AERB SAFETY GUIDE NO. AERB/SG/G-4

REGULATORY INSPECTION AND ENFORCEMENT IN NUCLEAR AND RADIATION FACILITIES

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FOREWORD

The establishment and operation of nuclear and radiation facilities, and the use of radioactive sources, contribute to the economic and social progress of the country. However, while undertaking such activities, the safety of workers concerned, the general public and the environment is to be ensured and this is possible through compliance with relevant provisions of the Atomic Energy Act, 1962.

Since the inception of the atomic energy programme in the country, importance has been given to the adoption and maintenance of high safety standards. In order to enforce safety standards, the Government of India constituted the Atomic Energy Regulatory Board (AERB), in November 1983.

The Board is entrusted with the responsibility of laying down safety standards and framing rules and regulations covering regulatory and safety functions envisaged under the above Act. AERB has therefore undertaken a programme of developing Safety standards, codes, guides and manuals for both nuclear and radiation facilities, covering all aspects such as siting, design, construction, operation, quality assurance, decommissioning and regulation.

Safety standards contain internationally accepted safety criteria for design, construction and operation of specific equipment, systems, structures and components of nuclear and radiation facilities. Safety codes are intended to establish objectives and to set minimum requirements that shall be fulfilled to provide adequate assurance for safety in nuclear and radiation facilities. Safety guides provide guidelines and make available methods for implementing specific requirements as prescribed in line with relevant Safety code(s). Safety manuals are intended to elaborate specific aspects and may contain detailed technical information and/or procedures.

Consistent with accepted practice, ‘shall’ and ‘should’ are used in these documents to distinguish between firm requirements and desirable option respectively, for the benefit of the user.

Emphasis in these documents is on protection of the site personnel, the public and the environment from unacceptable radiological hazards. For aspects not covered, applicable and acceptable national and international codes and standards shall be followed.

Industrial safety in nuclear and radiation facilities is to be ensured through strict compliance with applicable provisions of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996.

The codes, guides and manuals will be revised as and when necessary in the light of experience and feedback from users as well as new developments in the field.

Based on its experience, AERB has issued a Safety Code on 'Regulation of Nuclear and Radiation Facilities' (AERB/SC/G), 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. It is hoped that this will be of use to the Regulatory Body as well as to the applicant of any nuclear or radiation facility.

This Safety Guide on the 'Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities' provides guidance to the Regulatory Body on its role for regulatory inspection of nuclear and radiation facilities and enforcement action. It is also intended to assist these facilities and their participating/collaborating agencies in fulfilling the stipulated requirements of the above Code.

The Guide has been prepared by a Working Group consisting of AERB staff and other professionals. In drafting it, extensive use has been made of information contained in the relevant inspection procedures/reports of AERB and documents of the International Atomic Energy Agency (IAEA) under the Nuclear Safety Standards (NUSS) programme, specially the Guide on 'Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (50-SG-G-4)' have been made.

Experts have reviewed the Guide and the AERB Advisory Committees have vetted it before issue. The list of persons who have participated in the Committee meetings, along with their affiliation, is appended in the document.

AERB wishes to thank all individuals and organisations who reviewed the draft and helped in finalisation of the Safety Guide.

(Suhas P. Sukhatme)
Chairman, AERB

DEFINITIONS

Appeal

Request to the Appellate Authority authorising for review against any decision of the Regulatory Body.

Applicant

Any person who applies to the Competent Authority for consent to undertake any of the actions for which the consent is required.

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 facility and to perform safety and regulatory functions including enforcement for the protection of the public and operating personnel against radiation.

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.

Commissioning

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

Consent

It is a written permission, issued to the consentee by the Regulatory Body to perform specified activities related to nuclear and radiation facilities. The types of such consents are 'License', 'Authorisation', 'Registration' and 'Approval', and will apply depending upon the category of the facility, the particular activity and the radiation source involved.

Consentee

A person to whom Regulatory Consent is granted by the Competent Authority under the relevant rules.

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.

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 of the environment.

Design

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

Documentation

Recorded or pictorial information describing, defining, specifying, reporting or certifying activities, requirements, procedures or results.

Emergency

A situation which endangers or is likely to endanger safety of the site personnel, the nuclear/ radiation facility or the public and the environment.

Emergency Plan

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

Engineered Safety Features (ESF)

The system or feature specifically engineered, installed and commissioned in a Nuclear Power Plant (NPP) to mitigate the consequences of an accident condition and help restore normalcy, e.g. containment atmosphere clean-up system, containment depressurisation system, etc.

Event

Occurrence of an unplanned activity or deviations from normalcy. It may be one occurrence or a sequence of related occurrences. Depending on the severity in deviations and consequences, the event may be classified as anomaly, incident or accident in ascending order.

Examination

An element of inspection consisting of investigation of materials, components, supplies or services to determine conformance with those specified requirements which can be determined by such investigation.

Exclusion Zone

It extends up to a specified distance around the plant, where no public habitation is permitted. This zone is physically isolated from the outside areas by fencing and is under the control of the NPP.

Exposure

The act or condition of being subjected 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.

Full Power (FP)

The rated thermal power of the reactor, i.e. the gross fission power as established by station heat balance using approved methodology.

Inspection

Quality control actions which by means of examination, observation or measurement determine the conformance of materials, parts, components, systems, structures as well as processes and procedures with predetermined quality requirements.

Inspector (Regulatory)

A person authorised by the Regulatory Body to carry out regulatory inspection.

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* Licensed Person and Licensed Position).

Licensed Person

A person who has been licensed to hold certain Licensed Positions of an NPP after due compliance with authorised procedure of certification by the Regulatory Body.

Licensed Position

A position, which can be held only by persons certified by Regulatory Body or a body, designated by it.

Limit

The value of a parameter or attribute (which is variable) used in certain specific activities or circumstances that must not be exceeded.

Maintenance

Organised activities covering all preventive and remedial measures, both administrative and technical necessary to ensure that all structures, systems and components are capable of performing as intended for safe operation of plant.

Nuclear Facility

All nuclear fuel cycles and associated installations encompassing the activities covering from the front end to back end of nuclear fuel cycle processes and also the 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 any research or development activity related to any of the foregoing.

Nuclear Power Plant

A nuclear reactor or a group of reactors together with all the associated structures, systems, equipment and components necessary for safe generation of electricity.

Nuclear Safety

Protection of all persons against undue radiological hazard.

Operation

All activities following commissioning and before decommissioning performed to

achieve, in a safe manner, the purpose for which a nuclear/radiation facility was constructed, including maintenance.

Operational Limits and Conditions (OLC)

(*See* also Technical Specifications)

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.

Operational Records

Documents such as instrument charts, certificates, log-books, computer print outs and magnetic tapes, made to keep objective history of the NPP operation.

Plant Management

The members of site personnel who have been delegated responsibility and authority by the Operating Organisation for directing the operation of the plant.

Potential

A possibility worthy of further consideration for safety.

Practice

Any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people, or the number of people exposed.

Quality Assurance

Planned and systematic actions necessary to provide adequate confidence that an item or a facility will perform satisfactorily in service as per design specifications.

Radiation Facility

Any installation/equipment or a practice involving the use of radiation generating units or the use of radioisotopes in the field of research, industry, medicine and agriculture.

Records

Documents which furnish objective evidence of the quality of items and activities affecting quality. It also includes logging of events and other measurements.

Registration

A type of regulatory consent that include (i) medical diagnostic x-ray equipment, including computed tomography (CT) and therapy simulator, (ii) analytical x-ray equipment used for research, (iii) nucleonic gauges, (iv) radioactive sources in tracer studies, (v) bio-medical research using radioactive materials, and (vi) any other source and practice notified by the Competent Authority.

Regulatory Body

See 'Atomic Energy Regulatory Board' (AERB)

Regulatory Consent

See 'Consent'.

Regulatory Inspection

An examination by 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.

Reliability

The probability that a device, system or facility will perform its intended function satisfactorily under stated operating conditions.

Research Reactor

A critical/sub-critical assembly of nuclear fuel elements, used for the purpose of research, teaching and production of radioisotopes.

Safety

(*See* also Nuclear Safety)

Safety Analysis Report

A document provided by the applicant/consentee to the Regulatory Body containing information concerning 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 with normal conditions and accident situations.

Safety Critical System (Safety Systems)

Systems important to safety, provided to assure, under anticipated operational occurrences and accident conditions, the safe shut down of the reactor (shutdown system) and the heat removal from the core (Emergency Core Cooling System), and containment of any radioactivity (Containment Isolation System).

Safety Guide

It is a document containing detailed guidelines and various procedures/ methodologies to implement the specific parts of a Safety Code, that are acceptable to Regulatory Body, for regulatory review. This is issued under the authority of Regulatory Body and is of non-mandatory nature.

Safety-Related Systems

Those systems important to safety which are not included in Safety Critical Systems. viz. these include power supplies/ stored energy systems.

Safety System

(*See* Safety Critical System)

Setback

Controlled gradual reduction in reactor power effected by Reactor Regulating System in response to an identified abnormality in one or more plant process variables, until the conditions causing the setback are cleared or the preset limit for power rundown is reached.

Site

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

Site Emergency

Accidental condition/emergency situation in the plant involving radioactivity transgressing the plant boundary but confined to the site, or involving release of hazardous chemicals/explosion, whose effects are confined to the site, with off-site consequences expected to be negligible.

Site Personnel

All persons working on the site, either permanently or temporarily.

Siting

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

Specification

A written statement of requirements to be satisfied by a product, a service, a

material or process indicating the procedure by means of which it may be determined whether specified requirements are satisfied.

Surveillance

All planned activities viz. monitoring, verifying, checking including in-service inspection, functional testing, calibration and performance testing performed to ensure compliance with the specifications established in a facility.

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 facilities.

Testing (QA)

The determination or verification of the capability of an item to meet specified requirements by subjecting the item to a set of physical, chemical, environmental or operational conditions.

Ultimate Heat Sink

The atmosphere or a body of water or the ground water to which part or all of the residual heat is transferred during normal operation, or during anticipated operational occurrences or accident conditions.

Unusual Occurrence

Any occurrence which has the potential to impair or impairs the plant safety, radiological safety, or industrial and environmental safety. Of these, those which are violative of the limits and conditions stipulated by Regulatory Body are termed as safety related unusual occurrences.

Verification

The act of reviewing, inspecting, testing, checking, auditing, or otherwise determining and documenting whether items, processes, services or documents conform to specified requirements.

1. INTRODUCTION

1.1 General

1.1.1 Nuclear power plants and other nuclear and radiation facilities (NRF) are designed, constructed, commissioned and operated in conformity with the existing safety standards. The standards ensure adequate margin of safety so that NRF may be operated without undue risk to the plant personnel, the members of the public and the environment. Safety Code 'Regulation of Nuclear and Radiation Facilities (AERB/SC/G, 2000)' requires the Regulatory Body to be responsible for governmental surveillance and control over matters relating to safety in the siting, design, construction, commissioning, operation and decommissioning of NRF.

1.1.2 The Safety Guide on 'Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities' has been prepared as part of the programme for developing codes, guides and other standards to regulate NRFs. It lays down the procedure for conducting inspection and taking enforcement action by the Regulatory Body.

1.1.3 Inspections by the Regulatory Body shall not relieve the Consentee of the fundamental obligation to ensure safety of the facility and the protection of NRF personnel, the public and the environment.

1.2 Objective

The objective of this Safety Guide is to provide guidance for regulatory inspection to verify the compliance by the Consentee, of the prescribed safety requirements and for the enforcement action that may follow the inspection. This information would be of interest to both the Consentee and the inspectors from the Regulatory Body.

1.3 Scope

1.3.1 This Safety Guide deals with inspection and enforcement activities of the Regulatory Body in respect of the following:

(a) nuclear power plants and research reactors;

(b) nuclear fuel cycle and related industrial facilities (including facilities for processing of prescribed substances, such as heavy water plants, uranium mines, thorium processing plants, etc.);

(c) radiation facilities (use of radiation in medical, industrial and research applications);

(d) storage and transport of radioactive materials and hazardous substances; and

(e) radioactive waste management facilities.

1.3.2 This Guide also contains guidelines on:

- inspection resources of the Regulatory Body;
- organisation of inspection programmes;
- methods of inspection;
- obligations of the Consentee as regards the regulatory inspection;
- contents of inspection reports; and
- enforcement action.

2. REGULATORY INSPECTION PROGRAMME

2.1 General

2.1.1 The objective of regulatory inspection and enforcement is to ensure that the activities performed by the Consentee during all the stages of the consenting process and the phases of the life cycle of an NRF (siting, design, construction, commissioning, operation and decommissioning or closure) are executed in compliance with the safety requirements. The extent to which inspection is performed in the regulatory process should depend upon the potential, magnitude and nature of the hazard associated with the NRF or type of activity. The programmes should be comprehensive and should be developed within the overall regulatory strategy to ensure that NRF complies with the regulatory requirements.

2.1.2 In order to establish or modify an inspection programme for fulfilling the objectives set out in this Safety Guide, several criteria may be used when selecting the inspection areas and establishing priorities for the inspection programme. In formulating the regulatory inspection programme the following should be considered:

(a) established checklist;

(b) recommendations arising from regulatory review and assessment of safety systems and programme;

(c) performance indicators or any other systematic method for assessment of Consentee performance;

(d) operational review feedback on the system having direct bearing on the safety of NRF and members of the public;

(e) the results of previous inspections;

(f) inspection programmes of the Regulatory Bodies of other countries;

(g) operational experience and lessons learnt from other NRFs within the country and elsewhere as well as from research and development; and

(h) experience of the inspector (s).

2.1.3 The Regulatory Body should be in readiness to undertake inspection activities at any time as per its inspection schedule or as warranted by an unusual event/fault condition reported by the Consentee. For all the inspection areas of safety significance, minimum frequency of inspection should be specified.

2.1.4 Verification of overall Consentee performance also requires inspections that focus on a relatively broad range of subject areas, with adequate depth and frequency. Each planned inspection should have specific objectives, which have been identified in advance and informed to NRF and the inspection personnel. On the other hand, the inspection following an unusual event/fault condition will require an in-depth review of limited systems by specialists.

2.2 Scope of Regulatory Inspection Programme

2.2.1 The scope of regulatory inspection programme should include the following:

(a) developing required procedures for the effective conduct and administration of the inspection programme;

(b) conducting, as necessary, planned inspections during all stages of the consenting process and then throughout the service life of the NRF as well as on decommissioning;

(c) verifying the Consentee's compliance with the regulatory requirements and otherwise assuring continuous adherence to safety objectives [Ref. AEBR/SC/G and AERB/SG/G-1];

(d) carrying out reactive inspections, in response to events, incidents or unusual occurrences as applicable;

(e) documenting its inspection activities and findings;

(f) ensuring that the Consentee has adequate, comprehensive and up-to-date information on the status of the NRF and for the demonstration of its safety, and has a procedure to maintain this information; and

(g) reviewing and verifying corrective actions undertaken by the Consentee.

2.2.2 The regulatory inspection should include both planned and reactive inspections (ref. section 2.4.3). It should be carried out throughout the life cycle of an NRF, and where necessary, should include inspections of vendor facilities and activities too. The inspection should include examinations/observations of:

(a) NRF;

(b) procedures;

(c) records and documents;

(d) surveillance; and

(e) tests.

Besides, interviews with the personnel, the conduction of tests and measurements should also be included.

2.3 Powers of the Regulatory Body in Respect of Regulatory Inspection and Enforcement

2.3.1 The Regulatory Body, as per the Safety Code on 'Regulation of Nuclear and Radiation Facilities' (AERB/SC/G), has the powers to carry out regulatory inspections and take enforcement actions where necessary. These include the powers to:

(a) enter, at any time, for inspection purposes, the site/premises of any NRF under its regulatory control and of its vendors;

(b) inspect, examine, measure, copy, photograph, sketch or test, as the case may be, any building or room, any plant machinery, appliances or apparatus, any person, register or document;

(c) call for necessary reports and documents from the Consentee;

(d) make use of appropriate expertise from other governmental bodies, research establishments, and consultants;

(e) direct the Consentee to take action to remedy deficiencies, curtail activities or shut down the NRF when the results of inspection or other regulatory assessments so warrant;

(f) impose work restriction where found necessary; and

(g) initiate penal action for non-compliance with the specified requirements.

2.4 Types of Inspection

2.4.1 The Regulatory Body should conduct two general types of inspections, namely, planned inspections (including special inspections) and reactive inspections. Either type of inspection may be announced or unannounced.

2.4.2 Planned Inspections

2.4.2.1 Planned inspections are routine inspections carried out in fulfillment of the inspection programme developed by the Regulatory Body. They are scheduled in advance by the Regulatory Body and are usually linked to NRF's schedules for the performance or completion of certain activities at various stages of the consenting process. These inspections provide an opportunity to examine the Consentee's activities in order to verify conformance with safety requirements by the NRF and identify potential problems, if any, at an early stage. These inspections should consider amongst others:

(a) safety significance of the areas to be inspected;

(b) overall performance in the areas to be inspected; and

(c) operational experience and lessons learnt from events/problems at NRF or any other plant.

2.4.2.2 While planning the regulatory inspection, the following information, received periodically, by the Regulatory Body from the Consentee should also be considered:

(a) operating data and experience;

(b) modification and back-fitting information and activities;

(c) radiological information;

(d) environmental monitoring data;

(e) emission and effluent discharge data after treatment;

(f) hazardous waste monitoring data; and

(g) quality assurance information and activities.

2.4.2.3 Special inspections may be carried out for witnessing certain tests/activities and to consider specific issues, which may be of interest to the Regulatory Body, such as new research and development findings and experience at other NRFs. These inspections are usually in the category of planned inspections, since they are scheduled in advance. However under certain circumstances they may be reactive inspections. Such inspections help identifying underlying causes of problems for determining whether a safety concern represents an isolated case or signify a broader more serious problem.

2.4.2.4 Different approaches may be used when planning these inspections, such as:

(a) assessment of the performance of NRF operation;

(b) assessment of maintenance and engineering changes during an outage; and

(c) review of specific system(s) in-depth following an incident and examine its applicability in other NRF.

2.4.3 Reactive Inspections

2.4.3.1 Reactive inspections are especially initiated by the Regulatory Body in response to an unexpected or unplanned, or unusual situation or event, in order to review its significance and implications and the adequacy of corrective actions. A reactive inspection may be occasioned by an isolated situation or event occurring at the particular NRF under consideration, or may by a response to a generic problem encountered at another NRF or identified by the review and assessment staff of the Regulatory Body.

2.4.3.2 Reactive inspection may have to be given priority over planned inspection.

2.4.3.3 In order to allow for reactive inspection, or to aid inspection planning, the Consentee shall inform the Regulatory Body of actions or developments which could affect the ability of the Consentee at any phase during the life cycle of the facility to conform with the requirements established by the Regulatory Body. Matters to be reported by the Consentee should be clearly defined so that difficulties in interpretation can be avoided. This information should include notification of:

(a) unusual occurrences, including abnormal radioactive releases, and any violation of operating limits and conditions;

(b) under-performance or over-performance of any part of the plant/equipment affecting overall safety;

(c) overexposures of personnel;

(d) non-availability of safety equipment;

(e) abnormal test results;

(f) construction deficiencies;

(g) modification and corrective actions;

(h) any other situation giving rise to potential hazards for the site personnel, the public and the environment including lost radioactive sources; and

(i) events, which may be of concern to the public.

2.4.3.4 Notification to the Regulatory Body by the Applicant/Consentee shall be as prompt as is warranted by the situation according to established procedure. The Regulatory Body should establish requirements and guidelines for notification, specifying requirements of reporting periods and the formats.

2.5 Announced and Unannounced Inspections

2.5.1 Inspection by the Regulatory Body, both announced and unannounced, shall be an ongoing activity. An announced inspection is one in which the Consentee has been notified in advance by the Regulatory Body. The timing of the announcement may vary according to the circumstances of the inspection being performed. Inspections may be announced, for examples, when the Regulatory Body wishes to observe a specific test or activity or review a specific Consentee self-assessment, which is in progress. Under certain circumstances an unannounced inspection may be deemed necessary.

2.6 Relationship of Inspection Activities to Consenting Stages

2.6.1 Inspection by the Regulatory Body shall continue throughout all stages in the lifetime of an NRF. The major activities of the inspection process are related to the stages of the consenting process, namely:

(a) siting;

(b) construction;

(c) commissioning;

(d) operation; and

(e) decommissioning.

2.6.2 In each of these stages the Regulatory Body has different inspection needs. The Regulatory Body should organise and adjust its inspection activities to conform to the particular stage through which the NRF is passing. Specifically, as an NRF passes from one stage to another, the Regulatory Body will normally find it necessary to modify:

(a) the levels of attention given to particular inspection areas, and to redeploy its human resources accordingly;

(b) the extent to which various inspection techniques and methods are employed; and

(c) the depth and frequency of the inspection.

2.7 Inspection Areas

2.7.1 Inspection by the Regulatory Body should concentrate on areas of safety significance. These areas are generally those identified:

(a) in the application for Consent and documentation submitted;

(b) by the staff of the Regulatory Body in its review and assessment of the application;

(c) in the requirements and conditions stipulated in the prevailing consent;

(d) by feedback of operating experience at both national and international levels; and

(e) in the structures, systems and components, as brought out by safety assessment studies for the NRF as contributing significantly to safety.

2.7.2 The regulatory attention to major inspection areas continues with varying degrees of emphasis over the full life cycle of the NRF. This Safety Guide

is applicable to different types of facilities; it is therefore not possible for all NRFs to provide the phase wise details of specific areas that would be subject to inspection. The extent to which the areas need to be considered will depend on the nature of the facility and the potential hazard associated with it. Major inspection areas for NRF are presented in the **Appendix**. Typical examples of areas of inspection during commissioning stage are given in the **Annexure.**

2.7.3 Where the Consentee makes use of the services of contractors or products of a vendor, the Regulatory Body should make arrangements with the Consentee for their inspections.

2.8 Inspectors

2.8.1 The Regulatory Body may authorise a person or a group of persons to undertake the inspection functions.

2.8.2 While authorising persons for performing the inspection function, apart from their technical proficiency in the areas to be inspected, their ability to effectively communicate, both orally and in writing, should be considered.

2.8.3 The persons assigned the inspection function should undergo a well-designed orientation programme.

2.8.4 If required, services of qualified outside consultants and advisory committees may be utilised for inspection.

2.8.5 If required, resident inspectors may also be posted at the site.

2.8.6 The responsibilities and authorities of inspectors should be clearly defined.

2.9 Guidelines and Training to Inspectors

2.9.1 The Regulatory Body should provide to the inspectors, inspection related information, training and written guidelines in sufficient details. The guidelines should, while emphasizing on a systematic and consistent approach to inspection, provide for sufficient flexibility built into the plan to permit inspectors to deviate from the laid-down plan in response to particular needs and situations.

2.9.2 The guidelines should be provided in the form of an inspection manual. The manual may cover the objectives of different types of inspection and the following subjects:

(a) development of an inspection programme/plan;

(b) inspectors' responsibilities and authorities;

(c) relevant provisions of applicable rules, codes, guides and other requirements prescribed by the Regulatory Body;

(d) elements of the inspection programme, including:

- areas to be subjected to inspection,
- methods of inspection to be used,
- selection of inspection samples, and
- relevant technical information and questionnaires;

(e) practices on reporting requirements.

2.9.3 The Regulatory Body should organise periodic meetings of the inspectors assigned to various plants, locations or projects for exchange of experiences and reviews on the effectiveness of the inspection programmes.

2.10 Implementation of an Inspection Programme

2.10.1 The Regulatory Body should have an overall plan of inspection programme that it will undertake at an NRF.

2.10.2 The frequency of inspection in the various areas, and levels of effort required in an inspection, depend on the following aspects:

(a) the safety significance of issues involved;

(b) the extent of inspection;

(c) the performance record of the NRF, including the number of violations and deficiencies;

(d) results of review and assessment;

(e) the type of NRF and the duration of each consenting stage;

(f) incidents and problems encountered, and hence the number of reactive inspections required.

2.10.3 The Regulatory Body should also develop a plant or site-specific inspection plan that takes into account the factors mentioned in the previous paragraph. The inspection plans should be reviewed periodically and adjusted, where necessary.

2.10.4 Inspection of premises of vendors and contractors should be conducted through the Consentee. The Consentee shall facilitate necessary access and organise for inspection of items/areas as specified by the Regulatory Body.

2.10.5 The Regulatory Body should also establish a process to periodically evaluate the inspection findings and identify generic issues.

2.10.6 The Consentee should notify the Regulatory Body, well in advance, its schedules for carrying out activities and tests of regulatory interest. On receipt of the schedule, the Regulatory Body may indicate to the Consentee the activities and tests which it would like to observe through a special inspection. The Consentee should respond by submitting or making available, in a timely manner, the procedure for those activities and tests.

2.11 The Obligations of the Consentee with regard to Regulatory Inspections

2.11.1 Co-operation of the Consentee is essential to ensure that regulatory inspection can be carried out in an effective, informed and unhindered manner. The Consentee shall, therefore, provide and facilitate free and prompt access to inspection personnel:

(a) any area of the NRF and its site, for inspection purposes. Consentee, however, should bring to the notice of inspectors the access to areas which would constitute hazards;

(b) all concerned personnel at the NRF for discussion on respective inspection areas;

(c) all relevant documentation; and

(d) his vendors and consultants.

2.11.2 The Consentee should at all times, provide regulatory inspection personnel with such equipment, assistance and support as may facilitate carrying out their functions. These may include:

(a) on-site work facilities;

(b) transport at the site;

(c) access to means of communication;

(d) radiation protection equipment; and

(e) reports, measurements, copies of documents, location photography/and or sketch (of any building or room, plant machinery, appliances or apparatus, person) for the purpose of reporting and further follow-up in connection with safety of the NRF and the protection of NRF personnel, the public and the environment.

3. REGULATORY INSPECTION PROCEDURE

3.1 Preparation for an Inspection

3.1.1 The preparation for an inspection depends on the type of inspection to be carried out. The preparation should take into consideration the following:

(a) type of inspection;

(b) specific inspection plan for the NRF;

(c) detailed study of the inspection areas;

(d) past operating experience related to the inspection area;

(e) previous inspection findings related to the inspection area;

(f) past correspondence between the Regulatory Body and the Consentee on the inspection area;

(g) safety analysis reports and operational limits and conditions;

(h) NRF design and operating documentation; and

(i) consentee management procedures and quality assurance programme.

3.1.2 Preparation for inspection is the responsibility of the team or the individual designated for conducting the inspection. It will be advisable to establish a specific plan for each inspection. For this purpose a comprehensive checklist of the areas to be inspected and the documents to be reviewed/checked should be prepared.

3.2 Staff for Inspection

3.2.1 The Regulatory Body should have adequate strength of staff capable of performing activities stipulated in the inspection programme. The Regulatory Body should also be capable to adequately supervise and evaluate the quality of work carried out by outside consultants when they are used in inspection.

3.3 Consultants

3.3.1 The Regulatory Body may not always be entirely self-sufficient in all technical areas relating to inspection. On such occasions, it may be necessary to augment the strength of the Regulatory Body's inspection staff with suitably qualified consultants. These consultants may be :

(a) experts provided by other governmental departments/bodies, research and development organisations etc.; or

(b) consultants with recognised skill and experience, provided they are not employed by or otherwise closely associated with the Consentee or his vendors.

3.3.2 When consultants are engaged, arrangement should be made for them to have access to the NRF and to any information needed to perform their task.

3.4 Methods of Inspection

3.4.1 The inspection programme of the Regulatory Body should adopt one or more of the following methods:

(a) monitoring and direct observation (e.g. of working practices and equipment and their performance);

(b) discussions with the Consentee's personnel;

(c) examination by review of procedures, records and documentation; and

(d) independent tests and measurements.

3.4.2 Monitoring and Direct Observations

3.4.2.1 The inspection programme of the Regulatory Body should include monitoring (keeping track) of the Consentee's arrangements for monitoring of structures, systems and components, human factors significant to safety (i.e. performance of operating personnel, management attitudes) and of tests and other activities carried out related to safety.

3.4.2.2 The regulatory inspection programme should identify categories of structures, systems, components which should be inspected and the tests and activities to be witnessed by the inspectors.

3.4.2.3 In some cases, the monitoring of a specific structure, system, component, test or activity may be a requirement prescribed by the Regulatory Body as a condition (hold point) for the Consentee to take up subsequent areas of work or operation.

3.4.2.4 The regulatory inspection programme should provide time for general surveillance of the NRF site by the regulatory inspectors. Such observations are for acquiring an overall impression of the Consentee's capabilities and performance and are not tied to specifically designated components and systems or designated scheduled activities and tests. Examples of areas for observation include:

(a) control room and shift handovers;

(b) radiation protection practices including boundaries of controlled areas;

(c) safety systems;

(d) provisions for industrial safety and fire protection;

(e) housekeeping;

(f) interfaces between different sections;

(g) in-process inspection of testing/commissioning;

(h) compliance with quality assurance programmes/procedures;

(i) emergency preparedness;

(j) safe storage of nuclear materials and hazardous chemicals;

(k) management‘s involvement; and

(l) safety culture.

3.4.3 Interviews/Discussions with Consentee's Personnel

3.4.3.1 Regulatory inspectors should, as deemed appropriate, communicate directly with the Consentee's personnel responsible for supervising and performing the activities and tests under inspection. This is especially important in following up problem situations where the inspector is engaged in reconstructing events and assessing the Consentee's response.

3.4.3.2 Consentee's personnel should be kept appropriately informed of inspection activities and Consentee's responses to inspection findings should be

ensured. These considerations can be partially satisfied through discussions and interviews. An interview with the NRF manager and, as appropriate, other key personnel should be a standard feature of most inspection visits.

3.4.4 Examination of Procedures, Records and other Documentation

3.4.4.1 The Consentee is required to record all activities, results and considerations important to safety in siting, design, construction, commissioning, operation and decommissioning or closure of the NRF.

3.4.4.2 Examination of Consentee's documentation contributes to the Regulatory Body's verification of Consentee's compliance. The documentation examined by regulatory inspectors should normally include as relevant to the consenting stage:

(a) management procedures;

(b) consents;

(c) standing fire order;

(d) quality assurance programme, procedures and records;

(e) commissioning reports, test results and data;

(f) technical specifications;

(g) operating procedures and emergency operating procedures;

(h) maintenance and testing procedures and schedules;

(i) operational, maintenance and surveillance records;

(j) records of deficiency and abnormal/unusual events and their analyses;

(k) modification records;

(l) health surveillance records;

(m) radiological safety records;

(n) emergency plans and records of emergency exercises;

(o) minutes of meeting/reports of different committees concerning safety;

(p) records of any safety study carried out;

(q) training and qualification records;

(r) radioactive waste disposal records; and

(s) environmental surveillance and meteorological records.

For details, see Appendix.

3.4.4.3 Sufficient documentation should be inspected to provide reasonable confidence that the Consentee is complying with the Consent requirements at each stage of the NRF in accordance with the practices proposed by the Consentee and accepted by the Regulatory Body.

3.4.4.4 Part of the examination of documentation by regulatory inspectors may in some cases take place away from the site, like for instance at the headquarters, and can facilitate the preparation for inspection of the NRF.

3.4.5 Test and Measurements

3.4.5.1 The Regulatory Body may require tests and measurements to be carried out as part of the inspection programme.

3.4.5.2 Such tests and measurements should be undertaken in consultation with plant management.

3.4.5.3 Where the Regulatory Body itself carries out such tests or measurements it should not require the Regulatory Body (its inspectors or consultants) to assume direct operational control of the plant or any of its systems.

3.4.5.4 The Regulatory Body may seek assistance from outside experts and consultants to undertake tests and measurements.

3.5 Inspection Reports and Findings

3.5.1 Purpose of Inspection Reports

The results of all regulatory inspections should be documented and submitted as inspection report.

3.5.1.1 The purpose of the inspection report is to:

(a) document and record an assessment of the Consentee's safety activities;

(b) crecord the information gathered during inspection, from the NRF;

(c) record any findings or conclusions of the inspectors;

(d) record the recommendations, if any, of the inspectors for future action by the Consentee or the Regulatory Body; and

(e) provide a basis for notifying the Consentee of the inspection findings, and of any requirements, to be complied by him.

3.5.2 The scope, layout and contents of the inspection report should be prescribed by the Regulatory Body.

3.5.3 While deciding the scope, layout and contents of the inspection report, the Regulatory Body should take into consideration that these may vary according to:

(a) the type of NRF and its consenting stage;

(b) the location of the inspection, i.e. plant site or vendor's site or other places; and

(c) the type of the inspection, i.e. whether planned or reactive.

3.5.4 Contents of Inspection Reports

3.5.4.1 Inspection reports may typically contain:

(a) purpose, type and date of inspection;

(b) method used during the inspection (interview, observations, document review, etc.);

(c) reference to Consent requirements and relevant statutory provisions;

(d) criteria used in the assessment;

(e) results of any checks for compliance with the terms and conditions of the Consents for the NRF and of provisions in relevant statutes;

(f) details of NRF areas, activities, processes, systems, or components which have been inspected, assessed or reviewed;

(g) actual or potential problems relating to safety;

(h) any deficiency or violation found during regulatory inspections;

(i) any on-the-spot regulatory action taken by inspectors and any consequent action taken by the Consentee during the period covered by the report;

(j) relevant discussions held with the staff, management and other persons of NRF, including response of NRF management on points of concern found during inspections;

(k) status of earlier regulatory inspections and enforcement actions;

(l) recommendations for future action; and

(m) copy of documentary evidences, if any, as Annexure to the report.

3.5.5 Use of Inspection Reports

3.5.5.1 Inspection reports will be useful to:

- provide information to the Regulatory Body staff responsible for review and assessment;
- provide a basis for identifying items which require regulatory action and for initiating action;
- maintain the regulatory record of the concerned NRF for future reference;
- provide a basis for periodic reviews of inspection findings, including trends and root causes;
- identify changes that may have to be incorporated in the statutes and/ or standards; and
- share information about safety status of NRF with those interested.

3.5.5.2 It is advisable that the salient contents of inspection reports pertaining to different facilities are presented at periodic meetings in which all the inspectors and others concerned within the Regulatory Body should participate. This will add to the knowledge of the inspecting staff and help them in future inspections.

3.5.5.3 Inspection findings should be forwarded to the Consentee for necessary corrective actions.

4. ENFORCEMENT ACTION

4.1 General

4.1.1 The Regulatory Body has statutory powers to enforce compliance with the requirements as laid down in relevant statutes and/or Consents, including the authority to require a Consentee to modify and correct, procedures, practices, systems, structures or components or curtail any aspect of an NRF's operation as necessary to ensure the required level of safety.

4.1.2 Enforcement actions which are taken under those powers are designed to address non-compliance with the specified conditions and requirements noticed during inspection. These actions shall commensurate with the seriousness of the non-compliances. Thus the enforcement actions are graded, ranging from written directives/warnings to penal actions and, ultimately, withdrawal of Consent. In all cases the Consentee shall be required to correct the non-compliance, to perform a thorough investigation on an agreed time-scale and to take all necessary measures to prevent a recurrence. The Regulatory Body shall ensure that the Consentee has implemented corrective actions.

4.2 Types of Enforcement Actions

4.2.1 The following types of enforcement measures are available to the Regulatory Body :

- written directives;
- written warnings;
- orders to curtail activities;
- modification or revocation of Consents or Authorisations; or
- initiation of penal actions.

4.2.2 The type of enforcement action to be taken should be decided on

consideration of the factors listed in section 4.2.3 but in many cases it may be possible to resolve any non-compliance through discussions with the Consentee. Where such a process is inappropriate or has been unsuccessful, it would be necessary to invoke one of the above formal measures. In determining the enforcement measure to be applied, it should be noted that for some NRFs or at some phases of an NRF's life cycle the option to curtail activities may not be avoidable.

4.2.3 The factors to be taken into account by the Regulatory Body in deciding the type of enforcement action required in each case should include:

(a) the safety significance of the deficiency, and/or seriousness of the violation;

(b) whether it is a repeat of violation; and

(c) whether there has been deliberate or wilful violation of the prescribed limits and conditions or of provisions in relevant statutes.

4.3 Nature of Violations which Invite Different Enforcement Actions

The nature of violations in respect of which the Regulatory Body may take different enforcement measures, is outlined below.

4.3.1 Written Directives

4.3.1.1 Deviations from or violation of Consent requirements, or unsatisfactory situations, may occur at any stage or any phase of the NRF's life cycle. Under such circumstances the Regulatory Body should consider issuing a written directive to the Consentee.

4.3.2 Written Warnings

4.3.2.1 If the Consentee fails to take corrective actions in response to the written directives, the Regulatory Body should consider issuing written warnings.

4.3.3 Any written warning or directive should specify the particulars of each violation, deviation or unsatisfactory situation. It should also specify the period of time for taking corrective actions. This is the most common form of enforcement action.

4.3.4 Orders to Curtail Specific Activities

4.3.4.1 In the event of apparent deterioration of the NRF's structures, systems or components or in case of serious violations which in the judgment of the Regulatory Body pose an imminent hazard to the site personnel or the public and the environment, the Regulatory Body may require the Consentee to curtail activities. During the operational phase, for example, this could mean requiring conditional operation, reduction in power/production capacity, pressure, temperature or other relevant parameters, including, if necessary, shut down of the NRF.

4.3.5 Modification, Suspension or Revocation of the Operating Consent.

4.3.5.1 In the event of chronic or extremely serious non-compliance, or significant contamination of the environment due to serious malfunction or damage to the NRF, the Regulatory Body may modify, suspend or revoke the Consent, depending upon the nature and severity of the situation.

4.3.6 Penal Action

4.3.6.1 For serious violations or repeated violations of a less serious nature or for deliberate non-compliance of the applicable provisions of the Atomic Energy Act, 1962 and the Rules, issued thereunder, and of the requirements stipulated by the Regulatory Body, the latter may initiate penal action as prescribed in the Atomic Energy Act, 1962.

4.4 Inspector's Authority in Relation to Enforcement

4.4.1 The extent of authority delegated to the regulatory inspectors to take on-the-spot enforcement actions shall be specified by the Regulatory Body.

4.4.2 If regulatory inspectors are not permitted to take on-the-spot enforcement action and are required merely to inform their superiors of the situation and to propose necessary action, the speed of transmission of information to the Regulatory Body shall be suited to the urgency of the situation so that necessary actions are taken in time; information shall be transmitted immediately if the inspectors fear danger to the health and safety of the NRF personnel or the public or protection of the environment. The

Regulatory Body may delegate part of its decision-making authority to the inspector.

4.5 Enforcement Procedures

4.5.1 The Regulatory Body should have written instructions/guidelines on enforcement actions and procedures, for the benefit of those who are incharge of initiating enforcement action. The instructions/guidelines should also indicate the powers delegated to various levels of inspectors. All inspectors and other staff of the Regulatory Body should be made conversant with the above instructions/guidelines through suitably designed training/counselling programme.

4.5.2 All enforcement decisions shall be intimated to the Consentee in writing.

4.5.3 Enforcement actions taken on the spot by regulatory inspectors are appropriate only in unusual situations. In normal situations, decisions regarding enforcement actions, particularly those involving punitive actions, curtailment of activity or suspension of consents, shall be taken by the Regulatory Body according to the established procedures.

4.5.4 Regulatory procedures should state the circumstances under which it is appropriate to carry out further inspections to check whether the Consentee has responded to regulatory and enforcement measures.

4.6 Appeal against Decisions

4.6.1 In case of disagreement on the decisions of the Regulatory Body, the Consentee may appeal against such decisions to the Atomic Energy Commission (AEC) whose decision shall be final.

4.6.2 Even if the Consentee intends to prefer an appeal to the AEC against the decisions of the Regulatory Body, NRF the former shall implement the measures intended to protect the NRF personnel, the public and the environment against any radiological hazard.

5. QUALITY ASSURANCE

5.1 General

5.1.1 The quality assurance system of the Regulatory Body should encompass its inspection and enforcement activities. Such system for the inspection department should cover the following:

- management of inspection and enforcement activities;
- record of inspection and enforcement; and
- review of inspection and enforcement actions.

The specific features of the system are detailed below:

5.2 Management of Inspection and Enforcement Activities

5.2.1 Management of inspection and enforcement activities within the Regulatory Body, is an important facet of the consenting process. Consideration should be given to placing managerial responsibility in a single individual or organisational unit. These responsibilities include:

(a) planning of inspection activities;

(b) developing the guidelines and procedures for inspection;

(c) determining the type of inspection;

(d) determining the resources to be used in an inspection;

(e) making necessary arrangements for the co-ordination of inspection activities with the review and assessment process, particularly where this is tied to a programme agreed between the Consentee and the Regulatory Body (if such a programme exists);

(f) making arrangements for co-ordination with consultants or other

organisations as deemed appropriate;

(g) maintaining a record of inspection activities;

(h) ensuring that follow-up actions from inspections are taken;

(i) ensuring that there is a feedback of inspection findings at a particular NRF to inspectors involved in inspection of similar NRFs;

(j) ensuring that enforcement actions are carried out properly and within the legal framework and that corrective actions are performed;

(k) carrying out periodic review and assessment of the effectiveness of the inspection programme; and

(l) making arrangements for training of inspectors.

5.3 Record of Inspection and Enforcement

5.3.1 The format, for recording the inspection findings and the action taken thereon, should be such that information is easily retrievable and auditable.

5.3.2 All communications between the Regulatory Body and concerned other government departments, the Consentee, the consultants and the general public should be promptly recorded and stored for future reference.

5.4 Review of Inspection and Enforcement Actions

5.4.1 The Regulatory Body should have a system to assess, review and monitor all aspects of its inspection and enforcement activities to ensure that they are being carried out in an effective manner. The system should ensure that any changes due to improvements in techniques or otherwise are implemented. This system should consider among other matters:

(a) inspection guidance;

(b) inspection methods;

(c) allocation of inspection resources;

(d) procedures within the Regulatory Body in relation to inspection activities, such as procedures for planning of inspections and dealing with outstanding issues;

(e) procedures for co-ordination of inspection activities with the review and assessment process;

(f) procedures for involving consultants in inspection activities;

(g) maintaining documentation;

(h) procedures related to enforcement actions; and

(i) effectiveness of enforcement actions.

APPENDIX: A

INSPECTION AREAS FOR NUCLEAR AND RADIATION FACILITIES

The Appendix presents areas of nuclear and radiation facilities that may be of particular interest for inspection in different stages of consents.

A.1 The Siting Stage

A.1.1 Before construction of the NRF begins, the Regulatory Body should monitor, through its inspection programme, site preparation activities undertaken by the Consentee, including verification of site characteristics (which are input to site clearance and design of the NRF), and authorised excavation and earthwork.

A.1.2 Specific inspection objectives in these areas include verification that the Consentee is undertaking siting activities in conformity with existing regulatory requirements, and the assurance that the site preparation work does not proceed beyond that permitted by any Consent in force. During site preparation the Regulatory Body should also be concerned with confirming that the site characteristics remain consistent with the description presented by the Applicant in his application and in the subsequent supporting documentation submitted along with it. This is vital for disposal sites for which a major barrier to the movement of radionuclides is dependent on the site characteristics. In addition, inspectors should be alert to any new conditions or information being revealed as a result of activities for site preparation, which should then be considered by the Regulatory Body in making subsequent consenting decisions.

A.2 The Construction Stage

A.2.1 The main objectives of the regulatory inspection programme during design and construction of the NRF are to verify that

(a) site specific data such as for soil characteristics, hydrology, etc., as reported, are acceptable and appropriately incorporated;

(b) safety related materials, structures, systems and components (SSCs), meet the requirements established by the Regulatory Body and conform to relevant standards and established good practices;

(c) construction activities associated with fabricating and installing these SSCs are conducted in accordance with regulatory requirements and in conformity with general safety objectives; the as built configuration of SSCs is in conformity with the assumptions made in the review and assessment; any deviation is analysed and justified and the documentation is updated; and

(d) the Consentee's quality assurance and inspection system and procedures are adequate to ensure the conformance of equipment/ components to the technical specifications.

A.2.2 To attain these objectives the Regulatory Body should inspect the design and construction activities in a number of areas. This is because of the difficulty of detecting and correcting deficiencies, subsequent to construction. Some difficulties will be faced in detecting and correcting deficiencies once fissile and radioactive material is present on the site and the NRF has been loaded with fuel or charged with process fluid/chemicals and enters the commissioning stage. In particular, the following areas should receive close attention during the construction stage:

(a) foundation strata of safety-related structures after excavation;

(b) mixing and placement of concrete and its reinforcement, especially in:

- foundation, and
- safety-related structures, particularly containment structures;

(c) construction of cooling water intake, discharge systems and the

ultimate heat sink;

(d) installation of safety-related components; particularly

- the reactor coolant pressure boundary (for nuclear power plant),
- the internals of the vessels which will contain fissile and radioactive materials,
- containment and shielding boundaries, and
- the equipment to be used in radioactive areas;

(e) installation of safety-related control, protection and power systems;

(f) areas of the NRF that are inaccessible after construction is completed, particularly systems and components embedded in the foundation or building structure;

(g) housekeeping in respect of safety-related SSCs;

(h) storage of process chemicals/fluids;

(i) safety valves/safety devices;

(j) construction and installation of stack;

(k) stability of structures and provision of escape routes;

(l) effluent treatment plant;

(m) storage/preservation of equipment and systems;

(n) the quality assurance systems of the designer, the manufacturer and the constructor; and

(o) those parallel construction activities, which are inconsistent from quality assurance consideration.

A.3 The Commissioning Stage

A.3.1 Activities associated with commissioning of the NRF will normally begin before construction is completed. Accordingly, the Regulatory Body

should be prepared to inspect areas of commissioning activity concurrently with inspection of construction stage activities. The Regulatory Body should review the commissioning programme and identify certain hold points for which its permission has to be obtained by the Consentee. Regulatory inspection personnel should be present to observe identified key commissioning activities/tests at various stages of commissioning.

A.3.2 Inspection by the Regulatory Body during the commissioning stage should focus on the following identified phases/areas of Consentee activity:

(a) testing before introduction of fissile and radioactive material;

(b) initial introduction of fissile and radioactive material;

(c) testing of operations involving fissile and radioactive material; and

(d) other commissioning activities.

A.3.3 Testing before Introduction of Fissile and Radioactive Material

A.3.3.1 This inspection area encompasses inspections, tests and related activities to be performed before the introduction of fissile and radioactive material by the Consentee to demonstrate that SSCs function properly and conform to design requirements. It also covers the inspection and acceptance criteria of the receipt of fissile and radioactive materials at the facility. The regulatory inspection programme should include:

(a) examination of documented procedures to verify compliance with review and assessment conclusions;

(b) review of the implementation of these procedures;

(c) direct observation of the performance of certain key pre-operational tests;

(d) examination of the results of selected tests; and

(e) confirmation of the integrity of any engineered barrier.

A.3.3.2 The number and the key tests examined and directly witnessed by the Regulatory Body will depend on factors such as the importance of the test for safety, the resources available to the Regulatory Body and whether the

facility being commissioned is the first of its kind or one of a series of similar facilities. The Regulatory Body should, however, place particular emphasis on inspection, through examination of documentation and direct observation of some of the tests performed on those SSCs. These tests should be those:

(a) that prevent unsafe conditions or mitigate the consequences of anticipated operational occurrences and accident conditions; or

(b) whose failure to operate properly will require action from one or more of the above safety related components or systems.

A.3.3.3 This may involve the Regulatory Body in inspecting tests of:

(a) safety systems (e.g. instrumentation and control systems, shutdown systems and stand-by systems, emergency core cooling system);

(b) the integrity of the primary pressure boundaries (e.g. hydraulic tests of pressurised structures);

(c) the susceptibility of SSCs to vibration or to other design loads;

(d) the containment integrity (e.g. overpressure and leak rate tests) as appropriate;

(e) emergency power systems as appropriate;

(f) communication capabilities;

(g) ventilation systems;

(h) integrated cold and hot functional tests; and

(i) radiation protection and radioactive effluent monitoring systems.

A.3.4 Introduction of Fissile and Radioactive Material

A.3.4.1 The regulatory inspection programme should give close attention to Consentee's activities relating to preparation for and actual introduction of fissile and radioactive material. Regulatory inspection personnel should be present at the NRF site to observe some of these activities.

A3.4.2 Although some of these tests may be performed at times other than when fissile and radioactive material are first introduced, the Regulatory Body should be involved in inspecting the following:

(a) tests of the main control room (commissioning and tests);

(b) access control and implementation of the radiation protection programme;

(c) emergency preparedness and demonstration of the emergency plan;

(d) systems for monitoring radioactive releases and meteorological monitoring systems; and

(e) the distribution of fissile and radioactive material (such as the fuel loading pattern in a reactor) and checks on process and/ or criticality calculations, as appropriate.

A.3.5 Testing of Operations Involving Fissile and Radioactive Material

A.3.5.1 This inspection area encompasses Consentee’s activities performed in situations up to nominal operating conditions. At this point, SSCs are tested in an operational environment to ensure that they have been constructed and installed properly and are capable of functioning in accordance with approved design requirements. Over this period the Consentee is carrying out tests at increasing operational levels; the testing includes recording and analysis of data relating to temperatures, pressures, flows and variations in process parameters as well as other parameters.

A.3.5.2 Regulatory inspection personnel shall examine and assess the safety aspects of a sample of the Consentee's procedures for conducting operational tests. In addition, on completion of the tests, a sample of the test documentation and inspection results should be examined by regulatory personnel to verify that the tests have been completed in accordance with the test instructions and that the results are acceptable. Regulatory inspection should also involve monitoring and direct observation of several tests.

A.3.5.3 Important tests during this phase should be subject to regulatory review and inspection, and will depend on the type of NRF being commissioned. They include, tests to the extent possible to demonstrate that:

(a) systems respond to malfunctions in accordance with claims made by the safety analysis; and

(b) the NRF is being operated in accordance with the descriptions made in safety analysis.

A.3.6 Other Commissioning Activities

A.3.6.1 In addition to the examination of documentation and the surveillance tests, a number of other areas require inspection by the Regulatory Body during the commissioning stage. The inspection should include the ability of the Consentee's management to progress from supervising construction to supervising operation, and its arrangements for this, management's provisions for putting the emergency plan into effect, and for training and qualification of the personnel. Hold points during the operational testing phase and into the full operational phase should be closely monitored. These areas largely overlap, requiring continuing inspection attention during the operation stage.

A.3.7 A typical example of the areas for inspection during commissioning phase is given in the Annexure.

A.4 The Operation Stage

A.4.1 Once the NRF has attained the authorised operation stage, the Regulatory Body shall implement an inspection programme to verify systematically Consentee’s compliance with regulatory requirements and conformance to general safety objectives, and to detect potential safety problems. This verification should comprise monitoring and direct observation of activities in a balanced manner; interviews with plant personnel, including managers; review of qualifications of the Consentee's personnel; and sampling documents. For waste management and particularly waste disposal facilities, the structure of the programme and tests carried out will be primarily concerned with conformance to the relevant design and waste acceptance criteria for the facility and will be a consistent part of providing confidence for the long term safety case. For all NRFs these inspections should cover the following areas.

A.4.2 Operations

A.4.2.1 The area of operations should include control and execution of activities directly related to operating an NRF to the operational limits and conditions established by regulatory requirements or by procedures or specifications. Inspection personnel should perform an operational safety verification of, the operating procedures, the operating configuration of safety systems, the control room activities, and the abilities of the operation staff to discharge their duties. Simulator training (where

simulator facility exists) and operator responses to abnormal events and emergency conditions, as well as the adequacy of management involvement, should also be assessed. To perform this operational safety verification, the following should be carried out.

A.4.2.2 *Operating Procedures:* A sample review of operating procedures, including those for normal operations, abnormal or off-normal conditions, and emergency conditions, should be performed.

A.4.2.3 *Safety Systems:* A sample review of safety systems should be performed to evaluate any identified degraded equipment, discrepancies between installed component/system hardware and the NRF drawings, controls for performing maintenance of equipment and the quality of performance of operations staff in log-keeping and record-keeping and in routine monitoring of equipment. Note should be taken of the effectiveness of the operations staff in having degraded equipment repaired by the maintenance staff or in having it promptly evaluated to ensure operability. Inspection of the NRF should also include observations of the non-safety-related areas to ensure that discrepancies do not have an adverse impact on the safety of the NRF. The adequacy of fire protection and prevention programme, including the management's attention to this area, should be noted during these inspections.

A.4.2.4 *Control Room Inspections:* During control room inspections, which may include round-the-clock shift observations, inspection personnel should focus on the operator's adherence to the limits and conditions for operation and/or procedures to assess their usability and adequacy. Problems in this area may require sustained control room observations. The inspector should check the availability of safety systems and observe the way they are handled by the operators.

A.4.2.5 *NRF's Training Programme:* Adequacy of the NRF's staff training programme should be assessed routinely to ensure that the training reflects actual NRF conditions.

A.4.2.6 *Management:* The management's involvement in the NRF and in the control room should be noted, and its effectiveness in providing the appropriate attention to operational issues including abnormal events should be assessed. Effective management involvement can be reflected in the attitudes of control room staff during operator communications, the

highly professional control room decorum, and management's continued emphasis of operational safety to the staff.

A.4.3 Radiation Protection

A.4.3.1 The area of radiation protection should cover all activities related to radiation protection of the NRF and contractor personnel and the public to ensure that adequate protection measures are established.

A.4.3.2 *Organisational Structure for Radiation Protection:* The organisational structure, the procedures required for radiation protection programme implementation, and management effectiveness with respect to radiation protection should be assessed. Indicators of management effectiveness include low levels of radiation exposure of personnel and low levels of contamination in working areas, minimal radiological emissions and release of effluents, and understanding of the radiological control programme on the part of workers. Any self-assessments performed by the Consentee in these programmes should be reviewed.

A.4.3.3 *Occupational Radiation Exposure Records*: Inspection personnel should selectively review records of occupational radiation protection for both internal and external exposures. Work activities should be observed in the NRF to ensure that procedural and management controls are effective. This includes controls for radiation boundaries and contaminated areas, and the inspection of internal and external dosimetry activities. Exposures of personnel exceeding the Consentee's administrative dose limits and contamination limits in the radiologically controlled areas should be noted. Radiation protection training for technicians monitoring controlled areas and training for personnel working in controlled areas should also be assessed.

A.4.3.4 *Effluent Management:* The effluent management programme should be reviewed to verify that effluent characteristics are within the established limits. This should include review of radioactive waste treatment process, and effluent and environmental monitoring. Training and qualifications for technicians and workers employed in these areas should also be reviewed.

A.4.3.5 *Environmental Monitoring:* Environmental monitoring and protection programme should be reviewed occasionally to ensure that it is being

performed in accordance with NRF procedures. Independent measurements may sometimes be performed to verify the accuracy of the Consentee's monitoring equipment and measurement results.

A.4.3.6 W*aste Management:* The implementation of arrangements for on-site waste treatment, conditioning and storage should be reviewed and the records inspected. In particular, waste characterisation process, compliance with waste acceptance requirements, and records thereof should be subject to inspection.

A.4.3.7 Where unpackaged waste, or where waste packages are stored or placed in a waste repository pending a decision on closure, the possibility of degradation of the waste with time exists. The waste storage conditions and waste packages should be inspected at appropriate intervals to give confidence that the waste remains suitable for treatment or that the waste packages will be suitable for retrieval, transport and further steps for radioactive waste management as needed.

A.4.3.8 Transport arrangements for radioactive material on site should be examined. Status and arrangement for receipt and despatch should be inspected with attention paid to package integrity, residual levels of contamination and associated records and contingency plans to handle accident situations.

A.4.4 Maintenance, Inspection and Testing

A.4.4.1 The area of maintenance, inspection and testing comprises assessment of implementation of the maintenance, inspection and testing programme. This should include:

(a) all types of maintenance performed on NRF structures, systems and components, or maintenance of the physical condition of the NRF; and

(b) inspection and testing, which should include the conduct of all surveillance testing activities, all in-service inspection and testing, instrument calibrations, equipment operability tests and other special tests.

A.4.4.2 Direct observation by the Regulatory Body should include a sample check of the Consentee's inspection and testing activities, involving such tests, like calibration of nuclear instrumentation systems, verification of containment integrity, containment leak rate test, etc.; testing of piping support and restraint systems; tests for pumps, valve capacity and stroke timing; and breaker and transformer surveillance tests. Inspectors should note the capability of the individuals performing the tests and, in case of more complex surveillance observed, should assess the interface between the surveillance personnel and the operations staff involved in the performance of the test. The adequacy and usability of the procedures and the control and calibration of the test equipment should be observed. The inspection personnel should note management's involvement in these programmes to ensure that the programmes are effective and that safety equipment is being properly maintained, with few recurring problems. Maintenance of backlogs, the frequency with which repetitive repairs on safety-related equipment are carried out, and the amount of maintenance work actually being performed should be routinely noted, as these may be early indicators of declining performance in the maintenance programme. A high backlog or a high number of equipment failures and inadequate maintenance may be indicative of a maintenance programme that is difficult to manage and where little work can be performed without an unreasonable amount of documentation. Self-assessment activities in these programmes should be observed and the related findings routinely reviewed.

A.4.4.3 A sample of maintenance activities including inspection and testing should be routinely observed in the NRF to assess the adequacy of programmes and procedures and the capability of the maintenance technicians to perform their assigned tasks. The maintenance planning and scheduling should be assessed to ensure that maintenance activities are performed by competent staff and properly co-ordinated and that the appropriate priorities are given to the equipment being repaired. All types of maintenance activities should be observed. Special attention should be given to the isolation and tagging of out-of-service safety systems prior to the performance of maintenance work. Inspectors should observe implementation of the procedures for these isolation and tagging controls to evaluate their adequacy. In-service inspection and in-service testing programmes should be reviewed to ensure that their purpose, which is to

ensure reliability in the early detection of equipment or component degradation, is being satisfied. Programmes, procedures and data should all be reviewed and evaluated, particularly those that can only be done during outages. Data, which may indicate that a high number of components/systems need repair may require a further in-depth review of the programmes. Repair of piping systems, pumps, valves, electrical systems, and instrumentation and control systems should all be selectively sampled for review. Welding on NRF systems of safety significance, including non-destructive examination, should be observed.

A.4.5 Engineering

A.4.5.1 Engineering usually provides necessary support to the operation or maintenance staff in the NRF. It assists the operation staff in the evaluation of non-conforming or degraded conditions in the NRF and help the maintenance staff in the performance of activities in which problems may arise. Inspection personnel should review a sample of the evaluations for non-conforming or degraded conditions for both adequacy and quality, and should observe the interface between the maintenance and support engineering groups.

A.4.5.2 The inspector should walk down a portion of a system to assess how well the systems are being maintained and should note any non-conformance. Any problems identified by the inspector but not known to the NRF's management would reflect on the adequacy of the system engineering support programme.

A.4.5.3 Modifications may range from simple to complex, with most of the design engineering work usually performed prior to an outage and the actual installation work performed during the outage. Inspectors should review the procedures for planning and installing the modification and actually verify a sample of the installed modification and, where appropriate, verify that regulatory conditions have been met. A review of the process for evaluating a potential change to the safety analysis should be assessed. A sampling of evaluations should be reviewed to ensure that, if modification did require a change to the safety analysis, the prior approval of the Regulatory Body was taken. It should also be checked that the appropriate documentation and drawings were updated and any necessary retraining imparted. The quality of engineering reviews and the

qualification of the engineering staff should be assessed. The number of design changes and modifications performed on an annual basis should be noted.

A.4.5.4 Inspection should cover activities during outage, if appropriate, particularly in reviewing the engineering area. In addition to observance of modifications to the installation, outages provide opportunities to observe activities in areas that are not always accessible during normal operation. Certain activities, such as inspections within a highly radioactive area or maintenance and repair of highly contaminated systems or movement of fissile and radioactive materials, provide a number of challenges to the Consentee's engineering organisation. Inspection during outages can provide valuable insights into management's ability to perform such tasks.

A.4.6 Emergency Preparedness

A.4.6.1 This area should include the review of the emergency response plans and procedures in order to verify that there exists sufficient means to cope with an emergency. Procedures for emergency detection, classification and decision making as also those for notification, communication, shift staffing and shift augmentation, and dose calculation and assessment should be assessed. Emergency exercises should be witnessed to ensure that the emergency planning is adequate and its implementation is effective.

A.4.7 Access Control

A.4.7.1 This area should include all activities with access control, the physical protection of equipment in safety-related areas and fitness for duty programmes, if applicable. Inspection personnel should routinely monitor the access controls to the NRF. The impact of the physical security hardware on accessibility and the ability of the operator to operate the NRF safely should routinely be assessed. Inspection personnel should also review the fitness for duty programme and assess its effectiveness.

A.4.8 Quality Assurance Programmes

A.4.8.1 This area should include the Consentee's ability to perform in-depth self-assessment reviews of its own activities. The self-assessment function should have strong management support for its findings to ensure prompt correction of any deficiencies found. The organisation should be reviewed to ensure that the programme adequately covers all types of NRF activity, in addition to those discussed above, procurement, receipt, storage and handling of equipment, document control, status control, plant design change control, operational experience, and others as considered appropriate. The quality of the findings and the promptness, adequacy and effectiveness of the Consentee's corrective actions should be assessed.

A.4.9 Effectiveness of Management Systems

This area should include those indicators, which demonstrate the NRF management system focused on safe operation and on identification and remediation of problems and weaknesses within the programme. This would include management's involvement in day-to-day operations and its routine presence in the NRF. Most important is the question of whether management demonstrates a willingness to hear problems and ensure that they are promptly evaluated and solved. The management's ability to create an environment in which problems are openly identified and discussed, and where self-assessment programmes are effectively supported, contributes to an appropriate culture for safe operation of the NRF.

A.5 The Decommissioning Stage

A.5.1 During the decommissioning stage of an NRF, inspection activities should concentrate on the:

(a) removal of radioactive material;

(b) management's decommissioning strategy for radioactive material;

(c) depressurising and draining of fluid, if any;

(d) decontamination and dismantling activities;

(e) waste management strategy for the treatment, conditioning,

storage and disposal of all radioactive wastes;

(f) physical condition of the NRF, especially the surveillance of the integrity and/or availability of relevant NRF's structures, systems and components, including protective barriers and appropriateness of the procedures at each stage of decommissioning;

(g) characterisation of the residual activity;

(h) physical security, safeguards and access control;

(i) radiological monitoring and surveillance, including occupational and public protection plan;

(j) adequacy and maintenance of instrumentation and control systems for long-term safety;

(k) making the equipment free from all chemicals;

(l) storage and disposal of hazardous materials/chemicals; and

(m) environmental monitoring.

A.5.2 In a period of prolonged safe closure, some of these inspection activities may be reduced in thoroughness and frequency.

A.5.3 Closure of Waste Disposal Facility

A.5.3.1 Before the Regulatory Body considers the release of any waste disposal facility from further regulatory control, inspection activities should be concentrated on:

(a) confirmation of the overall waste inventory; and

(b) sealing arrangements for the NRF including any measures to prevent intrusion and arrangements for any post-closure environmental monitoring.

A.5.4 Areas of Interest Relating to the Release of an NRF and/or Site from Regulatory Control

A.5.4.1 To release a site from further control, regulatory inspection should be carried out to confirm that any residual activity has been reduced to acceptable levels. For waste disposal facilities, the release from control will be related to the long-term safety of the NRF as set out in the post-closure safety case.

B : ANNEXURE

TYPICAL EXAMPLE OF AREAS OF INSPECTION DURING COMMISSIONING STAGE

B.1 Nuclear Power Plants/Research Reactors

Inspection of a pressurised heavy water reactor (PHWR) based nuclear power plant (NPP) should be planned during the following broad phases of commissioning as per AERB Safety Guide on 'Consenting Process for Nuclear Power Plants and Research Reactors: Documents Submission, Regulatory Review and Assessment of Consent Applications' (AERB/SG/G-1). Similar to the PHWR based NPP, commissioning phases and areas of inspection shall be identified for other types of NPPs and research reactors.

B.1.1 Phase-A Commissioning**:**

Phase-A commissioning of a PHWR includes hot conditioning of primary heat transport (PHT) system, light water commissioning, initial fuel loading in the reactor core and heavy water addition to the PHT and

moderator systems. Inspection should include the following in particular during these sub-phases:

B.1.1.1 Hot Conditioning of the PHT System

(i) status of Consent;

(ii) examination of records related to construction completion certificates and compliance of their quality assurance for the construction of structures, erection of equipment and installation of component;

(iii) audit of:

(a) commissioning test reports for all the systems identified as pre-requisites for hot conditioning and light water commissioning tests;

(b) quality history dockets for safety related structures, systems and components supplied by the manufacturers/erection and construction agencies;

(c) acceptance reports for the design concession requests;

(d) safety related engineering correction notices;

(e) test reports of the safety valves;

(f) review of deficiency reports, corrective actions/plans with their follow-up;

(g) adequacy of pre-operational checks/tests performed on the PHT systems (viz. air-hold test, hydro-test, valve performance test, logic, interlocks, calibration of instruments, vibration of equipment, etc.);

(h) satisfactory performance of the coolant tube leak monitoring and detection system, viz. annulus gas monitoring system (AGMS);

(i) quality assurance (QA) records for verification and validation of computer based systems for hardware as well as software;

(j) commissioning procedures;

(k) pre-service inspection base line data; and

(l) emergency handling procedures.

(iv) special tests conducted to demonstrate the functional adequacy of the safety systems/safety related systems (viz. reactor shutdown systems, compressed air failure tests, emergency core cooling system (ECCS) integrated tests, containment proof and leakage rate tests, PHT instrumented relief valves opening test, Class-IV power supply failure tests, 220V DC control power supply failure tests, PHT feed and bleed valves failure tests, diesel generator (DG) acceptance tests, battery discharge tests, PHT primary coolant pumps (PCP) trip test/ PHT coolant flow coast down test, etc.);

(v) industrial safety and first aid arrangement;

(vi) arrangement for preservation of installed components/equipment, instrumentation, etc. for a commissioned system;

(vii) adequacy of spares;

(viii) availability of qualified manpower as stipulated in the Consent;

(ix) availability of clearances from various regulatory authorities (such as the Central and State Pollution Control Boards, State Chief Inspector of Boilers, etc.);

(x) housekeeping;

(xi) availability of approved technical specifications for operations; and

(xii) availability of updated safety analysis reports and design manuals.

B.1.1.2 Fuel Loading in the Core

(i) status of Consent; and

(ii) testing before fuel loading

The inspection area encompasses activities and tests performed before fuel loading by the Consentee to demonstrate that structures, systems and components function properly and conform to design requirements. It also covers the inspection and acceptance criteria of fresh fuel. The regulatory inspection

programme should include:

(a) examination of documented procedures to verify compliance with review and assessment conclusions;

(b) review of the implementation of these procedures;

(c) direct observation of the performance of certain key pre-operational tests; and

(d) examination of the results of selected tests.

(iii) The number and type of the key tests examined and directly witnessed by the Regulatory Body will vary depending on such factors as the importance of the test for safety, the resources available to the Regulatory Body, and whether the nuclear power plant being commissioned is the first of its kind or one of a series of similar plants. The Regulatory Body should, however, place particular emphasis on inspecting through examination of documentation and direct surveillance of some of the tests performed on those structures, systems and components:

(a) that prevent unsafe conditions or that mitigate the consequences of anticipated operational occurrences and accident conditions; or

(b) whose failure to operate properly will require action from one or more of the safety related components and systems.

This involves the Regulatory Body in inspecting tests of:

(a) safety systems (e.g. emergency core cooling systems, related instrumentation and control systems, shutdown systems and containment systems);

(b) integrity of the reactor coolant pressure boundary (e.g. hydraulic systems);

(c) susceptibility of structures and components to vibrations or to other design loads;

(d) containment integrity (e.g. proof and integrated leak rate tests);

(e) emergency power systems;

(f) communication capabilities;

(g) ventilation systems; and

(h) integrated hot functional tests.

(iv) *Initial Fuel Loading*

The regulatory inspection programme should give attention to Consentee activities relating to preparation for and actual loading of the nuclear fuel; and although some of these tests may be performed at different times other than at fuel loading, the Regulatory Body should be involved in inspecting:

(a) main control room (commissioning and tests);

(b) access control and implementation of the radiological protection programme;

(c) emergency preparedness and demonstration of the emergency plan;

(d) systems for monitoring radioactive releases and meteorological monitoring systems; and

(e) fuel loading pattern and criticality calculations.

B.1.1.3 Heavy Water Addition to PHT and Moderator Systems

Regulatory inspections for the stages of heavy water addition to PHT and moderator systems should include in particular:

(i) availability of approved procedures for heavy water addition and their compliance;

(ii) availability of approved technical specifications for operations in the control room and its compliance;

(iii) audit of:

(a) commissioning reports of reactor shutdown systems, core cooling systems and engineered safety features (viz. containment and ECCS);

(b) healthiness of the safety systems;

(c) adequacy of boron in the moderator to prevent inadvertent criticality;

(d) enforcement of radiological protection procedures;

(e) checking to ensure that all the radiation

instruments/monitors are fully operational;

(f) availability of decontamination centre and health physics laboratory;

(g) accuracy of chemical analysis being carried out by the chemical laboratory;

(h) commissioning of waste management facilities;

(i) emergency preparedness response plan;

(j) compliance with stipulations laid down by the Regulatory Body for hot conditioning, fuel loading and heavy water addition;

(k) emergency preparedness exercises carried out;

(l) compliance with pre-requisites for heavy water addition;

(m) heavy water inventory management; and

(n) compliance with other pre-requisites.

B.1.2 Phase-B Commissioning

Phase-B commissioning includes initial approach to criticality and low power physics tests and experiments. The inspection area should include the following in particular:

(i) status of Consent;

(ii) checking of compliance with approved procedures for initial criticality and low power physics tests and experiments;

(iii) fencing of site boundary and exclusion zone;

(iv) demonstration of plant, site and off-site emergency preparedness by conducting emergency exercises;

(v) commissioning of health physics and waste management facilities;

(vi) healthiness of radiation monitors and meteorological instruments;

(vii) commissioning of seismic instrumentation;

(viii) commissioning of environmental survey and meteorological lab;

(ix) performance of communication systems;

(x) compliance with technical specifications;

(xi) integrity of containment and operability of containment systems;

(xii) availability of emergency core cooling systems;

(xiii) integrated testing of adjusters and shutdown systems;

(xiv) operation of coolant tube leak detection system;

(xv) beetle monitoring system;

(xvi) containment and ventilation systems;

(xvii) performance of computer based systems;

(xviii) control room and supplementary control room function;

(xix) availability of adequate licensed/qualified manpower;

(xx) status of radiation protection qualification of operation and maintenance personnel;

(xxi) operating island and radiation zoning;

(xxii) enforcement of radiological protection procedures;

(xxiii) availability of ultimate heat sink;

(xxiv) availability of DG sets;

(xxv) operation of control instrumentation in the control room and field observations;

(xxvi) access control;

(xxvii) containment box-up logic; and

(xxviii) compliance with pre-requisites for criticality.

B.1.3 Phase-C Commissioning

Phase-C commissioning (power ascension testing) include initial performance tests at low power upto # 10% full power (FP) and performance tests by stable operation of the turbine, followed by the tests at #50% FP, #75% FP, #90% FP and #100% FP (rated).

(i) This inspection area encompasses Consentee’s activities performed after initial criticality but before reaching authorised power levels. At this point, the structures, systems and components are tested in an operational environment to ensure that they have been constructed and installed properly and are capable of functioning in accordance with approved design requirements. During this period the Consentee carries out tests at increasing power levels; this testing includes the recording and analyses of data related to temperatures, pressures, flows and variations in reactivity as well as other relevant parameters.

(ii) Regulatory inspection personnel shall examine and assess the safety aspects of samples of the Consentee's procedures for conducting power ascension tests. In addition, as the tests are completed, a sample of the test documentation and inspection results should be examined by the regulatory personnel to verify that the results are acceptable. Regulatory inspection should also involve direct surveillance of several power ascension tests, including at least one which involves tripping of turbo-generator from full power.

(iii) Examples of important power ascension tests for regulatory review and inspection are those concerned with:

(a) main coolant pump trip;

(b) main steam turbine trip;

(c) performance of relief and isolation valves;

(d) reactor core performance;

(e) shutdown from outside the main or central control room;

(f) load rejection tests;

(g) reactor setback tests; and

(h) loss of off-site power.

(iv) There will be additional tests of safety significance, depending on the type of plant being commissioned.

(v) status of Consents shall be checked.

B.1.4 Other Commissioning Activities

In addition to the examination of documentation and the surveillance of tests, there are number of other areas requiring inspection by the Regulatory Body during the commissioning phase. The ability of the Consentee's management to progress from supervising construction to operation, and its arrangement for this, should also be inspected. This inspection should include the management provisions for putting the emergency plan into effect and for training and qualification of the operators. Hold points during the power ascension phase and into the full power operation phase should be closely monitored. These are largely overlap areas requiring continuing inspection attention during the operation stage.

B.2 Nuclear Fuel Cycles and Related Industrial Facilities

Similar to the nuclear power plant the commissioning phase for nuclear fuel cycle and related industrial facilities (i.e. system flushing, initial charging of process fluids/chemicals, etc.) should be identified and the inspection plan for each phase should cover:

(a) status of Consent;

(b) verification of compliance with the approved design specifications during plant installation;

(c) review of the ‘as-built’ design of the plant;

(d) commissioning tests and results;

(e) provision for criticality safety, radiation protection, chemical, fire and industrial safety;

(f) waste management;

(g) limits and conditions for operation;

(h) qualification and training of plant personnel;

(i) quality assurance organisation and its programme;

(j) on-site and off-site emergency preparedness;

(k) nuclear/radioactive material inventory; and

(l) maintenance of records and systems of reporting to plant

management and the Regulatory Body.

B.3 Radiation Facilities

Similar to the nuclear power plant, the commissioning phases for radiation facilities should be identified and the inspection plan drawn up at each phase to include:

(a) status of Consent;

(b) commissioning programme;

(c) results of commissioning tests;

(d) operating instructions and procedures;

(e) quality assurance organisation and programme;

(f) emergency procedures;

(g) source loading operations;

(h) radiation protection;

(i) ‘as-built’ design of the radiation facility;

(j) terms and conditions during commissioning;

(k) provisions for radiological protection;

(l) source inventory;

(m) adequacy of source storage; and

(n) qualifications of the technicians.

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	January 28, 1999	December 20, 2000
	February 9, 1999	April 3, 2001
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ADVISORY COMMITTEE ON PREPARATION OF CODE AND GUIDES ON GOVERNMENTAL ORGANISATION FOR REGULATION OF NUCLEAR AND RADIATION FACILITIES (ACCGORN)

Dates of meeting	:	July 22, 1999	November 7, 2000
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		August 29, 2000	August 1, 2001

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LIST OF SAFETY CODE AND GUIDES ON REGULATION OF NUCLEAR AND RADIATION FACILITIES

Safety Series No.	Title
AERB/SC/G	Regulation of Nuclear and Radiation Facilities.
AERB/SG/G-1	Consenting Process for Nuclear Power Plants and Research Reactors: Documents Submission, Regulatory Review and Assessment of Consent Applications.
AERB/SG/G-2	Consenting Process for Nuclear Fuel Cycle and Related Industrial Facilities: Documents Submission, Regulatory Review and Assessment of Consent Applications.
AERB/SG/G-3	Consenting Process for Radiation Facilities: Documents Submission, Regulatory Review and Assessment of Consent Applications.
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 Consent for Nuclear and Radiation Facilities: Contents and Format.
AERB/SG/G-8	Criteria for Regulation of Health and Safety of Nuclear Power Plant Personnel, the Public and the Environment.