THE PERIODIC SAFETY REVIEW OF NUCLEAR POWER PLANTS

Practices in OECD countries

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium,Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971) and New Zealand (29th May 1973). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of all European Member countries of OECD as well as Australia, Canada, Japan and the United States. The Commission of the European Communities takes part in the work of the Agency.

The primary objective of NEA is to promote co-operation among the governments of its participating countries in furthering the development of nuclear power as a safe, environmentally acceptable and economic energy source.

This is achieved by:

- *encouraging harmonization of national regulatory policies and practices, with particular reference to the safety of nuclear installations, protection of man against ionising radiation and preservation of the environment, radioactive waste management, and nuclear third party liability and insurance;*
- *assessing the contribution of nuclear power to the overall energy supply by keeping under review the technical and economic aspects of nuclear power growth and forecasting demand and supply for the different phases of the nuclear fuel cycle;*
- *developing exchanges of scientific and technical information particularly through participation in common services;*
- *setting up international research and development programmes and joint undertakings.*

In these and related tasks, NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has concluded a Co-operation Agreement, as well as with other international organisations in the nuclear field.

Publié en français sous le titre :

LA RÉEVALUATION PÉRIODIQUE
DE LA SÛRETÉ DES CENTRALES NUCLÉAIRES
La pratique dans les pays de l'OCDE

Foreword

The Committee on Nuclear Regulatory Activities (CNRA) of the OECD Nuclear Energy Agency (NEA) is an international committee made up primarily of nuclear regulators. It was set up in 1989 as a forum for the exchange of information and experience among nuclear regulatory organisations and for the review of developments which could affect regulatory requirements.

As one of its first tasks, the Committee decided in 1989 to carry out a survey of approaches by OECD countries to the periodic review of the safety of nuclear power plants. It was recognised that over a certain period of time, changing regulations, advances in technology, plant backfits and modernisation, and component ageing necessitate a fundamental review and re-indexing of the safety status of each plant; it was also recognized that there exists a wide variety of practices in effecting such periodic reviews. There was a consensus within the Committee that the results of such a survey would permit each Member country to compare its approach with those of the others. In all likelihood, such comparisons will stimulate ideas both for improving these approaches and developing a greater consistency among national practices.

This report is the product of that exercise. The NEA secretariat wishes to thank Dr Frits Weehuizen, consultant from Wettingen, Switzerland, for his extensive efforts in formulating the questionnaire, compiling the responses and preparing this document which is published on the responsibility of the Secretary-General.

Table of Contents

1. Introduction

During its first meeting in November 1989, the Committee on Nuclear Regulatory Activities (CNRA) chose as one of its first activities a comparative review of regulatory practices involving the periodic safety review (PSR) of nuclear power plants (NPP) in NEA Member countries. This theme ranks high on the priority list of CNRA, in particular with regard to older plants. A comparative review of national approaches to evaluate the safety status of such plants and to ageing is also expected to give useful insights.

The survey of regulatory concepts and practices concerning PSR in Member states with nuclear power programmes was performed on the basis of a questionnaire, which contains 33 questions or groups of questions (working document of March 27, 1990).

Replies to the questionnaire were received from 16 countries. Three of these countries, however, do not yet have a nuclear power programme, or have not yet decided upon the construction of NPPs. Only 13 replies were therefore evaluated for this report. The assessment of the replies is considered representative, since they cover all NEA countries with nuclear power programmes. These include a total of 357 NPPs, most of which are in operation, and a few are under construction or recently shut-down.

The questionnaire was drawn up and the analysis performed by Mr. Frits Weehuizen, a retired former member of CNRA and of its predecessor, the Subcommittee on Licensing of the Committee on the Safety of Nuclear Installations (CSNI). He was temporarily engaged as a consultant to NEA and actively supported by its secretariat. Limited use was also made of the Summary Report on Periodic Safety Re-evaluations in Nuclear Power Plants in EC Member states, Finland and Sweden (Doc. WG 1-89/P15 of May 1990).

The second draft of the report was presented to CNRA at its meeting of November 1990. The Committee decided to issue the report and to use it as a basis for future actions on the subject of periodic safety review of nuclear power plants.

2. Objectives of the Survey

The main objective of the survey is a comparative review of national concepts and practices with regard to PSR. Aspects considered to be of importance in this respect were the statutory bases, the objectives and scope of review, the relationship to other regulatory activities such as routine surveillance, inspections and reviews, and the bases and documentation for them.

A number of questions more specifically address older NPPs, in particular the "first generation" plants designed and built in the early years of commercial nuclear power generation. At that time, the licensing bases and the scope and depth of regulatory review were, in general, less systematic and complete compared to today's state of knowledge and practices. In this context, aspects of particular importance when re-evaluating the safety status are the feedback of experience, the influence of modifications and of ageing on the safety concept, as well as developments in safety technology and safety analysis.

Since the PSR is only part of an extensive surveillance and review process, its relative importance can only be judged against the background of the overall regulatory process. For this purpose, the questionnaire consists of two parts:

– Part A: Summary of main regulatory practices, and;
– Part B: Questions with regard to PSR.

Part A contains ten questions on the general practices with respect to licensing, surveillance and safety review. They cover the general background, this in contrast to Part B, which is subdivided into four sections with a total of 23 more detailed questions -- or groups of questions -- specifically addressing PSR. These sections cover the statutory basis, the PSR process, the scope and depth of PSR, and the underlying bases and documentation.

The text of the questionnaire and two additional questions are attached as annexes.

3. Approach to the Analysis

3.1 Countries considered in the evaluation

The questionnaire (Annex 1) was dispatched to CNRA members in March 1990, and replies were received from 16 countries. Thirteen replies covered both parts A and B of the questionnaire and are considered here, together with comments to earlier drafts and answers to additional questions (Annex 2). They cover all NEA countries with nuclear power plants.

The 13 replies considered came from the following countries:

1. Belgium
2. Canada
3. Finland
4. France
5. Germany
6. Italy
7. Japan
8. Netherlands
9. Spain
10. Sweden
11. Switzerland
12. United Kingdom (UK)
13. United States (US)

The representative of Australia was not in a position to respond to the questionnaire, since there are no NPPs in his country. However, he expressed particular interest in the subject of periodic safety review of reactors.

The representative of Canada mentioned in his reply that PSRs are not carried out for the Canadian Deuterium Uranium (CANDU) NPPs, because of the national practice of frequent licence renewal (every 2 to 3 years). The day-to-day monitoring of plant performance is supplemented by a Periodic Licensing Review (PLR) process. In spite of this, the Canadian reply is taken into account where it is considered informative.

The representative of Greece also answered that there are no nuclear power plants in operation, or planned for, in his country.

The representative of Italy mentioned that his draft report (of June 1990) to the questionnaire was completed just prior to a parliamentary decision to phase out the two remaining nuclear power plants not yet shut-down definitely, and that as a consequence his country has no longer any NPP in operation. Furthermore, it has no plans to operate any reactor of the present generation. Since, however, PSRs were already performed in Italy, its experiences were considered of importance for this report.

The representative of Japan described in his reply the system for licensing the NPPs, including "Self-Safety Regulation" and periodic inspections. These are performed annually by the regulatory body and, because of their scope and depth, regarded as a kind of PSR.

The representative of Turkey was not in a position to answer the more specific PSR-oriented questions of Part B, since there are as yet no NPPs operating, or under construction in his country. Supporting his answers to the more general questions of Part A, he included a regulatory position "Basic Turkish Safety Philosophy for Nuclear Power Plants" of December 1983. He strongly supported the PSR activity of CNRA in view of the future preparation of a Code of Practice on Inspection for his country.

The representative of the USNRC explained in his reply that PSRs are not required as part of the regulatory process in the USA. This is because the NRC has (1) a comprehensive set of regulations, which also contains surveillance requirements addressed to the licensees, (2) a strong and systematic inspection programme, and (3) established programmes that continuously look for ways to improve safety. Thus all questions to Part B were not applicable in this case. In spite of this, the USA is nevertheless considered in the report on a case by case basis in view of its importance for nuclear energy and safety regulation.

3.2 Definitions used in the text

a) *Regulatory body.* In this report, the term regulatory body means a national authority or a system of national authorities, possibly assisted by technical or other advisory bodies, and having a legal authority for conducting the licensing process, for issuing permits and licences, for performing inspections and reviews and thereby regulating nuclear energy facilities.

b) *Periodic safety review (PSR).* As shown later in the text, the most frequently held view of PSR is one of a thorough periodic overall review of the safety status of a nuclear power plant, performed at a frequency of the order of once per ten years of reactor operation. With respect to specific safety reviews of older plants, Spain uses the term Safety Re-evaluation Programme (SRP), the United Kingdom uses the expression Long-Term Safety Review (LTSR), whereas the United States performs a Systematic Safety Evaluation Programme (SEP) of selected plants. In Japan, the yearly inspections are looked upon as a kind of PSR. In the UK, Short-Term Biennial Reviews (STBR) are carried out for the reactors, while in Canada ongoing surveillance is supplemented by Periodic Licensing Reviews (PLR). Such frequent reviews are generally of a more limited scope.

c) *Ongoing surveillance and review.* In the following, this term covers all activities regularly performed to verify that the safety status of a NPP and its operation satisfy requirements. It thus includes ongoing routine surveillance, periodic inspections and special safety reviews.

d) *Other special definitions.* In the UK, the term Safety Case(s) is used for the safety documentation justifying safety. It covers all phases from design up to and including decommissioning of a nuclear installation.

The Japanese reply does not use the term Safety Analysis Report, but refers to the documents required to obtain a permit for an NPP installation or approval of its detailed design, and to its "Self-Safety Regulation" which covers the requirements of technical specifications and administrative control of safety.

In the USA, the term Current Licensing Basis (CLB) includes the regulatory requirements and licensee commitments related to the design and operation of a specific nuclear facility.

3.3 Adequacy of the questionnaire

The subdivision of the questionnaire aimed at obtaining a picture of PSR practices against the general background of the overall licensing process. However, the evaluation of replies revealed a disadvantage of this concept in that the replies necessarily overlapped on some occasions. This was also the case for several groups of questions of Parts B3 and B4. This report, which roughly follows the contents of the questionnaire, tries to avoid this repetition, although it was not possible in all cases.

The objectives of periodic safety reviews and the responsibility for performing them were insufficiently covered by the questionnaire. However the replies contained sufficient information for considering these important subjects in section 4.3 and paragraph 4.4.5 respectively.

3.4 Character of the replies

The scope and depth of replies varied considerably between countries, which rendered the systematic presentation of the results of the survey rather difficult. Some replies gave concise information to specific questions, whereas other replies went into considerable detail in the main text or in the form of appendices. To some degree, these differences may be due to the detailed nature of some groups of questions, as mentioned before.

The differences in the degree of detail between replies might create the wrong impression – that countries giving fewer details do less for safety. A country attaching less weight to periodic safety reviews is not necessarily less safety-conscious, because its programme for ongoing surveillance and review may be more extensive, and cover themes which are reserved to the PSR programme in other countries.

Also, certain nuclear power plants, in particular those of the first generation, may require more extensive and thorough re-evaluations of their safety status than newer ones.

4. Results of the analysis

4.1 Summary of main regulatory practices (A)[1]

4.1.1 General data on NPPs and sites (A1)

Of the total 357 power reactors covered by this report, a few are in the process of start-up or to be commissioned soon, 23 are under construction (11 in Japan alone) and seven recently shut-down for various reasons. For the ongoing surveillance and for safety reviews, the number of units per site, and the similarity of units is certainly significant in that standardization simplifies such processes. The 357 reactors are installed at 169 sites, i.e. the mean number of units per site is roughly two.

The distribution is:

reactors per site	1	2	3	4	5	6	8	10
number of sites	65	65	13	19	3	1	2	1
number of reactors	65	130	39	76	15	6	16	10

At most sites, the individual plants are of (almost) identical design. However, 14 sites have reactors of different types: five sites with both PWR and BWR, five with both PWR and GCR (A2 - 4), one with BWR and GCR[2], and three with AGR and GCR.

4.1.2 General information on the operating licence (A2,3,4)

a) *Basic conditions of the OL (A2)*

In most countries, the duration of the validity of the OL is basically unlimited, as shown in Table 1. In the USA, however, the OL expires after a maximum of 40 years, whereas in Canada and Finland it has to be renewed every two to three and ten years respectively. The Spanish NPPs also have only so-called Provisional Operating Licences (POL) of two year's duration. In Sweden, some OLs have time limits imposed for energy policy reasons. The OL conditions in the UK include a biennial shutdown of the reactors. Such conditions require more frequent reviews, albeit of a limited scope, for OL extension and restart (such as the STBR in the UK).

---

1 Characters and numbers in parentheses refer to parts of the questionnaire reproduced in Annex 1.

2 GCR: Gas-cooled reactor of the Magnox type.

Special limits to the duration of OLs were applied in some countries for older plants. In Finland, the OL was at first issued for five years only. In Switzerland, the OL of two of the older plants was, for a number of years, limited to one year only, which was later extended to five or seven to eight years, with the intention to issue an unlimited licence after major backfitting and re-review. In Italy, the original OL of the first three NPPs had to be re-evaluated after ten years of operation. Temporary practices of this type were due to ongoing revisions of nuclear regulations or to an incomplete licensing basis at the time of issuance of the initial OL.

Table 1. **Basic and special conditions of operating licences (OL)**

Duration of validity of the OL	
Most countries:unlimited	
Canada:	2 to 3 years
Spain:	2 years
Finland:	10 years
USA:	max. 40 years
Examples of special conditions	
Finland:	duration of validity of OL at first 5, then 10 years
Italy:	re-evaluation of OL after 10 years
Sweden:	special limits for energy policy reasons
Switzerland:	duration of validity of OL for two of the older plants at first 1 year, then 5, then 7 to 8; in the future, unlimited
UK:	biennial shutdown for review

Other limiting conditions of the OL generally include maximum thermal power, as well as fuel and radioactive release limits for normal operation. These are normally referred to as "Conditions of the Technical Specifications (TS)", but other expressions such as "Operating Rules or Specifications" are in use too. Other specific examples of OL conditions are: minimum size of staff (Canada), the maximum amount of spent fuel and other nuclear waste at the site (Finland), or the allowed number of core loads (Germany). Japan mentions the required approval of "Self-Safety Regulation" of the utility, which includes the organisation, training programme, instructions for operation, radiation protection and inspections. Other data mentioned by some countries, e.g. reporting requirements or emergency procedures, may generally be considered to be part of the conditions of operation.

The Belgian and Dutch OLs prescribe a PSR to be performed once every ten years. As a new requirement, major periodic reviews are also an OL condition in the UK, but the interval is still under discussion (probably ten-yearly also).

b) *Basic documentation underlying the OL (A3)*

In the large majority of countries, the Final Safety Analysis Report (FSAR), or comparable documentation, is an integrated part of, or the main formal (or legal) technical basis underlying the OL. In most countries, the report has to be kept up to date, to be revised periodically – e.g. once per year in the USA – or prior to safety re-evaluations, as is the case in Italy, the Netherlands and Switzerland. In Canada, updating of the SAR is an ongoing process which involves a complete review every three to five years; the completion of such updatings, however, is not tied to OL renewal. In Spain, the two-year POL renewal interval coincides with the NPP document revision period.

Germany does not update the initial SAR, written in view of the construction permits, and the United Kingdom leaves the FSAR unchanged. In these cases the report is, however, supplemented by technical or other documents, which have to be kept up to date and submitted in case of modifications or new experiences and insights. In the case of Japan, no specific requirements for updating the documentation exist.

In some countries, the revisions of the FSAR or of comparable documentation have to be approved by the regulatory body.

Other documents normally covered by the OL in a more or less formal way are the Technical Specifications (TS) or comparable operation manuals, plant organisation and management rules, QA programmes, as well as incident, accident, emergency and security procedures. Revisions of these documents may also require regulatory approval, in particular in case of the TS.

The safety evaluation report (SER), prepared by a regulatory body in view of the issuance of a licence, also has a formal or legal status in a number of countries. This was, however, initially only mentioned in the USA reply with reference to the NRC's SER, and afterwards confirmed by Finland, Sweden and Italy. The Belgian comment confirmed that the FSAR, prepared by the licensee and approved by the regulatory body, has a legal status. The German comment states that the evaluation reports have no legal status, this being the case only for the OL, its conditions and the documents referred to in it. The situation in Switzerland is analogous.

c) *Renewal of or amendment to the OL (A4)*

Apart from the cases described in paragraph "a)" above, formal renewals of, or amendments to, the OL are needed only in rare cases. Typical causes are power upratings, major backfitting such as special emergency systems and filtered containment venting or, in general, major modifications affecting the basis for the OL. In Sweden, all types of safety-related plant changes necessitate modifications of the OL.

In Japan, modifications affecting the construction permit or the operation of an NPP, including those reflecting new regulations, require regulatory approval. In the UK, plant modifications do not require a renewal or modification of the OL, but the licensee must have approved arrangements for their control. In the USA, licensees intending to make modifications which would create an inconsistency with a TS condition or a potential decrease in safety must submit an application for amendment of the licence.

4.1.3 Role played by PSA in the licensing process (A5)

Until recently, probabilistic risk or safety analyses (PRA or PSA) played a minor role with regard to nuclear regulation, but they are growing in importance, in particular for new NPPs and for PSR (with respect to PSR, see also para 4.5.6).

Canada, Finland, Germany, Italy, Sweden and the UK included PSAs in some way in the licensing process for their latest NPPs, or intend to do so for future plants. In Finland, the Level 2 PSA[3] will have to be approved before future OLs will be issued. In Sweden, the PSA was part of the FSARs of the two latest BWRs, and in the UK also the PSA was part of the design safety case in the scope of the construction permit of its first PWR.

In Finland, Level 1 PSAs are actually under review and Level 2 analyses are foreseen for the near future. France refers to its recent PSAs for both its 900 and 1300 MWe PWRs. Until now, however, these and similar PSAs performed or in progress in most other countries played a minor role in the licensing process. The French reply points to the large uncertainties of results, which limit their applicability to decision-making.

Spain introduced an integrated PSA programme in 1986; plant-specific PSAs are required by the regulatory body to examine overall plant safety, but they are not related to any specific licence. This seems to be the case in most countries. In the USA, for instance, PSAs are applied to provide safety insights into many NPP design and operational issues; a licence is issued, however, on the demonstration that the NRC's deterministic requirements are satisfied. Canada also looks upon PSA as a support document to confirm the conclusions of the SAR. The Dutch reply, on the contrary, expects that PSA will play a significant role in the future licensing process.

4.1.4 Formal actions of the regulatory body on the basis of the OL (A4, A6)

Eight countries require some kind of formal regulatory approval for restarting a NPP following refueling, major inspections, or revisions (which often coincide with refuelling), and after incidents and accidents (Finland, Germany, Italy, Japan, the Netherlands, Switzerland, Sweden and the UK). Canada, France and Sweden only require such approvals prior to start-up after accidents or in important cases, such as for a non-standard fuel cycle. When a NPP is shut-down in Japan because of an incident, the utility can resume operation after identification of the cause and a check-up for possible damage to the plant in accordance with safety regulations. In Spain, only reports have to be submitted to the regulatory body normally; its approval for restart is restricted to important modifications implying plant shutdown, or in case additional clarifications or actions are required. Similarly, approvals for restart are only needed in the USA in case safety-related problems were identified during shut-down.

In most countries, the regulatory body has to be notified in advance of modifications relevant to safety; depending on their importance, approval may be required before they are realised (e.g. Finland, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden and Switzerland). Such modifications often not only concern equipment or structures, but also procedures and associated documentation relevant to safety. The Spanish licensees have to submit half-yearly reports on

---

[3] Level 1 PSA extends to the point of core relocation; Level 2 PSA treats containment behaviour up to and including the source term.

proposed or implemented modifications, including a safety analysis; they have also presented a quinquennial programme of modifications which is under review by the regulatory body. In the UK, the submission of relevant documentation is only required in certain cases, depending on their safety classification, but approval is needed with respect to changes in the Operating Rules. Similar requirements exist in most countries for modifications of the TS.

In the USA, only modifications which would create an inconsistency with a TS condition or a potential decrease in safety require regulatory approval; many changes and modifications to facilities or operation practices can, however, be made without prior approval. In Spain and Switzerland, modifications involving a high radioactive dose for the personnel have to be approved by the regulatory body prior to their implementation.

4.1.5 Scope of continuous surveillance (A7)

All operating nuclear power plants are subjected to a process of ongoing surveillance and review by the licensees under the auspices of the regulatory body. This normally consists of the following elements:

- ongoing routine surveillance of operation, which often includes regular reports to the regulatory body, e.g. before or after refuelling, yearly, half-yearly, monthly or even daily reports;

- periodic inspections of structures, systems, components, documentation, etc.;

- information and review meetings, e.g. once per year or prior to restart, concentrating on items of major safety relevance;

- special safety reviews, e.g. following incidents and accidents in the NPP or in other plants, or in case of modifications. It is common practice for the licensees to prepare special reports in such cases.

All replies state, in one way or another, that the purpose of this ongoing surveillance and review is to verify that the conditions of the OL are satisfied. It covers both technical and administrative aspects relevant to safety and is normally based on regulations or other documents having legal or formal value, such as the FSAR, TS, QA and other manuals.

Regulatory inspections are performed on an *ad hoc*, periodic or continuous basis. For this purpose, some countries employ resident inspectors (Canada, Spain and the USA), while others employ dedicated inspectors (e.g. France, Japan, Sweden and the UK). Special inspections as a prerequisite to certain actions are mentioned by Finland and France.

Both these, as well as other countries – especially the USA – underline the major importance of such ongoing surveillance and review; the Finnish reply in this respect pointing also to safety level reassessment through detailed review of the PSA studies. In the USA, the normal regulatory processes are supplemented by the Systematic Assessment of Licence Performance (SALP) programme, which collects and periodically evaluates every 12 to 18 months a wide range of safety-relevant information such as licensee event, inspection reports, enforcement history and licensing issues, in an integrated manner.

Feedback of experience is generally given high priority, but inputs from new regulations or designs may also lead to improvements. This point of view is shared by Switzerland; it is stated, however, that day-to-day supervision shall not question a licensed design unless evidence of important safety concerns or poor plant operation is discovered.

4.1.6 Rationale and effects of PSR (A8, A9)

Those countries that have introduced PSR – or intend to do so – regard it as an opportunity for an overall safety review in the light of experience and the state-of-the art. With reference to the extensive scope and depth of the ongoing surveillance and review process, additional periodic safety re-evaluations of the PSR type are, however, not considered in the US regulatory process (see also section 4.3). The Finnish and French replies also mention that for similar reasons periodic reviews are not essential, adding that in any case they have the power to suspend a licence at any time.

PSRs are more generally regarded as additions to the ongoing surveillance and review processes, although they are in some cases also required for OL renewal. Both France and Switzerland state that the regular PSR process is not expected to question the continued operation of plants, nor the validity of their licences. Some countries indicate, however, that the findings of a PSR may temporarily influence licence conditions pending improvements, or lead to prolonged shutdown for backfitting.

The first extensive re-reviews of older (often first generation) plants represent a special case. Their findings may affect their continued operation, as is indicated in the replies from Spain and the UK. For further details on these subjects, see sections 4.3 to 4.5.

4.2 Statutory basis for the periodic safety review (B1)

The PSR is apparently included as a special article only in the legislation of France and Sweden (see Table 2), while the Netherlands is considering giving it a legal status.

PSRs also obtain a formal status where they are a condition of a licence. This is the case in Belgium, the Netherlands, the UK and for some German plants; in Italy, a second safety review was a condition of the original OLs for the first three plants. OLs valid for a limited duration, such as those issued in Canada, Finland and Spain, automatically imply the need for more frequent review, which is also the case for the biennial shutdowns in the UK.

Comprehensive PSRs of the type considered in this report are, or will be, required by the regulatory bodies of most countries, in case they are not already included in legislation or licence conditions. The re-evaluation needed in the USA for OL extension does not have the character of a periodic safety review (for the particular situation in the USA, see also paragraph 4.5.3).

Table 2. **Statutory bases for periodic safety review (PSR)**

Article in legislation:	France, Sweden
Condition of the OL:	Belgium, some German plants, Italy (for first review), UK, the Netherlands
Requirement of regulatory body:	Germany, the Netherlands, Spain, Switzerland

Special reviews of a more limited scope are required because of more frequent OL renewal or extension in Canada, Finland and Spain, as well as in the UK, for biennial shutdowns.

4.3 Objectives of the periodic safety review (A8, B2.5)

Basically all countries with programmes for periodic safety reviews regard the following objectives as overall re-evaluations to confirm the adequacy of the safety status of NPPs.:

a) To periodically assure that the process of feedback of experience is well applied -- this includes the review of modifications performed on the basis of generic studies.

b) To strike a complete balance of plant operation, including results of surveillance and the adequacy of preventive maintenance under the special aspect of ageing. The main purpose is to verify that the level of safety, as initially envisaged, is not impaired.

c) To thoroughly evaluate the main differences between the concept of the plant reviewed and those of the latest plants, for which the evolution of safety requirements was considered. On this basis, the possible gains in safety and backfitting measures can be evaluated.

d) To understand the possible effect of the most recent safety investigations of the plant concerned.

Together with the inputs from ongoing surveillance and review, this concept makes it possible to periodically judge the compliance with the initial level of safety and the importance of deviations from the actual state-of-the-art and requirements. The French reply, as summarised in Table 3, systematically defines the objectives of these reviews and may also be considered representative for other countries:

Table 3. **Typical objectives of PSR, summarised from French response**

1.	To periodically assure that the process of feedback of experience is well applied.
2.	To verify that the level of safety, as initially envisaged, is maintained.
3.	To thoroughly evaluate the concept of the plant by comparison with the latest plants and the evolution of safety requirements.
4.	To understand the possible effect of the most recent safety investigations on the plant concerned.

The Belgian reply also refers to this element of PSR, adding that safety regulations of the USA and the European Community are also considered. Italy sees the PSR as the best way to guarantee the safety level of existing plants and to incorporate the evolution of the safety principles on which the design of the most recent plants is based. Evaluations against new developments and criteria are also performed in Germany, the Netherlands, Spain, Switzerland and the UK. Finland emphasises the scope of its ongoing surveillance and review, and thus basically looks upon the PSR as an inventory of work done in the safety field by both the licensee and the regulatory body since the issuance of the previous OL. Although formal PSRs are not part of the regulatory process in Canada, its reply contains examples of backfitting on older units initiated by the licensing of newer reactors.

A special case can be made for the first comprehensive re-evaluations of older (often first-generation) commercial NPPs, which may be of a wider scope as compared with the more regular PSRs foreseen for the future. They were undertaken in a number of countries before a national PSR policy was formulated. For a summary of the rationale behind such reviews, see Table 4.

In Finland, these first reviews were undertaken in respect of the temporary character of the initial OLs due to ongoing revision of nuclear energy legislation and the lack of concrete plans for nuclear waste management. The first three Italian NPPs were initially licensed under a special transitory rule. The initial lack of regulations to cover the complex design and construction of NPPs greatly emphasised the need for safety reassessment and compliance with new requirements for existing plants; the OLs of these plants therefore specified a period of ten years of operation, after which the regulatory body would have to start an overall review. In Spain, the first re-reviews of the two older plants (SRP) after 12 years of operation were also of a wide range. In Switzerland, the duration of the OL of two of the older plants was limited at first because of uncertainties in the licensing basis, in particular with respect to emergency core cooling, which together with new insights made the regulatory body initiate full-scope reassessments after approximately 20 years of operation.

Table 4. **Reasons given for comprehensive re-evaluations of older NPPs**

1. Shortcomings at the time of the initial OL, for example:

   - ongoing formulation or revision of nuclear legislation;
   - incomplete safety criteria and requirements;
   - uncertainties in licensing basis, e.g. with regard to ECC;
   - limited scope of initial safety review;
   - no specific plans for waste management.

2. Developments in safety technology and analysis, for example:

   - type and completeness of accidents and events considered new criteria, codes, standards;
   - new solutions in newer plants;
   - improved analytical capabilities, e.g. for accident and seismic analyses;
   - improved qualification of equipment;
   - new insights (experience, PSA, research, etc.).

For the older Magnox stations, LTSRs are carried out in the UK as they approach the age of 25 years, with the aim of justifying continued operation up to a specific target date (30, and at a later review stage, 40 years). Similar reviews are now being considered for the newer stations of this type.

In the scope of a large-scale re-review, the USNRC selected ten first-generation plants for its Systematic Evaluation Programme (SEP). Each of these plants was reviewed for compliance with the Code of Federal Regulations (CFR) and other NRC licensing criteria that were not established when the plant received its licence. An Integrated Safety Assessment (ISA) was performed for each safety area where differences were observed between criteria used in the as-built designs and current NRC licensing criteria. The ISAs served as a basis for decisions on facility modifications or procedural changes that would re-establish acceptable plant safety margins.

Naturally, the accidents at Three-Mile-Island and Chernobyl, together with insights from PRAs, gave further impetus towards safety reassessment of operating NPPs. Japan, for example, points to the many lessons learned from TMI and applied to all NPPs. Sweden has performed a reassessment of plant safety with regard to mitigation of radioactive release in case a severe accident should occur; it was carried out in addition to the first round of Swedish PSRs aimed at safety with respect to accident prevention. Most countries with NPP programmes are known to be performing similar reassessments with the objectives of prevention of severe accidents and of mitigation of their consequences. Apart from a few exceptions, e.g. Canada, the replies only occasionally refer to such actions, which were not a specific item of the questionnaire.

4.4 Periodic safety review process (B2)

4.4.1 PSR performed or planned (B2.1)

The following overview describes the actual situation in Member countries (see also Table 5):

a) Belgium

PSRs have been performed for the PWRs Doel 1/2 and Tihange 1 (1985). They are planned for Doel 3 / Tihange 2 (1992 - 93) and Doel 4 / Tihange 3 (1995). Repeat PSRs will take place for Doel 1/2 and Tihange 1 in 1995 also.

b) Canada

Non-comprehensive Periodic Licensing Reviews (PLR) are performed every two to three years for OL renewal of all NPPs.

c) Finland

PSRs of limited scope were performed in 1983 and 1988 for five and ten year OL renewal, respectively.

d) France

PSRs were performed for the first PWR Chooz A (1983), for 5 GCRs during the period 1978-88, and for the Phenix FBR (1986). The PSRs for the first 900 MWe PWRs at Fessenheim and Bugey were initiated in 1988. All other French NPPs will be periodically reviewed in coming years, taking due consideration of the high degree of standardisation.

e) Germany

A partial PSR (without probabilistic analysis) was performed for the Stade PWR; a second one is underway at the PWRs Biblis A and Unterweser. The other plants will be reviewed periodically in the future and these will be complemented by PSAs.

f) Italy

PSRs were performed for the Latina GCR and the Trino PWR.

g) Japan

No PSRs are foreseen, but in addition to thorough periodic inspections, comprehensive periodic surveys of safety management are implemented.

h) The Netherlands

PSRs have been initiated for the Doodewaard BWR and the Borssele PWR.

i) Spain

The first PSRs (called SRP) were initiated at the Zorita and Garona NPPs after approximately 12 years of operation. The SRP in progress on the Vandellos I GCR was interrupted after the suspension of its OL. The requirements for a SRP for Almaraz I and other "second generation" units are under review.

j) Sweden

Five PSRs covering six units – Barsebäck 1 and 2, Oskarshamn 1 and 2, Ringhals 1 and 2 have been performed and reported to the government. The first round of PSR for all NPPs will be completed around the year 1995.

k) Switzerland

The first PSR is in an advanced stage for the Mühleberg BWR. The next plants will be the 2 PWRs at Beznau. Partial reviews of these older plants were performed after approximately 10 and 15 years of operation. The two newer NPPs will be subsequently re-reviewed.

l) United Kingdom

In addition to the more frequent STBRs, medium-term reviews, corresponding to a type of PSR as defined in this report, are being discussed. For the older GCRs at Berkeley, Bradwell, Chapelcross, Calder Hall and Hunterston A, LTSRs have been performed, and similar reviews are under-way in four other stations. (The Berkeley and Hunterston A stations have been shut-down definitively in 1989 and 1990, respectively).

m) United States

No PSRs are foreseen, but special programmes exist such as SALP and SEP (see paragraph 4.1.5 and section 4.3, respectively).

Until recently, PSRs were normally performed for individual plants, but in some cases were combined for identical units at a site. The replies from France, Italy and the UK mention the large differences in plant design of older units. It is self-evident that more standardised designs, such as widely used in the French PWR programme and, on a restricted scale in some other countries, offer great advantages in this respect.

4.4.2 Frequency and number of PSRs (B2.2, 2.3)

Most countries with PSR programmes intend to perform such re-evaluations at intervals of roughly ten years (Table 5). The reply from France, although confirming this approximate value, nevertheless expresses some reservations that this may be too frequent because of the time needed to do it and possibly insufficient feedback of experience or too limited evolution of regulations or knowledge.

Germany and Sweden also specify a frequency of once every ten years, adding that there shall be three re-reviews in the course of expected plant lifetime; in the UK also, a value of approximately ten years is at present under review.

Switzerland considers a frequency of the order of 10 to 15 years. In Spain, a decision is pending on reviews of the second generation NPPs which are reaching ten years of operation. As already mentioned, the more frequent Canadian PLRs do not have the same character as a PSR.

First PSRs on older NPPs are – or have been – generally performed more on a case-by-case basis before a regular PSR programme was established. Typical examples illustrating the number of operating years at the time of such first reviews are: five years in Finland, 12 in Spain and, some 20 years – both in Switzerland (after earlier partial reviews) and in the UK (the first LTSRs).

It is noteworthy that no country intends to vary significantly the frequency of regular PSRs with the age of NPPs after the completion of these first special reviews.

4.4.3 Some general remarks on the scope of PSR (B2.4 - 2.6)

As described in detail elsewhere in this report, PSRs are generally characterised as overall reviews of the safety status of NPPs. Their scope, relative to that of the initial safety reviews for operating licences, varies considerably among countries. As the evaluation of replies indicates, however, this is not necessarily due to the varying scope of the PSR only, which, as already described, may depend on the extent of ongoing surveillance and review. Another factor to be considered in this respect is the character of the original safety evaluation, which may have been of rather limited scop, compared to today's approach.

Table 5. **Status of PSR programmes**

Country	PSRs performed or in progress	PSRs planned for all NPP	Interval years (approx.)	Remarks
Belgium	x	x	10	first round complete and second to start in 1995
Canada	-	-	2-3	PLR for OL renewal, not considered as PSR
Finland	x	x	10	of limited scope for OL renewal
France	x	x	10	
Germany	x	x	10	
Italy	x	-	-	no more NPPs in operation
Japan	-	-	some years	survey of safety management
Netherlands	x	x	10	
Spain	x	x	decision pending	PSR policy under review
Sweden	x	x	10	first round complete in 1995
Switzerland	x	x	10-15	first full-scope review of older plants in progress after approx. 20 years
UK	x	x	decision pending	PSR policy under review; LTSRs of older plants after approx. 20 years
USA	-	-	-	SALP, SEP and later review for OL extension

Belgium, Switzerland and the UK indicate comparable scopes; the Swiss reply adding that regular PSRs will be full-scope reviews, but that the depth to which subjects are treated depends on their safety significance. Similar statements are made by other countries. Germany and Spain also mention that for selected aspects, the depth of evaluation may be comparable to the OL review. The Canadian PLRs and the Finnish PSRs are of considerably reduced scope compared to the reviews performed for the initial OL. In Switzerland and Italy, on the contrary, the first PSRs of the older plants are much more extensive than the initial regulatory reviews. In the UK also, the LTSR extends beyond earlier evaluations, and by taking account of new developments, effectively supersedes the existing safety case. In Japan, the periodic inspection programme, which is regarded as a kind of PSR, is of wide scope and includes component ageing independently of the plant age.

Spain indicates criteria for the selection of subjects for its PSRs; the first two of these were of a wide range, the main topics being design aspects (new standards adaptation) and ageing. Both the Italian and Spanish replies refer also to the SEP of the NRC as one of the review bases. A number of countries attach considerable importance to PSA in the scope of their PSRs.

A reduction of ongoing surveillance and review is generally not expected from the introduction of PSR, which is regarded as an addition to, not as a substitute for other practices. Some replies, such as those from Germany, Italy and the UK, indicate that PSR findings may even result in additional surveillance programmes or cause a change in emphasis with respect to regulatory supervision.

4.4.4 Use of PSR findings with regard to licensing and public acceptance (B2.7)

In most countries, the results of the PSR can lead to an amendment, extension or renewal of the OL, depending on the validity of the latter. In France, no process for OL renewal is foreseen. In the Netherlands and Switzerland, this licence basically has unlimited validity; these countries have, as yet, no policy for possible effects of regular PSRs on the OL of NPPs. France refers to the possibility that restart may not be allowed in the case that major problems are identified. It is to be expected, however, that this would be the situation in most NEA countries.

PSR reports or findings are published or made accessible to the public in a number of countries (Canada, the Netherlands and Switzerland). In the UK, the LTSR reports are submitted to the regulatory body whose assessment of them is published. In Sweden also, the licence's report together with the findings of the regulatory body is a public document, required by and formally submitted to the government. In France, the documentation is presented to local commissions. In Italy, the reports are treated in a restricted way; they may be used in hearings during legal actions only. The Spanish reports are available to members of Parliament and accessible to other organisations under certain conditions. LTSRs of the licences in the UK and the assessments of the regulatory body could be used in hearings in the event of a major incident or prosecution. The German reply states that it is up to the authority responsible for issuing the licences of units under its supervision to decide what use will be made of PSR results. The Japanese regulatory body summarises the results of its periodic inspections in special reports, which are released to the public.

4.4.5 Responsibility for the PSR

The questionnaire did not specifically address the question of whether the licensee or the regulatory body has to periodically re-evaluate the safety status of a NPP. Additional information

was therefore requested in a letter from the NEA secretariat (Annex 2). A clearer picture has emerged, although not all countries replied to the question.

In most countries, the licensee has to submit documentation analysing the safety status of his plant.This often occurs in the form of reports on subjects laid down in a PSR programme, examples of which are given in paragraph 4.5.8 for Belgium, Germany, Sweden and the United Kingdom. Such programmes can be prescribed by the regulatory body (e.g. in Germany) or defined by agreement between the licensee and the regulatory body, as is the case in Belgium. The Canadian PLR requires an application by the licensee for licence renewal. The Italian PSR process is treated in a formal manner like the normal licensing procedure for a new NPP. In the case of older units, complete revisions of the FSAR can take the place of more restricted reports, as is the case in Switzerland.

The reports of the licensees are evaluated by the regulatory bodies, who generally summarise the results of their assessments, together with the findings of their own investigations, in special evaluation reports.

In actual practice, therefore, both the licensee and the regulatory body have their own specific responsibility with regard to PSR. It is interesting to note, however, that the replies from some countries quite specifically and often repeatedly refer to the responsibilities of the licensee. A typical example: it is stated in the reply from the UK that the licensee is responsible for periodically re-evaluating the safety status of his NPP, but he must satisfy the regulatory body that the re-evaluation is adequate.

4.5 Scope of the periodic safety review (B3)

4.5.1 Introduction

Most of the themes listed in Part B3 of the questionnaire are treated in the scope of PSRs in the countries performing such reviews, although the details of the process seem to vary considerably. This may be largely unavoidable due to the differences between licensing and surveillance practices. The lack of uniformity of the contents and details of the replies shall be taken into account in the succeeding sections of this report. A general overview is presented in Table 6.

The majority of replies refer to evaluations against new experience, safety criteria, standards, practices or designs in the scope of PSRs, and to decisions taken on the basis of such evaluations for backfitting or modifications of equipment and procedures (see also paragraph 4.6.3).

Four examples of country-specific review programmes are the subject of paragraph 4.5.8. Apparently such programmes are not necessarily final, because some replies and comparisons between first answers and later comments give the impression that PSR programmes are still under review.

Some additional information on documents to be submitted for the review is given in section 4.6.

Table 6. **General overview of scope and main elements of regular PSRs**

General aspects

Overall review of safety status of NPPs

Addition to, but no substitute for, ongoing surveillance and review; no reduction of such existing activities with the introduction of PSR

Evaluation against feedback of experience

Specific aspects considered by the majority of countries

- Plant concepts, safety-relevant equipment, unresolved safety issues, influence of modifications and backfitting; evaluation against new designs or practices, considering new national and international requirements
- Administrative control of safety (summarised)
- Theoretical analyses in the light of the state-of-the art, e.g. for incidents, accidents, mechanical and seismic loads
- Basic or conceptual aspects of ageing and QA
- Probabilistic Safety Analysis (PSA)

Specific aspects considered by one or more countries [4]

Accident management (AM)	Preventive maintenance	Cold-weather conditions
Administrative control of safety, safety management	Procedures and manuals for tests, incidents and accidents (often as summaries)	Protection against third parties
Emergency planning	External events, fire	Quality assurance (QA)
Radiation protection	Training, retraining	Leak before break
Other than full-power conditions of equipment	Reliability/qualification	Pipe rupture effects
Plant management	Requirements in the country of origin of the reactor	Pressurised thermal shock (PTS)
Simulator training		

[4] Such items are included in ongoing surveillance and review, or are the subject of separate project in most countries.

4.5.2 Administrative control of safety: organisational and QA aspects (B3.1 - 3.3)

Administrative control of safety and organisational factors play a major role in ongoing surveillance and review in most countries; the review of basic documents and procedures, or more often a summary of practices also forms part of the PSR. Normal surveillance in the form of reviews, inspections and audits in most countries covers all aspects listed in Parts B3.1-3.3. The Dutch reply specifically points to the importance of administrative control in case old documents are replaced, in particular to inform the operating personnel on the impact of the modifications.

The Japanese regulatory body implements a voluntary comprehensive survey of safety management and quality control systems at each nuclear power station every few years.

The following examples serve as illustration of administrative considerations included in PSRs: training and retraining policies, including simulator training, mentioned by Belgium, France, Germany, Italy and Sweden; the requirement for a second shift supervisor by Spain; the systematic feedback of in-house experiences and from other NPPs, and for QA, referred to by most countries. Other factors such as health physics, preventive maintenance and in-service inspection are listed in some replies.

4.5.3 Ageing of structures, systems and components (B3.4)

The recently published *Proposed Rule on Nuclear Power Plant Licence Renewal of the USNRC*, considers ageing of structures, systems, and components to be a major theme for the renewal of OLs. Although ageing is mentioned in most replies, the impression is that it is given less weight in the PSR programmes. Only France, the Netherlands, Spain and the UK (for its LTSRs) refer specifically to it in this respect. Italy reports on a systematic analysis of failed components. In Sweden, ageing is included in the PSR but addressed in detail elsewhere. Germany and Switzerland also intend to treat only aspects of ageing in their PSRs normal control over the quality of components being part of ongoing surveillance and review. In Finland and Japan, control of ageing is part of these activities.

The reason behind this difference in policies, as compared with US practice, probably stems from the fact that the duration of the validity of US licences (max. 40 years) may coincide with the initially specified design life of critical components.

The Canadian reply gives some examples of the regular monitoring of components where ageing effects play a role (e.g. pressure tubes and cabling). Similar programmes can be assumed to be part of ongoing surveillance and review in all countries.

4.5.4 Safety-related equipment, manuals and special subjects (B3.5/3.6/3.8)

In a number of countries, the equipment and themes listed in Parts B3.5, 3.6 of the questionnaire, with minor exceptions, generally form part of the PSR process (Canada, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK). France and Italy additionally refer to control systems and control rooms. In the course of this process, the status and the effect of backfitting on overall safety is also re-evaluated (France, Italy, the Netherlands, Sweden and Switzerland). Examples of backfitting decisions on the basis of previous PSRs were given by Belgium, Italy and Spain. As already mentioned in sections 4.3 and 4.5.1, most countries will also

perform an evaluation of the differences between the actual safety status of plants and new regulations or practices, and look for ways to reduce these as far as reasonable.

Special aspects of multiple-unit sites are considered by France and Sweden in their re-evaluations. The French reply mentions as examples the effects of the number and relative location of NPPs and of systems common to several units. In Japan, the safety of multiple-unit plants is evaluated in the scope of the permit for NPP installation.

Review of the incident and accident procedures more generally is part of ongoing surveillance, e.g. in Canada, Finland, Japan, the Netherlands, Spain, Sweden, Switzerland and the UK. Results of these and of other reviews may be summarised in PSR findings, as is the case in Finland, France, Sweden and Switzerland. In Canada, efforts are made to ensure consistency between the procedures used for CANDU reactors at the various sites. Some countries give examples of specific themes in the PSR process, such as accident management (AM) or symptom-oriented accident procedures (Germany and the Netherlands), which today may be considered as part of the state-of-the-art.

4.5.5 Theoretical analyses (B3.7)

Theoretical analyses, such as for design basis accidents (DBA), for stresses in structures and components, or for other load cases like seismically induced vibrations, were included in the questionnaire because inputs, scope, depth and methodology of such calculations may have undergone considerable developments since the issuance of the OL. It is reasonable to assume that first generation NPPs are most affected in this respect.

France, Italy and the Netherlands perform systematic reviews of all aspects relevant to the DBA analyses. The reply from France specifies the contents of its review: listing of events, assumptions, main parameters, criteria, main results and codes, which includes comparisons between initially used and today's codes. Requirements for new calculations are derived from these reviews. Other analyses concern severe accidents and associated procedures.

Germany, Japan, Switzerland and the UK (for LTSRs) also review DBA analyses, concentrating efforts on cases where new guidelines, knowledge and experiences, or incompleteness of existing documentation and modifications have to be considered. An in-depth, deterministic re-analysis of DBAs of the same type as in the FSAR is not required for the Swedish PSR. In Canada and Finland, theoretical analyses are frequently repeated as part of ongoing safety assessment. Some accident re-analyses, including radiological dose calculations following current practices, were also part of the Spanish PSRs.

Examples of analyses reviewed or redone for external events in the scope of PSR in more than one country concern earthquakes, fires, floods, the effects of pipe ruptures and the risk of an airplane crash(es). France specifically mentions cold-weather conditions, whereas Sweden intends to put more emphasis on external events and plant status other than full-power operation in its future ASARs. Other special themes mentioned are post-accident conditions (Belgium) and the leak-before-break concept (the Netherlands).

4.5.6 Probabilistic risk and safety assessments (B3.6.2, 3.9)

Replies describe three ways in which probabilistic methods are applied in safety reviews:

- reliability assessment of systems and components;
- probabilistic analysis for selected subjects;
- overall PSA (Level 1 or Level 1+ or Level 2).

Reliability assessment of safety-related equipment mentioned in the Canadian and Finnish replies was also part of the first PSR performed in Sweden. Finland refers also to such assessments as part of more overall PSAs, which certainly is the case in other countries too. Italy would include such analyses in future PSRs.

Selected subjects. Belgium refers to the difficulties with backfitting older plants against potential actions by third parties, and reports on specific probabilistic analyses to assess the degree of safety against such threats.

Overall PSA. Full scope PSAs are required for, or reviewed, in the course of PSRs in Germany (Level 1+)[5], the Netherlands (same) and Switzerland (Level 1 and 2). Level 1 PSAs were a major part (50 to 70 per cent) of the first round of Swedish PSRs, and the results affected backfitting programmes. In the UK, limited PSAs have been required in the reviews (LTSR) of older plants, but for future reviews more comprehensive PSAs will be required for judging the benefits of modifications. Updating of existing PSAs is only required if further extensions of plant life are envisaged. France expects to use the PSAs as tools for future PSRs to quantify the importance of differences between the original safety concept and later requirements. Finland does not intend to directly connect the PSA with its PSRs and OL renewal, but uses them intensively in the ongoing licensing and review process.

The Spanish reply considers PSAs – previously of the Level 1, in future also of the Level 2 type – as a sort of PSR; using them to quantify the increase in safety due to backfitting. Similar data were obtained from Swiss PSAs of older plants, which are also considered an essential element of PSR; if the latter is part of a licensing process, e.g. for OL extension, the PSA becomes a legal part of the regulatory process.

A report on the application and implications of the "Living PSA" concept, attached to the Swedish reply, refers to a comparative review of Swedish PSAs carried out recently within a so-called SUPER-ASAR project. A number of other countries indicate their intention to also establish a living PSA process.

The Current Licensing Basis (CLB), as applied in the USA, does not require a PSA (for the CLB, see also sections 3.2 and 4.6.2).

---

5 The German reply defines Level 1+ as the addition of the active parts of the containment system to Level 1, the Dutch reply as an extension into Level 2 to include accident management.

4.5.7 Emergency Planning (B3.10)

Emergency planning, both plant internal and external, is generally not included in PSR programmes, but treated as a special subject of ongoing surveillance and review. Germany refers in
this respect to the review of manuals, environmental conditions for plant personnel and communications under emergency conditions. PSR findings may, however, identify the need for changes (UK). Protection against third parties is normally also reviewed separately.

4.5.8 Examples of PSR programmes

The questionnaire did not ask for country-specific PSR programmes. The replies from four countries that formally require such reviews contain some information which is summarised here. This complementary information serves as typical examples illustrating the spectrum of themes considered.

a) Belgium

The Belgian reply describes the main subjects of the first PSR:
- protection against seismic effects;
- fire protection;
- pipe whip effects;
- stresses in the primary circuit due to PTS and over-pressure;
- post-accident conditions, such as requirements for shielding and component qualification;
- safety and support systems;
- operation, training and QA;
- external events due to human activities.

The review considers the evolution of safety regulations and operating experiences.

b) Germany

The Reactor Safety Commission (RSK) in 1988, issued a proposed list of subjects. Described in a condensed form, it considers:

1.) Systems engineering

1.1) Operating and safety systems
- components and piping;
- heat removal, including cooling water and spray systems;
- power supply, control and instrumentation;
- containment;
- exhaust ventilation system;
- control room, auxiliary shutdown station;
- protection against fire and external events;
- structures;
- sampling systems;
- ATWS.

1.2) Accident management
- emergency water injection to reactor;
- containment venting and hydrogen control;
- accident power supply;
- control room air filtration;
- sampling systems (for incidents).

2.) Operation

2.1) Normal operation and incidents
- operating manual;
- in-service inspections;
- general operating experience;
- unusual events;
- personnel qualification and training;

2.2) Organisational aspects of accident management
- emergency manual;
- stay-of-emergency personnel;
- communication equipment.

3.) Multi-unit aspects

The RSK also expects licensees to perform Level 1 PSAs for all plants, and to complete these within ten years.

c) Sweden

As an example, the ASAR on the PSR of the two Barsebäck units which the Swedish Inspectorate issued (including a summary of its own conclusions), contains the following listing of review reports:

- administrative control of safety;
- routines for operation and maintenance;
- training and personnel;
- operational experience;
- material, control and environment;
- systematic reliability analysis;
- safety analyses and improvements introduced to increase safety;
- future safety work.

Some additional information on the Swedish programme was already given in sections 4.5.5 and 4.5.6. The comment to the second draft of this report mentions that the second round of PSRs will put relatively less weight on PSA; the PSAs of all Swedish NPPs already having constituted a substantial part of the first round. More emphasis will be given to the analysis of organisational preparedness and functional aspects under various operational states, including outages. The comment also states that the "analysis of safety-related work and organisation" proved to be the most difficult task, and that the relevant experiences from the first round of PSRs will be duly considered in the second round.

d) United Kingdom

The following list of topic reports to be submitted by the licensee for a LTSR may serve as a typical example of the scope of a first extensive review of first generation – in this case Magnox stations:

- reactor pressure vessel, boilers, ducts and stand pipes;
- core, reactor and boiler internals;
- internal and external events;
- safety and control systems, including secondary and tertiary shutdown devices;
- data presentation, instrumentation and control;
- electrical supplies;
- coolant systems;
- safety analyses, including PSA;
- fuel handling;
- operation and operators;
- health physics;
- radwaste;
- decommissioning;
- modern standards;
- ageing.

4.6 Bases and documentation for the periodic safety review (B4)

4.6.1 Introduction

It may be assumed that part of the documentation prepared by the licensee for the initial OL is no longer up to date at the time the PSR is performed. This is partly due to modifications – in particular for older plants – but also because of the evolution of safety technology. The questions of Part B4 aimed, therefore, at the requirements for updating such documentation when preparing for a PSR.

Since most of the data on this subject are already mentioned in previous sections, the following text has more the character of supporting information.

4.6.2 FSAR, TS and other safety-related documentation (B4.1 - 4.3)

As already reported in section 4.1.2, "b", the FSAR or comparable documentation is the main legal or formal document underlying the OL in the large majority of countries, and regular updating is part of common practice in most countries. This document may thus be assumed to be generally the basis for the PSR. The replies from France, Italy, the Netherlands, Spain and Switzerland all point to the role of the FSAR in the PSR process. Although the report is not formally coupled to the PSR in Sweden, insights that have been implemented from analyses such as PSA, affect its contents. In the UK, the existing safety case is the starting point for the LTSR, but its findings result in an updated site safety case.

Some countries, such as Belgium, Finland and Spain refer to the USNRC regulatory Guide 1.70 as its basis. For some of the older NPPs, substantial revisions or rewriting of the FSAR were or will

be necessary for the PSR (e.g. in the Netherlands and Switzerland). The Technical Specifications and comparable manuals are normally treated in a similar way to the FSAR, or considered to be part of it.

A number of countries require the licensee to submit special reports to the regulatory body on their findings, such as the ASAR in Sweden – one of the examples given in section 4.5.8. In this case, the contents of the re-review to be performed are prescribed by the regulatory body, and include the results of living PSAs that must be updated once every one to three years. In Spain and the UK, special reports are prepared when considered necessary.

In the USA, where PSRs are not foreseen in the regulatory process, the Current Licensing Basis (CLB) will have to be reconstituted for the application of OL renewal to include all current regulatory requirements and licensee commitments relating to the design and operation of the facility.

The subjects listed in Parts B4.3.1 to B4.3.6 of the questionnaire, and the periodic revisions of the relevant documentation are, in general, part of ongoing surveillance and review. Summary evaluations and revisions of certain documents may, however, also take place as part of the PSR process.

4.6.3 Regulations and experiences (B4.4, 4.5)

Comparisons with current regulations and ways to resolve safety-relevant deviations from them are part of ongoing and periodic reviews in most countries. The Belgian PSR, performed once per ten years of operation, includes comparisons with the regulations, standards and practices in the USA and the European Community. Canada reports that the licensee has to resolve deviations from original requirements, and that modifications or new analyses shall conform to state-of-the-art technology. The safety of operating Finnish NPPs has to be re-evaluated whenever national regulations are upgraded; basically, new regulations have to be met within a certain time delay where modifications to achieve this can be implemented in a reasonable manner. In the revision process of national documents, international regulations are taken into account. In Japan and Sweden, international regulations are analysed and utilised where applicable.

France requires evaluations in light of new regulations in the course of PSR; it includes requirements for concept, construction and operation of NPPs to satisfy those of the IAEA's NUSS programme. The German PSR also requires a re-evaluation against national regulations, which it strives to harmonize with international standards. The Dutch national regulations conform with the Codes and Guides of the IAEA, with certain adaptations. These documents were also considered in Italy, together with US and CEC regulations. The IAEA Codes and Guides, the Basic Safety Principles of INSAG and the regulations of other countries, in particular those of the USNRC, are likewise used as basic references for the Spanish safety guides. An interesting feature of regulatory practices in Spain is the requirement that analyses of the applicability and consequences (for NPPs) of new requirements in the country of origin of the reactor system be included in the scope of the half-yearly reports submitted by the licensee to the regulatory body.

Switzerland does not require the licensee to perform a detailed comparison with current regulations in the PSR process, assuming that deviations from them are already known to and tolerated by the regulatory body. In case deficiencies are detected which require corrective actions, current regulations are used for justification and enforcement.

In the UK, the regulatory body monitors the licensees' activities and reviews their PSR submissions for compliance with national and relevant international regulations; a LTSR includes comparisons with modern national, foreign and international codes and standards. The licensees also have their own criteria (such as those issued by the former Central Electricity Generating Board [CEGB]). This regulatory body judges the adequacy against its Safety Assessment Principles (SAP).

In line with the major role of feedback of experience, incident and accident reports such as those prepared for the Incident Reporting System (IRS) are analysed in both ongoing and periodic review processes, and utilized where applicable. Several replies refer to the lessons learned from the accidents in Three Mile Island and Chernobyl, some also to other sources, such as the bulletins and reports of the USNRC, of INPO, and of the reactor vendors.

5. Conclusions

This report is a summary of a survey on regulatory practices involving the periodic safety review of nuclear power plants in NEA Member countries. It covers 13 countries with a total of 357 plants. Some 90 per cent of these plants are in operation, the remainder either in the construction or start-up phase, or were recently shut-down for various reasons.

The countries that have already performed PSRs, or intend to do so, generally regard them as overall reviews of the safety status of plants, in addition to, but not as a substitute for, ongoing surveillance and review. In a number of countries, re-evaluations of the safety status of older plants were the initiators for regular PSR programmes for all NPPs.

PSRs of the type defined in section 3.2 of this report have already been, or will be, performed in 10 of the 13 countries. They are either a legal requirement, a condition of the operating licence (OL), or required for its extension or renewal. In other countries, the PSR process is based on decisions of regulatory or political bodies.

The frequency of PSRs is generally of the order of once every ten years, but they may be less frequent in some countries (once every 15 to 20 years), particularly in the case of the first comprehensive re-evaluations. The replies give the impression that the actual scope and depth of reviews vary considerably between countries, depending on existing review and inspection practices. The reviews often include assessments of plant status and operation in the light of both initial and current, national as well as international regulations. Other main themes are the feedback of experience and the consideration of the state-of-the-art in safety technology and analysis. In some countries, the requirements with respect to frequency and scope of future PSRs seem to be still under review.

Because of the very short duration of the validity of OLs, Canadian reviews are frequent, but of more limited scope than the other PSRs considered here. In spite of a similar duration of its provisional OLs, more comprehensive longer-term reviews were already performed in Spain. In the USA, PSRs are not required as part of the regulatory process because of its comprehensive set of regulations, inspection and safety review programmes; this country, however, performs a systematic review of selected older plants and is already in the rule-making process for licence renewal. In Japan also, no PSRs as defined here are performed, but in addition to extensive periodic inspections, comprehensive periodic surveys of safety management are implemented.

In some countries, the first re-evaluation of the safety status of older plants – particularly for those of the first generation – is extensive relative to the safety reviews performed for the initial operating licences. These were often of limited duration of validity. Reasons for this, and for the re-evaluation, are the evolution of safety technology and analysis, revised or better-defined licensing bases, or a modified regulatory approach. These re-evaluations often led to additional requirements for backfitting, supplementing measures taken before.

Ageing of systems and components is referred to by some countries as part of their PSRs, but not generally emphasised to the same degree as is the case in the USA for licence renewal. This is due to the fact that in this country the expiration of the operating licences after a maximum of 40 years roughly coincides with the end of the design life of plants or of critical components, as initially specified.

Probabilistic Safety Analyses are receiving growing attention in PSR programmes. In some countries they are considered as an essential element of the reviews. Their findings are in general used as supporting information to the deterministic safety analysis.

Abbreviations

AGR	Advanced Gas-cooled Reactor (UK)
AM	Accident Management
ASAR	As Operated Safety Analysis Report (Sweden)
ATWS	Anticipated Transients without Scram
BWR	Boiling Water Reactor
CEC	Commission of the European Community
CEGB	Central Electricity Generating Board (UK)
CFR	Code of Federal Regulations (USA)
CLB	Current Licensing Basis (USA)
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CSNI	Committee on the Safety of Nuclear Installations (NEA)
DBA	Design Basis Accident
ECC	Emergency Core Cooling
FBR	Fast Breeder Reactor
FSAR	Final Safety Analysis Report
GCR	Gas-Cooled Reactor (Magnox type)
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operation (USA)
INSAG	International Safety Advisory Group (IAEA)
IRS	Incident Reporting System (NEA and IAEA)
ISA	Integrated Safety Assessment (USA)
LTSR	Long-Term Safety Review (UK)
NEA	Nuclear Energy Agency (OECD)
NPP	Nuclear Power plant
NRC	Nuclear Regulatory Commission (USA)
OECD	Organisation for Economic Co-operation and Development
OL	Operating Licence
POL	Provisional Operating Licence (Spain)
PLR	Periodic Licensing Review (Canada)
PSA	Probabilistic Safety Analysis or Assessment
PSR	Periodic Safety Review
PTS	Pressurised Thermal Shock
PWR	Pressurised Water Reactor
QA	Quality Assurance
SALP	Systematic Assessment of Licensee Performance (USA)
SAP	Safety Assessment Principles (UK)
SEP	Systematic Evaluation Programme (USA)
SER	Safety Evaluation Report (USA)
SRP	Safety Re-evaluation Programme (Spain)
STBR	Short Term Biennial Review (UK)
TS	Technical Specification

Annex 1

Working Document
27 March 1990

English text only

**Periodic Safety Review of
Operating Nuclear Power Plants
in OECD NEA Countries**

Questionnaire for a Comparative Review of Regulatory Practices

Responses to be sent no later than 21 May to:

Mr. Frits Weehuizen
Weizenstrasse 14
5430 Wettingen
Switzerland

Contents

Introduction

At its first meeting, November 6 - 7, 1989, the Committee on Nuclear Regulatory Activities (CNRA) decided to carry out a comparative review of regulatory practices involving the periodic safety review (PSR) of operating nuclear power plants (NPP) in NEA Member countries. An important aspect of this review, as indicated by the discussion between CNRA members, should be national approaches to dealing with ageing plants and components (see SEN/NRA(89)3).

PSRs of operating NPPs have already been performed or decided upon in a number of NEA countries. The rationale behind them may stem from a variety of considerations, such as:

1. limits to the duration of the operating license (OL);

2. ageing of materials, components or structures;

3. shortcomings relevant to the current state-of-the-art, (e.g. parameter display, degree of automation), theoretical analyses (scope, depth or methodology), backfitting performed since the OL, new technical or administrative requirements such as the introduction of a quality assurance (QA) system or the requirement for a probabilistic safety analysis (PSA);

4. operating experiences: lessons learned from shortcomings during operation, incidents and accidents;

5. developments or decisions taken in other countries with comparable NPP's.

For these or other reasons a regulatory body may decide to periodically update, extend its earlier evaluations, or to complete its normal permanent supervision in a more systematic way. The above catalogue of possible aspects indicates, however, that the scope of such a review may be much broader than questions regarding ageing alone.

Structure of the questionnaire

The questionnaire is structured with the aims of first obtaining an overall picture of the national practices with regard to continued regulatory supervision of a given NPP following the issuance of the OL, and then determining the importance and nature of PSRs in the scope of this supervision. In addition, the answer to specific questions should give a more detailed understanding of actual or intended practices with regard to PSR.

To achieve these aims, the questionnaire consists of Part A covering the main aspects of the "normal" regulatory supervision of operating NPPs, and Part B containing specific questions with regard to PSR.

Part A of questionnaire

Summary of main regulatory practices

Describe in a condensed text the main regulatory practices in your country with regard to the operation of nuclear power plants (NPP). The description should include, but not necessarily be limited, to the following type of information:

A1. General: number and types of NPPs in your country (include numbers and types at each site).

A2. Basic conditions forming an integral part of the OL, such as: limits on duration, maximum reactor power or radioactive emissions.

A3. Main documentation underlying the OL, such as: Final Safety Analysis Report (FSAR), Technical Specifications (TS), or internal organisational or administrative responsibilities. For such documents, indicate:

- What is their official or legal status in the licensing process?
- Are they required to be periodically updated and re-submitted for approval?

A4. Type of modifications, backfitting or additions to a NPP requiring a formal or legal renewal or modification of the OL.

A5. Role played by PSA in the licensing process.

A6. Requirements of the regulatory body with regard to the operation of a NPP after the issuance of the OL, e.g.:

- approval prior to modifications of safety relevant equipment, structures and documentation, or prior to repairs, or after incidents and accidents.

A7. Character of continuing supervision of NPP operation by the regulatory body, e.g.: inspection activities, regular review of plant and safety system concepts, quality of safety-relevant equipment or of analyses on the basis of new experiences or considerations.

A8. In case PSRs have been or will be performed, describe the rationale for doing so and the importance given to them relative to the normal "day to day" supervision.

A9. What are the possible outcomes of a PSR as it might affect the continuation of the OL?

A10. Any other aspects considered to be of value.

Part B of the questionnaire

Questions with regard to PSR

B1. Statuary basis

B1.1 In addition to the continuing regulatory supervision described in A7, describe the legal requirements in your country with regard to PSRs.

B2. The Periodic Safety Review Process.

B2.1 Have PSRs already been performed in your country, or are they intended for the foreseeable future?

B2.2 What is the approximate frequency of a PSR for a given NPP? Does it take place at regular intervals or with increasing frequency with the age of the NPP?

B2.3 Are the PSRs performed individually for each NPP or in a combined way for comparable NPP's?

B2.4 Is the scope or the depth of a PSR roughly comparable to or markedly different from the safety evaluation performed for the OL?

B2.5 Is the PSR primarily concentrated on selected aspects — such as ageing of materials, prevention of severe core damage, organisational aspects, etc., or has it the character of an overall review?

B2.6 Is the PSR expected to cause a substantial reduction in continuing supervision described in the answer to A7?

B2.7 Assuming the findings of the PSR are to be summarised in a separate safety evaluation report:

- To whom would the report be addressed?
- Could the report lead to a formal prolongation, conditional prolongation or withdrawal or the OL?
- Would the report be used in hearings?
- Would the report be published?

B3. Scope of periodic safety review

Characterise the scope of the PSR in your country for the aspects listed below:

B3.1 Administrative control of safety, including subjects such as:

3.1.1 Organisational structure of the NPP;
3.1.2 Qualification and (re)training of:
- operators, shift supervisors;
- technical, radiation protection, maintenance and QA-personnel.
3.1.3 System for feedback of operating experience, including unusual events in the plant itself and in other plants.

B3.2 Quality assurance (QA), including technical documentation from design, construction and operation.

B3.3 Programmes for, and documentation of results of periodic testing of systems and components per TS, inservice inspection (ISI) and other manuals.

B3.4 Ageing of materials and components (mechanical and electrical equipment, structures).

B3.5 Primary, safety and support systems, e.g.:
3.5.1 reactor and nuclear steam supply systems;
3.5.2 safety and shutdown systems;
3.5.3 containment and isolation system;
3.5.4 supporting systems (e.g. electrical, essential water and air);
3.5.5 radwaste systems, radioactive waste storage and transport;
3.5.6 radiation protection programmes and equipment for the protection of plant personnel and the environment;
3.5.7 other systems, such as fire or lightning protection.

B3.6 Other aspects
3.6.1 backfitting performed since the issuance of the OL and its effect on overall safety;
3.6.2 safety and support system reliability analysis;
3.6.3 special aspects of multiple units at a particular site;

B3.7 Theoretical analyses, e.g.:

3.7.1 safety analysis within the design basis (transients, LOCAs, etc.);
3.7.2 stress analysis of mechanical equipment;
3.7.3 seismic analysis of structures and components;
3.7.4 other analyses, such as for airplane crash loads;
3.7.5 Are the inputs to these analyses, such as initiating events, accidents and loads also reviewed in light of current practices?

B3.8 Incident and accident procedures manuals for the staff and operating personnel

B3.9 Is the PSA included in the PSR? What importance is attached to its results in the scope of the PSR?

B3.10 Emergency planning:

3.10.1 internal plant;
3.10.2 external plant;
3.10.3 sabotage;

B4. Bases and documentation for the PSR

It is reasonable to assume that part of the documentation prepared by the holder of the OL is no longer up-to-date compared with the current state-of-the-art and knowledge at the time the PSR is to be performed. In this case, the updating of such documentation would need special attention when preparing for a PSR.

B4.1 (Final) Safety Analysis Report (FSAR)

4.1.1 Is the (F)SAR a formal or legal basis for the PSR?
4.1.2 Does it contain detailed information (e.g. such as per US NRC-Reg. Guide 170) or is this contained in other documentation? If yes, what is the legal status of the latter?
4.1.3 Is the (F)SAR regularly or periodically updated due to modifications, backfitting or safety analysis?
4.1.4 Is the (F)SAR to be updated or renewed for the PSR or is a special analysis report to be provided?

B4.2 Technical Specifications (TS)

4.2.1 similar to 4.1.1;
4.2.2 similar to 4.1.3;
4.2.3 similar to 4.1.4.

B4.3 List the main other documentation, prepared by the holder of the OL, which is used as bases for the PSR. Indicate which documentation is required to be updated or to be renewed in light of current experience or knowledge. The information should cover, but not necessarily be restricted to:

4.3.1 organisational structure with main responsibilities;
4.3.2 quality assurance;
4.3.3 health physics;
4.3.4 inservice inspection;
4.3.5 maintenance.

4.3.6 Technical detail documentation, such as:
- system diagrams (process and instrumentation);

- functional control diagrams;
- wiring diagrams;
- system specifications or descriptions.

4.3.7 Theoretical analyses within the scope of the design basis, in particular:
- safety analysis, including initiating events and their combinations;
- stress and seismic analyses, including loadings and load combinations;
- system reliability analysis.

Remark: the scope, depth and methodology of such analyses may have undergone considerable developments since the time the OL was issued.

4.3.8 In case a PSA is used in the preparation of the PSR, indicate:
- the scope of it (Level 1, 2 and 3);
- plant specific PSA, or analysis based on PSA of comparable plant;
- must it be regularly or periodically updated (living PSA)?

B4.4 What, if any, comparisons are made with current regulations, codes and standards? What is the regulatory position with regard to observed deviations from these? Please answer for both:

4.4.1 national regulations, codes and standards
4.4.2 international regulations, codes and standards, such as:
- IAEA Codes and Guides;
- INSAG Basic Safety Principles;
- regulations in the country of origin of the reactor system or in neighboring countries.

B4.5 Indicate other bases as may be used for the PSR. Such information might include:

4.5.1 lessons learned (e.g. incident reports of the NEA-IRS, the US NRC or other regulatory bodies);
4.5.2 reports on actions taken for comparable NPP's in other countries.

Annex 2

Additional questions by the NEA secretariat in its letters to CNRA members on 18th September 1990, asking for comments on the first draft (August, 1990).

Question 1: (ref. page 13, final paragraph of 4.1.2 b of first draft). Does a Safety Evaluation Report, prepared by your regulatory body, have a formal (legal) status as it does in the US?

Question 2: (ref. page 24, first paragraph of 4.4.5 of first draft). Does a) the licensee or b) the regulatory body, have the responsibility of periodically re-evaluating the safety status of a NPP?

MAIN SALES OUTLETS OF OECD PUBLICATIONS
PRINCIPAUX POINTS DE VENTE DES PUBLICATIONS DE L'OCDE

ARGENTINA – ARGENTINE
Carlos Hirsch S.R.L.
Galería Güemes, Florida 165, 4° Piso
1333 Buenos Aires Tel. (1) 331.1787 y 331.2391
Telefax: (1) 331.1787

AUSTRALIA – AUSTRALIE
D.A. Book (Aust.) Pty. Ltd.
648 Whitehorse Road, P.O.B 163
Mitcham, Victoria 3132 Tel. (03) 873.4411
Telefax: (03) 873.5679

AUSTRIA – AUTRICHE
Gerold & Co.
Graben 31
Wien I Tel. (0222) 533.50.14

BELGIUM – BELGIQUE
Jean De Lannoy
Avenue du Roi 202
B-1060 Bruxelles Tel. (02) 538.51.69/538.08.41
Telefax: (02) 538.08.41

CANADA
Renouf Publishing Company Ltd.
1294 Algoma Road
Ottawa, ON K1B 3W8 Tel. (613) 741.4333
Telefax: (613) 741.5439

Stores:
61 Sparks Street
Ottawa, ON K1P 5R1 Tel. (613) 238.8985
211 Yonge Street
Toronto, ON M5B 1M4 Tel. (416) 363.3171

Les Éditions La Liberté Inc.
3020 Chemin Sainte-Foy
Sainte-Foy, PQ G1X 3V6 Tel. (418) 658.3763
Telefax: (418) 658.3763

Federal Publications
165 University Avenue
Toronto, ON M5H 3B8 Tel. (416) 581.1552
Telefax: (416) 581.1743

CHINA – CHINE
China National Publications Import
Export Corporation (CNPIEC)
16 Gongti E. Road, Chaoyang District
P.O. Box 88 or 50
Beijing 100704 PR Tel. (01) 506.6688
Telefax: (01) 506.3101

DENMARK – DANEMARK
Munksgaard Export and Subscription Service
35, Norre Sogade, P.O. Box 2148
DK-1016 Kobenhavn K Tel. (33) 12.85.70
Telefax: (33) 12.93.87

FINLAND – FINLANDE
Akateeminen Kirjakauppa
Keskuskatu 1, P.O. Box 128
00100 Helsinki Tel. (358 0) 12141
Telefax: (358 0) 121.4441

FRANCE
OECD/OCDE
Mail Orders/Commandes par correspondance:
2, rue André-Pascal
75775 Paris Cedex 16 Tel. (33-1) 45.24.82.00
Telefax: (33-1) 45.24.85.00 or (33-1) 45.24.81.76
Telex: 640048 OCDE

OECD Bookshop/Librairie de l'OCDE :
33, rue Octave-Feuillet
75016 Paris Tel. (33-1) 45.24.81.67
(33-1) 45.24.81.81

Documentation Française
29, quai Voltaire
75007 Paris Tel. 40.15.70.00

Gibert Jeune (Droit-Économie)
6, place Saint-Michel
75006 Paris Tel. 43.25.91.19

Librairie du Commerce International
10, avenue d'Iéna
75016 Paris Tel. 40.73.34.60

Librairie Dunod
Université Paris-Dauphine
Place du Maréchal de Lattre de Tassigny
75016 Paris Tel. 47.27.18.56

Librairie Lavoisier
11, rue Lavoisier
75008 Paris Tel. 42.65.39.95

Librairie L.G.D.J. - Montchrestien
20, rue Soufflot
75005 Paris Tel. 46.33.89.85

Librairie des Sciences Politiques
30, rue Saint-Guillaume
75007 Paris Tel. 45.48.36.02

P.U.F.
49, boulevard Saint-Michel
75005 Paris Tel. 43.25.83.40

Librairie de l'Université
12a, rue Nazareth
13100 Aix-en-Provence Tel. (16) 42.26.18.08

Documentation Française
165, rue Garibaldi
69003 Lyon Tel. (16) 78.63.32.23

Librairie Decitre
29, place Bellecour
69002 Lyon Tel. (16) 72.40.54.54

GERMANY – ALLEMAGNE
OECD Publications and Information Centre
Schedestrasse 7
D-W 5300 Bonn 1 Tel. (0228) 21.60.45
Telefax: (0228) 26.11.04

GREECE – GRÈCE
Librairie Kauffmann
Mavrokordatou 9
106 78 Athens Tel. 322.21.60
Telefax: 363.39.67

HONG-KONG
Swindon Book Co. Ltd.
13-15 Lock Road
Kowloon, Hong Kong Tel. 366.80.31
Telefax: 739.49.75

ICELAND – ISLANDE
Mál Mog Menning
Laugavegi 18, Pósthólf 392
121 Reykjavik Tel. 162.35.23

INDIA – INDE
Oxford Book and Stationery Co.
Scindia House
New Delhi 110001 Tel.(11) 331.5896/5308
Telefax: (11) 332.5993

17 Park Street
Calcutta 700016 Tel. 240832

INDONESIA – INDONÉSIE
Pdii-Lipi
P.O. Box 269/JKSMG/88
Jakarta 12790 Tel. 583467
Telex: 62 875

IRELAND – IRLANDE
TDC Publishers – Library Suppliers
12 North Frederick Street
Dublin 1 Tel. 74.48.35/74.96.77
Telefax: 74.84.16

ISRAEL
Electronic Publications only
Publications électroniques seulement
Sophist Systems Ltd.
71 Allenby Street
Tel-Aviv 65134 Tel. 3-29.00.21
Telefax: 3-29.92.39

ITALY – ITALIE
Libreria Commissionaria Sansoni
Via Duca di Calabria 1/1
50125 Firenze Tel. (055) 64.54.15
Telefax: (055) 64.12.57

Via Bartolini 29
20155 Milano Tel. (02) 36.50.83

Editrice e Libreria Herder
Piazza Montecitorio 120
00186 Roma Tel. 679.46.28
Telefax: 678.47.51

Libreria Hoepli
Via Hoepli 5
20121 Milano Tel. (02) 86.54.46
Telefax: (02) 805.28.86

Libreria Scientifica
Dott. Lucio de Biasio 'Aeiou'
Via Coronelli, 6
20146 Milano Tel. (02) 48.95.45.52
Telefax: (02) 48.95.45.48

JAPAN – JAPON
OECD Publications and Information Centre
Landic Akasaka Building
2-3-4 Akasaka, Minato-ku
Tokyo 107 Tel. (81.3) 3586.2016
Telefax: (81.3) 3584.7929

KOREA – CORÉE
Kyobo Book Centre Co. Ltd.
P.O. Box 1658, Kwang Hwa Moon
Seoul Tel. 730.78.91
Telefax: 735.00.30

MALAYSIA – MALAISIE
Co-operative Bookshop Ltd.
University of Malaya
P.O. Box 1127, Jalan Pantai Baru
59700 Kuala Lumpur
Malaysia Tel. 756.5000/756.5425
Telefax: 757.3661

NETHERLANDS – PAYS-BAS
SDU Uitgeverij
Christoffel Plantijnstraat 2
Postbus 20014
2500 EA's-Gravenhage Tel. (070 3) 78.99.11
Voor bestellingen: Tel. (070 3) 78.98.80
Telefax: (070 3) 47.63.51

NEW ZEALAND
NOUVELLE-ZÉLANDE
Legislation Services
P.O. Box 12418
Thorndon, Wellington Tel. (04) 496.5652
Telefax: (04) 496.5698

NORWAY – NORVÈGE
Narvesen Info Center – NIC
Bertrand Narvesens vei 2
P.O. Box 6125 Etterstad
0602 Oslo 6 Tel. (02) 57.33.00
Telefax: (02) 68.19.01

PAKISTAN
Mirza Book Agency
65 Shahrah Quaid-E-Azam
Lahore 3 Tel. 66.839
Telex: 44886 UBL PK. Attn: MIRZA BK

PORTUGAL
Livraria Portugal
Rua do Carmo 70-74
Apart. 2681
1117 Lisboa Codex Tel.: (01) 347.49.82/3/4/5
Telefax: (01) 347.02.64

SINGAPORE – SINGAPOUR
Information Publications Pte. Ltd.
41, Kallang Pudding, No. 04-03
Singapore 1334 Tel. 741.5166
Telefax: 742.9356

SPAIN – ESPAGNE
Mundi-Prensa Libros S.A.
Castelló 37, Apartado 1223
Madrid 28001 Tel. (91) 431.33.99
Telefax: (91) 575.39.98

Libreria Internacional AEDOS
Consejo de Ciento 391
08009 – Barcelona Tel. (93) 488.34.92
Telefax: (93) 487.76.59

Llibreria de la Generalitat
Palau Moja
Rambla dels Estudis, 118
08002 – Barcelona
(Subscripcions) Tel. (93) 318.80.12
(Publicacions) Tel. (93) 302.67.23
Telefax: (93) 412.18.54

SRI LANKA
Centre for Policy Research
c/o Colombo Agencies Ltd.
No. 300-304, Galle Road
Colombo 3 Tel. (1) 574240, 573551-2
Telefax: (1) 575394, 510711

SWEDEN – SUÈDE
Fritzes Fackboksföretaget
Box 16356
Regeringsgatan 12
103 27 Stockholm Tel. (08) 23.89.00
Telefax: (08) 20.50.21

Subscription Agency-Agence d'abonnements
Wennergren-Williams AB
Nordenflychtsvägen 74
Box 30004
104 25 Stockholm Tel. (08) 13.67.00
Telefax: (08) 618.62.36

SWITZERLAND – SUISSE
Maditec S.A. (Books and Periodicals - Livres et périodiques)
Chemin des Palettes 4
1020 Renens/Lausanne Tel. (021) 635.08.65
Telefax: (021) 635.07.80

Librairie Payot
Service des Publications Internationales
Case postale 3212
1002 Lausanne Tel. (021) 341.33.48
Telefax: (021) 341.33.45

Librairie Unilivres
6, rue de Candolle
1205 Genève Tel. (022) 320.26.23
Telefax: (022) 329.73.18

Subscription Agency - Agence d'abonnement
Naville S.A.
38 avenue Vibert
1227 Carouge Tél.: (022) 308.05.56/57
Telefax: (022) 308.05.88

See also – Voir aussi :
OECD Publications and Information Centre
Schedestrasse 7
D-W 5300 Bonn 1 (Germany)
Tel. (49.228) 21.60.45
Telefax: (49.228) 26.11.04

TAIWAN – FORMOSE
Good Faith Worldwide Int'l. Co. Ltd.
9th Floor, No. 118, Sec. 2
Chung Hsiao E. Road
Taipei Tel. (02) 391.7396/391.7397
Telefax: (02) 394.9176

THAILAND – THAÏLANDE
Suksit Siam Co. Ltd.
113, 115 Fuang Nakhon Rd.
Opp. Wat Rajbopith
Bangkok 10200 Tel. (662) 251.1630
Telefax: (662) 236.7783

TURKEY – TURQUIE
Kültur Yayinlari Is-Türk Ltd. Sti.
Atatürk Bulvari No. 191/Kat. 13
Kavaklidere/Ankara Tel. 428.11.40 Ext. 2458
Dolmabahce Cad. No. 29
Besiktas/Istanbul Tel. 160.71.88
Telex: 43482B

UNITED KINGDOM – ROYAUME-UNI
HMSO
Gen. enquiries Tel. (071) 873 0011
Postal orders only:
P.O. Box 276, London SW8 5DT
Personal Callers HMSO Bookshop
49 High Holborn, London WC1V 6HB
Telefax: (071) 873 8200
Branches at: Belfast, Birmingham, Bristol, Edinburgh, Manchester

UNITED STATES – ÉTATS-UNIS
OECD Publications and Information Centre
2001 L Street N.W., Suite 700
Washington, D.C. 20036-4910 Tel. (202) 785.6323
Telefax: (202) 785.0350

VENEZUELA
Libreria del Este
Avda F. Miranda 52, Aptdo. 60337
Edificio Galipán
Caracas 106 Tel. 951.1705/951.2307/951.1297
Telegram: Libreste Caracas

Subscription to OECD periodicals may also be placed through main subscription agencies.

Les abonnements aux publications périodiques de l'OCDE peuvent être souscrits auprès des principales agences d'abonnement.

Orders and inquiries from countries where Distributors have not yet been appointed should be sent to: OECD Publications Service, 2 rue André-Pascal, 75775 Paris Cedex 16, France.

Les commandes provenant de pays où l'OCDE n'a pas encore désigné de distributeur devraient être adressées à : OCDE, Service des Publications, 2, rue André-Pascal, 75775 Paris Cedex 16, France.

10-1992

OECD PUBLICATIONS, 2 *rue André-Pascal*, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(66 92 11 1) ISBN 92-64-13788-2 - No. 46147 1992