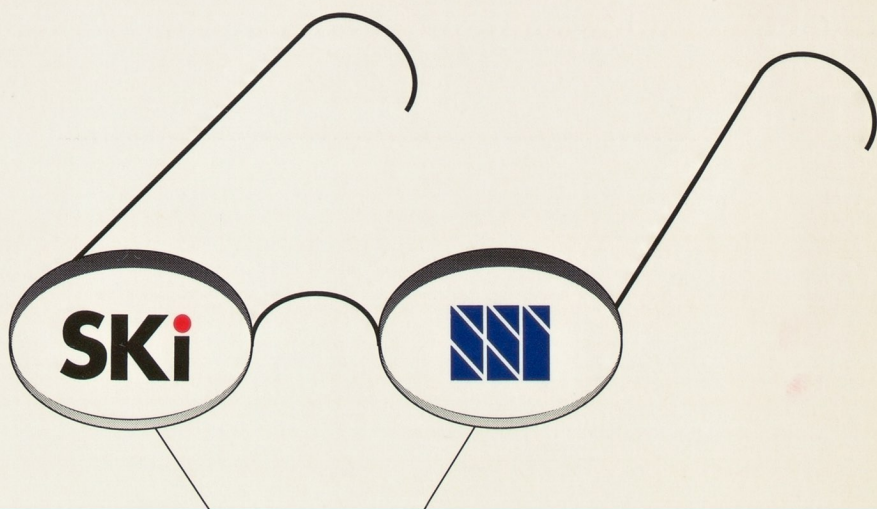


Swedish Nuclear Regulatory Activities

Volume 1 – An Assessment



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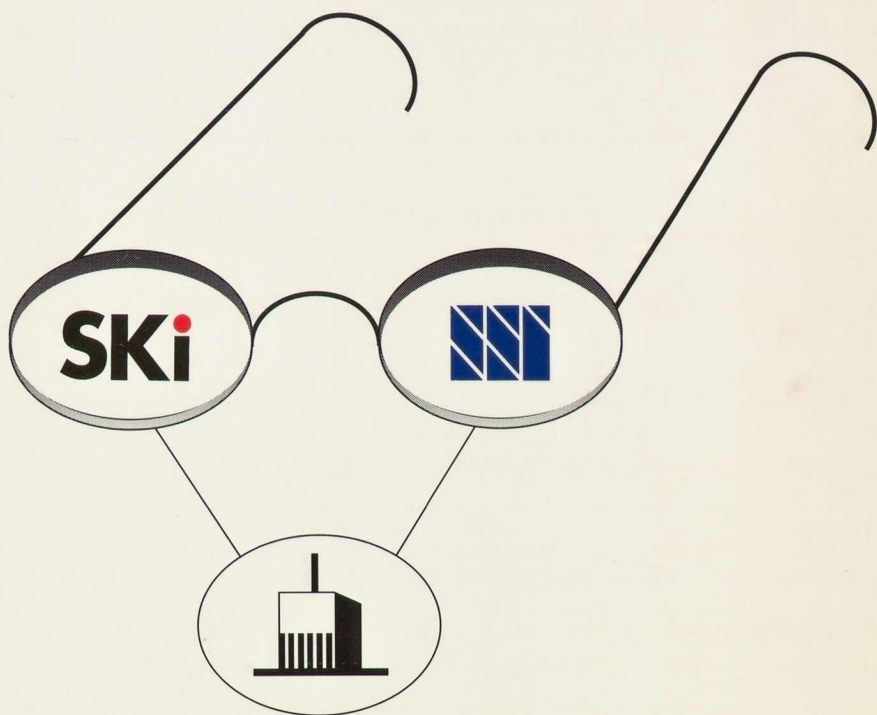
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Swedish Nuclear Regulatory Activities

Volume 1 – An Assessment



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Swedish Nuclear Regulatory Activities

Volume 1 – An Assessment

Report by the Commission of inquiry for an international
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Stockholm, 1996



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To the Minister of the Environment

By government decision on 10 March 1994, the Minister for the Environment and Natural Resources was authorized to appoint an international review group, in the form of a Government Commission of Inquiry, to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste.

Authorized by this decision, the Minister for the Environment and Natural Resources on 19 September 1994 appointed Deputy Director General Olof Söderberg as chairman of the Commission.

By decisions of the Minister of the Environment on 3 April 1995 the following members of the Commission were appointed: Director Robert M. Bernero (retired from Nuclear Regulatory Commission - NRC, USA), Section Head Annick Carnino (Coordination Section, Department of Nuclear Safety, International Atomic Energy Agency, IAEA, Vienna), Director of Safety Jörgen Firing (retired from the Statoil Group, Norway), Deputy Director General Jarl Forstén (Technical Research Centre of Finland, VTT), Air Carrier Operational Inspector Oskar S. Nordland (Scandinavian Flight Safety Survey and Analysis Office, Stockholm), Director Einar Ottne (Scandinavian Flight Safety Survey and Analysis Office, Stockholm) and Director Annie Sugier (Institut de Protection et de Sûreté Nucléaire, France).

The review group has called itself the Commission of Inquiry for an International Review of Swedish Nuclear Regulatory Activities.

On 31 January 1995 Special Advisor Lars Ekecrantz, Ministry of the Environment, PhD Mikael Jensen, the Swedish Radiation Protection Institute and Principal Engineer Bengt G. Pettersson, the Swedish Nuclear Power Inspectorate, were appointed as experts to the Commission.

Principal Administrative Officer Ann-Katrin Eriksson was appointed on 22 November 1994 as secretary to the Commission. Nina Rafting has served as clerk.

The working language of the Commission has been English (cf. Section 1.3); accordingly our report has been drafted in English.

The Commission hereby submits its report on Swedish Nuclear Regulatory Activities. A Swedish version is submitted simultaneously.

The report consists of two volumes. Volume 1, Swedish Nuclear Regulatory Activities - An Assessment, consists of the findings and recommendations of the Commission together with short factual accounts. Volume 2, Swedish Nuclear Regulatory Activities - Descriptions, contains comprehensive background information.

In submitting this report we have completed our task.

Stockholm, April 1996

Olof Söderberg

Robert M. Bernero

Annick Carnino

Jörgen Firing

Jarl Forstén

Oskar S. Nordland

Einar Ottne

Annie Sugier

/Ann-Katrin Eriksdotter

Table of contents

<i>Summary</i>	9
1 <i>Introduction</i>	13
1.1 The assignment	13
1.1.1 The Terms of Reference in summary	13
1.1.2 General commentary on and interpretation of the assignment	14
1.2 How the work has been organized	16
1.3 The outline of the Commission's report	18
2 <i>An overall assessment</i>	19
2.1 Background	19
2.1.1 Supervision of potentially dangerous activities	19
2.1.2 Swedish energy policy and nuclear power generation	23
2.1.3 Future developments affecting Swedish nuclear regulatory activities	25
2.2 The Commission's overall assessment of the nuclear regulatory activities	26
3 <i>The regulatory activities</i>	29
3.1 Discussion of the assignment	29
3.2 The legal framework	30
3.2.1 Description	30
3.2.2 Findings of the Commission	35
3.2.3 Recommendations regarding the legal framework	38

3.3	Regulatory objectives and underlying philosophy . . .	39
3.3.1	Description	39
3.3.2	Findings of the Commission	44
3.3.3	Recommendations regarding regulatory objectives	46
3.4	Internal rules and procedures, including quality assurance	47
3.4.1	Description	47
3.4.2	Findings of the Commission	48
3.4.3	Recommendations regarding internal rules and procedures, including quality assurance	50
3.5	Regulatory supervision in practice	50
3.5.1	Description	50
3.5.2	Findings of the Commission	55
3.5.3	Recommendations regarding regulatory supervision in practice	62
4	<i>Organization, competence and training</i>	65
4.1	Discussion of the assignment	65
4.2	Organization	65
4.2.1	Description	65
4.2.2	Findings of the Commission	68
4.2.3	Recommendations regarding organization . . .	75
4.3	Competence and training	76
4.3.1	Description	76
4.3.2	Findings of the Commission	77
4.3.3	Recommendations regarding competence and training	79
5	<i>Research and development programmes</i>	81
5.1	Discussion of the assignment	81
5.2	Description	81
5.2.1	The SKI	81
5.2.2	The SSI	83
5.3	Findings of the Commission	84
5.3.1	General	84
5.3.2	The SKI	85
5.3.3	The SSI	87
5.3.4	Waste-related research and development	88
5.4	Recommendations regarding research and development programmes	88

6	<i>Division of roles and responsibilities</i>	89
6.1	Discussion of the assignment	89
6.2	The division of roles between the regulatory authorities and the licensees	89
6.2.1	Description	89
6.2.2	Findings of the Commission	92
6.2.3	Recommendations regarding the division of roles between the regulatory authorities and the licensees	93
6.3	The division of responsibilities between the SKI and the SSI	93
6.3.1	Description	93
6.3.2	Findings of the Commission	96
6.3.3	Recommendation regarding the division of responsibilities between the SKI and the SSI	98
7	<i>Economic resources</i>	99
7.1	Discussion of the assignment	99
7.2	Description	99
7.2.1	The SKI	99
7.2.2	The SSI	101
7.3	Findings of the Commission	102
7.3.1	The SKI	102
7.3.2	The SSI	103
7.4	Recommendations regarding economic resources	104
8	<i>Swedish nuclear regulatory activities in an international perspective</i>	105
8.1	Discussion of the assignment	105
8.2	Description of internationally accepted rules	106
8.2.1	Introduction	106
8.2.2	Reactor safety	106
8.2.3	Nuclear waste management	107
8.2.4	Radiation protection	108
8.3	Findings of the Commission	109
8.3.1	General	109
8.3.2	Reactor safety	109
8.3.3	Nuclear waste management	110
8.3.4	Radiation protection	110
8.3.5	General conclusion	111
<i>Appendices</i>		
1	Terms of Reference	113
2	Abbreviations	119

SUMMARY

Background

On 10 March 1994 the Government decided that an international review group, in the form of a Government Commission of Inquiry, should be appointed to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste.

The following members of the review group were appointed by the Minister of the Environment: Director Robert M. Bernero (retired from US Nuclear Regulatory Commission), Section Head Annick Carnino (IAEA, Vienna), Director of Safety Jörgen Firing (retired from the Statoil Group, Norway), Deputy Director General Jarl Forstén (Technical Research Centre of Finland), Air Carrier Operational Inspector Oskar S. Nordland (Scandinavian Flight Safety Survey and Analysis Office, Stockholm), Director Einar Ottne (Scandinavian Flight Safety Survey and Analysis Office, Stockholm), Director Annie Sugier (Institut de Protection et de Sûreté Nucléaire, France) and - as Chairman - Deputy Director General Olof Söderberg, Stockholm.

The review group has called itself the Commission of Inquiry for an International Review of Swedish Nuclear Regulatory Activities. The group held its first meeting in May 1995 and has met at seven occasions in Sweden, the concluding meeting being in April 1996. Each meeting has lasted two to three days.

Based on the Terms of Reference, the Commission has interpreted its overall task to be to describe and evaluate certain regulatory activities of two authorities, the Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Institute (SSI). The activities concern reactor safety (SKI), nuclear waste management (SKI) and radiation protection in connection with nuclear installations and nuclear waste management (SSI).

A more elaborate discussion of the assignment, as well as an account of how the work has been organized and of the outline of the Commission's report are found in *Chapter 1*.

Conclusions and recommendations

An overall assessment is presented in *Chapter 2*. The opinion of the Commission is, that the regulatory work of the SKI and the SSI adequately serves its purpose of ensuring that the operators of nuclear installations are capable of fulfilling their obligations regarding nuclear safety, nuclear waste management and radiation protection. A first basic conclusion of the Commission is:

The SKI and the SSI are providing ample assurance of the confirmation and further development of safety and radiation protection in Swedish nuclear power production and waste management through their regulatory activities.

The Commission has identified areas in which the authorities should consider changes of the *manner* in which the activities are carried out. However, the Commission wants to make it clear that where recommendations for changes have been made, no criticism is implied concerning the results attained through the authorities' regulatory activities. The recommendations are mainly aimed at improving processes and procedures in order to make it easier for the authorities to maintain and improve quality and to increase effectiveness in their activities. Accordingly, a second conclusion of the Commission is that:

The SKI and the SSI might consider certain changes of the manner in which they perform their regulatory activities in order to increase their effectiveness within available resources.

Findings and recommendations in the report should be read bearing in mind these two basic conclusions of the Commission.

Chapters 3-7 deal with different aspects of the regulatory activities carried out by the two authorities and contain findings and recommendations of the Commission. The recommendations are mainly directed towards the two authorities, but some recommendations concern the Government. In the Findings and Recommendations Sections the reader will find the Commission's observations and critical remarks.

In *Chapter 8* Swedish nuclear regulatory activities are evaluated from the perspectives of internationally recognized instruments, conventions and agreements and of participation by the Swedish authorities in

international co-operation for reactor safety, nuclear waste management and radiation protection.

The Commission notes that Sweden has ratified or entered into a number of international conventions in the field of reactor safety, nuclear waste management and radiation protection. Sweden has also entered into bilateral agreements with other countries.

The Commission has noted the extensive participation of both the SKI and the SSI in work initiated within the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency (OECD/NEA). In these two international organizations their participation is highly appreciated and their expertise is particularly recognized for the development of many Standards and State of the art documents.

With regard to *reactor safety*, the Commission notes that the SKI has evaluated the Swedish regulatory system against the IAEA Safety Fundamentals document 'Safety of Nuclear Installations' and concluded that the Swedish legal and regulatory system conforms with the principles in the document. The Commission concurs with this conclusion of the evaluation. When assessing the safety of Swedish reactors or when laying down safety requirements for the reactors, the SKI has based its decisions on international criteria or guidelines.

The Commission understands that the Swedish programme in reactor safety is widely recognized as highly developed and that Sweden is a leading country in the international development of reactor safety controls.

The Commission understands that the Swedish programme for *nuclear waste management* is well developed and that the programme may be among the most advanced in the world. The Commission notes that in the field of nuclear waste management international rules are developing and that Sweden is active in that development and implementation.

The Commission notes that in the field of *radiation protection* Sweden has ratified or entered into a number of international conventions. The most important international body for guidance concerning radiation protection is the International Commission on Radiological Protection (ICRP). Sweden, as one of the initiators, has been actively involved in the ICRP work, and the SSI is providing continuing support and expertise for that work. The Commission also notes that Swedish radiation protection legislation is aligned with the ICRP Publication 60.

The Commission concludes that Swedish legislation and regulatory practice is in accordance with internationally accepted rules in the field of radiation protection.

1 Introduction

1.1 The assignment

1.1.1 The Terms of Reference in summary

The Government decided 10 March 1994 that an international review group, in the form of a Government Commission of Inquiry, should be appointed to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste.

An unofficial translation of the Terms of Reference for the Commission (Dir 1994:21; in Swedish) is provided in *Appendix 1* to this report.

The main purpose of the review is, according to the Terms of Reference, to describe and evaluate:

- the regulatory supervision in the fields of reactor safety and nuclear waste management as carried out in practice by the regulatory authorities;
- the harmonization of Swedish nuclear regulatory activities with Swedish legislation and with internationally accepted quality requirements;
- the harmonization of the organization, competence, training, research programmes and general resources of the authorities, with the regulatory objectives;
- the efficiency with which the economic resources are deployed;
- the way in which the roles have been allocated and the relations prevailing between the regulatory authorities and the licensees; and
- the Swedish regulatory activities, compared with the practice in other countries sharing a similar view of safety.

The review group shall also propose changes in those fields where it is found that Swedish regulatory activities can, or need, to be improved.

1.1.2 General commentary on and interpretation of the assignment

The overall description of the assignment, *to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste*, has been set out in greater detail in the Terms of Reference as follows:

'The assignment involves an independent group of Swedish and international experts reviewing and evaluating the quality of the regulatory activities of the Swedish authorities in the fields of reactor safety and nuclear waste management.

The review is to be conducted in such a way that the Government and the national authorities will be presented with an objective assessment of how Swedish regulatory work in the nuclear field bears comparison with international guidelines and the practice of other countries.

The general purpose of the review shall be to analyse the fields indicated and to compare the results of the evaluation of Sweden's regulatory activities with international experience and internationally accepted recommendations concerning regulatory supervision in the nuclear field.

A review conducted by an international, independent review group could ... provide a qualitative measure of the way in which activities are conducted as compared with similar activities abroad.'

The Commission interprets this overall description of the assignment as follows.

The Commission shall describe and evaluate the regulatory activities of two authorities, the Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Institute (SSI). At the SKI, the review shall be directed towards regulatory activities regarding the safety of nuclear reactors and in nuclear waste management. At the SSI, the review shall be directed towards regulatory activities regarding radiation protection in connection with nuclear reactors and nuclear waste management.

Therefore the Commission's review shall cover the regulatory activities of the two authorities within the following three fields:

- reactor safety (SKI);
- nuclear waste management (SKI); and

- radiation protection in connection with nuclear installations and nuclear waste management (SSI).

It is furthermore within the scope of the Commission's assignment to describe and evaluate the manner in which the authorities ensure that there is feedback between the work conducted in their research and development programmes and the work conducted in their regulatory activities.

For the SKI, the review shall not include matters concerning safeguards, preparedness for dealing with nuclear accidents and questions concerning financing in the area of nuclear waste management. Correspondingly, for the SSI the review shall not include matters concerning preparedness for dealing with nuclear accidents or any SSI activity which does not have a direct link to the nuclear field.

The Commission may question the division of responsibilities and tasks between the SKI and the SSI which is currently based on the Act on Nuclear Activities, the Radiation Protection Act and associated ordinances and other provisions.

However, organizational matters shall not be seen as a main issue. Any recommendations for organizational changes shall therefore be kept on a general level and shall not result in elaborated proposals. If the Commission finds strong reasons for proposing organizational changes, such a conclusion shall be expressed as a recommendation to the Government to investigate the issue in greater depth.

The Commission shall describe and evaluate the legal framework for regulation in the nuclear field. This framework consists of basic provisions decided by the Parliament and the Government as well as of supplementary provisions issued by the regulatory authorities. The description and evaluation of provisions issued by the authorities shall include the rules and procedures which the authorities have set up for their own work. The way in which the authorities assure quality in their work shall also be described.

The Commission shall scrutinize the regulatory objectives which the Government and the authorities have stated and the 'regulatory philosophy' applied by the authorities.

The way in which the SKI and the SSI perform their regulatory activities shall be described and evaluated.

Furthermore, existing 'internationally accepted recommendations concerning regulatory supervision in the nuclear field' shall be described. These recommendations primarily consist of international conventions (existing and in preparation), and such international guidelines, recommendations etc. as have been drawn up by the Inter-

national Atomic Energy Agency (IAEA) and by the International Commission on Radiological Protection (ICRP). In this connection, the Commission shall describe the regulatory work in the nuclear field in other countries with a similar approach to safety as that of Sweden.

The combined expertise of the Commission's members with a varied international background makes it possible to compare the results of the evaluation of Sweden's regulatory activities with international practice and experience.

Descriptions of regulatory activities within other fields demanding a high degree of safety - e.g. civil aviation and offshore activities - may also serve as guidance for the Commission when assessing the work of the SKI and the SSI.

In an evaluation of the Swedish nuclear regulatory practices, it should be noted that there is one major difference with regard to nuclear power generation as compared to other countries. In Sweden, a policy commitment has been made, by a parliamentary decision in 1980, stating that the last of the present twelve nuclear reactors in operation should be shut down no later than by 2010. However, energy policy in Sweden, including the future of nuclear power, is presently under consideration by the Government. The findings of a Government commission of inquiry (called the Energy Commission), which published its report (SOU 1995:139; with an English summary) in December 1995, form the basis of the Government's considerations.

This Commission may comment on which effects Sweden's nuclear power policy might have on the work and performance of the nuclear regulatory authorities. However, this Commission should phrase such possible comments in a way that makes it clear that this Commission has no intention of expressing an opinion on Swedish energy policy.

1.2 How the work has been organized

Preparatory work started in January 1995. The international members of the Commission were appointed in April 1995. A first meeting took place in May 1995. It was decided that the working language of the Commission should be English, that the final report should consequently be drafted and finalized in English and that a Swedish translation of the report should also be produced by the Commission.

A consequence of the decision to use English as a working language has been that the SKI and the SSI had to put extensive work into translations of documents which were originally only available in Swedish.

In January 1995, formal letters were sent to the SKI and the SSI

asking them to present a written self-evaluation with regard to the areas stated in the Terms of Reference for the Commission. In the same letters, the two authorities were also requested to present a description of those areas of their activities which are relevant to the inquiry.

At the same time, the regulated nuclear utilities and industry (a total of eight companies) were asked to present to the Commission their comments on the activities of the regulators. The local liaison safety committees (a total of five, one at each reactor site) and three environmentalist organizations were also given the opportunity to comment on the activities of the SKI and the SSI.

The statements received during March and April 1995 from the SKI, the SSI and the regulated companies have, together with other comments, formed a basis for interviews held by the Commission. Such interviews have been held with the managements of the regulated utilities and industry and with the managements and staffs of the SKI and the SSI. The two authorities have been invited to comment upon the opinions expressed from the utilities.

At the first meeting of the Commission, in May 1995, both the SKI and the SSI were given opportunities to present and describe their activities. In August 1995, the Commission met with staff members of the two authorities for extensive interviews, with questions which had been prepared in advance. Further interviews were held during the period of October 1995 – January 1996.

The Commission has devoted more time to evaluating the activities of the SKI than those of the SSI in the nuclear energy field. The reasons are the following.

After the introductions made by the authorities in May 1995, the Commission's impression was that it understood fairly well how the SSI functions, while its picture of the SKI was less clear. This was also the case after the August interviews with staff members of the two authorities. The SKI and the SSI were asked to present written descriptions of their regulatory activities. The SKI also had initial difficulties in presenting a coherent picture of itself in writing. In February 1996, the Commission received a final description of the SKI.

The initial problems that the Commission faced in understanding the activities of the SKI had as a result that the Commission devoted more time and effort to the review of the SKI than to that of the SSI. For example, the Commission took part in the inspection activities carried out by the SKI, but not in those carried out by the SSI. The Commission also studied the research and development (R&D) activities of the SKI in greater depth than those of the SSI. One further reason for giving special attention to the SKI R&D programme is that the

resources allocated to the SKI R&D programme are considerably larger than those allocated to the SSI R&D programme.

The facts which have just been accounted for, may explain why the findings and recommendations of the Commission concern the SKI to a greater extent than the SSI.

1.3 The outline of the Commission's report

The Commission's report is published in two separate volumes (Volume 1 and Volume 2).

Volume 1 consists of an assessment, together with short factual accounts. The findings and recommendations are based on extensive written material supplied by the SKI, the SSI and others, on interviews with the managements and the staff members of the SKI and the SSI, on interviews with the management of regulated utilities and industry and on observations made by Commission members during their investigatory work.

The contributions by the SKI and the SSI form parts of *Volume 2*. This volume also contains other factual accounts, which the Commission considers to be of particular importance for the understanding of the findings and recommendations in Volume 1. A list of the more important documents which have been used as a basis for the discussions at the meetings of the Commission is included in Volume 2. A list of individuals - apart from the managements or staffs of the two authorities - who have provided information at Commission meetings, is also included.

The responsibility for the accuracy of the accounts in Volume 2 rests with the authors.

2 An overall assessment

2.1 Background

2.1.1 Supervision of potentially dangerous activities

In all societies, many activities are conducted which could result in an accident leading to severe consequences for people, animals or the environment. The reason for allowing such potentially dangerous activities in society is that the benefits are considered to outweigh the possible harmful effects.

Allowing potentially dangerous activities makes it especially important for society to make sure that the probability of an accident is very low. Precautionary action is to be taken by those performing and by those regulating activities of this kind.

Some well-known examples of permitted - and strictly supervised - potentially dangerous activities are civil aviation, offshore oil extraction and nuclear power production. These activities are supervised, both by those who perform the activity and therefore have a direct responsibility for the daily operations (the operators), and by special supervisory organizations (the regulators). The regulator may be seen as representing the public interest of attaining 'safe' operations. In most cases, the supervision is carried out by government authorities and is based on provisions in a country's legislation. In some cases, such legislative provisions are based on international agreements or agreed principles and practices.

This system for supervision is in accordance with an industrial culture that requires internal control of potentially dangerous activities.

In Sweden, there are a number of government authorities, often called 'inspectorates', which are responsible for regulating potentially dangerous activities in order to ensure that they are performed in a 'safe' manner. There are, for example, authorities with duties covering civil aviation, sea transportation, rail transportation and the handling of explosives.

Supervision of nuclear activities in Sweden is performed both by the operators and by the regulators. The purpose of this supervision is to:

- implement dose reduction strategies under normal operations;
- prevent the occurrence of an accident; and,
- mitigate the radiological consequences of an accident, should it happen.

Sweden has always adhered to one of the basic principles expressed in the 1994 Convention on Nuclear Safety, namely that the prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence. Thus, in Sweden, the operator of a reactor (the power utility operating a nuclear reactor) is legally responsible for nuclear safety and radiation protection at its own installation. The task of the regulatory authorities is to ensure that the legally responsible utility has the ability to and does carry out its obligations.

An explicit definition of the concept 'nuclear safety' has not been included in the Convention on Nuclear Safety (cf. Volume 2, Section 8.2.1).

For the reader's understanding of the three basic concepts of 'nuclear safety', 'radiation protection' and 'nuclear waste management', the study of two recent documents issued by the International Atomic Energy Agency (IAEA) could be helpful.

The IAEA publication Safety Series No. 110 'The Safety of Nuclear Installations' (published in 1993 as a Safety Fundamentals document, cf. Volume 2, Section 8.1) contains the following discussion in paragraphs 203-208:

203. *General Nuclear Safety Objective:* To protect individuals, society and the environment from harm by establishing and maintaining in nuclear installations effective defences against radiological hazards.
204. This General Nuclear Safety Objective is supported by two complementary Safety Objectives dealing with radiation protection and technical aspects. They are interdependent: the technical aspects in conjunction with administrative and procedural measures ensure defence against hazards due to ionizing radiation.
205. *Radiation Protection 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.

206. *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.
207. Safety Objectives require that nuclear installations are designed and operated so as to keep all sources of radiation exposure under strict technical and administrative control. However, the Radiation Protection Objective does not preclude limited exposure of people or the release of legally authorized quantities of radioactive materials to the environment from installations in operational states. Such exposures and releases, however, must be strictly controlled and must be in compliance with operational limits and radiation protection standards.
208. To achieve the Safety Objectives, measures need to be taken to control radiation exposure in all operational states to levels as low as reasonably achievable and to minimize the likelihood of an accident that might lead to the loss of normal control of the source of radiation. Nevertheless, accidents can happen. Measures are therefore required to ensure that any radiological consequences are mitigated. Such measures include on-site management procedures and off-site intervention measures in order to mitigate radiation exposure after an accident has occurred. The greater the potential hazard from an uncontrolled release of radioactive material, the lower the likelihood must be of its occurrence.

The account in this IAEA document is the basis for the Commission's use of the terms 'nuclear safety' and 'radiation protection'. The Commission is of the opinion that this use of the two terms is consistent with Swedish law.

Another relevant document is the IAEA publication Safety Series No. 111-F 'The Principles of Radioactive Waste Management', published in 1995 and presented as a Safety Fundamentals document in the RADWASS hierarchy (cf. Volume 2, Section 8.1).

This document defines the objective of radioactive waste management as follows:

201. The objective of radioactive waste management is to deal with radioactive waste in a manner that protects human health

and the environment now and in the future without imposing undue burdens on future generations.

It should be noted that 'radioactive waste' includes, but is not limited to, the concept of 'nuclear waste'.

The following short account of differences between countries as to the range and extent of supervision by regulatory authorities may also serve as a useful background for the reader.

In some countries, e.g. in the USA, the nuclear regulatory authority prescribes in great detail how an operator should conduct his business in order to meet the demands for nuclear safety and radiation protection. This is the so-called 'prescriptive approach'. In other countries - like in France and in Sweden - the utilities are expected to assume their legal responsibilities for nuclear safety and radiation protection without detailed prescriptions by the regulatory authorities. The task of the regulatory authorities in these countries could best be described as follows: They should ensure that the nuclear utilities are not only willing, but also have the ability to assume and satisfy their legal responsibilities. This is the so-called 'non-prescriptive approach'.

On the Norwegian continental shelf, the principle of the operator's responsibility for safety is clearly defined in the Petroleum Act and regulations. It is a basic premise for the authorities' supervision of safety that anyone conducting or taking part in petroleum activities has a duty to ensure that the Act, regulations and administrative decisions are complied with.

Within the Scandinavian civil aviation industry a similar philosophy is applied. All operators or individuals conducting aviation activities need a certification granted by the civil aviation authorities. Documented ability to ensure that all employees are familiar with and are fully aware that they shall comply with the laws, regulations and procedures of the States in which operations are conducted, is a condition for the granting of such a certification.

It can also be noted that in at least one country - Finland - regulatory functions concerning nuclear activities are performed by one single authority, while in most other countries such functions are performed by two or more authorities. For the Norwegian offshore activities there are several supervisory authorities, but one of them has been appointed as the co-ordinating authority in safety matters.

In Sweden there are two authorities with responsibility for regulatory supervision in the fields of reactor safety, nuclear waste management and radiation protection. The two authorities are the SKI which focuses

on nuclear safety issues and the SSI focusing on radiation protection issues.

2.1.2 Swedish energy policy and nuclear power generation

The twelve Swedish nuclear power reactors, located in Ringhals (R1-R4), Barsebäck (B1-B2), Oskarshamn (O1-O3) and Forsmark (F1-F3) were taken into operation during the period of 1972-1985. They are presently supplying Sweden with about 50 % of its electricity demand. This situation has prevailed since the latter part of the 1980's, after O3 and F3 had been connected to the grid in 1985.

One major element in Swedish energy policy is the decision made in 1980 by the Parliament that nuclear power should be completely phased out by 2010 at the latest. This decision was confirmed in 1991 by an agreement between political parties representing a majority of the Swedish Parliament.

In December 1995 the Energy Commission, consisting of representatives from all political parties in the Parliament, presented a report to the Minister for Energy on the issue of restructuring and developing the energy system of Sweden (Swedish title: Omställning av energisystemet, SOU 1995:139; Summary in English). Among other things, the consequences of phasing out nuclear power were analysed.

A political majority of the Energy Commission concluded that one nuclear power reactor can be shut down during the 1990's without weakening the power balance noticeably (p. 61). Phasing out another smaller nuclear reactor would, however, according to the Energy Commission, decrease the margins significantly.

When it comes to the bigger issue of the future role of nuclear power in the Swedish electricity production system, a political majority of the Energy Commission concludes as follows (p. 62):

The Energy Commission believes that both economic and environmental arguments support the idea that the reorganization of the energy system should take place over a sufficiently long period of time so that the objectives of the 1991 energy policy agreement are attained.

The Commission considers that a number of conflicts of objectives remain to be solved. This is apparent from the climate issue. There are also problems for employment and welfare and difficulties in retaining competitiveness if all nuclear power generation is to be phased out to year 2010. The results of greater energy efficiency, the

supply of renewable energy and the possibilities of maintaining internationally competitive prices will determine the speed at which nuclear power is phased out. With regard to the Energy Commission's forecasts and assessments, an exact time-limit setting out the year in which the last reactor is finally taken out of operation should not be specified.

The Commission considers that it is important that the phase out be begun at an early stage so that the adjustment process can be initiated. In this context, powerful economic control measures are of crucial significance. The Energy Commission believes that one nuclear power reactor can be shut down during the present mandate period without noticeably affecting the power balance. (*Note: The expression 'mandate period' refers to the period ending with the next ordinary general election, September 1998.*)

The Energy Commission also discusses the workload and resource requirements of the SKI and the SSI. According to the Energy Commission (p. 62):

the workload and resource requirements of SKI and SSI may grow more than they already have in recent years. It is important that these authorities should have sufficient resources for their monitoring activities and for research, as well as for developing competence and for international exchange of experience. Society's supervision of nuclear safety and the state's overall responsibility for it must be preserved. The resource reinforcement which may be necessary should be financed through increased charges imposed on the nuclear power companies.

The report of the Energy Commission will be widely discussed during the first half of 1996. In March 1996 the Government invited all political parties to participate in discussions about the energy policy.

This Commission is not concerned with Swedish energy policy. The task of the Commission is to review the regulatory activities pursuing safety and radiation protection in connection with nuclear power production as long as this production exists. It is also the task of the Commission to assess the requirements for present and future regulatory activities in connection with the handling and disposal of waste from nuclear power production and with future decommissioning activities. Consequently, this Commission considers nuclear safety and radiation protection issues both in a short- and in a long-term perspective.

The long-term tasks of the regulatory authorities might be affected by the decisions concerning energy policy, which are expected to be made later this year.

2.1.3 Future developments affecting Swedish nuclear regulatory activities

In the view of the Commission, there are a number of circumstances, besides the energy policy, which might affect the tasks of the SKI and the SSI. According to the Commission, the following circumstances should be taken into account when the activities of the SKI and the SSI are considered.

- For the Swedish nuclear reactors, operating licences are based on the level of technical requirements from the 1970's and 1980's. The corresponding level of requirements now emerging in the European reactor designs of the 21st century is enhanced, and the question arises of which level of technical requirements should be applied for the existing Swedish reactors in the years to come.
- The nuclear power plants are ageing and may need more continuous surveillance, maintenance and repairs; such projects, where safety and radiation protection demands have to be balanced against each other, are gradually growing and becoming more complex. One example is the recent major renovation of one reactor at Oskarshamn (O 1).
- The operators' present willingness to initiate investments for improving safety, without necessarily being requested to do so by the regulatory authorities, might be affected negatively as nuclear reactors approach the end of their operational lifetime.
- During the phasing out of nuclear reactors the SKI and the SSI will be confronted with new tasks concerning the supervision of the decommissioning and the dismantling of the reactors.
- Developments in the field of nuclear waste management - especially spent nuclear fuel and high-level waste - will demand that the regulators change their focus, as the measures taken by the utilities proceed from research and development work to a phase with design, demonstration and implementation of possible methods for disposal.
- The issues concerning spent nuclear fuel management call for close collaboration between the two authorities. The siting programme for a repository for spent nuclear fuel requires extensive contacts with the inhabitants and local politicians in municipalities where a

repository might be located in the future. Inhabitants and local politicians in those municipalities demand to be advised and informed by independent government authorities with expert knowledge in relevant fields. The regulatory authorities are expected to meet such increased demands for information and consultation.

- Sweden's ratification, in 1995, of the Convention on Nuclear Safety will require the active participation of the SKI in the implementation and the review process foreseen in the Convention. Preparatory work within the IAEA on a Convention on Nuclear Waste Management will also require active participation both by the SKI and the SSI.
- It is increasingly important for all government authorities, and especially in complex fields such as nuclear safety and radiation protection, to be able to explain to laymen and the general public what they are doing and why.
- The Government and the Parliament are putting pressure on all government authorities to use their resources in an efficient way and to report, on an annual basis, the results of their activities with regard to goal attainment and cost-effectiveness.

The Energy Commission has recently discussed SKI's and SSI's future need for resources. This Commission discusses questions concerning resources in Chapter 7 of this report.

2.2 The Commission's overall assessment of the nuclear regulatory activities

The Commission notes that both the SKI and the SSI have a high international reputation for competence and integrity. The Commission also notes that the authorities have the same high reputation with the regulated utilities. The utilities have stressed that they consider demanding and competent authorities to be one of the key elements of their policy to maintain a sufficiently high standard in their own work for nuclear safety and radiation protection. They have also presented comments on areas where they believe that the functioning of the authorities could be improved and have made some suggestions with this in view.

The Commission shares the view that it is of crucial importance for nuclear safety, waste management and radiation protection that the regulatory authorities are well-functioning.

The overall opinion of the Commission is that the regulatory work of the SKI and the SSI adequately serves its purpose of ensuring that the operators of nuclear installations are capable of fulfilling their obligations regarding nuclear safety, nuclear waste management and radiation protection.

Based on the interviews of and the material supplied by the authorities, as well as on the information received from the nuclear utilities and the industry at large through interviews and in written form (Volume 2, Chapter 11), the Commission's first basic conclusion is that:

- The SKI and the SSI are providing ample assurance of the confirmation and further development of safety and radiation protection in Swedish nuclear power production and waste management through their regulatory activities.

The Commission has identified areas in which the authorities should consider changes of the *manner* in which the activities are carried out. However, the Commission wants to make it clear that where recommendations for changes have been made, no criticism is implied concerning the results attained through the authorities' regulatory activities. The recommendations mainly aim at improving processes and procedures in order to make it easier for the authorities to maintain and improve quality and to increase effectiveness in their activities. Accordingly, a second conclusion of the Commission is that:

- The SKI and the SSI might consider certain changes of the manner in which they perform their regulatory activities in order to increase their effectiveness within available resources.

Findings and recommendations in the following chapters should be read bearing in mind these two basic conclusions of the Commission.

3 The regulatory activities

3.1 Discussion of the assignment

According to the Terms of Reference, one main task of the Commission is to describe and evaluate the regulatory supervision in the fields of reactor safety and nuclear waste management as carried out in practice by the regulatory authorities. This task is specified more in detail in the Terms of Reference as follows:

The assignment involves an independent group of Swedish and international experts reviewing and evaluating the quality of the regulatory activities of the Swedish authorities in the fields of reactor safety and nuclear waste management.

Partly on the basis of national legislation and the administrative arrangements applied, an assessment should be made of the quality attained in inspections, investigations and analyses carried out by the authorities and of the possibilities which the authorities have of enforcing their requirements. The regulatory strategy chosen by the authorities is to be taken into consideration in this assessment. The assessment should also include the regulations and recommendations issued by the authorities and the way in which these are followed up through the regulatory work.

The Commission has interpreted this task as follows. The Commission shall describe and evaluate the legal framework for regulation in the nuclear field. This involves:

- Swedish acts, ordinances, letters of appropriation, regulations, recommendations, licence conditions etc.;
- the regulatory objectives of the authorities and the underlying regulatory philosophy; and
- the internal rules and procedures of the authorities, as documented in e.g. operation manuals, inspection manuals and manuals concerning internal quality assurance.

The review of the Commission is not aimed at assessing whether the two authorities have made correct decisions on a number of occasions

in the past. Instead the Commission assesses whether the manner of working is such that it supports regulatory activities of a sufficient quality. This means that the review of the Commission is 'process-oriented' rather than 'result-oriented'.

This chapter covers the legal framework, regulatory objectives and underlying philosophy, internal rules and procedures, including quality assurance, and regulatory supervision in practice.

3.2 The legal framework

3.2.1 Description

The basic legislation defining the responsibilities of the SKI and the SSI is the Act (1984:3) on Nuclear Activities and the Radiation Protection Act (1988:220). They are supplemented by two ordinances, issued by the Government. The specific tasks assigned to the SKI and the SSI are further described in two other ordinances with instructions for each of the two authorities. More detailed provisions, establishing for example regulatory objectives for each of the two authorities, are stated in separate government decisions (see Section 3.3).

Nuclear safety

The Act on Nuclear Activities and the Ordinance (1984:14) on Nuclear Activities define the requirements and responsibilities that apply to nuclear activities. The basic aim of this legislation is to ensure safety in connection with nuclear activities. The Act contains provisions putting the full responsibility for safety on the operators of nuclear installations. At the same time the Act creates instruments for the supervision of and public insight into nuclear activities. The regulatory supervision is further described in the Ordinance (1988:523) with instructions for the SKI.

For nuclear activities, a licence is required. Matters on licensing are decided upon by the Government and, in a few cases, by the SKI or by the SSI.

By law no new nuclear power reactors can be built in Sweden (cf. Chapter 2 and Volume 2, Section 2.2.3). The provisions in the legislation concerning the licensing of new nuclear installations are therefore only applicable to facilities for the disposal of nuclear waste

and spent nuclear fuel and for the handling of nuclear material and nuclear waste.

For an understanding of the legislative basis for regulating the nuclear activities (inter alia reactor operation, fuel manufacturing, nuclear waste management and the processing of nuclear material), some insight into the licensing process is essential. The licensing process includes elements such as the application of the operator supported by a safety analysis report, an authority safety review and assessment, the licensing decision and the issuing of licence conditions. The concept of licence conditions originated in the early phases of the development of the Swedish nuclear safety legislation, and has been carried over into the current Act on Nuclear Activities.

Licence conditions can, according to both current and earlier legislation, be issued at the time of granting the licence and also at any time during the time of validity of the licence. The first set of licence conditions is issued by the body granting the licence, in most cases the Government. A Government-issued licence includes a statement giving the SKI (its predecessor, as applicable) the right to issue additional licence conditions as may be, or may become, necessary from the standpoint of safety. The provision in the Act also makes it possible for the Government, in its capacity of having granted the original licence, to later issue additional licence conditions.

All existing nuclear installations in Sweden, and all ongoing nuclear activities, have been licensed in such a way that licence conditions apply. In modern terminology, these licence conditions practically form what is called 'safety regulations'. Due to the fact that the 'safety regulations' have been issued as licence conditions, all such conditions are specifically directed to the holder of the licence for the particular nuclear installation or activity that has been granted the licence.

Notwithstanding the fact that 'safety regulations', in the form of licence conditions, are specific to the operation carried out by one licensee, licence conditions may, in fact, apply to more than one operation or licensee. Examples include instances where Sweden is under the obligation of a bilateral or international agreement and where, therefore, identical safety-related requirements apply to several operations or licensees. International agreements relate, for example, to nuclear non-proliferation (safeguards) and common requirements relate, for example, to physical protection and quality assurance. The SKI early recognized the need for and benefit of drafting 'regulations' that were common to several operations, but, for legal reasons they had to be issued as licence conditions.

The SKI has issued such 'common regulations' concerning, inter alia, quality assurance, the training and competence of staff operating nuclear reactors and the transportation of nuclear material and nuclear waste. Other 'common regulations' concern physical protection and safeguards.

Licence conditions decided by the SKI can be based on a proposal drafted by the operator. In such instances, the SKI formally reviews the proposal, and subsequently approves the draft proposal. The approval results in the incorporation of the approved draft into the set of licence conditions in force. Where changes of such licence conditions are later proposed by the operator, the approval of the SKI is required. One of the most important components of the licence conditions for the nuclear power plants - the plant-specific Technical Specifications (STF) - has been established in this manner.

The current 1984 Act on Nuclear Activities underwent a comprehensive review in the early 1990's. Among the amendments resulting from the review is the provision which from 1993 authorizes the SKI to issue *general regulations*, i.e. regulations that each addresses a specific activity or aspect of nuclear safety and that legally applies to all operators engaged in that particular activity. Such general regulations become valid, and are applicable, once they are published in the SKI Code of Statutes (SKI FS). However, the concept of licence conditions still applies.

The SKI has so far issued one general regulation, based on the right from 1993 to issue such regulations (SKI's Regulations concerning Mechanical Devices in Nuclear Installations, SKI FS 1994:1). This means that the main part of the provisions regarding reactor safety is still in the form of sets of licence conditions, each of which is linked to the licence for a particular nuclear reactor.

Licensing of nuclear waste treatment and interim storage facilities at the nuclear reactor sites follows the same general procedure as that described for reactors. Criteria and rules for the assessment of safety in connection with the handling and final disposal of reactor waste from the nuclear power plants are mainly included in the licensing documents for the final disposal facility for low- and intermediate-level waste (SFR).

Licence conditions, irrespective of whether they have been issued as 'common regulations' or installation-specific conditions, and general regulations are equally supported by the enforcement provisions in the Act on Nuclear Activities.

For more detailed information about the licensing process, see Volume 2, Section 3.1.2.

Licensing criteria and rules for the assessment of the level of safety in connection with the final disposal of spent nuclear fuel and high-level waste are currently being developed at the SKI.

Radiation protection

The Radiation Protection Act and the Radiation Protection Ordinance (1988:293) constitute the overall legal framework for issues relating to protection against radiation. In the Ordinance (1988:295) with instructions for the SSI, it is stated that the SSI is the competent authority for issues concerning the protection of people, animals and the environment against the harmful effects of ionizing and non-ionizing radiation.

The Radiation Protection Ordinance gives the SSI the possibility of issuing general regulations. This provision has been in force for a much longer time than the corresponding provision for the SKI in the Ordinance on Nuclear Activities. Like the SKI, the SSI sometimes issues licence conditions. The SSI Code of Statutes (SSI FS) currently contains 29 general regulations. Of these regulations, eight are of special interest for the supervision of nuclear activities (SSI FS 1981:3, 1989:1, 1989:3, 1991:5, 1991:6, 1994:1, 1994:2 and 1994:5).

For a long time, the SSI has been regulating activities relating to radiation through prescribing, inter alia, dose limits for radiation work and for the release of radioactive material, requirements regarding equipment that generate radiation etc. The regulations concern both nuclear and non-nuclear activities. Some regulations apply to both kinds of activities, but generally they are related to only one of the areas.

At the SSI, work is in progress to define criteria for the protection of people, animals and the environment against radiation. Regulations are planned for the handling of spent nuclear fuel and radioactive waste from the decommissioning of nuclear facilities, clearance and documentation of waste etc. The regulation on personnel monitoring and protective measures for work in connection with a nuclear accident is being reviewed and regulations, alternatively guidance, for emergency preparedness are under consideration. An adaptation of regulations imposed by the European Union is also in progress.

Plans for co-operation between the SKI and the SSI on the issuing of general regulations

In a joint letter of June 1995 the Director Generals of the SKI and the SSI informed the licensees that they have discussed co-operation between the authorities on the issuing of regulations. They consider close co-operation and co-ordination between the SKI and the SSI to be important in the field of nuclear energy in order to avoid uncertainties and interpretation problems. Attached to the letter is a joint report describing current plans for the development work on regulations by both authorities and identifying particular co-operation and co-ordination needs. The highest demand on co-ordination relates, according to this report, to common safety requirements, nuclear waste management, emergency preparedness and transportation. According to the report, SSI regulations concerning the handling of spent nuclear fuel or other activities associated with the final disposal of nuclear waste, will be issued no later than by mid-1996. SSI regulations concerning the decommissioning of nuclear facilities are planned for a longer time scale. Also according to the report, it is foreseen that during 1996, the SKI will issue three general regulations and start consultations concerning several others.

Enforcement possibilities

Both authorities gain their enforcing power from legislation, namely the Act on Nuclear Activities and the Radiation Protection Act. Both authorities also have the mandate to issue regulations and licence conditions. The Acts specifically require a licence for carrying out nuclear activities and activities involving radiation. The Acts also specify requirements on and obligations for the licensee, with regard to safety and radiation protection and to the management of waste. If such basic provisions are not complied with, the licensee can be brought to court.

The SKI's regulatory supervision of nuclear installations is based on the assessment of the so-called 'safety case' of the installations. The 'safety case' may be regarded as the legally binding documents which define the minimum safety level that the licensee is legally committed to at least maintain, as a condition for a permit to operate the reactor. Such documents regulate the technical configuration of each reactor and its operating limits and conditions.

The authorities can promulgate provisions whereby the operator concerned may be required to qualify the 'safety case' for the plant or operation in order to obtain an operation permit, or to later re-qualify the 'safety case'. Failure to satisfy the authority requirements can result in the withdrawal of the operating permit, or in a delay in issuing a permit when the licence application is first submitted.

3.2.2 Findings of the Commission

The Commission notes that the conditions under which the SKI and the SSI conduct their supervisory activities differ. The responsibility of the SKI is to regulate nuclear safety, whereas the responsibility of the SSI is to regulate activities relating to radiation in non-nuclear fields, as well as in the nuclear field. This means that the concern of the SKI is the minimizing of risk through the enhancement of safety in connection with nuclear activities. The SSI, with its broader area of responsibility, has to consider risks in connection with radiation from nuclear activities together with other radiation risks. The regulation of nuclear safety is more diversified than that of radiation protection in the nuclear energy field.

Another difference is that recommendations concerning radiation protection in general have, for almost a century, been based on the findings of the international scientific community, whereas international co-operation concerning nuclear safety measures is a more recent development. The SSI has taken part in the International Commission on Radiological Protection (ICRP), and used the revised recommendations of the ICRP as a basis for the national regulation (cf. Chapter 8). The SKI bases much of its regulatory work on so-called consensus documents produced by the IAEA and the OECD Nuclear Energy Agency (OECD/NEA). Only recently has an international Convention on Nuclear Safety been adopted (cf. Section 2.1.1).

Nuclear safety

The Commission notes that it is difficult to obtain an overview of the present regulatory system which is based on the Act and Ordinance on Nuclear Activities. In accordance with older nuclear legislation, the system relies upon requirements that have been promulgated on a plant-specific basis as licence conditions. This has gradually led to a lack of transparency.

In particular, the large number of Technical Specifications (STF) which are an important part of the licence conditions and which were written individually for each reactor, are difficult to survey. According to the licensees, it is difficult for anybody to obtain an overview of the system of STFs. Also it is not an easy task to identify all the different sections of various STFs that ought to be changed as a result of any change determined in one of the STFs.

The STFs have been drafted by the utilities themselves, approved by the SKI and are applicable as binding conditions of operation. If some STFs are difficult to interpret, or even considered not to be valid at present, the utilities would, in the view of the Commission, be expected to inform the SKI about this situation, and to prepare remedies subject to SKI's approval.

The Commission advises the SKI to move from the present regulatory system to one which uses general regulations as well as licence conditions in a consistent and transparent way. When doing this, the SKI should observe that not even those requirements which have been promulgated in the form of 'common regulations' can be simply promulgated as new general regulations without appropriate analysis and planning to determine how they should fit into the new regulatory framework.

As mentioned in Section 3.2.1, only in 1993 did Swedish legislation give the SKI the right to issue general regulations. The main reasons for giving the SKI this right were, according to the Government bill 1992/93:98 (p. 33-35), to improve the general public's knowledge about nuclear safety work by creating more transparency in the regulations, to make the work of the regulatory authorities less complicated and to achieve co-ordination between the regulatory systems of the Act on Nuclear Activities and of the Radiation Protection Act.

The SKI has started working on formulating and issuing general regulations in accordance with the new provisions in the Act on Nuclear Activities. In its report attached to the previously mentioned joint letter of June, 1995, the SKI has identified the preliminary framework or categories for these regulations and the general near-term commitments for consultation about them between the two authorities. So far only one general SKI regulation has been issued and this Commission has doubts whether the SKI will be able to issue new regulations according to its plan, without a change in work priorities. The SKI has told the Commission that the work of issuing general regulations has been hampered by the workload experienced by the SKI over the last few years.

The Commission is aware that the SKI, although committed to the task of issuing general regulations, has purposely given it low priority. This may have been justified on the basis that the present regulatory system ensures the safety of the plants and according to the 'overall objectives' for the SKI, as decided by the Government, safety importance should be the decisive factor when the SKI sets the priorities for its tasks (cf. Section 3.3.1). However, in the opinion of the Commission, the present lack of transparency in a large portion of the provisions regulating nuclear activities, has to be remedied as soon as possible. Thus, the Commission advises the SKI to give high priority to the promulgation of general regulations in order to develop its regulatory system. A change to the new regulatory system is not only a question of making the system more transparent. With the present level of knowledge, the very process of transformation can be expected to result in the discovery and subsequent correction of inconsistencies and inadequacies. By such corrective measures greater assurance of plant safety might be promoted, justifying a higher priority than at present of this task for the SKI.

To facilitate the work, the SKI might consider using the experience in other countries in the development of its framework of new regulations (cf. Volume 2, Section 9).

Radiation protection

The SSI's right to issue regulations in their own Code of Statutes is, according to the SSI, one of its most powerful tools for controlling the compliance with the intentions of the Radiation Protection Act. As the general regulations require the same standards for all licensees, the issuing of regulations is an efficient way for the SSI to handle matters which could otherwise have generated a large number of individual applications.

According to the joint letter with SKI (cf. Section 3.2.1), the SSI plans to issue general regulations related to the final disposal of high-level waste during 1996. In the view of the Commission, it is important that the SSI fulfils these plans.

Co-operation on the issuing of general regulations

The Commission notes that in the field of radiological protection in connection with nuclear reactors there is a longer tradition concerning

the issuing of general regulations than in the field of reactor safety. The SSI has developed a consistent body of regulatory texts which are general in nature and are partly based on international recommendations.

The Commission observes that the SKI, as well as the SSI, have development work on regulations to carry out in the immediate future. The development work of the SKI is, however, on a considerably larger scale than that of the SSI.

The Commission encourages the SKI and the SSI to pursue their intention of close co-operation on regulation work. Such co-operation would facilitate the work and would help to achieve the co-ordination between the regulatory systems of the Act on Nuclear Activities and that of the Radiation Protection Act, which the Government has required, as expressed in the Government bill 1992/93:98 (p. 34). A concentrated effort on this project would also reflect the intentions behind the legislation, which gives the SKI the right to issue regulations.

Enforcement possibilities

The combination of the legislative requirements and the authority-issued regulations and licence conditions give both the SKI and the SSI strong powers to enforce their requirements. The Commission's assessment is thus that the possibilities for the authorities to enforce their requirements are adequate.

3.2.3 Recommendations regarding the legal framework

The Commission finds (cf. Chapter 8) that the national legislation in the areas of reactor safety, nuclear waste management and radiation protection is consistent with internationally recognized practices. Both the SKI and the SSI have strong powers to enforce their requirements. Accordingly, the Commission has no recommendations regarding changes in this legislation.

The Commission *recommends* that:

- *the SKI* should develop its regulatory system by giving priority to the promulgation of general regulations; and

- *the SKI and the SSI* should pursue a more structured co-ordination of their work with the development of new regulations.

3.3 Regulatory objectives and underlying philosophy

3.3.1 Description

Underlying the regulatory objectives of the SKI and the SSI is the regulatory philosophy of each authority.

Regulatory philosophy

The issue of the regulatory philosophy of the authorities is related to the issue of the division of roles between the authorities and the licensees (cf. Section 6.1).

The regulatory philosophy of the *SKI* may be described as that safety should be as high as reasonably achievable *and* that safety is constantly subject to such improvements as can be reasonably achieved. The minimum safety level is thus subject to continuous updating. The licensees have the full responsibility for safety and the SKI supervises how the licensees execute this responsibility.

For a further description of the SKI's regulatory philosophy, see Section 3.5.1 in Volume 2.

The regulatory philosophy and supervision strategy of the *SSI* is based on international radiation protection philosophy.

Radiation protection is based on the ICRP's three fundamental principles:

- *Justification*. No practice shall be adopted unless its introduction provides a positive net benefit. A practice should be understood as all processes, operations etc. which produce the benefit. For example, nuclear waste management is only one part of the nuclear fuel cycle rather than a practice of its own.
- *Optimization*. Once a practice has been justified and adopted, it is necessary to consider how to best use resources in reducing the radiation risks to individuals and the population. This principle is

usually referred to as the ALARA principle (As Low As Reasonably Achievable) and the goal is to optimize protection against the effects of radiation. The term 'reasonably' is explained by the ICRP as 'economic and social factors being taken into account'.

- *Dose limitation.* Dose limits are required in order to ensure that no individual is exposed to radiation risks that are judged to be unacceptable.

These three principles have been internationally accepted and are the cornerstones for practically all radiation protection work. The principles apply to *all* aspects of radiation protection and are not restricted to regulatory activities. Thus, the SSI and the licensees have the same fundamental objectives which provides an ideal situation for communication and mutual understanding.

The licensees have the full responsibility for radiation protection and it is SSI's task to ensure that the responsibilities are taken and that regulations and conditions are complied with. Due to the complexity and size of the nuclear plants, SSI's supervision in this field is dominated by the utilities' self inspections.

For a further description of SSI's regulatory philosophy, see Section 3.5.2 in Volume 2.

Regulatory objectives

In its letters of appropriation the Swedish Government has specified regulatory objectives for the SKI and the SSI. The objectives have been classified as overall or activity objectives.

The overall objectives for the *SKI* are the following (translation from the Letter of Appropriation for 1995/96):

The SKI activities shall have as their aim to ensure:

- that a high level of safety is achieved in Swedish nuclear activities and that, with this objective in view, initiatives are taken to increase the level of safety,
- that nuclear waste will be finally disposed of in a safe manner, that the scope of industry's activities regarding the final disposal of spent nuclear fuel will be sufficiently broad,
- that decision-makers and the general public are well informed about nuclear risks and safety and about the management and final disposal of spent nuclear fuel and
- that Sweden's international obligations in the field of nuclear activities are fulfilled.

When the SKI establishes the priorities for its tasks, safety importance should be the decisive factor. The tasks pertaining to Sweden's international obligations should also be considered. It is a fundamental prerequisite for the objectives of the SKI, and for the focus of its activities, that the licensees should have the full and undivided responsibility for safety. The SKI shall supervise how the licensees execute this responsibility by forming its own well-founded opinion of the safety status of the installations and of the quality of safety-related work performed by the licensees. The SKI shall, within its field of competence, contribute to a sustainable development.

In this connection the SKI shall:

- become a driving force in safety-related work when justified by operating experience, research results and technical progress; towards licensees as well as in international co-operation on safety,
- promote the maintenance of a comprehensive approach in the research and development programme of the nuclear industry concerning the management and final disposal of nuclear waste and for decommissioning and dismantling of such nuclear installations where no further activities will be carried out, and ensure that sufficient funds are established to cover future expenditures for such purposes,
- promote the maintenance and development of competence in the safety-related work at the SKI as well as at the licensees and generally in the country,
- issue and decide on conditions and regulations for nuclear activities to the extent that is deemed necessary for safety and for the fulfilment of Sweden's international obligations, and
- actively provide information about conditions and events that are of interest to safety and about management and final disposal of spent nuclear fuel and nuclear waste.

As a member of the European Union, Sweden shall work for efficient and increased achievements for the environment in the vicinity of Sweden, inter alia in the Baltic region and in Central and Eastern Europe. In this work, the SKI shall seek to attain close co-operation with the European Union.

In EU work, special demands will be put on the SKI as regards taking part in the different working and expert groups and in the committees of the Commission. The SKI shall, within its field of responsibility, give suggestions to the Ministry of the Environment on new proposals for the Commission, be responsible for ensuring that reporting to the Commission is performed according to the assumed obligations and contribute to Sweden fulfilling its obligations according to EU decisions.

The SKI activity objectives are the following (translation from the Letter of Appropriation for 1995/96):

The SKI shall:

- ensure that, in Swedish nuclear installations, there is satisfactory defence-in-depth to prevent serious incidents and accidents originating in technology, organization or competence, and also to prevent or mitigate the release of radioactive substances to the environment, should an accident occur,
- maintain preparedness in terms of organization and expertise to provide advice to other authorities - in the event of an accident situation - with the aim of mitigating medical and societal consequences resulting from the release of radioactive substances or the threat of such releases.
- ensure that the conditioning, interim storage and other handling of nuclear waste and spent nuclear fuel are carried out so that accidents and serious incidents are prevented, and that the release of radioactive substances to the environment is prevented or mitigated, should an accident occur,
- ensure that the final disposal of spent nuclear fuel and nuclear waste is carried out so that any potential leakage of radioactive substances to the environment, on different timescales, can be expected to be within acceptable levels,
- ensure that the research and development programme of the nuclear power industry is comprehensive and fulfils the intended purpose so that safe handling and final disposal of nuclear waste is achieved and that methods are available for the decommissioning and dismantling of nuclear installations,
- give decision-makers, special interest groups and the general public comprehensive and objective information concerning nuclear risks and nuclear safety.

The SKI Annual Activity Plan for 1995/96 contains 'safety objectives on the national level', 'general regulatory objectives' and 'objectives' for the so-called Main Programmes of the SKI. Many of the 'objectives' for the Main Programmes correspond to the activity objectives set by the Government. The Activity Plan also contains 'strategic directions for activities' and 'objectives for the year of activity' for different programmes under the offices and departments of the SKI. The programme 'objectives for the year of activity' have been grouped into priority 1 and priority 2 objectives. For further descriptions of the SKI regular objectives, see Volume 2, Section 3.1.3.

The overall objectives for the SSI are the following according to the Letter of Appropriation for 1995/96 (translation from Swedish).

- The SSI's main task is to enforce compliance with the Radiation Protection Act and as a government authority be responsible for issues concerning the protection of people, animals and the environment against the harmful effects of ionizing and non-ionizing radiation,
- the SSI shall define the aims for radiation protection, give advice and information (on radiation protection issues), regulate and supervise activities with ionizing and non-ionizing radiation, increase knowledge in the field by carrying out and financing research and otherwise promote the safe use of radiation,
- in the case of radiological emergencies, particularly nuclear accidents, the SSI shall maintain preparedness in order to give advice and information to the authorities concerned,
- the SSI shall take into consideration other radiation protection problems concerning great societal values,
- international co-operation is essential in the radiation protection work. The SSI shall contribute to a sustainable development, in accordance with the conclusions from the UN's conference on the environment and development held in Rio de Janeiro 1992,
- Sweden engages in activities for improving the environmental situation in, for example, the Baltic Sea region and Central and Eastern Europe. The SSI shall aim at co-ordination with the European Union's activities in this area,
- Sweden's work in the European Union will require efforts from the SSI with regard to, for example, participation in the Commission's different working and expert groups.

The Government has stated that the SSI's activity objectives concerning nuclear supervisory activities are the following (translation from the Letter of Appropriation for 1995/96):

The SSI shall work towards:

- keeping individual and collective doses below established limits,
- the management and disposal of radioactive waste in a manner that is adequate with regard to radiation protection,
- the maintenance of emergency preparedness against nuclear accidents,
- the SSI holding its research position internationally and nationally.

The SSI has described to the Commission how its regulatory objectives have been formulated (see Volume 2, Section 3.4.4). The SSI has also described how these objectives have been considered in its Annual Activity Plan. According to the plan, the overall objective for the SSI's supervisory activities in the nuclear field is:

- that the operation and maintenance of nuclear facilities shall be conducted in a radiologically safe way, with respect to people, animals and the environment.

The SSI's Annual Activity Plan for 1995/96 contains 'directional objectives', 'end results', 'quality standards', 'effects' and 'information achievements' given for the respective departments and divisions of the SSI.

3.3.2 Findings of the Commission

Regulatory philosophy

A discussion of the regulatory philosophy of the SKI and the SSI has to include the issue of the so-called Swedish model for regulating nuclear activities. The Commission comments on this model in Section 6.2.2.

Regulatory objectives

The regulatory objectives of the SKI and SSI are generally not easy to measure. The current regulatory objectives for the authorities have been developed in a dialogue between the Government and the authorities. It seems that the dialogue has, so far, resulted in what might be defined as requirements on the regulator, rather than as measurable objectives.

The Commission is aware of the difficulties in defining measurable or precise objectives for the regulatory authorities in the fields of reactor safety and nuclear waste management. In the view of the Commission, the ideal situation would be that overall regulatory objectives for nuclear supervision are set by the Government. These objectives should then be transformed by the SKI and the SSI into more detailed ones corresponding to each main activity of the respective authority. The detailed objectives, formulated on the authority level, should be measurable and well-defined.

As the SSI supervision includes both qualitative and quantitative approaches (measuring doses and radiation, and imposing limits), while the SKI supervision is largely based on a qualitative approach (assessing the level of safety), measurable objectives may be easier to set for the SSI than for the SKI. This notwithstanding, the Commission finds the elaboration of measurable objectives to be of great importance for both

the SKI and the SSI. Therefore, the Commission advises the Government to continue its dialogues with the SKI and the SSI, elaborating measurable activity objectives for the two authorities.

The Commission had difficulties in tracing the different objectives set by the SKI for different programmes back to the objectives set by the Government. In interviews with the staff of the SKI the Commission also was given the impression that staff members of the SKI are not clear on the manner in which the objectives are set. The Commission advises the authorities, and especially the SKI, to further develop the process of setting regulatory objectives. The objectives should be set in a hierarchical manner within the different offices and departments. If the regulatory objectives are set as a result of an iterative process involving staff members from all levels of the organization, an appropriate hierarchy of objectives will develop.

Furthermore, by taking part in the process of setting the objectives, staff members will understand the objectives better. This is of some importance, since the Commission's impression is that the regulatory objectives are not fully understood, or at least not interpreted in the same manner, by all personnel of the SKI.

Within the SKI, slightly different wording has been used in different steering documents describing the same objective. Such differences are not just a matter of editing as they may imply major differences in the significance of objectives. Clarity in defining objectives cannot be overemphasized. Readers of different documents must be able to interpret the objectives in the same way. The uncertainty concerning the objectives can be reflected within the regulated utilities, as well as within the authorities. The Commission advises the authorities, and especially the SKI, to ensure that the text describing a regulatory objective is unambiguous and consistent in different documents.

In the SKI's Activity Plan for 1995/96 concepts such as 'safety objectives on the national level', 'general regulatory objectives', 'activity objectives' and 'objectives for main programmes' are used and elaborated. The Commission had some difficulties in connecting these elaborations with the objectives as stated by the Government and with the explanation by the SKI to the Commission on the interpretation of those objectives.

The Commission notes that SSI's description of its regulatory objectives and how these objectives relate to the objectives defined by the Government is comparatively clear and unambiguous. There is, however, room for further improvement with regard to the exactitude when formulating the SSI's regulatory objectives.

The Commission stresses the importance for the authorities to have understandable and unambiguous objectives, that can be traced back to the objectives set by the Government. The Commission, therefore, advises the authorities to ensure that there are clear connections between the overall objectives and activity objectives set by the Government and the objectives set by the authorities.

The Commission notes that the SSI's Activity Plan seems to be a useful planning instrument. The Activity Plan is followed up at regular intervals. On these occasions, the management can decide on re-prioritization between different tasks.

The SKI's Activity Plan does not appear to have been used actively as a planning instrument. The Commission notes with satisfaction that the SKI has recently started regular follow-ups of its Activity Plan with the aim of re-prioritizing tasks when necessary. Based on studies of the Activity Plan, as well as on interviews with the staff of the SKI, the Commission, however, concludes that this document should be made more clear and precise to provide help in the daily running of activities at the SKI.

The impression of the Commission is that, although the authorities use their Activity Plans as planning instrument, they have so far not incorporated measurable objectives into the plans. The Commission, therefore, advises both the SKI and the SSI to incorporate measurable objectives into their Activity Plans to such an extent that achievement per field of activity can be measured.

3.3.3 Recommendations regarding regulatory objectives

The Commission *recommends* that:

- *the Government* in dialogue with the SKI and the SSI continues to elaborate measurable activity objectives for the two authorities;
- *the SKI and the SSI* continue to strive towards more transparency in stating their regulatory objectives by:
 - ensuring clear connections between the Government's overall objectives, and activity objectives and the objectives set by the authorities;
 - developing the hierarchy of regulatory objectives; and
 - ensuring that the text describing a regulatory objective is unambiguous and consistent in different documents;

- *the SKI and the SSI* incorporate measurable objectives into their Annual Activity Plans to such an extent that achievement can be measured.

3.4 Internal rules and procedures, including quality assurance

3.4.1 Description

The rules for the internal management of the SKI and the SSI are documented in their respective Administrative Manuals. The Manuals have been distributed to all staff members and are continuously updated. The Manuals include descriptions of work organization and allocation of responsibilities, rules for the delegation of authority (defining at which organizational level different decisions are to be taken) and rules for personnel administration, as well as administrative routines for incoming and outgoing correspondence and for documents issued by the authorities themselves.

Apart from the rules concerning their internal management, the authorities have issued, or are in the process of issuing, a small number of documents with instructions for their regulatory tasks. The SKI is developing manuals on how its inspections are conducted: the Inspection Manual, the Quality Systems Inspection Book, the Inspection Guide Book - Maintenance, and the SKI Reference Book - Maintenance. Although not formally adopted by the management, these manuals are used as guidance by SKI's staff.

At the SSI, the Department of Nuclear Energy Supervision has issued a document called Policy for Supervision and Related Activities. According to this document, written instructions will be worked out for frequently used methods of supervision. The SSI is also developing a manual in the nuclear field.

Neither the SKI nor the SSI have fully implemented a quality assurance (QA) system to ensure that quality is planned, obtained and maintained in their own work. The two authorities have elements of a QA system and plans for developing it further. The SKI has worked considerably on QA requirements for the licensees and has issued a 'common' regulation for quality assurance at nuclear facilities and during the transportation of spent fuel and nuclear waste. In its Annual Activity Plan for 1995/96 the SSI presents plans to develop a system for

internal control. In March 1996, the SKI formed a working group with the task of introducing and implementing an internal QA system.

3.4.2 Findings of the Commission

As is reflected in this and other chapters of the report, the Commission has reviewed a wide range of aspects of the manner in which the two regulatory authorities, the SKI and the SSI, carry out their regulatory activities. The Commission can clearly conclude that the results attained in these activities are of high quality. The Commission also notes that the licensees, being the subjects of the regulatory activities, share this view of the Commission. In fact, they go one step further, in that they require strong regulatory authorities and consistent regulatory activities.

Thus, the overall impression is that the SKI and the SSI have developed such procedures for their activities as are needed for their regulatory tasks to be performed in a satisfactory manner. However, procedures, apart from those concerning internal management, have to a large extent not been documented. One reason for this seems to be that, with the low turnover of personnel at the authorities, different tasks are so well known by those performing them that written instructions are considered unnecessary by them.

The Commission has found that the traditional means of quality control in Swedish authority decision-making are applied by the SKI and the SSI. These means of quality control include assigning responsibility to various management levels, and the independent review of more important issues by advisory committees. However, the Commission has also observed that the authorities have, so far, not implemented an internal quality assurance system according to modern standards.

The lack of a fully implemented internal QA system and the resulting lack of approved procedures, coupled with the fact that few documented instructions exist regarding the performance of the regulatory tasks, has contributed to the Commission's difficulties in obtaining a clear picture of the functioning of especially the SKI.

There is no internationally recognized practice regarding systems for regulatory authorities' internal QA. However, the Commission notes that the SKI requires the licensees to have a fully implemented QA system. Also the SSI has demands on the licensees with regard to quality assurance. It would, therefore, be logical for both authorities to follow a similar principle in their own activities.

In the opinion of the Commission, the SKI and the SSI should fully implement a quality assurance system for their own work to ensure that

quality is established, implemented and maintained. The Commission notes with satisfaction the recent formation at the SKI of a working group on internal quality assurance. The Commission also stresses the importance for the SSI to fulfil its plans to develop a system for internal quality control.

To support the implementation of their internal quality assurance systems, the Commission advises the SKI and the SSI to each designate a QA manager, who should report directly to the respective Director General to ensure that internal quality assurance matters are dealt with effectively and correctly.

The Commission believes that the following observations and suggestions are helpful for both authorities when developing systems for internal quality assurance.

In addition to the documents on internal management, the SKI is developing four manuals for different inspection activities. These manuals have not been formally adopted by the management of the SKI. This has resulted in a situation where the manuals have no clear status among staff members. From interviews with staff members, the Commission has also received the impression that these manuals are not fully accepted within the SKI. The Commission advises the SKI to finalize their development work on the inspection manuals and to have them formally adopted by the management. The manuals should be updated when needed and distributed to all departments of the SKI.

The SSI should fulfil its plan to prepare written instructions for those methods of nuclear energy supervision that are used frequently at the SSI. Also for the SSI, written instructions would facilitate both the performance and the supervision of its tasks.

In the opinion of the Commission, documented strategies and instructions would help new employees to acquaint themselves with their work, and would also make the activities of the SKI and the SSI more transparent to outsiders. The Commission therefore suggests that both authorities consider systematically documenting strategies and instructions for their different categories of regulatory tasks.

The Commission regards the process for decision-making to be a vital part of an internal QA system. In section 4.2.2, the decision-making process of both authorities is discussed. In that context, the Commission concludes that the SKI has ensured that the decision-making process within the SKI in connection with severe incidents functions efficiently. However, also the process for the daily decision-making is important. Therefore, the Commission advises the authorities to regularly re-evaluate their entire decision-making process.

3.4.3 Recommendations regarding internal rules and procedures, including quality assurance

The Commission *recommends* that the *SKI* and the *SSI*:

- implement internal quality assurance (QA) systems to ensure that quality is established, implemented and maintained;
- consider regular re-evaluations of their entire decision-making process;
- consider setting up a QA manager function where the manager would report directly to the respective Director General; and
- should document strategies and instructions for their regulatory tasks to a greater extent than at present.

3.5 Regulatory supervision in practice

3.5.1 Description

The *SKI*

The main types of *SKI*'s regulatory activities can be described as follows. For a more comprehensive description, see Volume 2, Section 3.2.1.

Routine regulatory tasks

The *SKI* has to review and approve all safety significant changes in the configuration of nuclear facilities and all changes in the STFs. Some 170 such regulatory tasks submitted by the reactor licensees were processed in the operating year 1994/95, tasks generated by the Oskarshamn 1 renovation project not included. The regulatory tasks may range from the control of minor modifications to the review of extensive installations of new equipment.

The safety analyses submitted by the licensees are checked by the *SKI*. When deemed necessary, the review of the analyses are supported by independent calculations carried out by the *SKI* experts or outside consultants. As a part of the review procedure, the *SKI* may use experts

inside and outside Sweden, and also make both informal and formal contact with sister authorities in other countries. Both bilateral contacts and the IAEA and the OECD/NEA networks are used in this context.

To ensure consistency in the procedure for making decisions based on the reviews, and to ensure that all relevant aspects of the safety issues involved have been covered, consultation is prescribed in the decision-making process between the head of the Department of Inspection and the heads of the expert departments involved in the task. Before taking regulatory safety decisions of particular importance concerning reactor safety, the SKI advisory Reactor Safety Committee has to be consulted. For some types of decisions made by the SKI Director General, the SKI Board is consulted.

The SKI decision is communicated in a regulatory letter to the licensee. The decision may include additional licence conditions of a temporary or permanent nature, e.g. concerning special tests to be performed, and/or special reporting requirements.

Inspections

Three types of inspections are performed by the SKI. These are regular or routine inspections, topical inspections and special inspections or investigations triggered by events of special safety significance. Regular inspections are carried out by the SKI inspectors visiting each reactor site several days per month. The annual outage for overhauls and refuelling are subject to intensified inspections. Topical inspections aim at deeper insight into the quality of the licensee's safety-related activities in particular topical areas, such as maintenance, core operation practices, quality assurance and training. Incident investigations shall initially be conducted by trained staff at the plant and be reported to the SKI. Depending on the circumstances, the SKI may choose to perform its own special inspections or investigations. The SKI programme of inspections is gradually focusing more attention on systems inspections of the safety-related performance and work quality at the plants.

Review and assessment of operating experience

Licensee Event Reporting (LER) requirements are specified in the STFs for each plant. Emphasis is put on events systematically evaluated by the utilities in an MTO (interaction between Man, Technology and Organization) perspective.

LERs from the nuclear plants are assessed by the Department of Inspection and copies are distributed to expert departments. The LERs are reviewed at weekly meetings by the ASK-group consisting of representatives from all departments in the Office of Reactor Safety. Further SKI actions are recommended by the Department of Inspection, the involved expert department or by the ASK-group. Such actions may be follow-up on routine inspections, dispatch of special inspections teams or initiation of a SKI review of licence conditions, resulting in modified regulatory requirements both for the plant submitting the LER and for other plants where applicable.

Series of comparable events observed over a limited time period and indicating an unsatisfactory trend with respect to safety also triggers SKI action. In addition, the potential existence of such trends are discussed at least once a year at top level meetings between the SKI management and the plant management. Data obtained from LERs, concerning reliability and safety performance, are recorded in the SKI database STAGBAS. Foreign events reported through bilateral agreements are recorded in the database ASKBAS.

It is the responsibility of each expert department to monitor and assess Swedish and international safety research, as well as international regulatory experience within their field of expertise in order to determine whether modifications to Swedish regulations and licence conditions are justified.

Assessment of periodic safety analysis reports

Periodic safety reviews of the nuclear power plants in Sweden are conducted on a regular basis. Every nuclear power reactor must be subjected to about three complete safety reviews up to the year 2010, i.e. about once every 8-10 years. On the basis of this policy decision, the licensee shall submit a report, called an *As Operated Safety Analysis Report (ASAR)*, including an analysis of the organization and implementation of the safety work at the plant, a comprehensive report on operational experience, a plant-specific probabilistic safety analysis and finally a report on current safety improvement programmes as well as proposed future programmes, based on the findings and conclusions of the recurrent safety review. The ASAR also contains a report on radiation protection.

Each utility ASAR is reviewed by the SKI, and the SKI review report, called the SKI ASAR, together with the utility ASAR provides an in-depth periodic review of the safety status of the reactor and the

quality of the safety work at the plant, including a plan for future safety improvements. After discussions in the Advisory Committee on Reactor Safety and in the SKI Board, the SKI ASAR is submitted to the Government.

The first round of periodic safety reviews, named ASAR-80, has been completed. The ASAR-80 programme effected a major breakthrough of methods for probabilistic safety analysis (PSA) in Swedish reactor safety work. According to current guidelines for ASAR work, the analysis and assessment are to focus on the perspective of the *Learning Organization*.

Assessment of waste management programmes

Every third year the nuclear industry is required to submit a R&D programme for the final disposal of spent fuel and high-level waste and the dismantling and decommissioning of nuclear installations (the so-called SKB RD&D programme). The SKI reviews the programme and then reports to the Government. The report is based both on reviews performed by SKI staff and on comments requested from a number of domestic and foreign institutions and organizations, including the SSI. The SKI's own review is largely based on the insight gained from its own research and development programme on safety assessment methods for the final disposal of spent fuel and long-lived nuclear waste. The SKI review report has to be finally approved by the SKI Board before it is submitted to the Government.

Issuing of general regulations

Since 1993, the SKI has the right to issue general regulations (cf. Section 3.2.1). According to present principles for the issuing of general regulations by Swedish government authorities, the formal regulatory text should preferably prescribe *what* must be achieved, not the detailed means to achieve it.

The SSI

The main types of SSI's regulatory activities can be described as follows. For a more comprehensive description, see Volume 2, Section 5.3.2.

The supervision of the radiation protection work at the nuclear power plants and at other Swedish nuclear facilities is performed using general regulations. The SSI also issues separate licences and, in connection with these and licences issued by the Government, licence conditions are established. It should be emphasized that the SSI aims at using general regulations for most of its regulatory work, as this will assure uniform treatment of applicants and harmonize the stipulated conditions for the different licensees.

The main objective for nuclear energy supervision is that the operation and maintenance of Swedish nuclear facilities shall be conducted in a radiologically safe way with respect to the work force (personnel doses as low as reasonably achievably, ALARA), the public and the environment.

The SSI's supervision of nuclear plants is dominated by the monitoring of the plants' achievement of, and continued compliance with, the licensees' radiation protection programme and quality assurance system. To promote good radiation prevention practice, all nuclear plants have a radiation protection adviser. The adviser serves as a link between the plant and the SSI and in this respect facilitates SSI's activities.

The SSI's management meets with the nuclear plant managements yearly to discuss matters of principal character. There are also formal meetings yearly between the SSI and the nuclear plants' Radiation Protection Department.

Inspections

The SSI's Department of Nuclear Energy Supervision is organized into three divisions, of which the Division of Nuclear Inspections and Transports deals with supervision related to the internal environment at nuclear installations, including their organization, education, occupational health issues and radioactive material's transportation. The Division of Waste Management and Environmental Protection deals with the supervision of the environment around the installations and their waste management, including material for recycling or deposition as waste.

The Division of Nuclear Installations and Transport has separate inspectors charged with plant site responsibility for each nuclear power plant and one such inspector for Studsvik. Site responsibility for supervision of other nuclear licensees, such as ABB Atom's Fuel Factory, is divided among these five inspectors.

The SSI's inspections are divided into several categories. System inspections are performed in connection with review of an application for a change in activities. The SSI endeavours to participate from the planning stage to the final commissioning. Detailed inspections address specific issues, i.e. new items of measuring equipment. Review inspections deal with the status in a certain area or system, common to all Swedish plants.

The SSI places high demands on the nuclear power companies to keep the personnel doses as low as reasonably achievable (ALARA). The progress and quality of the ALARA work has been reviewed by the SSI through a recent series of systematic inspections at the nuclear power plants.

Control measurements

The SSI's annual measurements cover all three of the inspection types. Control measurements are also carried out on waste packages destined for final storage in SFR-1. Reactor release and contamination control of the environment is monitored and all required measurements by the licensee on the plant's radiation and control programmes are verified.

Preparations for future regulatory needs

Preparations for final repository siting, as well as the siting of an encapsulation plant for spent nuclear fuel and other long-lived radioactive waste are progressing in Sweden. The SSI is involved in these processes with its own projects such as MKB-95, the objective of which is to prepare the authorities for future examinations and information activities in the municipalities concerned. A project has been initiated for establishing clear directives and criteria regarding the decommissioning of nuclear power plants.

3.5.2 Findings of the Commission

General

Both the SKI and the SSI seem to conduct their regulatory supervision in a manner consistent with their obligation to ensure that the licensees

are fulfilling their responsibilities for nuclear safety and radiation protection (cf. Section 3.4.2.)

The SKI's and the SSI's conduct of regulatory activities will, by the responsibilities defined in the Act on Nuclear Activities and the Radiation Protection Act, be different. While the SKI focuses on reactor safety, mechanical integrity and nuclear waste management in Sweden with a substantial attention to international nuclear safety-related activities, the SSI distributes its regulatory activities over a broad scope of radiation protection issues. Only a part of the SSI is directed to the supervision of nuclear activities.

As mentioned in Section 3.2.2, the manner of the regulatory supervision of the SKI also differs from that of the SSI in that the SKI is seeking to minimize risks, to prevent the occurrence of accidents, whereas the SSI is seeking to control exposures, to ensure that radiation exposure is controlled to a justifiable degree. The SKI seems to be very attentive to day-to-day activities at nuclear reactors, especially to events and their significance. The SSI seems to pay special attention to long-term experience and trends in worker radiation exposure.

The Commission has the following specific comments on the regulatory activities as carried out in practice by the SKI and the SSI.

The SKI

As mentioned above, the Commission regards the regulatory supervision of the SKI as consistent with stipulated obligations according to the Act on Nuclear Activities. The following comments should be read bearing this in mind. The comments apply in general, but specific comments regarding inspections have been included.

Event-driven organization - delayed long-term tasks

The Commission observes that several important long-term activities have been considerably delayed for some years in relation to plan or have been reduced to a smaller scale than intended. Such activities are periodic safety reviews, experience feed-back (especially exchange of experience in the international nuclear society), development of competence, research and development, development of internal quality assurance and the issuing of general regulations.

According to the SKI, long-term activities have been delayed or reduced because event-triggered supervisory tasks, such as the clogged

strainer issue at the Barsebäck reactors in 1992 and the recently completed renovation of the reactor Oskarshamn 1, have been added to the normal volume of commitments. Administrative programmes, like the development of an internal quality assurance system and the issuing of general regulations, have intentionally been given low priority by the SKI management. Regulatory commitments with a high safety significance have been given highest priority.

This Commission notes that a Special Commission of Inquiry to evaluate the SKI's handling of the clogged strainer issue, in 1993 recommended the SKI to allocate additional resources to the activities of periodic safety reviews and experience feed-back due to their major importance from the standpoint of safety. The Special Commission also recommended the SKI to implement systematic internal quality assurance of SKI's regulatory work. According to SKI's account of actions taken based on these recommendations (Volume 2, Section 7.2), funding has been granted to remedy a severe backlog in the periodic safety reviews. This Commission notes that some need remains for the SKI to reallocate resources to the mentioned activities, particularly to an internal quality assurance system.

In relation to the impact of the Government's budgetary demands on the SKI activities (cf. Section 7.2.1), the SKI, in the opinion of this Commission, could benefit from shifting its order of priorities. An in-depth dialogue with the Government is considered to be necessary to establish an agreed priority and balance in performing tasks which are regarded as having equally high importance or safety significance. It is noted that the SKI in its budget application for 1997 has mentioned the need for such a dialogue.

Transition from 'focus on detail' to 'focus on system' auditing practices

The fact that the SKI's regulatory supervision activities, which are still based upon regulations from the reactors' design and constructions phase, is contributing to the current overload of the SKI organization. Thus, SKI's inspections are to a high degree focused on details in the STFs and the licence conditions. In the view of the Commission it is important that the SKI should shift to checking the licensees' quality system or 'self-inspection' structure. This would encompass (among other areas) the licensees' organization, competence, resources, operational standards and monitoring processes.

The ageing of the nuclear reactors and the possible need for increased renovation, together with increased activities concerning the

management of nuclear waste, may increase the demand on supervisory activities in the nuclear field and thus make it all the more important for the SKI to review and reconsider the prioritization of its activities.

The Commission notes with satisfaction SKI's intent to promote a transition from 'focus on detail' to 'focus on system' supervisory practices. Issuing general regulations for basic duties of licensees may greatly facilitate this change. In the budget application for 1997, dated February 1996, the SKI has declared its intention to give high priority to the activities of developing general regulations and methods for supervision of the licensees' system of 'self-inspection' and quality assurance systems.

The Commission has noted the apparent lack of criteria for correct judgements to be reached during safety status assessments of nuclear installations. It has been observed that the SKI intends to promote such a development of common criteria, which shall be known and used by all staff involved in such judgements.

Co-operation between SKI departments

Each department of the SKI Office of Reactor Safety with their separate responsibilities constitute important elements of the total supervisory system of the SKI. The Commission notes that the internal information exchange between departments could be improved. At present there seems to be a lack of co-ordination in the formulation of the departments' individual objectives, although departments plan their supervisory tasks according to the general objectives of the SKI. Such co-ordination would, in the opinion of the Commission, enhance the efficiency of the total supervision and inspection activities of the SKI.

The impression from interviews with personnel from the SKI Department of Inspection leads to the conclusion that, although findings from inspections are documented in reports distributed within the SKI, the information contained in the reports are often subject to different or diverging interpretation by the various departments.

The Commission notes with satisfaction that the Office of Reactor Safety plans more frequent evaluation meetings with personnel from all its departments. The purpose of these meetings will be to pool all information on each nuclear power plant, with the aim to enhance the complete picture of the safety situation at every nuclear reactor.

Inspections

The licensees have emphasized the importance of all the SKI's inspectors being competent and professional with high knowledge of nuclear and industry practices. The Commission has noted that there seems to be sound and open relations established between the SKI plant site inspectors and the reactor operation units. According to the licensees, the day-to-day discussions and consultations between the inspector and the staff of the licensee enhance the safety dialogue and they would like to see the inspectors spending more time than they do at present at the plants. Preferably one inspector should be allocated as *the* inspector of an individual plant. The Commission notes that during the last two years the SKI has not been able to fulfil the inspection plan implying that each reactor site should be visited by inspectors for at least 3.5 days each month.

The Commission advises the SKI to promote and enhance the competence and professionalism of its inspectors in order to gain the confidence and respect of the licensees. The Commission also advises the SKI to reconsider its inspection plan and to shift priorities between tasks in such a way that the inspection plan can be fulfilled.

Although the licensees seem to be satisfied with the way they communicate with the SKI site inspectors, there seems to be difficulties in identifying the status of information emanating from the SKI. According to the licensees, this may have been caused by informal communication between the nuclear plant experts and the SKI staff experts with specialist knowledge of specific technical fields, having resulted in memorandums with no clear status of being informations, advices or prescriptions sent to the licensees. Before the early 1990's, all contacts between the SKI and the licensees were made through an experienced SKI site inspector, who in turn obtained advice from the SKI experts. This is still the licensees' preferred chain of communication.

The SKI has informed the Commission that a procedure has been implemented, designed to eliminate confusion on the status of communications from the SKI to the licensees. The Commission encourages the SKI to uphold a principle of formality in communication between the SKI and the licensees, with the pronounced caution that such formality should not lead to the erosion of the open and professional dialogue and consultation between the SKI staff and the licensees' experts. The Commission also suggests that the SKI more clearly designates the head inspector for each site.

The Commission observes that the SKI findings at inspections have not been systematically compiled and documented in order to be easily accessible to others apart from the individual inspectors. Each site inspector seems to have a record of inspection findings, but no central records seem to exist. The Commission advises the SKI to establish a computer-based system of findings and observations in order to achieve a better dissemination of information, follow-up and systematization of the inspections.

A system of yearly top-level meetings between the individual nuclear plants and the SKI has been established for many years. Matters of safety priority are discussed at these meetings and the nuclear plants inform the SKI about the plants' audit and inspection programmes. The Commission finds such meetings valuable. The Commission is under the impression, however, that the SKI does not analyze the results from the nuclear plants' audits and inspections and are not taking such analysis into account when planning its own inspection programmes.

The Commission advises the SKI to use the results and conclusions from the licensees' own audits and inspections when planning SKI's own inspection activities.

The Department of Inspection has not made sufficient use of quality assurance audits as a tool for assessing the adequacy of the licensees' internal quality systems or for ensuring that an acceptable level of safety exists at each nuclear plant. Also there is no formal system within the Department of Inspection for follow-up of recommendations made by the licensees.

Quality assurance audit activities have, in the opinion of the Commission, been too closely linked to the Department of Human Factors as being organizationally responsible for quality assurance. Consequently, the Department of Inspection's responsibility for auditing the licensees' system for quality assurance has been diluted.

The Commission advises the SKI to focus on formalizing the evaluation process of the licensees' system for quality assurance.

The SSI

The Commission is of the opinion that the SSI could further improve its review of operating experiences for root causes of increased worker exposures.

Another important issue, where the Commission believes that improvements might be possible, is the assessment on doses to the public. As an example, the Commission was informed of control

measurements of releases of radioactive substances at Swedish nuclear power plants. These are reported as doses to the critical group in the local population and are below the limits established by the SSI. The doses are calculated using models for the exposure of the critical group and rely on measurements of the emissions. Internationally, there is no consensus on the degree of realism or conservatism in such models; there is advice that such models should be as realistic as possible in order to determine whether or not exposures are as low as reasonably achievable (ALARA), or to compare with exposures calculated for reactors in other countries.

According to Article 45 of the recently revised Directive 'Basic Safety Standards for Radiation Protection' by the European Union, the competent authorities shall 'ensure that dose estimates from practices... are made as realistic as possible for the population as a whole and for reference groups of the population in all places where such groups may occur'.

An important challenge for the Swedish regulatory system is the adoption of the recently revised 'Basic Safety Standard for Radiation Protection of the European Union', as well as the integration of the existing set of European Union recommendations, rules and directives. In principle, there should be no major discrepancies, as both Sweden and the European Union follow the ICRP recommendations.

The Commission notes that the SSI has developed and implemented a 'systems approach' in its inspection activities. The fact that the SSI has issued general regulations specifying the responsibilities of the licensees, has made this approach appropriate.

According to the licensees, the SSI inspectors are competent and maintain a high level of professionalism in their activities. The licensees would, however, prefer the SSI inspectors to spend more time at the nuclear plants in order to be more familiar with the activities of the plants' organization and the managerial systems.

As mentioned above with regard to the SKI, the SSI is not making sufficient use of quality assurance audits as a tool for assessing the adequacy of the licensees' internal quality systems at each nuclear plant. Also, there is no formal system within the SSI for follow-up of recommendations made by the licensees. The Commission advises the SSI to produce regulations on quality assurance for radiation protection and to formalize its evaluation process of the utilities' quality assurance system.

Although SSI's work on nuclear supervision is of high standard, this standard might benefit from paying more attention to the licensees' monitoring of the quality assurance systems for the activities of

subcontractors in relation to reactor refuelling and maintenance outages and repair work.

It is the impression of the Commission that the internal co-ordination within the Division for Nuclear Inspection and Transport, as well as between the division and other organizational units of the SSI, functions in a satisfactory manner.

3.5.3 Recommendations regarding regulatory supervision in practice

The Commission *recommends* that:

- *The SKI improves the focus of its organization by*
 - developing a common internal basis for the assessment of reactor safety;
 - co-ordinating the formulation of the different departments' objectives; and
 - shifting the order of priority between different activities as appropriate;
- *The SKI improves the effectiveness of its supervision programme by*
 - considering the use of the results of licensees' self-assessments in the planning and emphasis of SKI's own inspection work;
 - systematically compiling findings of its inspections into documents easily accessible to others, besides the individual inspectors, in an information retrieval system for follow-up control;
 - more frequently arranging meetings with staff from the different departments with the object of evaluating the safety status at the different nuclear installations; and
 - communicating with the licensees in such a manner that there can be no doubt about the status of any information that is communicated by the SKI to the licensees;
- *The SKI improves the overall character of its regulatory programme by*
 - moving away from routine tasks and changing its own supervision from a focus on detail to a focus on system auditing practices (e.g. by setting and implementing criteria for licensees to use in submitting routine regulatory matters for formal SKI review); and

- reallocating resources to sustain important long-term activities such as periodic safety reviews and experience feedback;
- *The SKI and the SSI* should improve the oversight of the quality assurance systems of the licensees by
 - the SKI taking the lead on the review and approval of the quality assurance systems of the licensees as a whole, co-ordinating as appropriate with the SSI, which retains responsibility for radiation protection elements;
 - the SKI formalizing its evaluation process of the quality assurance systems of the utilities with the Department of Inspection taking more of the responsibility to audit the quality assurance systems;
 - the SSI formalizing its evaluation process of the radiation protection elements of the quality assurance systems of the utilities (considering issuing a regulation on quality assurance for radiation protection); and
 - the SKI and the SSI paying more attention to the way the licensees monitor the quality assurance system of subcontractors and their work;
- *The SSI* seeks to improve its review of operating experience to determine root causes of increased worker exposures.

The Commission *encourages the SSI* to continue its work towards the adoption of the Basic Safety Standards for Radiation Protection of the European Union and associated recommendations, rules and directives.

4 Organization, competence and training

4.1 Discussion of the assignment

According to the Terms of Reference, one of the main tasks of the Commission is to describe and evaluate the organization, competence, training and general resources of the authorities.

This part of the assignment is mentioned only in the 'Summary of the Assignment' and has not been set out in detail in the Terms of Reference. The Commission has interpreted this task as follows. Given the established regulatory objectives of the SKI and the SSI, the Commission shall assess whether the present organization, competence, training and general resources are appropriate. For a description and a discussion of the regulatory objectives of the two authorities, see Section 3.3.

4.2 Organization

4.2.1 Description

The SKI

The SKI is led by a Director General under the supervision of a Board of Directors, chaired by the Director General. The Director General, as well as the members of the Board of Directors are appointed by the Government. This is in line with general practice for most Swedish government authorities.

There are three advisory Committees associated with the SKI, namely the Reactor Safety Committee, the Safeguards Committee and the Research Committee. For each of the Committees, the chairman is appointed by the Government, and the members by the SKI Board of Directors.

The organization comprises three offices, namely the Offices of Reactor Safety, Nuclear Materials Control and Nuclear Waste Safety.

In addition, there are four departments reporting directly to the Director General: the Departments of Information, Research, Administration and Personnel. The Office of Reactor Safety has departments for Inspection, Plant Safety Assessment, Reactor Technology, Structural Integrity and Human Factors.

This Commission has only studied the activities within the Offices of Reactor Safety and Nuclear Waste Safety.

The responsibility for the various types of SKI's regulatory activities is allocated to the Offices. The Office of Reactor Safety has the responsibility for regulatory activities related to nuclear safety at the sites for:

- the nuclear power plants Barsebäck, Ringhals, Oskarshamn and Forsmark, excluding the CLAB at Oskarshamn and the SFR at Forsmark;
- the research reactor R2 in Studsvik; and
- the fuel manufacturing plant in Västerås and the Ranstad facility.

The Office of Nuclear Waste Safety has the responsibility for regulatory activities related to nuclear waste management at the following installations:

- the CLAB at Oskarshamn and the SFR at Forsmark;
- installations in Studsvik and at the nuclear power plants for the handling and storage of nuclear waste;
- the Ågesta reactor (shutdown and de-fuelled); and
- the future final repository for spent nuclear fuel, with an associated plant for the encapsulation of spent nuclear fuel.

The heads of offices and departments have the responsibility for the management of regulatory tasks assigned to them. This responsibility includes scientific/technical and administrative/legal quality control of the management of regulatory tasks and of regulatory decision-making as prescribed in the Administrative Manual. The heads of offices and departments also have the responsibility for initiating regulatory tasks, such as topical or special inspections, reviews and revisions of licence conditions and regulations etc., for inclusion in the Annual Activity Plan. Moreover, they have the responsibility of maintaining and developing the necessary regulatory assessment methods, criteria and expertise in their own staff, supported, as appropriate, by outside consultants and research institutions. In doing so, they have the responsibility for managing the relevant parts of the SKI research and development programme.

The Administrative Manual lists the types of decisions which are authorized at the levels of the Director General, Director of Office and Head of Department, respectively. There is an obligation at each level to consider whether a decision, although formally delegated, should be taken at a higher level, e.g. if policy setting is involved. There is also an obligation to inform the superior manager of decisions made.

In the SKI Activity Plan, regulatory tasks and other activities that can be planned at least 6-12 months in advance, have been listed and classified according to the degree of priority.

For further information on the SKI organization, see Volume 2, Section 3.2.2.

The SSI

The SSI is also led by a Director General under the supervision of a Board of Directors, chaired by the Director General. The Director General and the members of the Board of Directors are appointed by the Government.

The SSI's main regulatory concerns are currently handled by the Department of General Supervision, the Department of Research and Development, and the Department of Nuclear Energy Supervision. The latter department is organized in the Division for Nuclear Facilities and Transport, the Division for Waste Management and Environmental Protection, and the Division for Emergency Preparedness. The heads of these three divisions and the head of the department constitute a steering group, which distribute, and if necessary re-allocate, available resources.

Within the SSI there is also a formal delegation of authority. The Director General makes the major decisions and the head of the Department of Nuclear Energy Supervision decides on other issues concerning radiation protection and emergency preparedness relating to nuclear installations, unless they are particularly important or difficult to assess. The head delegates certain matters further within the department.

For further information on the SSI organization, see Volume 2, Section 3.4.5.

4.2.2 Findings of the Commission

Organization

The basic elements of the organization of the two authorities are quite similar, with a Board of Directors, a Director General, offices and departments and advisory bodies. In addition, the SKI has established activity programmes for the purpose of work planning and follow-up of utilized resources; there is no similar feature involved in the way the SSI has organized its work.

The considerations underlying the organizational particulars of the two authorities are different. In a sense, both authorities are assigned one single task each, namely that of the supervision of safety in nuclear activities and that of the supervision of radiation protection, respectively. However, while the SKI focuses on accident prevention in nuclear activities, the SSI focuses on radiation protection in nuclear, as well as other activities.

The implication for the two authorities, in terms of regulatory approach, is significantly different. The SKI, supervising safety in nuclear activities, is concerned with regulating risk, while the SSI, supervising radiation protection in nuclear activities, is concerned with regulating radiation dose. Regulating risk implies making decisions based on component or systems test results, analyses and operational experience etc. Regulating radiation dose essentially implies the setting of criteria and assuring compliance with the criteria. While radioactive releases and at least worker doses can be measured, the results from the regulating of risk are not easy to quantify.

Such differences in their respective assignments imply a need for different organizational structures for the SKI and the SSI, respectively. In the view of the Commission, this has been adequately reflected in the way the authorities are organized.

Regarding the SKI, the Commission makes the observation that the authority needs to provide additional clarification to its own staff of the full implications of the concept of activity programmes. A common understanding should be established within the SKI on assignments and responsibilities, and on how organizational units and activity programmes relate to each other.

It is the Commission's impression that the SKI as an organization is under stress. The stress appears to originate in a very high workload, but also in difficulties with regard to prioritization and delegating. The organization is coping with an increasing number of new, important and time-consuming tasks, at the same time as the backlog of long-term

unfinished tasks is growing. There is evidence of frustration experienced by individual staff members.

Individual staff members assert that part of the stress is due to managerial difficulties with regard to delegating. The Commission cannot confirm this allegation, but believes that the very fact that this view has been expressed to the Commission should be brought to the attention of the management of the SKI for consideration.

Because of the multi-disciplinary character of the SKI's task and the rather small staff (approximately 50, representing the areas of activity of relevance to the review), there is usually only one specialist assigned to any one specific field. Although general knowledge about a colleague's specialist field can reasonably be expected, the specialists are seldom immediately interchangeable. In the view of the Commission, added emphasis on focused training, job rotation and perhaps a wider distribution of tasks or wider involvement of junior staff members can alleviate some of the bottlenecks caused by the limited number of staff. For most of the specialists' fields, such efforts cannot, however, in the short term, provide true interchangeability. The Commission notes that the SSI, especially in its supervision of nuclear waste management, has to cope with the same kind of problems as the SKI. The number of staff is limited and experts are not immediately interchangeable.

The SKI reviews a large number of individual cases concerning plant modifications, mechanical integrity, the reactor core and the fuel, and modifications of the STFs. The number of such cases amounted to a rather high rate, about 170 for the 1994/95 financial year. These individual cases, together with the evaluation of Licensee Event Reports and operating experience reports, provide a kind of base load. On top of that, in recent years, major issues and projects have been added. Examples of such projects are the clogged strainer issue, the renovation of Oskarshamn 1, the steam generator replacement in Ringhals 3 and the replacement of old instrumentation and control systems of high safety significance with microprocessor-based systems. It is clear to the Commission that a work situation such as the described can result in organizational stress.

The Commission advises the SKI to seek to reduce the present stress situation as experienced by the staff by management measures or other means.

Focus on events and individual issues

As the Commission understands it, it is a feature of the SKI's regulatory approach to focus on the 'safety case' (see Section 3.2.1) of each installation, and on individual issues and events relevant to the validity of this 'safety case'.

In this context, individual issues include licensee applications for plant modifications and changes of the STFs, and events include incidents, performance deviations in tests, defects found during in-service inspections etc.

Until an event has been investigated in terms of its safety significance, there remains an element of uncertainty as to whether the level of safety specified in the 'safety case' documentation, forming the basis of the operational licence, has been achieved, and whether the safety issues related to the event have been adequately dealt with by the licensee. This need to focus on events and issues has, in the view of the Commission, been adequately met by the SKI's regulatory activities, as described in Volume 2, Section 3.2. However, the Commission finds that this approach creates a high workload for the SKI, as events and issues of widely varying safety significance have to be dealt with. This in turn creates severe prioritization problems, as is discussed below. Moreover, the Commission has noted that in a situation of high workload and time pressure, e.g. when the need to decide on permits to resume reactor operation is urgent, department heads and senior experts tend to deal with the issues themselves, instead of letting junior staff members develop their competence by performing the work under supervision. This tendency makes the organization very vulnerable. The result seems to be that the SKI depends heavily on a few key individuals.

The Commission advises the SKI to delegate in a way that makes the organization performance less dependent on a small number of individuals.

Prioritization

The need for the SKI to focus on events, results in planning and prioritization difficulties because, by their very nature, events cannot be foreseen. The Commission agrees with the prioritization principle established by the SKI, that of being directed by the safety significance of an issue, both in the original setting of priorities and in any subsequent change thereof. However, the Commission notes that, because of event-

triggered changes in the priorities, the timely conclusion of long-term projects, which are also of safety significance, has suffered. The development of general regulations is an example. In the view of the Commission, a separate management function is needed at the SKI for developing general regulations.

The Commission has seen signs indicating that difficulties in prioritization is a major contributor to stress in the SKI organization. These difficulties seem partly to emanate from the commendably high level of ambition permeating the whole organization, which makes it hard to resolve conflicts of priority between different tasks. For example, the organization seems to evade making such decisions that are needed to sort out which tasks are to be postponed in situations where choices have to be made between different important tasks.

As illustrated by the recently concluded project to renovate and modernize Oskarshamn 1, the nuclear power industry is in the opening stage of managing the situation with ageing plants and the consequential need to take appropriate action in order to maintain operational safety for their nuclear plants. As viewed by the Commission, it is obvious that other utilities will follow suit and launch similar projects. Experience from the Oskarshamn 1 project clearly shows that significant resources, both from the SKI and the SSI, must be allocated for providing appropriate supervision of the design and execution of the whole process. These situations are similar to the events discussed above, but also significantly different in that their occurrence, *per se*, can be foreseen; however, exactly when they will be initiated is far less foreseeable. For example, as the Commission has been told, the Oskarshamn 1 modification and re-start project took about three years to complete, compared with the 1.5 year estimate in the original OKG plans, due to the discovery of a number of unforeseen issues of high safety significance during the project.

Such major renovation projects provide a different perspective on prioritization for both authorities, namely that of economic importance versus safety significance. It is obvious that the utilities will request timely processing of the matters submitted to the authorities for approval, and it is equally obvious that such processing requests will compete with the need for the authorities to attend to other matters both of a more immediate and of a long-term safety and radiation protection significance. The resulting added complexity in terms of prioritization is deemed to be more apparent for the SKI than for the SSI, because of the much larger quantity of issues that require SKI's consideration. Thus, the Commission advises both authorities, and in particular the

SKI, to make appropriate preparations for managing prioritization, especially in the light of coming renovation projects.

In this context the Commission feels compelled to make the observation that the matter of prioritization cannot be regarded in isolation. There is a clear connection to resources available and to the regulatory objectives decided by the Government. It is not possible to set appropriate and sensible priorities in a situation where, given the resources allocated, all of the options available would result in not attaining the objectives. The Commission discusses the matter of resources available for the two authorities in Section 7.3.

Both authorities have an annual Activity Plan, in which tasks are identified and their respective objectives are defined. For the SKI, the tasks are grouped according to their priority, thus providing an indication of tasks which can be deferred or delayed when non-planned situations of safety significance occur. There is no similar priority grouping built into the SSI Activity Plan.

Regarding the SKI, it should be mentioned that many regulatory tasks are event-triggered, through national or international experience. Especially in the Office of Reactor Safety with its large number of incoming tasks, several deviations from the Activity Plan have to be handled each year by 'operational management'.

The need for such operational management is, according to the SKI, foreseen in the Activity Plan. Tasks in the Activity Plan are thus divided into two priority groups; those tasks that should be completed notwithstanding the occurrence of event-triggered tasks, and those tasks that may be delayed or postponed if event-triggered tasks require higher priority. This division is due to the fact that, by definition, event-triggered tasks cannot be foreseen with regard to the timing and type of expertise required. With these principles as a basis, the head of each office or department has the authority to re-allocate efforts and resources between planned and event-triggered tasks within the total budget for the office or department.

The SKI has stressed that, in practice, operational management according to these principles has often proved to be a difficult task in recent years. Large event-triggered tasks, such as the clogged strainer issue and the renovation of Oskarshamn 1, have added to the normal volume of tasks and have made it difficult to avoid overloading the organization as well as the individual. More long-term activities, such as the revision and development of regulations, as well as research, staff training programmes and the development of a system for internal quality assurance have been delayed, as reported in the SKI Annual Reports.

The Commission concludes that the authorities have the necessary mechanisms in place for both the planning of activities and for making any changes necessary in prioritization. However, the Commission advises the SKI to improve the operational implementation of any changes made in priorities.

Support for regulatory activities

It is common international practice for a nuclear regulatory authority to be able to rely on a Technical Support Organization (TSO). A typical TSO provides expert advice and support and, more generally, practical assistance to the national nuclear regulatory body. One purpose of establishing such organizations was originally to manage and further the work on the design, construction and operation of nuclear power plants, and at the same time, to resolve the associated safety issues. Also in Sweden, such an organization was established; the AB Atomenergi (the predecessor of STUDSVIK AB).

The focus of these research and development organizations has later changed, as the nuclear industry, both vendors and operators of nuclear installations, gained capability and the capacity to manage the development, design and safety-oriented work themselves. The research and development organizations remained competence centres, but they were no longer unique in that regard. This eventually led to a diversification of the range of services provided; partly because such services were in demand from other branches of industry, and partly because these organizations gradually lost their original status as national institutions. Only in cases where the status of the national institutions was not completely lost, what was originally a national research and development organization could evolve into what is now called a national Technical Support Organization; still characterised by providing a diversified range of services.

The task of a TSO is thus to support the authority in a number of ways, including following research achievements, performing relevant research, performing specialist in-depth analysis of events and generally providing technical and review input for decisions on regulatory matters.

The Commission has noted that neither the SKI nor the SSI has been able to systematically benefit from such arrangements, due to the fact that a necessary TSO infrastructure no longer exists in Sweden, after the restructuring of the Studsvik national nuclear research establishment in the 1980's (cf. Volume 2, Chapter 1). The present financial support for the Nuclear Technology Centre at the Royal Institute of Technology in

Stockholm, although commendable, cannot be seen as an alternative TSO, because this Centre is established as a national competence centre.

As regards the SKI, the authority has stated that its R&D programme does provide support for its regulatory activities, according to purpose. In the opinion of the Commission this support is, however, not sufficient.

There are two reasons for this opinion. The first is the fact that, during times with added workload caused by major safety significant events and large industry-initiated plant modification projects, the capability of the SKI to both manage the work situation and the initiation and follow-up of R&D projects is hampered; R&D suffers. The second reason, which also concerns the SSI, is that this kind of an R&D programme cannot truly replace a TSO proper. In other words, an R&D programme cannot provide the work force that a TSO can, and it cannot provide the spontaneous initiative or input that a fully functional TSO is capable of providing.

The Commission concludes, that the lack of a TSO significantly limits SKI's possibilities to plan for the execution of its activities. There is no buffer available for absorbing workload peaks, nor any competence and resource centre to which the SKI can assign specific tasks, including the handling of large review and assessment projects. There is also no organization with which to co-operate in terms of human resource development, without involving the nuclear industry.

As regards the SSI, the Commission notes that although the SSI has access to some R&D support from other organizations, also the SSI would benefit from such support as could be provided by a TSO.

The Commission strongly advises the Government, and the SKI and the SSI, to jointly explore ways in which the authorities may have access to such support that a TSO can provide. One possible way could be to investigate the possibilities of making available the services of a foreign TSO through a bilateral agreement. Another way could be an expansion of the scope of the Nuclear Technology Centre.

Decision-making

For both authorities, being government authorities, the same requirements apply regarding decision-making. Authority to make decisions is primarily vested in the respective Director General, and the mechanism of delegation of authority built into the system enables decisions to be made at lower levels; all in accordance with the formally established system of delegation.

Both authorities make use of the mechanism of delegation of authority, and the current order of delegation is included in the respective Administrative Manual.

Delegation of authority is exclusively linked to the organizational structure of the authorities. With regard to the SKI, it has been observed that no Activity Programme is associated with any delegated authority to make decisions. However, in practice, decision-making authority is delegated to office and department heads.

Closely tied to the decision-making authority is the responsibility of the decision-maker to exercise quality control. This means that the decision-maker is responsible for determining that the basis for the decision is complete and accurate (input information and review/assessment of that input), as well as the fact that the decision is correct in terms of the adopted authority policy, review and assessment criteria, and administrative and other requirements. The system of delegation implies that many decisions are made by department heads; i.e. staff members who are often also specialists. As has been noted above, the specialist characteristics of such posts can create bottlenecks in terms of the timely processing of tasks. In the view of the Commission, the development of general regulations in a manner so that decisions of a routine character can be made by the licensees according to procedures regulated by the SKI would reduce the number of detailed regulatory decisions that the SKI department heads have to make.

One conclusion of the evaluation report resulting from the review of the clogged strainer incident in Barsebäck is that it may be worthwhile evaluating the decision-making process in connection with events of this type. The Commission agrees with what is stated in the report regarding the need to ensure that the decision-making process within the SKI, in connection with severe incidents, functions efficiently, and that the established decision-making process is not sidestepped. Following the review of the SKI response to the evaluation report recommendations, the Commission concludes that the follow-up action taken is appropriate.

4.2.3 Recommendations regarding organization

The Commission *recommends the Government to*

- explore mechanisms for providing access for the SKI and for the SSI to technical support organizations.

The Commission *recommends the SKI* to

- create a common understanding within the organization of the relationship between organizational units and activity programmes;
- consider if management measures or other means can reduce the present stress situation as experienced by the staff;
- consider delegating in a way that makes the organization performance less dependent on a small number of individuals; and
- consider adding a separate management function to the organization for developing general regulations.

4.3 Competence and training

4.3.1 Description

The SKI

The SKI is a knowledge-based organization, where maintaining and developing competence is of prime and strategic importance. The management philosophy is accordingly based on all staff having the desire and ability to take responsibility for developing their tasks, and taking responsibility for their own development as targeted by the objectives of the SKI.

The SKI strives for the development of human resources at all levels of the organization by continuous learning at work supplemented by training. Responsibility for the development of human resources is assigned to each manager.

The SKI has a strategic plan for human resource development that is complementary to the regular management of the personnel. Each manager is responsible for having 'development discussions' with all staff members on an annual basis.

A comprehensive training programme, related to needs identified in the planning of SKI activities, is established annually. Due to the high workload and resulting lack of time, the SKI currently has difficulties in implementing its planned training programme.

The SSI

The SSI has issued a policy for the training of its personnel. According to this policy, the training should be based on what has been analyzed as needed. The objectives of the training are to maintain and further develop the expertise of the staff, to meet external or internal demands on change and development, to meet the individual's need for development, stimulation, motivation and security and to increase the efficiency of the activities of the authority.

A plan for the development of competence is decided by the Director General each year. A 'curriculum' is issued showing which kind of training is planned, how many are supposed to take part in the training from each division and the estimated cost. The plan is based on analyses of the need for training and development. These have resulted i.a. from yearly development talks that each manager conducts with his or her staff members.

Part of the resources which the SSI spends on competence development of the staff is co-ordinated through the Personnel Division which uses about 0.5 million SEK each year to fund, completely or partly in co-operation with the divisions concerned, external costs such as fees for courses, study tours and other activities deemed to be of more general interest. Other expenses are funded directly from each division, and the major cost is the actual working time spent. Activities vary from very general, such as language tuition and computer training, via specially designed courses, e.g. on the consequences of fuel damage, to strictly personal programmes like study periods at sister authorities in other countries.

4.3.2 Findings of the Commission

An adequate supply of trained personnel at the regulatory authorities is one of the requirements on which the safety of nuclear installations rests. The personnel should have the ability and competence to conduct careful and detailed safety evaluations of a nuclear installations project at all stages from its inception to decommissioning. Formalized safety criteria in the form of standards, codes, guides etc. can be of considerable assistance in ensuring that the basic requirements are understood and met. Safety criteria cannot, however, be treated in isolation, and can only be used effectively by qualified personnel (cf. Volume 2, Section 8.1.1). In its evaluation, the Commission is satisfied

that the personnel of both the SKI and the SSI are well qualified for their tasks.

The staff of both authorities have a high level of technical and scientific competence, and enjoy high international esteem. About 20 % of the staff have a post-graduate degree, and more than half of the staff have graduated from university - the situation is almost identical for both authorities.

Regarding education and training at the SKI, a human resource development plan supported by competence profiles has been developed. This plan is tailored to the situation and needs for the individual staff member. The plan covers development activities not only for new staff members (trainees) but also for the 'old hands' because of the needs originating in e.g. technology and safety assessment methodology development, and job rotation.

For new staff members, the unit manager supervises training progress, and the staff member will often have a tutor in the form of one of the 'old hands'. This training by means of a supervised introduction process continues over a period of a few to several years.

The Commission agrees with and supports this manner of designing and conducting a human resource development programme at the SKI. However, the Commission notes that the conduct of the training part of the programme is not as continuous and consistent as it could be. The Commission advises both the SKI and the SSI to ensure that plans for training and competence development are implemented in a timely manner.

The Commission wants to add some comments on details relating to competence and training of the personnel of both authorities.

The heads of offices, departments and divisions in the SKI and the SSI have generally been recruited on merits relating to their professional qualifications, and not necessarily on their leadership and/or managerial experience. As was discussed above, the present stress situation as experienced by the staff of the SKI, appears to be partly due to difficulties in delegating and prioritizing. In view of this, the Commission advises the SKI to further develop managerial competence within the organization.

The SKI has a tradition of being dependent on a few individuals who are involved in most issues (cf. Section 4.2.2). These are staff members of outstanding technical knowledge, many of whom are heads of units, and, in practice, typically all other staff members have to turn to them for consultation. Since there is no long systematic tradition of documenting rules, procedures and inspection follow-ups, the SKI is indeed dependent on the knowledge and competence of the individual.

The SKI is a small organization where there seldom will be more than one specialist in a specific field, and where redundancy of special expertise is almost non-existent. This is also valid for the SSI regarding the supervision of waste management. Broadening the specialist competence by structured specific training and controlled delegation of tasks would make the authorities less susceptible to loss of competence in the event of changes in personnel and resources. Individual training plans are part of an internal quality assurance system.

There have been some critical comments from licensees on the qualifications of some of the SKI inspection staff, and the manner in which inspections are carried out. The Commission does not consider those comments to be of major concern.

The Commission notes that no systematic qualification requirements exist for the SKI inspectors. The SKI and the SSI should formulate and document, in their quality assurance systems, standards for the competence of inspectors of nuclear installations.

The Commission observes that the SSI has no systematic qualification profiles documented. Competence profiles are a useful instrument, especially when recruiting new staff.

The Commission also observes that the personnel turnover at the SSI is very low and that the average age is high. In the opinion of the Commission, a somewhat higher turnover and rotation within the SSI could be of benefit to the organization. It is often considered good international practice to organize rotation of inspectors from one plant to another in order to prevent too much familiarity with plant staff and in order to promote good practices from a given plant to another. The Commission advises the SSI to consider rotation of inspectors.

4.3.3 Recommendations regarding competence and training

The Commission *recommends*

- *the SKI and the SSI* to ensure that plans for training and competence development are implemented in a timely manner;
- *the SKI and the SSI* to formulate and document, in their quality assurance systems, standards for the competence of inspectors of nuclear installations;

- *the SKI* to further develop managerial competence within the organization; and
- *the SSI* to consider rotation of inspectors of nuclear installations.

5 Research and development programmes

5.1 Discussion of the assignment

According to the Terms of Reference, one of the main tasks of the Commission is to describe and evaluate the harmonization of the research programmes of the authorities with the regulatory objectives.

The Commission has interpreted the task as follows. The Commission shall describe the scope of the research and development (R&D) programmes of the two authorities and assess the relevance and the management of the programmes. For a description and a discussion of the regulatory objectives of the two authorities, see Section 3.3.

5.2 Description

5.2.1 The SKI

The following account is based on information provided by the SKI during interviews and in writing (cf. Volume 2, Sections 6.1 and 7.3).

Responsibility for R&D forms part of the responsibilities defined for all offices and departments within the SKI. The responsibility for an SKI Activity Programme thus includes conducting R&D as required. In other words, R&D is fully integrated in the SKI Activity Programmes. All staff members involved in R&D also work actively with inspection and safety assessment. A small Department of Research (two or three persons) is charged with the overall responsibility for the co-ordination of the SKI R&D programme.

According to the SKI, the above-mentioned approach aims at gaining maximum benefit from the R&D programme in terms of the competence development of the SKI staff and ensuring that the research and development is truly governed by the regulatory needs. The SKI is ensuring a high international standard in R&D by an extensive participation in international R&D programmes and by exposing the findings and conclusions to international peer reviews.

Eleven 'Research Areas' have been identified in conjunction with each of the SKI's eleven Activity Programmes. Nine of the research areas relate directly to reactor safety, one to nuclear waste management and one covers both of these areas.

One of SKI's advisory committees, the Research Committee, occasionally reviews the R&D programme with regard to the identification of needs, priorities and efficiency (cost-benefit), considering also the dissemination and the use made of the results obtained, as well as whether the R&D meets the objective of maintaining strategic competence. There are, in addition, advisory reference groups and peer review groups for the various specific research areas.

The chairman of the SKI Research Committee is appointed by the Government and the members by the SKI Board of Directors. The present members are connected to the universities and to the nuclear industry. The SSI and the Nuclear Technology Centre of the Royal Institute of Technology (KTH) participate through observers.

When it is appropriate, R&D projects are conducted and funded jointly by the SKI and the industry.

The general objectives of the SKI's R&D programme follow SKI's general supervisory objectives. The SKI has formulated the following three objectives for its R&D programme (Volume 2, Section 6.1.2):

- improve the knowledge base for SKI's regulatory work;
- maintain and develop expertise and research capacity within areas of importance to safety-related work; and
- directly contribute to safety-related work on Swedish nuclear activities.

The SKI defines the scope of its R&D programme as follows:

Whilst 'research' is commonly understood as being concerned with gaining basic and novel knowledge, the SKI R&D programme additionally includes any investigations, testing, developments, evaluations and compilations of available knowledge and methodology which contribute to *generally* meeting the objectives quoted above.

A yearly appropriation is made for the funding of the SKI's R&D programme. This 'Research appropriation' is presently around 65 MSEK, but parts of the yearly appropriations have not been used and the accumulated balance brought forward was about 29 MSEK when entering the present budget period starting 1 July 1995.

According to the SKI Annual Report 1994/95 about 300 R&D projects were running during that year. The SKI has explained to the Commission that this figure is misleading and that the number of 'real' R&D projects is between 150 and 200.

According to the SKI, the distribution of resources in the R&D appropriation for the 1994/95 financial year was 57 % for Reactor and nuclear materials safety, 24 % for Nuclear waste safety, 4 % for Safeguards, 1 % for Information and 14 % for other R&D. The 'other R&D' portion is subdivided into 22 % for the KTH, 45 % for Nordic co-operation on nuclear safety and 33 % for other purposes.

Evaluations of the SKI's R&D programmes have been performed; the most recent one was made by SKI's Research Committee and was reported in March 1995. The report consists of Committee members' conclusions and evaluations of R&D conducted in the different research areas. Some of the recommendations concern priorities within or between research areas, others concern the SKI's management of its R&D programme. One of the recommendations was to increase personnel resources for R&D management.

It can be concluded from the actions that the SKI has taken, based on the review (see Volume 2, Section 7.3), that the implementation of most of the recommendations of the Research Committee has been hampered by the present SKI workload situation.

5.2.2 The SSI

The SSI conducts its own research and its own measurements, and also manages funds for commissioned R&D. Most of the R&D is conducted by personnel within the Department of Research and Development. Within this department there are four divisions with primarily laboratory activities: the dosimetry laboratory, the environmental laboratory, the radiochemistry laboratory and the biomedical laboratory, as well as the research secretariat, which administers external R&D.

The SSI has an overall responsibility for both basic radiation and applied radiation protection research, including R&D needed as a support and complement to the regulatory activities.

The radiation protection R&D related to nuclear power mainly includes radioecology, radioactive waste, emergency preparedness against nuclear accidents and personnel radiation protection.

The Chernobyl accident has meant that the greatest efforts during the last few years have been directed towards radioecological research and towards research concerning accidents. Extensive whole body

measurements of different groups of Swedes and repeated measurements of external radiation levels have been the basis for estimating the long-term health effects of that accident.

The objectives of SSI's R&D in the area of radioactive waste management are SSI's supervisory work within that area, and to assess the nuclear industry's programme for research, development and demonstration. The results of the radioecological research, which is financed by the SSI, are evaluated with regard to the possibility that they can be used in connection with waste management. Research funds are also used to produce reference material for future evaluations of environmental impact assessments.

According to the SSI, much of the radiation protection research may be of immediate importance for regulatory activities. If new processes or phenomena are identified, this may affect, for example, dose limits, and thus also regulatory and supervisory activities. The new SSI regulations for personnel radiation protection for work with ionising radiation at nuclear plants (SSI FS 1994:2), are a result of new recommendations in 1990 by the ICRP. Other R&D projects have not had an immediate impact on the regulatory activities, but are considered to be important for long-term and/or future supervision. Finally, according to the SSI, there are also examples of research where the sole purpose is to acquire new knowledge. Such knowledge could help the SSI to fulfil the regulatory objectives without the need for formal decisions, regulation or supervision, but simply by carrying out R&D and communicating the results.

The annual costs for the SSI's R&D related to nuclear energy are presently slightly less than 10 MSEK.

The SSI has an advisory Scientific Board, appointed by the Government. A majority of its members are scientists from different university departments. The SKI participates through an observer on the Board.

For a more detailed description of the SSI's R&D programme, see Volume 2, Section 6.2.

5.3 Findings of the Commission

5.3.1 General

The Commission notes that the nuclear regulatory authorities in Sweden do not have access to a national Technical Support Organization (TSO), as is the case in most comparable countries (cf. Section 4.2.2). This fact

should be kept in mind when reading the Commission's comments on the R&D programmes of both authorities, particularly that of the SKI.

The Commission has looked for signs of general co-operation between authorities in Europe on R&D in the fields of nuclear safety, radiation protection and nuclear waste management. The Commission is not aware of any co-operation between authorities through the European Commission, but has found extensive co-operation in nuclear safety, radiation protection and waste-related R&D through the IAEA, the OECD/NEA and through multilateral and bilateral co-operation agreements (see Volume 2, Sections 6.1 and 6.2). In addition the SSI has engaged the services of the Center for Nuclear Waste Regulatory Analysis (CNWRA) in the USA. The CNWRA is an organization dedicated to supporting the USNRC's regulatory work in nuclear waste through research and analysis. The SSI has engaged the services of the CNWRA because they are highly qualified, as well as independent of those developing high-level waste repositories.

In the view of the Commission, it is crucial that the SKI and the SSI maintain and develop their participation in international R&D projects and that they also, when appropriate, co-operate with independent expertise outside Sweden.

5.3.2 The SKI

The Commission comments on the SKI's R&D programme from an overall perspective.

Given the lack of a TSO in Sweden, a prime concern should be that R&D projects initiated and/or commissioned by the SKI are carried out to an extent that can give the necessary support to the regulatory function of the SKI.

It is the opinion of the Commission that the use of a reference group consisting of representatives from the SKI, nuclear industry, consultants and universities is a good practice. The integration of the Swedish nuclear safety R&D with international and other countries' R&D programmes should be continued.

The economic resources available for the SKI's R&D are generally adequate and it is crucial that the SKI has the flexibility to finance small projects when needs emerge. The large number of projects is, however, an area of concern. Taking into account administrative resources, impact value, communication problems etc., the Commission suggests that the average size of the projects should be increased, thus decreasing the total number. Focused effort on well selected and defined

projects, which should be completed within a restricted time span is recommended. It is better to perform fewer projects and to complete on time those projects which are under way.

The SKI's R&D projects are more development than research oriented. The majority of them include elements of data collection, literature surveys, regulatory summaries and background material for new regulations etc. For both internal and external reasons the objectives of the projects should be clearly defined.

The Commission advises the SKI to give enough priority to R&D in the departments in order for them to be able to carry out their R&D commitments. If this cannot be achieved by changes in priorities, other measures should be considered.

However, to give the responsibility of the R&D projects to the SKI departments may create difficulties. Firstly, as has been commented upon earlier in the report, the SKI departments currently have problems with prioritization. Secondly, a conflict of interest may arise because commissioning the R&D and subsequently using the results from the research to formulate new regulations, does not always provide the necessary objectiveness.

In the reactor safety R&D projects, it is not clear how the industry and licensees are consulted, besides their 'representation' in the reference groups, and how the results of R&D are communicated to them. There is, however, evidence of consultation and communication in some research areas. For example, the role and leadership of the SKI is recognized in international R&D on the issue of severe reactor accidents. In the same area the Swedish reactor licensees led the world in developing and installing filtered vent containment systems to mitigate the consequences of severe reactor accidents. The Commission would like a clarification of how such consultation is organized with utilities during the development of R&D also in other areas, such as ageing, plant modernization and periodic safety reviews.

The initiative to form the Nuclear Technology Centre at the KTH is a good one, as it is an attempt to collect the fragmented R&D carried out at the KTH and other organizations. This improves the possibility of accumulating the knowledge gained from subsequent nuclear safety-related projects.

The communication of the results from the SKI's R&D programmes has been criticized by the nuclear industry. However, the industry should not only criticize the SKI, but more actively seek the information required. The reference groups formed for the different programmes are good fora, in which both aims and objectives of the projects as well as results can be discussed.

Areas of further improvement are converting results into regulatory requirements, as well as transfer of know-how to regulators and the nuclear industry. The SKI must, in addition to the technical reporting, also take responsibility for a general reporting to the public at large. Special attention should be paid to the drafting of summaries of R&D reports in order to ensure that these will be correctly understood by non-specialists.

The Commission notes with satisfaction that the SKI, in the past, has initiated evaluations of its R&D programme. The Commission is of the opinion that this process should be repeated at regular intervals. However, the Commission is concerned about the apparent difficulties of implementing the recommendations in the 1995 evaluation report.

It is important that all involved parties are able to express their views on the needs of the R&D work to be carried out. The priorities and the focus of the safety-related R&D should be defined by a group having an overview of the need and possibilities. There should, in addition, be advisory reference groups and peer review groups associated with the various, specific areas of research.

To sum up, the Commission advises the SKI to re-examine its own R&D needs and performance, including the management of the R&D activities to ensure that the highest priority work is funded and performed. Priority should be given to the conduct of R&D in the departments in order for them to meet their commitments. If this cannot be achieved, a reorganization of the way R&D projects are handled must be considered. The Commission recognizes the need to be able to carry out small R&D projects on an urgent basis, but believes that the present number of projects is too high for effective management within the resources available to the SKI.

5.3.3 The SSI

The Commission has the impression that the SSI's R&D programme related to nuclear activities functions in a satisfactory way. However, the Commission has not carried out an in-depth analysis.

Results from radiological R&D are often noticed by and discussed in the media. The Commission advises the SSI to pay special attention to the drafting of summaries of R&D reports in order to ensure that these are correctly understood by non-specialists.

5.3.4 Waste-related research and development

In the area of radioactive waste disposal both the SKI and the SSI have formally reviewed the research and development programme of the nuclear industry, which has commissioned the Swedish Nuclear Fuel and Waste Management Co (SKB) with this task. The Commission is aware that for many years the SSI, the SKI and the SKB have been actively represented on the Radioactive Waste Management Committee of the OECD/NEA, where a great deal of co-operative R&D in waste management is reviewed. However, the SKI and the SSI have independent R&D programmes in waste disposal. The Commission has noted that, although co-ordination is sought by the two authorities, different views still exist. In times of scarce resources, it would be useful for the managements of the SKI and the SSI to review the two programmes together to seek improved and more cost-effective R&D.

In this area the Commission finds it especially important that the SKI and the SSI work in accordance with their recent agreement on communications (see Section 6.3), so that the affected public and local governments at candidate high-level waste repository sites have a clear, objective flow of information from the authorities acting in their interest.

5.4 Recommendations regarding research and development programmes

The Commission *recommends*:

- *the SKI* to improve the management of its R&D programme by re-evaluating the number and the size of planned R&D projects in order to ensure completion of needed R&D in a timely way;
- *the SKI and the SSI* to improve communication of the results of R&D to the involved parties as well as to the general public; and
- *the SKI and the SSI* to further co-ordinate their respective R&D programmes in the area of nuclear waste management.

6 Division of roles and responsibilities

6.1 Discussion of the assignment

According to the Terms of Reference, one of the main tasks of the Commission is to describe and evaluate the way in which the roles have been allocated and the relations prevailing between the regulatory authorities and the licensees.

This part of the assignment is mentioned only in the 'Summary of the assignment' and has not been set out in detail in the Terms of Reference.

The Commission has interpreted this task as follows. The assignment comprises two relationships, the one prevailing between the regulatory authorities and the licensees and the other prevailing between the authorities. The Commission shall describe and evaluate the present division of roles between the licensees and the regulatory authorities. Moreover the Commission shall describe the division of responsibilities and evaluate the co-operation between the SKI and the SSI. In doing so, the Commission shall consider the present organizational structure with two regulatory authorities in the nuclear field.

6.2 The division of roles between the regulatory authorities and the licensees

6.2.1 Description

In Sweden the division of roles between the licensees and the regulatory authorities is such that the full responsibility for the nuclear safety and radiation protection of nuclear installations rests with the licensees.

The holder of a licence for nuclear activities is responsible for ensuring that all measures required for maintaining safety are taken. The licensee is responsible for ensuring the safe handling and final disposal of nuclear waste and the safe decommissioning and the dismantling of nuclear installations.

As regards radiation protection, the licensee has the responsibility to take the measures and precautions required to prevent or counteract harm to people, animals and the environment. This implies that doses to personnel and the general public must be kept below imposed limits and that such doses must be as low as reasonably achievable. The licensee also has the responsibility of supervising and maintaining radiation protection at the nuclear site and of properly maintaining the technical devices and the measuring and radiation protection equipment used in the activities. An important part of the licensee's responsibility for radiation protection is to ensure that the radioactive waste is handled and eventually placed in a final repository in a manner that is satisfactory from the viewpoint of radiation protection.

The role of the SKI and the SSI is to ensure that the licensees assume their responsibilities. The SKI focuses on nuclear safety and the SSI on radiation protection.

The division of roles between the licensees and the regulatory authorities is often described as an important component of the 'Swedish model'. In an Evaluation Report in 1993, concerning the SKI's handling of the matter of the clogged strainers, the 'Swedish model' is described as follows (English version of the report, p. 22):

SKI applies the 'Swedish Model' to its regulatory work. In principle, this means that SKI gives the licensees the responsibility of establishing the level of safety which will then apply, after SKI's evaluation and approval. ... the licensees bear the full responsibility, in accordance with the Act on Nuclear Activities, of ensuring that the nuclear power plants are operated in a safe manner. In connection with this, SKI's role is to monitor and ensure that the licensees live up to their responsibilities and to take action in cases where SKI finds that this is not so. The advantage of this approach is that the licensees are given a certain measure of freedom to define the level of safety without being forced to comply with a particular definition decreed by the regulatory authority. Since the initiative for the safety-related work is taken by the licensees, the risk of the responsibility for safety unconsciously being transferred to the authority is also minimized. One disadvantage could be that, in certain situations, it may be unclear exactly what the level of safety is.

The Evaluation Report also has some comments on the merits of the 'Swedish model' in comparison with a system built on detailed regulation, as follows (p. 22):

The alternative to the 'Swedish Model' would be a system where criteria and limits are specified in detail and strictly enforced. The advantage of such a system is that there is never any doubt as to what the acceptable level of safety is. The disadvantage is that the licensees easily end up in a situation where their own safety work is only carried out in order to fulfil the authority's requirements. Thus, there is a risk that the initiative in the safety work can be lost and also the work to raise the level of safety. The individual licensee may also be forced to accept solutions which are not optimal for the specific plant. There is also a risk that such a system will inhibit an open dialogue on safety at the plants since the licensees can limit efforts to fulfilling the requirements of the authorities.

When describing its regulatory philosophy in Volume 2, Section 3.5.1, the SKI states that in the conduct of all its regulatory activities:

the SKI strives for an interaction with the licensees which urges and encourages them to assume their responsibilities in a correct and productive way. This is believed to be achieved by promoting open attitudes and mutual confidence, drawing in the first place on the willingness, competence and ability on the part of the licensees in providing for safety.

The SKI also states that:

an open and frank dialogue between the SKI and licensee experts is a key element in the conduct of the SKI regulatory activities, with the dialogue focusing on achieving fundamental safety objectives. Obviously, such a safety dialogue must be based on high professional competence on both sides.

This type of practice is commonly referred to in Sweden as the '*Swedish model*'. The experience of the practice is largely favourable. It requires due regard to be paid to the proper roles of the parties, and full realization, on the part of the regulator, that confidence on the part of the SKI in the other parties must not rule out the seeking of independent verification.

Also the SSI stresses the importance of confidence between the regulatory authority and the licensees and states as follows (Volume 2, Section 3.5.2):

It is SSI's policy to announce all inspections beforehand, and to strive for well prepared inspections. This allows the SSI to ask for meetings and consultations with appropriate staff at the plants and to demand thorough discussions and presentation. It is also a thoroughly considered policy to encourage the reporting of mistakes and irregularities and the SSI tries to avoid sanctions against those

who, on their own initiative, report problems. The responsibility of solving radiation protection problems rests with the plant, but the SSI can always be consulted for advice and examples.

6.2.2 Findings of the Commission

The Commission is of the opinion that the relations between the licensees and the regulatory authorities are good and that the prescribed division of roles is appropriate.

In the opinion of the Commission, the 'Swedish model' for the supervision of the Swedish nuclear activities does not notably differ from the models for how the roles and the respective responsibilities are divided between nuclear utilities and regulating authorities in other countries.

The 'Swedish model' is consistent with IAEA recommendations and is comparable to, e.g. the French and the UK model. As was discussed in Section 2.1.1, Swedish and French authorities, for example, do not prescribe in detail how the licensees should conduct their activities, as does the US authority. This is an example of individual differences between countries in their general approach to how supervision is conducted. However, such differences notwithstanding, the overall principle for the division of responsibilities is the same for most countries in which nuclear activities are supervised.

In Sweden the relations between the nuclear authorities and the licensees basically build on mutual confidence. One example of this is the SSI policy to encourage licensee staff to report mistakes.

The Commission notes that the SKI considers an open dialogue between the SKI and the licensee to be a key element in the SKI's regulatory activities. This practice of maintaining an open dialogue with the licensees might be contrary to the principles of authorities in other countries. However, in Sweden, with its long tradition of co-operation between regulators and those regulated, supervision by means of an open dialogue is not unusual. The condition for a supervisory model, which builds to a large extent on dialogue to function as expected, is that all parties involved should be able to recognize the moment when the dialogue ends and formality ensues. As has been discussed in Section 3.5.2, clarity in this respect has at times been missing in the communication between the SKI and the licensees.

During interviews with the utilities, the Commission was told that there exists some uncertainty as to how the 'Swedish model' should function in practice.

In the view of the Commission, the model should not be changed, but its implementation should be more precisely defined. Greater clarity would facilitate the licensees' and the authorities' work according to the model. One way of doing this would be for the SKI and the SSI to clarify, in their general regulations, the division of roles between the authorities and the licensees. This could be achieved by formulating their respective regulations in a way that clearly mirrors the principles, according to which nuclear regulatory activities are conducted in Sweden. The drafting would probably require consultations with the licensees. The resulting regulations would, in the opinion of the Commission, also contribute to a better public understanding of the nuclear regulatory activities and would thereby promote public confidence in the authorities.

The present practice to have management meetings between the authorities and the licensees is encouraged. In the view of the Commission, such meetings should take place more often than once a year.

6.2.3 Recommendation regarding the division of roles between the regulatory authorities and the licensees

The Commission *recommends* that *the SKI and the SSI*, in co-operation

- in their general regulations clarify the division of roles between the authorities and the licensees.

6.3 The division of responsibilities between the SKI and the SSI

6.3.1 Description

In Volume 2, Section 3.6, there is a factual account of the interface of responsibilities between the SKI and the SSI.

The Government has appointed the two Director Generals as a member of the Board of each other's authority and there are representatives from each authority in the respective advisory Research Committees.

The foundation for the interface of responsibilities between the SKI and the SSI is provided in the Act on Nuclear Activities and the

Radiation Protection Act. These two Acts, with corresponding Ordinances, define the responsibilities of the SKI and the SSI. Safety-related matters are handled by the SKI and radiation protection matters by the SSI. The possibility for overlapping responsibilities between the two authorities has been acknowledged and addressed in the preparatory documents to recent revisions of the Radiation Protection Act and the Act on Nuclear Activities.

The overlap has occasionally caused friction between the SKI and the SSI, in particular when the legislation has been changed or when unprecedented situations have occurred. The authorities have established more or less formal agreements, and practices on co-operation have evolved. The Government has also, on several occasions, requested that the SSI and the SKI discuss and report the possibilities of extending the collaboration on nuclear issues. This was, for example, requested in the Letters of Appropriation for the 1994/95 financial year.

The Letters of Appropriation requested the SSI and the SKI to report on the possibilities for rationalization regarding increased co-ordination of activities concerning the regulatory supervision of installations and nuclear waste. A joint report to the Government, dated 20 June 1995, has been issued. The report reflects the current practice and the authorities' opinions on the division of responsibilities and may be regarded as a commitment to implementing the intentions presented in the report.

The Terms of Reference for the joint working group that prepared the report were jointly issued by the Director Generals. The report of the working group presents conclusions and recommendations for both the supervision of installations and transportation and for supervision in the nuclear waste management field. The working group concluded that a well functioning and comprehensive co-operation has been established with regard to installations and transportation. However, it also pointed out that demands on increased co-operation and co-ordination are expected in the future, because an increasing need for surveillance, repair, maintenance and refurbishing work at the ageing nuclear plants will raise a number of radiation protection issues.

With regard to the nuclear waste field SKI's and SSI's working group concluded that certain friction and problems between the authorities have had disadvantageous effects on effectiveness. The fields of responsibility defined in the Act on Nuclear Activities and the Radiation Protection Act partly overlap. The working group found that friction is commonly caused by insufficient information and communication. One reason has been the difference in view regarding which requirements should be placed on radiation protection and safety.

The group also pointed out that in the nuclear waste management field there are many examples of well functioning co-ordination between the authorities regarding complicated issues, such as the final operating permit for the final repository for low- and intermediate-level operational waste, SFR-1. Also the formation of the working group has helped to create conditions for a more effective future co-operation and co-ordination. The report recommends continuing the development of co-operation between the SKI and the SSI, with a joint and powerful management involvement.

At a joint SKI/SSI senior management meeting in June 1995, regarding the licensing of future installations forming a part of a system for the disposal of spent nuclear fuel, it was agreed that (Volume 2, Section 3.6):

- the SKI and the SSI shall develop a joint plan for the publication of different types of general regulations according to the Act on Nuclear Activities and the Radiation Protection Act, respectively, and shall provide information thereof to licensees and other parties concerned. An example of current work to finalize regulations is SSI's protection criteria for waste disposal, a draft of which has been available for comment, and which is being developed by the authorities in close co-operation.
- the SKI and the SSI shall co-ordinate their contacts with the County Administrations etc., with regard to the... licensing of future installations forming a part of a system for the disposal of spent nuclear fuel.

In connection with the approval of SFR-1, the SSI and the SKI in 1987 jointly issued a document with the requirements on waste packages for final storage in SFR-1. In order to prepare this document and to examine the different waste categories, the authorities' Working Group (MAAS) was created. With time, MAAS has developed into a forum for the discussion of other matters of common interest. MAAS has, according to the authorities, proven to be a good way of developing co-operation and common views.

For the final disposal of spent fuel, there is extensive co-operation between the SSI and the SKI. The authorities have established a joint information policy, especially aimed at municipalities who take part in the SKB's feasibility studies for siting a repository. The SSI and the SKI are usually represented on each other's steering committees for large projects. This crosswise representation creates possibilities for forming common views and forms a basis for future supervision within areas where the authorities' responsibilities overlap.

6.3.2 Findings of the Commission

Different countries have chosen different organizational structures for their nuclear energy supervision. In Finland, for example, the two authorities which supervised nuclear activities have merged. Supervision is conducted by one authority handling matters both on nuclear safety and radiation protection. However, as described in Volume 2, Sections 9.2 - 9.4, there are numerous examples of countries where the nuclear regulatory tasks have been organized in a way similar to that of Sweden.

The IAEA, when advising smaller countries on reorganizing their nuclear supervision, has, in later years, advocated a solution with one single nuclear regulatory authority.

In 1983, a Swedish Government Committee for the review of the nuclear legislation evaluated whether the SKI and the SSI should merge, or whether the SSI Department for Nuclear Supervision should be transferred to the SKI. One purpose of the Committee was to consider the management and financing of the supervisory activities. The Committee decided not to recommend any form of a merger between the two authorities.

On the basis of this report, the Government in a bill (prop. 1983/84:60) declared that it was not, at that time, prepared to suggest any form of merger between the SKI and the SSI. In the bill, the Government expressed its view that a merger should only take place if the benefits were obvious. In the same bill, the Government stressed the fact that maintaining two regulatory authorities in the nuclear field would require close co-operation and co-ordination. The Government realized that a certain overlapping of the activities of the two authorities exists. However, such an overlap should not be considered always to be a disadvantage and should be accepted due to the formulation and character of the legislation, and due to the necessary balancing of the nuclear safety and radiation protection issues.

The Commission notes that the overlap in responsibilities between the SKI and the SSI has, over the years since 1983, led to some friction in the co-operation between the two authorities, especially in the waste management field. With this in consideration, the Commission has pondered whether the time has now come for the SKI and the SSI to merge. There are arguments for and against a merger, of which the Commission has taken into account the following:

- Radiation protection issues in Sweden may, in the long run, be more lasting than traditional nuclear safety issues. While nuclear energy

production may end some time in the future, there will always be a need for radiation protection.

- Both reactor safety and radiation protection are important and one way of promoting both issues is to have two equally powerful authorities.
- Close contacts and systematic co-operation between staff members supervising nuclear reactor safety issues and those supervising radiation protection issues should be facilitated.
- Resources, personnel and others, might be used with more flexibility in one organization, and thus more easily be directed towards 'critical' areas.
- The SSI has several supervisory tasks besides its supervision in the nuclear field.
- The supervision of the SSI is of a very different nature than the more engineering-oriented supervision presently carried out by the SKI.
- There is a certain overlap in the responsibilities between the SKI and the SSI, especially in the waste management field.
- Municipalities involved in the siting programme for a repository for spent nuclear fuel have had problems in discerning which of the authorities they should address in a given situation.
- A merger could lead to somewhat less administrative costs, but the costs for relocating the SKI and the SSI with its laboratories to the same building, or to adjacent buildings, would be considerable.

Having considered the listed arguments, the Commission does not recommend a merger between the SKI and the SSI. However, the Commission advises the authorities to continue improving their co-operation and dialogue, especially in the regulatory activities concerning nuclear waste management.

The Commission notes that the report by the SKI and the SSI to the Government in June 1995, shows that the two authorities are aware of the need for more co-operation and are in the process of taking measures to promote such a development. The Commission considers the report as an important step in the right direction.

In its considerations concerning the division of responsibilities between the SKI and the SSI, the Commission has discussed whether a task force for the supervision of nuclear waste management activities

should be created. Such a task force would be a standing group with representation from both authorities. The aim of creating the task force would be to promote co-operation between the authorities and thereby make the work more effective. The Commission advises the SKI and the SSI to consider creating such a task force for the supervision in the nuclear waste management field.

In the opinion of the Commission, the SKI and the SSI should also consider whether there is a need to define issues for which one of them should act as the lead authority, having the responsibility for following up and co-ordinating issues with the other authority.

To conclude, the Commission is of the opinion that the SKI and the SSI have to continue improving their co-operation and dialogue, especially in the regulatory activities concerning nuclear waste management.

6.3.3 Recommendation regarding the division of responsibilities between the SKI and the SSI

The Commission *recommends* that *the SKI and the SSI*, with a joint and powerful management involvement,

- further the present process of improving the co-operation between the two authorities.

7 Economic resources

7.1 Discussion of the assignment

According to the Terms of Reference, one of the main tasks of the Commission is to describe and evaluate the efficiency with which the economic resources are deployed.

This part of the assignment is mentioned only in the 'Summary of the assignment' and has not been set out in detail in the Terms of Reference. The Commission has interpreted this issue as follows. The term 'economic resources' refers to the economic resources which are at the disposal of the authorities. The purpose of the evaluation would be to form a basis for judging whether the available resources are adequate and/or are being used in an efficient way.

7.2 Description

7.2.1 The SKI

Appropriations from the state budget finance the SKI activities. Resources are made available to the SKI by the Government through an appropriation letter. In this letter, economic resources are allocated and objectives for the activities are specified. The appropriations are based on the evaluation by the Government of the SKI's budget request, as is the case for all government authorities. The result of the evaluation is accounted for in the budget bill.

Contrary to what is normal for appropriation-financed authorities, the cost of SKI's activities is offset by regulatory and research fees paid by the nuclear utilities. Consequently, the cost of SKI's activities has a neutral impact on the state budget, although the fees are not directly available to the SKI.

For the 18-month period from 1 July 1995 to 31 December 1996, the appropriation for the financing of the SKI's regulatory activities is 92 MSEK (61 MSEK for 12 months). Of these 92 MSEK, around 52 (36) MSEK will be spent on Reactor & Nuclear Materials Safety activities,

16 (10) MSEK on Nuclear Waste Safety activities, 8 (5) MSEK on Information activities and 16(10) MSEK on Safeguards activities.

The appropriation for the financing of the SKI's nuclear safety research during the above-mentioned 18-month period, is 88 MSEK (59 MSEK for 12 months).

In February 1996, the SKI submitted to the Government its budget request for the financial year 1997. According to this budget request, a resource increase of around 9 MSEK compared with the current appropriation is needed for the financing of the SKI's regulatory activities during 1997. The appropriation for regulatory activities would then amount to a total of 70 MSEK.

For the SKI's research activities an appropriation of 62 MSEK is requested for 1997.

The SKI explains its request for an increase in resources with expected increasing demands on SKI's services due to external developments. Additional resources will, according to the SKI, be needed to avoid unreasonable working conditions overloading the SKI staff.

As a result of political decisions to cut overall government costs, the SKI's appropriation for research activities was decreased by 13 % for the financial year 1995/96, in comparison with the appropriation for the year before. The Government has demanded further reductions on the order of 4.5 % for each of the 1997 and 1998 financial years. The reduction would result in a decrease in the appropriation for SKI's regulatory activities by around 2.7 MSEK per year and for research activities by 2.6 MSEK per year.

Altogether this would mean that the appropriation for SKI's regulatory activities would decrease by 9 % and the appropriation for SKI's research activities by 21 % during the period from 1994/95 to 1996. In order to avoid facing a situation where staff would have to be made redundant, the authority has, since the summer of 1995, kept two professional posts vacant; one in nuclear waste management and one in international relations.

According to the SKI, the planned decreases in appropriations would lead to a situation where current activity objectives would have to be amended significantly. The resource analysis carried out by the SKI in the budget request, shows that a number of changes in objectives will have to be made already with the current level of appropriation for regulatory activities.

According to the SKI, a dialogue with the Government is required in order to clearly state a new focus and level of ambition for SKI's activities. A change of focus and of the level of ambition would, in the opinion of the SKI, have to be decided, irrespective of whether the size

of the appropriation for SKI's activities would remain unchanged or would be reduced as the Government has demanded.

7.2.2 The SSI

The nuclear regulatory activities of the SSI are financed by a similar budgetary system as has been described for the SKI. Thus, the nuclear utilities are paying annual fees to the state. These fees are not directly available to the SSI.

Also for the SSI, resources are allocated and objectives for the activities are specified in the Government's letter of appropriation.

For the 18-month period from 1 July 1995 to 31 December 1996, the appropriation for the financing of the SSI's nuclear regulatory activities is 25 MSEK (16 MSEK for 12 months).

The appropriation for the financing of research commissioned by the SSI in the field of radiation protection is, for the same 18-month period, 23 MSEK (15 MSEK for 12 months).

As a result of the political decisions to cut overall government costs, the SSI's appropriation for its nuclear regulatory activities was reduced by 5 % for 1995/96. The Government has demanded further reductions by 6 % in total for the years 1997 and 1998. This would mean reductions by 0.5 MSEK per year for the SSI's nuclear regulatory activities.

The effect of such reductions would, according to the SSI, be that the staff would have to be reduced by one person each year. This would lead to a loss of competence, disturbances of the supervision programme for the final disposal of high-level waste and failure to strengthen the environmental monitoring, for which the Government has asked.

In the opinion of the SSI, it is necessary to devote more, instead of less, resources to the activities connected with the final disposal of nuclear high-level waste. Like the SKI, the SSI expects the workload and the demand on resources to increase. Therefore the SSI, in its budget requests for the 1997 financial year, asks for an increase in the resources for the nuclear energy activities by 0.1 MSEK, instead of the demanded reduction.

According to the Government's demands to reduce costs for commissioned research by 3 % per year, the appropriation would decrease by 0.4 MSEK. This would, in SSI's view, create problems for the regulatory activities. The SSI therefore proposes that the appropriation for research activities should remain on the same level as before.

The SSI intends to propose increases in resources in the next budget request. Also, the SSI intends to approach the Government for a

dialogue to clarify the changes in the level of ambition, which a possible decrease in resources might lead to.

7.3 Findings of the Commission

Most of the changes or actions which the Commission is recommending to the SKI and the SSI, would increase their effectiveness; resulting e.g. in less organizational stress. However, the Commission is concerned that the SKI and the SSI have been subjected to budgetary cuts in appropriations in accordance with state finance rationalization requirements. The concern is founded on the following observations.

Both authorities, especially the SKI, have difficulties in coping with their present workload. Also, both authorities will, in the near future, meet an increasing demand on their regulatory activities as a result of external developments. This is particularly true for the high-level waste repository programme, which is moving towards site selection. Such demands will have to be coped with.

The Commission notes that the cost of the nuclear regulatory activities of both the SKI and the SSI has a neutral impact on the state budget, since it is offset by regulatory and research fees paid by the nuclear utilities. It should also be noted that the utilities, when stressing the need for demanding and competent authorities (see Section 2.2), seem to be willing to pay the necessary costs.

7.3.1 The SKI

In its Annual Report for 1994/95, the SKI has pointed out that the experience of that year indicated that SKI's safety assessment and inspection resources are insufficient.

The Commission notes that for the 1995/96 financial year, the appropriation for SKI's regulatory activities was not reduced. Instead, all reductions on resources that were made for 1995/96, concern the SKI research activities. The SKI claims that during that period it has not been possible for the authority to carry out certain tasks at an appropriate level of ambition. Examples of such tasks are, according to the SKI, the timely completion of the evaluation of the waste management programme of the nuclear utilities, participation in meetings with local communities on the issue of the final disposal of spent nuclear fuel and participation in European Community work on nuclear safety and waste management. Also, research projects have been delayed because of lack

of resources and lack of time. The SKI has asked the Government to increase the appropriation for its regulatory activities by 9 MSEK from the next year, which allows for nine new people to be employed by the SKI. As a basis for this request, the SKI claims that there will be an increased demand on their regulatory activities in the coming years.

The Commission is aware of the expected increasing demands on the SKI (see Section 2.1.3). It is also obvious to the Commission that many of the SKI's tasks have been delayed. However, the Commission has not carried out such an in-depth analysis as would be necessary to ascertain whether the problems can be solved simply by adding new resources. There could also be a lack in the efficiency of the organization.

Based on the members' experience from nuclear regulatory activities in different countries, the Commission has the impression that resources for the SKI are scarce, considering the fact that services from a national technical support organization are not available (cf. Section 4.2.2).

In the opinion of the Commission, its recommendations concerning changes in the SKI organization and in the manner of performing its activities should be considered in the current budgetary discussions with the Government.

The Commission encourages the SKI to continue its dialogue with the Government in order to ensure that allocated resources are consistent with the objectives stated for the authority.

The Commission notes that the SKI has not broken down its objectives in such a way that it is possible to measure the outcome of SKI's different fields of activity (cf. Section 3.3). If objectives were measurable and were broken down per field of activity, this would facilitate more precise assessments of the efficiency of the authority.

7.3.2 The SSI

The Commission notes that the reduction in resources for the SSI's supervision of nuclear activities has led to a reduced level of ambition with regard to the control of low- and intermediate-level waste. Delays and reduced levels of ambition in the area of environmental protection may also be a result of such reductions.

For 1997, the SSI has requested an increase in the appropriation for nuclear activities and the same level of appropriation as for 1995/96 for commissioned research. The Commission notes that the SSI also expects a higher workload in the future due to external developments.

As was stated in the case of the SKI, the Commission cannot verify that SSI's problems can be solved simply by adding new resources. The Commission's recommendations concerning changes in SSI's manner of performing its activities should be considered in the current budgetary discussions with the Government.

Also, as in the case of the SKI, the Commission encourages the SSI to discuss its objectives with the Government in order to ensure that the allocated resources are consistent with stated objectives.

7.4 Recommendations regarding economic resources

The Commission *urges the Government to*

- consider, in the current budgetary discussions, the Commission's recommendations, giving special attention to the providing of outside technical support; and
- continue its dialogues with the SKI and the SSI respectively, in order to ensure that allocated resources are consistent with stated objectives.

8 Swedish nuclear regulatory activities in an international perspective

8.1 Discussion of the assignment

According to the Terms of Reference, one of the main tasks of the Commission is to describe and evaluate the harmonization of Swedish nuclear regulatory activities with Swedish legislation and with internationally accepted quality requirements. The task also includes describing and evaluating how Swedish nuclear regulatory activities compare with the regulatory practice in other countries, sharing a similar view on safety. It should be noted that the expression 'quality requirements' is used here to cover the Swedish term 'kvalitetskrav' in the original Swedish version of the Terms of Reference.

An evaluation of Sweden's legal framework for regulation in the nuclear field has been presented in Section 3.2. The description and evaluation of the harmonization of Swedish nuclear regulatory activities with internationally accepted quality requirements is the subject of this Chapter.

The Commission has concluded that it shall produce descriptions of more important internationally accepted rules with regard to nuclear regulatory activities within the areas of reactor safety, nuclear waste management and radiation protection. In this context, the Commission uses the term 'rules' both for formally binding conventions, treaties and bilateral agreements, as well as for not binding recommendations published by international organizations. On the basis of such descriptions the Commission shall evaluate whether Swedish legislation and regulatory practice is in accordance with internationally accepted rules, and how the Swedish regulatory activities compare with the regulatory practice in other countries with a similar approach to safety as that of Sweden.

The Commission has asked the SKI and the SSI to produce accounts of relevant international conventions and other documents within the three areas mentioned. Both authorities were also asked to supplement factual accounts with regard to Swedish compliance with these internationally accepted rules and quality requirements.

The contributions by the SKI and the SSI cover the areas of reactor safety, nuclear waste management and radiation protection and are presented in Volume 2, Sections 8.2, 8.3 and 8.4 respectively.

8.2 Description of internationally accepted rules

8.2.1 Introduction

There are several international mechanisms involved in the work to promote safety and radiation protection in the field of nuclear activities. Such mechanisms include the development of conventions, treaties and bilateral agreements and the development of recommendations by international organizations and other fora. Conventions and treaties are characterized by commitments by States regarding adherence to the respective international instrument, while recommendations are not associated with any such formal commitments.

Examples of the legally binding international instruments include the treaties associated with membership of the European Union and conventions in the field of reactor safety, nuclear waste management and radiation protection. Internationally developed recommendations often represent international consensus documents, or provide a basis for the development of national or international regulations. All such internationally developed recommendations have in common the fact that they have no legal validity in their own right; national implementation, or implementation through a convention or a treaty is necessary.

Sweden, as a member of the European Union, is under the obligation to adhere to the legislative mechanisms established by the Union. Where Sweden is a State party to any particular convention, a similar obligation exists for Sweden to adhere to the decision and implementation mechanism established by each of the conventions. Recommendations, principles and consensus documents established by other international fora are implemented by Sweden, and by other States, on a discretionary basis.

8.2.2 Reactor safety

The Convention on Nuclear Safety was signed by Sweden in September 1994, and was ratified by Sweden in September 1995. The Convention will enter into force after ratification by 22 States, with 17 States having

at least one nuclear installation which has achieved criticality in a reactor core. The entering into force of the Convention is expected by the end of 1996.

The objective of the Convention is to enhance nuclear safety worldwide in an incentive manner and to establish and maintain effective safety defences in nuclear installations. It contains obligations regarding nuclear safety to which the contracting parties shall adhere. Compliance with the Convention will be achieved through the commitment of the parties to reporting the current status in their countries at periodic meetings where reviews of national reports will be conducted.

Other international conventions that should be mentioned are the Convention on the Physical Protection of Nuclear Materials, the Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention), the Convention Supplementary to the Paris Convention and to the Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency.

There are also agreements entered into by the SKI. Examples are co-operation agreements with the US Nuclear Regulatory Commission, the Japanese Ministry of International Trade and Industry, and the Science and Technology Agency of Japan. Sweden participates in the IAEA and the OECD/NEA International Incident Reporting Systems established for feedback and exchange of experience from reactor safety-related events in the corresponding member countries.

8.2.3 Nuclear waste management

The Convention on Nuclear Safety is relevant for the handling and storage of nuclear waste and spent nuclear fuel at the reactor sites. For such operations, the same requirements on safety, quality assurance, organization etc. apply as for reactor operations.

An international convention on the safe management of radioactive waste is under preparation at the IAEA. This convention would correspond to the Convention on Nuclear Safety. Sweden strongly supports the development of such a convention with a broad scope including spent fuel and military waste.

Sweden is a State party to the London Convention, prohibiting the dumping of radioactive waste into the sea. It has been recognized in the context of this Convention that the operation of sub-seabed repositories

accessed from land, such as the SFR, should not be regarded as dumping.

8.2.4 Radiation protection

There are several international bodies, organizations etc. which issue recommendations, guidelines or similar documents on radiation protection, and there are a number of conventions that cover issues of interest for the SSI. One should in particular mention the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), the Commission of the European Communities (CEC), the ILO (International Labour Organization of the UN) Convention, the Nordic radiation protection authorities, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the working group on Biological Effects of Ionising Radiation (BEIR) in the USA.

During the latest 60 years, the most important international body for guidance on radiation protection has been the ICRP. The Commission gives recommendations in a generic form which usually have to be interpreted before being implemented in practical work.

One important recent publication of the ICRP is the '1990 Recommendations of the International Commission on Radiological Protection', ICRP Publication 60. This publication contains the general philosophy and constitutes the basis for radiation protection recommendations, guidelines etc. issued by other international bodies, such as the IAEA and the OECD/NEA.

The most important CEC Directive in the field of radiation protection is the Basic Safety Standards for the health protection of the general public and workers against the dangers of ionising radiation. This Directive is being revised, partly to accommodate the recommendations in the ICRP Publication 60.

Several of the conventions already mentioned in this Section are relevant in the field of radiation protection, as for example, the Convention on Nuclear Safety, which explicitly includes the ALARA principle.

The Oslo/Paris Convention and the Helsinki Convention deal with pollution of the environment from nuclear installations. Most Swedish nuclear installations discharge into the waters covered by those conventions.

8.3 Findings of the Commission

8.3.1 General

The Commission notes that Sweden has ratified or entered into a number of international conventions in the field of reactor safety, nuclear waste safety and radiation protection. Sweden has also entered into bilateral agreements with other countries.

The Commission has noted the extensive participation of both the SKI and the SSI in work initiated within the IAEA and the OECD/NEA. In these two international organizations, their participation is highly appreciated and their expertise is particularly recognized for the development of many Standards and State of the art documents. Through such participation, Sweden is ensuring harmonization of Swedish regulations and practices with guidance developed internationally.

As a member of the European Union, Sweden recognizes and implements legislation and regulations promulgated by the Union.

8.3.2 Reactor safety

The SKI has evaluated the Swedish legal and regulatory systems against the IAEA Safety Fundamentals document 'Safety of Nuclear Installations' and concluded that the Swedish legal and regulatory systems conform with the principles in the document (Volume 2, Section 8.2.2). The Commission concurs with this conclusion of the evaluation.

The safety criteria and principles contained in this Safety Fundamentals document have been largely reproduced in the Convention on Nuclear Safety, and will accordingly become legally binding in Sweden as the Convention enters into force. The evaluation of the Swedish regulatory system just mentioned, shows that Sweden is aligned with the safety requirements of the Convention.

When assessing the safety of Swedish reactors, or when laying down safety requirements for the reactors, the SKI has based its decisions on international criteria or guidelines. For example, the SKI has used the general Design Criteria in the US Code of Federal Regulations as the foundation for the safety requirements for the Swedish reactors. Also the Final Safety Analysis Reports which form the bases of the operating licences of the reactors have been created in accordance with the US NRC Standard Review Plan.

In recent reassessments of the safety of the Swedish reactors, such as the December 1995 decision to permit Oskarshamn 1 to resume operation, the SKI has built on guidelines recently published by the IAEA on the evaluation of the safety of reactors of different design generations.

The Commission understands that the Swedish programme in reactor safety is widely recognized as highly developed, and that Sweden is a leading country in the international development of reactor safety controls.

Considering the observations made by the Commission both in this Section and earlier in the report regarding international harmonization, the Commission concludes that Swedish legislation and regulatory practice in the field of reactor safety is in accordance with internationally accepted rules.

8.3.3 Nuclear waste management

The Commission notes that in the field of nuclear waste management international rules are developing and that Sweden is active in that development and implementation. The following examples illustrate the situation.

As the Commission has accounted for earlier, the 1994 Convention on Nuclear Safety is relevant also for the management of nuclear waste.

Sweden participates actively in the work conducted by the IAEA on formulating an international convention on nuclear waste management. The Commission notes that the SKI and the SSI are well in the forefront of the international exchange and discussions regarding nuclear waste management. Furthermore, the Commission understands that the Swedish programme for nuclear waste management is well developed, and that the Swedish programme may be among the most advanced in the world.

Considering these observations, the Commission concludes that Swedish legislation and regulatory practice in the field of nuclear waste management is in accordance with internationally accepted rules.

8.3.4 Radiation protection

The Commission notes that in the field of radiation protection, Sweden has ratified or entered into a number of international conventions, e.g. the Oslo/Paris and Helsinki Conventions. Compliance with the Conven-

tion on Nuclear Safety, as regards radiation protection, is ensured through several SSI regulations.

The most important international body for guidance concerning radiation protection is the ICRP. Sweden, as one of the initiators, has been actively involved in the ICRP work, and the SSI is providing continuing support and expertise for that work. The Commission notes that the Swedish legislation is aligned with the ICRP Publication 60. This document constitutes the basis for radiation protection recommendations, guidelines etc., issued by other international bodies.

The Commission has earlier in the report noted that the recommendations concerning radiation protection have for almost a century been based on the findings of the international scientific community. The SSI uses the recommendations of the ICRP as one of the bases for national regulations on radiation protection (Section 3.2.2).

Based on the above considerations, the Commission concludes that Swedish legislation and regulatory practice is in accordance with internationally accepted rules in the field of radiation protection.

8.3.5 General conclusion

The Commission has presented material describing how regulatory activities in the nuclear field are conducted in other countries, especially Finland, France and the USA, to provide a basis for a comparison with Swedish regulatory activities (cf. Volume 2, Chapter 9).

Based on these descriptions, the Commission members' experience from nuclear regulatory activities in different countries and considering the observations that have been made in the course of the review, the Commission concludes that Swedish nuclear regulatory activities are conducted in a satisfactory manner, compared with the practice in other countries with a similar approach to safety as that of Sweden.

tion on October 1954, and a further report in December 1954, through several 52, 1955.

The most important contribution to the understanding of the situation in the region is the report of the 1954-55 season, which has been published in the 1955-56 season. This report is a valuable contribution to the understanding of the situation in the region, and it is a valuable contribution to the understanding of the situation in the region.

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2.1.2. General conclusion

The Commission has been working on the situation in the region, and it has been working on the situation in the region. The Commission has been working on the situation in the region, and it has been working on the situation in the region.

Based on the above considerations, the Commission has been working on the situation in the region, and it has been working on the situation in the region.

Appendix 1 Terms of Reference

Terms of Reference for the Government Commissions of Inquiry

(Unofficial translation 30 January 1995)

International review of the Swedish regulatory activities in the fields of reactor safety and nuclear waste management

Dir. 1994:21

Resolution adopted at a Cabinet Meeting on 10 March 1994

Summary of the assignment

An international review group, in the form of a Government Commission of Inquiry, shall be appointed to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste.

The main purpose of the review shall be to describe and evaluate

- the regulatory supervision in the fields of reactor safety and nuclear waste management as carried out in practice by the regulatory authorities,

- the harmonisation of Swedish nuclear regulatory activities with Swedish legislation and with internationally accepted quality requirements,
- the harmonisation of the organisation, competence, training, research programmes and general resources of the authorities, with the regulatory objectives,
- the efficiency with which the economic resources are deployed,
- the way in which the roles have been allocated and the relations prevailing between the regulatory authorities and the licensees and
- the Swedish regulatory activities, compared with practice in other countries sharing a similar view of safety.

The review group shall also propose changes in those fields where it is found that Swedish regulatory activities can, or need to be improved.

Background

In its comprehensive budget proposal for the 1992/93-1994/95 fiscal years, the Swedish Nuclear Power Inspectorate (SKI) suggested that confidence in and the quality of its regulatory work could be further improved by an open and independent quality review of its activities.

Accordingly, in the appropriation warrant for the 1992/93 fiscal year, the Government instructed the SKI to put forward proposals, not later than the 1994/95 fiscal year, as to how such a review could be conducted and which national and international bodies could take part in it.

In the autumn of 1993, the SKI presented proposals for the organisation of an international quality review of Swedish regulatory supervision in the fields of reactor safety and nuclear waste management safety.

Within their respective spheres of competence and responsibility the SKI and the Swedish Radiation Protection Institute (SSI) share the responsibility for regulatory supervision in the fields of reactor safety and nuclear waste management. This makes it essential for a review of regulatory supervision to include both the SKI and the SSI activities. The SKI and the SSI have both been instructed to include in their

annual reports an evaluation of their performance within their fields of activity.

The evaluation of the performance of regulatory activities in the fields of reactor safety and nuclear waste management is not entirely straightforward, due to the difficulty of identifying easily quantifiable effect indicators. A review conducted by an international, independent review group could, to some extent, take the place of such an evaluation of regulatory performance, because it could provide a qualitative measure of the way in which activities are conducted as compared with similar activities abroad. A recurrent review of regulatory activities, at regular intervals, would also provide an opportunity for tracing developments within this field of activity. A predominantly international review of regulatory activities can be regarded as a valuable contribution towards assessing the overall safety of Sweden's nuclear energy programme, while at the same time, contributing towards the definition of priorities by the Government and the national authorities in their operational planning and budgeting.

Intensive work is currently in progress to bring about a convention on the safety of nuclear installations. One important part of the setting up of this convention will be the possibility of the participating states to demonstrate to the rest of the world that they are living up to the requirements of the convention and how they are doing so. One tool which is being discussed is for the participating states to accept an international peer review of their activities in the field of safety. Thus, a review of regulatory supervision within the fields of reactor safety and nuclear waste management in Sweden comes at an opportune moment in relation to work on the convention and can provide examples of appropriate procedures for conducting such a review within the framework of the convention.

Focus of the Review

The assignment involves an independent group of Swedish and international experts reviewing and evaluating the quality of the regulatory activities of the Swedish authorities in the fields of reactor safety and nuclear waste management. The experts must have direct personal experience of the activities which they review, or corresponding experience of similar safety-oriented activities. The expert

group's assessments of the regulatory work of the authorities should rest on the combined expertise of the various members.

The review is not to be regarded as a regular inspection of the regulatory supervision of the authorities in relation to certain predefined requirements. Instead, as far as this is possible, it is to be seen as a comparison of Swedish regulatory work with the international consensus which exists on effective regulatory supervision and which has been partly documented and published in the form of international guidelines, i.e. through the International Atomic Energy Agency (IAEA). The review is also intended to provide a further opportunity for the exchange of experience with equivalent regulatory authorities in other countries and in Sweden.

The review is to be conducted in such a way that the Government and the national authorities will be presented with an objective assessment of how Swedish regulatory work in the nuclear field bears comparison with international guidelines and the practice of other countries.

Partly on the basis of national legislation and the administrative arrangements applied, an assessment should also be made of the quality attained in inspections, investigations and analyses carried out by the authorities and of the possibilities which the authorities have of enforcing their requirements. The regulatory strategy chosen by the authorities, their existing competence and their available resources are to be taken into consideration in this assessment. The assessment should also include the regulations and recommendations issued by the authorities and the way in which these are followed up through the regulatory work. Furthermore, the review group should describe the manner in which the research programmes of the authorities are fed back to their regulatory activities.

Guidelines for the review

The general purpose of the review shall be to analyse the fields indicated and to compare the results of the evaluation of Sweden's regulatory activities with international experience and internationally accepted recommendations concerning regulatory supervision in the nuclear field. The review shall not include questions concerning preparedness for dealing with nuclear accidents, but the review group

should be at liberty to address matters other than those already indicated.

The review group shall comply with the Government's Terms of Reference (Dir. 1985:5) for Government Commissions and Commissioners, concerning the focus of the inquiry. The review group should also take into consideration the content of the Government's Terms of Reference (Dir. 1988:43) concerning EC-related aspects of the inquiry.

In carrying out its assignment, the review group shall consult closely with the SKI and the SSI. The review group should also consult other authorities, organisations and companies concerned.

The review shall be conducted in such a way that a report can be presented before 1 January 1995¹.

¹ Date of presentation has been postponed to 1 May 1996 by a resolution adopted at a Cabinet Meeting on 29 February 1996

should be a library to address matters that have already
 indicated

The review group shall comply with the Government's request
 Reference (D-1987) for Government's request to the
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 also take into consideration the content of the Government's request
 Reference (D-1987) concerning the work of the review group
 in carrying out its assignment. The review group shall
 with the SMI and the SMI. The review group shall also
 authorities, organizations and companies involved.

The review shall be conducted in such a way that the
 presented before 1 January 1997.

Date of presentation has been postponed to 1 July 1997 by a
 resolution adopted at a Cabinet meeting on 29 February 1997.

Appendix 2 Abbreviations

Abbreviations

ALARA	As Low As Reasonably Achievable
ASAR	As Operated Safety Analysis Report
ASKBAS	Foreign LER Database
ASK-group	LER Evaluation Task Group
ASKBAS	Foreign LER Database
BEIR	Working group on Biological Effects of Ionising Radiation, USA
CEC	Commission of the European Communities
CLAB	Central Interim Storage Facility for Spent Nuclear Fuel (Centralt Lager för Använt Bränsle)
CNWRA	Center for Nuclear Waste Regulatory Analysis
IAEA	International Atomic Energy Agency
ICRP	International Commission of Radiological Protection
ILO	International Labour Organization of the UN
KTH	Royal Institute of Technology (Kungliga Tekniska Högskolan)
LER	Licensee Event Report
MAAS	Authorities' Working Group for Waste to SFR-1 (Myndigheternas Arbetsgrupp för Avfall till SFR-1)
MKB	Environmental Impact Statement (Miljökonsekvensbeskrivning)
MTO	Man, Technology, Organization (Människa, Teknik, Organisation)
OECD	Organization for Economic Co-operation and Development



OECD/NEA	OECD Nuclear Energy Agency
PSA	Probabilistic Safety Analysis
QA	Quality Assurance
R&D	Research and Development
RADWASS	Radioactive Waste Safety Standards, IAEA
RD&D	Research, Development and Demonstration
SFR	Final Disposal Facility for Low- and Intermediate-level Waste (Slutförvar för Reaktoravfall)
SKB	Swedish Nuclear Fuel and Waste Management Co (Svensk Kärnbränslehantering AB)
SKI	Swedish Nuclear Power Inspectorate (Statens Kärnkraftinspektion)
SKI FS	SKI Code of statutes (SKI's Författningssamling)
SSI	Swedish Radiation Protection Institute (Statens Strålskyddsinstitut)
SSI FS	SSI Code of statutes (SSI's Författningssamling)
STAGBAS	Domestic LER Database
STF	Technical Specifications (Säkerhetstekniska Föreskrifter)
TSO	Technical Support Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USNRC	United States Nuclear Regulatory Commission



Statens offentliga utredningar 1996

Kronologisk förteckning

1. Den nya gymnasieskolan – hur går det? U.
 2. Samverkansmönster i svensk forskningsfinansiering. U.
 3. Fritid i förändring.
Om kön och fördelning av fritidsresurser. C.
 4. Vem bestämmer vad? EU:s interna spelregler inför regeringskonferensen 1996. UD.
 5. Politikområden under lupp. Frågor om EU:s första pelare inför regeringskonferensen 1996. UD.
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 7. Av vitalt intresse. EU:s utrikes- och säkerhetspolitik inför regeringskonferensen. UD.
 8. Batterierna – en laddad fråga. M.
 9. Om järnvägens trafikledning m.m. K.
 10. Forskning för vår vardag. C.
 11. EU-mopeden. Ålders- och behörighetskrav för två- och trehjuliga motorfordon. K.
 12. Kommuner och landsting med betalnings-svårigheter. Fi.
 13. Offentlig djurskyddstillsyn. Jo.
 14. Budgetlag – regeringens befogenheter på finansmaktens område. Fi.
 15. Union för både öst och väst. Politiska, rättsliga och ekonomiska aspekter av EU:s sjätte utvidgning. UD.
 16. Förankring och rättigheter. Om folkomröstningar, utträdesrätt, medborgarskap och mänskliga rättigheter i EU. UD.
 17. Bättre trafik med väginformatik. K.
 18. Totalförsvarspliktiga m95. Förslag om jobb/studier efter muck, bostadsbidrag, dagpenning, försäkringar. Fö.
 19. Sverige, EU och framtiden. EU 96-kommitténs bedömningar inför regeringskonferensen 1996. UD.
 20. Samordnad rollfördelning inom teknisk forskning. U.
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 22. Inflytande på riktigt – Om elevers rätt till inflytande, delaktighet och ansvar. U.
 23. Kartläggning och analys av den offentliga sektorns upphandling av varor och tjänster med miljöpåverkan. N.
 24. Från Maastricht till Turin. Bakgrund och övriga EU-länders förslag och debatt inför regeringskonferensen 1996. UD.
 25. Från massmedia till multimedia – att digitalisera svensk television. Ku.
 26. Ny kurs i trafikpolitiken + Bilagor. K.
 27. En strategi för kunskapslyft och livslångt lärande. U.
 28. Det forskningspolitiska landskapet i Norden på 1990-talet. U.
 29. Forskning och Pengar. U.
 30. Borgenärsbrotten – en översyn av 11 kap. brottsbalken. Fi.
 31. Attityder och lagstiftning i samverkan + bilagedel. C.
 32. Möss och människor. Exempel på bra IT-användning bland barn och ungdomar. SB.
 33. Banverkets myndighetsroll m.m. K.
 34. Aktiv arbetsmarknadspolitik + expertbilaga. A.
 35. Kriminalunderrättelseregister
DNA-register. Ju.
 36. Högskola i Malmö. U.
 37. Sveriges medverkan i FN:s familjeår. S.
 38. Nationalstadsparker. M.
 39. Rapport från klimatdelegationen 1995.
Klimatrelaterad forskning. M.
 40. Elektronisk dokumenthantering. Ju.
 41. Statens maritima verksamhet. Fö.
 42. Demokrati och öppenhet. Om folkvalda parlament och offentlighet i EU. UD.
 43. Jämställdheten i EU. Spelregler och verklighetsbilder. UD.
 44. Översyn av skatteflyktslagen.
Reformerat förhandsbesked. Fi.
 45. Presumptionsregeln i expropriationslagen. Ju.
 46. Enskilda vägar. K.
 47. Cirkelsamhället. Studiecirklars betydelser för individ och lokalsamhälle. U.
 48. Shaping Sustainable Homes in an Urbanizing World. Swedish National Report for Habitat II. N.
 49. Regler för handel med el. N.
 50. Förbud mot vapen på allmän plats m.m. Ju.
 51. Grundläggande drag i en ny arbetslöshetsförsäkring – alternativ och förslag. A.
 52. Precisering av handelsändamålet i detaljplan. M.
 53. Kalkning av sjöar och vattendrag. M.
 54. Kooperativa möjligheter i storstadsområden. S.
 55. Sverige, framtiden och mångfalden. A.
 55. På väg mot egenföretagande. A.
 55. Vägar in i Sverige. A.
 56. Hälften vore nog – om kvinnor och män på 90-talets arbetsmarknad. A.
 57. Pensionssamordning för svenskar i EU-tjänst. Fi.
 58. Finansiering av det civila försvaret. Fö.
-

Statens offentliga utredningar 1996

Kronologisk förteckning

59. Europapolitikens kunskapsgrund.
En principdiskussion utifrån
EU 96-kommitténs erfarenheter. UD.
60. Miljö och jordbruk. Om EU:s miljöregler och
utvidgningens effekter på den gemensamma
jordbrukspolitiken. UD.
61. Medlemsstater och medborgare. Förhållandet
mellan stora och små länder i EU. Rättsliga och
inrikes frågor. UD.
62. EU, konsumenterna och maten
– Förväntningar och verklighet. Jo.
63. Medicinska undersökningar i arbetslivet. A.
64. Försäkringskassan Sverige – Översyn av
socialförsäkringens administration. S.
65. Administrationen av EU:s jordbrukspolitik
i Sverige. Jo.
66. Utvärderat personval. Ju.
67. Medborgerlig insyn i kommunala entreprenader.
Fi.
68. Några folkbokföringsfrågor. Fi.
69. Kompetens och kapital + bilaga. N.
70. Samverkan mellan högskolan och näringslivet. N.
71. Lokal demokrati och delaktighet i Sveriges städer
och landsbygd. In.
72. Rättsspsykiatriskt forskningsregister. S.
73. Swedish Nuclear Regulatory Activities.
Volume 1 – An Assessment. M.
74. Swedish Nuclear Regulatory Activities.
Volume 2 – Descriptions. M.

Statens offentliga utredningar 1996

Systematisk förteckning

Statsrådsberedningen

Möss och människor. Exempel på bra
IT-användning bland barn och ungdomar. [32]

Justitiedepartementet

Kriminalunderrättelseregister
DNA-register. [35]
Elektronisk dokumenthantering. [40]
Presumptionsregeln i expropriationslagen. [45]
Förbud mot vapen på allmän plats m.m. [50]
Utvärderat personval. [66]

Utrikesdepartementet

Vem bestämmer vad? EU:s interna spelregler inför
regeringskonferensen 1996. [4]
Politikområden under lupp. Frågor om EU:s första
pelare inför konferensen 1996. [5]
Ett år med EU. Svenska statstjänstemäns
erfarenheter av arbetet i EU. [6]
Av vitalt intresse. EU:s utrikes- och
säkerhetspolitik inför konferensen. [7]
Union för både öst och väst. Politiska, rättsliga
och ekonomiska aspekter av EU:s sjätte
utvidgning. [15]
Förankring och rättigheter. Om folkomröstningar,
utträdesrätt, medborgarskap och mänskliga
rättigheter i EU. [16]
Sverige, EU och framtiden. EU 96-kommitténs
bedömningar inför konferensen 1996. [19]
Från Maastricht till Turin. Bakgrund och övriga
EU-länders förslag och debatt inför
konferensen 1996. [24]
Demokrati och öppenhet. Om folkvalda parlament
och offentlighet i EU. [42]
Jämställdheten i EU. Spelregler och
verklighetsbilder. [43]
Europapolitikens kunskapsgrund.
En principdiskussion utifrån
EU 96-kommitténs erfarenheter. [59]
Miljö och jordbruk. Om EU:s miljöregler och
utvidgningens effekter på den gemensamma
jordbrukspolitiken. [60]
Medlemsstater och medborgare. Förhållandet
mellan stora och små länder i EU. Rättsliga och
inrikes frågor. [61]

Försvarsdepartementet

Totalförsvarspliktiga m95. Förslag om jobb/studier
efter muck, bostadsbidrag, dagpenning,
försäkringar. [18]

Statens maritima verksamhet. [41]
Finansieringen av det civila försvaret. [58]

Socialdepartementet

Sveriges medverkan i FN:s familjeår. [37]
Kooperativa möjligheter i storstadsområden. [54]
Försäkringskassan Sverige – Översyn av
socialförsäkringens administration. [64]
Rättspsykiatriskt forskningsregister. [72]

Kommunikationsdepartementet

Om järnvägens trafikledning m.m. [9]
EU-mopeden. Ålders- och behörighetskrav för
två- och trehjuliga motorfordon. [11]
Bättre trafik med väginformatik. [17]
Ny kurs i trafikpolitiken + Bilagor. [26]
Banverkets myndighetsroll m.m. [33]
Enskilda vägar. [46]

Finansdepartementet

Kommuner och landsting med betalnings-
svårigheter. [12]
Budgetlag – regeringens befogenheter på
finansmaktens område. [14]
Borgenärsbrotten – en översyn av 11 kap.
brottsbalken. [30]
Översyn av skatteflyktslagen.
Reformerat förhandsbesked. [44]
Pensionssamordning för svenskar i EU-tjänst. [57]
Medborgerlig insyn i kommunala entreprenader. [67]
Några folkbokföringsfrågor. [68]

Utbildningsdepartementet

Den nya gymnasieskolan – hur går det? [1]
Samverkansmönster i svensk forskningsfinansiering. [2]
Samordnad rollfördelning inom teknisk forskning. [20]
Reform och förändring. Organisation och verksamhet
vid universitet och högskolor efter 1993 års
universitets- och högskolereform. [21]
Inflytande på riktigt – Om elevers rätt till
inflytande, delaktighet och ansvar. [22]
En strategi för kunskapslyft och livslångt lärande. [27]
Det forskningspolitiska landskapet i Norden på
1990-talet. [28]
Forskning och Pengar. [29]
Högskola i Malmö. [36]
Cirkelsamhället. Studiecirkelars betydelser för
individ och lokalsamhälle. [47]

Statens offentliga utredningar 1996

Systematisk förteckning

Jordbruksdepartementet

Offentlig djurskyddstillsyn. [13]
EU, konsumenterna och maten
– Förväntningar och verklighet. [62]
Administrationn av EU:s jordbrukspolitik
i Sverige. [65]

Arbetsmarknadsdepartementet

Aktiv arbetsmarknadspolitik + expertbilaga. [34]
Grundläggande drag i en ny arbetslöshetsförsäkring –
alternativ och förslag. [51]
Sverige, framtiden och mångfalden. [55]
På väg mot egenföretagande. [55]
Vägar in i Sverige. [55]
Hälften vore nog – om kvinnor och män på
90-talets arbetsmarknad. [56]
Medicinska undersökningar i arbetslivet. [63]

Kulturdepartementet

Från massmedia till multimedia –
att digitalisera svensk television. [25]

Näringsdepartementet

Kartläggning och analys av den offentliga sektorns
upphandling av varor och tjänster med
miljöpåverkan. [23]
Shaping Sustainable Homes in an Urbanizing
World. Swedish National Report for Habitat II. [48]
Regler för handel med el. [49]
Kompetens och kapital + bilaga. [69]
Samverkan mellan högskolan och näringslivet. [70]

Civildepartementet

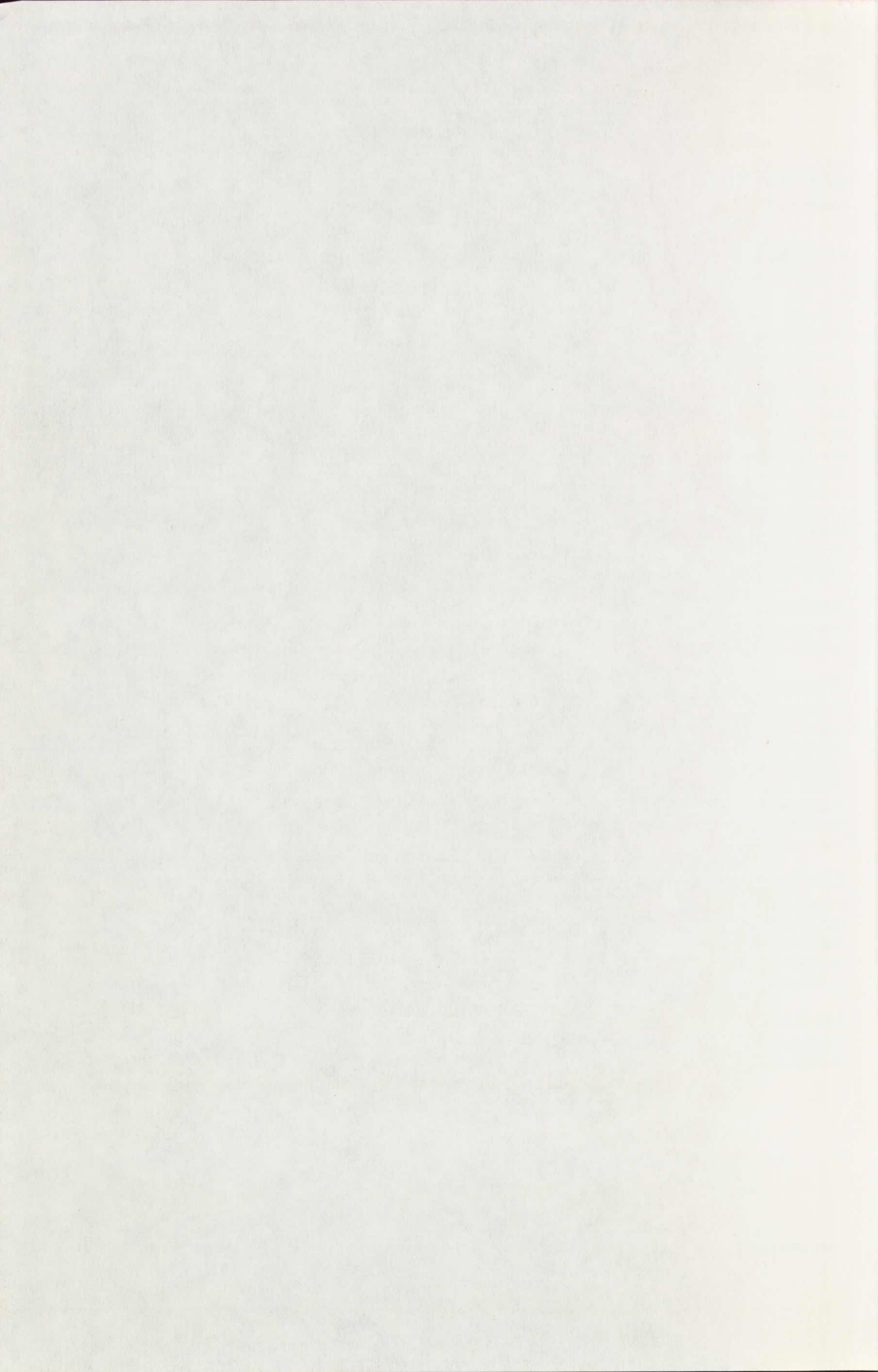
Fritid i förändring.
Om kön och fördelning av fritidsresurser. [3]
Forskning för vår vardag. [10]
Attityder och lagstiftning i samverkan
+ bilagedel. [31]

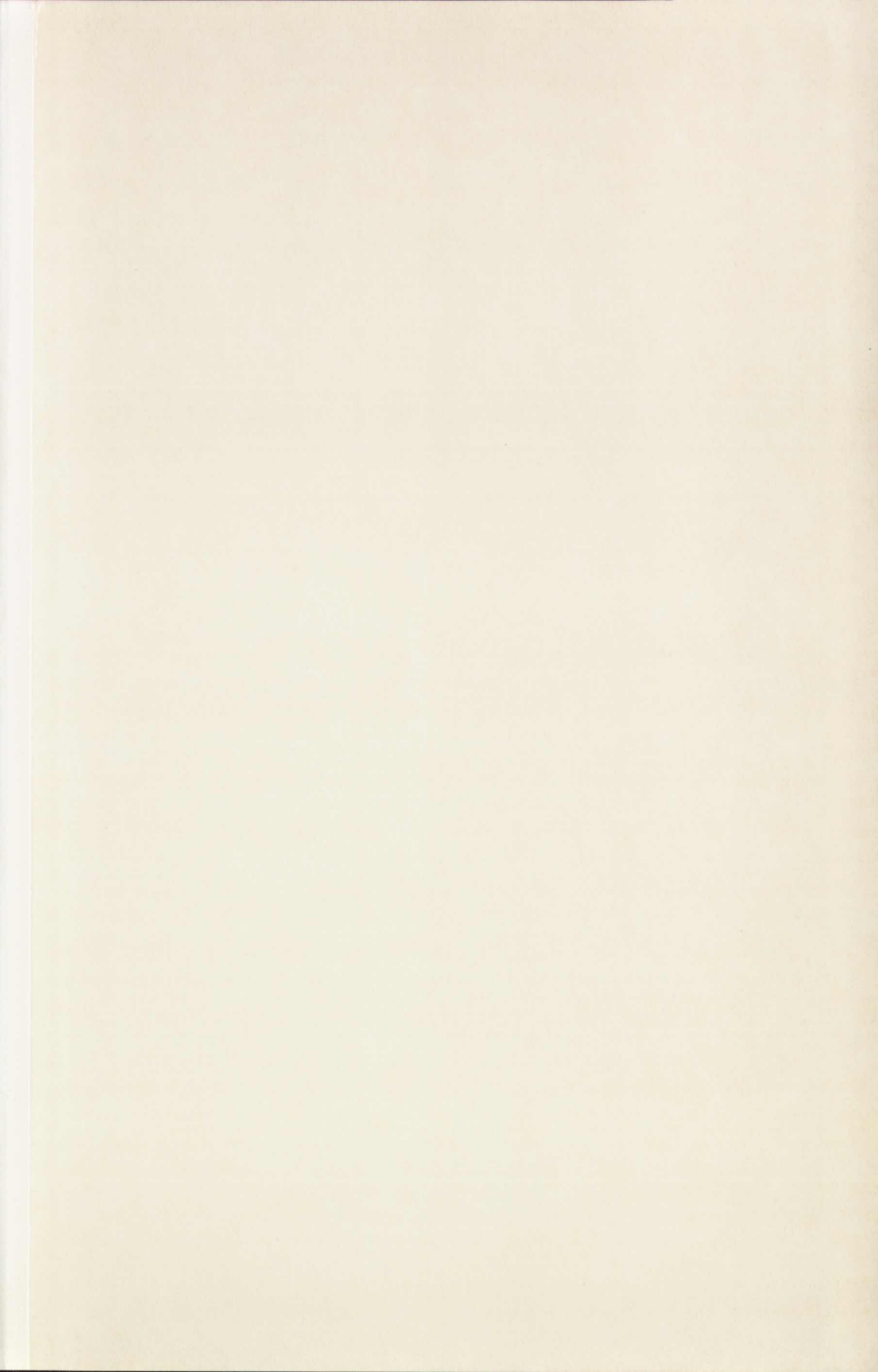
Inrikesdepartementet

Lokal demokrati och delaktighet i Sveriges städer och
landsbygd. [71]

Miljödepartementet

Batterierna – en laddad fråga. [8]
Nationalstadsparker. [38]
Rapport från klimatdelegationen 1995.
Klimatrelaterad forskning. [39]
Precisering av handelsändamålet i detaljplan. [52]
Kalkning av sjöar och vattendrag [53]
Swedish Nuclear Regulatory Activities.
Volume 1 – An Assessment. [73]
Swedish Nuclear Regulatory Activities.
Volume 2 – Descriptions. [74]







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