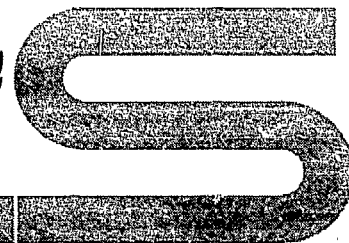


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IAEA ACTIVITIES TO PREPARE SAFETY CODES AND GUIDES  
FOR THERMAL NEUTRON NUCLEAR POWER PLANTS

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INTRODUCTION

The maturing of nuclear power programmes in several IAEA Member States and the rapid increase in the number of States launching nuclear power programmes make it desirable to develop and publish internationally acceptable practices for ensuring safety in these programmes. These are needed to prevent accidents that could expose persons working in nuclear establishments and members of the general public to undue radiological risk.

Some countries already have considerable experience in safety practices, but not all have documented their experience in a form suitable for general use. Many countries, especially developing countries embarking on nuclear power programmes, would benefit from consolidated and co-ordinated recommendations on such practices.

For this reason, the Agency decided two years ago to develop a set of safety recommendations based on national and international codes and guides, and on the practices of Member States. These recommendations would represent

<sup>1</sup> The other Scientific Secretaries for the programme are Mr. W. Dabek, Mr. N. Raisic, Mr. H. Specter and Mr. H. Wright

a standard frame of reference to which the countries could refer to in taking main decisions on nuclear safety of nuclear power plants with thermal neutron reactors.

Two types of documents are being developed: Codes of Practice and Safety Guides. One Code of Practice has been prepared on each of the following topics: Governmental Organization, Siting, Design, Operation and Quality Assurance. A number of Safety Guides in each of these areas will deal in more detail with some aspect of the corresponding Code of Practice. All these documents will be included in the Agency's Safety Standards and will in future normally form part of project agreements between the Agency and Member States concerning nuclear power plants. The manner in which they are written will allow them to be readily transformed into national codes and guides, should a country wish to use them as part of its national regulations.

Close control of a nuclear power programme is essential for safety, and at an early stage in their nuclear programmes most governments choose to establish a regulatory body to undertake the task of control. Much of the Agency documentation is concerned with this Regulatory Body, its power and functions, and with the manner in which the various organizations involved in a nuclear power programme must respond to the requirements it establishes. Other aspects of nuclear safety are also broadly considered in the documents, the primary purpose of the documents being to provide, in the form of recommendations and requirements, answers to safety questions which face the government, the Regulatory Body, operating and other organisations involved in national nuclear power programmes.

The preparation of these documents will not solve all the problems of the countries embarking on a nuclear programme but could represent a very substantial assistance in identifying problems and in establishing minimum requirements for safety and suggesting acceptable methods to achieve them.

## DEVELOPMENT OF THE SAFETY DOCUMENTS

For each topic the Agency has appointed a staff member as Scientific Secretary, and a Technical Review Committee (TRC) composed of ten to twelve experts from various developed and developing Member States and international organizations. The TRC proposes titles and scopes for documents within the area of its mandate and reviews and revises drafts of these documents. A Senior Advisory Group (SAG), composed of highly qualified experts in the nuclear safety field, again from both developed and developing countries and from international organizations, supervises the entire programme and reviews all documents. An Agency scientific co-ordinator is responsible for co-ordination within the various areas of the programme, with other branches of the Agency, and with other international organizations.

The importance of co-ordination between the IAEA programme on development of safety standards for nuclear power plants and between activities of other international organizations was recognized when the programme was launched. For this purpose, participants of the CEC, CMEA, ISO, NEA(OECD), WHO and WMO were included in the Senior Advisory Group and the Technical Review Committees. Direct contact was also established with the Secretariat of the IEC. These measures have to prevent overlapping of IAEA safety documents with related documents of other international organizations.

The main characteristic of the IAEA safety codes and guides is in the fact that they establish general recommendations and minimum requirements to ensure the safety of a nuclear power plant. They contain no concrete standards for design, manufacture or maintenance of power plant components and equipment. It is anticipated that the IAEA safety codes and guides could be further developed into specific standards by the corresponding international organizations.

The procedure for preparing the safety guides has been designed to ensure

that the content of each document is of high technical quality and provides at least the minimum requirements for safety, and

that each document is general enough to be applied to nations in various stages of development and to all the common types of thermal neutron power plants.

The initial step in the preparation of a safety guide, for example, is the TRC's selection of a high priority topic and on which there is a good chance of collecting enough information to develop an acceptable document. The topic and scope prepared by the Technical Review Committee is then submitted for Senior Advisory Group approval.

The next step is to collect all relevant national codes and guides available as well as relevant practices adopted by Member States. To obtain information on these latter, questionnaires prepared by the Scientific Secretary are sent to Member States and international organizations; at the same time any other relevant information is also requested. As a result, the basic material for the preparation of the document comprises:

existing national and international safety codes and guides,  
the completed questionnaires, and  
unpublished reports relevant to the preparation of the documents transmitted in reply to our request.

A small group of experts is then convened who analyze this information to find the common basis behind the different national solutions and prepare a preliminary draft of the safety document taking this information into account.

Each draft is revised in steps, exposing it to comments by an increasingly greater number of experts. In this manner, the draft

progressively acquires the character of a comprehensive document with wide applicability and thus avoids the risk of drastic changes or rejection of the final document.

The first revision of the working group draft is carried out by the Technical Review Committee in a meeting where not only the technical contents of the document are considered, but also its integration and coordination with the other documents already prepared or planned. Members of two or more Technical Review Committees could be involved in the revision of one safety guide when the subject of the guide extends beyond the responsibility of a particular TRC. After this stage, the document is translated as appropriate and sent to the Senior Advisory Group members who make their personal comments and also obtain comments from other experts in their home countries.

If the comments and proposed amendments are very numerous, the document may be recycled to the Technical Review Committee and working group experts for re-working. Otherwise, the document is reviewed and modified in the Senior Advisory Group meeting for transmittal to Member States.

Amendments proposed by Member States are discussed at the Technical Review Committee meeting and incorporated as appropriate in the document. It is then presented once more to the Senior Advisory Group which reviews it and after final approval transmits it to the Director General. Since the complete documents have all gone through such a sophisticated review procedure the Board of Governors of the Agency has authorized the Director General to promulgate all five codes without detailed discussion by the Board provided that no objection are raised by any governor within forty-five days after the documents have been distributed to the governors and made available to all Member States.

The codes and guides prepared in this manner represent the safety requirements and the recommended methods to achieve them at a particular stage of technology. However, nuclear technology develops rapidly and it is foreseen that a procedure for periodically revising the documents will be required. In this connection, the experience of Member States in using the documents will provide an important input for the revision. A proposal for a system of revision will soon be presented by the Secretariat to the Board.

#### STATUS OF THE PROGRAMME

Altogether, five codes and twenty-five safety guides have been drafted by working groups and have reached different stages of development as follows:

##### Governmental Organization

Code: A code of practice that contains recommendations on the governmental organization required for the regulation of the nuclear power plants has already been completed. In particular, the role and responsibility of the regulatory body, its organization, and the regulations to be adopted, the licensing process and the safety assessment of the nuclear power plant are described in this document.

The following safety guides are in the process of being developed in this area.

The first, "The Qualification and Training of the Regulatory Body Staff", presents methods for qualifying and training the staff of the regulatory bodies and for organizing an advisory committee.

The second, "Information to be Submitted in Support of Licensing Applications", recommends the format and the timing of information submitted to the regulatory body at the various licensing stages.

The third, "The Conduct of Regulatory Review and Assessment during the Licensing Process", gives the relationship, and the means of exchanging information between regulatory body and applicant, criteria and methods of safety assessment, and recommendations on the use of non-staff experts, advisory bodies, and on possible international co-operation in safety assessment.

The fourth, "Inspection and Enforcement by the Regulatory Body", deals with the responsibilities involved in conducting inspections and discusses type, method, frequency, and areas of inspections, and the duties of the applicant licensee with regard to these regulatory inspections.

#### Siting

Code: A code providing a basis for selecting a suitable site for a nuclear power plant and for defining the site-related design basis has been completed.

The following safety guides are in the process of being developed in this area.

The first, "Earthquakes and Associated Topics for Nuclear Power Plants", presents methods for evaluating the design basis earthquake and for dealing with related topics such as landslides, liquefaction, tsunami and surface faulting.

The second, "Aseismic Analysis and Testing of Nuclear Power Plants", describes methods for seismic classification of plant items, for load combination and related allowable maximum stress and strain. Recommendations are formulated for performing the seismic analysis and for testing the aseismic characteristics of plant items.

The third, "Meteorology, Climatology, Diffusion and Transport", deals with the methods and measurements used to evaluate dispersion of atmospheric effluent from the plant.

The fourth, "Extreme Meteorological Conditions", deals with the protection of a nuclear power plant against extreme phenomena such as tornadoes and hurricanes and with the definition of the extreme values of meteorological variables needed for the design.

The fifth, "Site Selection and Evaluation for Nuclear Power Plants with Respect to Population Distribution", presents various methods for selecting a site taking into account the population distribution around the proposed location.

The sixth, "Man-Induced Events Related to Nuclear Power Plant Siting", deals with the protection of the plant from events associated with human activities like air-crash, explosions or a hazardous drifting cloud, which could be generated in an industrial environment.

#### Design

Code: A code is in preparation which recommends a basis for ensuring that the design of a nuclear power plant provides adequate safety.

The following safety guides are in the process of being developed in this area.

The first, "Safety Functions and Component Classification for BWR, PWR and PTR", presents criteria for classifying the relevant safety functions as a basis for assigning systems, structures and components to different safety categories.

The second, "Fire Protection in Nuclear Power Plants", deals with methods for detecting fire and protecting the plant, through proper design and operation to mitigate the potential consequences



The third, "Protection Systems in Nuclear Power Plants", deals with methods for establishing the reliability of the protection systems, their design bases and their design verifications.

The fourth, "Protection Against Internally Generated Missiles and their Secondary Effects in Nuclear Power Plants", deals with the general philosophy and methods for protecting the plant against internally-generated missiles and their secondary effects.

The fifth, "Protection Against Man-Induced Events", presents methods for designing the plant to take into account the design basis incident described in a corresponding safety guide being developed in the area of siting.

The sixth, "Ultimate Heat Sink", outlines methods that may be used to ensure that in all conditions the reactor residual heat is removed to proper heat sinks.

The seventh, "Emergency Electrical Systems", establishes methods for designing electrical power supply, systems to cope with anticipated operational transients and accident conditions.

#### Operation

Code: A code has been already completed on the safe operation of nuclear power plants with particular emphasis on the responsibilities of the operating organization.

The following safety guides are in the process of being developed in this area.

The first, "Staffing, Recruitment, Training and Authorization of Operating Personnel", gives recommendations on how to select and train personnel and on the type of authorization to be issued to the staff members who perform functions essential to safety.

The second, "In-service Inspection" gives the objectives, test procedures, types and frequency to be performed by the operating organization together with related administrative and enforcement aspects.

The third, "Operational Limits and conditions", presents the restraints to the operation of the nuclear power plants related to safety. The assumptions and the necessary content of the document, specifying operational limits and conditions, are given, together with administrative requirements.

The fourth, "Commissioning Procedures", outlines methods for commissioning a nuclear power plant, for organizing a site organization, a commissioning programme and review procedures. Recommendations for the related documentation are given.

#### Quality Assurance

Code: A code which deals with the establishment and implementation of a quality assurance programme during all phases of the nuclear power project has nearly been completed.

The following safety guides are in the process of being developed in this area.

The first, "Quality Assurance Programme Preparation for Nuclear Power Plants", deals with documentation bases of quality assurance. It covers such aspects as preparation of quality assurance procedures and instructions.

The second, "Quality Assurance Record System", deals with the preparation, the collection and the disposal of quality assurance records which represent an evidence of quality assurance activities.

programme, and, in addition, there is the translation work both during the development stage and after completion of the review procedure, the editing, and the secretarial work. The total estimate of the work going in this programme is thus the equivalent of about 30 experts working full time.

The high technical level of the documents is due largely to the competence and experience of the working group members who perform the most difficult part of the work in preparing the preliminary drafts of the safety documents. Members of the Senior Advisory Group and the Technical Review Committees also deserve very high appreciation for their hard work during meetings and at home in revising the document. The Agency recognizes with gratitude the great contribution to the programme by all of them. The programme is a great burden not only for the experts but also for the Member States and international organizations concerned that sent voluntarily their highly qualified experts free of charge to the Agency. It seems clear that this support must continue at the present level to ensure that the programme is truly successful, and it is particularly important that comments on the drafts be returned promptly by the Member States since this makes for a smoother development of the programme and gains valuable time in the completion of the documents.

Within the next two or three years five Codes of Practice and a substantial number of Safety Guides will have been prepared and published by the Agency. We believe that they will contribute significantly to the safety of nuclear power plant throughout the world.

The third, "Quality Assurance for Procurement of Items and Services for Nuclear Power Plants", contains recommendations for implementing a quality assurance programme during all phases of procurement activities such as bid document preparation, supplier evaluation, bid evaluation and contract award.

#### COMMENTS ON THE PROGRAMME

The programme has aroused interest among the Agency's Member States, international organization and the experts involved, as evidence the large amount of valuable information and comments received. In general, thirty to forty Member States have sent comments on each document, the number of comments varying from a few to over a hundred.

The quality of the documents appears already to have been demonstrated since most amendments proposed by the Member States have been directed towards clarifying the concepts and no drastic changes in substance have so far been requested. This would imply that the contents are substantially accepted by a large number of experts all over the world.

The work performed by working groups, Technical Review Committees and Senior Advisory Group participants in meetings at IAEA Headquarters amounts to about 400 expert-weeks per year. Comments prepared by the experts at home are estimated to add another 400 expert-weeks of work per year. In addition, twenty to forty Member States and international organizations comment on each document. Estimating that a document is probably studied by an expert for at least a week, this adds another 200 expert weeks of work on the documents. Thus the work performed yearly external to the Agency, is at least 1,000 expert-weeks. Within the Agency nine professional staff members participate in the

