CONVENTION ON NUCLEAR SAFETY

National Report of the Kingdom of The Netherlands

Second Review Conference (April 2002)

Ministry of Foreign Affairs

Ministry of Housing, Spatial Planning and the Environment

Ministry of Social Affairs and Employment

Ministry of Economic Affairs

Ministry of the Interior

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CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

Acronym	Full name	Translation or explanation (in brackets)
ALARA	As low as readily achievable	
ANS	American Nuclear Society	
ANSI	American National Standards Institute	
ASCOT	Assessment of Safety Culture in Organizations Team	(IAEA)
ASME	American Society of Mechanical Engineers	
ASSET	Assessment of Safety-Significant Events Team	(IAEA)
ATWS	Anticipated transient without scram	
AVN	Association Vinçotte Nucléaire	(Nuclear safety inspectorate, Belgium)
Bkse	Besluit kerninstallaties, splijtstoffen en ertsen	Nuclear Installations, Fissionable Materials and Ores Decree
BV	Besloten vennootschap	Private company with limited liability
BWR	Boiling-water reactor	
COVRA	Centrale Organisatie voor Radioactief Afval	(Central organization for interim storage of nuclear waste)
CSNI	Committee on the Safety of Nuclear Installations	(OECD/NEA)
ECCS	Emergency core cooling system	
ECN	Energieonderzoek Centrum Nederland	Netherlands Energy Research Foundation
EU	European Union	
€	EURO	1 € = 0,9 US $ (approximate exchange rate end 2001)
GE	General Electric	
GKN	Gemeenschappelijke Kernenergiecentrale Nederland	(Operator of Dodewaard NPP)
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit	(Nuclear safety experts organization, Germany)
IAEA	International Atomic Energy Agency	
IEEE	Institute of Electrical and Electronic Engineers	
IMH	Inspectie Milieuhygiëne	Environment Inspectorate
INSAG	International Nuclear Safety Advisory Group	(IAEA)
IPERS	International Peer Review Service	(IAEA)
IRS	Incident response system	
ISO	International Standards Organisation	

Acronym	Full name	Translation or explanation (in brackets)
KEMA	NV tot Keuring van Elektrotechnische Materialen	(Dutch utilities research institute)
KFD	Kernfysische Dienst	Nuclear Safety Department (The Netherlands)
KTA	Kerntechnischer Ausschuss	Nuclear Standards Technical Committee (Germany)
KWU	Kraftwerk Union	(Siemens nuclear power group, nowadays Framatome ANP)
LOCA	Loss of coolant accident	
mSv	Millisievert	
NEA	Nuclear Energy Agency	(OECD)
NPK	Nationaal Plan Kernongevallenbestrijding	National Nuclear Emergency Plan
NPP	Nuclear power plant	
NRG	Nuclear Research and consultancy Group	(Recently formed company uniting the nuclear activities of ECN and KEMA)
NUSS	Nuclear safety standards	(IAEA)
NUSSC	Nuclear Safety Standards Committee	(IAEA)
NVR	Nucleaire veiligheids-richtlijn	Nuclear safety rule (The Netherlands)
OECD	Organisation for Economic Cooperation and Development	
OSART	Operational Safety Review Team	(IAEA)
PORV	Power-operated relief valve	
PRA	Probabilistic risk assessment	
PSA	Probabilistic safety analysis	
PWR	Pressurised-water reactor	
QA	Quality assurance	
RHR	Residual heat removal	
RIVM	Rijksinstituut voor Volksgezondheid en Milieuhygiëne	National Institute for Public Health and the Environment (The Netherlands)
RPV	Reactor pressure vessel	
RSK	Reaktor Sicherheits Kommission	Reactor Safety Committee (Germany)
SAR	Safety analysis report	
SAS	Stoffen, Afvalstoffen, Straling	(Directorate for) Chemicals, Waste, Radiation Protection (Policy department)
SG	Steam generator	
SGTR	Steam generator tube rupture	

Acronym	Full name	Translation or explanation (in brackets)
TMI	Three Mile Island	
TÜV	Technischer Überwachungs Verein	(Safety inspectorate, Germany)
USNRC	United States Nuclear Regulatory Commission	
VGB	Verein Grosskraftwerk Betreiber	(Power plant owners group, Germany)
WANO	World Association of Nuclear Operators	

INTRODUCTION

On 24 September 1994, The Netherlands signed the Convention on Nuclear Safety, which was subsequently formally ratified on 15 October 1996, and entered into force on 13 January 1997. The Convention obliges each contracting party to apply widely recognised principles and tools in order to achieve high standards of safety management at their nuclear power plants. The Convention also requires each contracting party to report on the national implementation of these principles to meetings of the parties to the Convention. This report describes the manner in which The Netherlands has fulfilled its obligations under the Convention.

The Netherlands has a small nuclear programme: only one nuclear power reactor plus a small number of research reactors are currently in operation. The technical details of this NPP are provided in Annex 1. It was originally thought that nuclear power would play an important role in the country's electricity generation. A small prototype reactor (Dodewaard BWR, 60 MWe) was put into operation in 1968, and in 1973 this was followed by the first commercial reactor (Borssele PWR, 480 MWe).

Although plans were made to expand nuclear power by 3000 MWe, these were shelved following the accident at Chernobyl in 1986. Instead, the government ordered a thorough screening of the safety of both plants, which led to major backfitting projects at both of them. The backfitting project at Borssele was successfully completed in 1997. Meanwhile, mainly because of the negative expectations of the future for nuclear energy in The Netherlands, the Dodewaard reactor was shut down in 1997.

Nuclear supervision is exercised by several, mainly governmental, organizations, which are staffed by only a very small number of people, as a result of the small scale of the country's nuclear programme. Plants operate under a licence, after a safety assessment has been carried out, based on the Safety Requirements[1] and Safety Guides of the IAEA Safety Series 50, as amended for application in The Netherlands. The licence is granted under the Nuclear Energy Act (Kew).

As the only operating nuclear power plant has been modernised in the mid-nineties, no major safety issues are outstanding at present. Of course, issues remain. Because Borssele is a relative old plant ageing is an issue that needs serious attention. But also less technical issues such as the effects of the liberalization of the electricity market on safety require and get regulatory attention. The last three to four years some more emphasis is given to the safety of one of the research reactors. Currently the safety of the High Flux Reactor (HFR), a 45 MWth research reactor operated by the Joint Research Centre of the European Commission in Petten, gets relatively a large share of regulatory attention. The first 10-yearly periodic safety review and associated backfitting are the key subjects here. The regulatory authorities are also interested in the COVRA interim storage facility in the municipality of Borsele[2] and the uranium enrichment facility operated by URENCO Nederland BV in Almelo. These facilities are not subject to the Convention and are hence not given any further consideration here.

This report gives an article-by-article review of the situation in The Netherlands, as compared with the obligations laid down by the Convention. The numeration of the chapters and sections of this report correspond with the articles of the Convention.
Chapter 2(a) of the Convention relates to the General Provisions; it contains a description of the existing installations with their main safety characteristics and activities, as is required under Article 6.

Chapter 2(b) describes the legislative and regulatory framework, the regulatory body and the responsibility of the licensee, as referred to in Articles 7, 8 and 9 respectively.

[1] Since the introduction of the IAEA Safety Series No. 50 as a basis for the Dutch regulations the nomenclature of the 'Codes' of the IAEA NUSS program has been changed into 'Requirements'. Therefore, the terms Code and Requirement are alternately used in this report.

[2] Borsele (with one 's') is the name of the municipality where the village of Borssele (with a double 's') is located.

Chapter 2(c) describes the priority given to safety (Article 10), the financial and human resources (Article 11), the human factors (Article 12), quality assurance (Article 13), the assessment and verification of safety (Article 14), radiation protection (Article 15), and emergency preparedness (Article 16).

Chapter 2(d) describes the safety of installations, in terms of siting (Article 17), design and construction (Article 18) and operation (Article 19).

Subsequently, the report describes plans for improving safety, on the basis of the safety issues referred to earlier on. Another chapter is devoted to the main remarks that were made during the first review meeting of the contracting parties to the Convention on Nuclear Safety in 1999. Although emphasis is given to the specific remarks for the Dutch situation also responses to several general remarks are dealt with in this chapter. Also the main differences between the 1998/1999 situation and the current situation regarding nuclear safety are indicated in this chapter

Six appendices are provided with more details on the regulations and their application. There are also three annexes with factual data, excerpts from national laws and regulations, and references to other relevant material.

Chapter 2(a): General Provisions

ARTICLE 6. EXISTING NUCLEAR INSTALLATIONS

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 shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

This chapter gives the information as is requested under Article 6 of the Convention. It contains:

- a list of existing installations, as defined in Article 2 of the Convention;
- a list of installations where significant corrective action was found to be needed;
- an overview of safety assessments which have been performed, plus their main results;
- an overview of programmes and measures for upgrading the safety of nuclear installations, where necessary, and/or the timing of shut-downs; and
- a description of the position of The Netherlands with respect to the further operation of the installations, based on a review of safety at the time when the Convention entered into force (i.e. 13 January 1997), as is required under Article 6 of the Convention.

a. Existing installations

The Netherlands has two nuclear power plants, the Dodewaard BWR (GE design, 60 MWe) and the Borssele PWR (Siemens/KWU design, 480 MWe). Only the Borssele NPP is still in operation. On 3 October 1996, the owners of the Dodewaard plant (SEP: a former alliance of Dutch utilities) decided to permanently shut down the reactor. The shut-down became effective as of 26 March 1997. This decision was taken for two main reasons: firstly, the SEP felt that there was no longer any prospect of the Dutch government giving the go-ahead to the further development of nuclear energy in The Netherlands in the foreseeable future. Secondly, the Dodewaard NPP had been built primarily as a means of gaining experience with nuclear energy. It was never ‘economic’ in the sense that revenues were higher than costs, and this situation was likely to be exacerbated by the impending deregulation of the European electricity market.

Dodewaard became operational in 1969. It was designed to operate with natural circulation, and was equipped with an isolation condenser to remove excess heat, features that later became standard elements of the new BWR design with passive safety characteristics. Originally planned to operate until 1 January 1995, its economic life was first extended to 1 January 1997, and later to 2004. The plant is now in the so-called post-operational phase and is preparing for the decommissioning phase. In Annex 2 more information is given regarding the technical details of the Dodewaard NPP and the decommissioning thereof.

Borssele is a two-loop Siemens PWR that started commercial operation in 1973. As it is the only NPP in operation, the emphasis in the remainder of this report is on this plant.

Technical details of the Borssele NPP are given in Annex 1.

b. Existing installations; necessary corrective action

At the time when the Convention took effect on 13 January 1997, it had already been decided to shut down the Dodewaard nuclear power plant. The Borssele plant was just undergoing a major backfitting and modernisation programme that was designed to bring the plant into line with modern safety standards. This project had been started in 1991, so as to satisfy the regulatory requirement in The Netherlands that the safety of existing installations should be reviewed on a regular basis. Further details of this programme are given in the next section and in Annex 1, which also gives an overview of the modifications that have been made at the Borssele NPP. Due to this programme the Borssele approached as far as readily achievable the safety level of a modern plant. Therefore, for the time being, no corrective actions were felt necessary after this programme was finalised. However, new challenges are appearing which in turn will result in new safety issues. Ageing, liberalization of the electricity market, the intention of the Dutch government of closing the Borssele NPP by the end of 2003, are all challenges to safety which require continuous regulatory attention and, if necessary, corrective actions. In addition, in the beginning of 2001 the second 10-yearly periodic safety review of Borssele NPP started. Whether or not safety upgrades are necessary will be dependent on the outcomes of this review. It is not expected however that major safety upgrades will be necessary. In case there is a court decision on short notice that the plant will be shutdown permanently by the end of 2003 (see paragraph e of this chapter), this review process will be stopped.

c. Overview of safety assessments performed; main results

After the Chernobyl accident, the government ordered a major safety review of existing nuclear power plants, as has already been mentioned in the Introduction. As a first step, OSART missions were sent to both plants. These missions were very useful and effective, and recommended a number of changes to the plant management. They are further addressed in the section on Article 10 of the Convention.

The review was led by the ‘Steering Committee for the Re-evaluation of Nuclear Energy’ (SPH) and resulted in the publication of a number of reports. An important aspect was the safety review conducted by GRS (Germany), which led to a number of recommendations in relation to severe accidents and other safety-related issues.

These reports made clear that a thorough and structured reassessment of both plants was needed. It was obvious that there had been many changes, both in regulations and in attitudes to safety, since the reactors first started operating on a commercial basis in 1968 (in the case of Dodewaard) and 1973 (Borssele). As a separate issue, there was a need for protection against the effects of severe accidents.

A systematic backfitting and modernisation programme was started at both plants, to enhance and complement the ad-hoc backfitting that had been conducted to date. This programme was completed in Borssele in mid-1997 and consisted of the following features:

- a comparison with modern safety regulations and practices, and the initiation of plant modifications where these were deemed useful or necessary, to enable the plant to comply with these regulations and practices insofar as was practical; this work covered design, operation and quality assurance.

The basic concern was that the plants which were build in the late sixties and early seventies would not meet modern safety insights as were laid down in several western regulations since that time. These were foreign regulations, as The Netherlands had not yet developed its own rules and regulations. For example, LOCA ECCS criteria were first defined by the USNRC around 1973. Many other regulations are of later date and, consequently, were not considered in the design of the plants. For instance - although there are differences between the various regulations - the overall trend is to have redundancy, diversity, protection against ‘pipe whip’, protection against seismic events, use of a representative set of Postulated Initiating Events, etc. Later, The Netherlands chose for the IAEA NUSS Codes and Guides, which were a reflection of such modern regulations. The actual comparison of the installation with such regulations was carried out on the basis of these IAEA regulations, as amended for The Netherlands. Where they were not sufficiently specified or detailed, regulations, guidelines and standards of US or German origin were considered (see also the section under article 7.2(i)).

- the installation of hardware to help control or mitigate the effects of major accidents; such hardware included a filtered containment vent and catalytic hydrogen recombiners.
- a full-scope PSA, comprising levels 1, 2 and 3, to identify plant vulnerabilities and to compare the plant risk with pre-defined quantitative risk objectives. Further details concerning the safety policy, safety objectives and the role of PSAs in assessing safety, are given in the section on article 7.2(i) and in Appendices 1 and 2.
- a full-scope replica simulator for the training of plant staff.

The total cost of the programme was about € 200 million (current exchange rate). Annex 1 contains a description of the modifications and the net safety gain that was obtained. One of the main results was that the calculated core damage frequency went down to $2.8*10^{-6}$ per reactor-year from the original value of $5.6*10^{-5}$

The progress of the programme at Dodewaard was interrupted by the decision to halt plant operation.

d. Overview of programmes and measures with regard to upgrading safety, where necessary, and the timing of shut-downs

As mentioned above in paragraph b of this chapter the second 10-yearly periodic safety review of the Borssele NPP started in the beginning of 2001. Whether or not safety upgrading is necessary will depend on the outcome of this review.

It is expected that in the end of 2002 construction of the so-called safe enclosure of the Dodewaard plant will start. At that time all the spent fuel will have been removed from the site. After this construction period, which will last for about 3 years, there will be a 40-year waiting period before actual dismantling of the plant starts.

e. Position of The Netherlands with respect to the further operation of the Borssele plant

After the completion of the large-scale backfitting and modernisation programme, the Borssele nuclear power plant meets most present-day safety requirements - in some cases by an appreciable margin - with the exception of the current requirements relating to certain external events such as a major aircraft crash, as these requirements are not readily achievable. The Borssele utility intended to recover the cost of the programme by extending its operational life to 2007, as compared with the original closing date of 2003 (i.e. 30 years after the start of commercial operation). This issue was the subject of intense debate in the Dutch Parliament, given that there is considerable public opposition to nuclear energy in The Netherlands. As a result, the government and SEP (the then alliance of Dutch utilities) agreed in 1994 that the Borssele NPP should not continue operating beyond the year 2003. In order to give this closing date some more footing, a licence restriction was issued in 1997 that the power plant should stop producing electricity by December 31, 2003. Several interest groups lodged an appeal to the Council of State (highest administrative court in The Netherlands) against this licence restriction. In the beginning of 2000 the Council of State revoked on formal legal grounds this licence restriction.

The political decision to close down Borssele NPP was made in a period when the electricity production was a public affair and under national supervision. But due to the recent economic deregulation of the European electricity markets, the operator of the Borssele NPP now questions the validity of this agreement and has announced that they intend to continue the operation of the plant after 2003. The government on the other hand take the view that the economic deregulation does not influence the earlier agreement and that the operator has been bound by it since 1994. As result of this dispute the government decided in 2000 to take this matter to court and ask for a ruling in this matter. A verdict is expected by the end of 2001.

As a last resort the government is also considering the possibility of special legislation to enforce the desired closure of the Borssele NPP.

The announcement of the closing down of any organization normally may or even will have an impact on operational continuity, if nothing is done in the remaining period. The regulatory body recognises the problem of maintaining enough staff of the necessary quality in view of the planned closing. In the supervision of the nuclear safety of the Borssele plant by the regulatory body this aspect is taken into account. The subject is discussed with the plant management on various occasions. The licensee has indicated that this matter has also their attention and where necessary actions will be taken accordingly. The regulatory body will also remain attentive.

In NVR 2.2.1 (on staffing of nuclear power plants) is laid down that the plant management will be provided with sufficient resources (human, financial, technical, etc.) to continue the safe operation of the plant. The obligation to fulfil this NVR is a licence condition; as a consequence this NVR stipulation becomes a regulatory requirement.

Milestones with regard to verification and comparison with actual and earlier situations are provided by the quarterly discussions with plant management. Where needed, augmented inspections will focus on this issue and search for compliance with the applicable sections of the Requirement and Guides on NPP operation (NVR 1.2 and NVRs 2.2.x). Finally, the issue will be checked before the restart approval after each fuel reloading.

Chapter 2(b): Legislation and Regulation

ARTICLE 7. LEGISLATIVE AND REGULATORY FRAMEWORK

Art. 7.1: Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

a. Overview of the legal framework

The following are the main laws to which nuclear installations are subject:

- the Nuclear Energy Act (1963); (Kernenergiewet, Kew);
- the Environmental Protection Act (Wet milieubeheer, Wm);
- General Administrative Law Act (Algemene wet bestuursrecht, Awb).

The basic legislation governing nuclear activities is contained in the **Nuclear Energy Act**. The Nuclear Energy Act was originally designed to encourage the use of nuclear energy and radioactive techniques, as well as to lay down rules for the protection of the public and the workers against the risks. The Act sets out the basic rules on nuclear energy, makes provisions for radiation protection, designates the various competent authorities and outlines their responsibilities.

Licences for nuclear power plants are granted jointly by the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs, and the Minister of Social Affairs and Employment (plus, where relevant, some other ministers whose departments may be involved). Together, these ministers form the competent authorities as defined by the Nuclear Energy Act and are jointly responsible for assessing the licence-applications and granting the licences. The Minister of Housing, Spatial Planning and the Environment acts as the co-ordinator in this respect. The powers and responsibilities of the various ministers are described in more detail in the section on Article 7.2 (ii).

With regard to nuclear energy, the purpose of the Act is to regulate (Article 15b):

- the protection of people, animals, plants and property;
- the security of the State;
- the storage and guarding of fissionable materials and ores;
- the supply of energy;
- the payment of compensation for any damage or injury caused to third parties;
- the observance of international obligations.

A number of decrees have also been issued containing additional regulations. The most important of these in relation to the safety aspects of nuclear installations are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse), and
- the Radiation Protection Decree (Bs).

The Nuclear Installations, Fissionable Materials and Ores Decree regulates all activities (including licensing) that involve fissionable materials and nuclear installations. The Radiation Protection Decree regulates the protection of the public and workers against the hazards of all ionising radiation. It also establishes a licensing system for the use of radioactive materials and radiation-emitting devices, and prescribes general rules for their use.

The Nuclear Energy Act and the above mentioned decrees are fully in compliance with the relevant Euratom Directive laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. The incorporation of the latest version of this Directive (96/29/Euratom) in the relevant Dutch regulations is almost finished. In this report incorporation of the Directive is assumed.

The **Environmental Protection Act**, in conjunction with the Environmental Impact Assessment Decree, stipulates (in compliance with EU Council Directive 97/11/EC; see also the section on Article 17 (iv)) that an Environmental Impact Assessment must be presented if an application is submitted for a license for a nuclear installation.

Normally (i.e. for non-nuclear installations) this Act regulates all conventional environmental issues (e.g. chemical substances, stench and noise), but in cases concerning nuclear installations the Nuclear Energy Act takes precedence and regulates also the aspects of such conventional environmental issues.

The **General Administrative Law Act** sets out the procedure for obtaining a license, and also describes the role played by the general public in this procedure (i.e. objections and appeals).

Some key articles of the Nuclear Energy Act are included in Annex 3.

b. Main elements of the Acts and Decrees

b.1 Nuclear Energy Act (Kew)

As far as nuclear installations are concerned, the Nuclear Energy Act covers three distinct fields concerning the handling of fissionable materials and ores, i.e. the registration, transport and management of such materials and the operation of sites at which these materials are stored, used or processed.

In the framework of the Nuclear Energy Act, fissionable materials are defined as materials containing uranium, plutonium or thorium to a certain percentage (i.e. 0.1% uranium or plutonium and 3% thorium by weight) and are used for fission or breeding purposes. All other materials are defined as radioactive materials.

(a) The registration of fissionable materials and ores is regulated in Articles 13 and 14 of the Nuclear Energy Act; further details are given in a special decree issued on 8 October 1969 (Bulletin of Acts and Decrees 471). The rules included in the legislation impose a reporting requirement under which notice must be given of the presence of stocks of fissionable materials and ores. The Minister of Economic Affairs has decided that the Central Import and Export Office should be responsible for maintaining the register and that the Economic Investigation Service should act as the supervisory authority in this connection.

(b) A licence is required in order to transport, import, export, be in possession of or dispose of fissionable materials and ores. This is specified in Article 15, sub a of the Act. The licensing requirements apply to each specific activity mentioned here. The Nuclear Installations, Fissionable Materials and Ores Decree of 4 September 1969 (Government Gazette 403, last amended on 26 January 1995, Government Gazette 92) sets out additional regulations in relation to a number of areas, including the procedure for applying for a licence. Furthermore, a licence is normally subject to certain conditions, relating to safety, public health, the health of workers and the environment. An exhaustive list of the areas which may be covered by such conditions is given in Article 15b of the Nuclear Energy Act. In practice these licences are granted on a fairly regular basis, mainly because of the large number of international transports that pass through Dutch territory.

(c) Licences are also required for building, operating and decommissioning nuclear installations (Article 15, sub b), as well as for using vessels powered by nuclear energy (Article 15, sub c). Up to date the latter category has not been of any practical significance.

Licences for nuclear installations are issued under the joint responsibility of the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs and the Minister of Social Affairs and Employment (plus other ministers, where relevant).

The Nuclear Energy Act distinguishes between construction licences and operating licences. In theory, a permit for building a plant may be issued separately from any licence for actually operating the plant in question. However, the construction of a nuclear power plant involves much more than simply building work. Account must be taken of all activities which are to be performed in the plant, which means that the government needs to decide whether the location, design and construction of the plant are such as to afford sufficient protection from any danger, damage or nuisance associated with the activities that are to be performed in the plant. In practice, therefore, the procedure for issuing a license for operating a nuclear power plant will be of limited scope, unless major differences have arisen between the beginning and the completion of construction work. For example, there may be a considerable difference between the Preliminary Safety Analysis Report (which forms the basis for the construction license) and the Final Safety Analysis Report (for the operating licence). It is also possible that views on matters of environmental protection change during the intervening period.

A licence also needs to be obtained in order to make modifications to a plant, if such modifications result in the description of the plant that was submitted at the time of the original application for a licence no longer being valid.

The decommissioning of nuclear installations is regarded as a special form of making modifications and is treated in a similar way.

In cases where very minor modifications are at stake, the licensee may make use of a special provision in the Act (Article 18) that allows such modifications without a separate licence for that modification. In these cases the licensee only has to submit a report describing the planned modification. This reporting system can only be used if the consequences of the modification for man and environment are within the limits of the licence in force.

The licensing requirements relating to nuclear installations as referred to in the Convention (which are covered by the term ‘plants’ in the Nuclear Energy Act) are also set out in the Nuclear Installations, Fissionable Materials and Ores Decree referred to above. Under Article 6 of this Decree, applicants are required to supply the following information when applying for a licence:

- a description of the site where the plant is to be located, including a statement of all relevant geographical, geological, climatological and other conditions;
- a description of the plant, including the equipment to be used in it, the mode of operation of the plant and the equipment, a list of the names of the suppliers of those components which have a bearing on the assessment of the safety aspects, and a specification of the plant’s maximum thermal power
- a statement of the chemical and physical condition, the shape, the content and the degree of enrichment of the fissionable materials which are to be used in the plant, specifying the maximum quantities of the various fissionable materials that will be present in the plant at any one time;
- a description of the way in which the applicant intends to dispose of the relevant fissionable materials after their use;
- a description of the measures to be taken either by or on behalf of the applicant so as to protect people, animals, plants and property, including measures to prevent any danger, damage or nuisance from being caused outside the plant during normal operation, and to prevent any harm or detriment arising from the Postulated Initiating Events (PIEs) referred to in the description, as well as a radiological accident analysis concerning the harm or detriment caused outside the installation as a result of those events (Safety Analysis Report);
- a risk analysis concerning the harm or detriment caused outside the installation as a result of severe accidents (Probabilistic Safety Analyses);
- a global description of the foreseen eventual decommissioning and the way the finances for this decommissioning will be provided for.

In addition to these regulations concerning the handling of fissionable materials, the Nuclear Energy Act in a separate chapter (Chapter VI) also covers intervention and emergency planning and response.

b.2 Environmental Protection Act (Wm)

In compliance with this Act and the Environmental Impact Assessment Decree, the construction of a nuclear plant requires the drafting of an environmental impact assessment as part of the licensing procedure. In certain circumstances, an environmental impact assessment is also required if an existing plant is modified. More specifically, it is needed in situations involving:

- a change in the type, quantity or enrichment of the fuel used;
- an increase in the release of radioactive effluents;
- an increase in the on-site storage capacity of spent fuel;
- decommissioning;
- any change in the conceptual safety design of the plant that is not covered by the description of the design in the Safety Analysis Report.

The Environmental Protection Act states that an independent Commission for Environmental Impact Assessments must be established, whose advice is to be sought if it is decided that an environmental impact assessment needs to be submitted by a person or body applying for a licence. The regulations based on this Act stipulate for which type of activities such assessments are necessary.

The public and interest groups often use environmental impact assessments as a means of commenting on and raising objections to decisions on nuclear activities. This clearly demonstrates the value of these documents for public debate and involvement.

b.3 General Administrative Law Act (Awb)

Appeals procedure

Notice must be given, both in the Government Gazette and in the national and local press, of the publication of a draft decree under which a licence is to be awarded to a plant as defined by the Convention. At the same time, copies of the draft decree and of the documents submitted by the applicant must be made available for inspection by the general public. All members of the public are free to lodge written objections to the draft decree and to ask for a hearing to be held under the terms of the General Administrative Law Act. Account is taken of the objections made to the draft version of the decree when the final version is drawn up. Anybody who has objected to the draft decree is free to appeal to the Council of State (highest administrative court in The Netherlands) against the decree under which the licence has been granted, amended or withdrawn. If the appellant asks the court at the same time for provisional relief (i.e. a suspension of the licence), the decree (i.e. the licence) does not take effect until the court has reached a decision in that request for suspension.

Art. 7.2: The legislative and regulatory framework shall provide for:

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

Nuclear Safety Rules (NVR)

In the framework of the Nuclear Energy Act (Article 21.1), a system of global goal orientated rules and regulations has been established in the areas of the design, operation and quality assurance of nuclear power plants. The system is referred to as the Nuclear Safety Rules (NVR) and has been developed under the responsibility of the Minister of Social Affairs and Employment and the Minister of Housing, Spatial Planning and the Environment.

The NVRs are based on the Requirements and Safety Guides of the IAEA Nuclear Safety Series (NUSS) programme, now referred to collectively as the IAEA Safety Standards Series (SSS). Using an agreed working method, the relevant SSS safety principles, requirements and guidelines were studied to see whether they would be applicable to The Netherlands. This procedure resulted in a series of amendments to the IAEA Codes and Safety Guides, which then became the draft NVRs. Additional NVRs were drafted to cover certain areas where the SSS were felt not to provide sufficient guidance. The amendments were formulated for various reasons: to allow a choice to be made from a range of different options, to give further guidance, to be more precise, to be more stringent, or to adapt the wording to specifically Dutch circumstances (e.g. with respect to the risk of flooding, population density, seismic activity and local industrial practices). In Appendix 6 the NVRs and related IAEA Codes and Safety Guides are tabulated.

The regulatory body reviewed these draft NVRs and, after a final draft had been written, the utilities and other relevant organizations were formally given an opportunity to comment on the text. The regulatory body took the decision on the final wording of the NVRs, in some cases after seeking the advice of the (former) Reactor Safety Commission. The regulations were then formally adopted, at the Code (i.e. requirements) level by the Ministers and at the Safety Guides (i.e. guidelines) level by the Directors-General of the relevant ministries.

The licence granted to a nuclear power plant includes specific conditions under which the NPP is under a formal obligation to observe the NVRs. It is this mechanism that allows the regulatory body to enforce the NVRs. At the Code level, the NVRs have to be followed in detail, as they are requirements. At the Safety Guides level, the NVRs are less stringent, i.e. they may be followed, but alternative methods may be used for achieving the same safety level.

It should be noted that all NVRs are based on the original NUSS-programme. Recently the IAEA has started publishing updated versions of the Safety Standards as Safety Requirements and Safety Guides. In principle, this would lead to updated versions of the Dutch NVRs. But due to the foreseen closure of the only remaining NPP by the end of 2003, it is very likely that this will only be done for a part of these updated rules.

In addition to the system of NVRs, the Ministry of Housing, Spatial Planning and the Environment has formulated a policy on the tolerance of risk posed by nuclear power stations. Although this policy has been formulated independently of the NVRs, it could be seen as encompassing these as 'technical safety objectives'. The basis and application of the policy are discussed more fully in Appendix 1, which includes references to official documents (laws, decrees, etc.). As far as the radiological hazard is concerned, the policy is derived from the IAEA INSAG Safety Fundamentals radiological safety objective:

> *To ensure that in all operational states radiation exposure within the installation or due to any planned release of radioactive material from the installation is kept below prescribed limits and as low as reasonably achievable, and to ensure mitigation of the radiological consequences of any accidents.*

The application of this objective requires the licensee to:

- verify that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk;
- reduce the risk, if required, until an optimum level is reached (based on the ALARA principle);
- exercise control, i.e. maintain the level of risk at this optimum level.

In more detail, the radiological risk criteria for members of the public are as follows:

Normal operation

- A maximum total individual dose of 1 mSv in any year for the consequences of *normal operation* of all artificial sources emitting ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, etc.).

- For a single source (for instance a single NPP), the maximum individual dose has been set at 0.1 mSv per year. As a first optimisation goal, a dose level of 0.04 mSv per year has been set for a single source in accordance with the ALARA principle

Incidents and accidents

- In accordance with the Dutch policy on the tolerability of risk, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per year for all sources together and 10^{-6} per year for a single source.
- Where severe accidents are concerned, not only the individual mortality risk must be considered but also the group risk (= societal risk). In order to avoid large-scale disruption to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per year. If the number of fatalities increases by the factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

In demonstrating compliance with the risk criteria, one has to assume that only the usual forms of mitigative measures (i.e. fire brigades, hospitals, etc.) are taken into account. Evacuation, iodine prophylaxis and sheltering, though initiated by the Emergency Preparedness Organization, are therefore not credited in the analysis.

See Appendix 1 for a more comprehensive discussion of these criteria and their background reference.

The Safety Guide-type NVRs set objectives on many specific items. However, they do not cover the level of industrial codes and standards. Applicants are therefore required to propose applicable codes and standards as part of their application, which will be reviewed by the regulatory body. Codes and standards in common use in major nuclear countries are generally acceptable (e.g. ASME, IEEE and KTA). The regulatory body can also formulate additional requirements if necessary.

In addition to the provisions of the Nuclear Energy Act, pressure retaining components must meet the requirements of the Steam Act and Steam decree. (In 2002 the Steam Act will be withdrawn due to new European legislation coming into force) There is a number of requirements in the Act and the Decree that should be met at all times. If there is a discrepancy between the foreign design code or standard and the Dutch rules, the most conservative standards applies.

The design assessment, the examination and pressure test of the structures and components and the in-service inspections are carried out by the Pressure Vessels Inspectorate. This was a government organization for over 130 years until 1995, when it was privatised. It now operates under a contract with the Dutch government, which authorises it to issue licences on the government's behalf.

NVR 1.2 stipulates that periodic safety reviews should be carried out; further details are given in NVR 2.2.12. This requirement is translated into an explicit licence condition, which states that ten-yearly integrated safety re-evaluations must be performed to check whether the plant complies with the latest NVRs. The principle is that the plant should comply as far as is reasonably feasible, i.e. all practicable backfitting measures should be proposed to ensure that any discrepancy is kept to a minimum, as it is recognised that existing nuclear power plants cannot always conform to the latest regulations. As regards operational safety aspects, these safety reviews must be conducted every two years. See the section on Article 10 for further details.

As the NVRs were only completed in the eighties whereas the start-up of the Borssele NPP was in 1973, the following remarks can be made on the retroactive application of these developments.

At the time of the construction of the Borssele (and Dodewaard) NPP there were no formalised nuclear safety codes and guidelines in The Netherlands and in fact, as in many other countries, the design rules of the country of origin were imported together with the imported NPP.

Application of the IAEA Safety Requirements and safety Guides in retrospect was performed in the integral safety revaluation of 1992 and the resulting safety modifications of the installation. Despite the fact that Borssele was built to earlier standards, full compliance was aimed for, but proved not always achievable and also not necessary. The goal was increasing the safety level and not compliance with later regulations at any price. Decisions, sometimes difficult decisions, had to be taken about necessary measures. Safety benefits on one side and investments and radiation dose on the other side had to be compared. In connection with the above-mentioned integral safety re-evaluation one should add that under the formal IAEA Safety Requirements and Guides other more detailed regulations of major (western) nuclear energy countries like USA, Germany and France have been taken into account to form a reflection of the current state of nuclear safety technology.

As result, real conflicts in the sense of old and new regulations leading to conflicting measures did not occur.

Art.7.2(ii): a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

As was discussed in the section on Article 7.1 of the Convention, the Nuclear Energy Act stipulates (in Article 15, sub b) that a licence must be obtained for constructing, commissioning, operating, modifying or decommissioning a nuclear power plant. Similarly, the Nuclear Energy Act also states (in Article 15, sub a) that a licence is required for importing, exporting, possessing and disposing of fissionable material, as was also indicated in the section on Article 7.1 of the Convention.

Under Article 29 of the Nuclear Energy Act, a licence is required in a number of cases (identified in the Radiation Protection Decree) for the preparation, transport, possession, import and disposal of radioactive material.

Article 15a of the Nuclear Energy Act lists the ministers who are responsible for licensing. As was already mentioned in the section on Article 7.1, responsibility for nuclear activities is not centralised, but is divided among a number of ministers who consult each other and also issue regulations jointly, as required, in accordance with their area of competence. The subdivision of responsibilities is as follows:

- the Minister of Housing, Spatial Planning and the Environment (VROM) is responsible, together with the Minister of Economic Affairs (EZ) and the Minister of Social Affairs and Employment (SZW), for licensing nuclear installations and activities;
- the Minister of Housing, Spatial Planning and the Environment is responsible, together with the Minister of Social Affairs and Employment for licensing the use of radioactive materials and radiation-emitting devices;
- the Minister of Housing, Spatial Planning and the Environment is responsible for all public health and safety aspects, including radiation protection of members of the public; the Minister of Economic Affairs is responsible for energy supply policy, the Minister of Social Affairs and Employment is responsible for radiation protection at places of work;

Other ministers may be consulted on nuclear activities which fall within their particular sphere of competence; for instance, discharges of radioactive material in air and water involve the Minister of Agriculture, Nature Management and Fisheries (LNV) and the Minister of Transport, Public Works and Water Management (V&W), while the subject of emergency response also involves these two Ministers as well as the Minister of the Interior (BiZa) and the Minister of Health, Welfare and Sport (VWS). See the table below for an overview.

	LNV	*V&W*	*BiZa*	*VWS*
Discharges in air	*X*			
Discharges in water	*X*	*X*		
Transport		*X*		
Emergency provisions	*X*	*X*	*X*	*X*
Medical applications				*X*

Under the terms of the Public Health Act, a Public Health Council exists to advise the ministers on issues concerning radiation protection and public health. There is nowadays no standing advisory committee for nuclear safety; if necessary, such a committee (Reactor Safety Commission)[3] is formed on an ad-hoc basis.

The first three ministers mentioned above are also the competent ministers for the suspension or withdrawal of a licence.

Article 15b of the Nuclear Energy Act enumerates the interests for the protection of which a licence may be refused (these are listed above in the section on Article 7.1, sub a). The licence itself lists the restrictions and conditions that apply so as to take account of these interests. The licence conditions may include an obligation to satisfy further requirements, related to the subject of the licence condition, as set by the competent regulatory body.

As stated before (see section on Article 7.1, sub b.1) in cases where very minor modifications are at stake, the licensee may make use of a special provision in the Act (Article 18) that allows such modifications without a licence. In these cases the licensee only has to submit a report describing the foreseen modification. This reporting system can only be used if the consequences of the modification for man and environment are within the limits of the licence in force.

The regulatory body conducts regular reviews to establish whether the restrictions and conditions under which a licence has been granted are still sufficient to protect the public and the environment, taking account of any developments in nuclear safety that have taken place in the meantime. Should one of these reviews indicate that, given the developments, the level of protection can and should be improved, the regulatory body will amend the restrictions and conditions accordingly. It should be noted that this is not the same as the periodic safety evaluations, which the *licensee* is required to perform.

Apart from the Nuclear Energy Act and Environmental Protection Act there is the Steam Act that represents some legislative requirements for pressure retaining components. The Steam Act prescribes a licence per individual pressure retaining component, which is issued by Stoomwezen BV on behalf of the Minister of Social Affairs and Employment.

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[3] In 1996 Reactor Safety Committee (an advisory body of the Dutch government) was abolished in the wake of a large reshuffling of all governmental advisory committees. Nowadays, the opinion of relevant experts is asked on an ad-hoc basis. These might be individual experts, other technical-scientific organizations or other regulatory bodies. The initiative for seeking advice lies entirely with the regulatory body.

Art. 7.2(iii): a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

Article 58 of the Nuclear Energy Act states that the ministers who are responsible for licensing procedures should entrust designated officials with the task of supervising inspection and enforcement. The Decree on Supervision of the Compliance with the Nuclear Energy Act also identifies certain bodies that should be given responsibilities in this connection. The main bodies for inspection and assessment are the Nuclear Safety Department (KFD) and the Regional Inspectorate for the Environment - southwest Region (IMH-ZW), both of the Inspectorate for the Environment of the Ministry of Housing, Spatial Planning and the Environment. One of the Directorates at this ministry is also responsible for assessing whether the radiological safety objectives have been met; this is the Directorate for Chemicals, Waste, Radiation Protection (SAS). It should be noted that this Directorate is responsible for licensing, and not for performing inspections.

With regard to nuclear fuel cycle installations and nuclear power plants in particular, almost all inspection tasks are carried out by the KFD, which possesses the technical expertise that is needed for the inspection of nuclear safety and radiation protection. IMH-ZW has a special inspection role in connection with radiation protection of the public and the environment. Inspectors of the Ministry of Economic Affairs are responsible for nuclear security and safeguards. Further information is given in the section on Article 8 of the Convention.

Stoomwezen BV is in co-operation with the KFD responsible for assessment of the integrity of pressure retaining components and performs inspection of those components on behalf of the KFD.

Regulatory assessment

The regulatory assessment process is as follows: the regulatory body reviews and assesses the documentation submitted by the applicant. This might be the Environmental Impact Assessment Report and Safety Report with underlying safety analyses within the framework of a licence renewal or modification request, proposals for design changes, changes to Technical Specifications, procedural changes such as the introduction of Severe Accident Management Guidelines (SAMGs), etc. The KFD assesses if the NVRs (i.e. requirements and guidelines) have been met and if the assessments (methods and inputdata) have been prepared conform the state of the art etc. As has already been mentioned, the Directorate SAS assesses the radiological consequences associated with postulated transients and accidents in the various plant categories; these are specified in Appendix 1. Further details of the assessment process are given below in the section on Article 14.

Regulatory inspection

The function of regulatory inspections is:

- to check that the licensee is acting in compliance with the regulations and conditions set out in the licence, Safety Report, Technical Specifications and self-imposed requirements;
- to report (to the director of the KFD) any violation of the licence conditions and if necessary initiate remedial actions;
- to check that the licence is carrying out all of its activities according its Quality Assurance system;
- to check that the licensee is carrying out all of its activities according the best technical means and/or worldwide accepted standards.

All inspections with regard to nuclear safety and radiological protection of personnel are carried out by the KFD. IMH-ZW is responsible for radiological protection outside the nuclear power plant, including transports of radioactive material. The Ministry of Economic Affairs handles inspections of nuclear security and safeguards.

To check that the licensee is acting in compliance with the Nuclear Energy Act, the licence and the associated safety report, there is a system of inspections, audits with supplementary international missions, assessment of operational month reports, and evaluation of operational occurrences and incidents. An important piece of information for inspection is the two-yearly safety evaluation report. In this report the licensee presents its self-assessment of all the relevant organizational, personnel and administrative matters.

The management of inspection is supported by a yearly planning, the reporting of the inspections and the follow-up actions. Regularly a meeting between plant management and KFD management is held devoted to inspections and inspection findings. During (more technical) regular meetings between plant staff and KFD staff these inspection findings are discussed. Also, during other management meetings which are held quarterly in order to discuss all kind of regulatory issues, the follow-up of remedial actions, if any, is discussed.

To have some reference on the quality of the regulatory inspections, bilateral exchange of KFD inspectors with those of other European regulatory bodies for a few months at a time is strongly supported. Also the KFD is actively participating in working groups of international bodies as IAEA, NEA/CNRA, NEA/CSNI and EU.

Many inspections performed by the KFD are characterised by an emphasis on technical judgement and expertise. They are compliance-based, i.e. the KFD investigates whether the licensee is acting in accordance with the terms of the licence. However, there is a need that the inspections also focus on organizational aspects, i.e. scrutinising the way the licensee has fulfilled its responsibility for safety and ascertaining whether the licensee’s attitude shows a sufficient awareness of safety aspects. Therefore, more performance-based inspections are taking place. Another trend is for inspections also to be more risk-oriented, i.e. to place more emphasis on those areas which are relevant to risk and less emphasis on those areas that are less important for risk. A study to formally introduce risk-oriented regulations has been initiated.

Apart from these inspections, in-depth international team reviews are also carried out by, for example, the IAEA (OSART and ASSET). These reviews are the results of separate decisions. Amongst others, these have been requested by the KFD, following a recommendation made by the former Reactor Safety Commission. KFD teams carry out smaller inspections of a similar nature from time to time. The Borssele utility itself carries out self-assessments at regular intervals. These have been requested by the KFD, following a recommendation made by the Reactor Safety Commission.

OSART and ASSET reviews have been held at both NPPs. Information on these inspections is also included in the section on Article 10 of the Convention.

Art. 7.2(iv): the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation

As indicated in the section on Article 7.2 (iii), a special decree on supervision was issued known as the Decree on Supervision of the Compliance with the Nuclear Energy Act. This deals with the inspection and enforcement of the regulations and the terms of licences. An extended series of articles has been published covering all aspects for which supervision is required, from public health to security and financial liability. The decree also specifies the responsible authorities.

Should there be any serious shortcoming in the actual operation of a nuclear installation, the Ministers of Housing, Spatial Planning and the Environment and of Social Affairs and Employment are empowered under Article 37b of the Nuclear Energy Act to take all such measures as they deem necessary, including shutting down the nuclear installation in question. Written procedures have been published describing which action should be taken if this article of the Act needs to be enforced. Special inspectors have been appointed to prepare an official report for the public prosecutor.

Article 19.1 of the Nuclear Energy Act empowers the regulatory body to modify, add or revoke restrictions and conditions in the licence in order to protect the interests on which the licence is based. Article 20a of the Act stipulates that the regulatory body is empowered to withdraw the licence, if this is required in order to protect these interests.

Article 15aa of the Nuclear Energy Act empowers the regulatory body to force the licensee to co-operate in a process of total revision and update of the licence. This action is indicated if for instance comprehensive modifications are proposed or when after a number of years the licence is less clear (or outdated) due to a large number of changes during that time.

ARTICLE 8. REGULATORY BODY

Art.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 fulfill its assigned responsibilities.

a. General

As was discussed in the section on Article 7, several ministers are jointly responsible for the licensing, assessment and inspection of nuclear installations. The various organizations within the ministries which are charged with these tasks, and the legal basis on which they operate, have already been discussed in the section on Article 7.2 (iii):

- Directorate for Chemicals, Waste, Radiation Protection (SAS) of the Ministry of Housing, Spatial Planning and the Environment;
- Nuclear Safety Department (KFD) of the Environment Inspectorate of the Ministry of Housing, Spatial Planning and the Environment;
- Regional Environment Inspectorate (south-west region)(IMH-ZW) of the Environment Inspectorate of the Ministry of Housing, Spatial Planning and the Environment;
- Directorate for Labour Conditions (Occupational Safety) of the Ministry of Social Affairs and Employment;
- Directorate for Energy and Electricity Production of the Ministry of Economic Affairs;
- Nuclear Security and Safeguards Section of the Ministry of Economic Affairs.

The Ministry of Housing, Spatial Planning and the Environment has the overall responsibility for legislation concerning the Nuclear Energy Act, for licensing and for ensuring that the current legislation is being adequately enforced. This ministry is also responsible for the technical safety considerations on which the decision to grant or reject an application for a licence is based. These considerations are mainly based on the assessments and inspections by the KFD of power plants for the purpose of the licensing procedure. The IMH-ZW, also operating under the Ministry of Housing, Spatial Planning and the Environment, advises on requirements relating to effluent discharge and environmental protection.

In June 2000 the KFD was transferred from the Ministry of Social Affairs and Employment to the Environment Inspectorate of the Ministry of Housing, Spatial Planning and the Environment. This enabled that the existing collaboration with the Directorate of Chemicals, Waste and Radiation Protection (SAS) and with IMH-ZW to be intensified and harmonised. This transfer caused the legal requirement to protect the population against undue risks of nuclear energy to fall almost entirely in the hand of one ministry; i.e., the ministry which is responsible for the protection of the environment. The supervision over the radiological safety of workers in nuclear installations remained with the KFD after this transfer, but the Ministry of Social Affairs and Employment remained responsible for policymaking and regulating the protection of workers.

As a result, the various bodies within the Ministry of Housing, Spatial Planning and the Environment, together with the Ministry of Social Affairs and Employment, are responsible for formulating the conditions attached to the licence concerning the safety and the (radiation) protection of the workers and the public and the environment. All requirements should be formulated in such a way that they are actually enforceable in practice.

The input from the Ministry of Economic Affairs is in the field of energy supply policy and safeguards.

b. Regulatory Bodies

The various bodies are described in the following sections.

b.1 Nuclear Safety Department (KFD)

The main organization within the regulatory body is the KFD, which encompasses all major reactor safety disciplines. For areas in which its competence is not sufficient or where a specific in-depth analysis is needed, the KFD has a budget at its disposal for contracting outside specialists. This is one of the basic policies of the KFD: the core disciplines should be available in-house, while the remaining work is subcontracted to third parties or technical safety organizations.

The core disciplines are:

- mechanical engineering;
- metallurgy;
- reactor technology (including reactor physics and thermal hydraulics);
- electrical engineering;
- instrumentation and control;
- radiation protection;
- probabilistic safety assessment and severe accidents;
- quality assurance;
- nuclear safety auditing and inspecting;
- process technology.

Basically, there is one member of staff for each discipline (although there are two for process technology). Three people are available full-time for conducting routine inspections of the installations.

The total professional staff of the KFD, for all nuclear facilities and including management, is 17 at present including one vacancy. Three of them are field inspectors. Each member of staff has at least ten years' experience in his or her respective discipline. The Department has a policy of allocating between 10 and 15 days each year to training.

Its main activities are regulation (licensing and rulemaking), assessment and inspection. In principle, staff can be deployed to tasks in each of these three fields concurrently. The work is co-ordinated by three project managers, using a matrix organization.

As regards budgets for external support, there is a budget equivalent to three man-years for contracting specialists on a temporary basis. On top of this, there is an outsourcing budget of about € 300.000 for contracting out special issues to outside experts or technical safety organizations in The Netherlands and abroad.

The question of KFD-manpower has been discussed almost as long as the KFD has existed (30 years). Build-up of staff started systematically by the mid 70s and continued well into the eighties. An almost complete coverage of disciplines was developed in principle by 1985 when there was advanced planning for the extension of the nuclear programme in The Netherlands. After the Chernobyl accident that however did not happen and extra personnel could not be attracted.

The present situation is essentially still the same. This means that one could argue following e.g. the respective IAEA safety guideline SG-G1 (Qualifications and Training of Staff of the Reg. Body) that the manpower should be increased. However, the situation is rather complex.

Nuclear capacity is very limited with only one NPP operating. Furthermore it is expected (at least by the Dutch government) that the Borssele NPP will be shut down permanently by the end of 2003. Additionally, this NPP underwent a very extensive backfitting programme some years ago, in which not only the whole design but also all operational aspects were re-evaluated. The completion of this programme resulted in some temporary reduction of the workload. Especially, the technical support of outside experts or organizations was no longer necessary to the same extent. On the other hand, closure of the Dodewaard NPP demanded new regulatory efforts, new skills to be gained. Also, after the completion of the modification project, regulatory manpower became available for the safety reviews of research reactors. Also one must be aware that the workload can change suddenly if serious incidents or accidents occur.

Some mitigating circumstances for the relatively small staff of the regulatory body can be found in the fact that on one hand the assessment and inspection tasks are rather limited, but on the other hand very diverse and variable in time. This requires flexibility and versatility of the individual regulatory staff members. A small staff is easier for meeting such an objective. Also the intended closure of the Borssele NPP in the near future and the rejection of the nuclear energy option as a whole by the Dutch government, causes any expansion on the staff of the KFD not to be a realistic option. As stated above, to compensate for possible insufficient manpower, a supplementary budget is available to contract a 3 man-year capacity on a yearly basis as well as an additional budget for contracts with technical safety organizations where specific problems of nuclear safety will be treated.

The general approach to the staffing of the KFD is that there must be sufficient general knowledge of all nuclear safety aspects, so that specialists can be properly informed on the problems they should investigate more deeply. Also the adoption of goal oriented rules and regulations requires a broader expertise of the staff of the KFD then would have been the case if a more detailed and prescriptive framework was selected. Especially, this is true for the field inspectors. Furthermore the KFD is in a relatively favourable situation regarding matters of general nuclear safety knowledge as most staff members have a very long experience. However, the average age of the individual staff-members is rather high (55 years).

A particular environmental aspect should finally be mentioned. The relationship between licensee and regulatory body is characterised by the very clear position on the responsibility for nuclear safety. The responsibility rests with the licensee. The regulatory body in The Netherlands has a non-prescriptive attitude and checks that the licensee has sufficient arrangements to assure a high level of nuclear safety. The clear responsibility for nuclear safety on the side of the licensee gets a special dimension due to the negative public opinion on nuclear energy. Therefore, the licensee is provoked, in a positive way, to demonstrate that safety and reliability are pursued to high standards..

Further information on the issue of limited staffing of the KFD is given in the chapter dealing with the responses on the remarks made during the first review meeting of the contracting parties to the convention on nuclear safety.

b.2 Directorate for Chemicals, Waste, Radiation Protection (SAS)

The main task of this Directorate is policy development and implementation in the field of radiation protection in relation to the public and the environment. The Directorate is also responsible for licensing nuclear installations and nuclear transports in general (all procedural aspects), as well as for all aspects concerning radiation protection and external safety. It has the following disciplines at its disposal: radiation protection, risk assessment, and legal and licensing matters. These disciplines are grouped together in the Radiation Protection, Nuclear and Biosafety Division. The above-mentioned duties do not require any specific budget, apart from that needed to cover staff costs. SAS does, however, make an annual contribution jointly with the IMH to support the work of the RIVM (National Institute for Public Health and the Environment). Within SAS, about four man-years per year are devoted to nuclear licensing and safety issues relating to all nuclear facilities.

b.3 Environment Inspectorate (IMH-ZW)

The regional inspectorate for the environment IMH-ZW is responsible for supervising radiation protection in the vicinity of nuclear installations. This means that its principal concern is the local measurement programme and the interface between a power plant and its direct vicinity (e.g. in the form of discharges and the management of such discharges). The IMH-ZW devotes less than one man-year per year for exercising this supervision. The Inspectorate's budget includes an annual contribution to the RIVM, which it pays jointly with the SAS, as has already been mentioned.

b.4 The Directorate for Labour Conditions

This Directorate within the Ministry of Social Affairs is responsible for the legal aspects of radiation protection of workers. Less than one man-year is allocated to this work.

b.5 The Directorate for Energy and Electricity Production (EEP)

The Directorate for Energy and Electricity Production (Ministry of Economic Affairs) is responsible for aspects concerning the energy supply. Within this Directorate less than one man-year is devoted to Nuclear Energy Act matters.

b.6 Nuclear Security and Safeguards Section

The security of nuclear power plants (in terms of nuclear security and safeguards) forms a separate element on the spectrum of supervisory duties. This has traditionally been the preserve of the Ministry of Economic Affairs. Two man-years per year are allotted to this work.

Art. 8.2: 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.

On 21 June 1999, a decree was published by which the care for the maintenance and implementation of the Nuclear Energy Act and the regulations based upon this act was transferred from the Minister of Economic Affairs to the Minister of Housing, Spatial Planning and the Environment. This means among others that the prime responsibility for the licensing of nuclear installations lies with the minister who is also responsible for the aspects of the protection of the public and the environment. The influence of the Minister of Economic Affairs is restricted to aspects concerning the energy supply; he has no longer control over any other aspects, including protection. In this arrangement the conditions as described in Article 8.2 of the Convention concerning effective separation as fully satisfied.

ARTICLE 9. RESPONSIBILITY OF THE LICENCE HOLDER

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.

The principle that the ultimate responsibility for safety lies with the licensee is laid down in several layers of the regulations. The highest level is the Nuclear Energy Act where in the explanatory memorandum of Article 37b is stated that the licensee must operate the installation in such a way that it reflects the most recent safety insights. More precise statements are given in the next level of regulation, notably three articles in NVR 1.2 (Safety requirement for nuclear power plant operation). Article 201 reads:

> *The operating organization shall have overall responsibility with respect to the safe operation of the nuclear power plant. However, the direct responsibility shall rest with the plant management, and therefore the operating organization shall delegate to plant management all necessary authority for the safe operation….*

Article 501 of this NVR reads:

> *The operating organization shall be aware of the special emphasis that needs to placed on safety when operating nuclear power plants. Although the operating organization may already have an organizational structure for managing non-nuclear power plants, this special emphasis and the commitment to achieve safety will require more than a simple extension of the earlier organizational structure.*

Article 601 of this NVR reads:

> *The plant management shall have the direct responsibility for the safe operation of the plant. The operating organization shall delegate sufficient authority to the plant management to ensure the effective discharge of this responsibility.*

Because this NVR is also contained in a license condition, this principle is a formal obligation.

The licence also states that the licensee must review the safety of the plant at both two-yearly and ten-yearly intervals (this point is examined in more detail below, in sections on other articles of the Convention). In addition, the licensee must draw up a decommissioning plan, which must be adjusted appropriately if there is any change in circumstances that influence this plan.

In accordance with chapter 5 (Structure of the operating organization) of NVR 1.2, the licensee developed a policy plan that addresses the licensee's responsibility for safety. This implies that adherence to safety is not only an obligation or a licence condition, but is also an institutionalised corporate objective. See the section on Article 10 of the Convention for further details on this policy statement.

Compliance with the licence and its terms is monitored by means of an appropriate inspection programme, as has already been discussed in the section on Article 7. The licensee's own QA organization is an important mechanism for enabling the licensee to adhere to the licence and attain its corporate safety objectives.

Chapter 2(c): General safety considerations

ARTICLE 10. PRIORITY TO SAFETY

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.

General

The whole process of the design, construction, operation and decommissioning of a nuclear power plant in The Netherlands (as well as the licensing of all these stages) is characterised by the high priority which is attached to safety at all stages. Reference is made to the Safety Requirement on Operation, NVR 1.2, chapter 5, which says that the operating organization must be aware of the special emphasis that needs to be placed on safety when operating nuclear power plants. This special emphasis and commitment to safety must be reflected in the organizational structure.

Reference is also made to the Borssele utility policy plan, which describes the priority attached to safety in relation to financial considerations as follows:

The prime objective of EPZ is the production of electricity in a cost effective way, but the environmental risk concerned with nuclear generation demands the highest priority for nuclear safety (overriding priority).

This policy statement can also be found in the objectives of the QA-system of the NPP Borssele:

Operation consists of a safety function, i.e. maintaining and improving operational and nuclear safety, and an economic function, i.e. producing electricity. The economic function is performed only if the nuclear power plant is safe, from a process and technical viewpoint, and if the safety function is performed in an adequate manner. The "conditions for operation" and the "limits" as laid down in the Technical Specifications shall be met at any time....."

It should also be mentioned in this context that the senior management at the Borssele utility must be competent in matters of nuclear safety (this is a requirement imposed by Article 6 of the Decree on Nuclear Installations, Fissionable Materials and Ores). This requirement was important as most of the power plants operated by the utility that operated the Borssele NPP were non-nuclear stations and the Management Board, which is the highest decision-making authority, operated at a distance from the Borssele NPP. As of May 2001 the licensee EPZ formed a new joint venture consisting of one NPP and one coal fired plant at the Borssele site. The other conventional power plants formed a new company with the rest of the original generating capacity. Although, on paper, the highest decision-making authority came closer to the plant, new commitments are necessary. Especially, commitments for financial, organizational and manpower provisions, as a necessary environment to ensure 'priority to safety' are a point of concern for the regulatory body at this very moment.

In addition, NVR 1.2 states that the plant management has a direct responsibility for the safe operation of the plant. How this is implemented in practice (at Borssele) may be demonstrated by the fact that the manager who is responsible for the independent supervision of nuclear safety, radiation protection and quality assurance at the plant reports directly to the most senior level of management at the Borssele site. All safety-relevant management functions, such as decisions on financial, material and manpower resources and operating functions, are properly performed and supported by this most senior level of management. This ensures that safety is given a proper role in this economically oriented environment.

The description of the NPP organization is part of the Technical Specifications (see the sections on Articles 11 and 14 of the Convention) and is therefore subject to regulatory review and inspection. The following paragraphs describe how the priority for safety is achieved at the various stages of the plant's lifetime.

The *design* of the NPP conforms to the safety requirements and regulations described in the preceding sections of this report. It is focussed around items such as defence-in-depth, redundancy and diversity in safety systems, and stringent design requirements derived from internationally accepted industry standards such as ASME III, ANS and KTA standards. The design characteristics are documented in the Safety Analysis Report that also describes the response of the nuclear power plant to a variety of postulated incidents and accidents. The modification project, as finalized in 1997, established that the plant is now fulfilling the NVR-D-series, with only minor exceptions.

The original *construction* of the Borssele NPP was carried out by qualified companies with considerable experience in constructing nuclear power plants. Although there are no formal regulations on the quality of such contractors in The Netherlands, the applicant must demonstrate that all stringent design requirements can be met, and these include the presence of a rigorous quality assurance programme at the vendor companies. This, in turn, imposes strict requirements on the qualifications of the labour force, such as welders. During the modification project special attention was given to this subject.

The *operation* of a nuclear power plant is initiated after a rigorous commissioning programme, in which all safety characteristics are tested and verified, in accordance with the applicable regulations (i.e. the NVRs on design and operation). During the operational life of the plant, operation is in strict conformity with the 'Technical Specifications' (TS), which set limiting conditions on the operation of the plant, including the minimum availability of safety systems. In 1998 the Technical Specifications were upgraded according to NUREG 1431. The TS are carefully documented and any deviation from them is reported to the regulatory body. The operating crew in the control room are thoroughly trained in all aspects of safety of the plant. Regular examinations are held, with a member of the regulatory body acting as an official and external examiner, to ensure that staff possesses all the necessary qualifications. The power plant operates at all times under the direct control responsibility of the control room operating personnel.

As a whole, the power plant operates in full accordance with the principles set out in the NVRs on Operation, which include a rigorous in-service inspection and testing programme, as well as maintenance and control of ageing.

Where new safety insights emerge, a study is performed of their relevance to the power plant and modifications are initiated if it is found that they offer sufficient safety benefits in comparison with their cost. Although there is no formal requirement in The Netherlands that a cost-benefit analysis be carried out, practical experience (such as the major backfitting programme at Borssele) has shown that the modifications have comfortably met the criteria applied in other countries. As we have already mentioned, regular safety updates have to be performed, at two-yearly intervals for operational aspects and at ten-yearly intervals for aspects that may affect the principles underlying the plant design basis.

When the plant finally terminates operation, the *decommissioning* stage starts. The first step is a careful study of the change in safety priorities, in view of the different requirements placed on the system, with all the fuel in a permanent residual heat removal condition. A new licence is granted once the safety precautions are judged to be adequate. The decommissioning of the Dodewaard NPP is currently in progress.

The *regulatory body* is formally distributed over a number of different ministries, as has already been explained. Safety aspects, in accordance with the mission of this ministry, dominate the work performed by the Ministry of Housing, Spatial Planning and the Environment. Since a more formal distinction is made between the economic and regulatory aspects of nuclear energy production it is fair to say that the safety aspects are ruling in all the aspects of regulation. The Directorate for Energy and Electricity Production (EEP) at the Ministry of Economic Affairs has only formal role in licensing activities restricted to aspects of electricity supply.

Safety culture

Although no formal criteria have been developed to measure ‘safety culture’, the inspections performed by the regulatory body include monitoring the licensee’s attitude to safety. Nowadays the staff of the Borssele NPP is fully aware of the necessity of having a ‘safety culture’ and its relevance to the operating organization. Although many elements of a safety culture are believed to be in place, improvements and a continuous alertness are still necessary in order to cope with the changing operating climate, such as liberalization of the electricity market.

Organizations that have always been alert to the importance of safety already had a safety culture even before it was acknowledged as being a programme topic. An OSART mission performed at the request of the regulatory body at the Borssele NPP in 1986/1987 included a wide-ranging review of the safety aspects of management, organization and procedures by means of a top-down approach. The mission confirmed that there was a high standard of technical nuclear safety, but recommended a number of organizational and operational improvements. In response to the OSART findings, the former Reactor Safety Commission recommended that ‘comparable’ (self)-assessments be held at regular intervals, e.g. every two years. A number of assessments have been held since as a consequence of this recommendation.

- The first mission, a specific aim of which was to look at the safety culture, was a pilot ASCOT review conducted in 1994 as a complement to an ASSET review. An expert from the IAEA, who interviewed individuals in the senior management structure, performed it. It was a novelty for the staff at Borssele to be subjected to an investigation of a regulatory nature that also looked at the social environment. Although the findings were encouraging, some critical remarks were made about the supervision of subcontractors and the conduct of some operational work.
- In 1995 Borssele initiated a self-assessment that was aimed mainly at middle and lowerlevel management. It was lead-managed by a Dutch consultancy called GITP Management Focus. The main topics of assessment were effectiveness and safety culture. The assessment team made use of the INSAG-4 checklists. They concluded that, although alertness and awareness of safety were high, horizontal communication could be improved. The follow-up to this assessment involved revision of procedures and instructions, extension of pre-job briefings, and use of modern communication and education tools. Organizational changes have been carried out in the plant in order to improve co-operation between departments.

In 1999 a WANO peer review was conducted at Borssele. Such a review is similar to an OSART mission, as the approach is also performance-based; however, the approach is bottom-up instead of top-down. Operational performance was reviewed and current performance of work in practice was observed. Discussions were held with plant personnel. The team was composed of 20 persons, and the review lasted three weeks. The work started with a plant walk-down. WANO performance objectives and criteria were used. Explicit attention was given to safety. As a result 14 issues for improvement were suggested in the areas: Organization and Administration, Operations, Maintenance, Engineering Support, Radiation Protection, Training and Qualification, Chemistry, Operating Experience Review, and Fire Protection. In 2000 a WANO-Peer Review Follow Up took place, in order to investigate the improvements that were made to resolve the 14 issues that were raised during the first WANO peer review. Almost all of these follow-up actions for improvement were judged adequate. Only one issue needed an intensified attention of plant management. With regard to radiation protection the WANO-team found that that extra effort would be necessary to avoid radioactive contamination within the plant. As a result of this remark Borssele started a programme to avoid contamination. More details of the safety culture at the Borssele NPP are given in Appendix 3.

A special point of regulatory concern is the effect of electricity market liberalization with amongst others its potential of downsizing the amount of NPP staff, minimizing the necessary training for staff or safety related decision-making in an environment where the economic factor is dominant: in other words a potential negative influence on safety culture. The KFD is participating in all kind of working groups and workshops of the NEA/CNRA (such as Working Group of Inspection practises which drafted a report called 'the effectiveness of licensees in managing safety' in which this issue is discussed, and which prepares a workshop on this issue in Vera Cruz, Mexico; April/May 2002) on this topic. The possible adverse effects of deregulation of the electricity market are nowadays special points for the regulatory inspections. The recommendations and outcomes of the OECD/NEA/CNRA report 'Nuclear Regulatory Challenges Arising from Competition in Electricity Markets' were translated into a list of attention points for inspections.

As already indicated in this chapter there is also a concern related to the effects of splitting the EPZ utility into a much smaller EPZ and a larger utility with its possible adverse effects on safety. Especially, the necessary resources to maintain an adequate level of safety culture are a point of concern.

ARTICLE 11. FINANCIAL AND HUMAN RESOURCES.

Art. 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.

Social and economic background

It should be pointed out that The Netherlands is a prosperous country with a stable social structure and a reliable banking system (that is subject to strict government supervision) and only a small number of days lost to strikes every year. It is a setting in which a huge range of firms operates on a businesslike footing, i.e. they are used to meeting their obligations. Electricity companies are no exception to this. This means that a firm operating a NPP has a good idea of its future financial liabilities, both short-term and long-term. In this sort of environment, there are good opportunities for creating a profitable energy industry that can also meet the relevant requirements regarding financial stability. The liberalization of the electricity market as such did not have any direct material effect on this situation. Although, in the long term some consequential events have the potential for negative influences. As already indicated in the previous chapter some regulatory concerns are co-related to the effects of the liberalization, i.e., the splitting of the utility operating the Borssele NPP into a smaller part (with the same company name; therefore, legally the same licence holder) and a larger non-nuclear part. A substantial part of the financial resources remains with the shareholder of the larger company (this shareholder is also for 50% shareholder of the new EPZ company). To what extent the financial resources of this new EPZ utility are adequate to warrant safety in the future (including the decommissioning of the plant) is currently under investigation by the regulatory body.

In the light of the country's social structure, operating organizations are expected to be financially sound businesses with sufficient financial resources at their disposal to enable them to take all relevant measures, including those relating to safety. It is for this reason that no special action has been taken to guarantee the liquidity of the businesses in question, with the exception of the licensing restriction referred to above.

Due to the effects of the liberalization of the European energy market it might be advisable in general to consider the introduction of legal requirements related to the financial and company organizational area. The effects of said liberalization is the departure of the old, very stable commercial and financial environment and behaviour, which potentially may have a negative influence on long term safety practices and culture as has been discussed.

History and legislative aspects of the liberalization of the electricity production sector in The Netherlands

Until a few years ago the Sep, a co-operation of the Dutch utilities, among others, took care of all the international contracts of the electricity sector. The SEP also owned the Dodewaard NPP. In order to come to a liberalised electricity market the co-operation agreement between the utilities and the Electricity Act of 1998 had to be dissolved. However, until that time a lot of the costs were made in nonconformity with the market, e.g., capital investments which were not profitable in the short run, like the construction of a demonstration coal-gasification plant or the district-heating projects. These costs, often as a consequence of governmental stimulation, could be borne by the electricity sector as a whole, i.e., the SEP. After the European decision to liberalise the electricity generating market a resolution had to be sought to resolve the financial consequences. First of all the utilities tried to create a new large Dutch utility by merging the existing utilities. After failure of the merging, a legal solution was necessary in order to come to a proper liquidation of the financial commitments and contracts, as well as the resolution of the costs which were made in nonconformity with the market by the Sep. In December 21, 2000 the so-called Transition Act Electricity Production Sector was published. This Act regulates the liquidation of the Sep.

In principle all the costs associated with the commitments and contract made in the past have to be borne by the separate utilities in a fixed ratio.

The government will pay, via a surcharge on the fares for the transport of electricity, the costs made in nonconformity with the market.

The national grid shall remain independent of the other parties in the electricity market, such as electricity producers, suppliers or brokers. They are not allowed to possess more than 10% of the shares.

In the explanatory memorandum of the Transition Act Electricity Production the advice of a Special Advisory Committee regarding these aforesaid matters is reported. With regard to the nuclear power plants the following is stated:

> *The Committee recommends that the ownership of the Dodewaard plant will be transferred from the SEP to COVRA (Central Organization for interim Storage of Radioactive Waste). This will also apply to the Borssele plant after its closure. Given the political nature of the decision-making regarding the closure and decommissioning of NPPs, it is strongly advised that the government will be the sole shareholder of the COVRA organization.*

The government has the intention to follow this advice. Therefore, at this very moment negotiations are at hand regarding the transfer of the Dodewaard plant to the COVRA organization. An important item in these negotiations is the funding of the decommissioning. Also negotiations are at hand to transfer the shares of the COVRA organizations which are in possession by the utilities and ECN, to the government.

Legislative aspects

The Nuclear Energy Act contains a number of articles which deal with criteria, interests and conditions under which a licence can be awarded. In the explanatory memorandum of article 70, which states that a licence is awarded to a corporate body, the term guarantee of necessary expertise and trustworthiness in relation to safety is used. In the present time trustworthiness related to safety can be associated with financial solvability.

The licence does not automatically pass to the licence-holder’s successor in title. On basis of article 70 of the Nuclear Energy Act any transfer of ownership must take place with the consent of the ministers who issued the licence. This allows the authorities to assess whether a new licence holder can offer the same standard of expertise, safety, security etc. as the old licence holder. Indeed, the authorities will refuse to issue a licence to a proposed new licence holder where a change in ownership alters certain circumstances that are of vital importance from a licensing point of view.

Rules and regulations on adequate financial resources

Although, NVR 2.2.9 (Management of Nuclear Power Plants for Safe Operation) do not contain any direct requirements to have adequate financial resources for a safe operation of a NPP, it contains these indirectly. For instance, the management of a NPP shall provide adequate facilities and services in a timely manner during operation and for responding to emergencies. The personnel involved in reviewing activities shall have sufficient independence from cost and schedule considerations. This applies to reviews of all safety related activities. Paragraphs 6.1.1 and 6.1.3 of this NVR read respectively:

> *Certain services and facilities complementary to the direct operating functions shall be provided for effective implementation of the management programmes and for ensuring safe operation of a nuclear power plant. These are called supporting functions. The services are the expertise and assistance made available to the plant management to support the operation of the nuclear power plant. The facilities are the equipment and systems required by the services….*

… the operating organization shall make arrangements to provide the following services and facilities:

1. Training service

2. Operation services

3. Quality assurance services

4. Radiation protection and emergency preparedness

5. Maintenance and surveillance services.

The requirement to provide these services and facilities implicitly contain the requirement to provide the necessary financial resources for it.

Rules and regulations on financing decommissioning

Article 1801 of NVR 1.2 states:

The operating organization is responsible for providing measures for the decommissioning of the nuclear power plant in a safe manner after it has been taken out of operation, and its responsibility can only be terminated with the approval of the regulatory body.

This requirement can be translated into a stipulation that the licensee should have sufficient (financial) resources to ensure proper decommissioning. In the draft amendment of the Bkse (Nuclear Installations, Fissionable Materials and Ores Decree) is stated that the licensee shall indicate in its submittals for a decommissioning license the costs for the decommissioning and the way the financing of the decommissioning is organized.

During the course of the operation of the NPPs, the licensees of the Borssele and the Dodewaard plant have built up (or are in the process of building up) the necessary funding. This will be used to pay for the cost of decommissioning once the NPP has reached the end of its useful life (see annex 2 for a description of the decommissioning plan and associated costs of the Dodewaard plant). One should keep in mind that in the past (before the deregulation) the energy policy and associated finances were regulated by the Ministry of Economic Affairs. Besides, the (private) utilities had public shareholders.

Art. 11.2: 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.

History

When NPPs were first designed and operated, ‘human resources’ were a subject that received limited attention from both the licensee and the regulatory body, as compared with the level of interest in hardware. The situation started to change, however, in around 1980. Firstly, more attention was paid to staff who were directly involved in plant operation. This led to the formulation of a rule on the recruitment, training and examination of control room staff in 1984. In addition, there was a gradually growing interest in human behaviour, a trend that was accelerated by the results of analyses of events where the human factor was found to play an important role.

Legislative aspects

The Nuclear Energy Act stipulates that an application for a licence must contain an estimate of the total number of employees, and a description of their tasks and responsibilities and, where applicable, their qualifications. This includes supervisory staff. The relevant regulations in this respect are NVR 2.2.1 and the specific Safety Guide NVR 3.2.1 for control room personnel. The latter was recently revised and made operational. The licensee has to submit to the regulatory body the education and training plan for information and approval.

Operation

The organizational structure of the plant is described in the Technical Specifications (see the section on Article 14), with a clear description of the responsibilities, authority interfaces and lines of communication, requisite level of expertise, and the requirements for training and education. It is therefore part of the licence and hence subject to inspection by the regulatory body. Any major organizational changes, e.g. at management level, must be reported to the authorities. After the first 10-yearly evaluation and following extensive modifications at the Borssele plant, the manpower was reduced by about 10% to return an operational level that was more in line with standard, normal continuous operation. Besides the KFDs own evaluation, an external, independent evaluation acting on behalf of the KFD confirmed the KFD findings. The recent splitting of the utility, which led to a much smaller utility with less own financial resources, is watched over by the KFD with increased interest, as this process may potentially negatively influence in the future the amount of personnel to be attracted for performing safety related tasks.

Under NVR 3.2.1, control room operating personnel need to be in possession of a special licence, which is granted after the candidate in question has completed a specified period of training, and has passed an examination set under the supervision of the regulatory body. The licences are signed by the plant manager and co-signed by the director of the KFD. All training, education, examinations and medical checks of licensed personnel are documented.

There are three levels of control room licences:

- reactor operator;
- senior reactor operator;
- shift supervisor.

There is no difference between the qualifications required for operators working on the nuclear side and those required for operators involved in power conversion, as the policy is that operators should be fully interchangeable.

The operators receive simulator training on a Borssele-specific simulator in a German training centre in Essen (Germany). The training is in Dutch. They are also trained in communication, both with other staff on the same shift and with outside contacts. Both the training programme and the simulator need to be approved by the regulatory body.

The Dodewaard power plant is in the process of being decommissioned. The regulatory authorities therefore no longer require shift staff to undertake training courses at the Dodewaard simulator. The training programme does, however, place more emphasis on radiation protection.

Another category of plant staff whose work has a direct bearing on safety is health physicists. They are also required to be in possession of appropriate qualifications.

Other personnel include those responsible for functions such as maintenance, technical support, quality assurance, security, administration, training, management, etc. Training and education requirements are laid down for all these staff categories, including on-the-job training. A full description of the programme and the organizational structure is available for assessment and inspection by the regulatory body.

ARTICLE 12. HUMAN FACTORS

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.

Introduction

Human factors are all those factors where the interface between humans and technology plays a role. They consist basically of two elements: internal factors such as talent, competence, professional skill, motivation, stress resistance and situational flexibility, and external factors such as work environment, actual and potential process control, procedures, training and education, accessibility of components and automation. The emphasis in the design of man-machine interfaces is on the external factors.

Although man-machine interfaces have always played a role in the design and operation of complex machinery such as nuclear power plants and aircraft, it was not until the early 1980s that their importance came to be widely recognised. The human factor was given a high profile in the WASH 1400 study on reactor safety, and its importance was felt dramatically during the TMI event in 1979 and the Chernobyl accident in 1986.

Research has been initiated into specific problems affecting the human factor. The focal points are control room design (ergonomics) and the modelling of the human factor for risk assessment applications.

Legislative aspects

NVRs take account of the human factor, as do the original IAEA Codes and Safety Guides. Hence, the inclusion of the human factor in design, operation and quality assurance is basically covered by the applicable rules and guidelines. As the NVRs are part of the licence, licensees are required to give full consideration to the human factor.

Specific points

An early example of the way in which account is taken of the human factor is the fact that the reactor protection system is required to be autarchic in operating the safety systems during the first 30 minutes after the start of an incident/accident.

The recommendations of the OSART reviews of the Borssele and Dodewaard plants in 1988 pointed to the need for introducing a more structured approach to dealing with the human factor. They resulted in:

- The development of symptom-oriented procedures, which allow operators to bring the reactor in a safe condition, even though they may not be aware of the specific nature of the event which is taking place. Because the procedures were event-based, a new training formula had to be introduced when the procedures were implemented.
- The installation of a ‘critical safety function status monitor’ in the control room of the Borssele NPP in 1988. It keeps track of all safety-relevant parameters on one single panel and guides operators through the symptom-based procedures.
- The establishment of an Incident Evaluation Group to analyse events having occurred at the facility, as well as relevant events and incidents having occurred at other plants (see also the section on Article 19 (vi)). This group takes explicit account of the human factor when undertaking its evaluations, for example by using HPES or ASSET methodology.

Another follow-up activity was that study programmes were started at both power plants, in conjunction with the KEMA and ECN research institutes, with the aim of modifying the control room. Among the issues that the study programmes addressed were the restructuring of the data flows, bridging connections for emergency situations and the habitability of the control room during accidents. The ECN study of the ergonomic design of an overview display in the control room is of particular interest in this respect, as it took all known human factor aspects of control room design into consideration. A complete re-design of the control rooms at Borssele and Dodewaard was initiated. Due to later developments, however, only the Borssele plant was actually modified. Key elements are further described in the section on Article 18 (iii).

The training programme was extended with the introduction of a full-scope replica simulator for the Borssele plant located at the nuclear powerplant school in Essen, Germany. Since the Severe Accident Management Guidelines were implemented in Borssele in mid-2000, these were also taken into effect in the local Borssele and the Essen education system. Severe Accident training is given to all those persons which have been designated for a decision-making and support role in severe accident space. The purpose of this training is to provides staff with the ability to make independent judgements on severe accident conditions and appropriate response actions. Above-mentioned persons include:

- Technical assessment staff responsible for assessing plant symptoms in order to determine the plant damage condition(s) and potential strategies that may be used to mitigate an event.
- Decision-makers, as designated to assess and select the strategies to be implemented, and
- Implementers, those personnel responsible for performing the actions necessary to accomplish the objectives of the strategies (e.g., hands-on control of valves, breakers, controllers, and special equipment.

Computational aids are available for the technical assessment and decision-making staff to assist with the assessment of key plant parameters, system status, and plant response relative to accident management decisions and actions.

Self-evaluation is the on-going process to ensure that the severe accident response capability is feasible, maintained and useful. This self-evaluating program comprises:

- The periodic conduct of table-tops (once or twice a year) or exercises to ensure personnel retain their familiarity with the use of SAM guidance and with the delineation of responsibilities during their use,
- Periodic review and assessment of the adequacy of the training and support material
- On-going evaluation of industry and government sponsored activities, including severe accident research, and a process for incorporating relevant material into guidance or other severe accident documents.
- Periodic briefings with the KFD (yearly)

To maintain the competencies in the field of human Factors, and to contribute in the sharing of experience, the KFD participates in the OECD Senior Experts Group on Human and Organizational Factors (SEGHOF).

Studies

Within the framework of the Working Group on RISK (WG-RISK) of the Committee on the Safety of Nuclear Installations (CSNI), a standing committee within the OECD Nuclear Energy Agency (NEA), a research programme was carried out on errors of commission in PSA. The objectives of this study were: (1) to develop insights on errors of commission; (2) to apply methods for the quantitative and non-quantitative analysis of errors of commission in a retrospective way on operating events which have occurred; (3) to identify data needs. The Netherlands participated actively in this project. Two studies were done. The first was the use of the ATHEANA-method (A Technique for Human Event ANAlysis, a method developed under contract for the US-NRC) in a retrospective way on an incident that has occurred in a chemical plant. The second study concerned the use of the method of assessing errors of commission that was applied in the Borssele PSA in a retrospective way on an operational event that has occurred in Borssele. The conclusions of these studies were that the concepts of ‘error forcing context’ and ‘recovery potential’ in these methods proved to be very useful for the examination of the causes of the event by giving rise to questions not previously considered.

Conclusion

The overall conclusion that may be drawn is that the human factor has been taken into account in relation to many safety-related aspects of the Borssele plant. Further studies are currently under way in order to ensure that the licensee has knowledge of the latest developments in this particular field, including the further use of a living PSA in this area. Regarding the latter, it can be said that Borssele is planning to update the afore-mentioned assessment of the Errors of Commisson which was performed in the mid-nineties within the context of the Borssele-PSA. Since these studies were performed, the methodology for assessing these type of errors has improved tremendously.

ARTICLE 13. QUALITY ASSURANCE

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.

History

The Dutch authorities realised in the mid-1970s that quality assurance was an essential tool for providing confidence that specified requirements for all activities important to nuclear safety were met. A working group was formed, consisting of operators, industry representatives and regulatory authorities, and was given the task of building a platform of common understanding on which a system of basic QA rules and guidelines could be created. These would be aimed at the interfaces between the regulatory body and the licensee. One of the key principles was that the licensee is aware of his responsibility in matters of nuclear safety.

Due to the limited size of the nuclear industry, it was not cost-effective to develop a specifically Dutch national programme of QA rules and guidelines. As a result, the IAEA NUSS QA safety series was chosen to provide the basis for the Dutch programme (as has already been mentioned in the section on Article 7.2).

In addition, there was a shift in emphasis during the period from 1980 to 1990 from the construction of new power plants to improving the safety of the existing plants.

The development of the ISO QA standards in the field of non-nuclear safety enhanced the work being performed on QA in nuclear safety matters, as well as its broad acceptance by the partners involved.

Regulations

A Code on Quality Assurance (NVR 1.3) is part of the licence and is hence binding for the licensee. QA rules and regulations are also included in the applicable rules on pressure vessels. The revised IAEA Quality Assurance Code and Guides are being introduced in The Netherlands, after an amendment process, as revised national nuclear rules.

Specific points

Factors which are specific to The Netherlands are the absence of a national nuclear industry and hence the country's dependence on foreign nuclear vendors and suppliers, and the relatively small size of the regulatory body. As a result, the national QA systems of these foreign parties (which also depend on their own national industrial standards and regulations) had to be taken into account during the development and implementation of the Dutch QA Safety Rules, as well as industrial standards that are applicable in areas such as pressure-retaining components.

In addition, the QA Programme gradually evolved into an organization-oriented application rather than a component-oriented application, with more emphasis now being placed on the evidence provided by the licensee that its organizational systems ensure that all safety criteria are met.

Quality assurance during operation

In the QM-handbook (Quality Management) of the Borssele NPP is justified how the QM-program of the NPP satisfies NVR 1.2 (Code for NPP Operation) and NVR 1.3 (Code for Quality Assurance for the Safety of NPPs). The QM system of the Borssele NPP is a living system which is continuously being improved by the organisation on the basis of internal and external experiences and developments. On the other hand findings of self-audits and -evaluations and external audits, inspections and peer reviews are also used to further improve the system. The NPP has an ISO-14001 and a certificate related to conventional labour safety.

The QA programme that has been adopted by the licensee at the Borssele plant was assessed by the regulatory body at the time of its introduction and is reassessed by means of regular audits and QA inspections. Some staff members of the regulatory body have been trained to understand the essence of the quality assurance 'culture' and are hence able to check whether all safety-related activities at the plant are covered by the relevant QA elements. Most inspectors have followed courses in QA and some are also certified as ISO lead auditors. This includes familiarity with the licensee-industry interfaces together with audits at suppliers' premises. As far as the plant is concerned, the regulatory body draw up an audit plan each year, consisting of a series of scheduled audits, combined with ad-hoc audits where these are felt to be necessary. The audit plan is organised in such a way that total coverage is attained within a certain time frame.

The assessment of the licensee's QA programme concludes with the performance of independent audits by third parties, such as: a civil structure audit and a commissioning audit during the final stage of the major modification project at the Borssele plant. Findings and/or action points are fed into a database, and checks are carried out to make sure that recommendations have indeed been implemented. Audit/inspection reports are submitted on a regular basis.

Quality assurance within the regulatory body

In order to improve the quality of the output of the KFD it was recognised that the internal QA process of the KFD organization had to be improved. In the past much of the regulatory activities were conducted on an ad-hoc basis. The quality of the work was in some way too much influenced by the personal commitment and expertise of the individual regulator in question, and consequently had the potential to be too subjective. There was no obligation to formally document and file the regulatory process, which meant in practise that the assessments were difficult to trace and information on them was sparse. In order to make the regulatory processes more objective, transparent, retraceable, etc., second opinions, internal reviews, work procedures for the assessment task, etc., had to be built in this QA process. The lack of a proper QA- regime together with the small staff, where in several cases the individual staff-members are responsible for several expertises, was in the past a cause that some staff-members were prone to indulge in too individualistic approaches. Therefore, in 1997 the KFD started with a formal process to introduce a quality system for all its tasks. Traceability, predictability and optimisation of the regulatory activities should be leading principles in this QA-process. In 1999 the KFD got its first ISO-9001 certificate. The ISO certification was chosen a.o. because this standard is well known in industrial and governmental circles. ISO 9001 is also used in the some of the powerplant-industry relations.

By application of the Quality System the following results were obtained:

- A transparent organization structure and procedures in which the decision making process became visible
- An improved awareness of the required quality of the processes in which the KFD is involved
- The formulation of objectives and projects with feedback of the accomplished results
- The performance of tasks with a better separation of policy and assessment/ inspection
- Providing a structured approach to accommodate improvements where necessary

The KFD Quality System is based on NEN-EN-ISO 9001 and NVR 1.3 (Code for Quality Assuance for the Nuclear Power Plants, adapted IAEA Code Safety Series 50-C-Q (Rev.1) with accompanying safety guides.

ARTICLE 14. ASSESSMENT AND VERIFICATION OF SAFETY

Each Contracting Party shall take the appropriate steps to ensure that: Art. 14(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;

Assessment of safety

A licence is only granted if the applicant complies with the NVRs on Design, Operation and Quality Assurance and with the Probabilistic Safety Criteria (including dose-frequency constraints within the design basis envelope. In Appendix 1 a detailed overview is given of the probabilistic safety criteria). To this end, the licensee drafts a Safety Report (SR) and a Safety Analysis Report (SAR), which it submits to the regulatory body. The SAR gives a detailed description of the proposed facility and presents an in-depth analysis of the way in which the facility meets the NVRs.

The SAR is supported by a Probabilistic Safety Analysis (PSA), comprising levels 1, 2 and 3 (see Appendix 2). The PSA and, notably, the level 3 part thereof, is needed to demonstrate that the facility meets the Probabilistic Safety Criteria set by the Minister of Housing, Spatial Planning and the Environment.

As the NVRs are fairly general and hence lack the technical detail that is common to existing national nuclear regulations in several other countries, additional material is needed to define the licensing basis. This includes e.g. the US Code of Federal Regulations, the USNRC Regulatory Guides and the USNRC Standard Review Plan, the ASME code, ANS/ANSI standards, KTA standards, and RSK recommendations. Although these documents do not have any formal status in The Netherlands, the NVRs require the applicant to define and justify which other technical basis and industry standards he is going to use. For this process, the regulatory body expects the applicant to demonstrate that:

- a chosen set of foreign regulations and industry standards are consistent with the relevant NVRs, and
- there is consistency among the various sets of standards or regulations, where more than one set is applied (e.g. when parts of both US and German regulations are used).

The SAR is studied in depth, often with the help of external bodies such as GRS, AVN and TÜV, as the KFD and IMH are both small organizations. The underlying and supporting documents are also reviewed in depth, to make sure that the regulations have been met. Selected items are analysed by computer codes other than the original ones (either by the licensee at the request of the regulatory body). Often, assessments of similar power plants by a foreign regulatory body are also considered.

The IAEA was asked to provide support in order to properly assess and review the PSA results. It provided this support by undertaking peer reviews of the PSAs (IPSART missions, formerly known as IPERS missions), and by giving training courses in PSA techniques and PSA review techniques. Appendix 2 gives more information on the role of the PSA in relation to safety assessment, as well as on the associated regulatory review and guidance.

After these reviews and regulatory assessments have been completed, and it is established that the applicant is acting in accordance with the rules, regulations and radiological safety objectives, the licence can be granted. The main elements of the assessment are documented, as is required by the internal QA process (ISO 9001) of the Regulatory Body.

As has been said, one of the conditions of the licence is that the safety of the nuclear installation shall be periodically reviewed in the light of operating experience and new insights. A review of operational aspects shall be performed once every two years, whilst a more basic review shall be conducted once every ten years. The latter may involve a review of the plant's design basis in the light of new developments in research, safety thinking, risk acceptance, etc. The policy on the fundamental review is documented in Appendix 4 (Policy Document on Backfitting). It should be noted that this policy has not been formally adopted, but is used by the regulatory body as guidance and accepted by the licensee.

The modification project was preceded in the early nineties by a licensing procedure that included a new safety report and an environmental impact statement. The regulatory body reviewed the safety report and underlying safety analysis report. External experts were consulted for the review. In the late nineties the safety report and some analyses were renewed when the licensee of the Borssele plant submitted a request for a modification of the licence in order to be able to use higher enriched fuel elements (from 3.3% up to 4%). Also here external experts were consulted for the review. In this case special emphasis was given to issues associated with high burn-up fuel in relation with reactivity insertion accidents (RIA-accidents)[4].

Assessment of safety by the licensee

Apart from the assessments of the impact of proposed operational or design changes on safety or the periodic safety reviews, which are both regulatory and institutionalised requirements, the licensee regularly performs self-audits, or request audits or peer review by others in order to evaluate its own operation. In particular the Organizational, Personnel and Administrative aspects of operation are subjects for these audits and peer-reviews.

An important aspect in the assessment of safety is the ability of the assessor to make use of the state-of-the-art. Therefore, experts of the licensee participate in audit and peer-review teams of IAEA and WANO to evaluate other plants. The insights gained from these participations can be and are used in their assessment work at Borssele.

Art. 14(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.

Verification of safety

In general, the licensee is responsible for inspecting and testing all NPP equipment and systems in order to guarantee their safe operation. The regulatory authority checks that the inspection and test programme is adequate for this purpose.

The applicable NVRs are 2.2.2 for in-service inspection, 2.2.3 for periodic testing according to the 'Operational Limits and Conditions' (also known as Technical Specifications), 2.2.8 for surveillance and 2.1.2 for fire protection. In addition, the licence requires that the Borssele NPP has a control system for monitoring wear and tear of all components and structures which are important for safety, so as to enable the plant management to take appropriate action in good time.

[4] It was proven by analysis that the enthalpy rise in case of rod ejection accidents of both the transition cores and equilibrium core remained far from the areas where fuel and/or cladding failures were detected at the RIA-experiments in Cadarache (France). Because new cladding material was foreseen, which wasn't fully qualified in the high burn-up region, a qualification program was initiated involving the deployment of 4 lead test assemblies in the core of the Borssele NPP.

The scope and frequency of the in-service inspection programme for pressure-retaining components are checked by the Pressure Vessels Inspectorate (as from 2002 this might be any qualified independent and certified organization). At Borssele, the Inspectorate checks the primary pressure boundary integrity under the Pressure Vessels Act, and under ASME XI. At the request of the KFD, the Inspectorate also carries out inspections of the functional capability of pressure-retaining components (e.g. operability of valves). The KFD conducts regular inspections and audits to check the plant's other inspection and test activities.

As has been mentioned, e.g. in the section on Article 14 (i), the NPP has to produce an evaluation report every two years demonstrating that the manner in which the NPP is being operated, with the existing (trained) staff, procedures and organizational structure, meets the requirements set out in the licence. The report and its findings are evaluated by the KFD and IMH.

Similarly, the NPP is obliged to produce an evaluation report every ten years giving an assessment of whether the design still conforms to the latest rules and regulations, as well as internationally applied safety practices. This report and its findings are also evaluated by the KFD and IMH.

The current licence awarded to the Borssele NPP includes a requirement that a living PSA (LPSA) is operational. This is because the regulatory body recognises an LPSA as being a suitable and sufficiently mature instrument of analysis that can assist certain safety-related decision-making in matters of design or procedures. These LPSA applications reveal the effect of any change in the design or operating procedure, even if such a change looks insignificant at first sight.

Both the licensee and the regulatory body are interested in extending the use of the LPSA. Exactly which application is most relevant to decision-making on operational matters (i.e. safety and economics) is a topic of debate at present. The IAEA was therefore asked for a 'Peer Advice' on LPSA applications. Because the regulatory body believes that LPSA insights should be used to a greater extent for its own safety assessments and verifications, and also to enable it to embark on a risk-informed approach to regulation, the IAEA was also asked to include these aspects in its report (See appendix 5 for further information on this 'Peer Advice' and the first steps towards a more risk informed regulation).

ARTICLE 15. RADIATION PROTECTION

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.

Radiation protection of workers

As has been stated before in the response to Article 7, the basic legislation on nuclear activities in The Netherlands is the **Nuclear Energy Act**. A number of decrees have also been issued, containing more detailed regulations based on the provisions of the Act. The most important decrees for the safety aspects of nuclear installations and the radiation protection of the workers and the public are:

- the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse); and
- the Radiation Protection Decree (Bs).

The above mentioned decrees are fully in compliance with the Euratom Directive 96/29/Euratom laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

The Bkse requires the licensee of a nuclear power plant to take adequate measures for the protection of people, animals, plants and property. Article 31 of the Bkse states that a licence must contain requirements aimed at preventing the exposure and contamination of people, animals, plants and property as much as possible. If exposure or contamination is unavoidable, the level must be as low as is reasonably achievable. The number of people exposed must be limited as much as possible, and the licensee must act in accordance with the individual effective dose limits.

The Bkse also states that these activities must be carried out by or under the responsibility of a person with sufficient expertise, subject to the judgement of the regulatory body. This expert should occupy a post in the organization such that he or she is able to advise the management of the NPP in an adequate way and to intervene directly if he or she considers this to be necessary.

Written procedures must be available to ensure that the radiological protection measures that have to be taken are effective and to ensure that the above-mentioned expert is properly informed. Full details of these conditions are given in the Radiation Protection Decree (Bs), which also lays down more specific requirements on the protection of people and the environment from radiation.

In conformity with the Euratom basic safety standards the aforementioned Radiation Protection Decree stipulates a limit of 20 mSv per year as the maximum individual effective dose for radiological workers.

The NPP licensee at Borssele has set a long-term average of 10 mSv per year as the objective for the individual effective dose limit for a radiological worker. The licensee's ultimate goal is to achieve a long-term average of 7 mSv per year, i.e. a radiological worker who receives a dose of 10 mSv during a particular year should receive less during subsequent years, until his average dose has reached 7 mSv per year.

The average effective individual dose at the Borssele plant shows a decreasing trend since 1983. This statement is valid for the Borssele plant personnel as well as for externally hired personnel. The average effective individual dose in the last two years is below 1 mSv per year per person. During that period the trend of the collective dose has been very similar to that of the individual doses. The total collective dose came up to an amount of 4 manSv per year in the beginning of the eighties. During the last two years this value has decreased to about 0.5 manSv per year.

The current licence lists the radiological data that the licensee has to document and file, and specifies the situations in which and the terms on which it must inform the regulatory body. Another example of a ‘radiation protection’ requirement in the licence is the licensee’s obligation to measure the radiation levels and the levels of contamination at those locations where workers may receive an effective dose of 5 μSv or more in less than one hour. The licensee is required to document and file these measurements.

Employees who carry out activities in places where there is a risk of internal contamination must be checked at least once a year for internal contamination. The results must be documented and filed.

The licensee is required to report to the regulatory body every three months the individual doses received by employees who work at locations where they are exposed to an effective dose of at least 5 μSv in less than one hour. If a person has received an effective dose that exceeds 15 mSv within a period of three months, the licensee needs to investigate all circumstances that could have caused this dose level and must inform the regulatory body about the results.

The licence also requires the Borssele NPP to comply with the amended IAEA codes and Safety Guides, i.e. the NVRs. In the domain of radiation protection, Safety Guide NVR 2.2.5 complements the requirements set by the Radiation Protection Decree (Bs), and lays down more specific requirements on:

- the lay-out of the controlled zones;
- the facilities within the controlled zones;
- staff qualifications and training; and
- the radiation protection programmes.

In order to comply with all the radiological conditions, the licensee must have adopted adequate procedures for the implementation of such a radiation protection programme. The regulatory body inspects the site to check the effectiveness of these procedures.

Prior to a reactor outage, the licensee must give the regulatory body an estimate of the anticipated collective dose. Once the outage activities have been completed, the licensee must draft a dose evaluation report and inform the regulatory body of the results.

If the anticipated collective dose relating to any job exceeds 20 man-mSv, the regulatory body requests the licensee to produce an ALARA report, in order to prove that the latter has indeed taken the best possible radiation protection measures. The ICRP-60 publication is used as a guideline in this optimisation process.

One of the conditions of the licence issued to the Borssele NPP requires that the manager responsible for radiation protection should be adequately qualified. The person in question is also required to hold a sufficiently independent position in the organization to allow him to advise the plant or site manager directly on all matters of radiation protection. A precise description of the requirements for this manager’s qualifications, as well as the qualifications which a number of other radiation protection officers need to possess, is given in the Technical Specifications (TS). The appropriate training programme covers the qualifications of the other officers.

Radiation protection of the public

The design of the installation is the first step in achieving the radiological safety objectives. The Safety Report must demonstrate that the design and planned operational conditions and procedures conform to these objectives. In addition, in any operational state, the radiation dose received by members of the public due to the operation of the NPP, including the discharges of radioactivity in water and air, must be controlled and minimised (ALARA).

As prescribed in the licence, all discharges of radioactive effluents must be monitored, quantified and documented. The licensee must report the relevant data on discharges and radiological exposure to the regulatory body. On behalf of the regulatory body, the National Institute for Public Health and the Environment (RIVM) regularly checks the measurements of the quantities and composition of discharges. The licensee is also required to set up and maintain an adequate off-site monitoring programme. This programme normally includes measurements of radiological exposures (with Thermoluminiscence Dosimeters, TLDs) and possible contamination of grass and milk in the vicinity of the installation. The results are reported to - and regularly checked by - the regulatory body. Under Article 36 of the Euratom treaty, the discharge data must be submitted to the European Commission each year.

ARTICLE 16. EMERGENCY PREPAREDNESS

Art. 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.

Introduction

There are no statutory regulations in The Netherlands requiring the presence of an on-site emergency preparedness plan. Such a plan is, however, prescribed in the regulatory framework viz. the Code on Operation, NVR 1.2, Ch. 11. Additional guidance is formulated in NVR rule 2.2.6, 'Preparedness of the Operating Organization for Emergencies at Nuclear Power Plants'. The licence also specifically addresses the question of an emergency plan: licence condition 23 of the Borssele NPP requires the licensee to establish and maintain an emergency plan and an emergency organization, and also to ensure that regular training takes place. The emergency plan and the emergency organization must be in line with the disaster relief facilities that have been conceived for dealing with an off-site emergency. The licence for the Dodewaard NPP contains an identical article. However, the original emergency plan and organization are only partially effective as the plant is currently in the process of decommissioning.

There are certain statutory regulations on off-site emergency planning and the action that must be taken in the event of an emergency at a nuclear power plant. The central government plays an important role in this.

On-site emergency provisions

An on-site emergency plan includes a specific emergency organization with adequate staff, instructions and resources.

The emergency plan has three principal goals:

- to ensure that the operating organization of the NPP is prepared for any on-site emergency situation;
- to mitigate as much as possible the effects on the operating personnel of the NPP and on the environment in the vicinity of the plant;
- to advise the relevant government bodies as effective as possible on emergency actions that should be carried into effect.

Specific procedures have been developed and adopted in order to prevent emergency situations and mitigate their consequences. With respect to the operation of the plant in abnormal situations, two types of emergency procedures exist:

- procedures for abnormal situations (incidents); and
- procedures for emergency situations, i.e. the symptom-based emergency procedures or 'function-restoration procedures' that are applicable in design basis and beyond-design basis accidents.

In important help for the on-site emergency provisions is the use of severe accident management guidance (SAMG), which is a system of written guidelines to guide the plant management and operating staff through all stages of a core melt accident, until a final stable state has been reached. The development and implementation of the SAMGs were completed in 2000.

The incident/accident classification system used by the Borssele plant is in line with the classification system used for the national emergency plan (NPK). This, in turn, corresponds with the IAEA emergency classification. The various types of emergency procedures, and the emergency plan and organization are sent to the regulatory body for inspection and assessment.

If an emergency arises, the plant management must inform the relevant authorities immediately, advise them about the classification of the accident, and supply whatever information is required to the KFD in order to help the latter to understand the accident, assess the potential for mitigating its effects and make a prognosis of potential radioactive discharges. A computerised data line, giving live process information, is part of the plant information supplied to the KFD during an emergency. The regulatory body maintains a strict on-duty call schedule in order to be prepared for its role during an (potential) accident or serious incident.

Training of the emergency organization

The training requirements are described in the various procedures and in the manual on emergency drills. The plant management is required to draw up a timetable of regular emergency drills and classroom training. Part of the obligatory training plan for shift staff is devoted explicitly to teaching them how to deal with emergencies. Larger-scale emergency exercises are also held about once every three years (although the intervals between them are not fixed). These exercises incorporate an interface with the various government organizations at local, regional and national levels (e.g. the National Crisis Centre (NCC)).

During these drills and exercises, inspectors from the KFD assess the performance of the plant emergency organization and also observe whether established procedures have been properly followed. These include the provision of information to the local and national authorities and the taking of action in accordance with government regulations, as laid down by the NCC.

Off-site emergency provisions

Chapter VI of the Nuclear Energy Act includes a list of the authorities that are responsible, *inter alia*, for preparing the organization of nuclear power plants for dealing with emergencies. Under Article 40 of the Act, the central government carries the bulk of the responsibility, both for the preparatory work and for actually dealing with any emergency that may arise in practice. The operational structure of the system for dealing with nuclear accidents is set out in the National Nuclear Emergency Plan (NPK). The NPK-organization consists of the following groups:

- A national alarm and coordination centre where all the reports of nuclear incidents and accidents are reported, as well as other environmental incidents. This centre is staffed and accessible 24 hours a day.
- An alert assessment team (BOT). This team assesses whether an incident or threat has to be scaled up or not and the full NPK organization has to notified and called on duty if necessary.
- A Technical Information Group (TIG). This group advises the policy team in case there is a real threat for an off-site emergency in a nuclear installation or a radioactive release (national or neighbouring country). It is an expansion of the BOT after scaling up an incident. For an efficient operation of the TIG the following functional sub-groups are part of this group:

  Source (Accident sequence inside installation; KFD expertise)

  Meteo

  Dispersion and measurement strategy

  Direct measures

  Indirect measures

  Use is being made of several support organizations like the KFD think-tank, Royal Dutch Meteorological Institute and the National Institute for Public Health and the Environment. The latter institute operates the national grid of radiation monitors and coordinates the 'local' measurements in the early phase of the accident. Also this institute performs the dispersion calculations of the release.

- A policy team. This team makes decisions regarding the measures to be taken. It consists of ministers and senior civil servants. The team is chaired by either the minister of Housing, Spatial Planning and the Environment or the minister of the Interior (Home Affairs).
- National information centre. This centre is responsible for the coordination of information to be provided to the public, the press, other national and international authorities and specific target groups such as farmers.

Currently a revitalisation process is taking place of the NPK organization in order to achieve a better harmonisation with the regular emergency planning and response organizations.

Under Article 41 of the Act, the local authorities also have a role to play in making contingency plans for emergencies. The mayors of municipalities which could be affected by an accident involving a nuclear power plant located either within their boundaries or in their vicinity (including on the other side of a national border) have drawn up emergency contingency plans in consultation with representatives of central government. These plans are obligatory under Article 7 of the Disasters and Major Accidents Act, and encompass all measures that need to be taken at both local and regional levels. Exercises are also held at regular intervals.

In case of an emergency in a Dutch nuclear installation almost the complete staff of the KFD is involved in the response. The fraction of KFD staff members that are not on call to serve in the above mentioned BOT, TIG and policy team are serving in the KFD 'think tank' for supporting tasks. Also the KFD inspectors are going to the site to be used as an extra pair of 'eyes and ears' for the NPK organization apart from their regular oversight tasks.

Intervention levels and measures

The following measures are taken at the various intervention levels:

- Preventive evacuation: 1000 mSv H_{eff} or 5000 mSv H_{th}
- First day evacuation: 500-50 mSv H_{eff} or 1500 mSv H_{th}
- Late evacuation: 250-50 mSv (first year dose)
- Relocation/return: 250-50 mSv (first 50 years after return)
- Iodine prophylaxis: child 500 mSv; adult 1000 mSv (first day)
- Sheltering: 50-5 mSv H_{eff} or 500-50 mSv H_{th} (first day dose)
- Grazing prohibition: 5000 Bq I-131 per m^2
- Milk(products), drinking water etc: 500 Bq/l I, 1000 Bq/l Cs, 125 Bq/l Sr, 20 Bq/l alpha emitters.

There are also derived intervention levels for foodstuffs that follow the appropriate EU regulations.

Dimensions emergency planning zones for Borssele

The organizational zone involves all municipalities within a range of 10 km from the NPP. The burgomaster of Borsele is the coordinating burgomaster.

The various zones for direct measures are defined geographically as follows:

- Evacuation zone: circle with a radius of 5 km
- Iodine prophylaxis: circle with a radius of 10 km
- Sheltering zone: circle with a radius of 20 km

It should be noted, however, that measures in cases of nuclear emergencies are coordinated at the national level.

Criteria for emergency situations

After consultation with the Ministry for the Environment and especially the KFD, Borssele NPP has established the 4 levels from the IAEA system in its Emergency Plan (Dutch: Alarmplan). Incident/accident parameters ranging from a small fire to a large actual off-site release are attached to each level. A difficult element in the criteria are the expected but not yet occurred possible consequences for which in fact larger scale protection and prevention measures should be started before the actual occurrence.

The specific parameters are as follows:

1. Emergency standby: Emission < 10 * permitted daily emissions (noble gases; this means for Borssele NPP $1.3 \cdot 10^{15}$ Bq Xe-133 equivalent). No intervention levels are reached.
2. Plant emergency: Emission ≥ 10 * permitted daily emissions (noble gases). No intervention levels are reached.
3. Site emergency: Emission ≥ 0,1 * accident emission (the accident emission for Borssele NPP is defined as $\geq 3 \cdot 10^{17}$ Bq Xe-133 and $\geq 5 \cdot 10^{13}$ Bq I-131), or an emission which leads to the lowest intervention level for indirect measures. This lowest level is a soil concentration of 5000 Bq I-131 per m^2; at this level a grazing prohibition must be considered. Furthermore, as the 0.1 * accident emission may lead to a dose level of 0.5 mSv H_{eff} or 5 mSv H_{th} in the first 24 hours after commencement of the emission, the off-site measure sheltering for the population may be considered.
4. Off-site emergency: Emission ≥ accident emission, being the emission that leads to the lowest intervention levels for direct measures. These lowest dose levels are 5 mSv H_{eff} or 50 mSv H_{th} in the first 24 hours after commencement of the emission. At these levels, sheltering for the population must be considered.

The emission level at which the category ‘Emergency standby’ changes to the category ‘Plant emergency’ (the transition point) follows directly from the permitted emission as laid down in the licence. The two other transition points depend among other things on the accident emission chosen. Determination of the accident emission is based on an emission of noble gases from the chimney. The reason for not using other nuclides as the trigger is that the classification on the basis of plant status will take place before a certain emission level of the nuclides has been reached; this does not apply to noble gases. In addition, noble gas emission can be measured directly, and is therefore more suitable as a first trigger than say, I-131 emission, which can only be measured with any degree of accuracy after a period of around an hour. The Xe-133 equivalent has been adopted as the yardstick for noble gas emission.

NPK revitalisation

Recently the Minister for Housing, Spatial Planning and the Environment and the Minister of the Interior started a project to update the National Nuclear Emergency Plan (NPK). Main purpose of the project is to reduce the differences between nuclear emergency preparedness and the planning and response for other ‘regular’ types of disasters and crises. Another main objective is to improve the organization and the means to inform the public and the media in case of a nuclear emergency.

Future developments

Integrated exercises (i.e. involving both the plant staff and the authorities) have turned out to be useful in order to improve the effectiveness of the licensee’s emergency plan and organization and the emergency organization of the authorities. After a period of mainly exercising aspects of nuclear emergencies and parts of the involved organizations there is a strong tendency to hold integrated exercises on a more regular basis.

Art. 16.2: 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 compe tent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

Chapter VI of the Nuclear Energy Act (viz. Article 43) also deals with the provision of information to those members of the population who might be affected by a nuclear accident. As is consistent with its responsibility for dealing with a nuclear accident, the central government is also responsible for informing the population. It does this in conjunction with the local authorities in question. The provision of information to the authorities in neighbouring countries forms the subject of Memorandums of Understanding that have been signed with Belgium and Germany.

Chapter 2(d): Safety of Installations

ARTICLE 17. SITING

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;

Soon after the Chernobyl accident in 1986, the government decided to halt the siting procedure for a new nuclear power plant that was then in progress. There are currently no plans for constructing any new nuclear power plants in the near future. The process for the selection and evaluation of, and decision-making on, a potential site, as described below, therefore reflects the situation before 1986. It is for the same reason that the IAEA Codes and Safety Guides on Siting were never amended and adopted as a Dutch Nuclear Safety Rule (NVR). A number of elements from the Codes and Safety Guides on Siting have, however, been used to amend the Code and Safety Guides on design, e.g. factors relating to seismicity.

Before a licence is granted, the applicant has to specify all 'relevant site-related factors that may affect the safety of the plant'. This is required under the Spatial Planning Act, NVR rule 1.1 ('Code on the Safety of NPP Design') and the relevant underlying guides. Examples of site-related factors are man-induced events such as an aircraft crash and a gas cloud explosion, and natural events such as seismic phenomena and high tides.

The Spatial Planning Act regulates the selection of a site for a nuclear power plant. After the government has decided to expand the nuclear generating capacity, a site selection procedure has to be launched (Planning Decision Procedure). This planning procedure required by the Spatial Planning Act involves:

- the publication of an initial proposal by the government describing the potential sites, based on an initial site selection;
- the holding of public hearings;
- the submission of recommendations by various governmental advisory committees and councils;
- discussions aimed at obtaining consensus between the various ministries involved;
- parliamentary debates on both the initial proposal and the final governmental decision.

The main site-relevant factors that must be taken into account in the initial site selection process are as follows:

- Any special circumstances which prohibit the erection of a nuclear power plant on a particular site, e.g. the location of an airport nearby, or the presence of industries with the potential for the release of explosive or toxic substances in the vicinity, or certain difficulties involving the existing electrical power grid.
- The population density within a radius of 20 km around the site, and especially in the most densely populated 45^{o} sector around a particular site. If these weighed population densities are too high compared with the weighed population densities of a reference site, the proposed site will be removed from the initial list.

For the reference site, use is made of the mean population density of The Netherlands (5-20 km), a 45° sector with a factor of 2.5 higher population density than the rest of the area to account for the fact that the population is not distributed uniformly in reality. In addition, use is also made of the concept of a Low Population Area around a nuclear power plant (0-5 km), and a weighing factor based on meteorological dispersion to account for the fact that people living close to the site are more at risk than people living further away.

Other factors play a role only after this initial selection has been made. The outcomes of public hearings and reports from advisory committees are taken into account. Such factors include:

- A more detailed look at the population density around the proposed site. For example, the size of the non-permanent population (i.e. day trippers and tourists) is taken into account. Also, the population densities within a radius of 100 km and within the most populated 45° sector of this area are used to compare the sites.
- The amount of fresh water in the area in relation to the amount of condensor cooling water required.
- Ecological factors such as whether or not the site may be described as constituting a landscape of special interest or a nature conservation area, or whether it offers opportunities for leisure activities.
- Current spatial planning policy on the area around the site, e.g. planning for further urbanisation or industrialisation.
- Economic factors such as the use made of the land around the site, whether or not economically important centres are located in the vicinity, the current infrastructure around the site.
- The location of the site relative to the national electricity grid.
- The site's location-specific sensitivity to external hazards, such as external flooding, seismic events, high winds, aircraft crashes, gas cloud explosions, large toxic releases, etc.

Art. 17(iii): for re-evaluating as necessary all relevant factors referred to in subparagraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

Pursuant to NVR 1.2 (Safety Code for Nuclear Power Plant Operation) as well as a separate licence condition, the licensee is required to perform regular safety assessments. The licence describes the nature of these assessments and also specifies the maximum period between any two such assessments. As an example, the safety of the nuclear power plant as a whole must be re-evaluated every ten years in the light of new safety insights and generally accepted safety practices. Account must be taken of 'site-relevant factors' as mentioned in the section on Article 17 (ii).

Art.17(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.

The procedure for obtaining a construction licence for a nuclear installation includes an obligation to submit an environmental impact assessment (EIA). As part of this procedure, neighbouring countries that could be affected by the installation are informed on the basis of the Espoo Treaty and a EU Directive:

The Espoo Treaty of 26 February 1991. The Netherlands ratified this treaty on 28 February 1995 and the European Union ratified it on 24 June 1997; the treaty came into force in September 1997.

Council Directive 97/11/EC of 3 March 1997, amending Directive 85/337/EEC on the assessment of the effects of certain public-sector and private-sector projects on the environment. The Espoo Treaty has been subsumed in this Council Directive.

The Netherlands has incorporated the provisions of the Espoo Treaty and the EU Directive in its Environmental Protection Act. Chapter 7 of this Act deals with environmental impact assessments and the relevant procedures. These include the provision of information to neighbouring countries and the participation of the authorities and the general public.

A special bilateral committee for nuclear installations has been set up with Germany (known as the Dutch-German Committee for Neighbouring Nuclear Installations, ‘NDKK’) to promote an effective exchange of information between the two countries. A bilateral Memorandum of Understanding of a similar nature has been agreed with Belgium.

The government is also bound by the provisions of Article 37 of the Euratom Treaty, under which all relevant data on the safety and environmental impact of any nuclear installation that could affect a neighbouring EU member state must be submitted to the Article 37 Expert Group before a licence can be granted. This Expert Group advises the European Commission on the acceptability of the proposed installation on the basis of safety evaluations. The Commission informs the member states concerned of the outcome of these evaluations.

ARTICLE 18. DESIGN AND CONSTRUCTION

Each Contracting Party shall take the appropriate steps to ensure that: Art. 18(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;

Defence-in-depth

In order to achieve the general safety objectives as laid down in the various NVRs, a design has to be based on the defence-in-depth concept as defined in NVR 1.1 (Safety Requirement for Nuclear Power Plant Design), i.e. characterised by five different echelons. ‘Defence-in-depth’ is the name given to a safety philosophy consisting of a set of diverse and overlapping strategies or measures, known as ‘echelons of defence’. A specific application is a system of multiple physical barriers of protection together with measures to keep each barrier intact.

The design and operation of the recently modernized Borssele NPP clearly demonstrate how all five echelons of defence have been implemented.

Operational experience, especially as indicated by collected plant-specific component failure data, data resulting from the non-destructive testing of the primary pressure boundary, as well as the programmes for inspection, maintenance, testing, ageing etc. applied to plant systems and components, has shown that the first echelon of defence is adequately preserved.

The current design of the control, protection and safety systems at the Borssele NPP, as described in the Safety Report, as well as their maintenance, inspection and testing fully satisfy the requirements for maintaining the second and third echelons of defence. The Safety Report indicates that the radiological consequences of design basis events, as calculated in the various safety analyses, meet the radiological criteria that specify smaller acceptance doses if the assumed frequency of the Postulated Initiating Events (PIEs) increases. These criteria are specified in Appendix 1.

The installed engineered safety features, the existing symptom-based Emergency Operating Procedures (EOPs) and the recently implemented Severe Accident Management Guidelines (SAMGs) demonstrate that the fourth echelon of defence is also adequately maintained.

The fifth echelon of defence is covered by the strategies for off-site emergency preparedness. See the section on Article 16 for more information on these strategies.

Annex 1 describes the measures taken at Borssele in the modernisation project and explains how these have strengthened the existing levels of defence-in-depth. In Appendix 2 the quantification of the consequential risk reduction due to this modernisation project is presented in terms of total core damage frequency prior to and after the modifications.

Art. 18(ii): The technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

Safety-relevant fluid-retaining components (safety classes 1, 2 and 3, as defined by NVR 2.1.1) have been designed and built according to the earlier ASME Code, Section III, Division 1, the Dutch Design Code for pressure-retaining equipment, and various Siemens/KWU component specifications. The periodic safety re-evaluation (PSR) conducted in 1994 found the original design basis to be conservative, based on recent versions of the respective industry codes.

The components were built according to German material specifications. For example, the steam generator tubing is made of Incoloy 800 and the control rod drive penetrations are of ferritic steel instead of Inconel 600. The PSR confirmed the low nil-ductility transition temperature of the reactor pressure vessel. New mechanical components installed during the Modifications Project (1997), were built according to the KTA design and construction rules, Siemens/KWU Konvoi component specifications (updated in 1992) and other international standards for nuclear products. Advanced (and proven) technology was introduced with the Super Compact Tandem Safety Valves on the primary system that were qualified by analysis, laboratory tests and test loop experiments.

In the 1980s, Borssele undertook a program for the partial replacement of electrical components, including instrumentation and control, in order to improve the environmental qualifications of the equipment involved. Since then, electrical components etc. in safety classes 1, 2 and 3 placed inside the containment have met the IEEE class 1E qualifications. Borssele components that must meet design basis LOCA environmental conditions now also meet the Konvoi or VGB (Association of German Power Plant Operators) qualifications. Electrical equipment is qualified on the basis of type testing, analysis and experience.

All products and services were delivered by qualified suppliers under an extensive quality control program, verified by independent inspectors. Quality assurance programs were introduced in the 1980s, and resulted in the partial transfer of quality control work to suppliers.

In summary, the technology for the design and construction of safety systems and components for the Borssele NPP has been qualified by analysis, testing and experience in accordance with the requirements of the relevant safety regulations (NVRs 2.1.3, 2.1.7, 2.1.8 and 2.1.13).

Art. 18(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.

The only operating nuclear power plant in The Netherlands is a light water reactor of the PWR-type. Only during start-up with a freshly loaded core there is a potential for a less negative moderator temperature feedback at Borssele, due to the high boron content of the coolant. This was why, unusually for PWRs, protection was also required against an ATWS event during start-up.

Alongside the stable power operation, there is a reactor protection system that initiates all safety measures such that no operator action is required for a period of at least 30 minutes. In addition, there is a ‘limitation’ system that initiates activities on safety parameters before safety limits will be exceeded and the engineered safety features will start automatically. All relevant safety parameters are shown on a special panel, to allow the operator to take a comprehensive look at all important safety parameters at the same time.

The modification programme that took place at Borssele gave explicit consideration to a whole range of man-machine interface elements (which are also discussed in the section on Article 12). The most notable elements included a newly designed control room, and adding an emergency control room and local control points to the available controls in an emergency. Other important elements were designing interlocking control processes (i.e. bridging, key-operation, and automatic blocking), tackling communication problems, evaluating and improving the accessibility (in terms of physical access and radiation doses) of systems and components during operational states and emergency situations, and designing remote controls or indicators for safety-relevant components.

A representative mock-up was used for optimising the design of the control room at the Borssele plant in terms of human factors. Free fields of view, readability, communication, manageability and walking distance optimisation were all studied and the results implemented. Control room staffs were also involved in planning the lay-out.

A final point worthy of mention is the ECN study of the ergonomic design of an overview display in a nuclear power plant control room, which was already mentioned in the section on Article 12. This study took all known human-factor elements of control room design into consideration.

ARTICLE 19. OPERATION

Each Contracting Party shall take the appropriate steps to ensure that: Art. 19(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;

It should be noted that experience is only limited, as no new power plants have been built in The Netherlands since 1973. This section has been produced on the basis of the experience with the Borssele modification process.

Appropriate safety analysis and commissioning programme

As was discussed in the section on Article 14 (i), an in-depth safety assessment of the NPP is made on the basis of the Safety Analysis Report. The commissioning aspects are reviewed once this assessment has been completed.

According to NVR 1.2 ('Safety Code for Nuclear Power Plant Operation'), the licensee must set up a programme for commissioning known as the 'commissioning programme' (CP). Instructions on this activity are found in NVR guideline 2.2.4, 'Commissioning Procedures for NPPs'. The CP has to be approved by the KFD. The KFDs chief task is to assess the completeness of this programme; some parts are evaluated in detail. The findings are discussed with the licensee, so that necessary changes can be made, after which the programme can be approved. The regulatory inspectors select certain items for a closer form of monitoring during the actual commissioning process. Audits are performed, both by the licensee and by the KFD, where necessary assisted by outside experts, to ensure that the CP is being properly executed. They focus on the organization and quality systems of both the licensee and its contractors. The establishment and performance of an appropriate CP, however, remains the full responsibility of the licensee.

Art. 19(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;

Technical specifications

The NPP licence states that 'the conditions must be described with which the systems, system components and organization of the operation of the installation must comply, as well as the measures taken in order to operate the installation in such a way that all requirements described in the licence are satisfied'.

These conditions are described in the Technical Specifications (TS). The bases for these TS are NVR rule 2.2.3 ('Operational Limits and Conditions for NPPs') and, more specifically, the Standard Technical Specifications of Westinghouse and General Electric, as adjusted to bring them into line with the Siemens/KWU design. The TS include the limits and conditions for operation, allowable outage times and surveillance requirements. All deviations from the Technical Specifications must be reported to the KFD. The KFD checks on compliance with the Technical Specifications during its regular inspections.

Art. 19(iii): operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

The Safety Code and Guides NVR 1.2 state that operation, maintenance, inspection and testing should follow established procedures. As the NVRs are part of the licence, the licensee is bound to these conditions. The plant is operated in accordance with the instructions given in the Operating Manual, which is an extensive document describing all relevant details of plant operation. Specific instructions are given for abnormal conditions, as well as for incidents and accidents (see also the section on Article 19 (iv)). These documents are approved by the plant management, but are not submitted to the regulatory body for approval. Only the Technical Specifications have to be approved by the regulatory body, as has already been mentioned.

Equipment that is taken out of service is identified as such in the control room. During maintenance and major modifications, a careful assessment is made of what safety equipment is still and should still be available. During the major modernization programme at Borssele, a 'provisorium' was built that was designed to perform all relevant safety functions during a shutdown, when key systems had been taken out of service.

The Borssele licensee has described in more fundamental terms the utility management processes in relation to functions such as operation, maintenance and testing. The emphasis is on the 'key processes' of the utility organization. Each key process describes what kind of essential process is needed, how communication between various groups and departments is regulated and what kind of instructions and forms must be used.

The KFD checks the use of instructions and forms during its regular inspections. The quality assurance system applying to a key process is verified during audits (carried out by the licensee, the KFD or a third party).

The system of key processes enhances the utility's self-assessment capability.

Art. 19(iv): procedures are established for responding to anticipated operational occurrences and to accidents;

The NPP has developed a comprehensive set of procedures to enable it to respond to anticipated operational occurrences and accidents. The more simple malfunctions form the subject of event-based instructions and procedures. Emergency situations are dealt with by symptom-based emergency operating procedures. Severe accident management (SAM) guidelines have recently been introduced. They are intended to provide guidance during accidents involving core damage and potential radioactive discharges into the environment.

The Borssele licensee follows the approach adopted by the Westinghouse Owners Group (WOG), both for EOPs and SAMG. The SAM guidance defines priorities for operator actions during the various stages of a core melt process, sets priorities for equipment repairs and establishes adequate lines of command and control. Care has been taken to modify the WOG approach appropriately so that it fully fits the characteristics of this Siemens/KWU station.

Both operators and staff are given frequent training in the use of emergency operating procedures. This they do by following courses on the full-scope simulator, which is located in Essen, Germany.

In the event of a severe accident, support is also available from the plant vendor, Framatome ANP (former Siemens/KWU), which operates a round-the-clock service to assist affected plants, and is available on call.

Art. 19(v): necessary engineering and technical support in all safety-related fields is available throughout the life time of a nuclear installation;

The Borssele licensee has built up considerable expertise in recent years and is able to manage most safety-related activities. In addition, the licensee works in close collaboration with the plant vendor and other qualified organizations in The Netherlands and abroad. Among the companies and institutions in question are NRG, Belgatom and AVN.

As the regulatory body has only a very small staff, it makes frequent use of outside support for its assessments and inspections. Support is provided by GRS in Germany and AVN in Belgium. Inspections and assessments have also been carried out with the aid of the IAEA. Also sometimes assistance is give by NRG. Full attention is paid to the suppliers' qualifications and the avoidance of any conflict of interest.

Because of the small nuclear programme, nuclear safety in The Netherlands has always been dependent on international contacts. This dependency will increase, given that the national nuclear energy policy has staunched the flow of government funding for education in nuclear engineering and research programmes.

Art. 19(vi): incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

An incident-reporting system is in operation for all existing nuclear installations, as is required by the licence. It is based on IAEA Safety Series No. 93, Systems for Reporting Unusual Events in Nuclear Power Plants.

The criteria for reporting to the regulatory authorities are described in the Technical Specifications. The KFD must be informed in all cases; in some cases, the Pressure Vessels Inspectorate and/or the Environment Inspectorate (IMH) also need to be informed. Depending on its nature, an event must be reported:

- within eight hours by telephone and within 14 days by letter, or
- within 30 days by letter (this type of incident is normally also reported the same day by telephone).

Examples of category (a) events are:

Violations of the licence and the Technical Specifications limits, exposure to high doses (as referred to in the Bkse), activation of the reactor protection system leading to reactor scram, ECCS actuation and/or start of the emergency power supply (diesel generators).

The following are examples of category (b) events:

- (Minor) leakages of fuel elements, leakage of steam generator tubes and of the primary system, non-spurious activation of the reactor protection system and events causing plant staff to receive a dose in excess of 10 mSv.
- Degradation of safety systems or components, and events induced by human activities or natural causes that could affect the safe operation of the plant.

In exceptional situations, i.e. if there is a major release of radioactive material or if a specified accident occurs (> 2 on the International Nuclear Event Scale -INES- scale), the NPP is obliged to notify the 'National Emergency Centre'. Depending on the nature of the accident, various government bodies are alerted. The KFD is always alerted. Further information is given in the section on Article 16.

Apart from having the duty to inform the authorities, the licensee is also required to evaluate the event and take any appropriate action that may be required.

Art. 19(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;

Standing task forces at both nuclear power plants assess incidents (the establishment of which is required under the licence, as has already been mentioned). The nuclear power plants both operate a data base for their own use that contains data on incidents from various sources, including the plant itself. The following organizations are also sources of data: WANO, IAEA and OECD/NEA IRS, VGB, Framatome ANP, KWU, USNRC, GE, GRS, etc. All reports of incidents reported under IAEA/NEA IRS are transmitted (at present in the form of hard copy) to the Borssele NPP.

The Netherlands is an active member of the IAEA and OECD/NEA mechanisms for sharing key operational experience, including Principal Working Group No. 1 and its successor the Working Group on Operational Experience (WGOE) of the OECD/NEA Committee for the Safety of Nuclear Installations (CSNI) and the international incident reporting system (IAEA and OECD/NEA IRS).

Borssele also reports any incidents to the WANO and the VGB. Information is regularly exchanged on a bilateral basis with all neighbouring countries, as well as a number of other European countries and the USA. There are frequent regulatory contacts with many European countries, the USA and Canada. In the framework of the NEA The Netherlands participates in a principal working group dealing on a regular basis with operational events.

Art. 19(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.

The licences for the NPPs state that the provisions of the NVRs must be satisfied. On the issue of radioactive waste management, the Safety Code for Nuclear Power Plant Design (NVR 1.1) requires adequate systems to be in place for handling radioactive solid or concentrated waste and for storing this for a reasonable period of time on the site. The licensees have such systems at their disposal and keep records of all radioactive waste materials, specifying the type of material, the form of packaging and the date of conditioning.

The licensee has adopted a written policy of keeping the generation of radioactive waste to the minimum practicable. One of the measures taken to this end is ensuring that the chemistry of the primary system is adequate, in order to reduce the generation of corrosion particles which may be activated. Internal procedures are used for achieving optimum water quality.

Solid waste from the site is transported in accordance with conditions set by the regulatory bodies. Under these conditions, the licensees of the NPP have to draw up a timetable for the transportation of radioactive waste to the COVRA, the interim storage facility for all radioactive waste produced in The Netherlands. The licensees must send a list to the regulatory body at the beginning of each year, stating how much radioactive waste is in storage on-site and how much waste was transported to the COVRA during the previous year.

The NPPs waste management programmes stipulate that the general internal radiation protection procedures are enforced so as to satisfy the radiation protection principles, as well as NVR rule 2.1.11 (Operational Management for Radioactive Effluents and Wastes Arising in NPPs), which includes the treatment and storage of spent fuel and waste directly related to operation (taking conditioning and disposal into account). The regulatory body is informed, as has already been described in the section on Article 15(i).

PLANNED ACTIVITIES AIMED AT IMPROVING SAFETY

As is already mentioned, the Borssele NPP has completed in 1997 a very comprehensive programme for bringing the plant's safety level in line with modern safety insights. This activity has been initiated as a consequence of the condition in the licence, requiring a periodical safety review, as already has been discussed. The government, therefore, believes that there is only a very low probability of accidents accompanied by large-scale releases. The final stage of this programme has been the development and implementation of severe accident management guidance, which is a system of written guidelines to guide the plant management and operating staff through all stages of a full core melt accident, until a final stable state has been reached (as was indicated in the section on Article 19(iv)). These efforts have been initiated, despite the low probability of such accidents, and have been completed by 1 April 2000. In parallel with this, studies are being conducted on the residual risk from local hydrogen explosions, after catalytic recombiners have been installed (which rule out global explosions). These studies are still ongoing.

The plant management at Borssele also keep abreast of the findings of international research. An example is the work on the effects of high burn-up during reactivity-initiated accidents. The licensee itself has been involved in the international assessment programmes in this area.

More integrated emergency preparedness exercises, i.e. involving both the plant staff and the authorities, have been planned. Beyond these measures, no specific activities are planned at or in connection with Borssele.

The KFD completed its internal QA programme in 1999, and both the KFD and IMH-ZW seek to further improve the effectiveness of their regulatory inspections and assessments. Projects are under way for streamlining assessment, e.g. in the assessment of the yearly core reloads.

Several years ago the IAEA was asked by the KFD for a Peer Advice regarding Living PSA application at the Borssele plant as well as in the regulatory body. As a result of this advice the KFD started a feasibility study regarding Risk-informed Regulation (RiR). Because Risk Informed Regulation is a topic that has the attention of most regulatory bodies, the KFD has initiated discussions on this subject with several other regulatory bodies in Western Europe such as Belgium, Spain, Sweden, the UK, Germany and Switzerland. These discussions are also the starting point of aforementioned feasibility study. In Appendix 5 an overview is given of the objectives of this project.

In early 2001 the operator of the Borssele NPP started with the second ten-yearly periodic safety review. This review will be finished in early to mid 2003. As a starting point for this review the Safety Guide Series 50 No. 50-SG-O12 (Periodic Safety Review of Operational Nuclear Power Plants) and INSAG-8 (A common Basis for judging the Safety of Nuclear Power Plants built to earlier standards) are chosen. For the new reference design basis a selection will be made from existing national and international rules and guides. As stepping stone the NVRs will be used. Apart from that, other international developments in the nuclear industry, insights stemming from safety research, or new rector designs will be evaluated. Other subjects which will be used as a contribution to this review are: aging, the Living PSA (including state-of-the-art of the PSA itself), evaluation of internal and external operational events, evaluation of 'good practices', generic and unresolved safety issues. In chapter 14 and Appendix 4 more information is given on this review.

RESPONSES TO REMARKS MADE DURING THE FIRST CNS REVIEW MEETING

I. General Remarks

In the Summary Report of the first Review Meeting (CNS-RM-99/021) contracting parties were invited to include more information on certain topics in their next reports. The Netherlands have responded to that invitation and included such information in the respective sections of this report. These include the following issues:

1. The effects of the deregulation of the electricity markets and associated ownership changes on safety. As already indicated in the section on Article 10 the KFD is actively involved in all kind of working groups and workshops of the NEA/CNRA on this topic. The possible adverse effects of deregulation of the electricity market are nowadays special points for the regulatory inspections. The recommendations and outcomes of the OECD/NEA/CNRA report ‘Nuclear Regulatory Challenges Arising from Competition in Electricity Markets’ were translated into a list of attention points for inspections. A current issue is the splitting of the utility into two utilities: one nuclear and one basically non-nuclear. See the section on Article 10 for more information on this subject.

2. Prescriptive versus goal oriented regulation. The Netherlands has always opted for a goal-oriented approach towards regulation. There are several reasons for this. In the first place there is the general nuclear safety principle as described in the Safety Fundamentals: ‘The Safety of Nuclear Power Plants’ (IAEA Safety Series 110) that the prime responsibility for safety and the measures necessary for its realization lies with the licensee. All relevant measures are discussed with the regulatory body. Up to now no important discrepancies between the two parties regarding their ideas on safety matters evolved. The fact that there were only two NPPs in The Netherlands, each of a different type and from vendors from two different countries, were reasons for not developing a very prescriptive framework for regulation. Another reason is due to the very small size of the regulatory body in The Netherlands. In some cases detailed technical design and construction rules from the countries of origin were chosen (see Chapter 14), such as the KTA-rules from Germany or IEEE-rules from the USA. In order to have a complete set of rules and guides, The Netherlands opted for adoption of the Codes and Guides of the IAEA Nuclear Safety Series program as a basis for regulation of the NPPs. However, the consequence of this system of goal oriented regulation is, that it puts an extra burden on the necessary knowledge of the regulatory staff.

3. Measures for severe accident management under development or implemented In the section on Article 19(iv) information is given regarding this topic.

4. Additional information on Probabilistic Safety Assessments. In appendix 2 information is given on the outcomes and some insights of the Borssele PSA. Emphasis is given on the effect of the modernization program (modifications) on the outcomes. In appendix 5 information is given on the first cautious steps on the road towards a more risk informed regulation.

5. Effects from national and international exercises on emergency planning and preparedness programs. On May 22, 2001 the Alert Assessment Team (BOT), Technical Information Group (TIG) and KFD think tank of the National Emergency Plan organization (NPK) participated in the INEX-2000 international exercise (Gravelines/France). The emphasis of this exercise was the exchange of information within the framework of Emercon (IAEA) and ECURIE (EU). Also the decision-making process within the BOT/TIG given the anticipated uncertainties and lack of information before and immediate after a release was part of the exercise. The special websites, which were available during the exercise, turned out to be very valuable. These websites could fill up the gap of some missing or not directly available in-house technical information on foreign nuclear installations. But, nevertheless it is necessary to make the existing in-house technical information better accessible and/or to complete this information. See the section on Article 16 for more information on training of the emergency organization.

6. Data on the evolution of trends in collective doses and effluent releases. In Annex 1 of this report an overview is given of all the appropriate data of the Borssele NPP. These data show a decreasing trend in all exposures to workers and the public.

II. Remarks concerning the report of The Netherlands

During the first review meeting of the contracting parties to the Convention on Nuclear Safety several remarks were made regarding the report of The Netherlands. The following safety policy issues were mentioned:

1. Necessary expertise for maintaining the nuclear safety.

In view of the fact that Dutch government has the intention to close down the only operating NPP (Borssele) by the end of 2003, remarks were made during the 1999 peer discussions concerning possible problems in keeping up to strength the workforce of necessary qualified, knowledgeable and motivated experts at the NPP.

Furthermore concerns were raised concerning the limited size of the KFD and the possibilities to maintain all necessary expertise in such a small organization.

This issue is under constant review by the regulatory body. In the sections on Article 6 (under e) respectively Article 8 (under b.1) the situation is described in more detail.

Concerning the situation at the Borssele NPP the following remarks can be added.

The revocation by the Council of State (highest administrative court in The Netherlands) of the licence condition restricting the operational lifetime of Borssele NPP to 31 December 2003 has created some uncertainty as to the actual closure date of the plant. However, as has been explained above under Art. 6, para e., the government has taken legal action to enforce its early closure decision. There has been some concern about the possible negative effect on work force morale and motivation of a rapidly approaching closure date, but till now there has been no evidence of any drain of expertise. Nevertheless, this issue will be followed actively both by regulatory body and plant management. For example, this issue is a standard item on the agenda during the quarterly meeting of KFD management and plant management. Also the possible effects of the liberalization of the electricity market, with its potential of downsizing the amount of personnel and other challenges for safety is a point of regulatory concern. Until this very moment the amount and expertise of the staff is still adequate and replacements can be realised in an acceptable timeframe (see section on Article 10). To be mentioned in this context is the recent split of the utility operating the Borssele NPP into a small part operating the nuclear plant and the adjacent coal fired plant and into a larger part operating the remaining non-nuclear units elsewhere in The Netherlands. In how far the financial structure of this new construction is adequate to warrant safety is currently an issue, which is under investigation by the regulatory body. Questions like: ‘Will there be enough financial resources made available for future training or hiring plant staff in a highly competitive environment?’ have to be answered.

Concerning the situation of manpower and expertise of the KFD, the following remarks can be added.

The question of KFD-manpower has been discussed almost as long as the KFD has existed (more than 30 years). Build-up of staff started systematically by mid 70 and continued well into the eighties. Plans for an almost complete coverage of disciplines were developed by the mid-eighties when there was advanced planning for the extension of the nuclear programme in The Netherlands. After the Chernobyl accident the nuclear energy option was reconsidered with the result that expansion was no longer a real option. Ergo, extra personnel could not be attracted.

The present situation is essentially still the same. This means that one could argue following e.g. the respective IAEA safety guideline SG-G1 (Qualifications and Training of Staff of the Reg. Body) that the manpower should be increased. However, the factual situation makes such an increase almost impossible.

It will be evident that, given the intended closure of the Borssele NPP in the near future by the Dutch government, any expansion of the staff of the KFD is not a realistic option. This, together with the ageing of the staff (the average age of KFD staff-members is currently 55 years) and a diminishing nuclear expertise in The Netherlands as a whole, creates a situation, which requires the necessary concern. Keywords for a solution are co-operation, co-ordination and a permanent education.

To overcome this main problem the KFD has assured itself of the support of the Belgian regulatory body AVN and the German Institute for Nuclear Safety (GRS) via an open contract. However, to assure the effectiveness of such a co-operation, there should be a certain amount of expertise within the regulatory body itself. Problems and safety issues need to be recognised by the regulatory body before external expertise can be asked for further assessment.

To keep the expertise within the KFD up to the mark the KFD-experts are actively involved in all kind of working groups of the NEA (CNRA and CSNI working groups), participate in IAEA Technical Committee Meetings or Expert Missions like IRRT-missions, OSART-missions or IPSART-missions. Attending all kind of topical conferences within their field of expertise is recommended. But also bilateral contacts with foreign colleague regulatory bodies are a source of permanent education. On the average about 10 to 15 days per expert per year are devoted to these kinds of activities.

Other activities to keep the quality of the regulatory output as high as possible were:

- The implementation of an internal QA system of the KFD. After several years of a intense preparation (e.g., by making a KFD QA-handbook which includes procedures for all regulatory tasks, internal processes, etc.) KFD got in 1999 its first ISO-9001 certificate.
- Contracting outside expertise on a temporary basis, e.g., to support this internal QA-system.

The embedding of the KFD in the Ministry of Housing, Spatial Planning and the Environment will also be helpful by offering a better ground for co-operation between the KFD, the Directorate for Chemicals, Waste, Radiation Protection (SAS) and the regional Inspectorate for the Environment (IMH-ZW).

In order to judge the effectiveness of the KFD organization on its merits and to make suggestions for improvements in those areas, which are ‘weak’, plans are made for a thorough review by an organization consultancy with enough knowledge of the internal structures and possibilities of the Ministry of Housing, Spatial Planning and the Environment and with knowledge of major risks. Such an approach provides results that can be compared with those of a review via an International Regulatory Review Team mission (IRRT-mission) of the IAEA.

2. Timing of decommissioning of the Dodewaard NPP.

During the 1999 peer discussions there was a concern that as the nuclear energy program in The Netherlands is ceasing to exist, the specific knowledge of its nuclear installations and expertise on dismantling operations would also be lost. In that case the dismantling of a nuclear power plant after a waiting period of 40 years should not be an optimal solution when regarded in a safety perspective.

In Annex 2 the situation at the Dodewaard NPP is described in more detail. The following remarks can be added.

Although the advantages of a more or less immediate dismantling were recognised by the government, it was decided that the licensee could proceed with its plans and associated licensing procedure for the construction of a safe enclosure and a final dismantling after a waiting period of 40 years. A factor in this (governmental) decision was that the extra costs of immediate dismantling would be chargeable to the government. The extra costs were estimated to an amount of about € 50 million. The difference is mainly due to the fact in the case of direct dismantling no capital growth via a 4% rate of discount could be calculated (this is a legally allowed and even recommended rate), thereby allowing more than doubling the reserved amount of money.

Furthermore it must be mentioned that in the opinion of the regulatory body, the operating organization of the Dodewaard NPP has very conscientiously described all details of the plant that are important in view of the dismantling. All relevant data are stored in databases and will be continuously maintained and updated when necessary. Concerning the expertise necessary for dismantling activities it has been concluded that in the future enough expertise will be available (nationally or internationally). By that time a vast number of NPPs will have been dismantled or will be in the process of dismantling, so there will be a substantial international experience in this field.

3. Separation between the regulatory body and organizations concerned with the promotion or use of nuclear energy.

During the 1999 peer discussions remarks were made concerning the fact that in The Netherlands the Ministry of Economic Affairs had the prime responsibility for legislation. Therefore the independence of the licensing body could be questioned.

The Dutch government had already at the time of signing the Convention, realised that this situation should be changed. In 1999 during the first review meeting the first steps were already made to do this. Eventually by mid 1999 the process of transferring the prime responsibility from the Minister of Economic Affairs to the Minister of Housing, Physical Planning and the Environment, was completed. In this new arrangement the conditions as described in Article 8.2 of the Convention concerning effective separation are fully satisfied.

APPENDIX 1: SAFETY POLICY AND SAFETY OBJECTIVES IN THE NETHERLANDS

a. Safety Objectives

Safety policy in the nuclear field is based on the following safety objectives.

The General Nuclear Safety Objective (see IAEA NUSSAG report entitled 'The Safety of Nuclear Installations - Safety Fundamentals', Safety Series No 110):

> *To protect individuals, society and the environment from harm by establishing and maintaining in nuclear installations effective defences against radiological hazards.*

This general nuclear safety objective is supported by two complementary safety objectives:

The Technical Safety Objective:

> *To take all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences should they occur; to ensure with a high level of confidence that, for all possible accidents taken into account in the design of the installation, including those of very low probability, any radiological consequences would be minor and below prescribed limits; and to ensure that the likelihood of accidents with serious radiological consequences is extremely low.*

The Radiological Safety Objective:

> *To ensure that in all operational states radiation exposure within the installation or due to any planned release of radioactive material from the installation is kept below prescribed limits and as low as reasonably achievable, and to ensure mitigation of the radiological consequences of any accidents.*

b. The Technical Safety Objective

As was discussed in the sections on the various articles of the Convention, extensive rules and regulations, derived from the IAEA NUSS Safety Codes and Guides, have been defined and formally established. No licence is issued unless the applicant satisfies the regulations. Inspections are carried out to monitor compliance with the rules. Priority is given to safety, and the licensee is aware of its responsibility for safety. Periodical safety re-evaluations are performed, to ensure that account is taken of new safety insights.

The Dutch government therefore believes that all echelons of the defence-in-depth principle have been preserved, so that there is a low probability of accidents and, should accidents occur, the probability of radiological releases is very low. Even for accidents beyond the design basis - those that might lead to serious radiological releases - measures have been taken to further reduce their probability and to mitigate the consequences, should they occur.

In the light of these measures, the Technical Safety Objective has been fulfilled.

c. The Radiological Safety Objective

Under the Radiological Safety Objective, the formal legal limit for the radiation levels to which members of the public are exposed is based on the Euratom 1996 Basic Safety Standards. The government has also formulated an environmental risk policy, which is taken into account.

c.1 Environmental risk policy

The concept of risk management and risk assessment was first introduced in environmental policy in the 1986-1990 Long-term Programme for Environmental Management. This concept was reassessed following debates in parliament. As part of the Dutch National Environmental Policy Plan [Lower House of the States General, 1988-1989 session, 21137, Nos. 1-2, The Hague 1989], the Minister of Housing, Spatial Planning and the Environment, the Minister of Economic Affairs, the Minister of Agriculture, Nature Management and Fisheries, and the Minister of Transport, Public Works and Water Management set out a renewed risk management policy in a document called 'Premises for Risk Management; Risk Limits in the Context of Environmental Policy' [Lower House of the States General, 1988-1989 session, 21137, No. 5, The Hague 1989]. In the following year, a separate document was issued dealing with the risk associated with radiation: 'Radiation Protection and Risk Management; Dutch Policy on the Protection of the Public and Workers against Ionising Radiation' [Lower House of the States General, 1989-1990 session, 21483, No. 1, The Hague 1990]. These two documents still form the basis for government policy on risk management.
The Nuclear Installations, Fissionable Materials and Ores Decree has recently been amended to incorporate this risk policy in the licensing process. Risk criteria are explicitly included as assessment principles for licences to be granted to nuclear power plants. The outcomes of a level-3 PSA must be compared with these risk criteria and objectives.

This concept of environmental risk management has the following objectives and steps:

- Verifying that pre-set criteria and objectives for individual and societal risk have been met. This includes identifying, quantifying and assessing the risk.
- Reducing the risk, where feasible, until an optimum level is reached (i.e. based on the ALARA principle).
- Maintaining the risk at this optimum level.

This means assuming a maximum total individual dose of 1 mSv in any year for the consequences of normal operation of all man-made sources of ionising radiation (i.e. NPPs, isotope laboratories, sealed sources, X-ray machines, etc). For a single source, the maximum individual dose has been set at 0.1 mSv per year. In addition, as a first step in the ALARA process, a general dose constraint for any single source has been prescribed at 0.04 mSv per year. The latter value corresponds with an individual human mortality risk of 10^{-6} per year (based on a mortality factor of $2.5*10^{-2}$ per Sv).

For the prevention of major accidents, the maximum permissible level for the individual mortality risk (i.e. acute and/or late death) has been set at 10^{-5} per year for all sources together and 10^{-6} per year for a single source.

As far as major accidents are concerned, both the individual mortality risk and the group risk (= societal risk) must be taken into account. In order to avoid large-scale disruptions to society, the probability of an accident in which at least 10 people suffer acute death is restricted to a level of 10^{-5} per year. If the number of fatalities increases by a factor of n, the probability should decrease by a factor of n^2. Acute death means death within a few weeks; long-term effects are not included in the group risk.

In demonstrating compliance with the risk criteria, one has to assume that only the usual forms of preventive action (i.e. fire brigades, hospitals, etc.) have been taken. Evacuation, iodine prophylaxis and sheltering may therefore not be included in these measures.

This risk management concept is used in licensing procedures for nuclear installations and all other applications of radiation sources. Guidelines for the calculation of the various risk levels have been drafted for all sources and situations. In principle, the calculations must be as realistic as possible (i.e. they should be 'best estimates').

For NPPs, this means that the level-3 PSA plays a leading role in the verification process. Specific procedure guides have therefore been drafted in The Netherlands for performing full-scope PSAs. The level-1 PSA guide is an amended version of the IAEA Safety Practice: ‘Procedures for conducting level-1 PSAs’ (Safety Series No. 50-P-4) and the level-2 guide is based on the IAEA Safety Practice: ‘Procedures for conducting level-2 PSAs (Safety Series No. 50-P-8.

The procedure guide for level-3 PSAs is a specifically Dutch initiative, in which the COSYMA code for atmospheric dispersion and deposition is used. It gives instructions on the pathways which should be considered, the individuals (i.e. critical groups) for whom the risks should be assessed and the type of calculations which should be performed. It also describes how the results should be presented.

Since it has been recognised that PSAs produce figures that can be used as a yardstick in safety decisions, a number of countries have developed probabilistic safety criteria. The regulatory body in The Netherlands has taken note of the INSAG-3 safety objective, i.e. the maximum acceptable frequency for core damage is 10^{-5} per year for new NPPs and 10^{-4} per year for existing NPPs.

In addition, the objective of accident management strategies should be that the majority of potential accident releases will not require any immediate off-site action such as sheltering, iodine prophylaxis or evacuation. This means that the dose to which members of the public are exposed in the first 24 hours after the start of the release should not exceed 5 mSv. The PSA can help in fixing these figures. For example, the limit of 5 mSv was used as an acceptance criterion in the design of the containment emergency venting filter for the Borssele NPP.

c.2 Minimisation of residual risk

The Rasmussen study (WASH-1400) showed that risk was not dominated by the design basis accidents, as was made very clear by the TMI-2 incident and the Chernobyl accident. For this reason, the government felt it would be useful to enhance the reactor safety concept, which had to date been based mainly on deterministically defined events such as a large break LOCA, by incorporating certain risk elements. In addition to the radiological hazard criteria already mentioned, it was decided to make various changes to the Code of Practice on Design that would define the required safety level more clearly and require the licensee to make a reasonable effort to minimise the risk. The following text was added under the heading ‘Postulated Initiating Events (PIEs)’:

> *The nuclear power plant shall be designed to cope with PIEs in such a way that it can be demonstrated in a probabilistic safety assessment that the probability of a large release is no greater than 10^{-6} per reactor-year. These PIEs may be of internal or external origin, or a combination of the two.*
>
> *Large releases are releases that could lead to doses outside the plant exceeding the acceptable limits for accident conditions (see paragraphs 315 and 1003 of the Code of Practice on Design). They might necessitate the consideration of external measures (i.e. off-site countermeasures). Evidence must be provided that there is no sharp increase in risk just below the probability of 10^{-6} per reactor-year.*

In the section on ‘Severe Accidents’, a more stringent form of wording was chosen in paragraph 317 (i.e. ‘shall’ instead of ‘should’):

> *Although the probability of severe accidents occurring is very low, these accidents shall be considered in the design so as to further reduce risks wherever these risks can be reduced by reasonable means.*

c.3 Design basis accidents

The public health risks due to incidents or accidents in the design basis area are also bound to the criteria of the individual risk concept. However, a conservative deterministic analysis of the respective design basis accidents is more effective than a PSA, which is based on a probabilistic approach, for the purpose of ensuring that the engineered safety features of a particular NPP are adequate. There are a number of reasons why a conservative, deterministic approach has certain advantages over a probabilistic approach:
Design basis accidents are postulated to encompass a whole range of related possible initiating events that can challenge the plant in a similar way. These other related initiating events do not therefore need to be analysed separately.

It is much easier to introduce the required conservatism. With a probabilistic approach, uncertainty analyses need to be performed to calculate confidence levels.

By definition, design basis accidents are events that are controlled successfully by the engineered safety features. Hence, they do not result in core melt scenarios, and are considered in a PSA as being ‘success sequences’. The related radioactive releases are negligible compared with the uncontrolled large releases associated with some of the beyond-design basis accidents. In other words, a general ‘state-of-the-art’ PSA, which focuses primarily on core melt scenarios and associated large off-site releases, does not take account of the consequences of design basis accidents.

Clearly, the above dose and risk criteria are not suitable for use as rigid criteria in the conservative and deterministic approach used in traditional accident analyses. A separate set of safety criteria was therefore formulated, as is prescribed by NVR 1.1, § 1201. This set, which is part of the amended Nuclear Installations, Fissionable Materials and Ores Decree, reads as follows:

Frequency of event F per year	Effective dose (H_{eff}, 50 years)	
	Adult	Child (1 year old)
$F \geq 10^{-1}$	0.1 mSv	0.04 mSv
$10^{-1} > F \geq 10^{-2}$	1 mSv	0.4 mSv
$10^{-2} > F \geq 10^{-4}$	10 mSv	4 mSv
$F < 10^{-4}$	100 mSv	40 mSv

An additional limit of 500 mSv thyroid dose (H_{th}) must be observed in all cases.

Correspondingly the provisions concerning the dose related to normal operation as a first step in the ALARA process, a general dose constraint has been prescribed at values of 40% of the above mentioned.

APPENDIX 2: THE ROLE OF PSA's IN ASSESSING SAFETY

Both Dutch nuclear power plants launched their PSA programmes in 1989. The main objective of these PSAs was to identify and assess the relative weak points in the design and operation of the power plants, and thus to facilitate the design of accident management measures, and also to support backfitting. An assessment of source terms, public health risks, etc., was regarded as unnecessary at that time.

The licensees translated the regulatory requirements as well as their own wishes regarding the objectives of the PSAs into their original bid specifications:

- To identify and analyse accident sequences, initiated by internal and area events, that may contribute to core damage and quantify the frequency of core damage.
- To identify those components or plant systems whose absence most significantly contributes to core damage and to isolate the underlying causes of their significance.
- To identify weak spots in the operating, test, maintenance and emergency procedures that contribute significantly to the core damage frequency.
- To identify any functional, spatial and human-induced dependencies within the plant configuration that contribute significantly to the core damage frequency.
- To rank the weak spots according their relative importance and to easily determine the effectiveness of potential plant modifications (both backfitting and accident management). See Annex 1 for a more detailed description of the PSA-based backfitting and modifications at the Borssele NPP.
- To provide a computerised level-1 PSA to support other living PSA activities such as the optimisation of Technical Specifications, maintenance planning, etc.
- To transfer technology and expertise to the licensee to allow it to evaluate future changes in system design, operating procedures and to incorporate these changes in a 'Living' PSA.

Major modification and backfitting programmes were announced at around the same time, partly as a result of the accident at Chernobyl. A backfitting requirement was formulated for the existing NPPs. Although backfitting primarily addresses the design basis area, the beyond-design basis area and associated severe accident issues are also taken into account. The 'backfitting rule' also requires ten-yearly safety reviews. This requirement is included in the operating licences issued for both plants. At that time an important part of these ten-yearly safety reviews was a level-1 'plus' PSA (level 1^+).

It became clear at a later stage that the plants needed to have new licences in order to put the major modification programmes into effect. As part of the licensing procedure, both plants were required to submit an Environmental Impact Assessment. A substantial part of this Environmental Impact Assessment was taken up by a 'full scope' level-3 PSA, including an assessment of the influence of the proposed modifications. This meant expanding the scope of the ongoing studies. These studies were completed early in 1994. Their findings were also communicated to the Dutch Parliament.

The scope of the PSAs was also extended in the light of review processes, interim findings of the PSA, changes in the state-of-the-art (e.g. assessment of the risks associated with low-power and shut-down states) and the broadening of the objectives.

In the early 1990s, these level-1^+ PSAs were expanded to full-scope level-3 PSAs, including internal and external events, power and non-power plant operating states, human errors of omission and commission. The PSAs were expanded partly in order to comply with the requirement that the studies should be 'state-of-the-art' (i.e. non-power plant operating states and human errors of commission), and partly because of the licensing requirements associated with the ongoing modification programmes (i.e. an Environmental Impact Assessment had to include a level-3 PSA).

Because the PSAs were intended primarily to identify weak spots in the operation and design of both Dutch NPPs, they could be used to support the modification programmes and to alter them if necessary. As the NPP Dodewaard is closed now, only the Borssele PSA is discussed here.

In table 1 an overview is given of the influences of the modification programme of the Borssele NPP on the TCDF and the contributing accident sequences in terms of initiating events.

In the current plant situation, 53% of the TCDF is due to internal events. Spatially dependent events (internal flood & fire) contribute 33% and External events contribute 13%. Internal events during Power Plant Operational States (POS), and spatially dependent events occurring in the Midloop POS dominate the level-1 results; both ca. 26%. In the old plant situation the internal events were still 76%, the spatially dependent contributed only 21% and the external events contributed only ca. 3%. These figures demonstrate clearly that the modification programme was quite effective for the internal events but less effective for the spatially dependent events and external events.

In both the old and current plant configuration a large percentage of the TCDF is contributed by a small number of cutsets. In both cases about 40 cutsets are responsible for 60% to 70% of the TCDF.

A good demonstration of the influence of the modifications on the level-1 outcomes is the reduction in the contribution to the TCDF of the very small break LOCAs (from 1.41E-5 to 1.18E-7). Before the modifications the dominant accident sequence was a very small LOCA followed by a success of reactor trip, high pressure injection via the volume control system, power available from offsite sources or diesels, feedwater to the steam generators and successful secondary cooldown. Late in the progression of events, failure of the low pressure residual heat removal system leads to failure to remove decay heat from the core and eventually results in core damage. With a sequence frequency of 8.9E-6 per year, it contributed 15.9 % of the total CDF (rank 1 sequence). After the modifications the frequency was reduced to 1.1E-7 per year, which is a contribution of 4.2% to the TCDF (rank 7 sequence). In the old case the top four cutsets (rank 3, 4, 7 and 8 of the total TCDF cutset list (cutset list involving all initiators and all POS)) involved failure to isolate the inundation tanks from the suction of the low pressure pumps. Failure to isolate the inundation tanks after switchover to recirculation leads to failure of the low pressure pumps. The frequency of the sum of these four cutsets was 8.3E-6. Due to the installation of the check valves in the inundation lines which prevent backflow from the sump to the inundation tanks and failure of the low pressure pumps these cutsets almost disappeared from the sequence cutset list. On the other hand, these extra check valves slightly increased the system unavailability. Therefore, this is a good example that system unavailability's of the safety systems don't provide the complete story of TCDF improvement.

In the non-power situation, the midloop POS dominates because of the reduced inventory and because there is only one manually actuated single system to act as a redundancy for the low pressure RHR/ LPIS, namely the Reserve Cooling System TE. Automatic actuation of the bunkered primary reserve injection system TW has a large impact on the accident sequence because it extends the time window for operator action and recovery.

In the current post-modification plant state, the total core melt frequency of 2.83 E-6 per year is governed by sequences with the containment initially intact (92%). The remaining sequences are classified as bypass sequences and include interfacing system LOCAs (1.3%), SGTR (1.4%), containment isolation failure sequences (0.1%), and external sequences which directly fail the containment (4.8%) of the non-bypass sequences. Transients (69%) and small LOCA (19%) are the dominant sequence types. Transients most likely lead to low pressure (< 9 bar) or intermediate pressure (9 - 134 bar) core melt (62% of transients - low, and 8% of transients - intermediate) whereas for small leaks low pressure core melt is dominant (72% of small LOCA sequences) followed by intermediate pressure (27%). Station blackout contribution to the core melt frequency is minor (1.2 %). For 72% of the high pressure transients, systems would become available to inject water in the core with depressurization. This percentage is even higher for LOCA sequences (approximately 100%). The major contributors (in terms of plant damage states, and not in terms of initiating events as in table 1) based on frequency are as follows:

36.2% Low pressure transient with the reactor vessel open, where injection is possible but containment heat removal is not available (Midloop operation).

9.4% Small LOCA with low system pressure, where injection is possible but containment heat removal is not available

6.5% High pressure transient, where injection is possible but containment heat removal is not available.

5.9% Transient in the fuel storage pool with no injection and no containment heat removal

4.7% Containment failed by initiating event at or near time of reactor shutdown

4.5% Small LOCA with intermediate system pressure, where injection is possible and containment heat removal is available.

A major difference with the 'old' plant situation is significant reduction of the medium pressure core melt transient type scenarios, from 37% to 8%). At these intermediate pressures, low pressure injection is not possible. The main reason for this reduction is the improved capability for secondary cooldown and improved high pressure primary injection capability.

Within the framework of the Borssele PSA, a qualitative assessment was made of the Errors of Commission (EOCs) with potential serious consequences. The assessment of the EOCs during power states is based on the 'HITLINE' method, which was developed at the University of Maryland. The method which was used for the analysis of the EOCs during the low-power and shut-down plant operational states closely resembles the methods which form the basis of current developments in the ATHEANA project (A Technique for Human Error Analysis; NUREG/CR-6265, NUREG/CR-6093 and NUREG/CR-6350), which has been developed for the USNRC.

Living PSA applications

After the PSA relating to the modification project was completed, the focus shifted towards 'Living PSA' (LPSA) applications. Even, the new licence for the modified Borssele plant required the licensee to have an operational 'Living' PSA, but gave no further details of the concept and applicability of such a LPSA. Both the licensee and the regulatory body are in the process of defining the boundary conditions for possible applications. The use of PSAs for configuration control, the optimisation of Technical Specifications, or event analysis are potential applications. The current ongoing LPSA applications, such as support for backfitting measures, support for periodic safety reviews, support for licensing activities, retrospective use of the risk monitor, optimisation of test and maintenance strategies, incipience of reliability-centred maintenance, etc., will be continued or intensified. However, the number of applications might need to be expanded in order to make maximum use of the LPSA. For this reason, in 1999 the IAEA was asked to produce a Peer Advisory Report on LPSA applications tailored to the specific conditions in The Netherlands. Because the regulatory authorities expressed its wish to make greater use of LPSA insights and to move to a more risk-informed form of regulation, the IAEA has also been asked to include these aspects in its report. The main conclusion and recommendation of this Peer Advice was:

In order to make use of risk information in regulatory decisions in a formal and predictable way, the authority should develop an appropriate framework.

In appendix 5 an outline is given of the conclusions and recommendations of this IAEA peer advice, and on the follow-up actions with respect to Risk-informed regulation.

Guidance and review of the PSAs

No national PSA guidelines existed at the onset of the Dutch PSA programmes in 1988/1989. To make matters worse, both the licensee and the regulatory body had very little experience with the development of a complete PSA for a nuclear power plant. Both licensees therefore requested foreign contractors to develop the two PSAs. At the first round of talks (in 1988) between one of the licensees (i.e. the Borssele NPP) and the regulatory body, only general requirements, and the scope and objectives of the PSA were discussed. One of the key elements in these talks was the need for technology transfer from the contractor to the plant staff. Much of the available knowledge came from studying literature, such as NUREG reports, rather than from any hands-on experience. It is fair to say that the ongoing regulatory guidance and assessment benefited greatly from this technology transfer, as well as from the peer reviews that were held. This was equally true for the licensees. The regulatory requirements set and instructions given concerned the scope, the level of detail, whether or not best-estimate techniques could be used for modelling purposes, etc. As far as more detailed technical matters were concerned, the USNRC PRA Procedures Guide (NUREG/CR-2300) and the PSA Procedures Guide (NUREG/CR-2815) were considered to be acceptable at that time.

Because the Dutch authorities and their traditional technical support organizations had only limited experience with nuclear PSA programmes, and also because of regulatory body had limited staff resources, the IAEA was asked for support. This support was provided in the form of peer reviews of the PSAs (IAEA-IPSART-missions, formerly known as IPERS missions), and training courses in PSA techniques and PSA review techniques. The PSAs of both plants were scrutinised by IPERS reviews at various stages of their conduct. For example, the first stage of a peer review of the Borssele PSA by the IAEA took place at the onset of the PSA programme. This review involved looking at the agreed scope of the PSA and assessing how this had been translated into a project proposal by the contractor. Another example was a limited IPERS mission which took place with the aim of checking whether all the issues raised in previous IPERS missions had been adequately resolved in the final report. This review showed that all the issues raised in previous IPERS missions had indeed been adequately resolved, and that the PSA was of high quality.

Table 1: Results of PSA - Borssele (All Plant Operating States, Internal & External Events)

Event	contribution to TCDF (Old Plant)	contribution to TCDF (Current Modified Plant)
INTERNAL EVENTS DURING POWER STATES	**3.6 E-5 64.1 %**	**9.4 E-7 33.2 %**
- LOCA	2.4 E-5 43.0 %	6.1 E-7 21.6 %
- Large LOCA (6"-29")	3.68 E-6 6.6 %	8.2 E-8 2.9 %
- Medium -Large LOCA (4"-6")	1.30 E-7 0.2 %	2.0 E-8 0.7 %
- Small-Medium LOCA (2"-4")	5.99 E-7 1.1 %	9.6 E-8 3.4 %
- Small LOCA (½"-2")	5.44 E-6 9.7 %	2.3 E-7 8.1 %
- Very Small LOCA (<½")	1.41 E-5 25.2 %	1.2 E-7 4.2 %
- Interfacing System LOCAs,	2.90 E-7 0.5 %	1.7 E-8 0.6 %
- Steam Generator Tube Rupture)	1.96 E-8 0.0 %	3.7 E-8 1.3 %
- Internal Flood/Fire	5.4 E-6 9.7 %	1.8 E-7 6.2 %
- Loss of Support System	4.3 E-6 7.7 %	1.0 E-7 3.7 %
Loss of Main & Auxiliary Cooling Water,	3.30 E-6 5.9 %	5.7 E-9 0.2 %
Loss of Closed Cooling Water (Component Cooling)	9.43 E-7 1.7 %	1.0 E-9 0.0 %
Catastrophic Feedwater Tank Rupture	8.61 E-8 0.2 %	9.9 E-8 3.5 %
- ATWS with Main Feedwater available	6.34 E-7 1.1 %	2.3 E-8 0.8 %
- ATWS with Loss of Main Feedwater	1.35 E-6 2.4 %	1.1 E-8 0.4 %
- Transient Losses of Feedwater (Steam/Feedwater Line Break Outside Containment & Ringroom)	1.1 E-7 0.2 %	2.8 E-9 0.1 %
EXTERNAL EVENTS DURING POWER STATES	**6.7 E-7 1.2 %**	**2.3 E-7 9.8 %**
- Vapour Cloud Explosions (Shipping LPG)	2.8 E-7 0.5 %	1.1 E-7 2.9 %
- External Flooding	1.7 E-7 0.3 %	2.0 E-8 0.7 %
- Toxic Gas Releases	1.1 E-7 0.2 %	6.8 E-8 1.6 %
- Long-term Loss of Offsite Power due to external hazards	5.6 E-8 0.1 %	1.3 E-8 0.3 %
- Other	5.6 E-8 0.1 %	8.6 E-9 0.2 %
INTERNAL & EXTERNAL EVENTS DURING (EARLY + LATE) HOT STEAMING POS (LOCAs dominate; added Reactivity Addition Accident during Start-up; Increased Loss of Offsite Power, due to potential problems in shifting Offsite Power	**5.6 E-7 0.9 %**	**1.66 E-9 0.0 %**
INTERNAL & EXTERNAL EVENTS DURING (EARLY + LATE) COLD SHUTDOWN	**1.1 E-6 1.9 %**	**2.0 E-7 7.0 %**
- LOCA inside containment	9.0 E-7 1.6 %	1.3 E-7 4.7 %
- IS-LOCA	< 5.6 E-8 <0.1 %	5.9 E-9 0.3 %
- Other	< 2.8 E-7 <0.5 %	5.9 E-8 2.0 %
INTERNAL EVENTS DURING MIDLOOP POS	**1.6 E-5 28.2 %**	**1.1 E-6 40,2 %**
- LOCA	7.9 E-6 14.3 %	2.4 E-7 8.5 %
- Fire	6.3 E-6 11.2 %	7.3 E-7 25.9 %
- Loss of RHR	6.2 E-7 1.1 %	4.2 E-8 1.5 %
- Loss of 6 kV ac bus BU	3.4 E-7 0.6 %	8.5 E-8 3.0 %
- Loss of component cooling	3.4 E-7 0.6 %	3.1 E-8 1.1 %
- Other	3.4 E-7 0.6 %	5.7 E-9 0.2 %
EXTERNAL EVENTS DURING MIDLOOP POS	**5.0 E-7 0.9 %**	**4.8 E-8 1.7 %**
- Vapour Cloud Explosions (Shipping LPG)	2.2 E-7 0.4 %	1.4 E-8 0.5 %
- External Flooding	2.2 E-7 0.4 %	1.0 E-8 0.3 %
- Other	5.6 E-8 0.1 %	2.4 E-8 0.9 %
INTERNAL & EXTERNAL EVENTS DURING CORE UNLOADING/LOADING POS	**< 1.0 E-9**	**< 1.0 E-9**
INTERNAL & EXTERNAL EVENTS FUEL POOL POS (All Fuel in In-containment Fuel-Pool)	**1.7 E-6 2.8 %**	**2.0 E-7 7.0 %**
- Loss of Support Systems (Station Blackout)	- 1.0 E-6 1.8 %	2.8 E-8 1.0%
- Loss of Fuel-Pool Cooling	- 5.3 E-7 0.9 %	1.7 E-7 5.9%
TOTAL	**5.6 E-5 100 %**	**2.83 E-6 100 %**

APPENDIX 3: THE SAFETY CULTURE AT BORSSELE NPP

Reference is made to the NPP Borssele policy statement:

> *EPZ supports the intention in respect to safety culture as defined in the IAEA reports 75-INSAG-3 and 75-INSAG-4. The definition of the term safety culture reflects the way that the organization is using people, resources and methods. It is the opinion of EPZ that attitude, way of thinking, professionalism and alertness of every employee is of great importance to safety. EPZ shall take all necessary measures to establish and maintain a good safety culture.*

Apart from aforementioned policy statement, the Operating Instructions of the Borssele NPP, which form a generally accessible set of information, contains a policy document entitled 'Nuclear safety and radiation protection' (92-0101, rev. 3), in which nuclear safety is declared to be the highest priority. The policy document describes nuclear safety as being based on two principles: defence-in-depth and safety culture. The policy document is followed by a memorandum called 'Concrete measures' (R6573), which lists the priorities. It links up with descriptions of the organization's 'main processes' (HPs), as laid down in the Operating Instructions and defined as:

- management and organization,
- personnel and organization,
- configuration management,
- operations,
- maintenance.

The main processes form the basis on which the annual departmental plans are drawn up. The policy document is linked with the business plan, which also discusses financial aspects.

In 1996 the utility EPZ started a safety culture programme for the NPP Borssele. As an ongoing programme every year new activities are defined to improve the safety culture of the personnel of the NPP. As examples the following activities could be mentioned:

- Introduction of the STAR-principle to all employees,
- Introduction of the aspect safety culture in the toolbox-meetings,
- Introduction of work practices sessions in the operations- and maintenance refresher courses,
- Introduction of management-on-the-floor principle and regular management-rounds,
- Management safety culture training,
- Special attention to safety culture aspects in performing root-cause event analyses,
- Involvement of staff in peer reviews of international nuclear power plants,
- Production of 'work-practices' training-movies for contractors and own staff.

Introduction of the STAR-principle to all employees:

All employees of the NPP Borssele followed a 2-hour training session, where the STAR-principle was explained, using day-to-day examples. The STAR-principle is developed to improve normal work practices. STAR stands for: (in case of deviations) Stop, Think, Act and Review.

Introduction of the aspect safety culture in the toolbox-meetings:

Monthly toolbox meetings are required for all operations and maintenance employees. Industrial safety issues are discussed in these meetings. Now also safety culture subjects are introduced. For example the STAR-principle, the system of work-licenses, the nuclear safety tagging-system, etc.

Introduction of work practices sessions in the operations- and maintenance refresher courses:

A full day training session, where the work practices are discussed, using last year's ill evens, is introduced. Special attention is to given to the subject 'how to handle safety, when seemingly all attention is given to schedule-time. The big message her is: (nuclear) safeties first, when there is any doubt, immediately inform the management about the issue, so that no unnecessary time will be lost.

Introduction of management-on-the-floor principle and regular management-rounds:

An important aspect of safety culture is the communication of 'management expectation'. The best way to communicate this expectation is by management-on-the-floor, e.g. working people must be in close contact with management in normal working situations, to avoid interpretation problems. The introduction of management-on-the-floor is difficult, because most managers tend to have a busy life, and being on the floor does not have the highest priority. Special programs and requirements are needed to force these people to be on the floor.

In the Borssele NPP the advancement of management-on-the-floor is combined with the introduction of regular management-rounds for all managers. The management-rounds are oriented on the installation. During the rounds all deficiencies in the plant are noted. Priorities are given to resolve the deficiencies in the right order. The management-rounds are scheduled in such a way, that management is visiting every room at least twice a year.

Management safety culture training:

In 1999 the Borssele management followed a special safety culture-training program.

Special attention to safety culture aspects in performing root-cause event analyses:

Work practices and safety culture could be an important root-cause of undesired events. To handle this aspect in a systematic way in the root-cause analysis, the HPES-methodology as developed by WANO, was introduced in Borssele.

Involvement of staff in peer reviews of international nuclear power plants:

The acceptance of small deficiencies in the plant has a tendency to drift away. After a while things are taken as normal. By involving the staff of the NPP in international peer reviews, resetting of the 'normal standard' is possible.

A yearly average of 5 employees of the Borssele NPP is involved in international peer reviews. (INPO (HPES), OSART)

Production of 'work-practices' training-movies for contractors and own staff:

The Borssele NPP produced a one-hour movie, showing normal work-practices, in a good and bad manner. All own staff and most of the important contractors must see this movie. Because the movie is very realistic, and the field workers do recognize the situations, it is very effective in improving work practices. The movie is upgraded every year, based on the yearly event-analysis. In 2001 the maintenance managers presented the movie. This way also management expectation could be communicated in an effective way.

APPENDIX 4: POLICY DOCUMENT ON BACKFITTING

1. What is backfitting?

The nuclear power plants at Dodewaard and Borssele became operational in 1968 and 1973 respectively. Various developments have influenced views on safety in the intervening period. These developments include the vast increase in experience with nuclear power plants, not only during normal operation but also during incidents and accidents, up to and including severe accidents as occurred at TMI and Chernobyl. In addition, systematic probabilistic risk assessment, of which the WASH-1400 (Rasmussen) report in 1975 was the first specimen, has led to significant changes, in particular concerning the balance between the various safety measures. Finally, significant progress has been made in the design of computer programs for performing complex calculations and in scientific research. As a result of these factors, there is a tremendous difference between the design characteristics of plants that have recently been put into operation and those of older plants.

When a nuclear power plant undergoes modification in the course of time, on the basis of new views on safety, this is termed ‘backfitting’. The same term is used to describe the situation when the power plant or the operational or maintenance procedures are modified with the aim of improving the compliance with the original safety standards. The initiative for such modifications may come from various sources: the regulatory body, the company operating the plant or the manufacturer.

2. Types of backfitting

Backfitting as defined above relates to systems, components, facility design, procedures, and organizational structures. These can be modified for two reasons, detailed below.

1. The rectification of failures to meet the original safety standards (i.e. the standards at the time when the operational licence was granted). These fall into the following categories:

a) Incidental changes in systems, components or procedures should always be evaluated in order to assess their effects on safety. An integrated analysis may reveal certain undesired interactions.

b) The recognition of accidents or combinations of accidents that may, as shown by experience or a safety analysis, lead to a situation that is not included in the list of design-basis accidents that formed the basis for the licence. A classic example is a large LOCA, which does not cover a smaller one.

c) Control of the ageing aspects of the facility. Adaptations must at least be consistent with the level of safety considered to have been originally present. Their objective must be the continuation of the reliability of systems and components in the long term.

2. The rectification of deviations from new safety standards. The safety level of the facility is thus raised in comparison with the level that was assumed to exist during the licensing procedure. This includes:

d) measures aimed at controlling additional beyond-design basis accidents;

e) the enlargement of safety margins;

f) the prohibition of previously admitted materials;

g) the introduction of more severe tests that may necessitate changes in construction.

The following subdivision can be made:

1. measures based on current, formalised principles and guidelines;

2. improvement of the original safety standards by adaptation to safety considerations that have not yet been formalised, for instance by adopting 'good practices' developed elsewhere. This also comprises systematic evaluation, including potential measures, based on in-house experience or experience with other facilities.

The two above categories of backfitting require different approaches, not only because of the varying importance attached to safety, but also for formal reasons. If there is a failure, whether actual or alleged, to attain the safety level imposed by the licence, immediate backfitting may be ordered. This applies to categories 1a, 1b and, depending on the findings, also to category 1c.

Category 2 usually requires a process of analysis, the object of which is to prove which adaptations are possible, taking account of the desired improvement in the level of safety on the one hand and the cost on the other. Because of the improvement in the safety level that may be attained, a category 2 activity may be given priority in practice. It should be noted, however, that there is a subtle distinction between 2a and 2b, viz. in that 2a-type backfitting can be enforced more easily.

There is also a difference with respect to the licensing procedure. Category 2 adaptations may necessitate changes in the licence, but this should in no way hamper the adaptations.

3. Basis for backfitting

Backfitting regulations can be imposed through any of a number of channels:

- by statutory means;
- by means of safety regulations imposed by law;
- through licensing requirements for the power plant in question.

A change in the regulations for power plant licensing is currently the fastest way of obtaining results. Studies could be performed to reveal whether backfitting could be included directly in the law or in law-based regulations.

4. Implementation of backfitting

4.1 Continuous versus periodic backfitting

A distinction should be made between backfitting as a semi-continuous process and backfitting performed in the context of a special, integrated study. The latter can be carried out, as is done in an increasing number of countries, after periods not exceeding ten years. The semi-continuous type of backfitting is a direct response to events and accidents from which lessons can be learned, and also to all types of developments in safety technology that are reflected in modern practice, insights and rules.

Ten-yearly backfitting is based on an integrated safety analysis of the as-operated facility, carried out in accordance with current views on safety. The analysis must take account of any modifications that have been made in the intervening period. 'Current views on safety' include safety principles and guidelines currently in force. The ten-yearly backfitting should also deal with the ageing of the facility. The situation as regards ageing is defined and adaptations must be aimed at renewed, long-term operation.

An integrated study includes a probabilistic safety assessment, which may also suggest certain topics for future investigation.

The boundary between 'semi-continuous' and ten-yearly backfitting may easily become fairly blurred in practice. This is because foreseeable backfitting will, for practical reasons, be spread in time and will consequently take place, at least partially, simultaneously with other maintenance activities. In this respect, regular integrated evaluation is to be considered primarily as an additional, systematic check of the more continuous type of backfitting.

4.2 Structure of backfitting projects

Backfitting projects consist, roughly, of five functional stages:

1. an investigation of the state of the facility (or parts of it) and a comparison of this state with the requirements;
2. an evaluation of the investigation of the state of the facility, including decisions on whether action is needed to deal with any deviations from the desirable state;
3. a search for practical measures that should lead to improved safety, if this is what is indicated by the evaluation;
4. weighing the costs of backfitting measures against improvements in the level of safety in which they will result (this does not apply where the safety is to be restored to its original level);
5. the implementation of measures provided the anticipated benefits are in reasonable proportion to the costs.

The weighing of the anticipated benefits against the probable cost should preferably not be performed using formal criteria in terms of monetary values set for the radiation doses that the measures are intended to prevent. A more pragmatic approach is to be preferred based on an evaluation, for each individual case, of what should be considered to be a reasonable effort in view of the raised level of safety. In those cases where a significant improvement in the safety level is beyond doubt, and where the costs are limited, backfitting should certainly be carried out.

Decisions on the implementation of backfitting measures should take sufficient account of the compatibility of these measures with the existing design. The potential negative effects of backfitting measures should be analysed before an existing design or procedure is adapted, as the existing design or procedure may have resulted from a consistent package of requirements or concepts regarding design or procedures. Priority should be given to measures that improve overall safety beyond doubt.

4.3 Nature of a ten-yearly review

The ten-yearly safety assessment should include:

- an analysis of the facility and the operating procedures in the framework of the safety requirements and safety concepts which are in force;
- an evaluation of the plant's own operational experience, in particular if this has not yet led to immediate action;
- an evaluation of operational experience elsewhere (if this has not yet led to immediate action), in particular of comparable facilities (this should also include backfitting measures taken in, or scheduled for, comparable facilities);
- an evaluation of the reliability of systems and components, in view of ageing that has taken place, or is expected to take place, in the medium term;
- a probabilistic safety assessment of the as-operated facility as referred to above, including to a sufficient degree:
  1. the specific operational procedures, with staff qualifications and training,
  2. the programme of tests performed on a regular basis,
  3. the maintenance schedule;
- on the basis of the above elements: a description and analysis of the backfitting measures, stating reasons for the choices made;
- a check to determine whether the description of the facility and the operational and safety systems still reflects the actual situation;
- a check to determine whether the description of the current operating procedures for normal operation, failure, and accident conditions still reflects the current situation.

Decisions on the implementation of specific measures will be taken after evaluation by the regulatory authorities and after consultation of the parties involved. The descriptions and analyses should become topical again after the various measures have been implemented.

APPENDIX 5: FIRST STEPS TOWARDS RISK-INFORMED REGULATION: A FEASIBILITY STUDY

IAEA-Peer Advice on Living PSA applications in The Netherlands

Because the regulatory body increasingly is confronted with design or operational changes which stem directly from, or are supported by arguments stemming from LPSA-applications at Borssele, which require approval of the KFD, the IAEA was asked to advice the KFD in order to support this process. Questions like: 'Are the LPSA-applications at the Borssele plant state-of-the-art and sufficient, or should Borssele do more?', 'How should the KFD respond to these applications, given a small regulatory staff and possible short remaining lifetime of the Borssele plant?', were the focal points of this review.

The main conclusions and recommendations were:

- Complete the implementation of the risk monitor with high priority in order for it to be used for maintenance scheduling, operating decisions and risk follow-up.
- Select those applications that can provide benefit to the plant in the near term. This selection could be based on criteria such as dose reduction, regulatory requirements, maintenance costs, refuelling outage duration, etc. Examples of such applications are risk-informed improvement of technical specifications, risk-informed increment of on-line maintenance activities.
- KFD was suggested to develop a framework for the use of risk information in regulatory decisions. This should include the identification of objectives, description of the decision-making process and acceptance criteria, and clarification of how risk-informed decision-making is to be incorporated in the existing regulations. Since developing such a framework may take considerable effort, they were suggested to review existing risk-informed frameworks, bearing in mind that acceptance criteria need to be developed for the specific situation in The Netherlands.
- The resources required for accomplishing risk-informed regulation depend on how much use will be made of this approach, however, the IAEA team suggested that, as a minimum, KFD should continue to allocate one person, having in-depth knowledge of the Borssele PSA, for PSA-related activities, and that all decision-makers should have some training in PSA.
- The IAEA team felt that if applications are requested by the KFD to Borssele NPP, these should be discussed with the plant to maximise mutual benefit. Also, the discussions raised the idea that perhaps the KFD and Borssele NPP could develop a consensus document to conduct and assess PSA applications.
- Finally, the KFD was suggested to use PSA to focus the regulatory inspection program on the more significant systems, components, and plant practices.

As a follow-up of this advice, which took place in 1999, the KFD cautiously defined a follow-up program/feasibility study in order to proceed towards a more risk-informed regulation. It was decided to take a step-by-step approach. The first step is to familiarise with risk-informed regulatory approaches in West-European countries, whilst the next steps are centred on a particular application, such as Technical Specification optimisation.

Follow-up program

The objective of this program is to come to a situation in which regulatory attention is more consistent with the risk importance of the equipment, events, and procedures to which the requirements apply, so that regulatory and licensee resources can be used in a more efficient way when making decisions with respect to ensuring the health and safety of the public. This objective implies that the regulatory requirements be commensurate with the risk contributions (i.e., regulations should be more stringent for risk important contributors, and less stringent for risk unimportant contributors). Therefore, provided risk informed regulatory criteria are appropriately developed, a systematic and efficient expenditure of resources are to be expected, while, simultaneously, a balance in overall plant safety can be achieved.

Examples of typical regulatory actions where risk-informed methods and requirements are thought to be helpful and therefore being investigated in the project, include:

- evaluation of the design and procedural adequacy;
- performance of periodic safety reviews;
- assessment of changes to the licensing basis, e.g. Technical Specification optimisation: surveillance test intervals, allowed outage times, limiting conditions of operation;
- assessment of operational practices or strategies on safety such as: plant systems configuration management, preventive and corrective maintenance prioritisation;
- prioritisation of regulatory inspection activities;
- evaluation of inspection findings;
- investigation of ageing effects;
- assessment of risk-based safety indicators;
- the need for regulatory action in response to an event at a plant;
- one-time exemptions from Technical Specifications and other licensing requirements; and
- assessment of utility proposals for modifications of the design or operational practices.

The development of risk-informed regulation in The Netherlands is bounded by the present limited nuclear power programme: one NPP (Borssele) in operation, and shutdown of this NPP eventually foreseen by the end of 2003 (although shutdown at a later time cannot be excluded due to legal procedures and processes). No new reactors are planned as well.

Currently the focus of future activities/events for Borssele is governed by licence requirements or external circumstances. It concerns initiation/continuation of:

- new 10-year periodic safety review, formally started in 2001;
- two-year operational safety review;
- monitoring of the plant safety culture during the expected plant staff reduction;
- deregulation of the electricity market;
- preparation for decommissioning.

Under these boundary conditions, emphasis of the development of risk-informed regulation will be in the operational and not in the design area. Also QA is assumed to focus on operational items, in this respect. The design area, however, cannot be ignored, as the plant configuration determines much of the plant safety characteristics.

As the application domain is limited, as is the available manpower within the KFD, the development of Risk-informed Regulation should be based on existing approaches elsewhere; no separate 'Dutch' RiR development is to be foreseen. Main vehicle could be the USNRC development, plus useful parts of the approaches in Spain, Switzerland, Sweden, Finland, Belgium and the UK. Where the sources are diverse, special care must be exercised to obtain a coherent and consistent product.

'Deregulation' is meant as a support to the utility to be and remain competitive on the electricity market. In practice, it means that active support will be given to activities aimed to decrease costs, as long as they do not compromise safety.

The main objectives of the RiR are therefore:

- support the above mentioned (bulleted) activities;
- focus KFD and plant resources on items relevant for risk; and
- eliminate unnecessary 'regulatory burden'.

As the available time frame is short, it is *not* the intention of the proposed RiR-project to generate formal revisions of the NVR-series Design, Operation and Quality Assurance, as would ultimately be the approach in a nuclear energy scenario of longer duration than just about 3 years. However, RiR-products will be documented and reviewed with industry.

Overall, the RiR products will be application-oriented. In some areas, fundamental aspects may be touched, where no written guidance can yet be formulated. In those cases, a conclusion must be reached how to proceed on a more ad-hoc basis.

A special aspect of this project is feasibility if the current oversight process can be transformed into a more risk-informed oversight process. This includes, the eventual use of safety significant performance indicators.

APPENDIX 6: SAFETY CODES AND REQUIREMENTS

Safety Codes and Safety Requirements

NVR 1.1.	Safety Code for Nuclear Power Plant Design. Adaptation of IAEA Code Safety Series 50-C-D (Rev. 1)
NVR 1.2.	Safety Code for Nuclear Power Plant Operation. Adaptation of IAEA Code Safety Series 50-C-O (Rev. 1)
NVR 1.3.	Code for Quality Assurance for the Safety of Nuclear Power Plants Adaptation of IAEA Code Safety Series 50-C-QA (Rev. 1)
NVR 1.4	Safety Requirements on predisposal radioactive waste management, including decommissioning. Adaptation of IAEA draft Safety Requirement NS-152; RADWASS programme. (to be published in Government Gazette)

Safety Guides on Design

NVR 2.1.1	Safety functions and component classification for BWR, PWR and PTR Adaptation of IAEA Safety Guide Series No. 50-SG-D1
NVR 2.1.2	Fire protection in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D2
NVR 2.1.3	Protection System and related features in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D3
NVR 2.1.4	Protection against internally generated missiles and their secondary effects in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D4
NVR 2.1.5	External man-induced events in relation to nuclear power plant design Adaptation of IAEA Safety Guide Series No. 50-SG-D5
NVR 2.1.6	Ultimate heat sink and directly associated heat transport systems for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D6
NVR 2.1.7	Emergency power systems at nuclear power plants Adaptation of IAEA Safety Guide Series No. 50-SG-D7
NVR 2.1.8	Safety-related instrumentation and control systems at nuclear power plants Adaptation of IAEA Safety Guide Series No. 50-SG-D8
NVR 2.1.9	Design aspects of radiation protection for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D9
NVR 2.1.10	Fuel handling and storage systems in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D10
NVR 2.1.11	General design safety principles for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D11
NVR 2.1.12	Design of reactor containment systems in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D12
NVR 2.1.13	Reactor coolant and associated systems in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D13
NVR 2.1.14	Design for reactor core safety in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D14
NVR 2.1.15	Seismic design and qualification for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-D15

Safety Guides on Operation

NVR 2.2.1	Staffing of nuclear power plants and recruitment, training and authorisation of operating personnel. Adaptation of IAEA Safety Guide Series No. 50-SG-O1 (Rev.1)
NVR 2.2.2	In-service inspection for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O2
NVR 2.2.3	Operational limits and conditions for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O3
NVR 2.2.4	Commissioning procedures for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O4
NVR 2.2.5	Radiation protection during operation of nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O5
NVR 2.2.6	Preparedness of the operating organization (licensee) for emergencies at nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O6
NVR 2.2.7	Maintenance of nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O7 (Rev. 1)
NVR 2.2.8	Surveillance of items important to safety in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O8 (Rev. 1)
NVR 2.2.9	Management of nuclear power plants for safe operation. Adaptation of IAEA Safety Guide Series No. 50-SG-O9
NVR 2.2.10	Core management and fuel handling for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O10
NVR 2.2.11	Operational management of radioactive effluents and wastes arising in nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-O11
NVR 3.2.1	Requirements for the training of operating personnel of NPPs. (only in Dutch)

Safety Guides on Quality Assurance

NVR 2.3.1	Establishing of the quality assurance programme for a nuclear power plant Adaptation of IAEA Safety Guide Series No. 50-SG-QA1
NVR 2.3.2	Quality assurance records for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA2
NVR 2.3.3	Quality assurance in the procurement of items and services for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA3
NVR 2.3.4	Quality assurance during site construction of nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA4
NVR 2.3.5	Quality assurance during commissioning and operation of nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA5 (Rev. 1)
NVR 2.3.6	Quality assurance in the design of nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA6
NVR 2.3.7	Quality assurance organization for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA7
NVR 2.3.8	Quality assurance in the manufacture of items for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA8
NVR 2.3.10	Quality assurance auditing for nuclear power plants. Adaptation of IAEA Safety Guide Series No. 50-SG-QA10
NVR 2.3.11	Quality assurance in the procurement, design and manufacture of nuclear fuel assemblies. Adaptation of IAEA Safety Guide Series No. 50-SG-QA11

Safety Guide on Decommissioning

NVR 2.4.1	Safety Guide on decommissioning of nuclear power plants and large research reactors. Adaptation of IAEA draft Safety Guide NS-257; RADWASS-programme (to be published in Government Gazette)

ANNEX 1: TECHNICAL DETAILS OF THE BORSSELE NPP

The Borssele nuclear power plant is a light-water PWR with a thermal power of 1370 MW and an electrical output of approximately 450 MW. The installation is a two-loop plant designed by Siemens/KWU. The plant has been in operation since 1973. The reactor and the primary system, including steam generators, are in a spherical steel containment. This steel containment is enveloped by a secondary concrete enclosure.

The Borssele NPP has the following characteristics:

<u>Overall plant</u>

Net electrical output	450 MW
Gross electrical output	477 MW
Rated thermal power	1370 MW

<u>Reactor</u>

Number of fuel elements	121
Number of control elements	28
Type of fuel elements	15 x 15 - 20
Active length of fuel pins	2650 mm
Outside diameter of fuel pins	10.75 mm
Average power density of reactor core	90.2 MW/m^3
Average linear heat rating	20.27 kW/m
Average heat flux	599 kW/m^2
Fuel	UO_2
Enrichment	4%

<u>Reactor coolant system</u>

Design pressure	176 bar
Normal (operating) pressure	155 bar
Internal diameter of RPV	3726 mm
Height of RPV	9825 mm
Basic construction material	22 NiMoCr 37
Core outlet temperature	317.5 ^oC
Core inlet temperature	292.5 ^oC

<u>Main coolant pumps</u>

Number of pumps	2
Rated flow rate	18000 m^3/h
Speed	25 s^{-1}
Electrical power (hot conditions)	5100 kW

<u>Steam generators</u>

Number of SGs	2
Design pressure, primary side	176 bar
Design pressure, secondary side	88 bar
Design temperature	350 ^oC
Material of U-tubes	Incoloy 800
Number of U-tubes	4234
Total heat transfer area	3600 m^2

Pressuriser

Overall volume	40 m^3
Water volume (at full power)	24 m^3
Steam volume (at full power)	16 m^3
Total power heaters	2000 kW

Primary pressure relief

Number and type	Three tandem PORV/Safety Valves (SEBIM); two of the three are actuated by both a motor-operated pilot and bleed valve and by a self-actuated pilot valve; one is only actuated by a motor-operated pilot and bleed valve
Relief pressure (safety valve)	172 bar/ 176 bar/ 180 bar

Pressuriser relief tank

Total capacity	40 m^3
Water volume (normal operation)	15 m^3
Gas volume (normal operation)	25 m^3
Temperature (normal operation)	50 ^oC

Safety systems

High-pressure core injection system

Number of high head pumps	4
Capacity	190 m^3/h at 65 bar
Maximum discharge head	110 bar
Type	Centrifugal pump

Low-pressure core injection & RHR system

Number of low-pressure pumps	4
Capacity	465 m^3/h at 8.1 bar
Maximum discharge head	9 bar
Type	Multi-stage centrifugal pump

RHR heat exchanger

Number of Heat Exchangers	2
Design pressure, tube side	44.1 bar
Design pressure, shell side	9.8 bar

Borated water storage tanks for core injection systems (inundation tanks)

Number of tanks	4
Capacity per tank	178 m^3 of borated water
Boron concentration (H_3BO_3)	2300 ppm B
Pressure	1 bar

Medium-pressure core inundation buffer tanks

Number of tanks	4
Capacity per tank	21.5 m^3 of borated water
Boron concentration (H_3BO_3)	2200 ppm B
Pressure	31.5 bar

Containment spray pumps

Number of pumps	2

Capacity	50 m^3/h at 13 bar
Maximum discharge head	14 bar

Bunkered primary side reserve suppletion system (reserve injection system)

Number of pumps	2
Capacity	18.8 m^3/h
Maximum discharge head	185 bar
Type	Piston pump
Number of borated water storage basins	2
Capacity	243 m^3/ 262 m^3 of borated water
Boron concentration (H_3BO_3)	2200 ppm B

Bunkered secondary side reserve suppletion system (reserve feedwater system)

Number of pumps	2
Capacity	14 kg/s
Maximum discharge head	900 m
Type	Centrifugal pump
Number of demin water storage basins	2
Capacity	496 m^3/ 469 m^3

Reserve core cooling/ RHR system

Number of pumps	1
Capacity	61.1 kg/s
Maximum discharge head	90 m
Number of Heat Exchangers	1 plate Heat Exchanger (titanium)

Emergency power

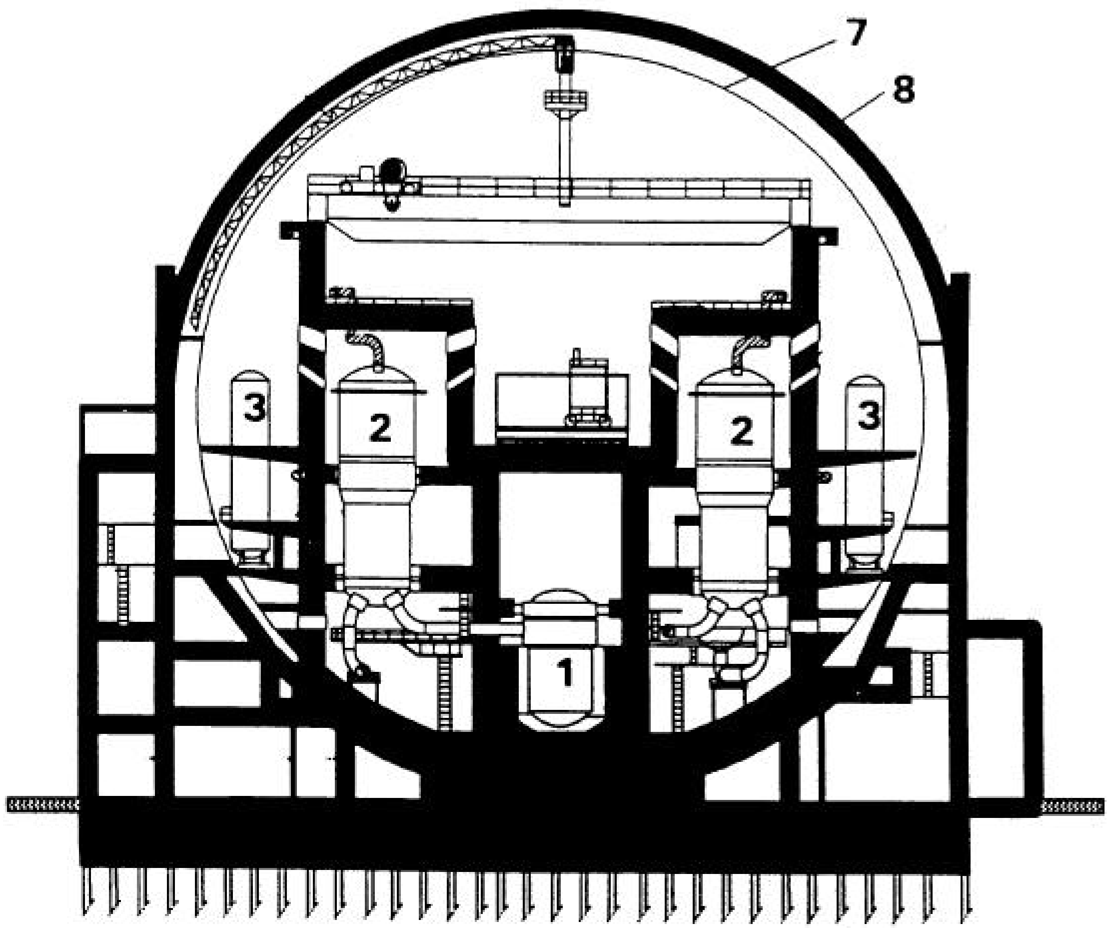
Number of diesel generators	5
Power (continuous)	3 x 4,343 MW and 2 x 0.88 MW

Spent fuel storage

Maximum capacity in inside-containment Storage Pool	500 elements in high density racks
Actual storage	190 elements (Sept 2001)

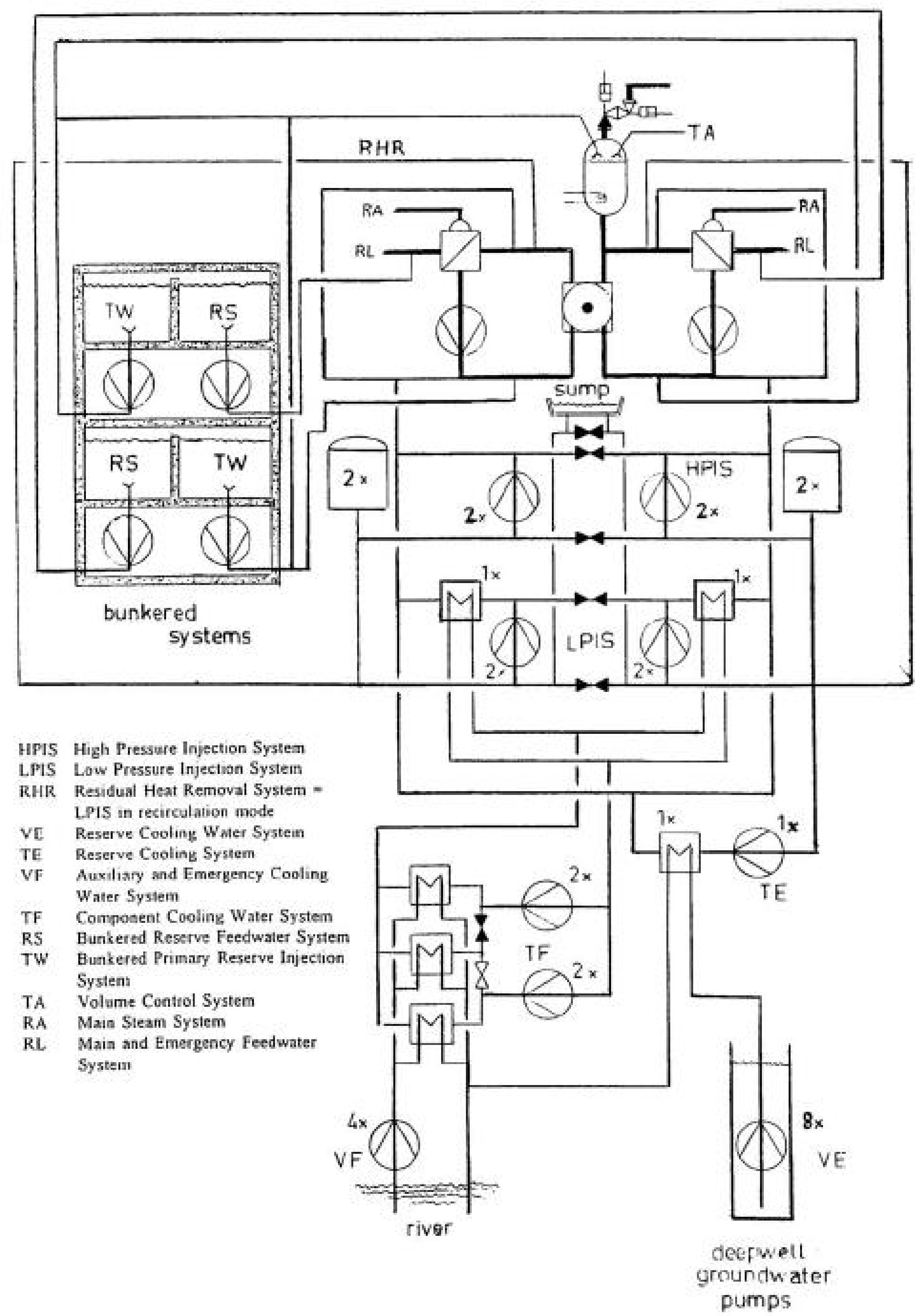
The end of this appendix shows graphs of the overall plant availability over the years, the number of incident reports from 1990 onwards and the number of unwanted automatic scrams over the years are shown.

Figure 1 Cross-section of reactor building of Borssele NPP



1. *Reactor pressure vessel*
2. *Steam generator*
3. *Medium-pressure core inundation buffer tank*
7. *Steel containment*
8. *Secondary concrete enclosure (shield building)*

Figure 2. Safety features of core injection & RHR systems at Borssele NPP



Recently implemented safety features designed to strengthen the defence-in-depth concept (the 1997 modifications)

In the late 1980s, mainly as a result of the Chernobyl accident, the Dutch government formulated an accident management and backfitting policy for the two NPPs that were in operation at the time. Both utilities were asked to upgrade the safety of their plants by incorporating state-of-the-art features, and hence to guarantee safe operation in the next decade. With the aid of the respective reactor suppliers, the two utilities developed a new safety concept for their plants in the early 1990s. In October 1996, the utility operating the Dodewaard NPP decided to close down the plant on economic grounds, and the ongoing modification programme was therefore halted. However, the utility operating the Borssele NPP (which was 20 years old at the time) embarked on a € 210 million modification programme.

The new safety concept was largely based on a comparison of the plant's current design basis with national and international deterministic nuclear safety rules, on deterministic studies of the plant, on insights gained from similar designs, on operating experience and, last but not least, on insights derived from the German Risk Study (DRS-B). Because a plant-specific PSA had not been completed at the start of the conceptual stage of the modification programme, the only PSA influences in the safety concept originated from the German Risk Study (DRS-B). However, a plant-specific PSA was performed in parallel with the activities for the conceptual design. This PSA played a major role in later stages of the modification programme. Once the safety concept had been finalised, it was translated into a 'safety plan', consisting of a package of modification proposals for the plant systems, structures and components.

The following list of features illustrates the impact of these modifications on the design of the Borssele NPP, especially the third, fourth and fifth echelons of defence:

- Functional and physical separation of redundant ECCS trains.
- Addition of a single train reserve cooling water system (RHR) to strengthen the decay heat removal capability. This system consists of a reserve decay heat removal system and a reserve emergency cooling water system including deep-well groundwater pumps.
- Functional separation of the closed component cooling water system trains, and the addition of a fourth pump to this system.
- Increase in the discharge head of the pumps of the bunkered primary side reserve suppletion system (reserve injection system) to 168 bar.
- Connection of the bunkered primary reserve suppletion system (reserve injection system) to the pressuriser (spray) to make it easier to decrease pressure in the event of an SGTR.
- Functional separation of the auxiliary and emergency cooling water system trains.
- Replacement of emergency power diesel generators to increase the electrical output.
- Replacement of the existing main steam and feedwater lines inside the containment and annular space (between the inner and outer containment) and partially in the turbine hall by qualified 'leak before break' piping; steam flow limiter at the containment penetration location and guard pipes around steam and feedwater lines in the auxiliary building.
- Replacement of the primary power-operated relief valves (PORVs) on top of the pressuriser to improve the Bleed & Feed capability and to improve reliability in the event of ATWS situations (tandem principle). The number of PORVs has also been reduced, thereby reducing the LOCA frequency due to spurious PORV opening (although the reduction in the PORV LOCA frequency is due mainly to the revised staggered pressure setpoints for opening the valves).
- Complete renewal of the control room.
- Installation of a filtered containment venting system.
- Installation of a catalytic hydrogen recombiner to enhance the capacity for preventing or mitigating hydrogen burn, deflagration or detonation.
- Installation of a new reactor protection system and second control room in a new external-event hardened building.
- Automation of the cooling-down of the primary system by means of SGs in the event of incidents or accidents such as minor break LOCAs (100 K/hour).
- Replacement of the turbine-driven pump of the emergency feedwater system by a motor-driven pump, to increase the cooling capacity of the primary system by means of the SG.
- Installation of check valves on inundation tank lines (low-pressure ECCS).

Data on radiation protection and exposure

The average effective individual dose at the Borssele plant shows a decreasing trend since 1983. This statement is valid for the Borssele plant personnel as well as for externally hired personnel. At the beginning of the eighties the average effective individual dose came up to 4 mSv per year for Borssele personnel and 5 mSv per year for externally hired personnel. At the end of the nineties these values had decreased to an average effective dose of 1 mSv, respectively 1,5 mSv per year per person.

During that period the trend of the collective dose has been very similar to that of the individual doses. The total collective dose came up to an amount of 4 manSv per year in the beginning of the eighties. At the end of the nineties this value had decreased to 1.0 manSv per year.

Apart from the regular activities, the modification activities, carried out in 1997, resulted in an additional collective dose of 1,8 manSv. The highest individual dose received in 1997 was 14.0 mSv.

The legal dose limits for members of the public are as follows:
- dose limits for any source is 0,1 mSv/year
-dose limit for all sources together is 1 mSv/year

See Appendix 1 for the background and justification of these numbers.

The discharge limits in the licence for Borssele NPP are as follows:

- **releases in air per year**:

noble gases	500 TBq
halogens	50 GBq of which a maximum of 5 GBq J-131
aerosols	500 MBq
tritium	2 TBq
carbon 14	300 GBq

- **releases in water per year:**

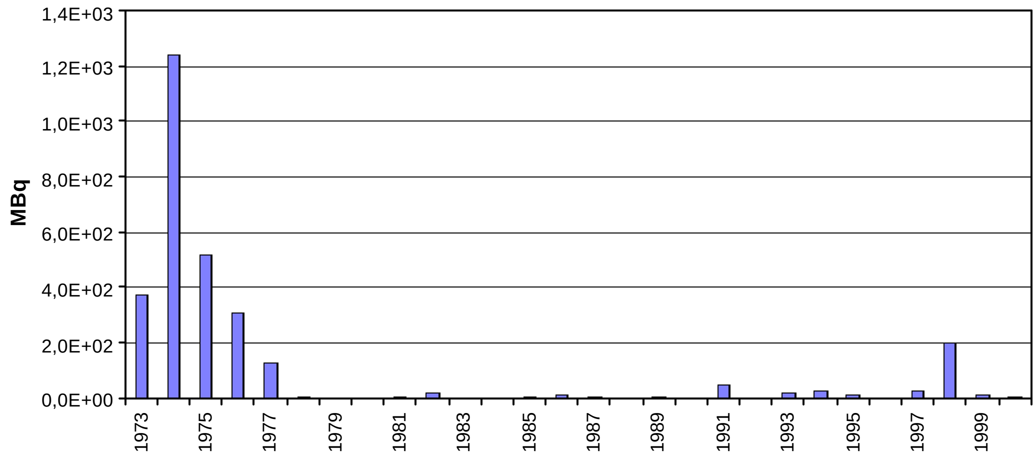
beta/gamma emitters (excl. H-3)	200 GBq
tritium	30 TBq
alpha emitters	200 MBq

The dose consequences to members of the public due to releases in amounts equal to the abovementioned limits are estimated to be:
- maximal individual dose from releases in air: ca. 0.8 µSv per year
- maximal individual dose from releases in water: ca. 0.04 µSv per year

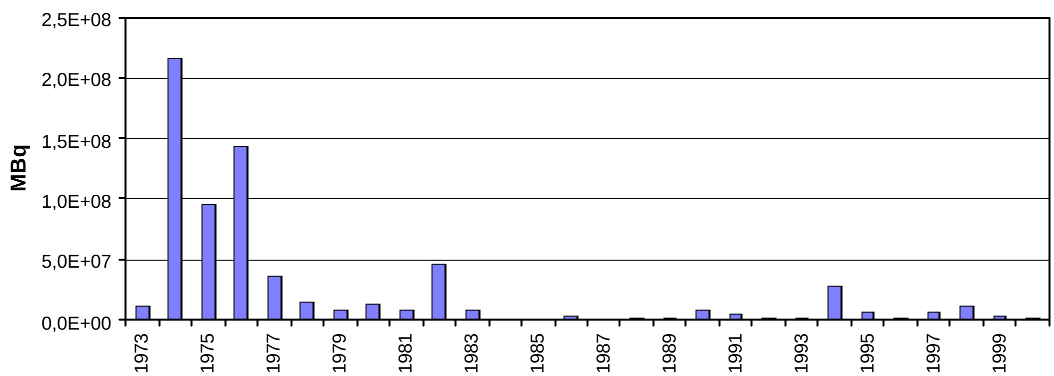
Actual releases from 1973 onwards are shown on the following pages. As the actual releases are normally less than 5% of these discharge limits, the actual doses are also less than 5% of the aforementioned maximal doses.

The (actual) collective dose to the public from the releases in air are estimated at $2.2 * 10^{-3}$ manSv/year
The (actual) collective dose to the public from the releases in water is estimated at $2.8 * 10^{-3}$ manSv/year.

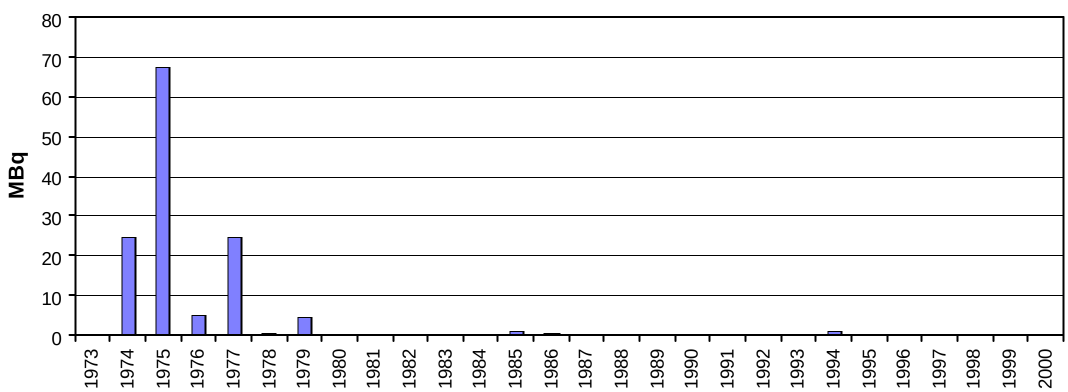
Borssele NPP discharges in air of I-131 (MBq/year); licence limit $5*10^3$ MBq/year



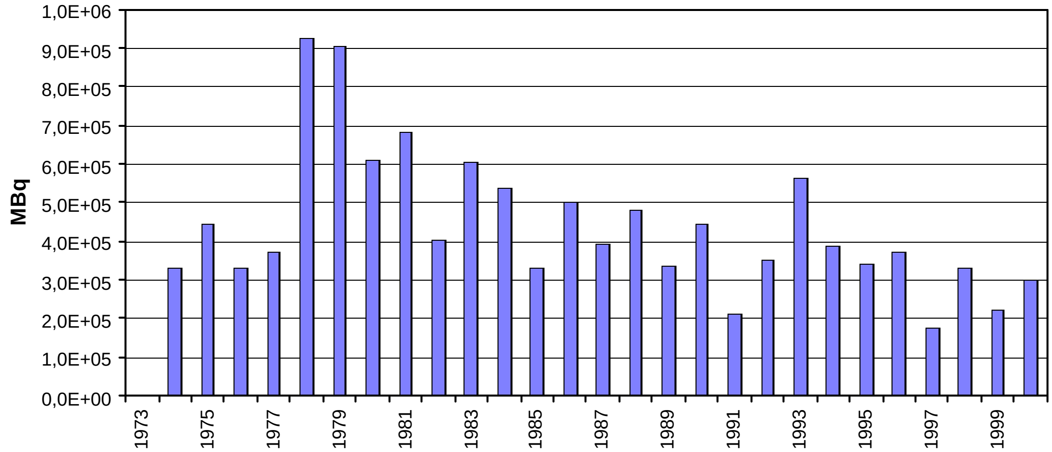
Borssele NPP discharges in air of noble gases (MBq/year); licence limit $5*10^8$ MBq/year



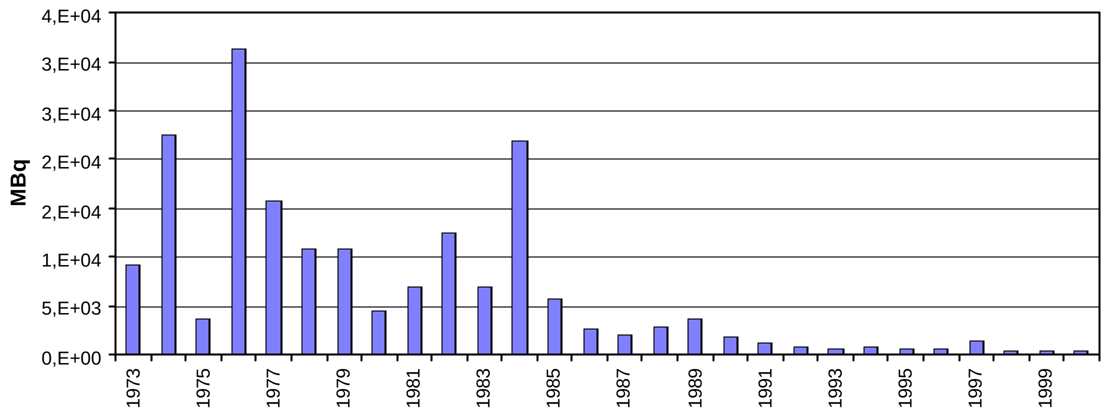
Borssele NPP discharges in air of aerosols (MBq/year); licence limit 500 MBq/year



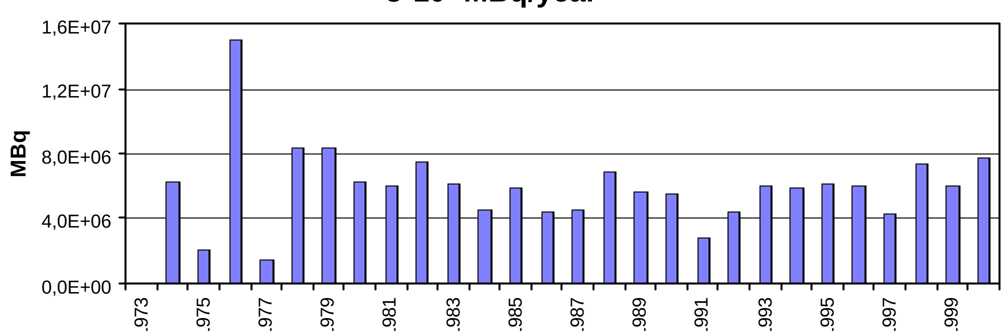
Borssele NPP discharges in air of H-3 (MBq/year); licence limit 2*10^6 MBq/year

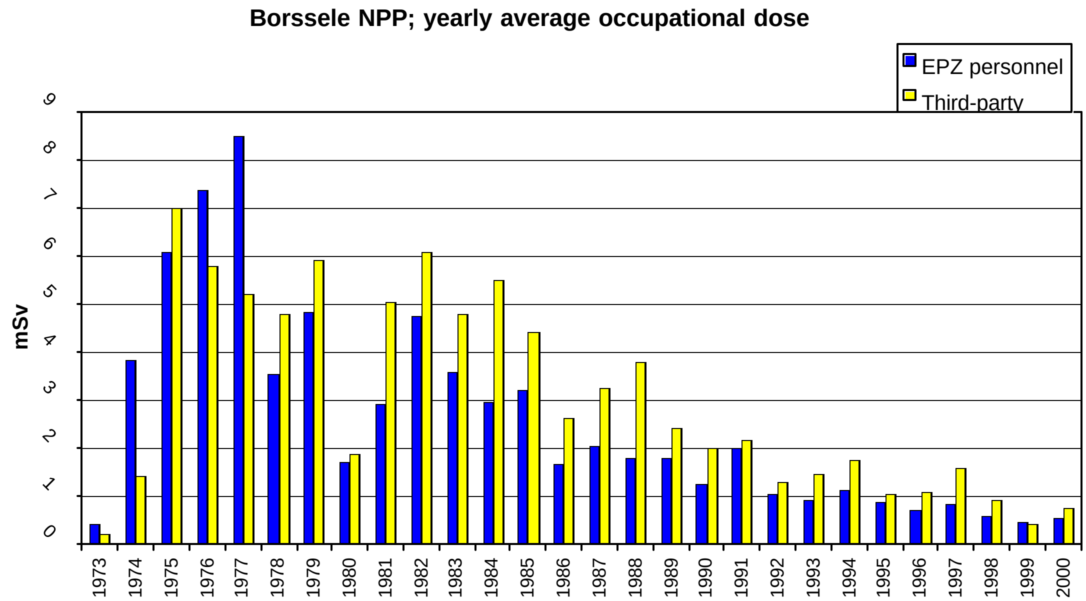


Borssele NPP discharges in water of beta/gamma-emitters; licence limit 2*10^5 MBq/year



Borssele NPP discharges in water of H-3; licence limit 3*10^7 MBq/year




Borssele NPP; yearly average occupational dose
EPZ personnel
Third-party
mSv
0
1
2
3
4
5
6
7
8
9
1973
1974
1975
1976
1977
1978
1979
1980
1981
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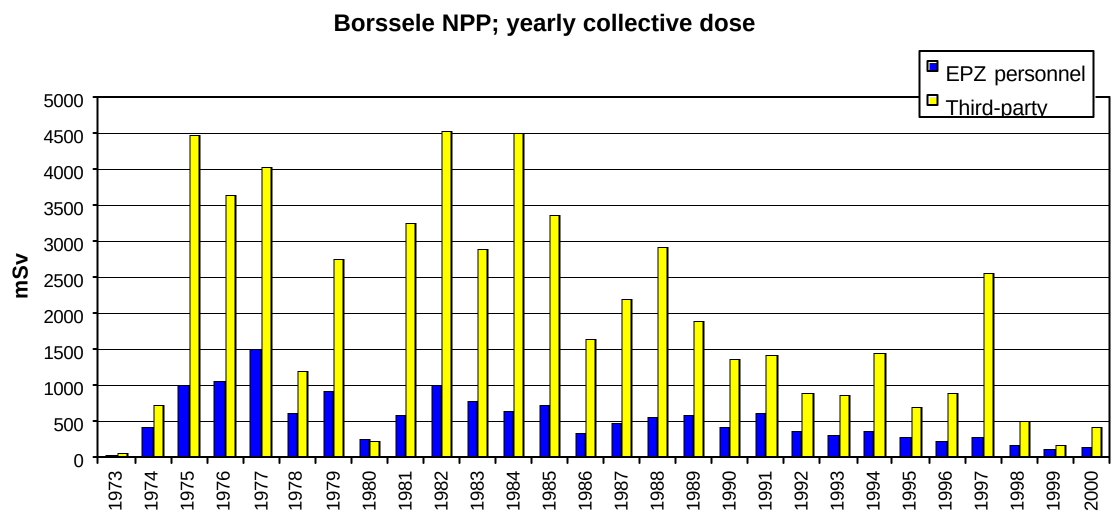
Borssele NPP; yearly collective dose
EPZ personnel
Third-party
mSv
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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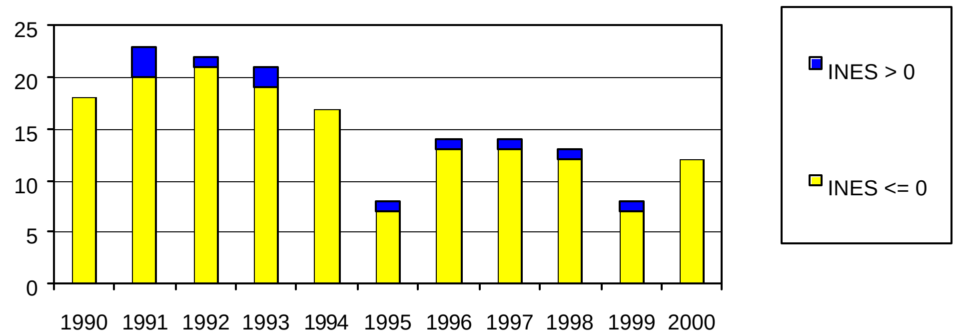
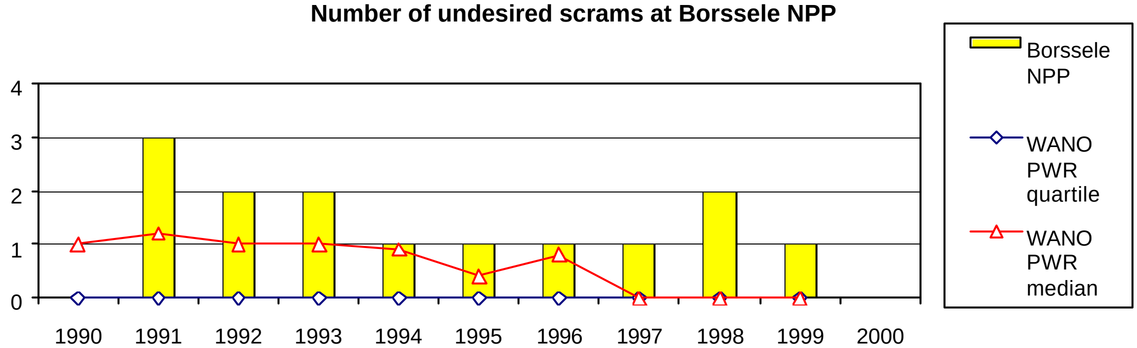
2000

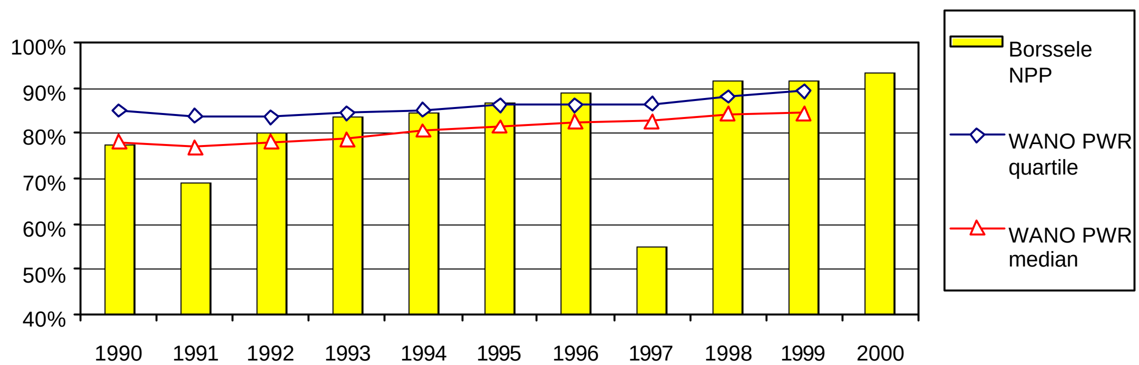
Number of Incident reports



Number of undesired scrams at Borssele NPP



Overall plant availability of Borssele NPP



ANNEX 2: TECHNICAL DETAILS OF THE DODEWAARD NPP AND DECOMMISSIONING DEVELOPMENTS

Introduction:

The Dodewaard nuclear power plant is a light-water BWR, designed by General Electric in the late 1950s (the design is known as the Humboldt Bay design). Construction work started in 1963 and the plant was in operation between 1968 and 1997. Dodewaard had a thermal power of 183 MW and an electrical output of 58 MW. The installation is characterised by the natural circulation of the coolant through the reactor core, which means that no forced recirculation pumps are needed. Another special feature of the Dodewaard plant is the isolation or emergency condenser. The purpose of this system is to keep the reactor pressure below the lowest setpoint of the primary relief valves in the event of an isolation scram. This system is capable of adequate decay heat removal in the event of a station blackout. The containment design can be characterised as a pre-Mark I design and comprises a reactor chamber (drywell), two pressure suppression vessels and two connecting ducts (see Figure 3). The reactor permanently ceased generating power in March 1997.

1. Technical details:

The Dodewaard NPP had the following characteristics:

<u>Overall plant</u>	
Type	GE-BWR (pre- Mark I)
Net electrical output	58 MW
Gross electrical output	60 MW
Rated thermal power	183 MW
<u>Coolant</u>	
Pressure	7.55 MPa
Steam outlet temperature	291 ^{o}C
Steam flow	81 kg/s
<u>Reactor pressure vessel & coolant system</u>	
Internal diameter of RPV	2798 mm
Height of RPV	9036 mm
<u>Safety systems</u>	
Maximum water storage (pressure suppression tanks)	2 x 205 m^3

2. Decommissiong developments:

History

The decision to close the Dodewaard plant was announced publicly in September 1996, and surprised the authorities. Until that date, the plant had been expected to close in 2003. The reason for this decision was that the licensee didn't believe anymore in a nuclear programme in The Netherlands. As Dodewaard always performed a research function for the utilities in order to maintain the nuclear expertise necessary for further expansion of nuclear power generation capability, it made no sense to keep the plant open. Furthermore the economic profitability of the plant was doubtful,

The operation of the Dodewaard plant was terminated in March 1997. Since then, the reactor is in a permanent shutdown state and a process has been initiated to decommission the plant.

The operator (GKN) of the Dodewaard NPP has chosen for a final dismantling of the plant after a waiting period of 40 years. Therefore a safe enclosure will be constructed in the coming years.
In 1998 a modification of the operating licence made it possible that a number of measures were taken as a consequence of the terminating of normal operation and in preparation of the installation of this safe enclosure. Furthermore the spent fuel was removed from the core in the reactorvessel to the spent fuel pool. By the end of 2000 the first spent fuel was shipped to Sellafield for reprocessing. It is expected that by the end of 2002 that all fuel will be shipped to Sellafield. From that moment on it will be possible to start the final activities for the installation of the safe enclosure.

For these upcoming decommissioning activities (installation of safe enclosure and maintain this installation for the next 40 years) an application for a licence has been submitted in May 1999. As the decommissioning of a nuclear installation is an activity that falls under the scope of the new Environmental Impact Assessment Directive of the EU (Directive 97/11/EC), an Environmental Impact Assessment (EIA) was also performed as part of this application. In this EIA 3 methods of decommissioning were compared: (1) dismantling after 40 years, (2) direct dismantling and (3) in-situ decommissioning (no dismantling for a very long period and a ‘burial’ of the site). There was not much difference in the environmental safety issues between these options and since the dismantling after 40 years was the cheapest method, GKN opted therefore.
After lengthy discussions within the government, in May 2000 it was decided that in principle the licence could be granted. At this moment (mid 2001) the licence is being drafted and this draft will soon be published for public discussion.

In parallel, also as a part of the application, a new Safety Analysis Report was being prepared by the licensee. This report is based on the sole option (chosen by the licensee) to dismantle the installation after a 40 years’ waiting time.

Apart from these legal activities, the regulatory body amended the draft IAEA Safety Requirements ‘Predisposal Radioactive Waste Management, including Decommissioning’; NS-152, and the draft IAEA Safety Guide ‘Decommissioning of Nuclear Power Plants and Large Research Reactors’; NS-257. These amended IAEA Safety Standard and Guide will, in the near future, be incorporated in the Dutch Nuclear Safety Rules as NVR 1.4 and NVR 2.4. For the time being they will be attached as conditions to the aforementioned licence.

Technical aspects

For the waiting period a so-called safe enclosure will be ‘constructed’. This safe enclosure consists of the reactor building, turbine building and radwaste building. All the other buildings like the workshop, offices, the ventilation stack, etc. will be dismantled during the preparation for the conservation period. The activities for the ‘construction’ of the safe enclosure comprise:

- modification of the entries of the controlled area;
- locking of other entries;
- modification of sewage systems;
- installation of a new ventilation system;
- installation of new electrical systems;
- installation of new systems for security (e.g., surveillance, monitoring, guarding);
- installation of a new fire-detection system;
- decontamination of the radioactive contaminated systems and components.

Decommissioning costs

The cost of immediate decommissioning of the Dodewaard plant is estimated at about € 150 million. About € 95 million is for the so-called post operational phase of the powerplant (phasing out and decontamination of equipment, removal of spent fuel from the site, etc.). The cost for a decommissioning after 40 year will be a bit higher, € 175 million (current price level), due to the extra costs for conservation of the installation. However, if the financial resources are set aside this moment, and applying a 4% rate of discount (legally allowed and even recommended), thereby allowing capital growth, an amount of € 75 million is sufficient.

These numbers were calculated in 1994/ 1995 by the German company NIS, which is specialised in NPP decommissioning activities. A Dutch working group that included representatives from both licensees and the electricity sector in general reviewed this study. Observers from the regulatory body participated in this working group on decommissioning. In 1995 the government agreed with the conclusions of the NIS-study as a basis for funding. When in 1997 decommissioning of the Dodewaard plant was no longer hypothetical but became an actual and even a political issue, and in view of the fact that the only discriminating factors in the decision-making regarding the decommissioning strategy were the costs, the government decided to call for a contra-expertise. The Netherlands Economic Institute together with Interfaculty Reactor Institute of the Delft University of Technology reached in their contra-expertise the same conclusions as NIS: by a delayed decommissioning some € 50 million to 60 million could be saved.

Latest developments

The fact that the Dodewaard NPP before final dismantling must be maintained in a state of safe enclosure for a period of 40 years makes it essential that this is done in a good organizational structure. As the future of the present owner (GKN) is very unsure (GKN has no other activities), it was decided that it would be a good move to transfer (the remains of) the NPP, including all financial assets, to an organization that is better equipped to perform the tasks to be done in the near and far future. This organization could be COVRA. COVRA is the state-owned central organization for radioactive waste management in The Netherlands. In its installations at Borsele all kinds of radioactive waste (including waste from the reprocessing) can be stored for a very long period (at least 100 years) before a final solution for storage has been found. At present it is investigated to see under which (financial) conditions this transfer could be carried out.

ANNEX 3: ARTICLES OF THE NUCLEAR ENERGY ACT RELEVANT TO NUCLEAR INSTALLATIONS

Article 13:

1 A register will be kept in which a record will be made of the data relating to the fissionable materials, ores and other materials from which fissionable materials can be obtained that contain at least 0,1% uranium or 3% thorium by weight, of which notice has been given in accordance with the provisions of Article 14.

2 The organization of the register will be prescribed, and the situations designated in which information from the register may be divulged to third parties, by or pursuant to order in council.

3 Our Minister of Economic Affairs is responsible for managing the register and for divulging information from it.

Article 14:

1 All persons who transport, store or dispose of fissionable materials, ores or other materials from which fissionable materials can be obtained that contain at least 0,1% uranium or 3% thorium by weight, import them into or export them out of Dutch territory, subject to the provisions of this Act, are obliged to keep full accounts in this connection and to give notice in order to allow a record to be made as referred to in Article 13, in those situations such as are defined by order in council and in accordance with the regulations laid down by order in council.

2 All persons who identify the presence of ores or other materials from which fissionable materials can be obtained that contain at least 0,1% uranium or 3% thorium by weight, in the soil are obliged to give notice thereof in order to allow a record to be made as referred to in Article 13, in those situations such as are defined by order in council and in accordance with the regulations laid down by order in council.

Article 15:

It is forbidden:

a to transport, store or dispose of fissionable materials or ores, or import them into or export them out of Dutch territory without being in possession of a licence;

b to build, commission, operate, modify or decommission a plant in which nuclear energy may be released, in which fissionable materials may be made or processed or in which fissionable materials are stored, without being in possession of a licence;

c to fit and to maintain in such a plant a device that is suitable for propelling a vessel or any other means of transport, or to commission, operate or modify such a device that has been fitted in such a plant, without being in possession of a licence.

Article 15a:

Our Minister of Housing, Spatial Planning and the Environment; Our Minister of Economic Affairs and Our Minister of Social Affairs and Employment are empowered jointly to decide, in consultation with Our Minister of Transport, Public Works and Water Management if it concerns the transport of fissionable materials or ores, or discharges in water, with Our Minister of Agriculture, Nature Management and Fisheries if it concerns discharges in air or water and with Our Minister of Health, Welfare and Sport if it concerns medical applications of radiation, whether or not to grant an application for a licence as referred to in Article 15.

Article 15b:

1 An application for a licence may be rejected only in the interests of:

- a the protection of people, animals, plants and property;
- b the security of the State;
- c the storage and guarding of fissionable materials and ores;
- d the supply of energy;
- e the payment of compensation for any damage or injury caused to third parties;
- f the observance of international obligations.

2 Other interests, in addition to those referred to in the first paragraph, may be designated by order in council.

3 If We have not sent to the Lower House of the States-General, within three months of the date on which an order in council as referred to in the second paragraph has taken effect, a bill to amend this Act in accordance with the order, or if such a bill is either withdrawn or defeated, we shall withdraw the order with immediate effect.

Article 15c:

1 A licence will clearly state its subject matter. The licence application is part of the licence, where this is so indicated in the licence.

2 A licence may be granted subject to certain restrictions, in order to protect the interests designated by or pursuant to Article 15b.

3 A licence is governed, subject to the relevant rules laid down by order in council, by those regulations that are needed to protect the interests designated by or pursuant to Article 15b. If it is not possible to prevent the activity in question from having an adverse impact on people, animals, plants and property by attaching certain regulations to the licence, the licence will be governed by those regulations which offer the maximum protection against this impact, unless it is not reasonable to set such a requirement.

4 If the fissionable materials, ores, plants or devices in question are governed by rules issued pursuant to Article 21, there may be discrepancies between the regulations and these rules only insofar as this is permitted by the rules.

Article 15d:

1 The regulations attached to a licence will describe the objectives which the licence-holder is obliged to achieve in order to protect the interests designated by or pursuant to Article 15b, and which it will achieve in a manner to be determined by the licence-holder.

2 If the competent authorities deem this necessary, the regulations may state that certain specified means should be used to protect the interests designated by or pursuant to Article 15b.

Article 15e:

1 Regulations other than those referred to in Article 15d may be attached to a licence in order to protect the interests designated by or pursuant to Article 15b.

2 A regulation may impose an obligation on the licence holder to meet, in connection with certain items specified in the regulation, certain requirements laid down by an administrative authority specified in the regulation. The regulations may indicate how the administrative authority in question should publish these requirements. The announcement of such a requirement will specify the date as from which the obligation to meet the requirement takes effect.

Article 21:

1 Rules may be laid down by order in council to protect the interests designated by or pursuant to Article 15b, relating to certain categories of fissionable materials, ores, plants, devices or components of plants or devices specified in the order. The order may state that the rules laid down in the order apply only to the particular types of situation specified in the order.

2 Instructions may be given by order in council to the effect that the prohibitions set out in Article 15 do not apply, in certain specified types of situation, to fissionable materials, ores, plants or devices which fall in a particular category specified by the order.

3 Articles 8.12. to 8.16 of the Environmental Protection Act apply *mutatis mutandis* to the regulations laid down under the rules, on the proviso that, in the application of the second paragraph, the only form of financial security which may be prescribed is the provision of insurance cover against liability for any losses resulting from an adverse impact caused by the plant on the interests designated by or pursuant to Article 15b.

4 Should an order in council issued pursuant to the first paragraph declare the provisions of the second paragraph to be applicable, the licence holder may be obliged to report any activities that are not subject to the prohibitions set out in Article 15.

5 Articles 8.40, second paragraph, 8.41, second, third and fourth paragraphs, and 8.42 of the Environmental Protection Act apply *mutatis mutandis*, on the understanding that the words ‘Our Minister’ are taken to refer to Our Minister of Housing, Spatial Planning and the Environment; Our Minister of Economic Affairs and Our Minister of Social Affairs and Employment jointly.