GUIDE NO. AERB/NF/SG/G-2

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GOVERNMENT OF INDIA

AERB SAFETY GUIDE

CONSENTING PROCESS FOR NUCLEAR FUEL CYCLE FACLITIES AND RELATED INDUSTRIAL FACILITIES OTHER THAN NUCLEAR POWER PLANTS AND RESEARCH REACTORS

ATOMIC ENERGY REGULATORY BOARD

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CONSENTING PROCESS FOR NUCLEAR FUEL CYCLE FACLITIES AND RELATED INDUSTRIAL FACILITIES OTHER THAN NUCLEAR POWER PLANTS AND RESEARCH REACTORS

Atomic Energy Regulatory Board
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Orders for this guide should be addressed to:

The Administrative Officer
Atomic Energy Regulatory Board
Niyamak Bhavan
Anushaktinagar
Mumbai-400 094
India

FOREWORD

Activities concerning establishment and utilisation of nuclear facilities and use of radioactive sources are to be carried out in India in accordance with the provisions of the Atomic Energy Act, 1962. In pursuance of the objective of ensuring safety of members of the public and occupational workers as well as protection of environment, the Atomic Energy Regulatory Board has been entrusted with the responsibility of laying down safety standards and framing rules and regulations for such activities. The Board has, therefore, undertaken a programme of developing safety standards, codes of practice and related guides and manuals for the purpose. While some of the documents cover aspects such as siting, design, construction, operation, quality assurance and decommissioning of nuclear and radiation facilities, other documents cover regulation aspects of these facilities.

Codes of practice and safety standards are formulated on the basis of internationally accepted safety criteria for design, construction and operation of specific equipment, structures, systems and components of nuclear and radiation facilities. Safety codes establish the objectives and set minimum requirements that shall be fulfilled to provide adequate assurance for safety in nuclear and radiation facilities. Safety guides elaborate various requirements and furnish approaches for their implementation. Safety manuals deal with specific topics and contain detailed scientific and technical information on the subject. These documents are prepared by experts in the relevant fields and are extensively reviewed by advisory committees of the Board before they are published. These documents are revised, when necessary, in the light of experience and feedback from users as well as new developments in the field.

AERB issued a safety code on 'Regulation of Nuclear and Radiation Facilities', to spell out the minimum safety related requirements/obligations to be met by a nuclear or radiation facility, to qualify for the issue of regulatory consent at every stage leading to eventual operation. This safety guide on the 'Consenting Process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors', provides guidance for reviewing applications for regulatory consent. While elaborating the requirements stated in the safety code, it provides necessary information intended to assist the facilities and to fulfil the requirements stipulated in the code. It also elaborates on the regulatory body's review and approval process of nuclear fuel cycle facilities. This guide apprises the applicant on the details of the consenting process, stages involved, and nature and extent of review.

Consistent with accepted practice, 'shall', 'should' and 'may' are used in this guide to distinguish between a firm requirement, a recommendation and a desirable option, respectively. Annexures, references and list of participants are included to provide information that might be helpful to the user.

For aspects that are not covered in this guide, applicable and acceptable national and international standards, codes and guides should be followed. Non-radiological aspects

of industrial safety and environmental protection are not explicitly considered. Industrial safety is to be ensured through compliance with the applicable provisions of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996.

A working group consisting of AERB staff and other professionals experienced in this field has prepared the safety guide. Experts have reviewed the guide and the relevant AERB Advisory Committee has vetted it before issue.

AERB wishes to thank all individuals and organisations who have prepared and reviewed the draft and helped in its finalisation. The list of experts who have participated in this task, along with their affiliations, is included for information.

(S.K. Sharma)
Chairman, AERB

DEFINITIONS

Accident

An unplanned event resulting in (or having the potential to result in) personal injury or damage to equipment which may or may not cause release of unacceptable quantities of radioactive material or toxic/hazardous chemicals.

Accident Conditions

Substantial deviations from operational states, which could lead to release of unacceptable quantities of radioactive materials. They are more severe than anticipated operational occurrences and include design basis accidents, as well as beyond design basis accidents.

Alara

An acronym for 'As Low As Reasonably Achievable'. A concept meaning that the design and use of sources, and the practices associated therewith, should be such as to ensure that exposures are kept as low as reasonably practicable, with economic and social factors taken into account.

Approval

A type of regulatory consent issued by the regulatory body to a proposal.

Atomic Energy Regulatory Board (AERB)

A national authority designated by the Government of India, having the legal authority for issuing regulatory consent for various activities related to the nuclear and radiation facility, and to perform safety and regulatory functions, including their enforcement for the protection of site personnel, the public and the environment against undue radiation hazards.

Audit

A documented activity performed to determine by investigation, examination and evaluation of objective evidence, the adequacy of, and adherence to applicable codes, standards, specifications, established procedures, instructions, administrative or operational programmes and other applicable documents, and the effectiveness of their implementation.

Authorisation

A type of regulatory consent issued by the regulatory body for all sources, practices and uses involving radioactive materials and radiation-generating equipment (see also 'Consent').

Commissioning

The process during which structures, systems and components of a nuclear or radiation facility, on being constructed, are made functional and verified in accordance with design specifications and found to have met the performance criteria.

Competent Authority

Any official or authority appointed, approved or recognised by the Government of India for the purpose of the rules promulgated under the Atomic Energy Act, 1962.

Consent

A written permission issued to the consentee by the regulatory body, to perform specified activities related to nuclear and radiation facilities. The types of consents are 'licence', 'authorisation', 'registration' and 'approval', and will apply according to the category of the facility, the particular activity and radiation source involved.

Construction

The process of manufacturing, testing and assembling the components of a nuclear or radiation facility, the erection of civil works and structures, the installation of components and equipment and the performance of associated tests.

Contamination

The presence of radioactive substances, in or on a material/the human body or other places, in excess of quantities specified by the competent authority.

Critical Pathway

The dominant environmental pathway through which members of the critical group are exposed to radiation.

Criticality

The 'stage' or 'state' of a fissile material system where a self-sustained nuclear chain reaction is just maintained.

Decommissioning

The process by which a nuclear or radiation facility is finally taken out of operation, in a manner that provides adequate protection to the health and safety of the workers, the public and the environment.

Defence-in-Depth

Provision of multiple levels of protection for ensuring safety of workers, the public or the environment.

Derived Limits

Values of quantities related to the primary or secondary limits by a defined model, such that if the derived limits are not exceeded, it is most unlikely that the primary limits will be exceeded.

Design

The process and results of developing the concept, detailed plans, supporting calculations and specifications for a nuclear or radiation facility.

Design Basis Accidents (DBA)

A set of postulated accidents which are analysed to arrive at conservative limits on pressure, temperature and other parameters, which are then used to set specifications to be met by plant structures, systems and components, and fission product barriers.

Dose Limit

The value of the effective dose, or the equivalent dose to individuals from controlled practices, that shall not be exceeded.

Effect Distance

(See 'Hazard Distance').

Emergency Plan

A set of procedures to be implemented in the event of an accident.

Exposure

The act or condition of being subject to irradiation. Exposure can be either external (irradiation by sources outside the body) or internal (irradiation by sources inside the body). Exposure can be classified as either normal exposure or potential exposure; either occupational, medical or public exposure; and in intervention situations, either emergency exposure or chronic exposure. The term 'exposure' is also used in radiation dosimetry to express the amount of ions produced in air by ionising radiation.

Hazard Distance

Distance upto which any adverse consequence of an accident would be felt.

In-service Inspection (ISI)

Inspection of structures, systems and components carried out at stipulated intervals during the service life of the plant.

Licence

A type of regulatory consent, granted by the regulatory body, for all sources, practices and uses for nuclear facilities involving the nuclear fuel cycle and also certain categories

of radiation facilities. It also means authority given by the regulatory body to a person to operate the above said facilities (see 'Licenced Person' and 'Licenced Position').

Monitoring

The continuous or periodic measurement of parameters for reasons related to the determination, assessment in respect of structure, system or component in a facility, or to control of radiation.

Nuclear Facility

All nuclear fuel cycle and associated installations encompassing the activities from the front end to the back end of nuclear fuel cycle processes, and also associated industrial facilities such as heavy water plants, beryllium extraction plants, zirconium plants etc.

Nuclear Fuel Cycle

All operations associated with the production of nuclear energy, including mining, milling, processing and enrichment of uranium or processing of thorium, manufacture of nuclear fuel, operation of nuclear reactors, reprocessing of irradiated nuclear fuel, decommissioning, and any activity for radioactive waste management and research or development activity, related to any of the foregoing.

Operation

All activities following and prior to commissioning, performed to achieve in a safe manner, the purpose for which a nuclear/radiation facility is constructed, including maintenance.

Operational Limits and Conditions (OLC)

Limits on plant parameters and a set of rules on the functional capability and the performance level of equipment and personnel, approved by the regulatory body, for safe operation of the nuclear/radiation facility (see also 'Technical Specifications for Operation').

Operational Records

Documents such as instrument charts, certificates, log books, computer printouts and magnetic tapes, made to keep objective history of the operation of nuclear/radiation facility.

Prescribed Limits

Limits established or accepted by the regulatory body.

Quality Assurance

Planned and systematic actions necessary to provide the confidence that an item or service will satisfy given requirements for quality.

Radioactive Waste

Material, whatever its physical form, left over from practices or interventions for which no further use is foreseen, (a) that contains or is contaminated with radioactive substances and has an activity or activity concentration higher than the level for clearance from regulatory requirements, and (b) exposure to which is not excluded from regulatory control.

Redundancy

Provision of alternative structures, systems, components of identical attributes, so that any one can perform the required function, regardless of the state of operation or failure of the other.

Regulatory Body

(See 'Atomic Energy Regulatory Board').

Regulatory Consent

(See 'Consent').

Regulatory Inspection

An examination through review of documents, observation, measurement or test, undertaken by or on behalf of the regulatory body during any stage of the regulatory consenting process, to ensure conformance of materials, components, systems and structures, as well as operational and maintenance activities, processes, procedures, practices and personnel competence with predetermined requirements.

Safety Analysis Report

A document, provided by the applicant/consentee to the regulatory body, containing information concerning the nuclear or radiation facility, its design, accident analysis and provisions to minimise the risk to the public, the site personnel and the environment.

Safety Assessment

A review of the aspects of design and operation of a source, which are relevant to the protection of persons or the safety of the source, including the analysis of the provisions for safety and protection established in the design and operation of the source and the analysis of risks associated both with normal conditions and accident situations.

Safety Code

A document stating the basic requirements, which must be fulfilled for particular practices or applications. This is issued under the authority of the regulatory body and mandatory to be followed by the respective utilities.

Safety Guide

A document containing detailed guidelines and various procedures/methodologies to implement the specific parts of a safety code, that are acceptable to the regulatory body, for regulatory review. This is issued under the authority of regulatory body and is of non-mandatory nature.

Safety Limits

Limits upon process variables within which the operation of the facility has been shown to be safe.

Safety Manual

A document detailing the various safety aspects/instructions and requirements, relating to a particular practice or application, that are to be followed by a utility.

Safety Standard

A document similar to a safety code, elaborating upon the various technical requirements that must be met for a particular practice or application, so as to meet the requirements of the code.

Safety System Settings

The levels at which protective devices are automatically actuated in the event of anticipated operational occurrences or accident conditions, so as to prevent safety limits being exceeded.

Site

The area containing the facility defined by a boundary under effective control of the facility management.

Site Evaluation Report (SER)

A document indicating the impact of a nuclear/radiation facility on the environment and the impact of the environment on the same, so as to establish the suitability of the site for safe operation of the facility.

Siting

The process of selecting a suitable site for a facility, including appropriate assessment and definition of the related design bases.

Technical Specifications for Operation

A document approved by the regulatory body, covering the operational limits and conditions, surveillance and administrative control requirements for safe operation of the nuclear or radiation facility. It is also called 'Operational Limits and Conditions'.

CONTENTS

FOREWORD i

DEFINITIONS iii

1. INTRODUCTION 1
   - 1.1 General 1
   - 1.2 Objective 1
   - 1.3 Scope 2

2. CATEGORISATION OF NUCLEAR FUEL CYCLE FACILITIES 3
   - 2.1 General 3
   - 2.2 Categorisation of Facilities 3
   - 2.3 Mining and Milling Licence 3

3. REGULATORY CONSENTING PROCESS 5
   - 3.1 General 5
   - 3.2 Statutory Provisions for Regulatory Consents 5
   - 3.3 Stages of Consenting Process 6
   - 3.4 Regulatory Consenting Procedure 6
   - 3.5 Review and Assessment Methodology 9

4. INFORMATION REQUIREMENTS FOR CONSENTING 13
   - 4.1 General 13
   - 4.2 Site Evaluation Report 13
   - 4.3 Safety Analysis Report/Safety Report 13
   - 4.4 Organisation for Commissioning and Operation 19
   - 4.5 Quality Assurance (QA) Manual 19
   - 4.6 Submissions for Commissioning Activities 19
   - 4.7 Technical Specifications for Operation 20
   - 4.8 Security Aspects 21
   - 4.9 Operational Information and Related Documents 21
   - 4.10 Training and Qualification of Plant Personnel 22
   - 4.11 In-service Inspection and Testing Programme 23
   - 4.12 Quantitative Risk Assessment Report 23
   - 4.13 Commissioning Tests and Reports 23
   - 4.14 Lead Time for Submission of Documents 23

5. REVIEW AND ASSESSMENT BY THE REGULATORY BODY 25
   - 5.1 General 25

5.2 Consent for Site 26
5.3 Consent for Construction 26
5.4 Consent for Commissioning 27
5.5 Consent for Operation 27
5.6 Consenting Decisions 29
5.7 Appeal against Decisions 29

ANNEXURE-1 FORMAT FOR APPLICATION FOR REGULATORY CONSENT 30

ANNEXURE-2 CONTENTS OF SITE EVALUATION REPORT 37

ANNEXURE-3 TYPICAL FORMAT AND CONTENTS OF SAFETY ANALYSIS REPORT FOR REPROCESSING AND WASTE MANAGEMENT PLANTS 40

ANNEXURE-4 FORMAT FOR QUANTITATIVE RISK ASSESSMENT DOCUMENT 47

REFERENCES 48

LIST OF PARTICIPANTS 50

WORKING GROUP 50

ADVISORY COMMITTEE ON PREPARATION OF CODE AND GUIDES ON GOVERNMENTAL ORGANISATION FOR REGULATION OF NUCLEAR AND RADIATION FACILITIES (ACCGORN) 51

PROVISIONAL LIST OF SAFETY CODE, GUIDES AND MANUALS ON REGULATION OF NUCLEAR AND RADIATION FACILITIES 52

1. INTRODUCTION

1.1 General

(i) The safety code on 'Regulation of Nuclear and Radiation Facilities', AERB/SC/G [1], has specified requirements for issue of consents for nuclear fuel cycle facilities from the standpoint of safe operation of such facilities, and protection of the operating personnel, the general public and the environment from radiological and industrial hazards. The code has also outlined the responsibilities of the regulatory body, as well as the obligations of the consentee in respect of safety of these facilities.

(ii) This safety guide on 'Consenting Process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors' provides explanatory details on the review, assessment and consenting process, specified in the safety code. The guide identifies important stages for obtaining the consent for a fuel cycle facility, and the technical documents that are required to be submitted to the regulatory body by the applicant at each stage. The regulatory process of review and assessment of safety of the concerned facility and issue of consent are described in this guide.

1.2 Objective

(i) The objective of this guide is to apprise the applicant on the regulatory requirements in setting up the nuclear fuel cycle facility. These include the regulatory consenting process, the relevant stages requiring consent and the nature of submissions at each stage and the extent of safety review by the regulatory body.

(ii) The guide enables the applicant to plan the actions and submissions in advance. The regulatory body, on review of the comprehensive information submitted by the applicant would assess the:

(a) suitability of the site for locating the facility,

(b) the plant design and safety features incorporated for safe operation of the plant,

(c) the safety measures for mitigating the consequences of design basis accidents, and

(d) the plant's security features in order to reduce risk of unauthorised removal of radioactive material, to minimise sabotage on the facility and to minimise the risk of adverse impact during above acts.

(iii) The guide also gives information on the methods of review and assessment adopted by the regulatory body.

1.3 Scope

(i) This safety guide explains in detail the regulatory consenting process at major stages in the setting up of a nuclear fuel cycle facility.

(ii) The review aspects during continued operation, including renewal of consent and decommissioning of the facility at the end of its useful service life, are not covered in this guide.

(iii) The consenting process for nuclear power plants and research reactors is given in AERB/NPP/SG/G-1 [2]. Hence it is not covered in this guide.

2. CATEGORISATION OF NUCLEAR FUEL CYCLE FACILITIES

2.1 General

(i) The nuclear fuel cycle comprises of all plants/activities, related to mining, milling, refining, conversion, enrichment, fuel fabrication, reactor operation for research or generation of electricity, spent fuel reprocessing, recycling of fuel and the associated nuclear waste management in all these activities.

(ii) In the context of the Indian nuclear programme, a few other activities, though not really part of the fuel cycle, such as handling or processing of prescribed substances, notified under the Atomic Energy (Working of Mines, Minerals, and Handling of Prescribed Substances) Rules, 1984 [3] are also brought under regulatory control and hence this guide also deals with such activities.

2.2 Categorisation of Facilities

(i) A broad categorisation of the nuclear fuel cycle facilities under the scope of this guide for regulatory control is listed below.

- (a) Uranium/Thorium mining and processing including uranium enrichment
- (b) Heavy minerals mining and processing
- (c) Uranium/Thorium fuel fabrication
- (d) Heavy water production
- (e) Spent fuel reprocessing
- (f) Plutonium recycling/fuel fabrication
- (g) Zirconium, Beryllium extraction and processing
- (h) Nuclear/chemical waste management
- (i) Isotope handling/processing

(ii) Facilities set up with the objective of research and development, special investigations, pilot plants for process development or feasibility studies, will also require regulatory consents.

2.3 Mining and Milling licence

A licence for mining activity is required to be obtained from the Indian Bureau of Mines under the Mines Act and Rules. Mining lease is granted by the Department of Geology and Mines of the respective State Government. Licence

is required to be obtained from the Department of Atomic Energy under the Atomic Energy (Working of Mines, Minerals and Handling of Prescribed Substances) Rules, 1984 as per the latest notification on 'Prescribed Substances' on case to case basis. Licence for mining and milling of uranium, thorium and heavy beach sand minerals is required to be obtained from the Atomic Energy Regulatory Board (AERB) under the Atomic Energy (Radiation Protection) Rules, 2004. Radioactive waste discharges are governed by the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987. Hence, authorisation should be obtained at relevant stages from AERB with respect to radioactive waste discharge.

3. REGULATORY CONSENTING PROCESS

3.1 General

(i) The regulatory consenting process begins with the safety review of the proposal submitted by the applicant for setting up a nuclear fuel cycle facility and the related technical documents, as specified by the regulatory body.

(ii) Consents in the form of authorisation or licence, as appropriate, are issued by the regulatory body at various major stages of establishment of the facility (siting, construction, commissioning, operation and decommissioning), subject to the facility's location, design and operation, fulfilling the safety objectives and requirements as specified in the relevant rules, codes and guides and stipulated by the regulatory body.

(iii) The regulatory consent at important interim stages of establishment of the facility shall be in the form of authorisations, and the final consent for regular operation of the facility for a specified period, shall be in the form of a licence.

(iv) Application for consent at each stage is to be submitted in the prescribed form. This section is aimed at elaborating the above aspects of the regulatory consenting process.

(v) Consent for transport of radioactive materials/packages, including radioactive waste arising during operation of the fuel cycle facility shall be in the form of an approval, issued by the regulatory body.

3.2 Statutory Provisions for Regulatory Consents

3.2.1 The statutory bases for issuing regulatory consents for the nuclear fuel cycle facilities, are the enabling provisions in the Atomic Energy Act 1962 [4] and the various rules issued thereunder, which include:

(i) The Automic Energy (Radiation Protection) Rules 2004 [5] provide for the issuance of a licence by the competent authority for handling of radioactive substances.

(ii) The Atomic Energy (Safe Disposal of Radioactive Wastes) Rules 1987 [6] provide for the issuance of an Authorisation from the competent authority for disposal of radioactive wastes, or transfer of radioactive wastes, to an approved waste management agency.

(iii) The Atomic Energy (Factories) Rules 1996 [7], issued for administering the provisions of the Factories Act 1948 in the nuclear facilities, also prescribe an Approval by the competent authority for using any premise for the purposes stated in the Atomic Energy Act 1962.

(iv) The Atomic Energy (Working of Mines, Minerals and Handling of Prescribed Substances) Rules 1984 [3] empower the competent authority to prescribe procedures for maintenance of radiation exposures and medical records of the workers, and to approve emergency plans as well as industrial safety aspects.

3.2.2 All the above rules are applicable to nuclear fuel cycle facilities. The competent authority/the regulatory body verifies and enforces compliance with the provisions of the above rules in setting up and operating a fuel cycle facility under its consent.

3.2.3 However, the Department of Atomic Energy issues licence for operation of mines and plants handling minerals and prescribed substances. Consents from other statutory agencies such as Ministry of Environment and Forests (MoEF) and the Central and State Pollution Control Boards are to be obtained as required.

3.3 Stages of Consenting Process

3.3.1 The major stages at which consents are required from the regulatory body for nuclear fuel cycle facilities are as follows:

(i) Siting

(ii) Construction

(iii) Commissioning

(iv) Operation

(v) Decommissioning

3.3.2 The consenting process involves a continuous safety review/ evaluation of the facility progressing through all the above stages. The inventory and toxicity of the radioactive materials or hazardous chemicals vary widely in different facilities of the nuclear fuel cycle. Consequently, the potential hazards, in terms of radiation/chemical exposures within the plant and environmental effects from releases under normal and accidental conditions, are also vastly different in magnitude. In view of this, the regulatory body may combine two or more stages of consent into a single consent in the case of low hazard potential facilities and carry out the safety assessment accordingly.

3.4 Regulatory Consenting Procedure

3.4.1 General

A consent is an official document which:

(i) allows a specified activity or set of activities dealing with siting, construction, commissioning, operation or decommissioning of a nuclear fuel cycle facility;

(ii) prescribes requirements and conditions governing the performance of these activities; and

(iii) where appropriate, specifies time limits on the validity of the consent.

The applicant shall submit an application for consent at each stage in the prescribed format (as given in Annexure-1).

3.4.2 Consent for Siting

(i) The consent at the first major stage, namely siting, involves the review of the safety aspects based on the conceptual design (or actual design, if available) of the facility and the site characteristics that have been considered for the location of the facility at the specified site.

(ii) The applicant is required to submit to the regulatory body a site evaluation report (SER). The SER should include:

(a) Salient features of the proposed site

(b) Site characteristics affecting safety

(c) Impact of the facility on the environment

(iii) The scope and contents of SER are indicated in Annexure-2.

(iv) Based on the above assessment, consent for locating the facility on the proposed site is issued.

3.4.3 Consent for Construction

(i) The consent at the second major stage viz, construction, involves review of the safety aspects as presented in the safety analysis report[1] (SAR)/safety report (SR) for the facility that has to be submitted by the applicant. Typical format and content of safety analysis report for reprocessing and waste management plants are given in Annexure-3 and for other plants in AERB/SG/IS-2.

(ii) The applicant should also submit job hazard analysis report identifying the jobs for which job hazard analysis has been done during construction.

(iii) Security features to be implemented in order to reduce risk of unauthorised removal of nuclear material, to minimise sabotage on the facility and to minimise the risk of adverse impact during above acts are to be delineated.

[1] SAR in this guide is same as SR in AERB/SG/IS-2

(iv) The above documentation requirements apply strictly to facilities with a hazard potential of large magnitude and plants handling highly toxic radioactive materials and chemicals such as fuel reprocessing plants, plutonium based fuel fabrication plants, high level waste immobilisation plants, heavy water plants.

(v) In the case of fuel cycle facilities, handling less hazardous materials such as mineral processing plants, natural uranium handling facility, etc., the regulatory body may relax, as considered necessary, the documentation requirements for the construction consent.

3.4.4 Consent for Commissioning

(i) The consent at the third major stage, namely, commissioning of the fuel cycle facility, may be issued in several interim stages, particularly for the highly hazardous facilities, as stated earlier. The interim stages of commissioning will vary widely depending on the type of the fuel cycle facility, its process flow sheet, inventory and toxicity of radioactive or other materials handled in the facility.

(ii) For plants such as fuel reprocessing plant, uranium mill/processing plant, the consent for commissioning may be issued separately for the different sections of the plant, in a sequence appropriate to the flow of process materials.

(iii) Cold commissioning with inactive materials is generally practised in most of the fuel cycle facilities and results of cold commissioning are reviewed before giving consent for hot commissioning with radioactive materials.

(iv) The applicant should submit for review, the schedule for commissioning, technical specifications for operation, radiation protection procedure manual, in-service inspection manual and emergency preparedness plans.

3.4.5 Consent for Operation

(i) The consent for the fourth major stage is for operation of the facility. The consent may initially be restricted to operation of the facility to process only a limited quantity of the feed material and/or for a limited period, in order to gain operating experience, or for test production of the end product to verify the quality and grade. This may also enable the consentee to rectify deficiencies, such as malfunctioning of equipment, off-grade final product, leakages from systems, etc.

(ii) Issue of a consent for operation of the facility for a limited period with stipulation, may also be considered by the regulatory body, in the event of the applicant not implementing certain recommendations, which do not, however, affect the safety of the plant, its personnel and the environment.

(iii) On establishing satisfactory and safe operation of the entire plant as per design intent, the plant will be issued with consent for regular operation and production at rated capacity. For these consents, the applicant has to submit detailed reports on the commissioning tests and also a safety analysis report (SAR)/safety report (SR) reflecting the as-built design, approved by the regulatory body.

(iv) The consent for regular operation is issued specifying a validity period after which it may be renewed on the basis of a regulatory review of the plant for safe performance.

(v) During regular operation of the facility for production, safety reviews are carried out by the regulatory body periodically, to ensure that the facility is being operated in accordance with the stipulations made in the consent and also the procedures outlined in the documents submitted to the regulatory body.

(vi) Modification to the process, plant design and operating procedures, having a bearing on safety and relevant to the consenting process, requires approval by the regulatory body.

(vii) Modification may also include augmentation, expansion, life extension, etc. Relevant documents on the modification, together with justification and safety implication, should be submitted to the regulatory body for safety review and assessment.

3.4.6 Renewal of Consent for Operation

The review requirements for renewal will be specified by the regulatory body depending on the type of the plant. The key elements for this review are:

- safety performance of the plant
- safety related unusual occurrences
- violations of technical specifications
- personnel exposures
- environmental releases

3.4.7 Consent for Decommissioning

(i) At the end of the service-life of the fuel cycle facility, decommissioning is envisaged. Guidelines for decommissioning of nuclear facilities are given in the AERB safety manual on Decommissioning of Nuclear Facilities (AERB/SM/DECOM) [8].

3.5 Review and Assessment Methodology

3.5.1 Three Tier Review and Methodology

(i) Safety in siting, design, construction, commissioning, operation and

decommissioning of fuel cycle facilities is ensured primarily through regulatory actions, which include grant of consents with appropriate stipulations for implementation by the applicant.

(ii) The regulatory body performs these functions through a process of safety review and assessment, aided by regulatory inspections and enforcement of safety requirements.

(iii) In general, a three-tier review process is followed by the regulatory body before any major stage is granted consent for the nuclear fuel cycle facility.

3.5.2 Review by Project Safety Review Committee (PSRC)/ Unit Safety Committee (USC)

(i) The first level of review is by the PSRC, constituted by the regulatory body for a specific project, or by the USC upon submission of an application and request for consent by the applicant. The Committee is composed of experienced scientists and engineers, who have the necessary expertise in different safety disciplines for review of the project.

(ii) The PSRC/USC reviews the specified documents submitted by the applicant right from the siting stage till the final operating stage at rated capacity of the plant. The PSRC/USC may at its discretion, get the review and assessment carried out by specialist working groups possessing the requisite expertise.

(iii) The PSRC and its working groups or USC may seek clarifications, supplementary submissions and presentations from the applicant and may also conduct site inspections to verify the implementation of the undertakings given by the applicant, as well as the recommendations made by the safety committee.

(iv) In addition, findings from the regulatory inspections and assessments made by dedicated teams of the regulatory body will be taken into consideration by the PSRC/USC. The recommendations of PSRC/ USC are submitted to regulatory body for further review.

3.5.3 Review by Advisory Committee for Project Safety Review (ACPSR) / Safety Review Committee for Operating Plants (SARCOP)

(i) The second level of review is conducted by an ACPSR or SARCOP. This committee is also constituted by the regulatory body with experts drawn from other technical organisations of the government, academic and research institutions as well as from the regulatory body itself.

(ii) The ACPSR/ SARCOP reviews the project taking into consideration the safety review and assessment of the PSRC / USC.

(iii) The review also covers the unresolved safety issues put forth by the PSRC/ USC, if any. The recommendations are submitted to the regulatory body.

3.5.4 Review by Regulatory Body

(i) The third and final review is by the regulatory body, which is the designated consenting authority for all nuclear fuel cycle facilities. The head of the regulatory body is the competent authority, designated under the various rules promulgated under the Atomic Energy Act 1962, for issuance of consents.

(ii) The competent authority considers the recommendations of the ACPSR/SARCOP and decides on the issue of consent for the appropriate activity/stage of the fuel cycle facility.

(iii) The consent may prescribe requirements and conditions governing the performance of the activity and may also specify a time limit on its validity, thereby requiring the consentee to apply for a renewal of the consent on its expiry.

(iv) In the event of denial of the consent by the competent authority, the applicant may submit a revised proposal, meeting the specified requirements of the regulatory body.

(v) The applicant or his designated representative(s) should interact closely with the regulatory body and its safety review committees for timely submission of the documents at different consenting stages and thereby expedite the consenting process.

(vi) The applicant and/or his representative may be required to participate in the deliberation of the safety committees, mainly with a view to providing necessary clarifications and also supplementary submissions, as needed for the review.

3.5.5 Deviations in Review Process

(i) The nuclear fuel cycle facilities as listed in section 2 are widely varying in the nature of process and quantities of radioactive and toxic chemicals handled. In view of this, the potential for hazardous situations within the plant and in off-site environment, also varies.

(ii) The regulatory body may adopt a slightly different approach for safety review and assessment of less hazardous facilities (e.g., mineral separation plants, natural uranium processing and natural uranium fuel fabrication plants etc). The three-tier review process, as stated above, may be retained only for the highly hazardous facilities of the nuclear fuel cycle (e.g., spent fuel reprocessing plants, heavy water plants etc).

(iii) For the less hazardous facilities, which are not complex in nature, the regulatory body may constitute only a PSRC or an ACPSR for the detailed review. The PSRC or the ACPSR may still get the review and assessment carried out by specialist working groups, as stated earlier.

(iv) The PSRC/USC or the ACPSR/SARCOP will forward its recommendations to the regulatory body for considering issuance of a regulatory consent. Thus the modified scheme envisages a two-tier review process for less hazardous facilities of the nuclear fuel cycle.

4. INFORMATION REQUIREMENTS FOR CONSENTING

4.1 General

(i) Information that is required to be submitted in support of the application for consent should cover comprehensively all aspects of safety in siting, design, construction, commissioning and operation of the fuel cycle facility under all conditions, viz., normal operation, anticipated mal-operations and accident conditions. It should also address the security system envisaged in the facility.

(ii) Additional information in respect of subsequent modifications having a bearing on safety shall also be furnished to the regulatory body.

(iii) Submission of various documents and the consenting stage at which they are required are identified in this section. Guidance on the contents of these documents is also provided.

4.2 Site Evaluation Report

(i) The site evaluation report (SER) forms the main document for review by the regulatory body in respect of siting clearance. A general description of the facility followed by information relating to the site, with particular emphasis on factors important to radiation/ environmental safety and emphasising those site characteristics, which may influence the design and operation of the facility, should be provided. Information regarding the interaction of the facility and the environment should also be provided.

(ii) The SER should specify the exact location of the fuel cycle facility and provide a description of the geographical, demographic, meteorological, hydrological, geological and seismological characteristics of the site and surrounding areas.

(iii) Ecological data for the site should also be furnished for assessment of the environmental/radiological impact of the nuclear facility. Information furnished should be adequate to permit an independent evaluation of the suitability of the site for locating the facility.

(iv) The guidelines on the contents of SER are given in Annexure-2.

4.3 Safety Analysis Report/Safety Report

(i) The regulatory consent for the construction phase of the fuel cycle facility requires the submission of safety analysis report (SAR)/safety report (SR). The safety report forms the principal document for the regulatory body to determine whether the operation of the fuel cycle facility under review will result in unacceptable radiological, chemical

and industrial hazards/ risk to the plant/ site personnel, the public and the environment.

(ii) Guidelines for preparing the safety report (SR) for industrial plants other than NPPs and RRs are given in the AERB safety guide AERB/ SG/IS-2.

(iii) A typical Table of Contents of the SAR for reprocessing and waste management plants is presented in Annexure-3.

(iv) Some of the important aspects that are required to be included in the SAR are elaborated in the following sections.

(v) In addition the regulatory body may ask for additional information to facilitate review of SAR.

4.3.1 Provisions against Criticality Hazards

The SAR should contain the criticality safety aspects of the plant, if applicable, and how it is achieved along with calculations and results. Criticality safety design calculations should consider the following:

(v) use of validated codes for safety assessment

(vi) all foreseeable mal-operating conditions

(vii) neutron interaction between equipment/fissile units, material compatibility

(viii) provision of adequate safety margin.

4.3.2 Radiation Protection and Monitoring

(i) The applicant should provide information on radiation safety provisions in the design of the facility and management/administrative procedures established for the purpose of radiation protection of plant personnel.

(ii) Estimation of radioactive source strength during the operation of the facility and the associated dose rates in plant areas, and methods used for computing the estimates should be presented. Adequacy of radiation shielding, wherever provided to bring down the radiation levels, should be substantiated.

(iii) Demarcation of plant areas into different zones with regard to the potential for radioactive contamination of area or air and measures available for contamination control should be explained. Features of the plant ventilation system design from the standpoint of control of air activity should also be presented.

(iv) Details on radiation protection staff organisation and the radiation protection programme should be furnished. The programme should

cover personnel monitoring for external and internal exposures, installed and portable area monitoring and air monitoring systems with alarm provisions, activity measuring instruments with detection limits and other radiation survey instruments.

(v) Details should be furnished on personnel protective equipment, change-room facilities, personnel and equipment decontamination facilities, provision for medical examination of plant staff and medical management of exposed workers.

(vi) Description of the monitoring systems provided for gaseous and liquid effluents discharged from the facility should be furnished.

(vii) Pre-operational base line data on background radiation/radioactivity level of site and environment should be established. Details of the environmental monitoring programme covering radioactivity measurements in various environmental matrices, and background radiation survey and assessment of the impact of the facility on the environment should be included.

4.3.3 Chemical Hazards

(i) Applicant should describe the precautionary steps to be followed in the handling, transport and storage of hazardous chemicals [9]. Design details of the storage of hazardous chemicals ensuring adequate margin of safety, maximum quantity that can be stored and distance to be maintained between two storage areas/tanks, should be presented.

(ii) For storage capacity exceeding the threshold quantity specified in the relevant rules [9], safety provisions such as pressure relief system, draining arrangement, isolation of the vessel/tank, alarm system for high level/high temperature/high pressure and standby empty tank, should be described. Safety data sheets should be annexed for all the hazardous chemicals handled in the plant.

(iii) Hazard control measures that are to be adopted in the facility should be described. For hazardous chemicals present in the form of dust, fumes and sprays in the working environment, engineering measures taken to control them are to be described. Personal protective equipment that are required should be specified.

(iv) System for monitoring the concentration of hazardous chemicals, temperature, humidity, etc., in the working environment should also be described. Provisions for routine monitoring of the environment around the plant for hazardous chemicals should be explained.

(v) Reactive materials (K, Na, H_2) handled and runaway reactions encountered in the process, if any, and incorporated safety features should be mentioned.

(vi) Preventive measures to avoid internal contamination of working personnel by ingestion, inhalation or by skin contact are to be described. Procedures for safe handling of spillages should be explained.

(vii) Details regarding health surveillance of workers in respect of hazardous chemicals should be presented.

(viii) For facilities like heavy water plants, handling large quantities of hazardous chemicals, a detailed quantitative risk assessment (QRA) should be provided. This should include hazard identification, consequence analysis, risk estimation and hazard control.

4.3.4 Fire Safety

(i) Design provisions for fire safety such as fire detection, fire barriers, etc., should be detailed. Fire rating of the plant should be assessed. Fire hazard control system for solvents, flammables and volatiles should be described.

(ii) Details on fire fighting provisions for the plant such as portable fire extinguishers, fire tenders, fire hydrant system, fire water reservoir with source of supply, emergency power, etc., should be furnished.

(iii) The standards for fire protection are given in the AERB safety document 'Standards for Fire Protection Systems of Nuclear Facilities (AERB/S/IRSD-1)' [10].

4.3.5 Industrial Safety during Construction

The following documents on industrial safety for the construction phase, as applicable, should be submitted.

(a) Job Hazard Analysis Report

This report should include the following:

- Main activities/tasks
- Sub-activities
- Hazards associated with activity/task including cause and consequence analysis
- Actions and action plans to prevent/control/mitigate the hazards

(b) Construction Safety Management Manual

This manual should include in detail the following:

- Safety policy, organisation chart and responsibilities for departmental personnel as well as for contractors (principal contractor should be held responsible for sub contractors)

- Safety manpower qualifications, experience, training and competency to perform assigned duties
- Job safety procedures to prevent/control hazards due to activities of various agencies at site
- Job control/work permit system
- Job inspection/supervision and enforcement methodology, agencies and accountability
- Accident reporting and investigation system

(c) Supporting Documents for Industrial Safety during Construction

These include the following:

(1) Procedures for controlling the movement of earth moving machinery, concrete mixing and pouring system, lifting machinery

(2) Procedures for carrying out inspection of excavation activities

(3) Procedures for carrying out inspection of concrete handling, mixing, pouring, form work/shoring activities

(4) Procedures for carrying out inspection of rigging operations, platforms, stair cases, ladders and ramps, working at heights, welding and cutting and supporting

(5) Control measures to prevent cave-in, land slide, water accumulation, run-off due to rain, loose excavated material falling/rolling, etc.

(6) Control measures to prevent failure of formwork/shoring

(7) Control measures to prevent fall of personnel/material from height

(8) Safety training procedure/manual for departmental/ contractor's personnel

(9) Test certificates for all lifting machinery, lifting tools and tackles

(10) Safety work permit procedures for blasting, excavation, concrete handling activities, all erection activities especially involving heights, etc.

(11) List of competent persons under various sections of the Factories Act, 1948

(12) Certification of concrete handling, mixing, pouring and form work/shoring by a competent civil/structural engineer

(13) Certification of platforms, scaffoldings, rigging methods, hand tools and powered tools by a competent engineer

(14) Fire order

(15) Measures with respect to electrical safety.

4.3.6 Management of Radioactive and Chemical Waste

(i) The applicant should provide information on anticipated sources of wastes and system design provided to maintain control over their generation.

(ii) The estimated maximum and average volumetric rates of accumulation of the various forms of waste, their categorisation, identification of sources, estimated isotopic contents and activity concentrations should be given.

(iii) The selected method of disposal for each category of radioactive wastes should be given.

(iv) In the case of gaseous and liquid wastes discharged to the environment, the radiation dose apportionment to the public and the derived limiting radioactivity concentration in the discharged streams and release rates should be presented.

(v) Chemical wastes, gaseous, liquid and solid, should be categorised as toxic and non-toxic wastes, and the measures provided to control their generation within design limits, should be indicated.

(vi) Appropriate limits for the discharge of toxic gaseous and liquid chemical wastes should be established based on relevant Acts and Rules; viz., the Water (Prevention and Control of Pollution) Act 1974; the Air (Prevention and Control of Pollution) Act 1981; Environmental Protection Rules, 1986 and the Hazardous Waste (Management and Handling) Rules 1989, amended in 2003.

(vii) Systems for monitoring and surveillance of the discharge/disposal activities should be described.

(viii) The following information should be provided in respect of both radioactive and hazardous chemical wastes.

(a) Description of the plant ventilation, confinement, filtration and dust collection systems, stack details, specifications and locations of such systems; type and concentration of effluents discharged, efficiency of the systems;

(b) Liquid effluent management including collection, storage, processing, transfer/transport and discharge;

(c) Collection, processing, packaging, assaying, transport, storage and disposal facilities for solid waste.

4.4 Organisation for Commissioning and Operation

(i) The organisational structure of the personnel for commissioning and operating stages of the facility, with designations and required qualifications and allocation of responsibilities should be furnished by the applicant.

(ii) The adequacy of the manpower and technical training for specified activities should be dealt with in the submission.

(iii) In addition to the above, organisational arrangements for radiological protection and industrial safety, in-service inspection, maintenance and testing of equipment and components should be provided.

(iv) The applicant should also identify the team of qualified personnel, who will conduct in-house safety review of commissioning and operating stages of the facility.

4.5 Quality Assurance (QA) Manual

(i) The QA manual for construction and operation should be prepared. Implementation of the QA manual should ensure that the quality of the work is as per the requirements of approved documents and practices in the nuclear industry.

(ii) The QA manual should emphasise the plant management's policy on achievement of quality in all activities including the organisational structure, management functions and responsibilities.

(iii) The manual should include information on quality assurance plans, specific to each phase of the project, qualification of the process and equipment, non-conformance control and corrective actions, internal audit and verification, maintenance of QA records and retrieval etc.

(iv) The QA programme should cover in particular all safety related structures, systems and components.

4.6 Submissions for Commissioning Activities

Commissioning schedule should be submitted to the regulatory body comprising all the commissioning activities.

(i) A comprehensive commissioning programme should be prepared for the testing of the components and systems after their erection/ construction in order to demonstrate that they are in accordance with the design intent and meet the required performance criteria.

(ii) The programme should also include suitable testing of systems of safety significance such as shielding integrity, ventilation system, activity containment, effluent lines, criticality alarm systems.

(iii) For heavy water plants, scram and dump system and flare stack system should also be tested. The programme should lay down clearly defined procedures for the test runs of the plant.

(iv) The test runs prescribed, for example, for U/Th/Pu based fuel cycle facilities and heavy water plants are as follows:

Facility	Commissioning Tests/ Runs
(i) Uranium /Thorium fuel fabrication Plants	(a) Inactive tests (cold) (b) Active tests (with U/Th)
(ii) Pu based fuel fabrication Plants	(a) Inactive tests (cold) (b) Active tests (with fresh natural uranium) (c) Active tests (with Pu)
(iii) Reprocessing Plants	(a) Inactive runs (with Acid/TBP) (b) Cold runs with fresh natural uranium (c) Active runs with irradiated uranium
(iv) Heavy Water Plants	(a) Nitrogen-water cold run (b) Film formation/passivation (H_2S based plants)

4.7 Technical Specifications for Operation

(i) The applicant should submit technical specifications containing the operational limits and conditions for the safe operation of the facility. The specifications should aim at prevention of situations, which might lead to an accident condition. Despite this, should an accident situation occur, the specifications should cover mitigation of the consequences.

(ii) Operational limits and conditions should comprise the following.

(a) Safety limits

(b) Safety system settings

(c) Limiting conditions for operation and

(d) Surveillance requirements, in-service inspection, maintenance and periodic testing.

(iii) The governing bases for each of the technical specification should be substantiated by giving the reasons for its adoption. The technical and administrative procedures/methods employed to deal with situations when the operational limits/conditions are violated, should be described and justified.

(iv) Qualifications established as pre-requisites for key positions in the operating organisation and also the minimum number of trained personnel for such key positions should be laid down in the technical specifications.

(v) The procedures to report violation of technical specifications and safety related unusual occurrences to the regulatory body should be stated in the document.

4.8 Security Aspects

The applicant should submit on a confidential basis details of physical protection system to ensure that:

- suitable technical and administrative steps will be taken in order to prevent persons from carrying out unauthorised actions, which could jeopardise safety, whether wilfully or otherwise,
- arrangements are made whereby only persons, vehicles and materials authorised in accordance with the written procedures are at the site,
- effective provision is made to detect and assess any violations of the security arrangements,
- provision has been made for proper liaison with competent authority, and
- a methodology has been established for training of security personnel.

The applicant should submit a manual on the security system comprising the above.

4.9 Operational Information and Related Documents

(i) A document on the structure of the plant organisation and division of the responsibilities should be prepared and this should include the following aspects:

(a) functional description of the structure of the plant management

(b) qualification of personnel assigned to key positions in the plant management

(c) the lines of responsibility and authority for both operation and safety

(d) number of personnel to be assigned to different activity groups including radiation safety, industrial safety surveillance and environmental monitoring/surveys.

(ii) The applicant should confirm the availability of the following manuals for purposes of training, familiarisation and reference:

(a) operating procedures covering normal operation, anticipated mal-operations and emergency situations

(b) maintenance

(c) in-service inspection

(d) periodic testing

(e) handling, storage and transport of fissile/ radioactive materials

(f) handling, storage and transport of hazardous chemicals

(g) radiation protection

(h) radioactive waste management

(i) other hazardous waste management

(j) industrial safety

(k) standing fire order.

(iii) The applicant should also submit information on the plans for handling radiation emergencies or emergencies caused by large-scale release of hazardous chemicals. The details should include emergency organisation, training, notification procedures, emergency facilities, emergency preparedness and action plans for on-site and off-site conditions.

(iv) The emergency preparedness manual should be prepared as per AERB safety guidelines AERB/SG/EP-1, EP-2, EP-3 and EP-4 [11, 12, 13, 14] for nuclear and non-nuclear facilities.

4.10 Training and Qualification of Plant Personnel

A training manual should be prepared and submitted.

(i) Training of staff is compulsory for all fuel cycle facilities. The operating organisation should have a scheme to provide initial training and later retraining at appropriate intervals.

(ii) This scheme should also include training on radiological protection where necessary. The operators should be trained not only for normal operation but also for the operation of the plant under emergency conditions.

(iii) The applicant should provide details of the training and if applicable, licensing/certifying programmes for the operating and maintenance personnel at different levels and also the minimum qualification for these levels. The required number of personnel trained, qualified and licensed, where applicable, should be available during commissioning and operation of the plant.

A document on licensing operating personnel (if required by the regulatory body) should be submitted.

4.11 In-service Inspection and Testing Programme

The in-service inspection (ISI) and testing programme should provide the status of the quality of safety related components. The information on ISI should bring out the in-built provisions, inspection techniques, frequency of inspection and acceptance criteria. In-service inspection manual should be submitted.

4.12 Quantitative Risk Assessment Report

Quantitative risk assessment report comprising of identification of hazards and analysis (ref. Annexure-4) should be submitted.

4.13 Commissioning Tests and Reports

A report on the commissioning activities carried out and the tests and results obtained should be submitted.

4.14 Lead Time for Submission of Documents

(i) Considering the period required for the regulatory body for review and assessment of the documents submitted by the applicant for the different consenting stages, the lead time for document submission for a large scale green site project is indicated below. However, for a smaller project in the existing sites a shorter lead time will be indicated by the regulatory body in a case to case basis.

Sl. No.	Consenting Stages	Documents to be submitted	Lead time (months)	Para in Text
1	Siting	Site Evaluation Report	6	4.2
2	Construction	Safety Report/ Safety Analysis Report	6	4.3
		Job Hazard Analysis Report	3	4.3.5
		QA Manual for construction	3	4.5
3	Commissioning	Technical Specifications	4	4.7
		Commissioning Schedule	3	4.6
		Radiation Protection Procedure Manual	2	4.3.2
		Document on Licensing Operating Personnel (where AERB is required to license)	1	4.10

Sl. No.	Consenting Stages	Documents to be submitted	Lead time (months)	Para in Text
4	Operation	QA Manual for Operation	3	4.5
		Commissioning Tests and Results	1	4.13
		Technical Specifications with Revisions, if any (Final version)	1	4.7
		Operation and Maintenance Manual	2	4.9
		Training Manuals	2	4.10
		Manual on Security System	4	4.8
		Quantitative Risk Assessment Report	6	4.12
		Revised Safety Report/ Safety Analysis Report	1	4.3

(ii) The above lead times are only indicative. The regulatory body and the applicant may jointly arrive at a schedule of submissions based on the project schedule. The regulatory body may seek from the applicant additional information that may be required as the project review is in progress, such as technical reports, validating calculations and methodologies, R & D work related to the process in use and experience at similar facilities elsewhere.

(iii) The documents on emergency preparedness plans and in-service inspection manual should be available before commissioning of the facility.

(iv) Other necessary manuals/procedures e.g. waste management manual etc. should be available prior to commissioning of the facility.

(v) The regulatory body may demand the submission of any other supporting document which may be needed during the consenting process.

5. REVIEW AND ASSESSMENT BY THE REGULATORY BODY

5.1 General

(i) The review and safety assessment of a new project is performed by the regulatory body, based on the technical documents submitted in support of the application for regulatory consent. The review enables the regulatory body to arrive at appropriate decisions regarding the acceptability of the site as well as, the nuclear fuel cycle facility from considerations of safety. The review and assessment takes into account the safety objectives and requirements specified by the regulatory body in the relevant safety codes and guides and rules issued by the government.

(ii) The safety objectives are primarily related to the protection of the plant personnel, the general public and the environment. During normal operation of the facility, the radiation exposures to the personnel within the plant and the site, and exposures to the public from the routine environmental release of radioactive materials from the plant should be kept as low as reasonably achievable (ALARA) and within the prescribed limits.

(iii) In the event of design basis accidents (DBA), the radiological consequences should be minimal and the radiation exposures should be within the prescribed emergency reference levels.

(iv) For release of toxic materials during normal operation of the facility, the chemical exposure to the personnel within the plant and site shall be maintained below the permissible levels prescribed in the Factories Act 1948. Release of toxic materials to the environment from the facility should be kept within the limits prescribed in the rules under the Environmental Protection Act, 1986. A major accident would normally manifest itself in one or more of the three forms viz., fire, explosion or toxic release. The effect distance of such consequences shall be calculated.

(v) The probability of occurrence of severe accidents (beyond DBA) should be extremely small and prevention of such accidents and/or mitigation of the consequences through emergency action plans should be made effective by the operating organisation of the facility.

(vi) The regulatory body performs a step-by-step review and assessment of the project and the procedure consists of examining the submissions from the applicant on siting of the facility, plant design and process systems, operational procedures, administrative arrangements and safety analysis.

(vii) The regulatory body may also perform an independent analysis on its own, to verify the applicant's evaluations. The submissions to be made by the applicant for various consenting stages have been identified in section 4.

5.2 Consent for Site

(i) The site identified for locating the facility is reviewed for the favourable characteristics and assessed to verify that no adverse interaction exists between the facility and the site, and the suitability of the site for setting up the facility is confirmed.

(ii) In the review, the regulatory body takes note of the characteristics that influence the design of the facility and also the impact on the environment that may lead to specific design or operational requirements.

(iii) In the case of hazardous plants, such as heavy water plants and spent fuel reprocessing plants, siting considerations also include potential external man-induced events such as aircraft crashes, fires and explosions and flooding of the site due to failure of dams.

(iv) Seismic aspects of the site are also critically examined, particularly for:

(a) facilities where large inventory of fissile materials or hazardous chemicals are present

(b) structures like waste tank farms, where high level radioactive liquid waste arising from reprocessing of spent fuel is stored

(c) pond like structures wherein tailings consisting of radioactive materials and chemicals arising from uranium ore processing, are impounded.

(v) Based on these reviews, the regulatory body considers issuance of a consent, for the site for locating the fuel cycle facility.

5.3 Consent for Construction

(i) For construction clearance, the design of the facility is reviewed in detail with the aid of safety analysis report and the job hazard analysis report.

(ii) Important to this stage of review is the safety approach of the applicant in respect of defence-in-depth and redundancy in design and accident prevention. An assessment is made to determine whether all the design safety requirements are met, the design features are compatible with the site, where required, and the facility can be constructed to operate safely.

(iii) Issue of construction consent is considered by the regulatory body, on compliance with the requirements brought out in the above review.

5.4 Consent for Commissioning

(i) Prior to the issue of consent for commissioning of equipment and systems, the regulatory body reviews the final and as-built design and conformity of the construction with the design and regulatory requirements.

(ii) The programme of commissioning tests and procedures, operating limits and conditions, adequacy of manpower available and their qualification and training are reviewed.

(iii) In addition, quality assurance reports on installation of components and systems, are also examined.

(iv) The consent for commissioning of the plant is given in several interim stages, as appropriate, for different plant systems depending upon the type of fuel cycle facility.

5.5 Consent for Operation

(i) Consenting for the operation of the fuel cycle facility is a major stage in the licensing process and requires a detailed examination of the project as a whole, to ensure implementation of all safety provisions and recommendations of the reviewing agency.

(ii) A final review of the design of the as-built facility including modifications incorporated and safety analyses including revisions made in the evaluations due to changes in the design or assumptions, if any, is carried out. The status of implementation of the recommendations of the safety review committees is also reviewed, with appropriate follow-up actions. All pending safety issues should be resolved before the consent for operation is considered by the regulatory body.

(iii) The technical specifications for the operation of the facility, specifying the safety limits, safety system settings, limiting conditions for operation, surveillance and in-service inspection requirements, are reviewed and approved by the regulatory body for adoption by the plant. The availability of all operating manuals, including operating procedures under emergency condition, is verified.

(iv) The radiation protection programme, treatment and discharge of radioactive effluents, management of solid waste (radioactive as well as toxic chemicals), fire safety and industrial safety programme, training and retraining programme for the operating personnel, are important subjects that need a final review and assessment by the

regulatory body, before commencement of plant operation. Emergency preparedness plans for the nuclear facility are also reviewed before adoption by the plant.

(v) On confirmation of the overall safety of the facility, the regulatory body issues a consent to the applicant in the form of a licence for operation of the facility. The licence may stipulate certain conditions and requirements governing the operation of the facility and also specify a time limit on the validity of the licence.

(vi) The applicant may also be issued, under special circumstances, with a consent so that a section of the plant may be operated for a specified period, during which time, the rest of the plant should be brought to operational readiness. The regulatory body will ensure that such partial operation of the facility does not impair the overall safety and those sections of the plant can be operated independently of other sections for production purposes. The applicant should demonstrate the complete readiness of the entire plant, before applying for a consent for full scope operation.

(vii) At times, the regulatory body may also issue a consent for operation of a facility for a limited period, if the pending recommendations for implementation are not safety related, and if an undertaking is given by the applicant for their implementation before the expiry of the consent. On implementing the pending recommendations, the applicant may apply for consent for continued operation as for normal circumstances.

(viii) The facility continues to remain under regulatory control after commencement of routine or commercial operation and is subjected to regulatory inspections and enforcement, to ensure that the plant is being operated as per the regulatory requirements.

(ix) The licencee is required to submit to the regulatory body periodic reports on plant performance and its safety status. In addition, data on radiation exposures to plant personnel and public, disposal of radioactive wastes, environmental monitoring, etc., should be furnished.

(x) It is mandatory for the licencee to inform promptly any safety related unusual occurrence at the plant and follow it up with a detailed report.

(xi) Violations of the approved technical specifications for operation should also be reported promptly to the regulatory body.

(xii) Before expiry of the validity period of the licence, the applicant/ licencee should apply for renewal of the licence. The regulatory body, after a detailed review of the safety performance of the plant, considers renewal of the licence.

5.6 Consenting Decisions

(i) The regulatory body, on the basis of its review and assessment of the fuel cycle facilities, may issue or refuse a regulatory consent. The findings and recommendations of the safety review committees form the basis for such decisions.

(ii) Where the regulatory body had issued a consent for the operation of a facility or part of the facility, the applicant should fulfil the requirements specified in the consent within the stipulated period. The applicant may apply for an extension of the consent but should justify with proper reasons for the failure to meet the stipulations in the consent. The regulatory body will take an appropriate decision based on the recommendations of the safety review committees.

(iii) Any new information that becomes available to the regulatory body from research and development results, experience at similar nuclear facilities elsewhere by way of incidents or accidents, change in off-site conditions etc. will be considered by the regulatory body in its review and assessment process. Where such information has relevance to the safety of the facility, the regulatory body may stipulate modifications.

(iv) The regulatory body may also perform a review and assessment of previously approved facilities in the light of the new information and make additional recommendations for implementation.

5.7 Appeal against Decisions

5.7.1 An appeal against the decision(s) of the Board of the regulatory body shall lie with the Atomic Energy Commission whose decision will be final.

5.7.2 An appeal against the orders of the Regulatory Body will be reviewed by the Board of the regulatory body for appropriate further action. However, it shall be obligatory for the concerned institution to implement the directions of the regulatory body not withstanding any appeal being filed by the institution.

ANNEXURE-1

FORMAT FOR APPLICATION FOR REGULATORY CONSENT

This Annexure provides the format for applications seeking the consent of the regulatory body at various stages of setting up the nuclear fuel cycle facility. The application for each consenting stage consists of three parts, viz.,

Part A - General particulars of the applicant and the project

Part B - Information/documents to be furnished at different consenting stages

Part C - Certificate of undertaking to be furnished by the applicant

While the particulars stated in Part A and Part C will remain the same for all consenting stages, particulars to be furnished in Part B, should be relevant to the consenting stage (viz., siting, construction, commissioning or operation) for which the application is submitted to the regulatory body and these requirements are explained in section 4 of this guide.

Part A and Part C should accompany Part B, while applying for consent at each stage.

ANNEXURE- 1 (Contd.)

FORM- A

I. APPLICATION FOR SITING CONSENT

PART- A

GENERAL PARTICULARS

1. Name of the utility/ institution setting up the facility/project :

2. Postal address of the utility/institution :

3. Name, designation and address of the applicant, officially representing the utility/institution :

4. Mode of communication :

   Telephone - Office :
   ,, - Residence :
   Fax No. :
   E-mail id :

5. Project details:
   (a) Type of nuclear fuel facility :
   (b) Objective/purpose :
   (c) Nature of facility:
      (i) Regular production : Yes/ No
      (ii) Pilot plant for process development/feasibility study : Yes/ No
      (iii) Research & Development/ special investigations : Yes/ No
   (d) Design capacity of the plant for end product(s) :
   (e) Radioactive and hazardous chemicals handled, with approximate quantities :
   (f) State whether a similar plant is operating elsewhere and its location :

6. Location of the plant:
   (a) Proposed site : New site / Existing site (i.e., site with plants operating already)

(b) Site address :
(c) Details of operating plants located nearby to the proposed site :
(d) Tentative schedule for commencement of activity at site (with due consideration for lead time as per sub section 4.14 of this guide) :

PART- B

INFORMATION TO BE FURNISHED FOR SITING CONSENT

1. Details of documents submitted (Lead time for submission as per sub section 4.14 of this guide) :
   (a) Site Evaluation Report (Contents as detailed in section 4 and Annexure-2 of this guide) :
2. State whether site clearance is to be obtained or already obtained from the Ministry of Environment & Forests (MoEF), Government of India; If yes, attach approval granted by the MoEF :
3. Constraints, if any, on the site for setting up a nuclear facility (such as restrictions imposed by the regulatory body, while granting consent for operation of other facilities at the site) :
4. If mining of U, Th or heavy minerals is involved, attach clearance from Indian Bureau of Mines (IBM) or state whether applied to IBM or not :

PART- C

CERTIFICATE/ UNDERTAKING

I hereby certify that the information furnished in Parts A and B is correct to the best of my knowledge and belief.

I undertake to:

1. comply with the conditions and requirements that may be stipulated in the consent;

2. keep the regulatory body informed of any changes in the information furnished in Parts A and B;

3. abide by the instructions/directives of the regulatory body;

4. fulfil all other relevant requirements prescribed in the Atomic Energy Act 1962 and the Rules issued thereunder, and in the relevant codes, and

5. meet the requirements prescribed in other relevant statutes.

Date: (Signature of the applicant)

ANNEXURE- 1 (Contd.)

FORM-A

II. APPLICATION FOR CONSTRUCTION CONSENT

PART- A

GENERAL PARTICULARS (AS UNDER APPLICATION I)

PART- B

INFORMATION TO BE FURNISHED FOR CONSTRUCTION CONSENT

1. Details of Siting Consent
   - Date of Consent :
   - Status of compliance to stipulations made in the consent :

2. Details of documents submitted (lead time for submission as per sub section 4.14 of this guide)
   - (a) Safety Analysis Report/Safety Report Contents as detailed in Annexure-3) :
   - (b) Construction schedule :
   - (c) Job Hazards Analysis Report :
   - (d) QA Manual for construction :
   - (e) Status of emergency preparedness (for existing sites only) :

PART- C

CERTIFICATE OF UNDERTAKING (AS UNDER APPLICATION- I)

ANNEXURE- 1 (Contd.)

FORM- A

III. APPLICATION FOR COMMISSIONING CONSENT

PART- A

GENERAL PARTICULARS (AS UNDER APPLICATION I)

PART- B

INFORMATION TO BE FURNISHED FOR COMMISSIONING CONSENT

1. Details of Siting Consent
   - Date of Consent :
   - Status of compliance to stipulations made in Siting Consent :

2. Details of Construction Consent
   - Date of Consent :
   - Status of compliance to stipulations made in Construction Consent :

3. Details of Documents Submitted. (lead time for submission as per sub section4.14 of this guide)
   - (a) Technical specifications for operation :
   - (b) Radiation protection procedure Manual :
   - (c) Commissioning schedule :
   - (d) Document on licensing of operating personnel :

PART- C

CERTIFICATE OF UNDERTAKING (AS UNDER APPLICATION I)

ANNEXURE- 1 (Contd.)

FORM- A

IV. APPLICATION FOR OPERATION CONSENT

PART- A

GENERAL PARTICULARS (AS UNDER APPLICATION- I)

PART- B

INFORMATION TO BE FURNISHED FOR OPERATION CONSENT

1. Details of Siting Consent
   - Date of Consent :
   - Status of compliance to stipulations made in Siting Consent :

2. Details of Construction Consent
   - Date of Consent :
   - Status of compliance to stipulations made in Construction Consent :

3. Details of Commissioning Consent
   - Date of Consent :
   - Status of compliance to stipulations made in Siting Consent :

4. Details of Documents Submitted: (lead time for submission as per sub section 4.14 of this guide)
   (a) QA manual for operation
   (b) Commissioning tests and results
   (c) Technical specifications with revisions, if any (Final version)
   (d) Manual on security systems
   (e) Training manual
   (f) Quantitative risk assessment report
   (g) Operation and maintenance manuals
   (h) Revised safety report/safety analysis report

PART- C

CERTIFICATE OF UNDERTAKING (AS UNDER APPLICATION- I)

ANNEXURE- 2

CONTENTS OF SITE EVALUATION REPORT

The contents of the site evaluation report should cover all items under the following broad categories:

1. Salient features of the proposed site

(a) Geography, Demography and Topography

(i) The site and its location should be described with the aid of maps of suitable scale. The present and foreseeable uses of surrounding area should be described. Data on food/ milk production and on dietary habits in the area should be compiled, with special attention to food processing or any other sensitive industry.

(ii) Existing or planned industrial and public facilities in the neighbourhood (5-10 km depending on the hazardous nature of the facility), such as roads, railways, waterways, transport of dangerous goods, chemical plants, military installations, gas pipelines, airports, archaeological monuments and places of pilgrimage, including anticipated changes in their utilisation and distance from the proposed facility should be described in such a way as to facilitate the evaluation of the risks which they may pose to the nuclear facility and vice versa.

(iii) The current and the forecast population of permanent residents in the surrounding area should be tabulated as a function of distance and direction, in such way as to demonstrate the feasibility of emergency plans to protect the population against the accidental release of radioactivity. Similar information should also be given for transient and seasonal population.

(iv) Access to the site should be discussed, where it may influence outside intervention in case of emergency, ease of evacuation of personnel or members of the public, or hazards associated with the shipment of irradiated fuels or radioactive waste. The topography of the surrounding area and the site should be described.

(b) Meteorology

(i) Meteorological conditions having an influence on the consequences of normal and accidental releases of radioactive/ hazardous materials should be described and discussed.

(ii) The frequency of occurrence and possible consequences of extreme meteorological conditions, such as cyclones and heavy precipitation, should be discussed.

(iii) The information should include the distribution of wind velocity and direction and atmospheric stability conditions. Annual/ monthly average data on temperature, humidity and rainfall should be included.

(iv) The effect which meteorological considerations have in establishing design bases and operating conditions for the plant should be shown.

(c) Hydrology

(i) Information should be submitted, giving quantity and quality, about the water at and around the site. This information should include, in particular, sources of cooling water and their availability, ground water movement, river or lake current, dispersion conditions, potable and service water supplies.

(ii) Attention should be given to the uses, present and projected, of water originating in or flowing through the area, taking into account possible contamination by the nuclear facility in normal operation and accident conditions.

(iii) Where applicable the effect of natural phenomena such as tidal effects, floods and coastal cyclones should be evaluated. The consequences of failure of installations such as dams (up-stream or down stream) should also be evaluated.

(d) Geology

(i) Information should be provided on the geological formation of the site and its surrounding area and the effect it may have on the design of the foundations and structures.

(ii) This information should include investigation of surface faulting, stability of sub-surface material, and stability of slopes and embankments. Such features as geological anomalies and underground workings should be identified.

2. Site characteristics affecting safety

(a) Seismicity

(i) Information concerning the seimicity of the site and its surrounding area, and the method followed for establishing the design basis vibratory ground motions, should be discussed and the data given.

(ii) This information should include a description of the behaviour of the ground during tremors in the past, a seismic history of the area, an indication and evaluation of the active faults within a significant radius, and data on the seismotectonics of the site.

3. General description of plant covering basic design features, e.g.

(i) overall safety approach

(ii) codes and standards applicable to the design

(iii) safety margins in prevention of accidental criticality, red oil explosion etc., where applicable

4. Nuclear security

(a) Impact of site and surroundings on nuclear security

(b) Physical protection system, physical barrier, communication, etc.

5. Interaction of the facility with its environment

(a) Radiological and Chemical Impact

(i) All necessary ecological data from the site and its surrounding area, that are important for review and assessment of the radiological/ environmental impact of the nuclear facility, such as biological systems and critical pathways, should be presented.

(ii) In case such data still needs to be generated, program for the generation of the same may be given. In the mean time conservative assumptions/ approaches could be used with respect to the radiological impact. The purpose is to get an assurance that the requirement regarding specified dose limits are met.

(iii) A description should be given of the organisation and conduct of an environmental monitoring program, to establish base line data on radioactivity levels.

ANNEXURE-3

TYPICAL FORMAT AND CONTENTS OF SAFETY ANALYSIS REPORT FOR REPROCESSING AND WASTE MANAGEMENT PLANTS [15, 16, 17, 18]

1. INTRODUCTION AND GENERAL DESCRPTION OF THE PLANT

1.1 Introduction

1.2 General Plant Description

1.3 General Process Description

2. SUMMARY OF SAFETY ANALYSIS

2.1 Impact-Normal Operation

2.2 Impact-Accidents

3. SITE CHARACTERISTICS

3.1 Geography and Demography of Site Selected

- 3.1.1 Site Location
- 3.1.2 Site Description
- 3.1.3 Population, Distribution and Trend
- 3.1.4 Uses of Nearby Land and Water

3.2 Nearby Industrial, Transportation and Military Facilities

3.3 Meteorology

- 3.3.1 Regional Climatology
- 3.3.2 Local Meteorology
- 3.3.3 On-Site Micro Meteorological Measurements
- 3.3.4 Diffusion Parameter Estimation

3.4 Surface Hydrology

- 3.4.1 Hydrological Description
- 3.4.2 Floods
- 3.4.3 Potential Dam Failures

3.4.4 Water Canals and Reservoirs

3.4.5 Flooding Protection

3.4.6 Environmental Acceptance of Effluents

3.5. Subsurface Hydrology

3.5.1 Dilution and Reconcentration Characteristics

3.5.2 Regional Area Characteristics

3.5.3 Site Characteristics

3.6 Geology

3.6.1 Basic Geological Information

3.6.2 Surface Faulting

3.6.3 Characteristics of the Soil

3.6.4 Stability of Subsurface Material

3.7 Seismology

3.7.1 General Seismic History

3.7.2 Locations of Geological Faults with respect to Site

3.7.3 Zone as per Indian Standards and Criteria for Seismic Design of Structures

3.8 Site Analysis

3.8.1 Natural Phenomenon

3.8.2 Site Characteristics Affecting the Safety Analysis

3.8.3 Effect of Nearby Industrial, Transportation and Military Facilities

4. PRINCIPAL DESIGN CRITERIA

4.1 Purpose of the Plant

4.1.1 Plant Feed

4.1.2 Plant Products and By-products

4.2 Structural and Mechanical Criteria

4.2.1 Wind Loading

4.2.2 Water Level (Flood) Design

4.2.3 Missile Protection
4.2.4 Seismic Design
4.2.5 Process and Equipment Derived Loads
4.2.6 Combined Load Criteria
4.2.7 Subsurface Hydrostatic Loading
4.3 Safety Protection Systems
4.3.1 General
4.3.2 Protection by Multiple Confinement Barriers and Systems
4.3.3 Protection by Equipment and Instrumentation Selection
4.3.4 Nuclear Criticality Safety
4.3.5 Radiological Protection
4.3.6 Fire and Explosion Protection
4.3.7 Fuel and Radioactive Waste Handling and Storage
4.3.8 Industrial and Chemical Safety
4.4 Classification of Structures, Components and Systems (where applicable)
4.5 Decommissioning
5. FACILITY DESIGN
5.1 Summary Description
5.1.1 Location and Facility Layout
5.1.2 Principal Features
5.2 Process Building
5.2.1 Structural Specification
5.2.2 Building Layout
5.2.3 Individual Facility Description
5.3 Description of Service and Distribution
5.3.1 Building Ventilation
5.3.2 Electrical (Normal and Emergency)
5.3.3 Compressed Air

5.3.4 LPG

5.3.6 Furnace and Diesel Oil

5.3.7 Vacuum System

5.3.8 Steam Supply and Distribution

5.3.9 Water Supply

5.3.10 Cooling Water

5.3.11 Sewage Treatment

5.3.12 Safety and Communication Alarms

5.3.13 Fire Protection System

6. PROCESS SYSTEM

6.1 Process Description

6.1.1 General

6.1.2 Flowsheets

6.1.3 Identification of Items for Safety Analysis Concern

6.2 Process Chemistry

6.3 Mechanical Process System

6.4 Chemical Process System

6.5 Process Support System (Instrumentation and Control)

6.6 Analytical Sampling

6.7 Product Handling

7. WASTE MANAGEMENT

7.1 Waste Management Criteria

7.2 Radiological Wastes - Characteristics, Concentration and Volumes

7.3 Non-Radiological Wastes

7.4 Off-Gas Treatment and Ventilation

7.4.1 Design Objectives

7.4.2 Equipment and System Description

7.4.3 Operating Procedures

7.4.4 Disposal Criteria
7.5 Liquid Waste Treatment
7.5.1 Design Objectives
7.5.2 Equipment and System Description
7.5.3 Operating Procedures
7.5.4 Disposal Criteria
7.6 Solid Waste Management
7.6.1 Design Objectives
7.6.2 Equipment and System Description
7.6.3 Operating Procedures
7.6.4 Packaging, Transport and Storage Facilities
7.6.5 Disposal Criteria
8. RADIATION PROTECTION
8.1 Design Considerations
8.2 Operational Considerations
8.3 Radiation Sources
8.4 Radiation Protection Design Features
8.4.1 Facility Design Features
8.4.2 Shielding
8.4.3 Ventilation
8.4.4 Radiation Monitoring
8.5 Estimated Collective Dose for Plant Personnel and Public
8.6 Health Physics Programme
8.6.1 Organisation
8.6.2 Equipment, Instrumentation and Facilities
8.6.3 Procedures
8.7 Environmental Survey
8.7.1 Effluent and Environmental Monitoring Programme

8.7.2 Analysis of Multiple Contribution

8.7.3 Estimated Exposures

9. INDUSTRIAL AND FIRE SAFETY

9.1 Hazardous Chemicals

9.1.1 Material Safety Data Sheets

9.1.2 Composition and Inventory

9.1.3 Transport and Storage

9.2 Hazard Control Mechanism

9.3 Fire Fighting Provisions

9.4 Fire Alarm Systems

9.5 Emergency Plans

9.6 Medical Facilities

10. SAFETY ANALYSIS

10.1 Impact from Normal Operations

10.2 Impact from Abnormal Events

10.3 Accidents

10.4 Risk Assessment

10.5 Conclusions

11. CONDUCT OF OPERATION

11.1 Organisational Structure

11.1.1 Corporate Organisation

11.1.2 Operating Organisation

11.1.3 Safety Organisation (Competent Persons, Safety Officers, RSO/Health Physicists)

11.1.4 Personnel Qualification Requirement

11.1.5 Maintenance and Inspection

11.2 Pre-Operational Testing

11.2.1 Administrative Procedures

11.2.2 Test Programme Description

11.2.3 Test Discussion

11.3 Training Programme

11.4 Normal Operation

11.4.1 Plant Procedures

11.4.2 Plant Records

11.5 Emergency Planning

11.6 Decommissioning

12. QUALITY ASSURANCE

12.1 Organisation

12.2 QA Programme Plan

12.2.1 QA in Construction

12.2.2 QA in Commissioning

12.2.3 QA in Operation

12.3 In-service Inspections

ANNEXURE-4

FORMAT FOR QUANTITATIVE RISK ASSESSMENT DOCUMENT

1. General

- Executive summary
- Objective and scope
- Information about the plant
- System description, including changes done during review/ construction/commissioning/operation
- Methodology adopted

2. Hazard Identification

- Identification of unwanted events and ranking if any
- Credible accident scenarios/worst case scenarios
- Source characteristics

3. Consequence Analysis

- Spreading, vaporisation, dispersion with time and distance
- Result interpretation based on consequence modelling

4. Accident Frequency Estimation/Probability of Release

- System boundaries
- Specific assumption
- Generic data
- Calculated frequency of occurrence of the worst accident

5. Determination of Impact Analysis

- To identify the people who could be affected

6. Limitations/Remedial Measures

- Summary of analytical method, its assumptions and limitations
- Realistic remedial measures

7. Recommendations/Mitigating effects

- Evacuation, sheltering
- Medical treatment

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18. UNITED STATES NUCLEAR REGULATORY COMMISSION, Standard Format and Content of Licence Applications for Uranium Mills; Regulatory Guide 3.5 (1977)

LIST OF PARTICIPANTS

WORKING GROUP

Dates of meeting	:	November 24, 2000 April 12, 2001 September 3, 2001

Members and invitees of working group:

Shri T.N. Krishnamurthi, (Chairman)	:	AERB (Former)
Shri A.R. Sundararajan	:	AERB (Former)
Shri Jagdish Lal	:	AERB (Former)
Shri K.K. Chandraker	:	AERB (Former)
Shri Kanwar Raj	:	BARC
Shri A.K. Gupta	:	BARC
Shri K.A. Pendarkar	:	BARC
Dr. Pushparaja	:	BARC
Shri George Thomas (Member-Secretary)	:	AERB

ADVISORY COMMITTEE ON PREPARATION OF CODE AND GUIDES ON GOVERNMENTAL ORGANISATION FOR REGULATION OF NUCLEAR AND RADIATION FACILITIES (ACCGORN)

Dates of meeting	:	January 3, 2001 August 2, 2001 December 12 & 14, 2001 October 8, 2004 April 1, 2005

Chairman, members and invitees of ACCGORN:

Dr. S.S. Ramaswamy (Chairman till Jan. 2003)	:	DG, FASLI (Former)
Shri G.R. Srinivasan (Chairman since Feb. 2003)	:	AERB (Former)
Shri S.K. Chande	:	AERB
Dr. S.K. Gupta	:	AERB
Shri P.K. Ghosh	:	AERB
Dr. P.C. Basu	:	AERB
Shri R.I. Gujarathi	:	AERB
Dr. Ompal Singh	:	AERB
Shri R. Venkatraman	:	AERB
Dr. A. Nandakumar	:	AERB
Shri S.P. Agarwal	:	AERB
Shri A. K. Asrani	:	AERB (Former)
Shri T.N. Krishnamurthy	:	AERB (Former)
Shri Deepak De	:	AERB (Former)
Dr. K.S. Parthasarathy	:	AERB (Former)
Shri S.K. Agarwal	:	AERB (Former)
Shri P. Hajra	:	AERB (Former)
Shri A.R. Sundararajan	:	AERB (Former)
Shri Y.K. Shah (Member Secretary)	:	AERB
Shri S.T. Swamy (Permanent Invitee)	:	AERB

PROVISIONAL LIST OF SAFETY CODE, GUIDES AND MANUALS ON REGULATION OF NUCLEAR AND RADIATION FACILITIES

Safety Series No.	Title
AERB/SC/G	Regulation of Nuclear and Radiation Facilities
AERB/NPP/SG/G-1	Consenting Process for Nuclear Power Plants and Research Reactors
AERB/NF/SG/G-2	Consenting Process for Nuclear Fuel Cycle Facilities and Related Industrial Facilities other than Nuclear Power Plants and Research Reactors
AERB/RF/SG/G-3	Consenting Process for Radiation Facilities
AERB/SG/G-4	Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities
AERB/SG/G-5	Role of Regulatory Body with respect to Emergency Response and Preparedness at Nuclear and Radiation Facilities
AERB/SG/G-6	Codes, Standards and Guides to be Prepared by the Regulatory Body for Nuclear and Radiation Facilities
AERB/SG/G-7	Regulatory Consents for Nuclear and Radiation Facilities: Contents and Formats
AERB/SG/G-8	Criteria for Regulation of Health and Safety of Nuclear Power Plant Personnel, the Public and the Environment
AERB/NPP/SM/G-1	Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors
AERB/NF/SM/G-2	Regulatory Inspection and Enforcement in Nuclear Fuel Cycle and Related Facilities other than Nuclear Power Plants and Research Reactors
AERB/RF/SM/G-3	Regulatory Inspection and Enforcement in Radiation Facilities

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