the emergency on-site and its effects on the environment beyond the site;
   iii) the end of the on-site emergency and the return to normality off-site.

b) at media briefings to provide, where necessary, an authoritative response on behalf of the Government on all these matters;

c) to ensure that the lead Government Department is kept fully informed on all matters relating to the emergency.

16.34 The GTA would meet all the other authorities represented at the off-site facility and would ensure that an adequate assessment on the way the situation was developing, and likely to develop, was available as required for the facility's representatives to make decisions and take appropriate actions. The GTA position is advisory and does not carry any executive responsibility. Once the GTA is appointed, the state of emergency can only be terminated on the advice of the GTA, in consultation with the operator, the various organisations dealing with the emergency and central Government organisations.

16.35 To assist communications between the GTA at the off-site facility and the NEBR or SEER, the lead Government Department nominates a Senior Government Liaison Representative (SGLR) to support the GTA at the off-site facility. The SGLR would be a Senior Government Officer and would provide a direct link to the NEBR or SEER and, if necessary, Government Ministers. The SGLR would ensure that the GTA was informed of Central Government actions and would also keep the NEBR or SEER informed of actions taken at and media statements issued from the local off-site facility. This is to ensure that co-ordinated, consistent and unambiguous advice is given to the general public through the media.

Local Organisations

Police

16.36 As in any civil emergency, the responsibility for co-ordinating off-site action to protect and advise individual members of the public following a nuclear accident lies with the police. It would be a matter for the police, in consultation with other interested agencies, to decide on the course of action to be taken to protect the public in the vicinity of the site.

16.37 Police forces, in areas that could be affected by a nuclear accident, have their own standing instructions on the actions to be taken. These are provided for within the framework of general plans for a response to any type of major accident or emergency in their area, and include arrangements to bring in additional resources from outside the area and to extend some actions beyond existing detailed planning zones. Police actions would, for instance, include advising people either to shelter indoors or to evacuate an area where this is thought to be necessary. In discharging their responsibilities the police would receive advice from various technical experts, in particular the GTA, on what action is necessary to protect the public, and would liaise with the other emergency services and associated agencies when implementing these actions.

Local Authorities

16.38 Local authorities generally have Co-ordinated Plans for Major Incidents or equivalent disaster response plans. These are designed to cope with a wide range of emergencies, such as floods, major fires and crashes and are in addition to any site specific plans. The UK Government's Home Office provides advice on the preparation of these plans in the form of guidance on emergency planning for major accidents and natural disasters. With the exception of the plans for radioactive monitoring for contamination of food and water supplies, none of the zones for detailed pre-planning for nuclear emergencies cross county or regional boundaries. However, a severe accident could mean that an emergency response was needed over a larger area, which could cross county or regional boundaries. Individual authorities would need to activate their plans once the police had notified designated representatives of the affected authorities.

16.39 Local authorities have important responsibilities to assist with the implementation of any counter measures, including such matters as emergency transport, housing, feeding and the provision of welfare services. In addition, local authorities may operate public information centres (see paragraph 16.73 ~~2~~). The responsibility of each local authority department is laid down in the relevant emergency plan. The local authority also plays a leading role in implementing mutual assistance arrangements with neighbouring local authorities. Some local authorities will, in addition, have facilities for carrying out radiation monitoring for entry into the RIMNET system (see paragraphs 16.82 ~~1~~ to 16.84 ~~3~~).

16.40 In most counties and metropolitan districts an Emergency Planning Officer is responsible to the Chief Executive for co-ordinated contingency planning. The normal process of off-site emergency planning includes co-ordination, liaison and communication by the emergency planning officer with neighbouring local authorities, unitary authorities and emergency services. During an emergency, information would be obtained by the local authority representative at the off-site facility, thus enabling those concerned with emergency response action in

the area to be kept fully informed on the course and possible consequences of the accident. Local authorities also have statutory duties under PIRER {Ref. 28 ~~1~~} (shortly to be subsumed by REPPIR) to distribute information prepared by nuclear site operators to any members of the public who may be affected by the accident (see paragraph 16.67 ~~6~~).

16.41 In Scotland powers to prepare emergency plans for civil emergencies are vested in the local authorities. Actions to be performed by local authority departments are laid down in these plans, which are drawn up in close consultation with the emergency services.

Fire Service

16.42 The fire service would respond to any emergency incident at a nuclear installation to which it was called. Fire service emergency plans specific to a particular site are pre-planned in consultation with the site operator would form the basis of its response. The main role of the fire service during an emergency would be that of fire-fighting and search and rescue operations at the incident. A fire service officer located in the on-site emergency control centre would assist the fire brigade Incident Commander to co-ordinate fire-fighting and search and rescue actions. The operator's Site Emergency Controller would advise the fire brigade on the plant status, safe routes to the plant and on matters of nuclear safety which affect fire-fighting. Where it is considered essential to prevent further escalation of the incident, or to aid the recovery process, the fire service may also be able to assist with decontamination tasks other than those necessary for first aid decontamination of its fire-fighters. Any such assistance given would only be undertaken following advice and guidance from the operator's Site Emergency Controller and fire-fighters would at all times remain under the direct control of the fire service Incident Commander present. The fire service may also have off-site responsibilities, for example, dealing with fire and accidents that may occur in the area around the affected site.

Local Health Authorities

16.43 A nuclear accident could result in demands being made on health authority services both in the vicinity of the accident and more widely. Health authorities (including the ambulance services) local to the site would be notified of a nuclear emergency by the operators or the police as part of the standard alerting procedure. Health authorities are responsible for ensuring that plans for the issue of stable iodine tablets are drawn up; for the provision of medical advice to site operators, the police and other authorities involved; and for making appropriate arrangements for the treatment and care of any casualties arising from a nuclear accident both on and off the site, including any who might have been exposed to radiation or contaminated by radioactivity.

16.44 Because the scale of release of radioactivity in any reasonably foreseeable accidents would not cause any early effects among the public, the main actions required of the health services would be to provide monitoring facilities and information for people who had been, or believed they had been, contaminated, and for those who had been evacuated. The health authorities would take the lead in organising these activities and would receive assistance from the operators and, where necessary, the NRPB. Some other facilities may be required, for example, the ambulance service could be called upon to assist in the evacuation of people with poor mobility. In the extremely unlikely event of a more severe accident, there might be a need for more extensive application of counter measures to protect the public. The appropriate health authorities would provide any additional services of the kind detailed above.

Water undertaker

16.45 The water undertakers are responsible for deciding what action, if any, is necessary to restrict water supplies following a nuclear accident. In practice it is unlikely that the level of contamination of water following accidental release of radioactivity from a nuclear site would require restriction on mains water supplies. Water undertakers would, however, be informed promptly by the operators of any nuclear emergency and the possibility of substituting alternative supplies would be examined, even at very low levels of contamination of a particular source. The EA in England and Wales and SEPA in Scotland would advise water undertakers.

Central Government

Department of Trade and Industry/Scottish Executive ~~Office~~

16.46 The Secretary of State for Trade and Industry or the Minister for Enterprise and Lifelong Learning ~~Secretary of State for Scotland~~ would be the lead Minister for an accident at a civil nuclear installation in England/Wales or Scotland respectively. Their departments would be responsible for setting up and staffing either the NEBR or the SEER. These facilities are equipped with diverse communications to enable contact to be quickly established with the operator's headquarters and with the off-site facility. Staff at the NEBR or SEER would work in close liaison with local agencies at the off-site facility.

16.47 The lead Minister will be in close touch with the nuclear site operator and with representatives of HSE, the NRPB, Government departments and agencies represented in the NEBR or SEER.

16.48 The lead departments regularly participate in exercises at which the above procedures are tested. This enables them to understand the issues and problems that have to be dealt with at a local level and to contribute to the development of plans. It also allows the lead departments to test and improve their own internal procedures and to train staff. The DTI would be responsible for policy on the control within the UK of potentially contaminated consumer goods, and for policy on the control of contaminated exports.

Food Standards Agency

16.49 A release of radioactivity following an incident could contaminate grass, crops, foodstuffs and food sources in both the terrestrial and aquatic environments. Food Standards Agency has extensive powers under the Food and Environment Protection Act 1985 {Ref. 53 ~~47~~} to control the production and supply of contaminated or potentially contaminated foodstuffs in the United Kingdom. It has detailed national plans for responding to all types of nuclear emergency. These are supplemented by regional plans that provide for farmers or producers whose land is affected to be notified quickly by the police or ~~MAFF~~ Rural Payments Agency officials in England and SEERAD officials in Scotland. ~~MAFF~~ Food Standards Agency representatives would be sent to the appropriate off-site facility and to the lead department's emergency room.

16.50 The ~~appropriate MAFF Regional Director or nominated deputy (or the Welsh Office Agriculture Department for incidents affecting Wales)~~ Food Standards Agency, working in close collaboration with the local Rural Payments Agency officials or SEERAD officials, would be responsible for co-ordinating the local ~~MAFF~~ response in an emergency involvinge

any restrictions on foodstuffs, including milk and vegetables, and the movement of livestock. ~~The Regional Director would be instructed by MAFF headquarters staff who would seek advice from MAFF~~Advice would be sought from Food Standards Agency scientists in deciding the range and nature of restrictions to be recommended to Health Ministers. Food Standards Agency ~~MAFF~~ would activate its emergency room in London to co-ordinate the implementation of any necessary measures.

Scottish Executive Environment and Rural Affairs Department (SEERAD)

16.51 The procedures and contingency planning for the SEERAD and DEFRA are very similar, both having the same general responsibilities in the event of a nuclear emergency. For nuclear accidents affecting Scotland, the SEERAD would send representatives to the appropriate off-site facility and to the SEER.

Scottish Environment Protection Agency (SEPA)

16.52 SEPA has duties in Scotland under the RSA 93 {Ref. 26 ~~19~~}, for regulating the use and disposal of radioactive substances. In the event of an accident, SEPA would send representatives to the off-site emergency facility and would set up their own emergency response centres to assess the extent of the environmental contamination, to instigate appropriate environmental monitoring and to advise on, or take any necessary actions to mitigate the effects. SEPA would be the authorising agency for disposal of any radioactive wastes that may arise as a consequence of an accident and would advise on appropriate disposal methods. Also in the event of such an accident, the Water Services Unit of the SE, in consultation with SEPA, would give advice to the water authorities in Scotland which are responsible for public water supplies. SEPA would advise the water authorities on appropriate monitoring of water supplies.

Department for Environment, Food and Rural Affairs (DEFRA)

16.53 DEFRA is the lead Department in the event of an overseas nuclear accident where there are consequences for the UK. The UK -has, since Chernobyl, developed a nation-wide network for monitoring gamma dose rates at 92 fixed monitoring sites (RIMNET, see also paragraphs 16.82 ~~1~~ to 16.84 ~~3~~), and a National Response Plan for co-ordinating the UK Government's response.

16.54 In the unlikely event of an off-site emergency at a UK nuclear installation, DEFRA in conjunction with the EA, would set up an Environment Operations Centre to assess and respond to the wider UK environmental effects of the emergency in England and Wales. In Scotland, the Scottish Executive and SEPA would put similar arrangements in place.

Environment Agency

16.55 The EA has a broad statutory role under the Environment Act 1995 {Ref. 31 ~~24~~} to protect and enhance the environment as a whole - air, land and water - in England and Wales. In the specific context of nuclear emergencies, the EA regulates the management and disposal of radioactive waste arisings under the RSA 93 {Ref. 26 ~~19~~}, and also provides agreed support to its sponsoring Department, DEFRA - particularly by providing advice on environmental radiation protection to DEFRA and to other bodies including water companies and local authorities. In the event of an emergency in England or Wales, the EA would send representatives to the off-site facility and to other central Government centres, and would set up its technical assessment centre. If there were a discharge of radioactive substances to the water environment, the EA would arrange sampling and radiochemical analysis of those waters, with a view to protecting the environment and advising downstream users and abstractors. The EA would consider whether it might reduce the impact of such a discharge by managing the flows of regulated waters which are under its control, for example, by releasing water from reservoirs or altering river levels.

16.56 During the recovery phase, central Government may request through DEFRA that the EA provides a GTA to advise on decontamination and clean-up.

16.57 In the event of a nuclear emergency occurring outside the UK, the EA would additionally decide whether to invoke the UK's National Response Plan and to convene the UK's Technical Co-ordination Centre, and would then manage that Centre if it were convened.

~~Welsh Office (WO)~~ National Assembly for Wales

16.58 While lead responsibility for civil nuclear accidents in England and Wales rests with the DTI, in the event of an emergency that could affect Wales, the National Assembly would deal with matters relating to the First Minister ~~Secretary of State~~ for Wales' responsibilities for the environment, water supply, health and agriculture. It would establish an operations room in Cardiff that would liaise with its representatives at the off-site facility and at the NEBR in order to provide co-ordinated advice to the First Minister ~~Secretary of State~~for Wales on all aspects of the emergency.

Department of Health

16.59 The Department of Health would provide advice to other government departments on the health implications of any exposure to radiation. It is also responsible for ensuring local health authorities have plans to provide treatment and health advice to the public and monitoring facilities for people who may have, or fear they have, been contaminated by exposure to radiation. Additionally, it provides guidance to local health authorities on arrangements for the distribution of stable iodine tablets. In Scotland these responsibilities would be exercised by the SE ~~Office Home and~~ and Health Department.

Health and Safety Executive (HSE)

16.60 In the event of an emergency, the HSE is responsible for monitoring the activities of the operators and advising the GTA and central government. Using statutory powers, HSE nuclear installation inspectors would inspect and review the activities of the operators to ensure that they were taking all reasonable steps both to restore the plant to a safe state and to minimise the risk to the general public. On being notified of an emergency, HSE would send

inspectors both to the site and to the appropriate off-site facility who would monitor the situation and the steps taken to restore control. The inspectors have regulatory powers, including the power to Direct the licensee (see Annex 2), that they could use if they felt the emergency situation warranted it. The HSE would set up its own ~~emergency room~~ Response Centre at its Bootle, Merseyside headquarters to provide a technical assessment capability and to support the Chief Inspector of Nuclear Installations and the nuclear installation inspectors on the site, at the off-site facility or at the central emergency support centre. This would allow HSE to make independent assessments of the likely course of the accident and its consequences, and to consider any implications for other nuclear installations. These assessments would be transmitted to the Chief Inspector of Nuclear Installations at the NEBR or SEER.

16.61 The Chief Inspector of Nuclear Installations would act as adviser to central government in nuclear emergencies and would give advice based on HSE's assessments to government departments, the HSC, the Executive and the operators as appropriate.

National Radiological Protection Board (NRPB)

16.62 The NRPB is responsible for advising government departments and other bodies on radiological protection matters in an emergency and for specifying emergency reference levels of dose saved of radiation dose to members of the public. NRPB would also co-ordinate monitoring for radioactivity in a nuclear emergency. To do this, NRPB would deploy a team to liaise with all the various organisations undertaking environmental and personal monitoring. Its representatives at the off-site facility would also advise the co-ordinating group meetings which would take decisions on the requirements for monitoring. NRPB would send representatives to the lead department's briefing room and, if appropriate, to the appropriate off-site facility.

Meteorological Office

16.63 The Meteorological (Met.) Office is responsible for responding to all requests for meteorological advice following a nuclear incident or accident. A forecast for the incident site giving details of the wind speed and direction, cloud cover and significant weather is supplied to the relevant operator (usually within 30 minutes of notification). Output from the Met. Office's long-range dispersion model (called NAME) is transmitted to the RIMNET Central Database Facility (CDF). The Met. Office liaises with relevant international agencies including other National Meteorological Services and also with the Lead Authority's Press Office in respect of any media interaction. A forecaster would attend the NEBR following initiation of national nuclear emergency response arrangements. The forecaster is able to provide expert meteorological advice as it impacts at the strategic level. In the case of nuclear accidents occurring outside the UK, the forecaster would attend the Technical Co-ordination Centre, following initiation of national nuclear emergency response arrangements. The Met. Office actively participates in the exercising of nuclear plans and arrangements.

Radioactivity Monitoring

16.64 Site emergency plans include provisions for monitoring radioactivity. Monitoring equipment installed on the site will provide information on the amount of radioactive material being released to the environment. The operator would also despatch specially equipped mobile monitoring teams to measure the radioactivity in the plume as it travelled downwind from the site and also the level of radioactive material deposited on the ground. The area local to the site covered by the operator's mobile monitoring teams will depend on the type of installation and will vary between 15 to 40 km. The NRPB would co-ordinate monitoring for radioactivity. Operators have arrangements for other sites operated by them to provide additional monitoring teams and national mutual aid agreements between the UK operators also provide for monitoring assistance if this is requested.

16.65 Additional monitoring for radioactivity by DEFRA ~~MAFF~~ and the EA (or the SEERAD ~~SOAEFD~~ and SEPA in Scotland and the National Assembly ~~Welsh Office in~~ for Wales), local authorities, water undertakers, and Ministry of Defence would provide further information so that longer-term decisions regarding restrictions on milk, foodstuffs and water supplies could be made. Potential public exposure to radiation from contaminated foodstuffs and milk would not present as immediate a hazard and thus there would be time for appropriate restrictions to be introduced in affected areas. Rather, the Food Standards Agency would issue precautionary advice within a few hours followed up by food restrictions if deemed necessary once monitoring results were available.

16.66 Monitoring information would also be available from the DEFRA's RIMNET (see paragraphs 16.82 ~~1~~ to 16.84 ~~3~~) system which continuously monitors gamma radiation dose rates at 92 stations throughout the UK. In addition, the system allows approved organisations throughout the UK to enter a wide range of other radiological measurements - of air, food, water, and the environment - which would be used to assist the response. This system is intended to detect the presence of radioactivity from any source whether from an overseas accident or an accident in the UK. It would play an important role in establishing those areas that were not affected by the accident. Wider-scale monitoring information would also be available from those local authorities that have established their own independent radiation monitoring capabilities.

Public Information

16.67 The PIRER {Ref. 28 ~~1~~} (shortly to be subsumed within REPPIR) provide a legal basis for the supply of information to members of the public who may be affected by a nuclear emergency. The requirements on the operator and the local authorities under these Regulations are described in the following paragraphs. In addition, the various information services of the local agencies involved and of central government, together with the news media, are available to help in informing the public of the facts and of the assessments being made of the course of the accident.

16.68 It is important that people living or working near to nuclear installations are provided with information about the plans for responding to an emergency. PIRER requires that members of the public within or close to a detailed emergency planning zone who could be at risk from a reasonably foreseeable radiation emergency should receive certain prescribed informa-

tion. Such information is required to be distributed in advance of any emergency occurring and covers, for instance:

(a) basic facts about radioactivity and its effects;

(b) the types of reasonably foreseeable nuclear emergency that might occur and their consequences for the public and the environment; and

(c) arrangements to alert, protect and assist the public in the event of an emergency, including advising on steps that people can take to protect themselves.

16.69 Site operators provide such information in a variety of forms. The information supplied has to be updated at regular intervals not exceeding three years. The operator also has a duty to make the information available to the wider public and this is usually done by providing information on request or by placing copies in public buildings such as libraries and civic centres.

16.70 Every nuclear installation operator has local liaison arrangements that provide links with the public in the vicinity of the site. Typically there are two bodies: a local liaison group, which represents a forum at which all aspects of the operations at the site can be discussed, and an emergency planning sub-committee which provides a focus for more detailed discussions of emergency planning matters. The local liaison group is usually chaired by the manager of the nuclear installation and has a wide membership representing local interests. A typical group would include members and observers from:

{ Local and unitary authorities (officials and elected members from counties, districts and parishes)
{ National Health Service
{ Water undertakers
{ Police
{ Fire service
{ National Farmers' Union
{ Local industry near to the site
{ Coastguard
{ Ambulance service
{ HSE
{ DEFRA~~TR~~ (Welsh Assembly in Wales, Scottish Executive in Scotland)
{ Food Standards Agency
{ SEERAD in Scotland
{ EA or SEPA

16.71 The main purpose of local liaison groups is to provide a formal channel of communication between the operators and the local community and to this end they meet at least once a year. The groups are routinely informed about activities on the nuclear site and receive reports on the results of environmental monitoring for radioactivity outside the site.

16.72 The emergency planning group provides a channel of communication between the operators, the local authorities, the emergency services and other organisations which have defined roles in the emergency plans for the particular site. It provides a forum for discussing the working details of the emergency plan and the broader aspects of the off-site emergency arrangements, and aims to respond to general queries raised by the local liaison group about such plans. The emergency planning group may be chaired by the manager of the site, a local councillor or a local authority emergency planning officer, depending on local arrangements.

Information in the event of an emergency

16.73 PIRER requires local authorities to prepare and keep up-to-date arrangements that ensure that members of the public actually affected by a nuclear emergency receive prompt and appropriate information. Such information needs to cover the facts of the emergency and advice on intended health protection measures. In some cases the police may tour affected areas and inform people by means of door-to-door visits or by the use of police patrol vehicles with loud-hailers. The arrangements often also rely on information bulletins being issued by prior agreement with local radio and television stations. Local arrangements may include the establishment by the local authority of public information centres and telephone helplines to answer questions from the public. The operator would also be expected to make a formal announcement as soon as possible after the emergency had been declared.

16.74 It is recognised that public concern in the event of a nuclear emergency would be widespread and not confined to the vicinity of the site. While the agencies involved in responding to the emergency would seek to deal with any queries they received, the main channel of communication with the public outside the immediate vicinity of the affected site would be the media. A local media briefing facility, which would be quickly set up, would provide press, radio and television facilities and ensure a regular update of information. All media briefing local to the site would be carried out at the media briefing facility, and not at the site of the accident. In addition, media briefing would be available from the lead government department's briefing room and, possibly, other agencies' emergency centres who would liaise with each other and with the local media briefing facility.

16.75 The duration and extent of an emergency would depend on the scale and nature of the radioactive release. Once the release had been terminated, ground contamination would be checked and those who had been evacuated would be advised by the police when they could return home. At about this stage the emergency condition would be officially terminated, but the return to completely normal conditions might take place over a period of time. At a mutually agreed point in the recovery phase, the police would hand over responsibility for managing the return to normality to the local authority. The DEFRA (or SERAD in Scotland), with the Food Standards Agency, would be responsible for assessing the management requirements for any radioactive waste arising from cleaning up after the accident. SEPA in Scotland and EA in England and Wales are responsible for authorising the disposal of such waste.

Longer term actions

16.76 In the longer term, the DEFRA and SEERAD would be involved with other government departments in actions to be taken should a restoration phase be necessary following a major accident involving serious contamination of the environment. Restrictions on milk and other foodstuffs introduced by the Food Standards Agency may need to remain in force for some time. Monitoring in these areas would continue until it was confirmed that levels of radioactivity no longer posed a threat to people's health. In the event of high radiation levels persisting in some areas, local authorities would need to give consideration to longer-term relocation of those people affected. SEPA in Scotland and EA in England and Wales have a duty to investigate the impact of the accident on the wider environment and to mitigate the effects of any resulting pollution on the environment.

Emergency Exercises

16.77 The HSE requires all employees at nuclear installations who could be involved in an emergency to be trained for their tasks and to be involved in regular exercises to ensure appropriate team performance. In addition to these training exercises, HSE requires regular demonstration exercises at each site. Such exercises, known as Level 1 exercises, are witnessed by HSE nuclear installation inspectors, and this is one of the means whereby HSE assesses the effectiveness of the arrangements, training and resources of the operators for dealing with emergencies.

16.78 Level 1 exercises mainly concentrate on the operators' actions on and off site and may not always be based on a scenario involving an off-site release. Such exercises may involve the emergency services and other external organisations. The extent to which the off-site facility is activated varies according to the needs of the operators or as required by HSE. The timing and scenario of the exercise have to be agreed with HSE.

16.79 In addition to the Level 1 exercises there are programmes of exercises to rehearse the function of the off-site facilities and the wider central government involvement. These are known as Level 2 and Level 3 exercises respectively.

16.80 The programme of Level 2 exercises tests the function of each off-site facility at least once every three years. Each such exercise requires the operator to staff the off-site facility and provides an opportunity for agencies with responsibilities or duties to take part and exercise their function as appropriate. This includes the GTA. HSE, in addition to exercising its own emergency duties, provides staff for the GTA team and observers to assess the operator's role and the broad function of the emergency plan. A wide range of government departments and agencies usually take part in such exercises.

16.81 The Level 3 exercise is a national exercise and, in addition to testing the setting up and operation of the off-site facility, includes the exercising of the various government departments at their headquarters and at the NEBR or SEER, and the interactions between the various centres. The exercise may last more than one day and is chosen from the programme of Level 2 exercises once each year.

International Arrangements

16.82 DEFRA is the nominated first point of contact in the UK in the event of a nuclear accident overseas. RIMNET has been set up as part of the UK Government's National Response Plan for dealing with overseas nuclear accidents. It is operated by DEFRA and provides facilities for the collection and analysis of radiological monitoring data, necessary for the response to a nuclear accident. It also provides communications systems for distributing data summaries and Government information and advice bulletins.

16.83 RIMNET provides continuous gamma radiation dose rate measurements from over 90 fixed sites throughout the UK. In addition, it allows other key radiological monitoring measurements, necessary for accident response, to be directly input to a UK national database facility. These additional data would include measurements of radioactivity in air, food, water, other environmental materials and people. The design of RIMNET permits input of these additional data both by Government departments and other bodies approved by DEFRA. Data entry by the latter group is by way of computers linked to the RIMNET database via a public data network.

16.84 Measurements held on the RIMNET database will be used as a basis for decisions aimed to ensure the safety of members of the public within the UK. As such, they must be adequately quality assured and reliable. They must also be supported by known and consistent techniques of sample collection and measurement. Only bodies which can demonstrate their ability to meet the necessary standards and to operate to RIMNET protocols are, therefore, approved to supply data.

16.85 For any emergency at a nuclear installation in the UK the DTI in London would take the responsibility for notifying other countries and initiating requests for international assistance. Under existing early notification conventions, the DTI would inform the European Community, the IAEA, and countries with which the UK has bilateral agreements, about the accident and its likely course and effects.

Extendibility

~~1~~16.86 Emergency planning is based around a design basis accident that is a reasonably foreseeable accident or reference accident with detailed arrangements for a rapid response within a defined zone close to the site. The detailed arrangements are flexible and capable of being extended for extremely unlikely but greater consequence accidents. To aid extendibility the detailed emergency plans dovetail with local and national disaster plans.

16.87 The reference accident would require the implementation of countermeasures and is used to determine the size of the detailed emergency planning zone (DEPZ). For Magnox reactors DEPZs range from 1.6 to 3.5 km. In the case of modern plants, AGRs and PWR, improvements in design standards and safety assessment methods have resulted in successive reductions in the size or consequences of the reference accident. For these plants the reference accident may not require any actions beyond the site boundary. The need for a detailed emergency planning zone in such cases arises from the desirability of having a foundation for responding to larger accidents (basis of extendibility).

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 16

Q16.1 In assessing the radiological release due to a nuclear accident, have "worst case scenario" assumptions been applied?

Where there is the potential for an offsite release of radioactivity which would require implementation of countermeasures detailed emergency planning zones are provided around nuclear installations. These zones are defined based on the most significant release of radiation from an accident, which can be reasonably foreseen. In the event of an accident being larger than the reasonably foreseeable event there are arrangements for extending the detailed emergency-planning zone.

Q16.2 It appears that the operator is responsible in the first phase of an emergency situation for proposing off-site protective measures. Are these proposals reviewed by HSE or other independent agency before implementation?

During the initial phases of an emergency with off-site consequences the operator will be responsible for notifying relevant off-site organisations and for recommending actions to protect site staff and members of the public. The response for the initial phase including the criteria for giving advice on public protection is pre-determined and included in the operator's off-site emergency plan. The operator's emergency plans are routinely reviewed and approved by HSE.

Q16.3 The values of intervention levels for ingestion of stable iodine tablets and evacuation are much lower than the recommended values of ICRP publication 40. Could the United Kingdom explain the rationale for adopting these values?

Intervention levels represent a balance between the expected harms and benefits of implementing a countermeasure. These harms and benefits include a wide range of factors. Some are, in principle, quantifiable, but subject to large uncertainty, like dose averted. Others are much more subjective, like reassurance provided and disruption caused. Any numerical guidance is therefore indicative, not precise. In this context, the UK views the numerical values of its ERLs and ICRP's intervention levels to be consistent: the difference between 30 mSv and 50 mSv is small compared with the uncertainties inherent in the criteria themselves.

Q16.4 Are there computerised support systems to understand the status of the installation, to predict the accident progression and the doses around the plant?

A range of tools, including computerised support systems, are used by different operators to predict the future consequences of plant situations: these range in focus from core conditions and future evolution through to off-site dispersion and deposition and consequent public exposure from radionuclides released to the environment. Other bodies, such as national authorities employ tools appropriate to their responsibilities.

Q16.5 The last sentence of para 16.20 [now 16.21] gives an impression that the Site Emergency Controller and his staff isolate themselves from the off-site agencies once the latter becomes operational. Should this be so, how does the off-site facility obtain its dynamic site-related information on releases etc.? In the same vein, who keeps the Government

Technical Adviser updated on a developing emergency (Para's 16.31 and 16.32 [now 16.32 and 16.33])?

The site emergency controller and his staff do not isolate themselves from the off-site agencies once the off-site facility (OSF) is operational, since contact is maintained with the operator's technical support team at the OSF. The operator's technical support team ensures that information on the developing situation at site is distributed to all organisations at the OSF including the GTA. In addition, HSE despatches a team of inspectors to the incident site and upon their arrival they establish contact with the HSE team at the OSF and keep them informed of the situation on the site. The HSE OSF team keeps the GTA informed of the developing situation as do other agencies including Food Standards Agency and NRPB.

Q16.6 Emergencies may go beyond the bounds of procedures authorised in the nuclear licence e.g. severe accidents. Since HSE inspectors, under statutory powers, ensure that operators take all reasonable steps to restore plant safety and minimise the risk to the public, clarification is sought regarding ownership of the ultimate responsibility for safety in emergency situations. In addition, information is requested on any guidelines that are available to aid in the mitigation of such severe accidents.

During an accident the HSE response is primarily one of witnessing, monitoring and recording the operators response to the event. The responsibility for taking corrective actions at the site remains with the operator. The operators' emergency plans have been developed to cater for accidents greater than the reasonably foreseeable event and therefore the provision for extending the detailed emergency planning zone.

Q16.7 For what time period is the averted dose calculated?

The integration time for the averted dose is the time for which the countermeasure is expected to be in force. This may range from a few hours to a few days, depending on the countermeasure and the accident.

Q16.8 How often does HSE require training for all employees for nuclear installations to be prepared for emergencies?

The nuclear site licence requires the licensee to have adequate arrangements for responding to an emergency. This requires the licensees to satisfy themselves that those who have responsibilities for responding to an emergency are adequately trained. Therefore HSE do not prescribe the frequency of training requirements to the licensee. A part of the licensees training arrangements include all staff participating in a regular programme of emergency exercises, which requires each shift at each nuclear site to exercise the arrangements at least once a year. Also, each site is required to demonstrate its arrangements once every year and to test the off-site facility once every three years. To satisfy itself on the adequacy of the licensees emergency arrangements HSE routinely witness emergency exercises (see paras 16.76 to 16.80 [now 16.77 to 16.80]).

Q16.9 The national report gives evidence on compliance with the CNS requirements for this area. Nevertheless, with reference to 'Guidelines Regarding National Reports' it is requested to complement information in the national report related to Article 16 of the Con-

vention with a block scheme (diagram) of the overall emergency preparedness system, which will give an overview of interfaces between its individual elements.

This request for a block diagram to summarise the explanatory text on emergency preparedness will be included in the revision to the National Report, which will be prepared for the next Review Meeting.

Q16.10 Guidelines recommend that the same Chapter shall mention all international agreements related to the emergency preparedness. Introduction of bilateral/multilateral agreements into this Chapter will provide for a better understanding of the overall emergency preparedness system in the United Kingdom.
The UK Government has bilateral arrangements with Denmark, France, The Netherlands, Norway and the Russian Federation. HSE has bilateral arrangements with Belgium, Canada, the Czech Republic, France, Germany, Hungary, Ireland, Italy, Japan, Korea, the Russian Federation, South Africa, Spain, Sweden, the Ukraine and the USA.

Q16.11 There is a 'detail emergency planning zone' around each nuclear installation in which public protective actions are planned in detail. What is the rationale and the assumptions used for establishing 'detail emergency planning zone' in the case of postulated accidents and accident consequence? (If possible, include an example of the existing NPPs in the UK)
Where there is the potential for an offsite release of radioactivity which requires the implementation of countermeasures detailed emergency planning zones are provided around nuclear installations. The zones are defined based on the most significant release of radiation from an accident which can be reasonably foreseen (often called the reference accident), for example for a Magnox reactor the reference accident is a burst bottom duct with a single channel fire resulting in a release of 1000 curies of iodine. In the event of an accident being larger than the reasonably foreseeable event there are arrangements for extending the detailed emergency planning zone.

Q16.12 The use the International Nuclear Event Scale (INES) for emergency plans initiation is not correct as INES is based upon the analysis of actual consequences of and accident, and decisions on population protection under emergency shall be taken in the course of accident basing upon other criteria and predictions as indicated in item 16.18 [now 16.19].

INES is not used by operators for the initiation of their emergency plans. Implementation of the off-site emergency plan would be based on whether the information being collected indicated countermeasures were needed to protect the public. INES would be used to inform the public on the scale of event.

Q16.13 It is not clear, if a system if clear-cut criteria to be followed to invoke the emergency activities at the initial accident stage exit. If the decisions are made proceeding from the prediction of probable consequences for population, who and when performs such predictions?
The emergency plan has criteria, which can be used by the Emergency Controller to establish the actions to be taken. If the radiological hazard beyond the site is such that countermeasures to protect the public are required, this advice will be given to those responsible for implementing countermeasures.

ARTICLE 17 - SITING

Text of Article 17:

'Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

(i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

(iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

(iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.'

This section of the report covers:

- **laws and regulations (paragraphs 17.1 to 17.6);**
- **siting policy (paragraphs 17.7 to 17.12);**
- **implementation (paragraphs 17.13 to 17.20);**
- **maintaining the continued acceptability of the site (paragraphs 17.21 to 17.27);**
- **international arrangements (paragraph 17.28).**

National Laws, Regulations for Planning and Licensing Process

17.1 An organisation wishing to construct, extend or operate any type of power generating station in the UK must first obtain planning permission from the relevant local authority under the Town and Country Planning Act (1990) (TCP Act) {Ref. 54 ~~48~~}.

17.2 For proposals for stations exceeding 50 megawatts, organisations must also obtain a consent under Section 36 of the Electricity Act 1989 (see paragraph 7.15) from the Secretary of State for Trade and Industry for stations in England and Wales, the Secretary of State for Scotland for stations in Scotland or, in the case of stations in Northern Ireland, the Secretary of State for Northern Ireland. Before granting a Section 36 consent, the relevant Secretary of State must consult the relevant planning authority. If that authority objects to the proposed development and those objections are not subsequently addressed and the proposal modified accordingly, a public inquiry must be held. Public Inquiries may consider all factors relating to the proposal. Where the relevant planning authority does not object to the proposal, the relevant Secretary of State may, in any case, choose to hold a public inquiry if he or she considers this to be appropriate in the light of other objections and considerations. In the case of a nuclear installation, while a public inquiry is not legally obligatory, given the inevitable objections which will arise, one would be held.

17.3 Under the Electricity Act, the relevant Secretary of State has the power, having consulted the relevant local authority and following any public inquiry which might have been required, to direct that a Section 36 consent means that planning permission under the TCP Act has also been granted.

17.4 Proposals for nuclear power stations and also for non-nuclear stations with a heat output of over 300 megawatts, must be accompanied by an assessment of the environmental impact of the proposed development for consideration by the relevant Secretary of State.

17.5 For Scotland, the Town and Country Planning (Scotland) Act 1997 {Ref. 55 ~~49~~} provides a comparable planning framework for the consideration of the siting of a nuclear installation to that for England and Wales in the TCP Act and the Secretary of State for Scotland has similar powers to direct that a public inquiry be held.

Nuclear Site Licence

17.6 In addition to the above, under the NI Act section 1(1) (see Annex 6) no corporate body can use any site for a nuclear installation unless a nuclear site licence has been granted in respect of that site by the HSE and is for the time being in force. Also, under section 4(1) of the NI Act, on granting any nuclear site licence HSE can attach such conditions as may appear to HSE necessary or desirable in the interests of safety. The Licence Conditions (LCs, see Annex 4) include provisions with respect to siting. In particular, LC 2 requires the licensee to mark the boundaries of the nuclear licensed site. Section 6(1) of the NI Act requires the Minister to maintain a list showing every site for which a nuclear site licence has been granted and including a map or maps showing the position and limits of each such site.

Government Siting Policy

17.7 Government policy on siting nuclear installations reactors has developed over time. The White Paper 'A programme of nuclear power' (1955) section 37 stated that '... the first stations, even though they will be of an inherently safe design, will not be built in heavily built-up areas.' A definition of a remote site, based on characteristics of the early sites, was used for all subsequent steel vessel Magnox reactors.

17.8 The Government's siting criteria were developed in 1955 as:

- Only a few people should be subject to extreme risk: plans should be prepared for affecting the urgent evacuation of persons close to the site in the downwind direction.

- Protracted evacuation or severe restriction on normal living should not be imposed on any but small population centres.

- Temporary evacuation or restrictions should not be necessary for more than 10,000 people in any but exceptional weather conditions. If an accident were to coincide with exceptional weather conditions, not more than 100,000 persons should ultimately be affected.

17.9 On 6 February 1968 the Minister of Power stated that as a result of advances in technology the safety of a gas-cooled reactor in a concrete pressure vessel was such that it may be constructed and operated much nearer built-up areas than had so far been permitted. The Minister commented that there were advantages in having these stations near centres of population in terms of amenity and of transmission costs.

17.10 The Minister of Technology on 23 March 1970 stated that before a site is accepted for a nuclear power station, account is taken of all known development plans. This ensures that projected developments in the vicinity of the station are not hampered.

17.11 On 5 December 1973 the Secretary of State for Trade and Industry stated that first of a kind reactors, if licensable, would be built on sites similar to those used for early Magnox reactors, i.e. remote sites, and relaxation to sites nearer centres of population would depend on relevant experience.

17.12 The Secretary of State for Energy on 11 March 1988 tabled the demographic criteria for assessing potential sites, both for Magnox reactors and AGRs. Magnox reactors in concrete pressure vessels would be allowed some relaxation of the general Magnox criteria if necessary. The Secretary of State for Energy stated that once a site has been accepted for a nuclear station, arrangements were made to ensure that residential and industrial developments were so controlled that the general characteristics of the site were preserved, (see paragraph 17.22).

Implementation

Licensing

17.13 Would-be operators of nuclear installations make simultaneous applications for planning consent and for a nuclear site licence. The licensing process is therefore concurrent with a Public Inquiry. However, HSE would not grant a licence in advance of a 'Section 36' decision by the Secretary of State (see paragraph 17.2).

17.14 The HSE assesses the suitability of a site before granting a nuclear site licence, or before giving evidence to a Public Inquiry as to the licensability of a nuclear installation.

17.15 For new nuclear installation sites, the licensee submits to HSE details of present and predicted population around the site out to 30 km. Information on nearby schools, industry, hospitals, institutions and other places where people may congregate is included. HSE will assess this information against its criteria, defined in the SAPs {Ref. 7 ~~2~~}.

Hazards

17.16 When siting nuclear installations account is taken of natural and man-made hazards in the area. Earthquakes, flooding, drought, high winds and extremes of ambient temperature are examples of natural hazards which are considered. Man-made hazards include the possibility of an aircraft crash on the site and storage, processing or transport of hazardous materials in the vicinity. Particular attention is given to both seismic events and hazards from aircraft in the SAPs which require that:

- The aircraft crash frequency of the site be determined using the most recent statistics taking into account forecast changes of flight patterns.

- The relevant bodies should be consulted with the object of minimising the risk from aircraft approaching or overflying the plant.

- The seismology, geology and earthquake history of the area should be established.

17.17 Consideration is also given as to whether the presence of the nuclear installation might have undue effects on the local environment. For example the environmental effects of radio-active discharges.

Emergency arrangements

17.18 Another factor is the population distribution and access facilities in the area. Although high safety standards are required of nuclear installations, effective emergency arrangements are also required. This is dependent upon how many people might be involved and how the appropriate counter measures, in particular the distribution of stable iodine, and evacuation might be introduced.

17.19 The emergency plans will address the design basis accident (see Article 18) for the plant. This gives the off-site release as the basis for the immediate emergency response (see Article 16). The HSE must be satisfied that the size, nature and distribution of the population around the site are properly taken into consideration. If planning permission is granted for the site there will be planning controls to ensure that significant and unacceptable population growth does not occur. In the UK the area requiring these restrictive controls varies from 3 to 3.5 km for the older plants to 1 km for modern stations. The area is determined by the HSE in accordance with PIRER 1992 {Ref. 28 ~~21~~}. These Regulations (in so far as they apply to nuclear installations) will be subsumed into the Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR) due to be enacted later this year.

Topography

17.20 The siting of the nuclear installation will require consideration of the topography for the area which might effect the dispersion of the authorised radioactivity discharged from the site in normal operation or release in the event of an accident. In addition, aspects of the to-pography of the area around the site which may affect the movement of people and goods are identified and their effect on the safety of the plant examined. This examination determines whether the topography and road and rail systems are such as to create difficulties if it became necessary to evacuate people from the area around the plant.

Maintaining the continued acceptability of the site

17.21 Continued re-evaluation of external hazards and of the emergency plans is required under LCs 15 and 11 respectively. Guidance on re-evaluation of the specific demographic requirements on siting is given to HSE nuclear installation inspectors in the SAPs.

17.22 Local authorities consult the HSE with regard to any proposed development which might lead to an increase in population close to the site and on large developments further from the site. Limiting criteria based upon population distribution are used only for guidance and the HSE cannot necessarily insist on rigid adherence to them.

17.23 A joint circular to local authorities from the Department of the Environment (11/1992/84) and the Welsh Office (11/1992/WO) and a similar circular from the Scottish Development Department (5/1993) gave advice on the exercise of planning control over hazardous development and over development in the vicinity of hazardous installations.

17.24 Appendix 2 of the circular gives guidelines for the types of development in the vicinity of hazardous installations on which HSE should be consulted. These circulars established HSE as a statutory consultee for development in the vicinity of hazardous installations covered by the Regulations for Control of Development (Hazardous Installations) {Ref. 56 ~~50~~}. HSE has non-statutory arrangements, operated under the same administrative arrangements, to be consulted by local authorities in the case of planning applications in the vicinity of all nuclear installations. HSE's nuclear installation inspectors assess such planning applications to determine:

- whether a proposed development would raise the population to near the maximum guidelines set out in the Government's siting policy for nuclear installations;

- whether the external hazards in the nuclear safety case envelope the hazard from a proposed hazardous installation, or alternatively whether the nuclear safety case can be modified to incorporate the new hazard;

- for a proposed development within the nuclear licensed site, whether the licensee has made a satisfactory safety case for the proposed development and for any existing licensable activities on the site that it would impinge upon, and whether the proposed activity is suitable for a nuclear licensed site;

- for a proposed development within the detailed emergency planning zone (where applicable), HSE refers the application to the licensee, who must in turn liaise with those bodies having responsibilities under the off-site emergency plan, to find:

whether the development can be incorporated into the emergency plan; or failing that,

whether the emergency plan could be modified such that the development could be incorporated into the emergency plan.

17.25 Local authorities are not obliged to, but normally follow HSE's advice. HSE can appeal to the Secretary of State for ~~the~~ Environment, Food and Rural Affairs ~~Transport and the Regions~~ if a local authority does not accept HSE's advice.

17.26 The HSE maintains a database of the estimated population around nuclear installations based upon the most recent ten-yearly population census, updated to take account of subsequent planning applications for residential developments. This database is used to compare the projected population following a proposed residential development with government demographic guidelines before HSE advises a local authority on the acceptability of such a planning application.

Periodic review of nuclear installation discharge authorisations

17.27 Authorisations are reviewed regularly involving consideration of the level of actual discharges and the margin between discharges and limits. Against a background of Government policy that limits should reflect closely actual discharges, the environment agencies may decide to vary authorisations following a review, to set more stringent limits and conditions and to require improvement programmes to be instituted.

International Arrangements

17.28 In the case of an application to the Secretary of State for Trade and Industry for a Section 36 consent for a new nuclear power station, the UK Government will send a copy of the application to the Directorate General for Energy of the European Commission. The Commission will make the application known to other Member States through the Official Journal of the European Communities. Once a public inquiry is called, evidence may be submitted to the inquiry by anyone from any country.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 17

Q17.1 Have state-of-the-art seismic analyses been performed for the United Kingdom nuclear power plant sites (e.g., probabilistic seismic hazard analyses, seismic margin analyses, seismic PSA)? Did any upgrading result from these analyses? If the analyses are planned, what is the schedule for their completion?

State of the art seismic analyses have been performed on all UK nuclear power plant sites including in some cases probabilistic seismic hazard analyses and seismic margin analyses. All plants are compared against modern standards in the periodic safety review. For the plants that were not originally designed for earthquake forces this has often meant that upgrading modifications have had to be carried out or are being progressed at present. Upgrading to essential plant as a result of seismic analysis has included: anchoring of previously unanchored equipment e.g. cabinets, the addition of extra bracing to steel structures, the improvement of the robustness of battery systems and the strengthening of masonry walls. Seismic qualification of diverse shutdown systems and tertiary feedwater systems has also been undertaken.

Q17.2 Attention is given to maintaining the continued acceptability of the site regarding population and industrial uses. Is there a surveillance programme for assessing the validity of other site parameters, like meteorological, hydro-geological or seismic?

There are a variety of surveillance programmes for assessing the validity of site parameters. For example for seismic events there is a national network of strong ground motion instruments, also each site has its own earthquake instrumentation. Meteorological data (wind, rainfall) and tide levels (river levels were appropriate) are recorded by sites. PSRs have required the licensees to assess plants against extreme winds having a non-exceedance of one in 10,000 per annum. The licensees also take account of factors such as global warming in their safety cases.

Q17.3 Paragraph 17.8 provides for consultation with neighbouring CPs only through the Commission of the EU. Ireland believes this does not fully comply with the obligation for each CP to consult as laid down in Art. 17(iv).

The UK is committed to the Article 17 requirement that "appropriate procedures are established and implemented (iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation (i.e. a nuclear power plant), insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation". The UK has some existing mechanisms e.g. consultation through the Euratom Community and a public inquiry system, which ensure that the key information, which would enable any other Contracting Party to the Convention to assess for itself any impact any new nuclear installation (i.e. a new nuclear power plant) might have on its own territory and public, is made publicly available to them.

INTENTIONALLY

BLANK

ARTICLE 18 - DESIGN AND CONSTRUCTION

Text of Article 18:

'Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.'

This section of the report covers:

- **the licensing process and the regulatory control (paragraphs 18.1 to 18.7);**
- **the implementation of the defence in depth concept (paragraphs 18.8 to 18.10);**
- **the prevention of accidents and their mitigation (paragraphs 18.11 to 18.16);**
- **measures for ensuring the application of technologies are proven by experience or qualified by testing or analysis (paragraphs 18.17 to 18.19);**
- **requirements on reliable, stable and easily manageable operation (paragraph 18.20).**

Licensing process and regulatory control

18.1 The design and construction aspects of a nuclear installation are controlled by the Licence Conditions (LCs) 14, 19, and 20 (see Annex 4) attached to the nuclear site licence required by the NI Act (see paragraph 7.5).

18.2 Under LC 14, the operator makes and implements adequate arrangements "for the production and assessment of safety cases consisting of documentation to justify safety during the design, construction, manufacture, commissioning, operation and decommissioning phases of the installation."

18.3 Under LC 19, the operator makes and implements "adequate arrangements to control the construction or installation" of a new plant. It requires the construction or installation to be divided into phases. The HSE can specify that its consent must be obtained before proceeding from one stage to the next of the construction or installation. There is also a requirement for "adequate documentation to justify the safety of the proposed construction or installation" which, as appropriate, is submitted to the HSE.

18.4 Under LC 20, the licensee makes and implements “adequate arrangements for modification to the design of the plant during the period of construction”. The HSE may specify that these arrangements may be submitted for approval in whole or in part. Modifications can,

where appropriate, be divided into stages and the HSE can specify that stage consents be sought before proceeding beyond that stage in the modification.

18.5 All these LCs require "the provision of adequate documentation to justify the safety" of the particular aspect (see Article 14). LC 22 is the means by which any changes to the design and construction of the nuclear installation are assured to be equivalent or to improve standards with respect to the original construction.

Regulatory control over the design process

18.6 The regulatory control over the design process is described under Article 14.

Regulatory control over the construction process

18.7 In carrying out its control and regulatory function, HSE satisfies itself that the licensee applies the highest practicable standards in the fabrication and inspection of new nuclear plant or the repair and replacement of components in existing plant. The HSE's nuclear installation inspectors confirm that the relevant SAPs (see paragraphs 14.48 to 14.52) are satisfied. This is particularly the case where the “Special case procedure” (see Annex 8) is invoked. The HSE's nuclear installations inspectors satisfy themselves that such components are manufactured and inspected to standards that are consistent with the incredibility of failure claim.

Defence in depth

18.8 In the UK, defence in depth is an important aspect of a nuclear installation's safety case. The UK's system of defence in depth incorporates:

{ prevention of abnormal operation and failures;

{ control of abnormal operation and detection of failures;

{ control of accidents within the design basis;

{ control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of severe accidents;

{ mitigation of radiological consequences of significant releases of radioactive materials.

18.9 Each licensee has recognised that the design safety criteria in place at the time of the original design and construction of its current plant do not necessarily fully meet modern standards and expectations. Guidance has therefore been prepared for designers and assessors on the nuclear safety principles to be used in the review of existing designs of nuclear installations and the preparation of proposals to modify them. These principles address the reasonable practicability of achieving improvements in existing plant safety performance. For the newest nuclear installations in the UK, the licensees' approach to “defence in depth” includes many of the following:

1. Defence in depth against potentially significant faults or failures using:

a) multiple physical barriers to the release of radioactive materials to the environment; and

b) several levels of protection which prevent the breach of any barriers or mitigate the consequences of a breach. These levels of protection include not only engineered control and safety systems but also aspects such as conservative design, quality assurance, accident management strategies and off-site emergency response.

2. Structures, systems and components important to safety are designed to be inherently safe or to fail in a safe manner. Potential failure modes are identified, using a formal analysis where appropriate.

3. The design makes the best use of diversity, redundancy and segregation in the structures, systems and components that are important to safety.

4. All structures, systems and components are allocated a safety categorisation that take account of the consequences of their potential failure and of the failure frequency requirements placed on them in the safety analysis. This categorisation is used to determine the standards to which those items are constructed.

5. External and internal hazards that could affect the safety of the plant are identified. They are treated as potential initiating events of fault sequences and, where appropriate, taken in combination with other plant faults.

6. Adequate safety systems are available to reduce the frequency or limit the consequences of fault sequences. No fault, internal or external hazard, disables the safety systems provided to safeguard against that event. Control systems and safety systems are physically separated and do not share equipment or services.

7. The layout of safety system equipment and safety-related plant and services minimises the effects of internal and external hazards and of any interactions between a failed structure, system or component and other safety-related structures, systems or components.

8. A qualification procedure confirms that all safety systems and safety related equipment would perform their required safety functions throughout their operational lives, under the operational, environmental and accident conditions specified in the design. This procedure where reasonably practicable, includes a demonstration that individual items can perform their required functions under the specified conditions.

9. Provisions are made for monitoring and inspecting safety systems, safety-related structures, and components in service or at intervals throughout plant life commensurate with the reliability required of each item. In especially difficult circumstances where this cannot be done, either additional design measures are incorporated to compensate for the deficiency, or adequate long-term performance is achieved without such measures.

10. Normally, a safety system is automatically initiated and no human action should be necessary for a period following the start of the requirement for protective action. The design, however, is such that plant personnel can initiate safety system functions and can perform necessary actions to deal with circumstances that might prejudice safety, but cannot negate correct safety system action at any time.

11. No single random failure assumed to occur anywhere within the safety systems provided to perform a safety function prevents that function being performed during any normally permissible state of plant availability. Consequential failures resulting from the assumed single failure are considered as an integral part of the single failure.

12. Redundancy is incorporated within the designs of safety systems so as to achieve required high levels of reliability unless it is demonstrated with high confidence that the reliability is achieved by other means.

13. Diversity and segregation is used, as appropriate, where the possibility of common cause failures would otherwise threaten the achievement of the reliability required for a safety function.

14. Where high reliability is sought from a safety system through the use of redundant identical components, measurements or actions, a common cause failure limitation is placed on the claimed reliability of the system.

18.10 The HSE, during its assessment of the licensee's safety case, checks that the above approach has been followed, so far as is reasonably practicable.

Prevention of accidents and their mitigation

18.11 A central and key element during the design process is the analysis of possible accidents on the nuclear power plants. This covers all significant sources of radioactivity associated with the plant and all planned operating modes. The analysis starts with a list of initiating faults, including internal and external hazards, and faults due to personnel error which have the potential to lead to any person receiving a significant dose of radiation. The safety case demonstrates a systematic process for establishing the list of faults. A radiological analysis is performed for fault sequences, which could lead to the release of radioactive materials, to determine the maximum effective dose to persons on or off the site. The fault sequences are normally grouped and a "bounding case" for each group is specified. These bounding cases take account of the demands made on the safety system. They have consequences at least as severe as any member of the group of fault sequences that they bound.

18.12 The fault analysis process leads to the determination of the Design Basis Accidents (DBAs) for the nuclear installation. These accidents are drawn from the fault analysis but do not include initiating faults which are determined to be very improbable and meet the following criteria:

- internal plant faults which have an expected frequency lower than about 10^{-5} per year;

- failures of structures, systems or components which form a principal means of ensuring nuclear safety and which have been accepted by a comprehensive examination, using relevant scientific and technical issues, to ensure an acceptable standard of integrity commensurate with the potential radioactive consequences if they fail;

- external hazards to the plants where it can be demonstrated that their frequency is less than once in 10 thousand years.

18.13 The design basis fault sequences are identified starting with each design basis initiation fault, i.e. those not excluded by the criteria outlined above. They include as appropriate: failures consequential upon the initiating fault; failures expected to occur due to having a common cause; and single failures within the safety systems. The analyses of DBAs are done on a conservative basis and assume the worst normally permitted configuration of equipment, unavailability for maintenance, test or repair.

18.14 For each design base fault sequence or bounding case, which leads to a release of radioactive material, the radiological analysis to determine the maximum effective dose to a person outside the site assumes:

i) that the person remains at the point of greatest dose for the duration of the release (except for extended releases, when more realistic times at the location can be assumed);

ii) weather conditions occur that produce the highest dose to the person;

iii) there are no off-site emergency counter measures.

18.15 The design basis fault sequences show that:

i) none of the physical barriers to the escape of radioactivity is breached or if any are, then at least one barrier remains intact;

ii) there is no release of radioactivity except in the most severe cases when no person outside the site will receive an effective dose greater than 100 mSv;

iii) no person on the site will receive an excessive dose from the release of radioactive material.

18.16 The design basis analysis establishes the minimum safety system requirements for each initiating fault and also identifies the operator's administrative requirements. It therefore provides information for:

i) the trip setting and performance requirements for the safety systems and safety related equipment;

ii) the determination of the plant operational limits and the formulation of the operating rules;

iii) the preparation of the plant operating instructions for fault conditions.

Technologies proven by experience or qualified by testing or analysis

18.17 Nuclear installations designed to modern standards, such as Sizewell B or the more recent AGRs included the qualification of equipment for all DBAs within their safety cases. This qualification often involved arduous testing or comprehensive analysis or both usually in line with modern national or international standards or other specific regulatory requirements.

18.18 For older plant, there will not be evidence from the design phase to address modern requirements for equipment qualification and safety analysis. However, the designers employed more conservative design approaches and less complex control and instrumentation technology than current designs and had access to comprehensive prototype and rig data. In addition, the experience of operation of earlier nuclear installations has provided operational, maintenance and inspection data. This has led to increased confidence in meeting required safety equipment performance levels or, alternatively, the need for a modification or replacement with more modern technologies meeting current safety design criteria where appropriate.

18.19 Furthermore, almost all nuclear installations have now completed at least one major PSR (see paragraphs 6.14 to 6.29 and paragraphs 14.22 to 14.30 ~~24~~). These reviews and other routine regulatory activities, together with the ongoing plant monitoring and collection of lifetime data provides additional assurance that safety related equipment is capable of performing its intended duty.

Requirements on reliable, stable and easily manageable operation

18.20 Another important aspect of the design process is a detailed consideration of the role of the operator. Particular emphasis during the design stage is placed on identifying the safety actions required of the operators and specifying the User Interface design. Article 12 provides a statement of the UK approach to ensuring an adequate treatment of human factors throughout the life cycle of the plant.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 18

Q18.1 Which provisions were made to address ageing effects for the first generation gas cooled reactors? Are provisions also required for the second generation?

See response to Q14.3.

Q18.2 It is stated that the original design of some plants do not necessarily fully meet modern standards, therefore guidance has been prepared for achieving improvements in existing plant safety performance. What have been the main concerns and how have they been addressed?

One objective of Periodic Safety Reviews is to assess compliance with current standards. This does not mean that a plant must comply fully with current standards but it does mean that all shortfalls must be fully evaluated and remedial action taken where reasonably practicable. The guidance for this process is embodied in the SAPs {Ref. 7}, which are described under article 14 of this report (paragraphs 14.48 to 14.52). The main regulatory concerns for the Magnox plants are outlined in Annex 3 to the UK report. Some examples of plant modifications undertaken to address these concerns are: -

1) Secondary shutdown systems have been installed at reactors to provide defence in depth against failure of the original system to operate on demand.

2) Tertiary shutdown systems have been installed to inject neutron absorbers into the reactor in the event of failures of the primary and secondary systems.

3) Improvements have been made to fire safety by modifications to fire detection, barriers and fire suppression.

4) Seismically qualified diverse and redundant power supplies have been installed and dedicated to supplying post trip cooling requirements.

5) ~~The provision of additional diverse and redundant cooling water supplies to provide post trip cooling in the event of failure of the original designed systems.~~ Tertiary cooling systems have been installed of diverse design to the existing systems.

6) Secondary ~~control~~ emergency indication centres have been built to monitor the reactor and cooling circuits in the event of an accident, should the original control room become untenable.

7) Cranes and nuclear lifting equipment have been upgraded to modern standards to provide assurance that they will not compromise nuclear safety. Restrictions may also be placed upon crane operations and movements.

As well as hardware upgrades some issues have been resolved by additional inspections or other verification work (e.g. reactor pressure vessels) or by changes to procedures (e.g. ageing management systems). This work is underpinned by the defence in depth principle, which

permits the loss of a complete protection system, without placing the plant at risk. (Also see response to Q6.5)

Q18.3 No mention of the approach towards beyond design basis accidents is made in this article. Is there some generic policy by HSE for addressing severe accident response by current plants?

There is a requirement for the licensees to identify the beyond design basis fault sequences which have the potential to lead to a severe accident, to provide an analysis to determine what failures could occur in the physical barriers to the release of radioactive material and to determine the magnitude and characteristics of the radiological consequences.

The results of such analyses have been used as the basis for identifying the accident management strategies, which have been developed to reduce the risk from severe accidents by preventing the failure of the barriers or mitigating the consequences. This analysis has resulted in the production of procedures for dealing with severe accidents and the provision of instrumentation and other equipment where necessary.

Q18.4 The design principles are given in detail. However, it is less clear how these principles are applied, and especially for the oldest plants. It is indicated that* "guidance has been prepared for designers and assessors of the nuclear safety principles to be used in the review of existing designs of nuclear installations and the preparation of proposals to modify them".** ***Could the United Kingdom give a general description of this guidance in order to understand how the safety of the oldest plants has been justified? In particular it would be worthwhile to explain how the plants satisfy the basic safety limits (BSL) defined in the SAPs.

This refers to the SAPs {Ref. 7} and corresponding corporate guidance maintained by the licensees. (Note that licensees are not required to adopt the SAPs as their own standard.) These are used to define the 'modern standards' with which older plants are compared in Periodic Safety Reviews (see para 14.22(ii)). Paragraphs 14.48-52 cover the SAPs, including their use in assessment of existing plants.

Paragraph 14.27 identifies specific topics identified from the PSRs, where further work has been required to improve the justification of the safety of older plant. Compliance with the basic safety limits (BSLs) is addressed by the use of probabilistic safety analysis, as mentioned in Paragraph 14.9.

Q18.5 It is recognised that, for the oldest plants, the equipment qualification was less complete. How this incompleteness is justified? Is it taken into account in the probabilistic safety analysis?

See the response to Q18.6 on this topic. The fault sequence analysis carried out as part of the PSA identifies the failures of safety system equipment that could occur as a consequence of the initiating event. This includes the consequential failures which would occur due to the environment (temperature, pressure, humidity, etc.) generated by the initiating event. In general, the assumption is made that a component or system would fail where the level of equipment qualification has not been shown to be adequate.

Q18.6 The wording about the subject 'equipment qualification' indicates that components may be in use in the old(er) British NPPs that are not sufficiently qualified for the environmental conditions that arise after accidents. It is possible that this lack of qualification is dealt with by generic remarks about the larger safety margins that were used in the design in those earlier days, and the experience that was obtained from test reactors. In the report we only find generic statements about equipment qualification. What has been done in the UK regarding environmental qualification of individual equipment and components, especially in older NPPs?

Although the term "equipment qualification" was not used at the time the early plants were designed and built, the concept that underlies it was well understood. There was recognition of the need for redundancy, segregation and conservative safety margins where safety was known to depend on equipment behaviour.

Not as well understood at that time however, because safety analysis was itself in its infancy, were the more complex failure mechanisms and their effects, especially those involving system and human interactions. These shortcomings have to a large extent been corrected by later work, resulting from the outcomes of mandatory PSRs. The review includes a full assessment against modern standards, including PSA, and any shortfalls must be justified. Equipment qualification represents a major feature of these reviews, especially in relation to ageing of structures, systems and components, and to environmental conditions both during normal operation and after accidents.

Q18.7 Is the defence in depth principle laid down/ anchored in any official code or guide? Or are the licensee's obligations to submit its safety guidelines and to produce a 'Safety Case', as described in chapter 7.28 the heart of the matter? In other words, are there any official guidelines for the licensee on which design basis is acceptable for the HSE/NII?

The defence in depth principle is set out in the SAPs (see paragraphs 14.48 - 14.52). The SAPs are primarily a guide to the HSE assessors and are the basis on which HSE will make judgements. The licensees have developed the SAPs to produce their own more detailed guidance that is used for the development of safety cases and for the design of safety enhancements. The SAPs are consistent with IAEA safety standards.

Q18.8 What are the 'relevant standards' being used for the construction of the User Interface Design (sec. 12.11 national report)? How is an 'easily manageable operation' achieved?

When a licensee carries out modifications to a User Interface - e.g., for reasons of refurbishment or as part of an equipment modification, then HSE expects the licensee to demonstrate that it has applied good human factors practice. HSE does not set out the standards that are used by the licensee. To do so would not be compatible with the non-prescriptive UK regulatory regime. However, we seek evidence that a structured design approach has been adopted. That approach should involve the use of suitable human factors standards or guidelines. The licensee may choose to draw upon guidelines contained in documents such as NUREG-0700, or it may decide to develop its own guidelines. In the recent case of a station that carried out a major refurbishment of the information presentation systems in its Main Control Room (MCR), the latter approach was adopted. This enabled the licensee to take account of a wide range of guidance and research, and to set this work in context of its own design and operating philosophy. HSE monitored this work, and was satisfied that good human factors principles were developed and applied.

The use of the term "easily manageable operation" (sub heading to Para 18.20) although used in Article 18 text, may be slightly misleading. In the submission under Article 12 it was emphasised that the MCR - and, indeed, all parts of plant - should be designed in such a way as to enable efficient and reliable operation (this could equate to “easily manageable”). In order to achieve this, HSE considers that the licensee should clearly identify the job and task demands that are placed on the operators, and should then design the plant so that operator actions are properly supported. This means taking account of human capabilities and limitations, and applying ergonomics principles underlying the design and operation of factors such as Man-Machine Interface (MMI) specification and design, procedure design and presentation, training, working environment, staffing provisions and the organisational/working arrangements.

Q18.9 To what extent has probabilistic analysis been conducted on the various UK nuclear installations to identify and mitigate severe accident challenges?

Probabilistic safety analyses (PSAs) have been carried out for all the nuclear power plants in the UK. These PSAs identify the fault sequences that have the potential to lead to severe accidents. The results of such analyses have been used as the basis for identifying the accident management strategies that have been developed to reduce the risk from severe accidents by preventing the failure of the barriers or mitigating the consequences. These analyses have resulted in the production of guidelines for dealing with severe accidents and the provision of instrumentation and other equipment where necessary.

Q18.10 The description of “defence in depth” concept lacks the requirement for sufficient safety barriers state monitoring aimed at ensuring the performing by those barriers the assigned tasks of prevention of radioactive products propagation in to environment under emergency situations.
The multiple physical barriers and levels of protection which form the ‘defence in depth’ to prevent the release of radioactive material are monitored. The main physical barriers are the fuel cladding and the pressure vessel. Both are monitored in terms of their operating environment and their integrity, primarily by the licensees as plant operators but also by HSE through the regulatory inspection regime.

Q18.11 The section is concentrated mainly upon the safety-related items under design-basis accidents and the strategy of beyond design-basis accident mitigation strategy is not discussed, though these accidents, in spite of much lower probability, still may occur. The matters of severe accidents management are only briefly touched upon in item 19.12.
There is a requirement for the licensees to identify the beyond design basis fault sequences which have the potential to lead to a severe accident, to provide an analysis to determine what failures could occur in the physical barriers to the release of radioactive material and to determine the magnitude and characteristics of the radiological consequences.

The results of such analyses have been used as the basis for identifying the accident management strategies that have been developed to reduce the risk from severe accidents by preventing the failure of the barriers or mitigating the consequences. This analysis has resulted in the production of appropriate procedures; these are called Symptom Based Emergency Response Guidelines (SBERG). The only time staff are known to have needed to go to SBERGs is during simulator training. The licensees have also developed Severe Accident Guidelines (SAGs) and provided additional instrumentation and other equipment to assist in the event of a severe accident.

ARTICLE 19 - OPERATION

Text of Article 19:

'Each Contracting Party shall take the appropriate steps to ensure that:

(i) The initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

(iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

(iv) procedures are established for responding to anticipated operational occurrences and to accidents;

(v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

(vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

(vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;

(viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.'

This section of the report covers:

- **the licensing process and law (paragraph 19.1);**
- **obligations under Article 19:**
  - **(i) initial authorisation to operate (paragraphs 19.2 to 19.3);**
  - **(ii) operational limits and conditions (paragraphs 19.4 to 19.8);**
  - **(iii) approved procedures for operation, maintenance, inspection and testing (paragraphs 19.9 to 19.11);**
  - **(iv) operational occurrences and accidents (paragraph 19.12);**
  - **(v) engineering and technical support (paragraphs 19.13 to 19.21);**
  - **(vi) reporting of incidents (paragraphs 19.22 to 19.26);**

(vii) collecting and analysing operating experience (paragraphs 19.27 to 19.29)
(viii) radioactive waste (paragraphs 19.30 to 19.35 ~~33~~)
discharges (paragraphs 19.36 to 19.40)

- **Other licence conditions relevant to operation (paragraphs 19.41 ~~34~~ to 19.42 ~~35~~).**

Licensing process and national law

19.1 In the UK, the operational phase of a nuclear installation is regulated principally through the Licence Conditions (LCs) (see Annex 4) attached to the nuclear site licence required by the NI Act {Ref. 23 ~~15~~} (see paragraph 7.27). Compliance with these Conditions is monitored by the HSE through inspection and assessment (see paragraphs 14.42 to 14.54). The LCs are framed to cover all aspects of operation which have a relevance to safety. Using the structure of Article 19 the relevant LC for each aspect is given below:

Obligations under Article 19:

Article 19(i) Initial Authorisation to operate a nuclear installation

19.2 In the UK a nuclear site licence is required prior to commencement of the construction of the nuclear installation on the site. This means that no feature important to nuclear safety can be constructed on the site until HSE gives consent to the activity. The report on Article 14 addresses the safety analysis undertaken prior to initial authorisation to operate a nuclear installation. LC 21 ensures that adequate arrangements exist for the commissioning of a new or modified plant, or particular process on the plant which may affect safety. It allows the commissioning to be divided into stages and for the HSE to specify that the licensee cannot proceed from one stage to the next without the HSE granting Consent (see Annex 2). Such Consent is dependent upon the licensee providing adequate documentation to justify the safety of plant at that stage. The LC also requires that a suitably qualified person or persons are appointed to control, witness, record and assess the result of the commissioning tests. Full and accurate records are required for any commissioning test or operation.

19.3 In practice, this means that there is a transitional period for the nuclear installation as it moves from its construction to its operational phase. A commissioning schedule and programme control this period, which give details and requirements for each item of plant or equipment and groups of plant or equipment to be brought to a state which is acceptable for operation in the totality of the station. Certain key stages in the Commissioning Programme are identified when HSE Consent is required before further progress towards operation can be made. These might be such times as: the bringing of nuclear fuel onto site; loading fuel into the reactor; bringing the reactor to criticality; and various power levels up to full power. The final Consent during the Commissioning phase is the Consent to move to routine operation. This is not issued until the safety case has been substantiated by the commissioning tests and the test results, and it is confirmed that all the necessary documents and systems are in place for the continued operation and maintenance of the plant. This final Consent is effectively an authorisation for routine operation.

Article 19(ii) Operational Limits and conditions

19.4 The operational limits and conditions for a nuclear installation are based upon its safety case (see Article 14). The safety case limits are normally the measurable plant parameters that define the envelope for demonstrably safe operation and the safety conditions that are prerequisites, in terms of plant configurations and operator actions, to keep plant within this envelope. These are incorporated into two key sets of documents: Operating Rules (ORs) and Operating Instructions. The ORs identify the conditions and limits necessary for the safe operation of the station. The Instructions set down the way in which all operations that may affect safety are carried out and ensure that the conditions and limits defined in the ORs are implemented. LC 23 ensures that all operations that may affect safety are supported by a safety case. It also ensures that the safety case identifies the conditions and limits that keep the plant in a safe condition. LC 24 requires the licensee to ensure that the safety case limits and conditions of the ORs are an integral part of the written instructions to operators. The licensee will normally ensure that the limits and conditions in the Operating Instructions have a safety margin. The safety margin will be established having regard to the plant transients arising in normal operation, or in the event of a plant system breakdown, so that there is reasonable confidence that no transgression of the ORs' limits will arise. ORs have been replaced at some nuclear installations with HSE's agreement by Technical Specifications, which serve the same function.

19.5 In addition to these requirements, LC 26 (control and supervision of operations) requires that no operations are carried out which may affect safety, except under the control and supervision of suitably qualified and experienced persons appointed by the Licensee for that purpose (see LC 12). These persons must ensure that the ORs and Instructions are complied with. If they identify any matter which indicates that the safety of any operation or the safe condition of the plant may be affected they inform the licensee. In such circumstances, the licensee takes appropriate action and ensures the matter is notified, recorded, investigated and reported in accordance with arrangements made under LC 7 (incidents on the site). This action would be taken by the senior person present on the site with immediate responsibility for plant operation or the Station Manager. The licensee's arrangements ensure that those with responsibility for compliance with the licence have authority to decide whether or not to continue operation.

19.6 Under LC 25 (operational records) the licensee ensures that adequate records of operation, inspection and maintenance of the plant which affect safety are made and kept. These records include the amount and location of all radioactive material (e.g. nuclear fuel and radioactive waste, used, processed, stored or accumulated) on the site.

Revision of operational limits and conditions

19.7 HSE receives from the licensee the safety case that substantiates the proposed limits and conditions. Normally, HSE would only approve the limits and conditions defining the nuclear safety envelope in the form of the operating rules. Once approved, no alteration or amendment can be made to such operating rules unless the HSE has approved the alteration or amendment.

19.8 In the particular case where the results of operation, maintenance or inspection show that the safe condition or safe operation of the plant may be affected, the licensee's arrangements would ensure that HSE receives a safety case that substantiates the continued operation of a reactor whether or not the Operating Rule limits and conditions need to be changed.

Article 19(iii) Approved Procedures

19.9 LC 24 is to ensure that all operations that may affect safety, including any instructions to implement ORs, are undertaken in accordance with written operating instructions.

19.10 LC 28 requires licensees to make and implement arrangements for the regular and systematic examination, inspection, maintenance and testing of all plant which may affect safety. This work is set out in a Maintenance Schedule that details the timing requirements. The Maintenance Schedule consists of those examinations, inspections, maintenance and tests required to demonstrate the continued ability of the plant to meet claims in the safety case. The intervals between Maintenance Schedule activities are determined by the safety case, operational experience and engineering judgement. The work is carried out in accordance with schemes laid down in writing by suitably qualified and experienced persons under the control and supervision of an appropriate person specifically appointed for that task who must sign a full and accurate report on completion of the work. Any examination, inspection, maintenance or test that shows that the safety of the plant may be affected is reported to the licensee, who takes appropriate action. HSE has the power to require the Maintenance Schedule, or part of it, to be submitted for its approval.

19.11 In addition to LC 28, there are also powers under LC 29 (duty to carry out tests and inspections) for HSE, after consultation with the licensee, to require the licensee to perform any tests, inspections or examinations which it may specify, and to be provided with the results. LC 30 ensures that any part of the plant or process is shut down in accordance with the plant maintenance schedule. HSE has discretion to require its consent to start-up of any plant shut down under LC 30.

Article 19(iv) Operational Occurrences and Accidents

19.12 The design basis of the safety case identifies a range of fault conditions that will generate plant alarms for operator action or automatic response. The Operating Instructions required by LC 24 (see paragraph 19.4) identify the necessary operator actions. Beyond the design basis, reasonably foreseeable but remote fault conditions are addressed in providing strategies and guidelines to help operators decide on their emergency response. Even more remotely, approaches to the management of serious accidents have been considered to identify equipment and materials. The arrangements for dealing with Accidents and Emergencies are set out under Article 16. The licensee has key responsibilities under these arrangements and, in particular, bringing the plant back to a safe condition. To this end the licensee, under LC 11 (on emergency arrangements), ensures that all persons who might be involved are properly instructed and rehearsed in the procedures.

Article 19(v) Engineering and Technical Support

19.13 Under the LCs there are a number of requirements aimed at ensuring that there is sufficient engineering and technical support available in all safety-related fields throughout the life of a nuclear installation. In particular, LC 12 (duly authorised and other suitably qualified and experienced persons) has a general requirement that only suitably qualified and experienced persons should perform any duties which may affect the safety of operations on the site. Within this overall provision, there is the specific requirement under LC 26 (control and supervision of operations) for the appointment in appropriate cases for persons to control and supervise operations that may affect plant safety.

19.14 These licence requirements are reinforced by HSE's SAPs {Ref. 7 ~~2~~}. These state that:

i) a safety culture should be established which will enhance and support the safety actions of all staff involved in safety related activities (see Article 12);

ii) there should be a written company policy setting out the commitment to safety;

iii) duties and responsibilities should be clearly defined;

iv) there should be good QA arrangements (see Article 13);

v) all staff involved in safety related activities must be adequately trained;

vi) arrangements should be made for obtaining and utilising information and experience from national and international sources.

19.15 An important aspect which demands the necessary engineering and technical support in all safety fields during the nuclear installation's lifetime is the requirement for an adequate safety case for the nuclear installation (see Article 14).

Research and Development

19.16 There are aspects that require technical substantiation. This substantiation is obtained by research and development programmes. The licensees commission and undertake research to support the safe operation of their nuclear installations. In addition, the UK Government has given HSC the responsibility to co-ordinate a long-term generic (i.e. not site specific) safety research Programme to address the following objectives:

i) adequate and balanced programmes of nuclear safety research continue to be carried out, based on a view of the issues likely to emerge both in the short and long term;

ii) as far as reasonably practicable, the potential contribution the research can make to securing higher standards of nuclear safety is maximised; and

iii) the results of the research having implications for nuclear safety are disseminated as appropriate.

19.17 There are two secondary objectives:

i) to take account of the desirability of maintaining a sufficient range of independent capability to ensure the attainment of the primary objective; and

ii) to ensure that proper account is taken of the advantages of international collaboration in furthering the primary objectives.

19.18 HSE directs the programme, on behalf of HSC, by identifying safety issues that are expressed in the Nuclear Research Index {Ref. 57 ~~51~~}. The licensees, through their Industry Management Committee (IMC) use this index as a focus for commissioning the programme. The IMC has representatives from BEGL, BEG(UK)L and BNFL, and prioritises research issues in the context of the overall programme strategy.

19.19 The HSC Programme embraces the full range of safety issues on a nuclear reactor plant. Information on each of these projects is available from HSE's Nuclear Research Register {Ref. 58 ~~52~~}, which is produced annually.

19.20 The HSC Co-ordinated Programme comprises two elements:

The IMC programme is that part identified, placed and paid for directly by the nuclear licensees. It mainly addresses HSE nuclear safety issues and the maintenance of essential capability.

The HSE Levy Programme is that part that is identified and placed by HSE and paid for through a levy on the licensees. It has three main elements:

{ research commissioned to maintain sources of independent advice to HSE;

{ research collaboration that requires the participation of UK Government;

{ and research to address any issues of concern to HSE not adequately addressed in the IMC Programme.

19.21 The HSC Programme excludes:

- nuclear safety research activity related to the fuel cycle, which is covered under separate arrangements

- research undertaken by the licensees for purposes other than safety, or to meet licensing conditions or their own safety design rules

- research commissioned by HSE to enable it to make licensing decisions, this is covered under HSE's nuclear safety support programme

Article 19(vi) Incident Reporting

19.22 LC 7 (incidents on the site) is a general requirement to make arrangements to notify, record, investigate and report incidents:

a) as is required by any other condition attached to the licence;

b) as the HSE may specify; and

c) as the licensee considers necessary.

19.23 Under (a) above there are for example currently requirements to notify, record, investigate and report incidents arising under LC 23 (Operating Rules), LC 28 (Examination, Inspection, Maintenance and Testing), and LC 34 (Leakage and escape of radioactive material and radioactive waste). Incidents to be notified, etc., include those referred to in NI Act section 7 {Ref. 23 ~~15~~}; in the Nuclear Installations (Dangerous Occurrences) Regulations 1965 {Ref. 27 ~~20~~}; the IRR99 {Ref. 3 ~~17~~}, regulations 25~~,~~ and 30. In making the arrangements required under LC 7, the licensees include the need to notify incidents within the scope of:

Occurrences on a nuclear installation site, under S22(1) of the NI Act, are to be reported by the quickest means possible under S4(1) of the Nuclear Installations (Dangerous Occurrences) Regulations 1965 to the DTI and HSE;

A confirmed breach of, or discharge expected to breach quantitative limits of a Certificate of Authorisation for the disposal of radioactive waste issued under the RSA 1993 {Ref. 26 ~~19~~};

A confirmed release to atmosphere or spillage of a radioactive substance which exceeds or is expected to exceed, the limits set out in Column ~~7~~4 of Schedule ~~28~~ of the IRR99~~85~~, (except where the release is in a manner specified in an Authorisation under RSA 1993) to be notified forthwith to HSE;

A confirmed or suspected over exposure of a worker to ionising radiation under Section ~~29~~25 of the IRR99 to be notified ~~forthwith~~as soon as practicable to HSE;

19.24 HSE has made arrangements with licensees to be informed of incidents covered by international reporting arrangements, for which HSE is the UK reporting authority, i.e.:

the International Nuclear Event Scale (INES);
the IAEA/NEA Incident Reporting System (IRS).

19.25 Certain incidents are covered by agreements for ministerial reporting to Parliament, these are issued by HSE in a Quarterly Statement.

19.26 The UK is a signatory to the 1986 IAEA Convention on 'Early Notification of a Nuclear Accident' which requires notifying the IAEA when "... a release of radioactive materials occurs or is likely to occur and which has resulted or may result in an international transboundary release that could be of radiological safety significance for another state". The UK

competent authority and contact points for issuing and receiving notification and information on the nuclear accident are DTI and DEFRA ~~DETR~~, respectively.

Article 19(vii) Operating Experience

19.27 Operational matters which may affect safety and which are identified during operation (LC 23 Operating Rules) or maintenance, inspection or test (LC 28 Examination, Inspection, Maintenance and Testing) are notified, recorded, investigated and reported as required by LC 7. These requirements ensure that experience gained during operation is properly considered and any findings or recommendations that will improve safety are recognised and acted upon. The operational records required to be kept under LC 25 not only demonstrate to the regulators compliance with site licence and other regulatory requirements, but also constitute part of the plant history that operators need to make safety and commercial judgements. For instance, the results of routine examinations of the plant under LC 28 may be used to justify a change to the interval between maintenance or the change from preventive maintenance to condition-based maintenance.

19.28 The licensee arrangements for investigation of plant events include requirements for impact on other installations and operators to be considered in off-site reporting and regular reviews of such reports by all reactor operating licensees. The outcome of this review could be a dissemination of a plant event on one installation with a requirement on each other installation to assess and report formally on its impact on their plant.

19.29 HSE is responsible for national publication of the results of its regulatory activities (such as the assessment of licensees' Periodic Safety Reviews) and international reporting of events. HSE brings to the attention of licensees any international events of significance. Licensees distribute information through WANO and other organisations, which also provide international experience that may be relevant to UK operators.

Article 19(viii) Radioactive Waste

19.30 Four LCs are directed at the control and handling of radioactive waste. They are:

i) LC 4 on restriction of nuclear matter on the site. This requires that there must be adequate arrangements for the storage of nuclear matter (which includes radioactive waste generated on the site). These arrangements include the preparation and assessment of a safety case and the identification of limits and conditions necessary in the interests of safety. In most cases, this safety case is identifiable as a part of the installation Radioactive Waste Management Safety Case which, with the Radioactive Waste Management Strategy, is considered and assessed by regulators.

ii) LC 32 on accumulation. This requires that, as far as is reasonably practicable, the rate of production and the total quantity of radioactive waste on the site at any one time is minimised. The quantity, type and form of the radioactive waste accumulated or stored may be subject to limitations specified by the HSE.

iii) LC 33 on disposal. This requires that the disposal of radioactive waste must be in accordance with an Authorisation granted under the RSA 1993 (see paragraph 7.22).

iv) LC 34 on leakage and escape. The basic requirement of this LC is that radioactive material or waste is controlled and contained so that it does not leak or escape. Any leak or escape must be notified, recorded, investigated and reported, as required by the arrangements made under LC 7.

19.31 The White paper, Command 2919 {Ref. 59} published in 1995, stated Government policy as being that ~~W~~where the demands of safety are overriding, waste is treated, as necessary, to improve storage conditions. In addition, early treatment of waste is undertaken if it secures worthwhile safety benefits or worthwhile economic benefits without prejudicing safety. The relevant costs and commercial risks are borne by the owner of the waste. Decisions by operators and regulators have regard to all relevant factors, including the following:

{ the need for continuing safe storage of the waste, treated and/or contained as necessary;

{ the benefits of placing the waste in a chemically and physically stable form, so that safety may be achieved by passive means;

{ the risk that treated waste will be incompatible with future disposal requirements and the practicability of re-working treated waste in the future, for disposal or for a period of further storage, should this be necessary;

{ the state of storage facilities, including the benefits which would be derived from refurbishment or upgrading;

{ the need to minimise waste degeneration, secondary waste arisings and releases to the environment;

{ the need to minimise dependence on active safety systems, maintenance, monitoring and human intervention;

{ the retrievability of the waste for disposal.

19.32 The UK currently has no plans for the disposal of intermediate level waste (ILW). The House of Lords Select Committee on Science and Technology prepared a report on the management of nuclear waste {Ref. 60}, to which the Government responded {Ref. 61}. In doing so the Government noted the Select Committee's preference for deep disposal of ILW, and agreed that the national policy for long-term management of nuclear wastes should be as comprehensive as possible. Various management options for radioactive wastes would be considered, but before coming to a final decision, the Government stated that it wished to undertake widespread public consultation.

19.33 The OSPAR/Sintra agreement, which the Government signed in July 1998, aims to prevent pollution of the maritime area from ionising radiation through progressive and substantial reductions in discharges, emissions and losses of the radioactive substances. Such discharges, emissions and losses are to be reduced, by the year 2020, to levels where the resulting concentrations in the marine environment, above historic levels, are close to zero. If no new LLW or ILW facilities are constructed between now and year 2020, this agreement may re-

strict, or may even prevent continued use of existing disposal routes for routine discharges and result in additional radioactive waste volumes being stored on nuclear licensed sites.

19.34 While it was not one of the original generic safety issues for PSRs (paragraph 6.20), HSE assessment of PSRs currently includes consideration of radioactive waste management and safety cases.

19.35 Spent Magnox and AGR fuel is stored at the nuclear installations for a period to allow it to cool to meet limits and conditions of irradiated fuel transport packages. There is no treatment of the fissile material before transport, but the fuel assembly is mechanically modified to minimise its volume. This modification produces low and intermediate level radioactive waste, which is stored on site in facilities designed for this purpose and from which the waste will be recovered subsequent to the operational phase. Spent PWR fuel is stored in a purpose-designed pond at the nuclear installation in the form discharged from the reactor.

Radioactive waste disposals

19.36 Discharges of liquid and gaseous radioactive waste, and disposals of solid waste, are regulated by conditions and limitations imposed under RSA 93 (see para 7.22). The Act prohibits any disposal of radioactive waste other than in accordance with the conditions and limitations of an authorisation granted by the appropriate regulatory body. Liquid and gaseous radioactive discharges to the environment are considered to be disposals of radioactive waste under RSA 93. Nuclear licensed sites are exempt from the requirement to have a RSA 93 authorisation to accumulate radioactive waste on the sites. The regulation of such accumulation of radioactive waste is undertaken using licence conditions (see paragraph 19.30 above) at least as stringently as it would if it came under RSA 93.

19.37 In the UK regulation under RSA 93 is a devolved matter. Therefore, there are three regulatory authorities in the UK that have responsibility for issuing radioactive discharge authorisations under RSA 93. These authorities are: The Environment Agency (EA), for discharges made in England and Wales; The Scottish Environment Protection Agency (SEPA), for discharges made in Scotland; and The Environment and Heritage Service of the Department of the Environment, for discharges made in Northern Ireland. In addition, the Food Standards Agency has responsibility for all aspects of food safety and is consulted on the setting of authorisations to assess the impact and uptake of radioactive discharges to the food chain.

19.38 Authorisations for nuclear licensed sites granted by the environment agencies set limits on the discharge of specific radionuclides, or groups of radionuclides. The EA incorporates conditions for annual, quarterly and monthly limits whereas SEPA places conditions on annual limits when granting authorisations. In addition, the environment agencies include conditions in authorisations that require the site operator to notify, explain reasons why and take action if either daily or monthly discharge levels are higher than normal. The conditions on limit setting require operators to use Best Practicable Means (BPM) to minimise the volume of waste produced and the activity of waste discharged, and to minimise the radiological impacts of discharges. Authorisations require operators to monitor compliance with the authorisation and

may also impose requirements on the operators to carry out monitoring of levels of discharged radionuclides in the surrounding environment.

19.39 As a general policy, the limits in discharge authorisations are progressively reduced and are kept close to the level of actual discharges. The UK has consulted on, and is due to publish during 2001, a Strategy for Radioactive Discharges to cover the period 2001 to 2020. In parallel, Statutory Guidance is to be issued to the EA, to help it to take account of radiological principles and environmental policy objectives when determining discharge authorisations under RSA 93, in England. Separate guidance will also be issued for the other devolved administrations in the UK.

19.40 Full information on radioactive discharges and on the disposal of solid radioactive waste will be provided in the UK's national report under the Joint Convention.

Other Licence Conditions relevant to Operation

19.41 In addition to the LCs outlined above there are others that have a relevance to the operation of a nuclear installation (see Annex 4). These are:

i) LC 2 on marking of the site boundary

ii) LC 3 on restriction on dealing with the site

iii) LC 5 on consignment of nuclear matter

iv) LC 6 on documents, records, authorities and certificates

v) LC 8 on warning notices

vi) LC 9 on instruction to person on the site

vii) LC 13 on nuclear safety committees

viii) LC 15 on periodic review

ix) LC 22 on modification or experiment on existing plant

x) LC 30 on periodic shutdown

xi) LC 31 on shutdown of specified operations.

19.42 It is an offence for a licensee to contravene the requirements of a Site Licence. Annex 2 describes the powers under the licence with which HSE can control the operation of UK nuclear plant. These powers are implemented as described in Article 8. As stated in Article 14, the HSE divides its work into two broad areas, Assessment and Inspection. It is the regular nuclear site inspections that are in the forefront in ensuring that the nuclear stations are complying with the LCs and operating their plant safely. To this end HSE has dedicated nuclear in-

stallation inspectors responsible for overseeing the safety of operations at each nuclear site. These inspectors spend around 30% of their time on site and over a period of time check compliance with every LC. Furthermore they are the immediate contact points when non-compliance occurs, or a problem arises, both for the licensee and the rest of HSE.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT ON ARTICLE 19

Q19.1 What kinds of accident mitigation procedures are used at the different reactor units?

The earlier designs rely upon automatic shutdown response to abnormal operational states, supplemented by staff training in accident management and provision of post-fault instructions and procedures. Extensive simulator training is given regularly in dealing with various fault scenarios.

With the newer AGRs greater reliance is placed upon automatic post-trip operation, with the operator taking more of a monitoring role for the first thirty minutes.

Generally speaking, the first instructions worked to will be fault-based, rather than symptom-based. This is because it is in the nature of plant operations to work with plant systems. Symptom-based instructions are used by a Control Room Supervisor several minutes after each reactor trip to check for significant faults. The desk operator deals with the direct fault management and the Supervisor keeps an overview. Essentially, this is done by completing a check-sheet at a predetermined time after the start of the event. Any deficiencies are high-lighted during this process, and the most significant deficiency directs the Supervisor into the appropriate Symptom Based Emergency Response Guidelines (SBERG). For most events there is no call for their use. They only relate to major faults well beyond normal expectation. The only time staff are known to have needed to go to SBERGs is during training. (Also see response to Q 6.11 and Q12.3)

Q19.2 Which is the HSE review and control process for design modifications being implemented by the operator? Is there a permit before completion of the modification? Are there criteria to exempt the operator from this procedure?

Under the modifications arrangement required by the nuclear site licence, the licensee is required to give each modification a safety classification. Modifications with the highest safety classification, i.e. broadly defined as a proposal that if inadequately conceived or implemented would have a serious effect on nuclear safety, cannot be carried out without the formal agreement of HSE.

Less stringent requirements apply to lower category modification proposals, under the licence arrangements these can be implemented without HSE agreement, unless specifically 'called in' for scrutiny. HSE site inspectors regularly monitor the arrangements to ensure that the procedures are being adhered to.

Q19.3 Is a root-cause analysis methodology being used by HSE or the operator to assess operating experience? What are the HSE screening criteria regarding assessment of operating events?

Operators use root cause analysis, including human factors assessment techniques, to analyse events. Station-based reviews of all events are carried out, and those with greater significance are recorded on a national nuclear event database operated on behalf of the UK industry by British Energy. This database is managed by a central feedback unit that analyses events and

calls for site co-ordinators to respond to requests for information about those with greater significance.

An agreed classification system is used to indicate the safety significance of events. HSE site inspectors have access to these assessments and the resulting recommendations and can influence the course of some investigations, where appropriate. Individual judgement is used to evaluate which events require to be followed up by HSE, but would be expected to follow broadly the classification criteria used in the agreed reporting arrangements.

Q19.4 The report states that: "Certain incidents are covered by agreements for ministerial reporting to Parliament, these are issued by HSE in a Quarterly Statement". What are the reporting criteria for these incidents? Could the United Kingdom enumerate the most important incidents that were reported?

The events that the Secretary of State requires to be notified about are:

1. dangerous occurrences reportable under Nuclear Installations (Dangerous Occurrences) Regs 1965 {Ref. 27};

2a. confirmed exposure to radiation of individuals which exceed or which are expected to exceed the dose limits specified in Schedule 4 to the IRR99 {ref. 3};

2b. examination, inspection, maintenance or test of any part of the plant that has revealed that the safe operation or condition of the plant may be significantly affected;

~~1.~~3. confirmed breach of or discharge expected to breach quantitative limits of a Certificate of Authorisation for the disposal of radioactive waste issued under Radioactive Substances Act 1960;

4a. an abnormal occurrence leading to a confirmed release to atmosphere or spillage of a radioactive substance which exceeds or is expected to exceed the limits set out in column 4 of Schedule 8 of the IRR99, except where the release is in a manner specified in an Authorisation under the RSA 93 {Ref. 26};

4b. an abnormal occurrence leading to a confirmed release or spread of radioactivity off the site if the estimated effective dose equivalent to the potentially most exposed member of the general public is or is expected to be in excess of 0.05 milliSieverts; and

5. an abnormal occurrence leading to a release or suspected release or spread of radioactivity on or off the site which requires special action or special investigation by the operators.

The HSE publishes a quarterly statement of all incidents that have been reported under the ministerial reporting criteria. These statements identify each incident, its location, significance and the actions being taken to prevent a recurrence. The number reported varies but a typical figure would be 10 incidents per annum for all nuclear licensed sites in the UK.

Q19.5 According to what mechanism is feedback of operational experience carried out systematically in the UK?

British Energy operates the Nuclear Plant Event Reporting system database on behalf of the UK nuclear industry. Its Central Feedback Unit assesses national and international events and co-ordinates requests for additional assessments, where appropriate. HSE has access to summaries from the system and site inspectors have access to reports and assessments relating to their sites.

Licensees carry out a review of events on the site and the results are usually reported at the pre-start up meeting with HSE. Intermediate reviews are also carried out at other times and sites usually have a high-level management panel considering events and their response to them.

Q19.6 Licence Condition (LC) 21 requires that a suitably qualified person or persons are appointed to control, witness, record and assess the results of the commissioning test. What legal system does the UK have for the qualification of persons who are engaged in the works relevant to the safety of reactor operation?

All people who carry out safety related activities have to be suitably qualified and experienced (SQEP). Certain key tasks are identified. Staff carrying them out are required to be designated as Duly Authorised Persons (DAPs). The use of people who were not SQEP or DAP when appointed would be a criminal offence.

Responsibility for ensuring that the training and qualifications are appropriate rests with the licensee. There is no formal national licensing arrangement for individuals. However, licensees' arrangements provide for such staff to be individually assessed for their duties and appointed in writing. The certificate that achieves this function is, in effect, the legal recognition of the appropriateness of individual's qualification and can be revoked if performance fall below standard. To carry out actions without such internal authorisation could lead to regulatory action by HSE. HSE have the power to remove DAP status from individuals if inspectors are not satisfied with their competence. (Also see response to Q11.1 and Q12.2).

Q19.7. The HSE brings to the attention of licensees any events occurred aboard, which are important to nuclear safety. Does the regulatory body have the organisational structure to assess international operating experiences provided by IRS, etc? If so, are there any cases where the regulatory body applied the results of these assessments to nuclear installations?

British Energy operates the operational feedback system on behalf of the UK nuclear industry and its Central Feedback Unit collates international experience obtained through operator and regulatory sources.

In relation to assessing international operational feedback HSE provides the competent UK IRS co-ordinator and INES national officer. HSE's co-ordinator would direct any results of its assessments to the operator's Central Feedback Unit or a specific operator, as appropriate. Any PWR related events are directed at the Sizewell B operators. Two relatively recent events that led HSE to probe site capabilities resulted from the issues surrounding the Mill-

stone and Ontario Hydro plants. These events raised management issues for both the regulator and the licensees.

HSE considers that it needs to increase the time spent on incident analysis, both domestically and internationally, and with this in mind is allocating extra resources to this area.

References

Ref No	Reference Title	Relevant Articles
1	Nuclear Site Licences - Notes for Applicants HS(G) 120 HSE Books June 1994 ISBN 07176 0795 X	1.7, 7.28
2	British Energy Safety Management Audit	1.41
3	The Ionising Radiations Regulations 1999	7.16, 14.9, 15.1,16.1, 19.23
4	Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999	6.34,7.24
5	Utilities Act 2000	1.63
6	HSE web site: www.hse.gov.uk	1.74
7	Safety Assessment Principles for Nuclear Plants HSE/HMSO 1992 ISBN 0 11 882043 5	6.16, 7.35,Annex 8 11.33,12.2,12.20,13.2 14.44,14.48,17.15, 9.14
8	Magnox nuclear power reactor programme: NII's report on the outcome of the programme of generic safety issues HSE Books 1994 ISBN 0 11 7176 0688 0	6.2
9	Bradwell nuclear power station: The findings of NII's assessment of CEGB's long term safety review HSE Books 1987 ISBN 0 11 883927 6	6.22
10	Berkeley nuclear power station: The findings of NII's assessment of CEGB's long term safety review HSE Books 1988 ISBN 0 11 883985 3	6.22
11	Hunterston A nuclear station: The findings of NII's assessment of SSEB's long term safety review HSE Books 1989 ISBN 0 11 885498 4	6.22
12	Calder Hall and Chapelcross nuclear power stations: The findings of NII's assessment of BNFL's long term safety review HSE Books 1990 ISBN 0 11 885539 5	6.22
13	Hinkley Point A nuclear power station: The findings of NII's assessment of NE's long term safety review HSE Books 1991 ISBN 0 11 885666 9	6.22
14	Dungeness A nuclear power station: The findings of NII's assessment of NE's long term safety review HSE Books NUC 1	6.22
15	Sizewell A nuclear power station: The findings of NII's assessment of NE's long term safety review HSE Books NUC 4	6.22
16	Oldbury on Severn nuclear power station: The findings of NII's assessment of NE's long term safety review HSE Books NUC 5	6.22
17	Wylfa nuclear power station: The findings of NII's assessment of NE's long term safety review HSE Books NUC 6	6.22
18	Hinkley Point B and Hunterston B PSR findings, HSE Books, 1997, NUC 10	6.24
19	Dungeness B PSR findings, HSE Books, 1998	6.24
20	Heysham 1 and Hartlepool PSR findings, HSE Books, 1999	6.24
21	Heysham 2 and Hunterston B PSR findings, HSE Books, 2001	6.24
22	Health and Safety at Work etc. Act 1974 (1974 c.37)	7.1,7.27,15.1
23	Nuclear Installations Act 1965 (as amended) (1965 c.57)	7.1,7.14,7.27,16.1, 19.1,19.23, Annex 6
24	Nuclear Installations Act 1965 etc. (Repeals and Modifications) Regulations 1974	7.1
25	Electricity Act 1989	7.8,7.15
26	Radioactive Substances Act 1993	7.9,7.22,8.16,15.21, 16.52,16.55,19.23, Annex 6
27	The Nuclear Installations (Dangerous Occurrences) Regulations 1965	7.18,19.23
28	The Public Information for Radiation Emergencies Regulations 1992	7.19,16.4,16.40 16.67,17.19
29	European Commission Directive 96/29/Euratom	7.19,7.23,15.1,15.3
30	The Management of Health and Safety at Work Regulations 1999	7.20,12.19,14.9,16.53

31	Environment Act 1995	7.23,8.16,16.55
32	Utilities Act 2000	7.25
33	The Tolerability of Risk from Nuclear Power Stations HSE/HMSO, ISBN 0 11 886368 1	7.35,Annex 7
34	The Sizewell B Public Inquiry - The Layfield Report HMSO ISBN 0 11 411575 3	7.36,10.1,15.18
35	The Hinkley Point Public Inquires - The Barnes Report HMSO Volumes 4,6 & 7 ISBN 0 11 412955 X	7.36,10.1
36	British Nuclear Fuels Annual Report, www.bnfl.co.uk	10.2,10.13,11.1,11.6, 11.15
37	British Energy Annual Report, www.be.co.uk	10.3,10.14,11.1,11.5, 11.15
38	British Energy Shares Offer Prospectus, 26 June 1996	11.15,11.6
39	Successful Health and Safety Management (1997) HSG65 ISBN 0 7176 1276 7	12.19,13.14
40	ACSNI - Study Group on Human Factors: Training and related matters HMSO ISBN 0 11 885543 3	12.21
41	ACSNI - Study Group on Human Factors: Organising for Safety, 1993 HSE Books ISBN 0 7176 0865 4	12.21
42	IAEA 50-C-Q Code on Quality Assurance for safety in nuclear power plants and other nuclear installations	13.5,13.12
43	ISO 9000:2000, Quality Management and Q A Standards, Parts 1,2 and 3	13.5,13.12
44	BS 8800:1996 Guidance to occupational health and safety management systems ISBN 0580 25859 9	13.14
45	Approved Code of Practice for IRR99, ISBN 0 7176 1746 7	15.1,15.11
46	The 1990 Recommendations of the International Commission on Radiological Protection (ICRP) Publication 60, Volume 21 no. 1 - 3, 1991	15.2,15.23
47	Occupational Exposure to Ionising Radiation 1990 - 1996 Analysis of doses reported to HSE's CIDI, Printed and Published by HSE	15.11,15.20, Table 7
48	Scottish Environment Protection Agency web site – monitoring programme	15.27
49	Environment Agency web site – monitoring programme	15.27
50	A framework for the restriction of occupational exposure to Ionising Radiation 1992, ISBN 0 11 886324 X	15.11
51	Contamination of Food E C Regulations	16.9(iv)
52	NRPB Statement on ERLs, Documents of the NRPB Vol. 1 No. 4 1990 ISBN 0 85951 329 7	16.9
53	Food and Environment Protection Act 1985	16.49
54	Town and Country Planning Act 1990	17.1
55	Town and Country Planning (Scotland) Act 1997	17.5
56	Regulations for Control of Developments (Hazardous Installations)	17.24
57	Nuclear Research Index - available from HSE's NSD Unit 1E	19.18
58	Nuclear Research Register - available from HSE's NSD Unit 1E	19.19
59	Command 2919	19.31
60	House of Lords Select Committee on Science and Technology, Management of Nuclear Waste Third Report, March 1999	19.32
61	Government response to Ref. 60, DETR, October 1999	19.32
62	Occupational Exposure to Ionising Radiation 1997, 1998, 1999, Printed and published by HSE	

Glossary and Abbreviations

ACoP	Approved Code of Practice (paragraphs 15.1, 15.11)
ACSNI	Advisory Committee on the Safety of Nuclear Installations, the forerunner of NuSAC (see below)
ADS	Approved Dosimetry Service (paragraph 15.17)
AGR	Advanced Gas-cooled Reactor
AIC	Alternative Indication Centre (page 37)
ALARA	As low as reasonably achievable
ALARP	As low as reasonably practicable - the ALARP principle is fundamental to the regulation of health and safety in the UK. It requires that risks should be weighed against the costs of reducing them. Measures must then be taken to reduce or eliminate the risks unless the cost of doing so is obviously unreasonable compared with the risk.
BDBA	Beyond Design Based Accident (page 38)
BE	British Energy plc
BEGL	British Energy Generation Ltd.
BEG(UK)L	British Energy Generation (UK) Ltd.
BMS	Business Management System (paragraph 1.76)
BPM	Best Practicable Means (paragraph 15.26, 19.38)
BNFL	British Nuclear Fuels plc
BSL	Basic Safety Limit (Annex 8)
BSO	Basic Safety Objective (Annex 8)
CCR	Central Control Rooms (page 87)
CDF	Central Database Facility (paragraph 16.63)
CE	Chief Executive (page 68)
CEGB	Central Electricity Generating Board (paragraph 1.34)
CIDI	Central Index of Dose Information (paragraph 15.19)
CNS	Convention on Nuclear Safety
CPD	Continuous Professional Development (paragraph 1.70)
DBA	Design Base Accident (paragraph 18.12)
DEFRA	Department for Environment, Food and Rural Affairs (paragraph 8.14)

DEPZ	Detailed emergency planning zone
DTI	Department of Trade and Industry
DTLR	Department of Transport, Local Government and the Regions
EA	Environment Agency for England and Wales
EC	European Commission (paragraph 16.4)
EFQM EM	European Foundation for Quality Management Excellence Model (paragraph 1.75)
EH&S	Environment, Health and Safety (paragraph 10.13)
EIAD99	Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (paragraph 1.62)
ERL	Emergency Reference Level (paragraph 16.6)
ES	Environmental Statement (paragraph 1.62)
EU	European Union (paragraph 8.26)
GEMA	Gas and Electricity Markets Authority (paragraph 8.18)
GI	Generic Issues (page 35)
GTA	Government Technical Adviser (paragraph 16.32)
HSC	Health and Safety Commission - created by the HSW Act 1974 and responsible to the Secretary of State for the Transport, Local Government and the Regions (and other Secretaries of State) for the administration of the Act. The HSC makes substantial use of independent advisory committees (see NuSAC) who advise the Commission directly.
HSE	Health and Safety Executive - a distinct statutory body with day-to-day responsibility for making arrangements for the enforcement of safety legislation. HSE is the statutory licensing authority for nuclear installations. This function is delegated to senior officials within the HSE's Nuclear Safety Directorate.
HLW	High Level Waste
HSW Act	Health and Safety at Work etc. Act 1974
IAEA	International Atomic Energy Agency
INSAG	International Nuclear Safety Group (of the IAEA)
ICRP	International Commission on Radiological Protection (paragraphs 1.61 and 15.2)
IIP	Investors In People (paragraph 1.67)
ILW	Intermediate Level Waste
IMC	Industry Management Committee (paragraph 19.18)

INES	International Nuclear Event Scale
INPO	Institute of Nuclear Power Operators(paragraphs 12.34)
INRA	International Nuclear Regulators Association (paragraph 8.29)
INSAG	IAEA's International Nuclear Safety Advisory Group (page 36)
IRAC	Ionising Radiations Advisory Committee
IRR99	Ionising Radiations Regulations 1999
IRS	Incident Reporting System (paragraphs 12.20, 19.24)
ISI	In-service inspection (paragraph 14.37)
ISRS	International Safety Rating System (paragraph 12.26)
LC	Licence Condition
LLW	Low Level Waste
LTSR	Long Term Safety Review, the forerunner of Periodic Safety Reviews
ME	Magnox Electric plc (paragraph 1.1)
MCR	Main Control Room (paragraph 12.11)
Met. Office	Meteorological Office (paragraph 16.63)
mSv	milliSievert
MoU	Memorandum of Understanding (page 118)
MTR	Material Test Reactors (paragraph 14.40)
NDA	Nuclear Decommissioning Agreement (Annex 10)
NEAF	Nuclear Emergency Arrangements Forum (Annex 11)
NEBR	Nuclear Emergency Briefing Room (paragraph 16.25)
NEPLG	Nuclear Emergency Planning Liaison Group
NETA	New Electricity Trading Arrangements (paragraph 1.35)
NGC	National Grid Company (paragraph 1.37)
NI Act	Nuclear Installations Act 1965 (as amended)
NII	Nuclear Installations Inspectorate - a part of the HSE's Nuclear Safety Directorate.
NPP	Nuclear Power Plant (pages 24 and 160)
NRPB	National Radiological Protection Board

NSD	HSE's Nuclear Safety Directorate, senior officers of which have delegated regulatory and enforcement powers relating to nuclear site licensing under the NI Act (see HSE above).
NuSAC	Nuclear Safety Advisory Committee - independent advisors on nuclear safety matters to HSC. Prior to mid 1997 NuSAC was known as the Advisory Committee on the Safety of Nuclear Installations (ACSNI).
NVQ	National Vocational Qualification (paragraph 1.68)
OECD NEA	Organisation for Economic Co-operation and Development Nuclear Energy Agency (paragraph 1.57)
ORs	Operating Rules (paragraph 12.13)
OSART	Operational Safety Review Team (paragraph 12.34)
OSF	Off-site Facility (page 143)
PCSR	Pre-construction Safety Report
pga	peak ground acceleration (Annex 11)
PIRER	Public Information for Radiation Emergencies Regulations 1992
POSR	Pre-operational Safety Report
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
PWR	Pressurised Water Reactor
QA	Quality Assurance
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations
RIMNET	Radiation Incident Monitoring Network (paragraphs 16.30)
RPA	Radiological Protection Adviser (paragraph 15.12)
RPS	Radiological Protection Supervisor (paragraph 15.12)
RSP	Relevant Statutory Provision (page 59)
RPV	Reactor Pressure Vessel (Annex 3)
RSA	Radioactive Substances Act 1993
SAG	Severe Accident Guidelines (page 162)
SAPs	HSE's Safety Assessment Principles
SBERG	Symptom Based Emergency Response Guidelines (page 162)
SCE	Shift Charge Engineer (page 87)

SE	Scottish Executive
SEER	Scottish Executive Emergency Room (paragraph 16.25)
SEPA	Scottish Environment Protection Agency
SEERAD	Scottish Executive Environment and Rural Affairs Department (paragraphs 16.9 and 16.52)
SGLR	Senior Government Liaison Representative (paragraph 16.35)
SNL	Scottish Nuclear Ltd (paragraph 1.34)
SOI	Station Operating Instruction (page 88)
SoS	Secretary of State
SPD	HSE's Safety Policy Directorate
SPI	Safety Performance Indicators (page 25)
SQEP	Suitably Qualified and Experienced Person (paragraph 1.83)
SSEB	South of Scotland Electricity Board (paragraph 1.34)
SSR	Station Safety Report
STAR	Stop, Think, Act, Review concept (paragraph 12.31)
TCP	Town and Country Planning Act 1990 (paragraph 17.1)
Tech Specs	Technical Specifications (paragraph 12.13)
TOR	Tolerability of Risk
TQM	Total Quality Management
UK	United Kingdom of Great Britain and Northern Ireland
User Interface	The medium through which personnel obtain information about the plant and perform actions which impact upon plant behaviour
WANO	World Association of Nuclear Organisations (paragraphs 10.7(ii))
WA	Welsh Assembly (paragraph 16.70)
WENRA	Western European Regulators Association (paragraph 8.25)

List of Annexes

Annex 1 - Civil Nuclear Power Stations - Key Parameters

Nuclear Installation	Bradwell	Calder Hall	Chapel-cross	Dungeness A	Dungeness B	Hartlepool	Heysham 1	Heysham 2
Licensee	ME plc	BNF plc	BNF plc	ME plc	BEGL	BEGL	BEGL	BEGL
Reactor type	Magnox	Magnox	Magnox	Magnox	AGR	AGR	AGR	AGR
No. of reactors	2	4	4	2	2	2	2	2
1st power operation	1962	1956	1959	1965	1983	1983	1983	1988
Reactor thermal power (MWt)	538	270	265	840	1550	1500	1500	1600
Electrical gen. Power (MWe)	129	61	60	228	630	660	600	690
Sent off site MWe	123	50	50	220	570	615	550	625
Nuclear fuel	U rod	U rod	U rod	U rod	UO2	UO2	UO2	UO2
Fuel Cladding	Magnox	Magnox	Magnox	Magnox	S. Steel	S. Steel	S. Steel	S. Steel
Nuclear moderator	Graphite	Graphite	Graphite	Graphite	Graphite	Graphite	Graphite	Graphite
Reactor Core								
Fuel channels	2837	1696	1696	3932	408	324	324	332
Assemblies Per channel	8	6	6	7	8	8	8	8
Rods/ Assembly	-	-	-	-	36	36	36	36
Coolant	CO2	CO2	CO2	CO2	CO2	CO2	CO2	CO2
Coolant containment	Steel PV	Steel PV	Steel PV	Steel PV	PCPV	PCPV	PCPV	PCPV
Coolant pressure (Bar)	10	7	7	20	34	42	42	43
Coolant max. temp (C)	360	345	345	370	673	675	651	635
Steam turbine inlet press. (Bar)	54	15.5	15.5	25	163	163	163	163
Steam turbine inlet temp. (C)	355	321/193	329/185	370	555	538	538	538
Total Power Generated	246	244	240	440	1140	1230	1100	1260

Key:

BNF plc	British Nuclear Fuels plc	ME plc	Magnox Electric plc
BEGL	British Energy Generation Ltd	BEG(UK)L	British Energy Generation (UK) Ltd
U Rod	Natural Uranium Rod	UO2	Enriched Uranium Oxide Pellet
Steel PV	Welded Steel Pressure Vessel	PCPV	Pre-stressed concrete pressure vessel

For AGRs there is one fuel assembly per channel of 8 elements and the table indicates the number of pins per element

Annex 1 - continued

Nuclear Installation	Hinkley Point B	Hunter-ston B	Oldbury-on Severn	Sizewell A	Sizewell B	Torness	Wylfa
Licensee	BEGL	BEG(UK)L	ME plc	ME plc	BEGL	BEG(UK)L	ME plc
Reactor type	AGR	AGR	Magnox	Magnox	PWR	AGR	Magnox
No. of reactors	2	2	2	2	1	2	2
1st power op-eration	1976	1976	1967	1966	1994	1988	1971
Reactor thermal power (MWt)	1494	1496	893	948	3411	1555	1875
Electrical gen. Power (MWe)	665	660	225	250	1256	682	550
Sent off site MW	622	624	217	210	1188	625	475
Nuclear fuel	UO2	U02	U rod	U	UO2	UO2	U
Fuel cladding	S.Steel	S.Steel	Magnox	Magnox	Zr-4	S.Steel	Magnox
Nuc. moderator	Graphite	Graphite	Graphite	Graphite	Water	Graphite	Graphite
Reactor Core							
Fuel channels	308	324	3320	3788	-	332	6156
Assemblies per channel	8	8	8	8	193	8	8
Rods / channel	36	36	-	-	264	36	-
Coolant	CO2	CO2	CO2	CO2	Water	CO2	CO2
Coolant con-tain.	PCPV	PCPV	PCPV	Steel PV	Steel PV	PCPV	PCPV
Coolant pres-sure (Bar)	42	40	27	20	158	43.3	27.6
Coolant max. temp (C)	648	639	365	360	323	635	370
Steam turbine inlet press. (Bar)	160	163	27	46.6	67	160	35
Steam turbine inlet temp. (C)	495	538	350	354	283	538	320
Total Power Generated	1244	1248	434	420	1188	1250	950

Key:

BNF plc British Nuclear Fuels plc
BEGL British Energy Generation Ltd
U Rod Natural Uranium Rod
Steel PV Welded Steel Pressure Vessel
ME plc Magnox Electric plc
BEG(UK)L Britsh Energy Generation (UK) Ltd
UO2 Enriched Uranium Oxide Pellet
PCPV Pre-stressed concrete pressure vessel

For AGRs there is one fuel assembly per channel of 8 elements and the table indicates the number of pins per element

Annex 2 - HSE's Powers under a Nuclear Site Licence

Consents - A Consent is required before the licensee can carry out any activity which is specifically identified in the licence. For example, consent is required before a reactor is allowed to be started up again following its periodic shutdown. Before being granted a Consent the licensee must satisfy HSE that the proposed action is safe and that all procedures necessary for control are in place.

Approvals - An Approval is used to freeze a licensee's arrangements. If HSE so specifies the licensee is required to submit the arrangements and cannot carry them out until HSE has given its approval. Once approved, the procedures cannot be changed without HSE's agreement, and the procedure itself must be carried out as specified; failure to do so would infringe the licence condition and would be an offence. For example, for nuclear power stations HSE has approved operating rules important to safety in order to ensure that licensees cannot change these without seeking HSE's agreement to the change.

Directions - A Direction is issued by HSE when it requires the licensee to take a particular action. For example, Licence Condition 31(1) gives the Executive the power to Direct a licensee to shut down any plant, operation or process. Such a Direction would relate to a matter of major or immediate safety importance and has been used rarely.

Agreements - An Agreement issued by HSE allows a licensee, in accordance with its own arrangements, to proceed with an agreed course of action. For example, Licence Condition 22 requires a licensee to have adequate arrangements to control modifications to safety related plant. Such arrangements will often state that for modifications which, if inadequately conceived or implemented, there could be serious nuclear safety implications, the modification cannot be carried out without the agreement of HSE. Hence, the licensee submits a safety case justifying the modification and does not proceed until HSE has written agreeing to this proposal.

Notification - The standard licence gives HSE powers to request the submission of information by notifying the licensee of the requirement. For example in Licence Condition 21(8) the licensee shall, if notified by the Executive, submit a safety case and shall not commence operation of the relevant plant or process without the consent of the Executive.

Specification - The standard licence gives HSE discretionary controls with regard to a licensee's arrangements and these are implemented through Specifications. For example, in Licence Condition 23(2), if the Executive specifies, the licensee is required to refer operating rules to its Nuclear Safety Committee for consideration.

Licence Instruments - Agreements, notifications, and specifications are all legally binding communications between HSE and the licensee which allow the licensee to carry out an activity or require some form of action to be taken. To administer these requests/authorisations, HSE has produced a standard form of letter known as a licence instrument.

Additional powers under the Health and Safety at Work etc. Act 1974

Improvement notice - The HSW Act provides (s.21) for an inspector, if of the opinion that a statutory provision is being or has been contravened (and the contravention will continue), to serve a notice requiring the person to remedy the contravention.

Prohibition notice - The HSW Act also provides (s.22) for an inspector, if of the opinion that activities are being carried out which risk causing serious personal injury, to serve a notice with immediate effect to prohibit the activity.

Annex 3 - List of Generic Issues for the Magnox Periodic Reviews

A3.1. Reactor pressure circuit safety case

a) Consider the reasonable practicability of extending in-service volumetric examination to the pressure vessel welds and ductwork features within the biological shield.

b) Confirm that defects which could have survived the original proof-pressure test could not propagate to failure within the projected lifetime of the station.

c) Confirm the adequacy of the leak-before-break case for the pressure circuit and show that procedures and equipment are available to detect sub-critical defects before they could propagate to failure.

d) Confirm that the material properties during the projected lifetime are adequate for all operating conditions, particularly for start-up and shut-down and for conditions arising when circuits are taken into and out of service while the plant is on-load.

e) Confirm that adequate Operating Rules are in place to meet the conditions described in d).

f) Confirm the extent to which the pressure circuit can withstand boiler tube failures.

A3.2. Biological shield

The capability of the biological shield to withstand the pressure loading arising from duct failure should be demonstrated. In particular the demonstration should show that the function of circuits next to the affected duct is not impaired.

A3.3. Shut-down systems

a) Confirm the extent to which the overall performance of the shut-down systems complies with modern standards and introduce any reasonably practicable improvements.

b) A diverse means of shutting down the reactor separate from the control rod system should be installed and must be capable of initiation from the central control room.

A3.4. Post-trip cooling

a) A diverse means of supplying post-trip cooling water to the boilers should be installed and should, as far as reasonably practicable, meet modern standards.

b) The capability of natural circulation to cool the reactor following a trip from the most adverse operating conditions for post-trip cooling requirements should be demonstrated.

A3.5. Fire hazard

Consider whether any improvements to fire zoning and equipment are available and confirm the extent to which the installed system complies with modern standards.

A3.6. Resistance to earthquakes

Demonstrate what level of earthquake the plant can withstand without sustaining unacceptable damage.

A3.7. Operator action following faults

a) The role of the operator under major fault conditions should be considered.

b) Any actions required by the operator within particular time periods to limit the effects of faults should be shown to be practicable.

A3.8. Reactor control room

Consider the reasonable practicability of providing an alternative emergency indication centre.

A3.9. Ageing

a) Produce a systematic programme for examining and monitoring of plant and components for the effects of ageing.

b) Confirm that no component important to safety will limit the safe operational life to less than the projected life of the station.

A3.10. Reactor refuelling machines

Undertake volumetric non-destructive testing of those parts of the refuelling machine pressure vessel components where access is reasonably practicable.

A3.11. Cranes

Confirm that cranes do not pose an unacceptable risk to plant safety.

A3.12. Radiological protection

a) Provide a comparison of radiation doses to operators with the HSE's safety assessment reference levels and make any reasonably practicable improvements if they are not met.

b) Confirm that direct radiation doses to members of the public comply with the most recent recommendations of the ICRP.

c) If occupancy factors are claimed in b), demonstrate by habit surveys that these are soundly based.

d) Where doses from direct radiation to members of the public are in excess of HSE's safety assessment reference levels, consider and introduce any reasonably practicable improvements.

The findings of the Generic Issues Review have probably resulted in the most significant corrective actions being required by the HSE. By way of example the assessment work and resulting corrective actions for some of the more important of the generic issues are briefly described below on: material properties; in-service-inspection; shut-down systems; emergency indications centres; and segregation and protection of boiler water supplies.

Material properties

Issue 1(d) arose out of concerns that, due to environmental effects, primarily irradiation embrittlement, the reactor pressure vessel (RPV) might become too brittle and hence too vulnerable to failure due to any small defects that may exist and have not been detected. These concerns led to extensive work being carried out by the licensees. The work involved programmes of material testing, improved dosimetry and instrumentation, more refined structural analyses, improved material modelling and revised Operating Rules to increase the temperature of those parts of the RPV which may be significantly stressed during any routine operation, including reactor start up and shut down. All of this work was assessed by HSE's specialist assessors to ensure that a satisfactory safety case for the remaining planned life of the reactors could be made.

The two Magnox reactors situated at Trawsfynydd in North Wales were shut down on economic grounds because the licensee concluded that the costs of resolving to HSE's satisfaction safety issues relating to the possible extent of RPV embrittlement were too high to be economically worthwhile. A major programme of material sampling from the two Trawsfynydd RPVs is underway to provide additional validation for some of the models used in making safety cases for other Magnox RPVs.

In-service inspection

It is recognised that significant areas of the Magnox steel RPV's are not amenable to in-service inspections. The safety cases therefore place considerable importance on post manufacture pre-service inspections to indicate that defects above a certain size were unlikely to exist at start of life. Nevertheless the integrity of the RPV is judged to be so important that HSE has directed the licensees to explore the reasonable practicability of extending the areas of the RPVs and pressure circuits which can be inspected in service. This is important because inspection methods have developed considerably since manufacture. In particular the use of volumetric inspections using ultrasonic inspection techniques are now widely used. Although several areas of RPVs still cannot be inspected it is accepted that the results of the additional inspections that have been carried out provide extra confidence in the integrity of those parts which cannot. This is because all the RPVs were manufactured and inspected to similar standards using similar materials and geometries. As part of the additional work that has been initiated, ultrasonic inspections of significant areas of hitherto un-inspected (during service) parts

of the RPV and ductwork have now been carried out and in general these have confirmed the absence of structurally significant defects (but see paragraph 1.13 on Sizewell A).

As well as using the pre-service and limited in-service inspections to improve confidence that no significant defects exist, the safety cases for the RPVs are also strengthened by consideration of the pre-service proof (over) pressure test. This test was used to show that defects above a certain size were very unlikely to exist at start of life (or the vessel would have failed during the test). This has the additional advantage of indicating that the material properties were also above a certain level of toughness at that time. This additional "leg" of the safety case is a particularly strong supporting argument for many of the Magnox RPV's. HSE directed the licensees to confirm that defects which could have survived the proof test would not propagate to failure during the predicted life of the station. This involved significant analytical work by the licensee's because of the many different stress locations within a typical Magnox RPV.

Stresses in the steel pressure circuit of a Magnox reactor are generally small. Therefore, relatively large defects would have to be present in the as-built vessels before any could grow to reach a critical size. All reactor pressure vessels were built to basically the same design code and the methods of design, construction, inspection and testing were similar.

Shut-down systems

As already stated, the LTSRs required a comparison against modern standards. Modern standards apply a cut-off limit for the level of reliability which can be claimed for any individual line of protection. The HSE therefore considered that the reliability of the shutdown system could be improved both by introducing a totally diverse guardline into the shut down initiation system, and a diverse shut-down system separate from the existing control rod system. Both of these requirements have involved the licensees in extensive work, firstly by the installation (and testing) of an additional set of segregated and diverse guardlines for the control rod shut down systems and secondly by the introduction of a secondary shut-down system for those stations which did not already have such a system (many stations already had boron ball shut-down devices). A system based upon the use of articulated control rods has now been agreed between the licensees and HSE for most of these plants and has been installed. Although this does not meet all the requirements for diversity and segregation which would be sought of a new nuclear installation it has been agreed that this provides a realistic and cost effective method of enhancing the safety of the shutdown system.

Emergency indication centres

The LTSR comparison with modern standards indicated there was a small probability that the main control room and its associated instrumentation could be lost as a result of some fault situations. The need for an alternative location where data would be indicated if an emergency occurred was therefore identified. None of the existing Magnox stations had this facility and as a result HSE required the licensees to commission emergency indication centres to provide this back-up. This involved extensive discussion upon the data to be replicated and involved the licensee in significant work to install the additional instrumentation.

Segregation and protection of boiler water supplies

Magnox reactors have the significant advantage that cooling can be maintained after shutdown by natural circulation of the carbon dioxide coolant. This requires the maintenance, or re-establishment within a few hours, of boiler water. Assessment of some of the Magnox reactors revealed that safety could be improved by introducing further segregation and protection for the boiler water supply. In particular, HSE recognised that there was a small probability that a major fire or large steam release could disable both the primary and secondary feedwater systems on some reactors. The licensees were therefore directed to install additional boiler feedwater systems on these plants. These systems (known as tertiary feed systems) were required to be totally independent of the existing primary and secondary feedwater systems and to meet modern safety standards. The work required to satisfy this direction has varied from station to station but includes features such as redundant sources of water and suction pipework, diesel driven pumps in separate new pump houses and new discharge pipework connected directly to the boilers. All of these plant modifications have been assessed by the HSE and the licensees have demonstrated their procedures for connecting up these systems where they are not permanently connected.

Annex 4 - Nuclear Site Licence: Standard Licence Conditions

1: Interpretation

The purpose of Licence Condition (LC) 1 is to ensure that there is no ambiguity in the use of certain specified terms which are found in the text of the Conditions. It also contains important powers for the Executive to modify, revise or withdraw approvals, etc. and to approve modifications to any matter currently approved. Where appropriate reference is made back to the relevant statutory Acts of Parliament.

2: Marking of the Site Boundary

(1) The licensee shall make and implement adequate arrangements to prevent unauthorised persons from entering the site or, if so directed by the Executive, from entering such part or parts thereof as the Executive may specify.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The licensee shall mark the boundaries of the site by fences or other appropriate means, and any such fences or other means used for this purpose shall be properly maintained.

(5) The licensee shall, if so directed by the Executive, erect appropriate fences on the site in such positions as the Executive may specify and shall ensure that all such fences are properly maintained.

The purpose of LC 2 is to delineate the extent of the site in order to prevent unauthorised access in order to limit the risk of injury to intruders and to other persons or damage to their property.

3: Restriction on Dealing with the Site

The licensee shall not convey, assign, transfer, let or part with possession of the site or any part thereof or grant any licence in relation thereto without the consent of the Executive.

The purpose of LC 3 is to ensure that nothing confuses the absolute responsibility of the licensee under the NI Act in respect of safety on the whole licensed site. The licensee should be able to demonstrate that there are organisational procedures to prevent individuals within the company from conveying, assigning, transferring, letting, feuing or granting any licences in relation to the site or parts of the site without first obtaining the Consent of the Executive.

4: Restrictions on Nuclear Matter on the Site

(1) The licensee shall ensure that no nuclear matter is brought onto the site except in accordance with adequate arrangements made by the licensee for this purpose.

(2) The licensee shall ensure that no nuclear matter is stored on the site except in accordance with adequate arrangements made by the licensee for this purpose.

(3) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(4) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(5) For new installations, if the Executive so specifies, the licensee shall ensure that no nuclear matter intended for use in connection with the new installation is brought onto the site for the first time without the consent of the Executive.

The purpose of LC 4 is to ensure that the licensee carries out its responsibilities to control the introduction and storage of nuclear matter on the licensed site. (Nuclear matter being fuel, sources, radioactive waste, etc., as defined by the NI Act).

5: Consignment of Nuclear Matter

(1) The licensee shall not consign nuclear matter (other than excepted matter and radioactive waste) to any place in the United Kingdom other than a relevant site except with consent of the Executive.

(2) The licensee shall keep a record of all nuclear matter (including excepted matter and radioactive waste) consigned from the site and such record shall contain particulars of the amount, type and form of such matter, the manner in which it was packed, the name and address of the person to whom it was consigned and the date when it left the site.

(3) The licensee shall ensure that the aforesaid record is preserved for 30 years from the date of dispatch or such other period as the Executive may approve except in the case of any consignment or part thereof subsequently stolen, lost, jettisoned or abandoned, in which case the record shall be preserved for a period of 50 years from the date of such theft, loss, jettisoning or abandoning.

The purpose of LC 5 is to ensure that the transfer of nuclear matter, other than excepted matter and radioactive waste, to sites in the UK other than relevant sites:
(a) is carried out only with the consent of the Executive; and that
(b) the licensee has adequate records of where such nuclear matter has been sent.
The licensee should also be able to demonstrate that there are organisational procedures to prevent individuals from inadvertently consigning such matter to non-relevant sites without first obtaining a Consent from the Executive.

[Relevant sites are other licensed or Crown sites as defined in the NI Act and excepted matter is defined in the NI Act and Statutory Instrument (S.I.) 1965/1826 and S.I. 1978/1779].

6: Documents, Records, Authorities and Certificates

(1) The licensee shall make adequate records to demonstrate compliance with any of the conditions attached to this licence.

(2) Without prejudice to any other requirements of the conditions attached to this licence, the licensee shall make and implement adequate arrangements to ensure that every document required, every record made, every authority consent or approval granted and every direction or certificate issued in pursuance of the conditions attached to this licence is preserved for 30 years or such other periods as the Executive may approve.

(3) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(4) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(5) The licensee shall furnish to the Executive copies of any such document, record, authority or certificate as the Executive may specify.

The purpose of LC 6 is to ensure that adequate records are held by the licensee for a suitable period to demonstrate compliance with licence conditions.

7: Incidents on the Site

(1) The licensee shall make and implement adequate arrangements for the notification, recording, investigation and reporting of such incidents occurring on the site:

(a) as is required by any other condition attached to this licence;
(b) as the Executive may specify; and
(c) as the licensee considers necessary.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

The purpose of LC 7 is to ensure that incidents are notified, recorded, investigated and reported as required by other licence conditions, as may be specified by the Executive and as the licensee considers necessary.

8: Warning Notices

The licensee shall ensure that suitable and sufficient notices are kept on the site for the purposes of informing persons thereon of each of the following matters, that is to say :

(a) the meaning of any warning signal used on the site;
(b) the location of any exit from any place on the site, being an exit provided for use in the event of an emergency;
(c) the measures to be taken by such persons in the event of fire breaking out on the site or in the event of any other emergency;

and that such notices are kept posted in such positions and in such characters as to be conveniently read by those persons.

The purpose of LC 8 is to ensure the safety of all people on site in respect of their ability to be able to respond appropriately and without delay to an emergency situation. The licensee therefore needs to ensure that all warning notices are in appropriate places to advise people on what to do in that area in the event of fire or any other emergency.

9: Instructions to Persons on the Site

The licensee shall ensure that every person authorised to be on the site receives adequate instructions (to the extent that is necessary having regard to the circumstances of that person being on the site) as regards the risks and hazards associated with the plant and its connection therewith and the action to be taken in the event of an accident or emergency on the site.

The purpose of LC 9 is to ensure that the licensee provides all persons allowed on the site with adequate instruction where necessary so that they are aware of the risks and hazards associated with the

plant and its operations, the precautions that must be taken to minimise the risk to themselves and others and the actions to be taken in the event of an accident or emergency.

10: Training

(1) The licensee shall make and implement adequate arrangements for suitable training of all those on site who have responsibility for any operations which may affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration is made to the approved arrangements unless the Executive has approved such alteration or amendment.

The purpose of LC 10 is to ensure that all those people on the site who have responsibility for an action which may affect safety are adequately trained for that purpose. This Condition is in addition to the general duty under HSW Act s. 2(2)(c) and the IRRs, regulation 12(a).

11: Emergency Arrangements

(1) Without prejudice to any other requirements of the conditions attached to this licence the licensee shall make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) Where any such arrangements require the assistance or co-operation of, or render it necessary or expedient to make use of the services of any person, local authority or other body the licensee shall ensure that each person, local authority or other body is consulted in the making of such arrangements.

(5) The licensee shall ensure that such arrangements are rehearsed at such intervals and at such times and to such extent as the Executive may specify or, where the Executive has not so specified, as the licensee considers necessary.

(6) The licensee shall ensure that such arrangements include procedures to ensure that all persons in his employ who have duties in connection with such arrangements are properly instructed in the performance of the same, in the use of the equipment required and the precautions to be observed in connection therewith.

The purpose of LC 11 is to ensure that the licensee has adequate arrangements in place to respond effectively to any incident ranging from a minor on-site event to a significant release of radioactive material .

12: Duly Authorised and Other Suitably Qualified and Experienced Persons

(1) The licensee shall make and implement adequate arrangements to ensure that only suitably qualified and experienced persons perform any duties which may affect the safety of operations on the site or any duties assigned by or under these conditions or any arrangements required under these conditions.

(2) The aforesaid arrangements shall also provide for the appointment, in appropriate cases, of duly authorised persons to control and supervise operations which may affect plant safety.

(3) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(4) The licensee shall ensure that once approved no alteration is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(5) The licensee shall ensure that no person continues to act as a duly authorised person if, in the opinion of the Executive, he is unfit to act in that capacity and the Executive has notified the licensee to that effect.

The purpose of LC 12 is to ensure that only suitably qualified and experienced persons perform duties which may affect the safety of any operations on the site or any duties required by other licence conditions or their arrangements made thereunder.

13: Nuclear Safety Committee

(1) The licensee shall establish a nuclear safety committee or committees to which it shall refer for consideration and advice the following:

(a) all matters required by or under these conditions to be referred to a nuclear safety committee;

(b) such arrangements or documents required by these conditions as the Executive may specify and any subsequent alteration or amendment to such specified arrangements or documents;

(c) any matter on the site affecting safety on or off the site which the Executive may specify; and

(d) any other matter which the licensee considers should be referred to a nuclear safety committee.

(2) The licensee shall submit to the Executive for approval the terms of reference of any such nuclear safety committee and shall not form a nuclear safety committee without the aforesaid approval.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the terms of reference of such a nuclear safety committee unless the Executive has approved such alteration or amendment.

(4) The licensee shall appoint at least seven persons as members of a nuclear safety committee including one or more members who are independent of the licensee's operations and shall ensure that at least five members are present at each meeting including at least one independent member.

(5) The licensee shall furnish to the Executive the name, qualifications, particulars of current posts held and the previous relevant experience of every person whom he appoints as a member of any nuclear safety committee forthwith after making such appointment. Notwithstanding such appointment the licensee shall ensure that a person so appointed does not remain a member of any nuclear safety committee if the Executive notifies the licensee that it does not agree to the appointment.

(6) The licensee shall ensure that the qualifications, current posts held and previous relevant experience of the members of any such committee, taken as a whole, are such as to enable that committee to consider any matter likely to be referred to it and to advise the licensee authoritatively and, so far as practicable, independently.

(7) The licensee shall ensure that a nuclear safety committee shall consider or advise only during the course of a properly constituted meeting of that committee.

(8) The licensee shall send to the Executive within 14 days of any meeting of any such committee a full and accurate record of all matters discussed at that meeting including in particular any advice given to the licensee.

(9) The licensee shall furnish to the Executive copies of any document or any category of documents considered at any such meetings that the Executive may specify.

(10) The licensee shall notify the Executive as soon as practicable if it is intended to reject, in whole or in part, any advice given by any such committee together with the reasons for such rejection.

(11) Notwithstanding paragraph (7) of this condition, where it becomes necessary to obtain consideration of or advice on urgent safety proposals (which would normally be considered by a nuclear safety committee) the licensee may do so in accordance with appropriate arrangements made for the purpose by the licensee, considered by the relevant nuclear safety committee and approved by the Executive.

(12) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements described in paragraph (11) of this condition unless the relevant nuclear safety committee has considered and the Executive has approved such alteration or amendment.

The purpose of LC 13 is to ensure that the licensee sets up a senior level committee which should consider and advise on matters which affect the safe design, construction, commissioning, operation and decommissioning of the installations on the licensed site and any other matter relevant to safety. The committee must have members who are adequately qualified to perform this task and to provide a source of authoritative advice to the licensee. The committee, however, is purely advisory and must not be considered to have an executive function, but the Executive must be informed if the advice of the committee is not to be followed by the licensee.

14: Safety Documentation

(1) Without prejudice to any other requirements of the condition attached to this licence the licensee shall make and implement adequate arrangements for the production and assessment of safety cases consisting of documentation to justify safety during the design, construction, manufacture, commissioning, operation and decommissioning phases of the installation.

(2) The licensee shall submit to the Executive for approval such parts or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment

(4) The licensee shall furnish to the Executive copies of any such documentation or any such category of documentation as the Executive may specify.

The purpose of LC 14 is to ensure that the licensee sets up arrangements for the preparation and assessment of the safety related documentation comprising "safety cases" to ensure that the licensee justifies safety during design, construction, manufacture, commissioning, operation, and decommissioning.

15: Periodic Review

(1) The licensee shall make and implement adequate arrangements for the periodic and systematic review and reassessment of safety cases.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The licensee shall, if so directed by the Executive, carry out a review and reassessment of safety and submit a report of such review to the Executive at such intervals, within such a period and for such of the matters or operations as may be specified in the direction.

The purpose of LC 15 is to ensure that the plant remains adequately safe and that the safety cases are kept up to date throughout its lifetime. The safety cases should be periodically reviewed in a systematic manner against the original design intent and current safety objectives and practices.

16: Site Plan, Designs and Specifications

(1) The licensee shall submit to the Executive an adequate plan of the site (hereinafter referred to as the site plan) showing the location of the boundary of the licensed site and every building or plant on the site which might affect safety.

(2) The licensee shall submit to the Executive with the site plan a schedule giving particulars of each building and plant thereon and the operations associated therewith.

(3) If any changes are made on the site which may affect the said buildings, plant or operations, the licensee shall forthwith send an amended site plan and schedule to the Executive incorporating these changes.

(4) The licensee shall furnish to the Executive such plans, designs, specifications or any other information relating to such buildings, plant and operations as the Executive may specify.

The purpose of LC 16 is to ensure that the licensee indicates, using a site plan, all buildings and plant or areas which might affect safety and provides a schedule updated as necessary giving details of each building and its associated operations.

17: Quality Assurance

(1) Without prejudice to any other requirements to the conditions attached to this licence the licensee shall make and implement adequate quality assurance arrangements in respect of all matters which affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The licensee shall furnish to the Executive such copies of records or documents made in connection with the aforesaid arrangements as the Executive may specify.

The purpose of LC 17 is to ensure that the licensee sets out the managerial and procedural arrangements that will be used to control and monitor those actions necessary in the interests of safety, and to demonstrate compliance with the site licence conditions (and in particular the arrangements made under them) and any other relevant legislation.

18: Radiological Protection

(1) The licensee shall make and implement adequate arrangements for the assessment of the average effective dose equivalent (including any committed effective dose equivalent) to such class or classes of persons as may be specified in the aforesaid arrangements and the licensee shall forthwith notify the Executive if the average effective dose equivalent to such class or classes of persons exceeds such level as the Executive may specify.

(2) The licensee shall submit to the Executive for approval such part or parts of the arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

The purpose of LC 18 is to ensure that the licensee makes and implements adequate arrangements to assess the average effective dose equivalent to specified classes of persons. Also the licensee shall notify the Executive if such dose exceeds the specified level. This is complementary to the IRR, regulation 13.

19: Construction or Installation of New Plant

(1) Where the licensee proposes to construct or install any new plant which may affect safety the licensee shall make and implement adequate arrangements to control the construction or installation.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The aforesaid arrangements shall where appropriate divide the construction or installation into stages. Where the Executive so specifies the licensee shall not commence nor thereafter proceed from one stage to the next of the construction or installation without the consent of the Executive. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of the proposed construction or installation and shall where appropriate provide for the submission of this documentation to the Executive.

(5) The licensee shall, if so directed by the Executive, halt the construction or installation of a plant and the licensee shall not recommence such construction or installation without the consent of the Executive.

The purpose of LC 19 is to ensure that the licensee provides and implements adequate control over the construction and installation of new plant which may affect safety.

20: Modification to Design of Plant under Construction

(1) The licensee shall ensure that no modification to the design which may affect safety is made to any plant during the period of construction except in accordance with adequate arrangements made and implemented by the licensee for that purpose.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The aforesaid arrangements shall provide for the classification of modifications according to their safety significance. The arrangements shall where appropriate divide modifications into stages. Where the Executive so specifies the licensee shall not commence nor thereafter proceed from one stage to the next of the modification without the consent of the Executive. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of the proposed modification and shall where appropriate provide for the submission of this documentation to the Executive.

The purpose of LC 20 is to ensure that where necessary adequate arrangements exist to control safety-related modifications during design and construction of plant or process.

21: Commissioning

(1) The licensee shall make and implement adequate arrangements for the commissioning of any plant or process which may affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration and amendment.

(4) The aforesaid arrangement shall where appropriate divide the commissioning into stages. Where the Executive so specifies the licensee shall not commence nor thereafter proceed from one stage to the next of the commissioning without the consent of the Executive. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of the proposed commissioning and shall where appropriate provide for the submission of this documentation to the Executive.

(5) The licensee shall appoint a suitably qualified person or persons for the purpose of controlling, witnessing, recording and assessing the results of any tests carried out in accordance with the requirements of the aforesaid commissioning arrangements.

(6) The licensee shall ensure that full and accurate records are kept of the results of every test and operation carried out in pursuance of this condition.

(7) The licensee shall ensure that no plant or process which may affect safety is operated (except for the purpose of commissioning) until:

> *(a) the appropriate state of commissioning has been completed and a report of such commissioning, including any results and assessments of any tests as may have been required under the commissioning arrangements referred to in paragraph (1) of this condition, has been considered in accordance with those arrangements; and*
>
> *(b) a safety case or cases as appropriate, which shall include the safety implications of modifications made since the commencement of construction of the plant and those arising from the commissioning of the plant, and any matters whereby the operation of the plant may be effected by such modifications or commissioning, has been considered in accordance with the arrangements referred to in paragraph (1) of this condition.*

(8) The licensee shall, if so notified by the Executive, submit to the Executive the safety case for the aforesaid plant or processes prepared in pursuance of paragraph (7) of this condition and shall not commence operation of the relevant plant or process without the consent of the Executive.

The purpose of LC 21 is to ensure that adequate arrangements exist for the commissioning of a new or modified plant or process which may affect safety and to ensure qualified supervision of this work.

22: Modification or Experiment on Existing Plant

(1) The licensee shall make and implement adequate arrangements to control any modification or experiment carried out on any part of the existing plant or process which may affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The aforesaid arrangements shall provide for the classification of modifications or experiments according to their safety significance. The arrangements shall where appropriate divide the modification or experiment into stages. Where the Executive so specifies the licensee shall not commence nor thereafter proceed from one stage to the next of the modification or experiment without the consent of the Executive. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of the proposed modification or experiment and shall where appropriate provide for the submission of the documentation to the Executive.

(5) The licensee shall if so directed by the Executive, halt the modification or experiment and the licensee shall not recommence such modification or experiment without the consent of the Executive.

The purpose of LC 22 is to ensure that adequate arrangements exist to ensure that all modifications and experiments that may affect safety are adequately controlled.

23: Operating Rules

(1) The licensee shall, in respect of any operation that may affect safety, produce an adequate safety case to demonstrate the safety of that operation and to identify the conditions and limits necessary in the interests of safety. Such conditions and limits shall hereinafter be referred to as operating rules.

(2) The licensee, where the Executive so specifies, shall refer the operating rules arising from paragraph (1) of this condition to the relevant nuclear safety committee for consideration.

(3) The licensee shall ensure that operations are at all times controlled and carried out in compliance with such operating rules. Where the person appointed by the licensee for the purposes of condition 26 identifies any matter indicating that the safety of any operation or the safe condition of any plant may be affected that person shall bring that matter to the attention of the licensee forthwith who shall take appropriate action and ensure the matter is then notified, recorded, investigated and reported in accordance with arrangements made under condition 7.

(4) The licensee shall submit to the Executive for approval such of the aforesaid operating rules as the Executive may specify.

(5) The licensee shall ensure that once approved no alteration or amendment is made to any approved operating rule unless the Executive has approved such alteration or amendment.

(6) Notwithstanding the preceding provisions of this condition the Executive may, if in its opinion circumstances render it necessary at any time, agree to the temporary suspension of any approved operating rule.

The purpose of LC 24 is to ensure that all operations that may affect safety are supported by a safety case. Also that the safety case identifies the conditions and limits that ensure that the plant is kept in a safe condition.

24: Operating Instructions

(1) The licensee shall ensure that all operations which may affect safety are carried out in accordance with written instructions hereinafter referred to as operating instructions.

(2) The licensee shall ensure that such operating instructions include any instructions necessary in the interests of safety and any instructions necessary to ensure that any operating rules are implemented.

(3) The licensee shall, if so specified by the Executive, furnish to the Executive copies of such operating instructions and when any alteration is made to the operating instructions furnished to the Executive, the licensee shall ensure that such alteration is furnished to the Executive within such time as may be specified.

(4) The licensee shall make and implement adequate arrangements for the preparation, review and amendment of such operating instructions.

(5) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(6) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

The purpose of LC 24 is to ensure that all operations as defined in Condition 1 which may affect safety, including any instructions to implement Operating Rules, are undertaken in accordance with written operating instructions.

25: Operational Records

(1) The licensee shall ensure that adequate records are made of the operation, inspection and maintenance of any plant which may affect safety.

(2) The aforesaid records shall include records of the amount and location of all radioactive material, including nuclear fuel and radioactive waste, used and processed, stored or accumulated upon the site at any time.

(3) The licensee shall record such additional particulars as the Executive may specify.

(4) The licensee shall furnish to the Executive such copies of extracts from such records as the Executive may specify.

The purpose of LC 25 is to ensure that adequate records are kept regarding operation, inspection and maintenance of any safety-related plant.

26: Control and Supervision of Operations

The licensee shall ensure that no operations are carried out which may affect safety except under the control and supervision of suitably qualified and experienced persons appointed for that purpose by the licensee.

The purpose of LC 26 is to ensure that safety-related operations are carried out only under the control and supervision of suitably qualified and experienced personnel.

27: Safety Mechanisms, Devices and Circuits

The licensee shall ensure that a plant is not operated, inspected, maintained or tested unless suitable and sufficient safety mechanisms, devices and circuits are properly connected and in good working order.

The purpose of LC 27 is to ensure that plant is not used unless safety mechanisms, devices and circuits are installed and maintained to an adequate standard.

28: Examination, Inspection, Maintenance and Testing

(1) The licensee shall make and implement adequate arrangements for the regular and systematic examination, inspection, maintenance and testing of all plant which may affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The aforesaid arrangements shall provide for the preparation of a plant maintenance schedule for each plant. The licensee shall submit to the Executive for its approval such part or parts of any plant maintenance schedule as the Executive may specify.

(5) The licensee shall ensure that once approved no alteration or amendment is made to any approved part of any plant maintenance schedule unless the Executive has approved such alteration or amendment.

(6) The licensee shall ensure in the interests of safety that every examination, inspection, maintenance and test of a plant or any part thereof is carried out:

> *(a) by suitably qualified and experienced persons;*
> *(b) in accordance with schemes laid down in writing;*
> *(c) within the intervals specified in the plant maintenance schedule; and*
> *(d) under the control and supervision of a suitably qualified and experienced person appointed by the licensee for that purpose.*

(7) Notwithstanding the above paragraph of this condition the Executive may agree to an extension of any interval specified in the plant maintenance schedule.

(8) When any examination, inspection, maintenance or test of any part of a plant reveals any matter indicating that the safe operation or safe condition of that plant may be affected, the suitably qualified and experienced person appointed to control and supervise any such examination, inspection, maintenance or test shall bring it to the attention of the licensee forthwith who shall take appropriate action and ensure that the matter is then notified, recorded, investigated and reported in accordance with the arrangements made under condition 7.

(9) The licensee shall ensure that a full and accurate report of every examination, inspection, maintenance or test of any part of a plant indicating the date thereof and signed by the suitably qualified and experienced person appointed by the licensee to control and supervise such examination, inspection, maintenance or test is made to the licensee forthwith upon completion of the said examination, inspection, maintenance or test.

The purpose of LC 28 is to ensure that all plant that may affect safety is scheduled to receive regular and systematic examination, inspection, maintenance and testing, by and under the control of suitable personnel.

29: Duty to carry out Tests and Inspections

(1) The licensee shall carry out such tests, inspections and examinations in connection with any plant (in addition to any carried out under condition 28 above) as the Executive may , after consultation with the licensee, specify.

(2) The licensee shall furnish the results of any such tests, inspections and examinations carried out in accordance with paragraph (1) of this condition to the Executive as soon as practicable.

The purpose of LC 29 is to enable the Executive, following consultation, to require the licensee to perform any tests, inspections and examinations which it may specify, and to be provided with the results.

30: Periodic Shutdown

(1) When necessary for the purpose of enabling any examination, inspection, maintenance or testing of any plant or process to take place, the licensee shall ensure that any such plant or process shall be shut down in accordance with the requirements of its plant maintenance schedule referred to in condition 28.

(2) Notwithstanding paragraph (1) of this condition the Executive may agree to an extension of a plant's operating period.

(3) The licensee shall, if so specified by the Executive, ensure that when a plant or process is shut down in pursuance of paragraph (1) of this condition it shall not be started up again thereafter without the consent of the Executive.

The purpose of LC 30 is to ensure that any part of the plant or process shall, where necessary to allow examination, inspection, maintenance and testing to take place, be shut down in accordance with the plant maintenance schedule. The Executive has discretion to require its consent to start-up of any process shut down under this condition.

31: Shutdown of Specific Operations

(1) The licensee shall if so directed by the Executive shut down any plant, operation or process on the site within such period as the Executive may specify.

(2) The licensee shall ensure that when the plant, operation or process is shut down in pursuance of paragraph 1 of this condition it shall not be started up without the consent of the Executive.

The purpose of LC 31 is to give discretionary powers to the Executive to shut down any plant, operation or process within a given period and to require its consent to start-up of any plant, operation or process shut down under this condition.

32: Accumulation of Radioactive Waste

(1) The licensee shall make and implement adequate arrangements for minimising so far as is reasonably practicable the rate of production and total quantity of radioactive waste accumulated on the site at any time and for recording waste so accumulated.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) Without prejudice to paragraph (1) of this condition the licensee shall ensure that radioactive waste accumulated or stored on the site complies with such limitations as to quantity, type and form as may be specified by the Executive.

(5) The licensee shall, if so specified by the Executive, not accumulate radioactive waste except in a place and in a manner approved by the Executive.

The purpose of LC 32 is to ensure that the production rate and accumulation of radioactive waste on the site is minimised, held under suitable storage arrangements and that adequate records are made.

33: Disposal of Radioactive Waste

The licensee shall, if so directed by the Executive, ensure that radioactive waste accumulated or stored on the site is disposed of as the Executive may specify and in accordance with an Authorisation granted under the Radioactive Substances Act 1960 or, as the case may be, the Radioactive Substances Act 1993.

The purpose of LC 33 is to give discretionary powers to the Executive to direct that radioactive waste be disposed of in a specified manner. This is related to the powers available to the EA in England and Wales and SEPA in Scotland under of the Radioactive Substances Act 1993, s. 13.

34: Leakage and Escape of Radioactive Material and Radioactive Waste

(1) The licensee shall ensure, as far as is reasonably practicable, that radioactive material and radioactive waste on the site is at all times adequately controlled or contained so that it cannot leak or otherwise escape from such control or containment.

(2) Notwithstanding paragraph (1) of this condition the licensee shall ensure, so far as is reasonably practicable, that no such leak or escape of radioactive material or radioactive waste can occur without being detected, and that any such leak or escape is then notified, recorded, investigated and reported in accordance with arrangements made under condition 7.

(3) Nothing in this condition shall apply to discharges or releases of radioactive waste in accordance with an approved operating rule or with disposal authorisation granted under the Radioactive Substances Act 1960 or, as the case may be, the Radioactive Substances Act 1993.

The purpose of LC 34 is to ensure so far as reasonably practicable that radioactive material and radioactive waste is adequately controlled or contained so as to prevent leaks or escapes, and that any unauthorised leak or escape can be detected and reported.

35: Decommissioning

(1) The licensee shall make and implement adequate arrangements for the decommissioning of any plant or process which may affect safety.

(2) The licensee shall make arrangements for the production and implementation of decommissioning programmes for each plant.

(3) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements or programmes as the Executive may specify.

(4) The licensee shall ensure that once approved no alteration or amendment is made to the arrangements or programmes unless the Executive has approved such alteration or amendment.

(5) The aforesaid arrangements shall where appropriate divide the decommissioning into stages. Where the Executive so specifies the licensee shall not commence nor thereafter proceed from one stage to the next of the decommissioning without the consent of the Executive. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of the proposed decommissioning and shall where appropriate provide for the submission of this documentation to the Executive.

(6) The licensee shall, if so directed by the Executive where it appears to them to be in the interests of safety, commence decommissioning in accordance with the aforesaid arrangements and decommissioning programmes.

(7) The licensee shall, if so directed by the Executive, halt the decommissioning of a plant and the licensee shall not recommence such decommissioning without the consent of the Executive.

The purpose of LC 35 is to require the licensee to make adequate provisions for decommissioning. It also gives discretionary powers to the Executive to direct that decommissioning of any plant or process be commenced or halted.

36: Control of Organisational Change

(1) The licensee shall make and implement adequate arrangements to control any change to its organisational structure or resources which may affect safety.

(2) The licensee shall submit to the Executive for approval such part or parts of the aforesaid arrangements as the Executive may specify.

(3) The licensee shall ensure that once approved no alteration or amendment is made to the approved arrangements unless the Executive has approved such alteration or amendment.

(4) The aforesaid arrangements shall provide for the classification of changes to the organisational structure or resources according to their safety significance. The arrangements shall include a requirement for the provision of adequate documentation to justify the safety of any proposed change and shall where appropriate provide for the submission of such documentation to the Executive.

(5) The licensee shall if so directed by the Executive halt all change to its organisational structure or resources and the licensee shall not recommence such change without the consent of the Executive.

Annex 5 Extracts from the HSW Act relevant to the CNS

Section 2 of the HSW Act places the following duties on employers to their employees:

(1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.

(2) Without prejudice to the generality of an employer's duty under the preceding subsection, the matters to which that duty extends include in particular -

(a) the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health;

(b) arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;

(c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of his employees;

(d) as far as is reasonably practicable as regards any place of work under the employer's control, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks;

(e) the provision and maintenance of a working environment for his employees that is, so far as is reasonably practicable, safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.

Under **Section 3** of the HSW Act employers have the following duties to persons other than their employees:

(1) It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not exposed to risks to their health or safety.

(2) It shall be the duty of every self-employed person to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that he and other persons (not being his employees) who may be affected thereby are not thereby exposed to risks to their health or safety.

(3) In such cases as may be prescribed, it shall be the duty of every employer and every self-employed person, in the prescribed circumstances and in the prescribed manner, to give to persons (not being his employees) who may be affected by the way in which he conducts his undertaking the prescribed information about such aspects of the way in which he conducts his undertaking as might affect their health or safety.

Section 7 of the HSW Act places general duties on employees:

(a) to take reasonable care of the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and

(b) as regards any duty or requirement imposed on his employer or any other person by or under any of the relevant statutory provisions, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or complied with.

Section 8 places a duty on persons not to interfere with or misuse things provided pursuant to certain provisions:

'No person shall intentionally or recklessly interfere with or misuse anything provided in the interests of health, safety or welfare in pursuance of any of the relevant statutory provisions.'

Section 14 gives powers to investigate and make a special report on any accident, occurrence, situation or other matter.

Section 15 allows health and safety regulations to be made that:

{ repeal or modify any existing statutory provisions;

{ impose requirements for approval by a specified body or person;

{ provide for exemptions from any requirement or prohibition imposed by or under any of the relevant statutory provisions.

Section 16 allows, for the purpose of providing practical guidance on meeting the HSW Act Regulations made under the Act and of the relevant statutory provisions, the issuing of codes of practice.

Section 19 allows the enforcing authority to appoint as inspectors such persons having suitable qualifications as it thinks necessary for carrying into effect the relevant statutory provisions within its field of responsibility. Every appointment of a person as an inspector must be made by an instrument in writing specifying which of the powers conferred on inspectors by the relevant statutory provision are to be exercisable by the person appointed.

Section 20 gives an inspector the following powers:

"(1) .... for the purpose of carrying into effect any of the relevant statutory provisions within the field of responsibility of the enforcing authority which appoints him, exercise the powers set out in subsection (2) below.

(2) ...., namely -
(a) at any reasonable time (or, in a situation which in his opinion is or may be dangerous, at any time) to enter any premises which he has reason to believe it is necessary for him to enter for the purpose mentioned in subsection (1) above;
(b) to take with him a constable if he has reasonable cause to apprehend any serious obstruction in the execution of his duty;
(c) without prejudice to the preceding paragraph, on entering any premises by virtue of (a) above to take with him -
(i) any other person duly authorised by his (the inspector's) enforcing authority; and
(ii) any equipment or materials required for any purpose for which the power of entry is being exercised;
(d) to make such examination and investigation as may in any circumstances be necessary for the purpose mentioned in subsection (1) above;
(e) as regards any premises which he has power to enter, to direct that those premises or any part of them, or anything therein, shall be left undisturbed (whether generally or in particular respects) for so long as is reasonably necessary for the purpose of any examination or investigation under paragraph (d) above;

(f) to take such measurements and photographs and make such recordings as he considers necessary for the purpose of any examination or investigation under paragraph (d) above;
(g) to take samples of any articles or substances found in any premises which he has power to enter, and of the atmosphere in or in the vicinity of any such premises;
(h) in the case of any article or substance found in any premises which he has power to enter, being an article or substance which appears to him to have caused or to be likely to cause danger to health or safety, to cause it to be dismantled or subjected to any process or test (but not so as to damage or destroy it unless this is in the circumstances necessary for the purpose mentioned in subsection (1) above);
(i) in the case of any such article or substance as is mentioned in the preceding paragraph, to take possession of it and detain it for so long as is necessary for all or any of the following purposes, namely -

(i) to examine it and do to it anything which he has power to do under that paragraph;
(ii) to ensure that it is not tampered with before his examination of it is completed;
(iii) to ensure that it is available for use as evidence in any proceedings for an offence under any of the relevant statutory provisions or any proceedings relating to a notice under section 21 or 22;

(j) to require any person whom he has reasonable cause to believe to be able to give any information relevant to any examination or investigation under paragraph (d) above to answer (in the absence of persons other than a person nominated by him to be present and any persons whom the inspector may allow to be present) such questions as the inspector thinks fit to ask and to sign a declaration of the truth of his answers;
(k) to require the production of, inspect, and take copies of or any entry in -

(i) any books or documents which by virtue of any of the relevant statutory provisions are required to be kept; and
(ii) any other books or documents which it is necessary for him to see for the purposes of any examination or investigation under paragraph (d) above;

(l) to require any person to afford him such facilities and assistance with respect to any matter or things within that person's control or in relation to which that person has responsibilities as are necessary to enable the inspector to exercise any of the powers conferred on him by this section;
(m) any other power which is necessary for the purpose mentioned in subsection (1) above."

Section 21 gives an inspector the power to serve improvement notices.

Section 22 gives an inspector the power to serve prohibition notices.

Section 25 gives an inspector the power to deal with cause of an imminent danger

Section 28 places restrictions on the disclosure of information.

Section 39 gives an inspector the power in England and Wales to prosecute before a magistrates' court proceedings for an offence under any of the relevant statutory provisions.

Annex 6 Extracts from the Nuclear Installations Act 1965 (as amended) relevant to the CNS

Sections 1, 3 to 6, 22 and 24A of the NI Act {Ref. 23} are relevant statutory provisions of the HSW Act. The relevant parts of each of these sections to this Convention are:

Section 1 restricts certain nuclear installations to licensed sites:

"(1) Without prejudice to the requirements of any other Act, no person shall use any site for the purpose of installing or operating

(a) any nuclear reactor (other than such a reactor comprised in a means of transport, whether by land, water or air)

unless a licence so to do (a 'nuclear site licence') has been granted in respect of that site by the HSE and is for the time being in force."

Section 3 concerns the granting and variation of nuclear site licences:

"(1) A nuclear site licence shall not be granted to any person other than a body corporate and shall not be transferable.

(1A) The HSE shall consult the appropriate Agency [the Environment Agency (EA) in England and Wales and the Scottish Environment Protection Agency (SEPA) in Scotland] before granting a nuclear site licence in respect of a site in Great Britain.

(2) Two or more installations in the vicinity of one another may, if the HSE thinks fit, be treated for the purposes of the grant of a nuclear site licence as being on the same site.

(6) The HSE may from time to time vary any nuclear site licence by excluding therefrom any part of the licensed site -

(a) which the licensee no longer needs for any use requiring such a licence; and

(b) with respect to which the HSE is satisfied that there is no danger from ionising radiations from anything on that part of the site.

(6A) The HSE shall consult the appropriate Agency [EA or SEPA] before varying a nuclear site licence in respect of a site in Great Britain if the variation relates to or affects the creation, accumulation or disposal of radioactive waste, within the meaning of the Radioactive Substances Act 1993."

Section 4 allows HSE to attach conditions to licences:

"(1) The HSE by instrument in writing shall on granting any nuclear site licence, and may from time to time thereafter, attach to the licence such conditions as may appear to the HSE to be necessary or desirable in the interests of safety, whether in normal circumstances or in the event of any accident or other emergency on the site, which conditions may in particular include provision -

(a) for securing the maintenance of an efficient system for detecting and recording the presence and intensity of any ionising radiations from time to time emitted from anything on the site or from anything discharged on or from the site;

(b) with respect to the design, siting, construction, installation, operation, modification and maintenance of any plant or other installation on, or to be installed on, the site;

(c) with respect to preparations for dealing with, and measures to be taken on the happening of, any accident or other emergency on the site;

(d) without prejudice to Sections 13 and 16 of the Radioactive Substances Act 1993 {Ref. 16}, with respect to the discharge of any substance on or from the site.

(2) The HSE may at any time by instrument in writing attach to a nuclear site licence such conditions as the HSE may think fit with respect to the handling, treatment and disposal of nuclear matter.

(3) The HSE may at any time by a further instrument in writing vary or revoke any condition for the time being attached to a nuclear site licence by virtue of this section.

(3A) HSE shall consult the appropriate Agency [EA or SEPA]

(a) before attaching any condition to a nuclear site licence in respect of a site in Great Britain or

(b) before varying or revoking any condition attached to such a nuclear site licence,

if the condition relates to or affects the creation, accumulation or disposal of radioactive waste, within the meaning of the Radioactive Substances Act 1993.

(5) At all times while a nuclear site licence remains in force, the licensee shall cause copies of any conditions for the time being in force under this section to be kept posted upon the site, and in particular on any part thereof which an inspector may direct, in such characters and in such positions as to be conveniently read by persons having duties upon the site which are or may be affected by those conditions."

Section 5 deals with the revocation and surrender of licences:

"(1) A nuclear site licence may at any time be revoked by the HSE or surrendered by the licensee.

(1A) HSE shall consult the appropriate Agency before revoking a nuclear site licence in respect of a site in Great Britain.

(2) Where a nuclear site licence has been revoked or surrendered, the licensee shall, if so required by the HSE, deliver up or account for the licence to such person as the HSE may direct, and shall during the remainder of the period of his responsibility cause to be kept posted upon the site such notices indicating the limits thereof in such positions as may be directed by an inspector; and the HSE may on revocation or surrender and from time to time thereafter until the expiration of the said period give to the licensee such other directions as the HSE may think fit for preventing or giving warning of any risk of injury to any person or damage to any property by ionising radiations from anything remaining on the site.

(3) In this Act, the expression 'period of responsibility' in relation to the licensee under a nuclear site licence means, as respects the site in question or any part thereof, the period beginning with the grant of the licence and ending with which ever of the following dates is the earlier, that is to say -

(a) the date when the HSE gives notice in writing to the licensee that in the opinion of the HSE there has ceased to be any danger from ionising radiations from anything on the site or, as the case may be, on that part thereof;

(b) the date when a new nuclear site licence in respect of a site comprising the site in question or, as the case may be, that part thereof is granted either to the same licensee or to some other person"

Section 6 refers to the maintenance of a list of licensed sites by the Secretary of State for Trade and industry.

Section 22 refers to reporting of and inquires into dangerous occurrences:

"(1) The provisions of this section shall have effect on the happening of any occurrence of any description as may be prescribed, being an occurrence -

(a) on a licensed site

(2) The licensee shall cause the occurrence to be reported forthwith in the prescribed manner to the HSE and to such other persons, if any, as may be prescribed in relation to occurrences of that class or description, and if the occurrence is not so reported the licensee shall be guilty of an offence. "

Section 24A covers the recovery of expenses by the HSE.

Annex 7 - Extracts from HSE's 'Tolerability of Risk'

A7.1 TOR {Ref. 33} gives guidelines on the tolerable levels of individual and societal risks to workers and the public from nuclear installations for both normal and accident situations. It puts forward the concept that risk can be divided into three regions on the TOR diagram (Fig. 4): an unacceptable region; the as low as reasonably practicable region (ALARP); and a broadly acceptable region.

{ In the **unacceptable risk region** arguments of reasonably practicability cease to be acceptable. In essence, risks in this region cannot be justified except in extraordinary circumstances. The maximum tolerable risk to workers should not exceed 1 in 10^3 each year. The maximum tolerable risk to any member of the public from any large industrial plant should not exceed 1 in 10^4 each year but with a benchmark figure for any new nuclear installation of 1 in 10^5 each year. For accidental risks, the risks for both normal operation and accidents taken together, then the risk for most people in the vicinity of a nuclear installation would be at or near 1 in 10^6 each year. For societal risk, the tolerable risk is linked to the number of persons affected and a figure of around 1 considerable accident per 10,000 years from any one of a programme of nuclear installations would be just tolerable bearing in mind the complications of what constitutes the programme.

{ In the **ALARP (or tolerable) region** licensees are required to do what they reasonably can to reduce risks until the cost of doing so more than outweighs any benefit likely to be gained. The risks should be weighed against the costs of reducing them; measures must be taken to reduce or eliminate the risks unless the cost of doing so would be obviously unreasonable compared to the risks.

{ In the **broadly acceptable region**, risks are low and are so insignificant that they need not claim attention. Although the legal duty of ALARP still applies, the regulator need not ask employers and licensees (in the case of nuclear licensed sites) to seek further improvement provided that it is satisfied that the low levels of risk will be attained in practice, and maintained.

A7.2 Risks must always be balanced against the benefits arising from the activity.

A7.3 These concepts of 'unacceptable', 'tolerable' and 'broadly acceptable' levels of risk are embedded in the SAPs (see Annex 8). The SAPs are written as guidance for HSE nuclear in-

stallation inspectors to use when carrying out assessment but they are available to licensees and the public. Apart from the few which embody statutory limits, they do not place mandatory requirements on licensees. If a proposed plant design satisfies the principles, licensing is quite straightforward. On the other hand, the non-mandatory nature of the SAPs gives the UK's licensing approach a flexibility which would enable the UK, for instance, to consider licensing nuclear installations built to non-UK standards despite apparent differences in the wording of those standards and the HSE's SAPs.

ANSWERS TO THE QUESTIONS POSED BY OTHER CONTRACTING PARTIES ON THE UNITED KINGDOM'S FIRST NATIONAL REPORT

Q Annex 7.4 What is the procedure in UK to define benchmark figures for tolerable and unacceptable risk levels (may be HSE made public hearing, etc)?

Discussion and numerical risk criteria are set out in HSE's publications on the *'Tolerability of Risk from Nuclear Installations'* (Ref. 33) and its *'Safety Assessment Principles'* (Ref. 7) which were produced in response to requests for such information arising from the Sizewell B public inquiry in 1986. The TOR document was subject to very wide public consultation; in essence it seeks to compare nuclear risks with other industrial and societal risks and gives some indication of how risk reduction is effected. The SAPs have been revised once and TOR is currently under review. Both these publications are available to members of the public through libraries and high street bookshops.

Annex 8 - HSE's 'Safety Assessment Principles'

A8.1 The safety of a nuclear installation is the responsibility of the licensee, who is required to submit to HSE a written demonstration of safety, the safety case. This safety case is periodically updated to reflect changing conditions. Assessment is the process by which HSE establishes whether the licensee's safety case is adequate. The SAPs are used for that purpose.

A8.2 SAPs define 'Fundamental' and 'Engineering' Principles, which follow the requirements of the HSW Act and the approach to risk developed in TOR (see Annex 7). The five fundamental principles are derived from recommendations of the ICRP which are implemented in the UK by the IRRs (see Article 15). They embody the requirements for statutory radiation dose limits and for the ALARP principle to be applied to radiation exposures resulting from normal operation and to the risks from accidents. The engineering principles are aimed at ensuring that, when a proposed plant comes into operation, the fundamental principles are satisfied.

Fundamental Principles

A8.3 The five fundamental principles are:

P1 No person shall receive doses of ionising radiation in excess of statutory dose limits as a result of normal operation.

P2 The exposure of any person to radiation shall be kept as low as is reasonably practicable.

P3 The collective effective dose to operators and to the general public as a result of operation of the nuclear installation shall be kept as low as is reasonably practicable.

P4 All reasonably practicable steps shall be taken to prevent accidents.

P5 All reasonably practicable steps shall be taken to minimise the radiological consequences of any accident.

Safety Analysis

A8.4 The SAPs develop the general TOR philosophy. The concept of a limit of tolerability has been translated into Basic Safety Limits (BSLs) for the risks from normal operation and from accident conditions. A proposed plant must satisfy these limits in order to be considered for licensing. Having satisfied the BSLs, the ALARP principle is applied to drive the risks from the plant even lower. There comes a point at which further consideration would itself be more costly in HSE resources than the benefit from applying its regulatory effort to other tasks. Each BSL is complemented, therefore, by a Basic Safety Objective (BSO). The BSOs define the point beyond which HSE nuclear installation inspectors need not seek further safety improvements from the licensee. Instead, they can confine their studies to the validity of the estimates put to them by the licensee. However, the licensee should take further risk reduction measures if it is reasonably practicable for the licensee to do so.

A8.5 The BSLs and the BSOs are related to individual and societal risks, and cover:

- radiation doses likely to be received by workers or members of the public in the course of normal operation; and
- the predicted frequency of accidents leading to radiation doses to workers and the public, releases of radioactive materials, or damage to plants which might lead to such releases.

A8.6 The BSLs and the BSOs therefore provide a framework against which HSE's nuclear installation inspectors can make judgements on the safety of proposals put to them.

Engineering Principles

A8.7 The Engineering Principles include criteria and guidance to assist HSE's nuclear installation inspectors determine whether engineering aspects which are important for safety have been adequately considered. They reflect best engineering practice used in engineering generally and also embody the requirements for safety which have been developed by the civil nuclear power industry. The Engineering Principles include an emphasis on: defence in depth with multiple physical barriers to prevent the release of radioactivity; automatic safety systems; detailed fault analysis; and QA and inspection.

A8.8 The basic philosophy of the SAPs is that a new plant should be designed according to modern engineering principles. Then the design is reviewed through fault analysis and PSA to check that: the design presents low risks; it is "balanced" (i.e. no undue reliance on a particular safety feature, or undue dominance of a particular fault); and risks are ALARP.

Special Case Procedure

A8.9 There are components in a nuclear installation whose safety is difficult to demonstrate in such a way as to readily satisfy the accident frequency requirements of the SAPs, the reactor pressure vessel of a pressurised water reactor being an example. This possibility is catered for in the SAPs by having a principle which allows for such items to be justified on a special case basis and this route has been used on a number of occasions.

A8.10 The two particularly important safety aspects to be addressed are that: the structure is as defect free as possible; and a demonstration that the structure is defect tolerant. In order to achieve this, several related but independent arguments must be used. For example, the arguments could include a demonstration that:

- sound design concepts and proven design features have been incorporated;
- potential failure modes have been analysed;
- proven materials have been used;
- there has been a high standard of manufacturing;
- a high standard of QA has been applied;

- the component has been the subject of pre-service inspection, and will be the subject of in-service inspection, to detect defects at sizes below those which have the potential for causing or developing into a failure mode;
- provision is made for in-service plant and material monitoring;
- a leak-before -break safety case has been made.

A8.11 Where the special case procedure is applied, or where any safety system is required to achieve a high reliability, the licensee has an independent assessment of the item carried out.

Annex 9 - Nuclear Installation Operators' Financial Accounts

This information can be found at References 36 and 37

Annex 10 - British Energy's Segregated Fund for Decommissioning costs

NOTE: The National Audit Office published a report on the sale of British Energy (HC 694 1997/98) 8 May 1998, ISBN 010295984.

Segregated Fund

(a) Introduction

The arrangements for the segregated fund are set out in the deed of trust dated 27 March 1996 between British Energy and the Secretary of State constituting The Nuclear Trust, the memorandum and articles of association of Nuclear Generation Decommissioning Fund Limited (the "fund company") and the nuclear decommissioning agreement (the "NDA") entered into on 29 March 1996 between the fund company, British Energy, Nuclear Electric, Scottish Nuclear and the trustees of The Nuclear Trust.

The Nuclear Trust owns the fund company, which was incorporated on 28 March 1996. The NDA provides, among other things, for the making of payments by Nuclear Electric and Scottish Nuclear to the fund company by way of an initial endowment and future contributions and for the fund company to make payments to meet costs of decommissioning in respect of British Energy's existing stations. The principal provisions of these arrangements are summarised below.

(b) The Nuclear Trust

The primary purposes of The Nuclear Trust are:

(i) to protect and preserve for the benefit of the nation the environment of the United Kingdom by being a member, directly or through nominees, of a company limited by shares or by guarantee, whose purpose is to receive and hold monies, investments and other assets so as to secure funding for decommissioning of British Energy's existing stations and to make payments for such decommissioning in approved cases;

(ii) to reduce the national debt of the United Kingdom; and

(iii) insofar as it is impossible or not reasonably practicable to carry out the foregoing purposes then such purposes as are charitable.

There are to be five trustees. British Energy is to appoint two licensee trustees and the Secretary of State is to appoint three independent trustees, save in exceptional circumstances, from a shortlist provided by British Energy. The Secretary of State and British Energy may in certain circumstances remove any of their appointed trustees who cease to satisfy specified appointment criteria. The normal term of office of a trustee is three years but is renewable.

The trustees have power to accumulate any income for 21 years from the date of the trust deed rather than distribute it and may pay any income in furtherance of the primary purposes and may hold capital to facilitate the primary purposes. Once British Energy's existing stations

have been fully decommissioned, the trustees may distribute capital only for the primary purposes (ii) and (iii) above.

The trustees have wide powers of management and administration. Their powers of investment are however limited to the Trustee Investments Act 1961 but exclude the power to invest in any company involved in the nuclear power industry.

The trustees may only alter the provisions of the trust deed with the consent of the Secretary of State and British Energy. British Energy with the Secretary of State's consent may dispose of its powers under the trust to its subsidiary or holding company.

The quorum for trustees' meetings is three trustees, including at least one licensee trustee and two independent trustees. At trustees' meetings each trustee has one vote. Resolutions are passed by a majority of votes except in certain specific circumstances where a unanimous resolution is required (eg. delegation of powers and appointment and payment of staff). The chairman of the trustees is to be one of the independent trustees and has a casting vote.

(c) Summary of the memorandum and articles of association of the fund company

(i) Objects

The fund company's principal object is to provide arrangements for funding decommissioning of British Energy's existing stations.

(ii) Share capital

The fund company's authorised and issued share capital is £100, divided into 98 ordinary shares of £1 each, which are jointly held by the trustees of The Nuclear Trust in their capacity as such, one A special rights redeemable preference share of £1 (the "A special share"), held by the Secretary of State (the "holder of the A special share") and one B special rights redeemable preference share of £1 (the "B special share"), which is jointly held by Nuclear Electric and Scottish Nuclear (together the "holder of the B special share").

(iii) General meetings

Each member (other than the holders of the A and B special shares) has one vote. The chairman (who is the chairman of the board of directors) has a casting vote.

The quorum for general meetings is two persons entitled to vote. Where a variation of rights is proposed, the quorum is at least one person representing at least one-third of the value of the specific class affected.

(iv) Directors

The maximum number of directors is five, comprising three A directors, one of whom is to be the chairman, and two B directors. A directors are appointed by the independent trustees of The Nuclear Trust, save in exceptional circumstances, from a shortlist provided by the holder of the B special share. B directors are appointed by the holder of the B special share. The independent trustees and the holder of the B special share may in certain circumstances

remove any of their appointed directors who cease to satisfy specified appointment criteria. The normal term of office of a director is three years but is renewable.

(v) Board meetings

At board meetings, each director has one vote. Resolutions are passed by a majority of votes. Each A or B director may exercise the voting rights of other A or B directors respectively not present.

The directors may delegate any of their powers to a committee of directors which includes at least one A director and one B director and shall include at least one more A director than B director.

The quorum for board and committee meetings is three directors, including at least two A directors and one B director, save that in the case of an adjourned meeting, the quorum is any two directors.

(d) Nuclear Decommissioning Agreement

The NDA provides that the contractual objectives of the fund company are:

(i) to accumulate assets sufficient to meet the decommissioning liabilities of British Energy's existing stations;

(ii) to have as a target the accumulation of assets with a value equal to 110 per cent. of the accrued discounted decommissioning liabilities of those stations;

(iii) for Nuclear Electric and Scottish Nuclear (the "licensees") to pay the initial endowment to the fund company and to agree to make future contributions;

(iv) for the fund company to make payments to meet costs of decommissioning; and

(v) to achieve the objectives in (i) and (iv) above at the lowest cost to Nuclear Electric and Scottish Nuclear reasonably achievable.

Scope of the segregated fund

The NDA provides for the fund company to meet the costs of making safe, surveillance and ultimate dismantling of the licensed facilities and the costs of the clearing, decontamination and reinstatement of the licensed site and related costs of waste management, in each case in accordance with the decommissioning strategy agreed from time to time by each of Nuclear Electric and Scottish Nuclear with the HSE. The costs of certain fuel storage activities will also be covered by the segregated fund if they become part of a future agreed decommissioning strategy. The obligation of the fund company to make payments to meet these costs is limited to the amount of the assets of the fund company.

The costs of post operational clean out of a power station by the removal of fuel and radioactive materials from a reactor and related waste management costs are not covered by the segregated fund arrangements.

Accumulation of the segregated fund

Nuclear Electric and Scottish Nuclear made an initial endowment to the fund company of £157,146,000 and £71,238,000 respectively. These payments were made on, or within one business day of, Admission. At the same time, Nuclear Electric and Scottish Nuclear made aggregated payments of £3,989,000 to the fund company for the quarter to 30 June 1996. Thereafter, future contributions will be made to the fund company by each of Nuclear Electric and Scottish Nuclear over the operational life of the stations on a quarterly basis, commencing 30 September 1996. These contributions (shown in the table below in 1996 current values) will be adjusted in accordance with an inflation index and will initially be of the order of £16 million in aggregate per annum, but reducing in time as each of the stations ceases to be operational. Scottish Nuclear's contributions to the fund company are expected to end in 2018 following the closure of Torness and Nuclear Electric's contributions are expected to end in 2035 following the closure of Sizewell B.

	Quarterly contributions	
Quarterly contributions due at the end of March, June, September and December	Nuclear Electric £m	Scottish Nuclear £m
30 September 1996 to 31 March 2006	2.99	1
30 June 2006 to 31 March 2008	2.59	0.515
30 June 2008 to 31 March 2009	1.51	0.515
30 June 2009 to 31 March 2018	1	0.515
30 June 2018 to 31 March 2035	0.56	--

The initial endowment and the quarterly contributions were invested by the fund company in accordance with an agreed investment policy which can be changed as part of the review procedure described below. A benchmark has been agreed against which the overall investment performance of the assets of the fund company will be measured. Professional investment managers and suitably qualified actuarial and technical advisers will be engaged by the fund company.

Reviews

The decommissioning strategy adopted by each of Nuclear Electric and Scottish Nuclear is to be reviewed by the HSE on a five-yearly basis. This review is scheduled to be completed by 31 March of the relevant year. In tandem with this, there is to be a review of the fund company's assets and British Energy's projected decommissioning costs, to enable a determination to be made as to whether any increase (or reduction) in the future level of contributions by Nuclear Electric and Scottish Nuclear is appropriate. This review is scheduled to be completed by 31 October in the relevant year. There may be a review at other times in the event of a material change in circumstances and there will be a further review prior to closure of the last station to close.

If in the context of a review the actuarially assessed value of the assets of the fund company is within the range 90 to 220 per cent of the then accrued discounted decommissioning liabilities in respect of all British Energy's existing stations (save in the case of the review prior to closure of the last station, when the assets of the fund company must represent 100 per cent of the then accrued discounted decommissioning liabilities), no adjustment will be made to the contribution rates (other than the indexation increase). If the actuarially assessed value exceeds 220 per cent, future payments will be adjusted on a basis designed to ensure that the amount of the excess will be eliminated over the next five year period. If the excess is greater than the payments which would otherwise be made, no contributions will be made by the licensees in that five year period, and the balance will be paid by the fund company to the licensees in annual instalments over that period.

ANNEX 11 - KEY ISSUES ARISING FROM THE ORAL QUESTIONS ON THE UK's NATIONAL REPORT AT THE FIRST REVIEW MEETING.

PRIVATISATION

A11.1 What positive and negative impact has privatisation had generally on safety? Could any conclusions drawn be shared with other countries? In particular how do the operators fund safety improvements and what are the effects on licensees' staffing levels? How does HSE ensure that staffing reductions do not go too far? How has the use of contractors affected the licensees' safety performance?

Response

A11.2 The privatisation of the AGRs and PWR took place relatively recently and changes within the Licensees' organisation and management are still evolving. Thus the full impact of the changes have yet to emerge. As a result of privatisation and deregulation there has been a move on the part of the licensees to cut costs in a very competitive market. HSE is paying particular attention to organisational downsizing and an increasing use of contractors in partnering arrangements to ensure safety is not being downgraded.

A11.3 The increased commercial pressures have led the licensees to focus on operating their existing plant, downsizing "in-house" support teams and the extensive use of contractors. Regulatory concerns have been expressed to the licensees about the retention and maintenance of "in-house" expertise and the implications of high reliance on contractors. Scrutiny in relation to these concerns has been and continues to be significant. The HSE is especially vigilant for signs of fall off in safety performance. Experience has shown that it is essential for the regulatory body to intervene at a very early stage in any privatisation/deregulation discussion. Declining safety performance is of concern to all regulators but detecting it early is the key to success. HSE has so far relied on its inspection programme to monitor safety performance.

A11.4 Regulatory action has been taken and HSE requires licensees to have rigorous and comprehensive management of change arrangements. These arrangements are designed to ensure that organisational changes are considered in relation to any impact they may have on safety. Staff reductions have to be carefully analysed so that the safety impact of any lost job is clearly justified. This proactive approach is intended to identify and prevent threats to safety before they occur.

MAGNOX REACTORS

Life Extension and Generic Issues

A11.5 The Magnox plants do not meet modern standards. How does the UK provide a justification for continuing to operate these old stations i.e. continuing to extend their lives? Have the Generic Issues that were identified resulted in safety improvements to the plants?

Response

A11.6 For all nuclear power stations in the UK the nuclear site licence requires a fundamental review of the plant safety case to be carried out at regular intervals. HSE and the licensees have agreed that the appropriate interval will be 10 years, which is in line with international "best practices". The PSRs are complemented by more regular reviews, as well as the day to day regulatory inspection and assessment that are carried out. This robust regulatory regime and the priority that the licensees give to safety ensures that prompt action is taken whenever specific safety issues arise, for example the Trawsfynydd RPV; Dungeness B bellows and Sizewell A boilers (see below for additional information).

A11.7 The licence requires the licensee to periodically shutdown the reactor for inspection and maintenance. On completion of the outage, the safety case, including the most recent in-

formation from in service inspections, results from operational experience feedback analyses and from surveillance programmes for ageing and degradation effects is considered prior to NII consenting to the return of a reactor to service. Consequently in between the major PSR reviews the safety cases are re-evaluated every year in the case of Magnox steel reactor pressure vessel stations and a maximum of every two years for concrete pressure vessel stations.

A11.8 Generic Issues are common to all Magnox plants and as such none are exempt from implementing plant safety upgrades as a result of consideration of these issues. The original identification and objective of the GIs was to ensure an earlier implementation of safety upgrades at the "younger" plants precisely because of the recognition that these issues were equally applicable to all Magnox plants. The GIs have also been taken into account in the PSRs for the AGR stations.

Steel Reactor Pressure Vessel Integrity

A11.9 How does the UK satisfy itself of the adequacy of the structural integrity of the steel RPVs bearing in mind access for inspection is limited?

Response

A11.10 ME/BNFL have submitted a safety case for its confidence in the RPV structural integrity which is based on five distinct, and largely independent, elements:-

i The pressure vessels were well built and thoroughly inspected during construction.

ii They were subjected to an over pressure proof test and there is a low probability that any defects which might have survived the proof test could grow in service.

iii The vessels can tolerate large defects without failing.

iv Even if a large defect were to arise and penetrate the pressure vessel wall it would generally be detected by the carbon dioxide leak detection system before it could grow to a critical size.

v The vessels are maintained at temperatures which keep the material fully ductile under steady state operation.

A11.11 A comprehensive in-service inspection programme is performed to measure operational parameters and other factors that affect the safety case.

A11.12 Inspections of Magnox pressure vessels are targeted to locations where the defect tolerance is least good, it is not simply targeted on where the welds are most accessible. The locations targeted for inspection, e.g. the Bradwell and Hinkley Point A outlet duct nozzles, are not the easiest places to inspect; but the licensee has developed ways of carrying out remote inspections in difficult areas. The licensees have also been doing a lot of work to determine the capability of the manufacturing inspections to detect defects of structural significance; this was complemented by detailed reviews of the construction records to confirm the effectiveness of these inspections to give confidence in the quality of manufacture.

A11.13 The main ageing mechanism is neutron embrittlement that is monitored by withdrawing surveillance specimens for testing.

A11.14 The licensees analyse the structural integrity of the RPVs in great detail annually for normal operating conditions and for potential faults and hazards. This, together with the quality of original manufacture, their robust and simple design, low stresses, defect tolerance and the targeted inspections gives substantiation of the safe operation of Magnox pressure vessels.

A11.15 If at any time the HSE judges that there is not an adequate safety case, a station's RPV it will not be allowed to operate. For example, Trawsfynydd ceased operation on 1991 as a direct result of regulatory concerns over embrittlement and HSE's rejection of the licensee's safety case.

Equipment Qualification

A11.16 For the oldest plants, the report infers that Equipment Qualification was less complete. How is this justified and is it taken into account in the probabilistic safety analysis?

Response

A11.17 Although the term 'equipment qualification' was not used at the time the early plants were designed and built, the concept that underlies it was well understood. There was recognition of the need for redundancy, segregation and conservative safety margins where safety was known to depend on equipment behaviour.

A11.18 Not as well understood at that time however, because safety analysis was itself in its infancy, were the more complex failure mechanisms and their effects, especially those involving system and human interactions. These shortcomings have to a large extent been corrected by later work, resulting from the outcomes of mandatory Periodic Safety Reviews (PSRs). Equipment qualification represents a major feature of these reviews and the upgrading of the reactors has included both replacing, and providing additional, systems and components and ensuring that they can provide the required safety functions under foreseeable environmental conditions both during normal operation and after accidents.

A11.19 The fault sequence analysis carried out as part of the PSA identifies the failures of safety system equipment which could occur as a consequence of the initiating event. This includes the consequential failures which would occur due to the environment (temperature, pressure, humidity, etc.) generated by the initiating event. In general, the assumption is made that a component or system would fail where the level of equipment qualification has not been shown to be adequate.

SEVERE ACCIDENTS

A11.20 What approach does the UK take to the management of severe accidents?

Response

A11.21 The UK accepts that the report did not cover the response to severe accidents in detail. A fuller response is provided in the written answers

A11.22 Licensees are required to:

i identify the beyond design basis fault sequences that have the potential to lead to a severe accident;

ii to provide an analysis to determine what failures could occur in the physical barriers to the release of radioactive material;

iii to determine the magnitude and characteristics of the radiological consequences;

iv to identify accident management strategies to reduce the risk by preventing failure of barriers or mitigating consequences;

v to provide instrumentation and other equipment where necessary;

vi to produce procedures for dealing with severe accidents;

vi to include simulator training in using these procedures.

A11.23 There is a requirement for the licensees to identify the beyond design basis fault sequences which have the potential to lead to a severe accident. The licensees also provide an analysis to determine failures that could occur in the physical barriers to the release of radioactive material, and the magnitude and characteristics of the radiological consequences. The results of such analyses have been used as the basis for identifying the accident management strategies that have been developed to reduce the risk from severe accidents by preventing the failure of the barriers or mitigating the consequences. This analysis has also resulted in the production of procedures for dealing with severe accidents and the provision of instrumentation and other equipment where necessary.

A11. 24 The earlier designs rely upon automatic shutdown response to abnormal operational states, supplemented by staff training in accident management and the provision of post-fault instructions and procedures. With the newer AGRs greater reliance is placed upon automatic post-trip operation, with the operator taking more of a monitoring role for the first thirty minutes.

A11.25 Extensive simulator training is given regularly in dealing with various fault scenarios.

A11.26 Generally speaking, the first instructions worked to will be fault-based, rather than symptom-based. This is because it is in the nature of plant operations to work with plant systems. Symptom-based instructions are used by a Control Room Supervisor several minutes after each reactor trip to check for significant faults. The desk operator deals with the direct fault management and the Supervisor keeps an overview. Essentially, this is done by completing a check-sheet at a predetermined time after the start of the event. Any deficiencies are highlighted during this process, and the most significant deficiency directs the Supervisor into the appropriate Symptom Based Emergency Response Guidelines (SBERG). For most events, though, there is no call for their use as they really only relate to major faults well beyond normal expectation. The only time staff are known to have needed to go to SBERGs is during training.

A11.27 The licensees have also developed Severe Accident Guidelines, these are concerned with making prior provision for mitigation and were introduced after the Chernobyl accident.

DEFENCE IN DEPTH

A11.28 Is there formal guidance for licensees on the defence in depth requirements for their plants and thus what is an acceptable design basis?

Response

A11.29 The defence in depth principles are set out in the HSE Safety Assessment Principles (SAPs) which are consistent with IAEA safety standards. The licensees have their own design guidelines which incorporate modern thinking on defence in depth.

A11.30 As an illustrative example of the defence in depth principles applied to UK plants some features of Magnox reactors are:-

i Predominately natural uranium metal fuelled and hence low power densities and low power rating.

ii Diverse shutdown/hold down systems with Control rods and seismically qualified Boron Ball Shut Down Devices for steel vessel RPV Magnox stations. Articulated control rods for Oldbury and Wylfa.

iii Ultimate shutdown of Boron Dust injection for all Magnox reactors.

iv Multiple gas circulators and pony motors to cover loss of power situation

v Diversity of post trip cooling and tertiary feed to boilers.

vii In the ultimate because of low power densities there are natural circulation safety case arguments.

AGEING MANAGEMENT

A11.31 What Ageing Management provisions are made for the UK reactors and what is the link to life extension decisions?

Response

A11.32 Ageing and plant life extension are managed by the licensees as an integral part of the PSR process. As indicated in para 6.14 the identification of ageing and life limiting phenomena are one of the main aims of these reviews. HSE concluded that some degradation processes would require more regular reviews than that afforded by the ten year PSR periodicity. The Licensees have established generic arrangements to undertake this important work at all installations and the outcome is taken into consideration by HSE when making regulatory decisions such as issuing a Consent for a reactor to return to routine operation after its statutory shutdown.

A11.33 As an example, for the Magnox steel Reactor Pressure Vessel (RPV) stations, following the closure of Trawsfynydd Power Station, the Licensee developed a strategy to sustain the safety cases for the primary circuit, including the RPV. The key objective is management of ageing and plant life extension. The strategy is underpinned by a detailed work programme, which is updated annually, and discussed with HSE at frequent meetings to review progress. Whilst HSE has not formally agreed the work programme it influences the work and key safety issues to be addressed through the regulatory process. For the RPVs, in response to the LTSR and PSRs, the safety case is updated each year to take account of new data and ageing processes. An example of the work being undertaken by Magnox Electric is the sampling and testing of material removed from the RPVs at Trawsfynydd which is being used to underpin irradiated materials properties issues.

A11.34 In addition to the Licensee's directly funded programme of work, research is undertaken under the auspices of the Health and Safety Commission co-ordinated nuclear safety research programme. Applicable areas of research are plant life management of steel components and graphite cores. The HSE, and the industry, contribute to the identification of research issues and an extensive research programme is funded each year to investigate ageing and safety issues for plant life extension.

A11.35 As already indicated earlier in the presentation, the safety cases for all installations are re-evaluated every year in the case of Magnox steel reactor pressure vessel stations and a maximum of every three years for concrete pressure vessel stations (both Magnox and AGRs). These reviews are formally linked to the statutory outage and including the most recent information from in service inspections and other surveillance programmes for ageing and degradation effects.

A11.36 If prior to HSE consenting to restart there were unresolved safety issues as a result of an ageing related issue then the reactor would remain shutdown, possibly permanently e.g. Trawsfynydd.

SEISMIC RESISTANCE

A11.37 What seismic analysis has been carried out at UK nuclear power plants and what standards are applicable? What resultant upgrades have taken place?

Response

A11.38 State of the art seismic analyses have been performed on all UK nuclear power plant sites including in some cases probabilistic seismic hazard analyses and seismic margin analyses.

A11.39 The licensees have undertaken a detailed station-by-station assessment. They concluded that all plants can be safely shut down, cooled and monitored following an earthquake with a peak horizontal ground acceleration of 0.1g (as recommended by IAEA safety standards), expected to occur about once in 1000 years for UK average seismicity areas. The licensee has also demonstrated that the Magnox reactors have a margin above the 0.1g level. The extent of the margin is dependent on the characteristic seismic hazard level at a particular site. The acceptability is judged on a site-specific basis.

A11.40 For the plants which were not originally designed for earthquake forces this has often meant that upgrading modifications have had to be carried out or are being progressed at present. Upgrading to essential plant as a result of seismic analysis has included; anchoring of previously unanchored equipment e.g. cabinets, the addition of extra bracing to steel structures, the improvement of the robustness of battery systems and the strengthening of masonry walls.

Additional Background Information

A11.41 The UK is situated in an intra-plate region of northwestern Europe that has low seismicity. Since the late 70's techniques for the determination of seismic hazard have developed significantly in the UK using research developments from the US.

A11.42 The reviews carried out to date by licensees have compared the performance of a structure to various seismic input reference levels. This approach has been used in preference to finding the level of hazard which would cause failure of the system as, the complexity of the structure and the definition of failure often make the calculation of ultimate seismic capability very difficult.

A11.43 The minimum ground motion used to review reactor is defined by a piece-wise linear spectrum developed from southern European and US time histories using the Newmark Hall methodology anchored at 0.1g horizontal peak ground acceleration (pga). A consideration in choosing this level was undoubtedly that the IAEA Code for siting of new nuclear power plants recommends that, regardless of any lower apparent exposure to seismic hazard, all plants should adopt a minimum value of 0.1g peak ground acceleration.

PROBABILISTIC SAFETY ANALYSIS (PSA)

A11.44 Have PSAs been carried out on all UK installations and what are the main conclusions to be drawn from them?

Response

A11.45 PSAs have been produced for all nuclear power plants and are a requirement of Periodic Safety Reviews [for Sizewell B, PSA was used in the design process].

A11.46 The UK licensees and regulators are very cautious when interpreting the value of PSAs. HSE would never accept a safety case built on probabilistic grounds alone. PSA is a powerful tool for analysing safety but needs to be part of a set of inputs into the final decision process, which include deterministic fault analysis and consideration of engineering. SAPs contain far more principles on, for example engineering, than PSA (or even fault analysis as a whole)

A11.47 PSAs are limited as there are areas where knowledge and data are lacking e.g. there is inadequate operational years for some major components and inadequate historical data for many external events, it is difficult to translate engineering safety factors etc into failure probabilities, human reliabilities are difficult to assess and it is difficult to demonstrate completeness of fault identification.

A11.48 Concentration purely on the numerical risk estimates could be misleading and undervalues the other aspects of PSA output e.g. demonstrating balance of risk, identifying weaknesses and checking provisions for defence in depth. A safe plant requires sound engineering design and good managerial control.

A11.49 PSA contributes to the overall judgement on what improvements to existing plants are required both in determining the level of risk and the reasonable practicability of implementing improvements.

SIMULATORS AND OPERATOR AUTHORISATION

A11.50 Does the UK have simulators for all plant designs? Why doesn't HSE carry out operator certification/authorisation ?

Response

Use of Simulators

A11.51 Simulators are available for all UK nuclear rector designs. The physical fidelity of these vary, and fidelity is highest on the more recent stations.

A11.52 For some of the older Magnox stations, a generic simulator is used. In this simulator, the physical fidelity is lower, but the controls, alarms and indications can be driven by high fidelity functional models of each of the different plants. In addition, two of the oldest reactor sites (Calder Hall and Chapelcross), that have conventionally instrumented control rooms, have produced simulators which present information via VDU screens. The displays mimic the layout of instruments in the control room.

A11.53 High functional fidelity is the key factor when determining the adequacy of the licensees' simulators. The important thing is for the operators to develop, maintain and demonstrate the conceptual skills needed to operate the reactor. This requires that the model is accurate and representative, and that plant controls and indications behave and operate as they do in the real plant.

A11.54 It should be noted that high fidelity simulators are not available for all plants - but realistically this is not reasonably practicable for the older Magnox stations at this stage of their lifetimes.

Operator Authorisation

A11.55 UK licensees have the prime responsibility for nuclear safety and as such retain responsibility for identifying the competence and training needs of their staff and for ensuring that these needs are met.

A11.56 Licensees are required to implement adequate arrangements for training and to ensure that staff with safety responsibilities are suitably qualified and experienced (SQEP). Reactor operators are designated 'Duly Authorised Persons' DAPs and HSE has power to remove DAP status. HSE satisfies itself that training and SQEP arrangements are adequately implemented. HSE requires licensees to develop and apply assessment methods and criteria that ensure that people are demonstrably competent to work in their designated roles.

A11.57 HSE considers that this approach provides a sound basis for confidence in the competence of operators. HSE sees a major potential disadvantage of certification by the regulator, namely a blurring of responsibility for safety between licensee and regulator.

SAFETY CULTURE

A11.58 How does the regulator assess safety culture?

Response

A11.59 HSE takes the view that the regulator should not and cannot prescribe a safety culture for its licensees. The safety culture must be owned by the licensee and promulgated amongst the workforce - both employees and contractors alike.

A11.60 HSE therefore places emphasis on monitoring the licensees' efforts to foster and maintain a good safety culture.

A11.61 HSE does not apply hard and fast criteria when judging the adequacy of a licensee's safety culture. HSE does not consider that valid and reliable criteria are available for this multifaceted concept. However, HSE expects the licensees to be informed about current developments in this area. It regularly probes the licensee's awareness and activities through the monitoring by the Site Inspectors, and through targeted specialist inspections.

A11.62 Staff from the licensees and HSE regularly participate in international fora where safety culture issues are discussed and developed (e.g., IAEA and OECD NEA's CSNI workshops/seminars). This enables UK personnel to maintain an awareness of current developments.

A11.63 HSE and the UK nuclear industry have commissioned several research projects that examine different aspects of safety culture - for example, recent work reviewed the safety culture enhancement methods that are currently in use.

QA IN LICENSEES AND REGULATORS

A11.64 What QA regime is applied to the suppliers of safety related equipment and services to the licensees? What QA arrangements are in place?

Response

Supplier QA

A11.65 The nuclear site licence requires the licensee to have adequate QA arrangements for all safety-related activities. The licensee has absolute responsibility for nuclear safety, and this includes activities undertaken on its behalf by contractors. This means that the licensee must be competent to act as the 'intelligent customer' when procuring and deploying support from contractors.

A11.66 All suppliers of safety related equipment and services must comply with the QA specifications provided by the licensees. As indicated in the report a graded approach to QA is adopted, thus the levels of quality assurance provided by the supplier are related to the safety significance of the product or service. Proven suppliers operating to systems in compliance with and certified to ISO 9000 series are predominantly used with additional requirements placed upon them should the safety significance warrant it. Suppliers are included in a listing compiled by the licensees which is used to control where services and equipment are procured.

A11.67 As the prime responsibility for safety rests with the licensees in the UK, HSE is not involved in supplier selection or evaluation this is clearly the work of the licensees.

Regulatory QA

A11.68 In 1998 NII decided to align its management processes with both ISO 9001 and the Business Excellence Model (BEM). NII has already gained the UK award Investors in People (IiP) to demonstrate its commitment to training quality. Most of the other elements of a quality management system have existed in NII for many years (including policies, responsibilities, interfaces, standards and guidance) and have undergone periodic updating.

A11.69 The decision to increase the formalisation of the systems has been taken because of a recognition of the need to continuously monitor and improve the way NII does its regulatory business. The biggest change will be the introduction of a more formal internal auditing programme that will start in mid 1999.

A11.70 Currently there is no intention to seek third party certification of the quality system. (Note the EA does have a certified QA system that meets the requirements of ISO 9001).

A11.71 The UK does not view QA within the regulatory body as an obligation of the CNS; it is not currently required by any international standards, nor do many regulatory bodies in the world seek the full formality of independent third party certification.

EMERGENCY PREPAREDNESS

A11.72 Does HSE approve licensees' emergency procedures? Do the arrangements cover severe accidents (extendibility) and how is technical support provide through all phases of the emergency situation?

Response

A11.73 Department of Trade and Industry lead government department for nuclear accidents in England and Wales and Scottish Office lead department for incidents in Scotland. UK emergency arrangements have evolved over 40 years. Regular rehearsals and demonstrations have tested the robustness of the arrangements.

A11.74 The nuclear site licence requires the licensee to make and implement arrangements for dealing with a nuclear emergency. NII currently approves these arrangements. The licensee arrangements do no cover offsite emergency planning other than to consult with the external agencies.

A11.75 The design basis accident is equated with the reasonably foreseeable accident or reference accident. Basis is that there should be detailed arrangements for a rapid response within a defined zone close to the site. The detailed arrangements are flexible and capable of being extended for extremely unlikely but greater consequence accidents.

A11.76 The off-site emergency arrangements are developed through the Nuclear Emergency Planning Liaison Group. The police co-ordinate the actions to protect the public at the off-site facility. Organisations attending are the licensee, local authorities, lead government department, Government Technical Adviser, Nuclear Installations Inspectorate, Environment Agency (SEPA for Scotland), Coastguard, emergency services, health authorities, MAFF, NRPB, MoD. National briefing arrangements are included i.e. NEBR and SOER.

A11.77 For extendibility the detailed emergency plans dovetail with local and national disaster plans.

Additional information

A11.78 Emergency actions in the UK are based upon:

i a defined zone closely surrounding each installation the detailed emergency planning zone within which arrangements to protect the public are planned in detail. The boundary of this zone is defined in relation to the size of any accident that can be reasonably foreseen;

ii the capability to respond to accidents which, although extremely unlikely, could have consequences beyond the detailed emergency planning zone (extendibility).

A11.79 The control of any nuclear plant involved in an accident begins and remains with the operator, who is responsible throughout for bringing the plant under control and thus reducing any off-site consequences. In the early stages before the setting up of the off-site centre and the arrival of the government technical adviser it is only the operator who can assess the position and provide guidance on any countermeasures required to protect the public. Once the OSF has been established and other organisations notably the GTA and NII have arrived (within a maximum of four hours for any UK site) the role of technical adviser moves from the operator to the GTA. In the interim period independent advice is provided to the police from NII's representative's at its emergency room in Bootle.

A11.80 The Nuclear Emergency Planning Liaison Group is chaired by DTI the lead government department for Nuclear Industries and is a group formed of representatives from all those organisations and bodies that have a role to play in ensuring public protection in the event of a Nuclear Emergency. These are: DTI, ACPO, HMNII/HSE, Home office, Scottish Office, Licensees, MoD, NRPB, DoH, Confederation of Chief Fire Officers, ACPO Scotland, MAFF, DETR. The role of this group is to discuss current practices at ensuring the robustness of emergency arrangements and to identify and draw out good practice and draw up any necessary guidance.

A11.81 Accidents which give rise to the most significant off-site consequences is taken as the reference accident .

Extendibility

A11.82 The reference accident would require the implementation of countermeasures and is used to determine the size of the detailed emergency planning zone. For Magnox reactors DEPZ's range from 1.6 to 3.5 km. In the case of modern plants, AGR's and PWR, improvements in design standards and safety assessment methods have resulted in successive reductions in the size or consequences of the reference accident. For these plants the reference accident may not require any actions beyond the site boundary. The need for a detailed emergency planning zone in such cases arises from the desirability of having a foundation for responding to larger accidents (basis of extendibility).

Off-site Arrangements

A11.83 All of the larger civil nuclear installations have established or have the use of ancillary emergency facilities at some distance from their nuclear sites and are referred to generically as off-site facilities. Currently in the UK these are between 10 to 150 km from the nuclear sites they support.

A11.84 The prime function of the off-site facility (OSF) is to decide on the actions to be taken off-site to protect the public, to ensure that those actions are implemented effectively, to provide technical support to the affected site and to ensure that authoritative information and advice on these issues is passed to the public (all OSF's have media briefing facilities). Technical support is also provided at the OSF. Decisions would generally be taken by way of regular co-ordinating group meetings, usually chaired by the police, involving all the principal organisations represented at the OF. For all sites the OF relieves the site of the responsibility for co-ordination of off-site monitoring activities, this function is carried out by NRPB.

A11.85 In the UK emergency arrangements for responding to a nuclear emergency are regularly rehearsed and NII has taken the initiative in defining and co-ordinating a national programme of exercises for demonstrating on-site and off-site aspects of emergency arrangements. The off-site exercises are aimed at demonstrating and improving local and national arrangements for dealing with accidents with significant off-site consequences. There is currently a three-year rolling programme for all exercises, i.e. level 1, 2 and 3. Each licensee is required to demonstrate the off-site aspects of the emergency plan once every three years. For UK this means that approximately each year six emergency exercises are carried out. One of these exercises is selected as the exercise to test the national arrangements. The programme is agreed by the Nuclear Emergency Arrangements Forum (NEAF), which is a forum where representatives from all licensees meet with NII to discuss matters relating to emergency arrangements. NII chairs NEAF and is the secretariat. NEAF produces papers of guidance on emergency matters.

INCIDENTS AND OPERATIONAL EXPERIENCE FEEDBACK

A11.86 What mechanism is in place to ensure systematic feedback of operational experience, both within the UK and from abroad? In relation to incident reporting what role does HSE play and what reporting criteria are adopted in the UK?

Response

Operational feedback

A11.87 British Energy operates the Nuclear Plant Event Reporting system database on behalf of the UK nuclear industry. Its Central Feedback Unit assesses national and international events and co-ordinates requests for additional assessments, where appropriate. HSE has access to summaries from the system and site inspectors have access to reports and assessments relating to the individual sites.

A11.88 A review of events on the site is carried out by licensees and the results are usually reported at the pre-start up meeting with HSE. Intermediate reviews are also carried out at other times and sites usually have a high-level management panel considering events and their response to them.

A11.89 Operators use root cause analysis and other human factors assessment techniques to analyse events. Station-based reviews of all events are carried out, and those with greater significance are recorded on a national nuclear event database operated on behalf of the UK industry by British Energy. This database is managed by a central feedback unit that analyses events and calls for site co-ordinators to respond to requests for information about those with greater significance.

Incident Classification

A11.90 An agreed classification system is used to indicate the safety significance of events. HSE site inspectors have access to these assessments and the resulting recommendations and can influence the course of some investigations, where appropriate. Individual judgement is used to evaluate which events require to be followed up by HSE, but would be expected to follow broadly the classification criteria used in the agreed reporting arrangements.

A11.91 The events that the Secretary of State requires to be notified about are:

i Dangerous occurrences reportable under Nuclear Installations (Dangerous Occurrences) Regs 1965;

ii Confirmed exposure to radiation of individuals which exceed or which are expected to exceed the dose limits specified in Schedule 1 to the Ionising Radiations Regulations;

ii Examination, inspection, maintenance or test of any part of the plant that has revealed that the safe operation or condition of the plant may be significantly affected;

iii Confirmed breach of or discharge expected to breach quantitative limits of a Certificate of Authorisation for the disposal of radioactive waste issued under Radioactive Substances Act 1993;

iv An abnormal occurrence leading to a confirmed release to atmosphere or spillage of a radioactive substance which exceeds or is expected to exceed the limits set out in the Ionising Radiations Regulations 1999, except where the release is in a manner specified in an Authorisation under the Radioactive Substances Act 1993;

iv An abnormal occurrence leading to a confirmed release or spread of radioactivity off the site if the estimated effective dose equivalent to the potentially most exposed member of the general public is or is expected to be in excess of 0.05 milliSieverts; and

v An abnormal occurrence leading to a release or suspected release or spread of radioactivity on or off the site which requires special action or special investigation by the operators.

A11.92 The HSE publishes a quarterly statement of all incidents, which have been reported under the ministerial reporting criteria. These statements identify each incident, its location, significance and the actions being taken to prevent a recurrence. The number reported varies but a typical figure would be 10 incidents per annum for all of the UK's nuclear licensed sites.

A11.93 HSE investigates incidents regularly through the site inspection regime and also provides the UK national IRS and INES officers. However HSE intends to increase the time spent on incident analysis and with this in mind is allocating extra resources to this end.

SAFETY PERFORMANCE INDICATORS

A11.94 What kind of safety performance indicators are used by the regulatory body to assess the licensees' activities in operating NPPs?

Response

A11.95 UK licensees use Safety Performance Indicators (SPIs) to monitor their own performance. They are largely based on WANO or other international measures.

A11.96 Through its inspection and assessment activities the HSE monitors licensees' arrangements for managing safety that includes reviewing what indicators are used throughout a licensee's organisation to improve safety.

A11.97 HSE mainly uses qualitative indicators e.g. inspection findings and quality of safety case submissions, but recognises the need to use numerical criteria subject to the above caution on their use. HSE is currently developing the use of safety performance indicators based upon licence compliance inspection findings. Development is at an early stage. HSE has also been actively involved over the years in the work of the IAEA in its attempts to develop meaningful SPIs.

RADIATION PROTECTION

A11.98 What are the licensee's procedures and measures to ensure that the doses to individuals are ALARP? And how does the regulatory body confirm whether the licensees maintain the ALARP principle or not? What dose reductions have been achieved in the last ten years in the individual nuclear power plants?

Response

A11.99 As explained in para 15.10, the licensee is responsible for ensuring that work with ionising radiations is properly controlled and for ensuring that doses are as low as reasonably practicable (ALARP). All activities are carried out by, and under the control and supervision of, suitably qualified persons within an effective management system (para 15.8 refers). A variety of measures are adopted to keep occupational doses to a minimum, these include engineered controls and operational safety features.

A11.100 Engineered controls include physical separation, containment, shielding, and remotely operated equipment. Examples of operational safety features are, physical barriers, warning devices/notices to control access and radiation monitoring arrangements. These measures are supplemented by operational controls such as pre-planning and prior assessment of exposures, written systems of work and the provision and use of personal protective equipment.

A11.101 Currently statutory upper dose limits are set out in the Ionising Radiation Regulations 1999 which are in line with ICRP 60 and the latest EC Directive. In practice the licensees have their own limits which are well within statutory or international limits. In its SAPs the HSE set safety objectives which represent limits within which it would not expend undue effort in pressing for a further reduction, bearing in mind that ALARP is a fundamental tenet of the law. The basic objectives for individual annual doses to workers and to members of the public are set at 2mSv and 0.02mSv respectively. Where these objectives are not satisfied the HSE looks very closely, through inspection and assessment of the licensee's operations to consider whether the right balance has been achieved between the costs and the benefits of dose reduction (see Para 15.7).

A11.102 The National Radiological Protection Board (NRPB) was created by the Radiological Protection Act 1970. The functions of the NRPB are to give advice, conduct research, and provide technical services in the fields of both ionising and non-ionising radiations. Since 1977, the NRPB have also been required to give advice on the acceptability to and the application in the UK of standards recommended by international or intergovernmental bodies, e.g. the International Commission on Radiological Protection. The NRPB issues advice in the "Documents of the NRPB" series.

A11.103 HSE's Health Directorate have the lead for developing regulatory policy in relation to radiological protection, this included negotiating the content of the Euratom Directive 96/29/Euratom (laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation), and also leading the development of the regulatory package to implement the Directive in the UK. The latter has been facilitated by publishing a Consultative Document on proposals for revised Ionising Radiations Regulations and also consultation with the Ionising Radiations Advisory Committee (IRAC).

A11.104 HSC established IRAC to consider all matters concerning protection against ionising radiations that are relevant to the work of the HSC. The committee consists of a wide cross-section of organisations including CBI, TUC, local authorities, government departments and professional bodies. IRAC's work includes consideration of the standards of protection for workers and others from work activity involving ionising radiations, monitoring the effectiveness of legislation and monitoring developments in technology.

Dose trends

A11.105 Dose information is collated annually by the nuclear site licensees but is not publicly available. HSE published information is based on industrial sectors rather than individual sites.

DISCHARGES AND RADIOACTIVE WASTE MANAGEMENT

A11.106 Information provided on regulatory environmental surveillance and the regulation of radioactive effluent releases and solid waste disposal is limited. How is adequate co-ordination ensured between the different agencies involved?

Response

Discharges

A11.107 The protection of people's safety from operations on licensed nuclear sites is regulated by HSE. However, airborne and liquid radioactive discharges and solid radioactive waste disposals are controlled by authorisations issued by the Environment Agency (EA) in England and Wales, and the Scottish Environment Protection Agency (SEPA) in Scotland. Legal requirements and responsibilities are outlined in the Radioactive Substances Act 1993. Radioactivity in food and the environment is monitored by the Ministry of Agriculture, Fisheries and Food (MAFF) in England and Wales and by the Scottish Office Agriculture and Fisheries Department in Scotland. These bodies also have responsibility for food safety in the event of a nuclear accident.

Note: Since the above was written, the situation in Scotland has changed. The situation now is that radioactivity in food and the environment is monitored by SEPA and the Food Standards Agency. SEPA conducts a holistic programme for the monitoring of radioactivity in food and the environment in Scotland. Throughout the UK, the Food Standards Agency has responsibility for the safety of food in the event of a nuclear accident. SEPA has no formal responsibility for food safety and therefore has agreed a Memorandum of Understanding with the Food Standards Agency (Scotland), which is due to be signed soon.

A11.108 Information on environmental radiological surveillance, effluent release and radioactive waste disposal is published annually in monitoring reports issued by the Environment Agency, and by MAFF/Scottish Environment Protection Agency. A compilation of year on year discharges of radioactivity from the UK's nuclear installations, together with considerable other information on radioactive wastes and public radiation exposure is given in the annual Digest of Environmental Statistics which is published by the Department of the Environment, Transport and the Regions. This information can also be found on these organisations' Internet sites

(at :- www.environment-agency.gov.uk, www.detr.gov.uk, www.sepa.org.uk.)

Correction: SEPA do not publish the report of effluent release and waste disposal in the annual digest of Environmental Statistics. Data relating to liquid and gaseous discharges is published in the Radioactivity in Food and the Environment report.

A11.109 The operators of the nuclear power stations also publish, annually, reports of their safety and environmental performance including details of their radioactive discharges and solid radioactive waste disposals (see, for example, www.british-energy.co.uk)

Co-ordination between Regulators

A11.110 HSE regulates the handling treatment and storage of radioactive waste on licensed nuclear sites through conditions attached to the nuclear site licence. A Memorandum of Understanding between HSE and EA is used to co-ordinate regulatory activities at nuclear licensed sites so that the licensees are not faced with conflicting regulatory requirements. A similar Memorandum of Understanding has also been signed between HSE and the Scottish Environment Protection Agency. An example of where the MoU is of value is that before agreeing to operations in which wastes will be conditioned, HSE liaises with the EA or SEPA, as appropriate, to ensure that they are content with the proposed waste conditioning operation and arrangements for the control of secondary wastes arising.

A11.111 Before allowing relevant proposals affecting ILW waste treatment to proceed, HSE also require reassurance from the relevant body, for the time being UK NIREX Ltd, that the proposed waste forms are likely to be acceptable for disposal in a future ILW repository.

A11.112 The House of Lords Select Committee on Science and Technology has recently reported on its investigation into radioactive waste management. The report contains some important conclusions and is currently being considered by the UK government.

Tables

Table 1 Status of Periodic Safety Reviews

STATION	STARTED OPERATION	FIRST REVIEW	SECOND REVIEW	THIRD REVIEW
Magnox Power Stations				
Bradwell	1962	1987	1992	Closes in 2002
Berkeley	1962/3	1988	Closed	
Hunterston A	1963	1988	Closed	
Calderhall/Chapelcross	1956/59	1982	1990	1996
Trawsfynydd	1964	Closed		
Hinkley Point A	1965	1990	1995	Closed
Dungeness A	1966	1994	1996	Closes in 2006
Sizewell A	1966	1994	1996	Closes in 2006
Oldbury	1968	1995	1998	
Wylfa	1971	1996	2004	
AGR and PWR power stations				
Hinkley Point B	1976	1996	2006	
Hunterston B	1976	1996	2006	
Dungeness B	1982	1997	2007	
Heysham 1	1983	1998	2008	
Hartlepool	1984	1998	2008	
Heysham 2	1989	1999	2009	
Torness	1989	1999	2009	
Sizewell B	1995	2005		

Note: The first safety reviews were called Long Term Safety Reviews and were undertaken at about 25 years of operational life. These were followed by PSRs which are now undertaken at approximately 10 yearly intervals.

Table 2 Principle nuclear installation life phases requiring safety reports

PHASE	LICENSEE'S SAFETY REPORT	PURPOSE
DESIGN	**Design Safety Criteria** **Pre-Construction Safety Report (PCSR)**	Design and safety principles Justify start of nuclear safety related work on site (including licensing) Identify data from commissioning and parallel research and development work to support safety case
CONSTRUCTION AND COMMISSIONING (including modifications)	**Pre-Operation Safety Report (POSR)** **Station Safety Report (SSR)** is the safety case for nuclear fuel to be loaded into the reactor	Development of the PCSR during construction and commissioning up to fuel load SSR is consolidated with further commissioning data until routine operation safety case is established
OPERATION	**Station Safety Report** Periodic Safety Reviews (PSR) - every 10 years	Justifies safety of continued operation and takes strategic look forward to consider the next 10 years
END OF LIFE SHUTDOWN	Pre-Decommissioning Safety Report Stage II Care and Maintenance Safety Report Periodic Safety Reviews Stage III Dismantling Safety Report	Unloading of Fuel Justify resources and scope of operations, maintenance, contingency and emergency arrangements.

Table 3 Pre-construction Safety Report (PCSR)

PURPOSE	USE MADE BY:	
	LICENSEE	**HSE**
To demonstrate to the Licensee and the Regulator the safety of: - detailed design proposals for new plant or major modifications prior to commencement of construction or installation; - the construction and installation activities.	1. To identify design standards and safety criteria. 2. To define the arrangements for management of safety. 3. To demonstrate how the design will meet the licensee's safety criteria. 4. Define the status of safety issues and confirm that any which are unresolved will not prejudice the design. 5. To confirm a Safety Category for the project. 6. To refine the safety specification for detailed design. 7. To allow independent assessors to make a judgement on the adequacy of proposals.	1. To understand the basis of the design and confirm that safety principles and criteria are appropriate. 2. To assess the adequacy of proposals. 3. To determine the extent of Regulatory involvement.

Table 4 Pre-operation Safety Report (POSR)

PURPOSE	USE MADE BY:	
	LICENSEE	**HSE**
To justify to the licensee and the regulator the safety of: - the design of the facility following construction and installation prior to the start of commissioning; - the commissioning of the facility and any remaining installation activities. The safety case identifies those commissioning tests and inspections required to: - confirm the plant's design safety assumptions and predicted performance, in particular that of the safety provisions; - characterise the plant as a basis for evaluating its behaviour during its operating life. The safety analysis is reviewed in the light of the results of the commissioning programme and any modifications made to the design of intended operating procedures since the commencement of construction.	To describe 'as built' facility and justify any deviation from the proposed design. To identify commissioning arrangements for demonstrating that the design intent and performance have been met or exceeded. To identify schedule of tests necessary or desirable in the interest of safety. To identify contingency plans should the design intent or performance not be met. To confirm design standards and criteria and justify any variation from those previously declared. To define arrangements for management of safety. To identify the plant specific arrangements for complying with the licence conditions and other relevant statutory provisions. To demonstrate how the facility design will meet the licensee's safety criteria. To confirm that any outstanding safety issues have been resolved. To identify any further safety issues which are required to be resolved or the need to invoke the special case procedure. To confirm that any unresolved issues are unlikely to prejudice the commissioning and operation of the facility. To facilitate independent assessment. To refine the safety analysis for all fault conditions. To confirm how the radioactive waste and decommissioning strategies will be implemented.	To identify the plant specific arrangements for complying with the site licence conditions and other regulatory provisions. To identify regulatory issues to be addressed during the commissioning of the plant.

Table 5 Station Safety Report (SSR)

PURPOSE	USE MADE BY	
	LICENSEE	**HSE**
Confirm prior to fuel load that the as-built plant meets safety standards and criteria and adequate management arrangements are in place Consolidate the result of development and commissioning to support safety of routine operations Consolidate results of subsequent modifications and justifications for continued operation	Identify the safe operating envelope, including the safety limits and conditions in operating rules Confirm that operational experience does not affect the safe condition or safe operation of the plant Identify operational implications for chosen decommissioning strategy Implementation of the radioactive waste management strategy	Assess the adequacy of safety of the facility and the basis for consent for routine operation and start-up after statutory shut down Confirm the extent of further regulatory involvement Form the basis of regulatory inspection and the examination of arrangements

Table 6 Periodic Safety Review (PSR)

PURPOSE	USE MADE BY	
	LICENSEE	**HSE**
Demonstrate that the plant is adequately safe for continued operation for a period of at least 10 years	Define the current safety standards and criteria to be applied Demonstrate how the plant meets the safety standards and criteria Identify programmes of work including analysis and modifications where reasonably practicable in response to safety issues Define the arrangements for the management of safety	Regulatory reassessment of the adequacy of the safety of the plant Provide input for regulatory inspection of the plant

Table 7 Dose information for classified persons - nuclear installations {Refs. 47 and 62}

(excluding those with a recorded dose of less than 0.1 mSv)

Year	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Collective Dose in ManSv	16.2	12.7	10.9	9.9	8.8	7.8	8
Mean dose in mSv	1.3	1.2	1.2	1.2	1.1	1	1
Classified persons with dose:							
> 5 mSv	822	592	593	490	455	329	446
> 10 mSv	66	21	16	18	12	16	25
> 15 mSv	17	0	1	1	0	0	0
> 20 mSv	8	0	1	0	0	0	0

FIGURES

Figure 1: HSE STRUCTURE (Relevant to CNS)
(from July 2001)

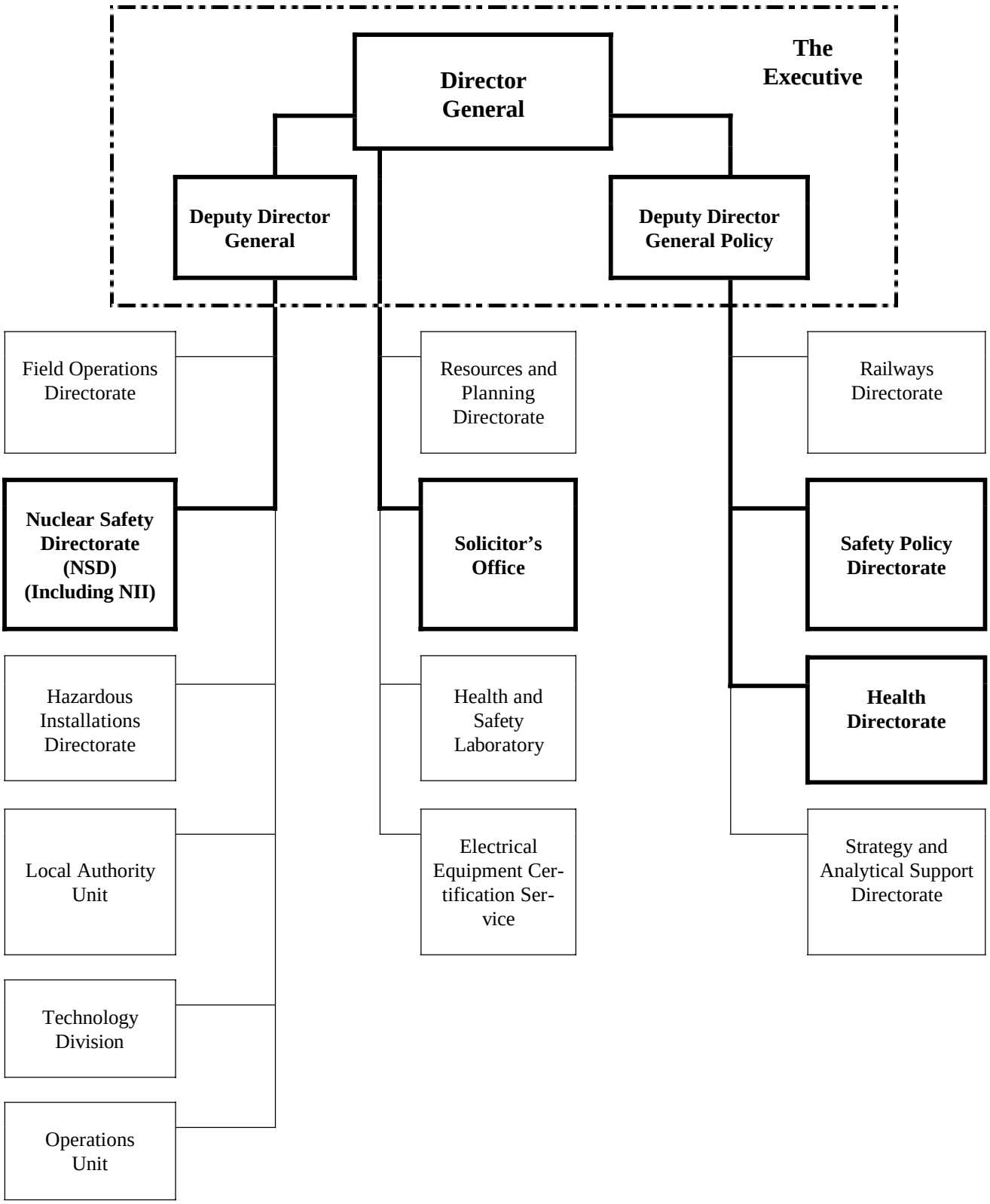

Figure: 2 Structure of HSE's Safety Policy Directorate's

Nuclear and Hazardous Installations Policy Division

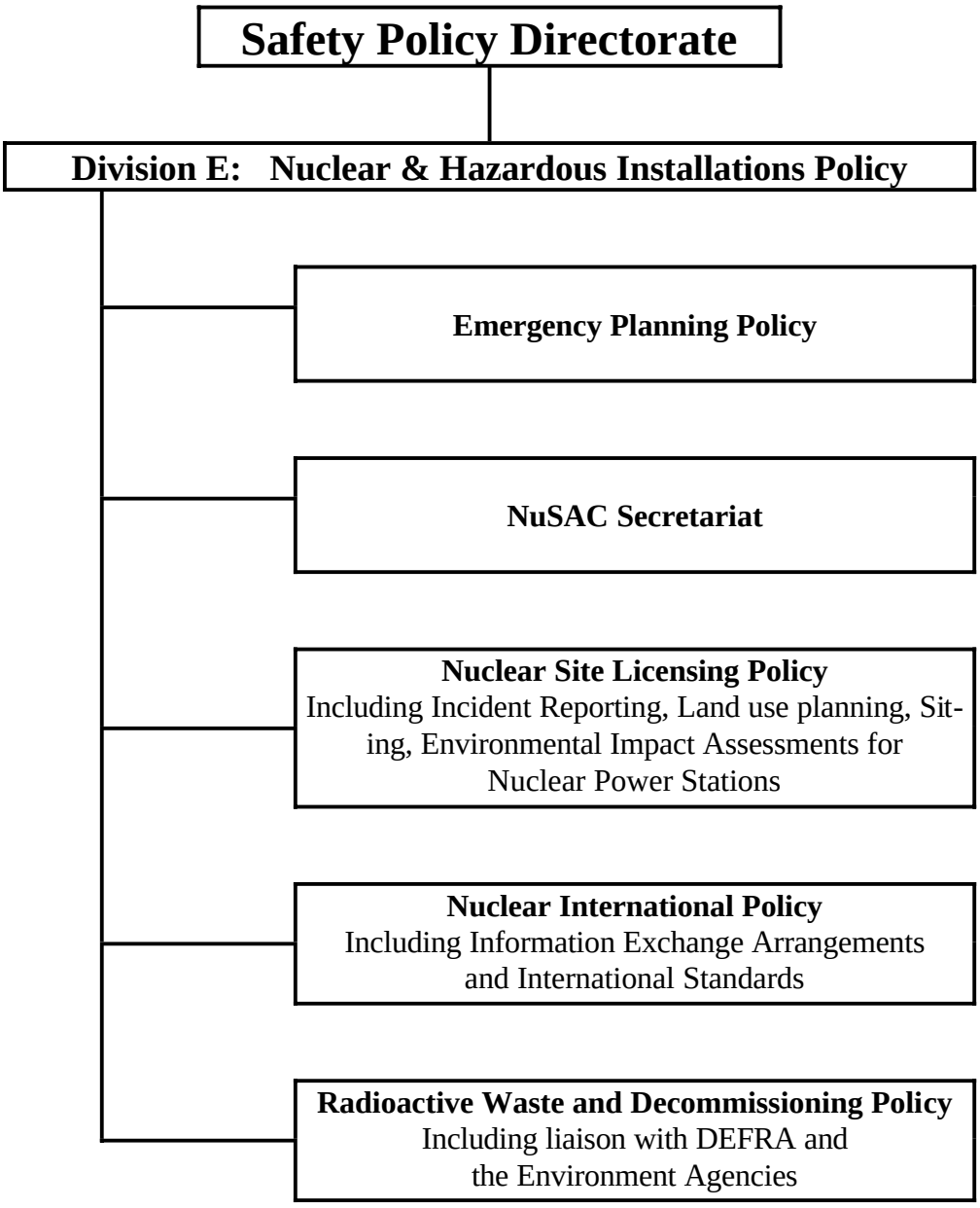

Figure: 3 Structure of HSE's Nuclear Safety Directorate

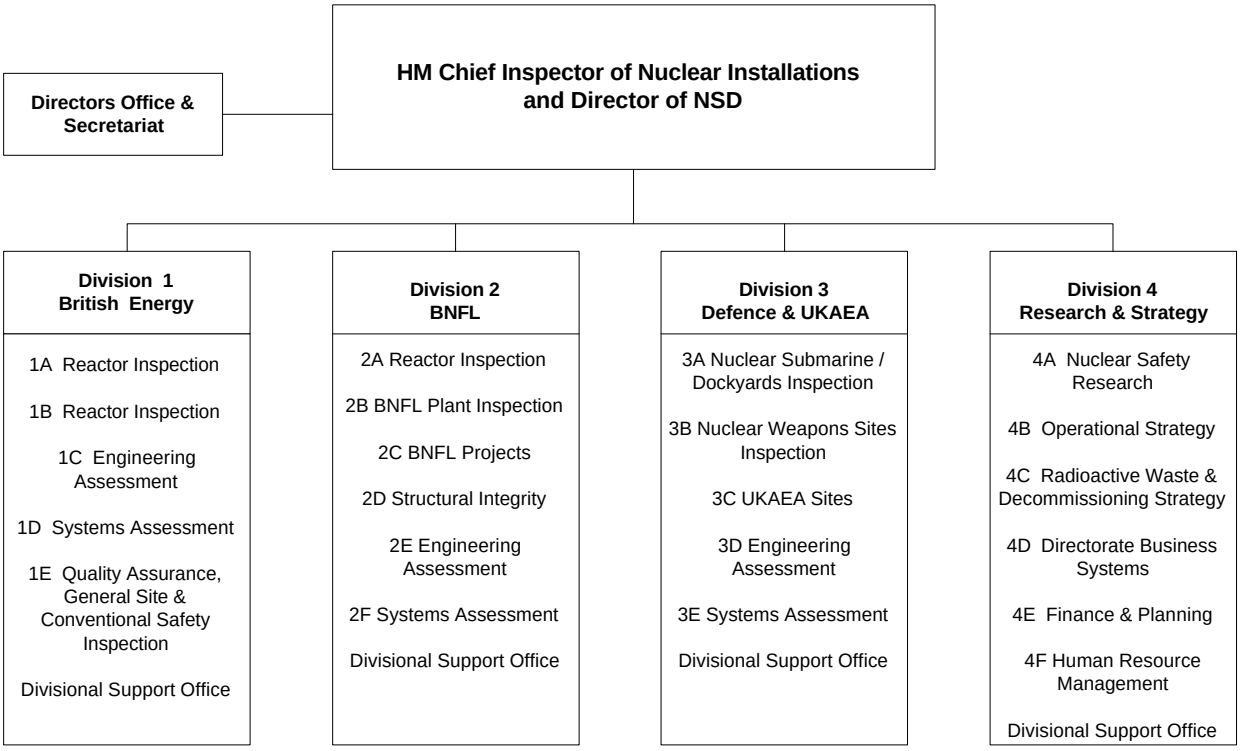

Figure 4: Tolerability of Risk Diagram

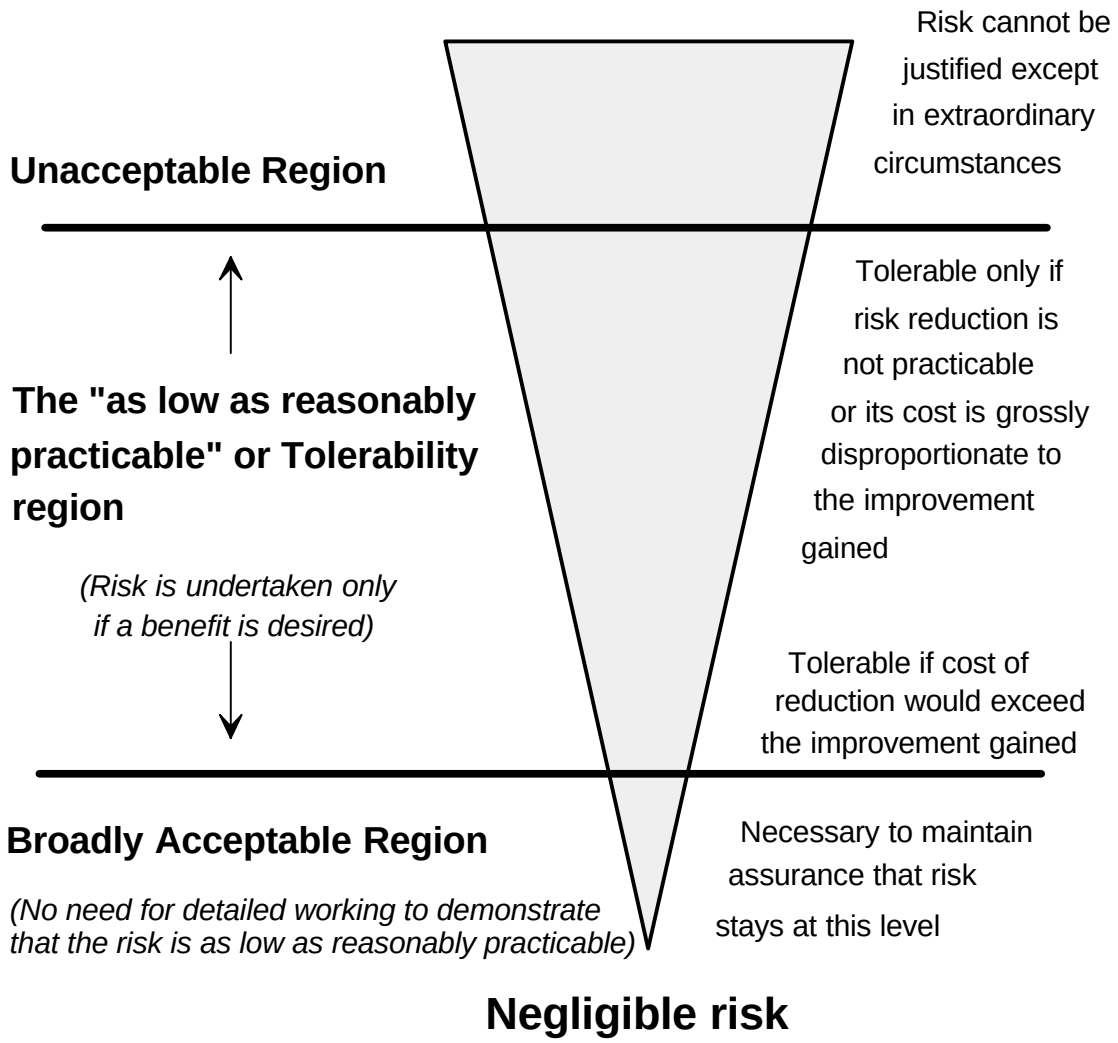

Figure 5: Emergency Arrangements Structure

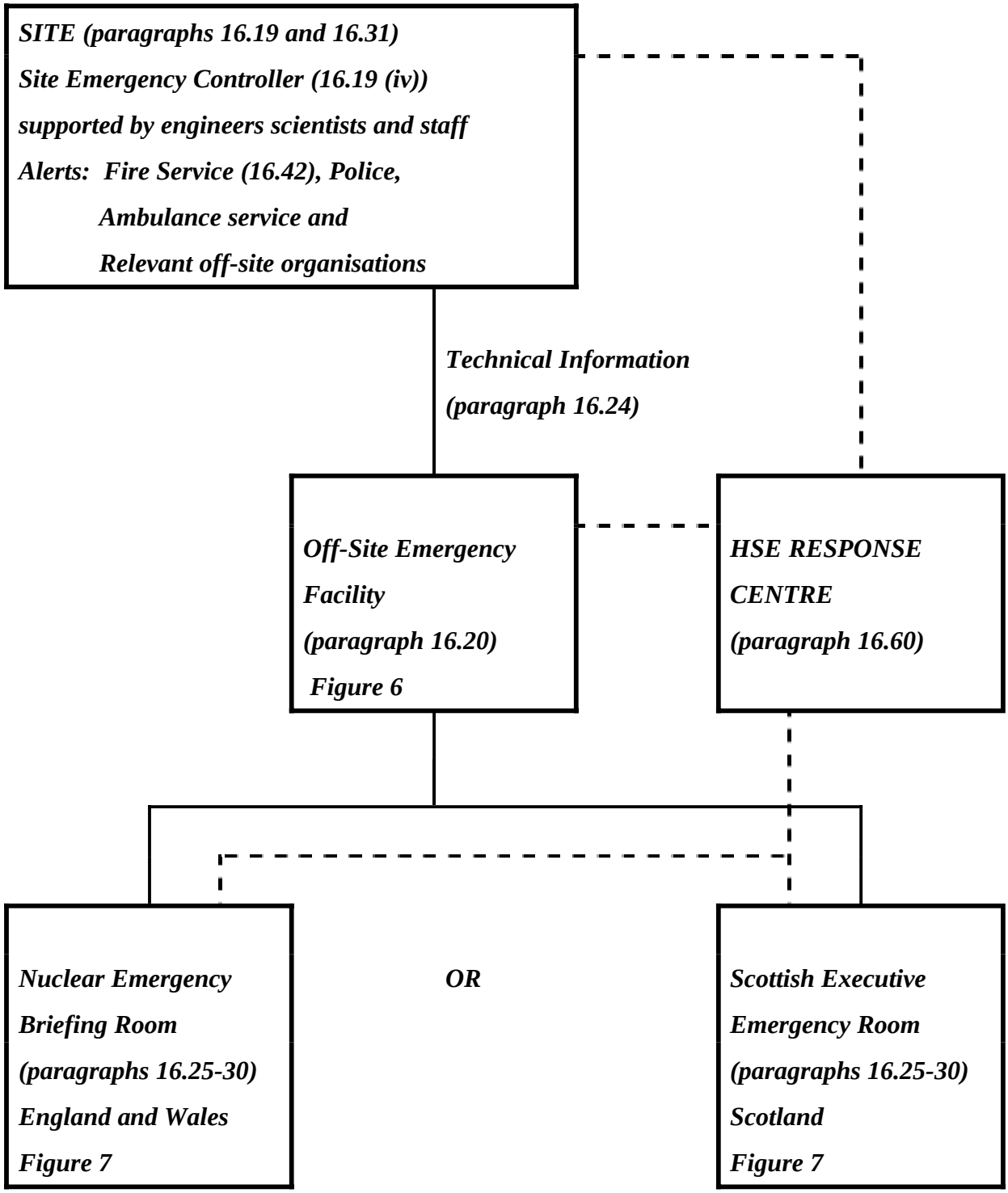

Figure 6: Off-Site Facility Representatives

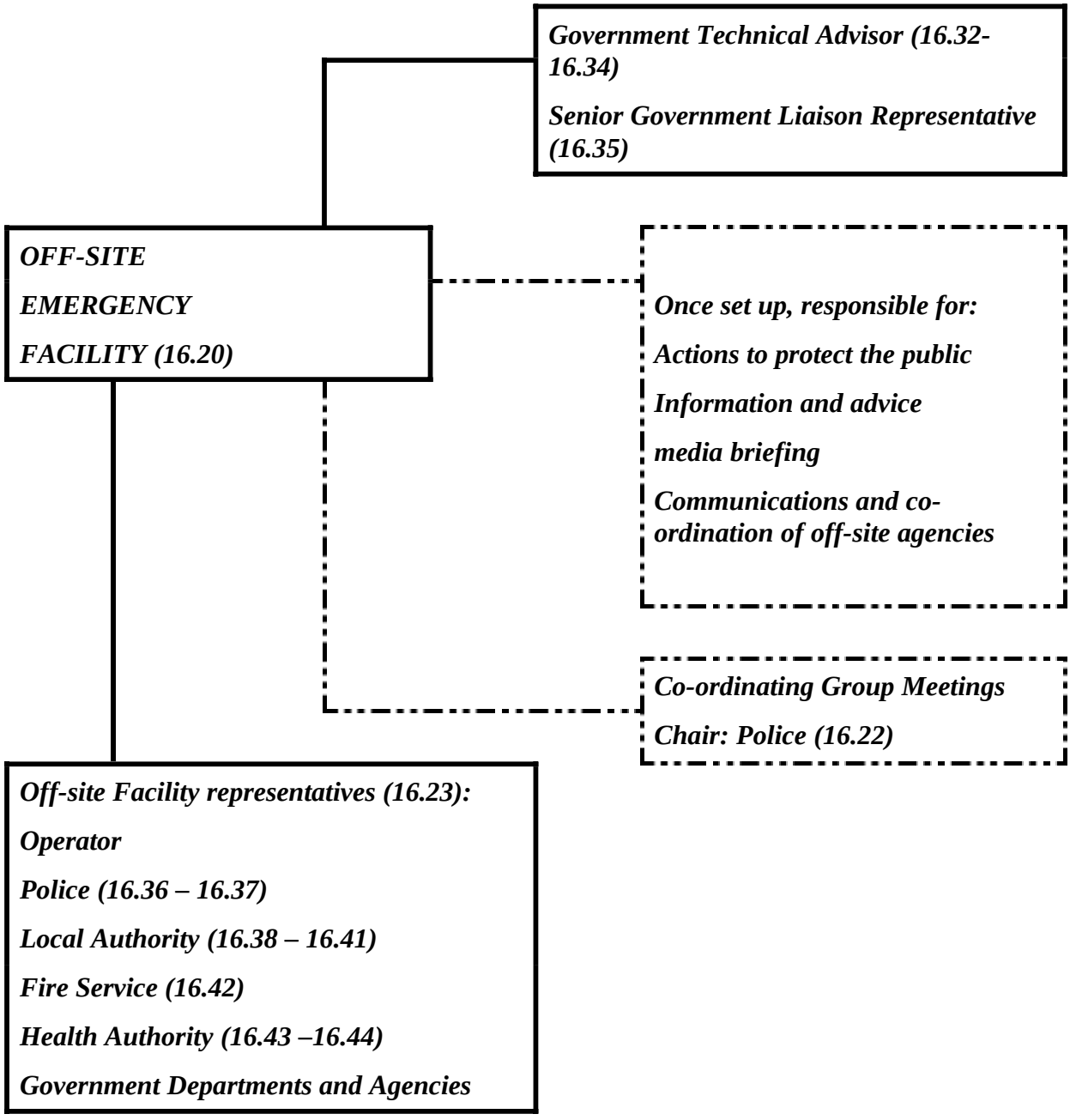

Figure 7: Nuclear Emergency Briefing Room (NEBR) and Scottish Executive Emergency Room representation (SEER)