1. INTRODUCTION

1.1 General

1.1.1 Nuclear power plants (NPPs) and research reactors (RRs) have to be sited, designed, constructed, commissioned, operated and decommissioned in conformity with the existing safety standards. Conformance to the standards ensures adequate margins of safety so that the NPPs/RRs can be operated safely without undue risk to the plant personnel, the members of public and the environment. The safety code on 'Regulation of Nuclear and Radiation Facilities (AERB/SC/G)' requires the regulatory body to be responsible for surveillance and control over matters relating to safety in the siting, design, construction, commissioning, operation and decommissioning of NPPs and RRs.

1.1.2 The safety guide, 'Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities (AERB/SG/G-4)' addresses issues related to regulatory inspection and initiate enforcement actions for NPPs/RRs under construction, commissioning and operation. This safety manual, 'Regulatory Inspection and Enforcement in Nuclear Power Plants and Research Reactors' (AERB/NPP/SM/G-1) has been prepared to elaborate the provisions given in the guide (AERB/SG/G-4).

1.2 Objective

1.2.1 The objective of the manual is to cover the methodology for implementation of the regulatory inspections including the enforcement actions in the NPPs and RRs.

1.3 Scope

1.3.1 This safety manual deals with the methodology of carrying out regulatory inspections during construction, commissioning and operation of NPPs/RRs to check the functioning of project/plant systems and compliance with specifications, quality assurance programme, approved procedures, requirements specified in safety documents and consents issued by the regulatory body.

1.3.2 The areas to be covered in inspections during siting, design, and decommissioning are briefly stated and the areas to be covered during construction, commissioning and operation of NPPs/RRs are addressed in detail.

1.3.3 The manual covers the methodology of enforcement actions by the regulatory body, either directly or through appropriate committees appointed by the regulatory body.

1.3.4 The manual also covers inspection of some of other nuclear facilities related to NPPs/RRs such as waste management facilities and spent fuel storage facilities.

1.3.5 The manual does not address the regulatory inspection during manufacture of items important to safety. In case such an inspection is required/specified by regulatory body, by following the guidelines mentioned in this manual, inspections may be carried out.

1.3.6 The regulatory inspections to check aspects related to nuclear security of NPPs/RRs are not covered in this manual as they are covered in a separate document.

1.3.7 Typical checklists covering the regulatory inspection requirements attached as Annexures 1,2, 3 A and 3B and 4 may be revised and issued separately based on experience and are independent of the manual.

2. REQUIREMENTS OF INSPECTION AND ENFORCEMENT

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 stages of authorisation (siting, design, construction, commissioning, operation and decommissioning) are in compliance with the safety requirements laid down / stipulated in various regulatory documents including

(i) The Factories Act 1948.

(ii) The Atomic Energy Act 1962.

(iii) The Atomic Energy (Working of Mines and Minerals and Handling of Prescribed Substances Rules 1984).

(iv) The Atomic Energy (Safe Disposal of Radioactive Wastes GSR 125 Rules 1987).

(v) The Radiation Surveillance Procedures for Safe Transport of Radioactive Materials 1987.

(vi) The Atomic Energy (Factories) Rules 1996.

(vii) Atomic Energy (Radiation Protection) Rules, 2004.

In addition, compliance with the relevant requirements prescribed in the following documents, is checked:

(a) Technical specifications for operations including surveillance requirements, station policies, procedures and safety analysis reports, quality assurance **(**QA) and In-Service-Inspection (ISI) manuals.

(b) The safety documents published by AERB and by international agencies (IAEA, ASME, IEEE) and any other relevant document.

(c) Stipulations of the regulatory body while authorising a particular activity.

(d) Observations/recommendations brought out during earlier inspections.

Compliance with the relevant requirements prescribed in the following statutes is also checked in general:

- The Indian Boilers Act 1923 and the Indian Boilers Regulations 1950.
- The Petroleum Act 1934 (as amended in 1982) and the Petroleum Rules 1976 (as amended in 1990).
- The Water (Prevention and Control of pollution) Act 1974 as amended up to 1988 and the Rules 1975 as amended up to 1989.
- The Gas Cylinders Rules 1981 (as amended in 1991).
- The Air (Prevention and Control of Pollution) Act 1981, as amended up to 1987 and the Rules 1982.
- Other Acts and Rules applicable e.g. the Environment (Protection) Act, 1986 and Environment Protection Rules, 1987 including its amendment in 1996.
- The Building and other Construction Workers (regulation of employment & conditions of service) Act, 1996 and Central Rules, 1998.
- The Electricity Act, 2003.

2.1.2 During the regulatory inspections, the NPP/RR as well as the related nuclear facilities like waste management and spent fuel storage facilities under the control of regulatory body, and vendors'/

contractors' workshops at site should be inspected. Off-site facilities like environmental radiological laboratory, hospital, decontamination center and water sources should also be inspected. The inspection should be commensurate with the importance of the item to safety and inspections should include the following areas:

Site inspection prior to construction clearance :

i. Verification of site characteristics including any new information/changes.

ii. Verification of implementation of regulatory body's stipulations, if any.

Design Stage:

During the design stage, designers are responsible for implementation of QA programe. Normally the designers, by means of a third party, take care of the QA during designing of a NPP/RR.

The safety committees constituted by the regulatory body review the compliance to the safety requirements during design review stage. Normally inspections are not planned during design review. However, if the regulatory body desires, inspections during design stage may be carried out either fully or on case-by-case basis.

Construction stage:

i. Project organisation.

ii. Specification for construction of structure, systems and components (SSC).

iii. Construction of civil structures including manufacturing, fabrication and erection activities.

iv. Reactor erection, mechanical equipment and piping erection, installation of electrical and I&C equipment.

v. Storage/preservation (pre and post installation) of safety related equipment.

vi. QA during site construction of NPP/RR as per AERB Safety guide, 'Quality Assurance during site construction of Nuclear Power Plants' (AERB/SG/QA-4).

vii. Procedures for construction.

viii. Radiological emergency preparedness at a multiple units site.

ix. Industrial and fire safety.

x. Radiation protection for NDT activities.

xi. Records and documentation (inspection reports of incoming equipment and materials, inspection and test reports for construction activities, construction completion certificates (CCC) and system transfer documents (STD) during construction phase).

xii. Compliance to safety committee recommendations.

Commissioning Stage:

i. QA during site commissioning and operation of NPP/RR as per AERB Safety guide, 'Quality Assurance during Commisssioning and Operation of Nuclear Power Plants' (AERB/SG/QA-5).

ii. Fuel storage and radiation zoning.

iii. Commissioning of system or equipment for first time and/or subsequently etc.

iv. Proof test and leakage rate test of containment.

v. Primary system hot conditioning and light water commissioning.

vi. Fuel loading programme prior to first approach to criticality.

vii. Setting up operation and maintenance groups including training.

viii. Moderator charging, first approach to criticality and low power physics tests.

ix. Power operation and simulation of various disturbances to confirm the analysis of various design basis events to the extent possible.

x. Industrial and fire safety.

xi. Documentation including commissioning procedures.

xii. ISI manual including PSI.

After first approach to criticality of the NPP/RR, inspections should cover O&M aspects in detail.

Operating Stage:

i. Reactor physics and core management.

ii. Reactor start-up and shutdown.

iii. Technical audit and surveillance.

iv. Tests, measurements, ISI.

v. Operations, fuel handling and chemistry control.

vi. Radioactive waste management.

vii. Pressure testing of containment.

viii. Performance of regulating and protection systems.

ix. Emergency preparedness.

x. Training.

xi. Maintenance, ageing management program and life management.

xii. Industrial and fire safety.

2.1.3 Regulatory enforcement actions are initiated in case the consentee does not comply with the safety requirements and stipulations laid down in the documents listed in 2.1.1.

2.2 Authority/Powers for Regulatory Inspections and Enforcement

2.2.1 The Atomic Energy Regulatory Board is empowered to enforce rules and regulations framed under the Atomic Energy Act, 1962 for nuclear and radiological safety. The executive functions of the Board are vested with the Chairman, AERB.

Based on section 23 of the Atomic Energy Act, AERB is empowered to administer the provisions of the Factories Act, 1948 in all the units of the Department of Atomic Energy.

Atomic Energy (Radiation Protection) Rules, 2004 (Rules 29 to 32) empower the competent authority to authorise any person to undertake inspection responsibility and define the powers of such authorised persons.

The Atomic Energy (Factories) Rules, 1996 empower the competent authority to appoint any person as inspector to undertake the inspections to ensure Industrial and Fire Safety aspects.

The Competant Authority may, accordingly, authorise the lead inspector/team leader to undertake the activities related to regulatory inspection and enforcement.

2.2.2 The lead inspector/team leader along with his/her team of inspectors is empowered to:

(a) enter, at any time, for inspection purpose, the premises of any NPP/RR during any stage of consent/authorisation (siting, design, construction, commissioning, operation and decommissioning) and associated facilities including vendors if required;

(b) observe, inspect, examine, measure, copy, photograph, sketch or test, as the case may be, any SSC or test instruments/equipment, query any personnel, review document etc, for the purpose of safety of the NPP/RR, site personnel, public and the environment;

(c) make use of appropriate expertise from technical support organisations[1] with permission from regulatory body;

(d) inform the consentee to take corrective/ preventive action to rectify deficiencies or curtail activities or shutdown the NPP/RR if warranted by the results of inspection or other regulatory assessments, with necessary approval from regulatory body; and

(e) take penal enforcement action through competent authority for withdrawing the authorisation to continue further construction/operation of NPP/RR for non-compliance with specified requirements and stipulations which may endanger the safety of NPP/RR, site personnel, the public and the environment due to:

- non-conformance to safety directives mentioned in the authorisations, safety supervision and quality control which may endanger the safety of site personnel in the NPP/RR,
- non-availability of safety/safety-related systems, violations of safety directives and technical specifications and non adherence to radiation control measures which have resulted in gross increase in radiation and contamination levels in and around the operating island in the NPP/RR during commissioning, operation and decommissioning, and
- any other significant event endangering the safety of site personnel, the public and the environment.

In such cases, the lead inspector/team leader should have verbal/written permission from the competent authority before intimating the enforcement action to the consentee. Written enforcement letter from the competent authority shall follow immediately.

1. Technical support organisation (TSO): An organization including governmental, non-governmental and consultants that provides or could provide technical support such as (e.g. assessments, dosimetric services) to a regulatory body or government department.

2.2.3 Authority card/letter may be issued by regulatory body in the name of the lead inspector/team leader in the format given in Annexure-5 to perform the above duties. Notification issued by competent authority regarding 'Empowerment of Inspectors' with respect to industrial safety is covered in section 5.4.

2.3 Designations of Regulatory Inspection Officers

Lead Inspector:	The inspector authorised to lead the inspection team for carrying out regulatory inspections of any NPP/RR. This person should preferably be from AERB.
Team Leader:	The inspector in the process of qualifying to become lead inspector and authorised to carryout inspection of any/particular NPP/RR. This person should preferably be from AERB.
Inspector:	The person authorised for carrying out regulatory inspections of any area of NPP/RR independently.
Team Member:	The person in the process of qualifying to become an inspector.
Expert Member:	Consultant or an officer from technical support organisations (TSO) drawn for a particular inspection.

2.4 Qualifications and Training of Inspectors

The officers who are assigned the responsibilities of carrying out regulatory inspection of NPPs/RRs should have adequate knowledge of the plant systems and should be trained and qualified as stipulated below.

2.4.1 Academic Qualification

The inspectors should at least be graduates in engineering discipline. Inspectors for specialised subjects (HP, QA and Reactor Physics etc,) should have relevant qualification in their area of expertise with graduation in a basic discipline. In special cases, trained diploma holders and science graduates with prescribed years of field experience may also be qualified as inspectors. Expert members should also be qualified as mentioned.

2.4.2 Initial Training

The candidates should complete one-year training course provided by training establishments like BARC training school or nuclear training centers (NTC) of NPCIL or training arranged by AERB through various training centers and/or other equivalent training program in his area of expertise. These persons should be adequately trained in the respective areas of specialisation through familiarisation programs and /or on the job training at various NPPs/RRs for 1-3 months to cover operational practices and station policy document and other national training institutes imparting training and qualification for various areas of specialisation. The candidates trained at NTC of NPCIL should attend the simulator familarisation course at the end of their initial training.

2.4.3 Inspector's Training

Candidates should be trained to have adequate knowledge in relevant areas for carrying out inspections. The candidates should be trained in the following subjects/topics prior to certifying him/her as inspector/ team member.

- Statutory powers, responsibilities and functions of the regulatory body.
- Regulatory inspection procedures and general inspection principles.
- Design basis and safety analysis and their importance.
- Technical specifications for operations of various NPPs.
- Non-destructive examination methods used for ISI and PSI.
- Reliability analysis, probabilistic safety analysis, deterministic analysis and risk based regulations.
- Relevant regulatory safety documents (codes, standards, guides, manuals and directives) of AERB.
- Other applicable international (such as IAEA, ASME, and IEEE) safety codes, guides and manuals.
- The current consenting/authorisation process for new NPPs/RRs.
- Objectives of various commissioning tests for NPPs/RRs.
- Radiation protection procedure.
- Flow sheets of NPP/RR systems.
- Emergency operating procedures.
- Industrial and fire safety requirements.
- Emergency preparedness and procedures (radiological and industrial).
- Operation and maintenance activities in general.
- Radioactive material handling and transportation.
- Quality assurance in NPP/RR construction and operation.
- Civil engineering requirements pertaining to NPPs/RRs.
- Storage, preservation and erection of equipment at construction site.
- Communication skills and methods for efficient inspections.
- Security systems at NPPs/RRs.
- Related abilities (covered separately in section 2.5).
- Team management and team work.
- Sense of prioritisation.
- Quick grasp of non-adherence.
- Report writing and summarisation.
- Confidentiality.
- Time management.

The entire training requirements should be programmed in a structured way and training imparted in 6 to 12 months after joining the regulatory body. The required training material and modules should cover the requirements of inspector's training.

2.4.4 Special Training in Radiation Protection and Emergencies

If any member of the team especially the expert members (consultants and members drawn from various technical units) are unaware of the radiation protection procedures and emergency preparedness etc., he/ she should be suitably trained. Before proceeding to site, a brief training should be arranged for such members to get acquainted with the radiation protection procedure and use of radiation protection equipment, and decontamination facilities and emergency preparedness including radiation emergency. Such person should enter the active zones of the operating area of NPP/RR along with station qualified person only.

2.4.5 Re-training

The inspectors should be periodically sent to appropriate training programs, workshops, seminars, etc..

2.5 Experience of Inspectors

2.5.1 Experience of a Lead Inspector/Team Leader

i) Lead inspectors/team leader should possess the qualification and training laid down in 2.4 above.

ii) The lead inspector/team leader should have sufficient experience and adequate knowledge in his area of specialisation and general idea about the various aspects of the regulatory process.

iii) Before assuming charge as lead inspector/team leader he/she must have been part of the inspection team as an inspector for at least 3-5 years to acquire sufficient knowledge of regulatory requirements of all areas.

iv) The lead inspector/team leader of NPPs/RRs under construction should be associated with design safety review of the respective NPP/RR (PDSC/ACPSR) during its stage wise regulatory review and consenting process.

v) The lead inspector/team leader of operating plants should be associated with operational safety review of respective NPP/RR (USC/SARCOP etc.).

vi) For an operating NPP/RR, a lead inspector/team leader with a few years of operating experience as shift-charge-engineer or equivalent is desirable.

2.5.2 Working Experience of Inspectors /Expert Member/Team Member

i) All the inspectors should possess the qualification and training laid down in 2.4 above.

ii) The inspectors should have knowledge in their area of specialisation and at least 2-3 years of field experience at any NPP or similar unit.

iii) The expert members should also have 2-3 years experience in their area of expertise.

iv) Team members should undergo on the job training for at least 2-3 years under the supervision of an inspector during the inspections to qualify as an inspector.

2.6 Delegation of Authority for Inspectors

2.6.1 The regulatory body may issue authority letter to individuals after completion of required training and based on appropriate recommendations.

i) A lead inspector to carryout the inspections of any NPP/RR with a group of inspectors or

ii) A team leader to lead the inspection team of any/particular NPP/RR or

iii) An inspector to inspect any NPP/RR independently.

A Format for delegation of powers to lead inspectors and authorisation of an inspector is given in Annexure-5 (forms 1 & 2).

2.6.2 The divisions of regulatory body responsible for safety review of NPPs/RRs under construction and operation should formalise the inspection team with officials drawn from regulatory body and technical support organisations as follows:

i) Lead inspector/team leader: to lead the inspection team.

ii) Inspectors: to carry out inspections of specific areas independently.

iii) A team member, to carry out inspections under the supervision of an inspector and lead inspector/ team leader.

iv) An expert member, if required, to carry out the inspection of any specific plant area, under the supervision of lead inspector/team leader.

2.7 Related Abilities Required for Inspectors

The inspectors should have the capability to independently interact with the plant personnel to assess the plant and conduct appropriate discussions so that a crisp, clear and accurate inspection report can be prepared.

The inspectors should have trust in site personnel unless they have sufficient evidence otherwise.

The inspectors should have the capability to draw conclusions and confirm the findings based on review of relevant/related documents, field observations, consultation with site personnel and their own judgment. They should obtain reference documents from where information/evidences have been extracted. In case of difficulty he/she should take the help of other inspectors of the team and/or lead inspector. While reporting the deficiencies in the inspection report, the specific requirements from various documents referred should be mentioned. Supporting station documents may be enclosed to the inspection report in case felt necessary.

2.8 Confidentiality of Regulatory Inspection

2.8.1 While carrying out the regulatory inspection of certain areas of NPP/RR, it may be necessary to maintain the confidentiality of the observations and reports.

2.8.2 In case the inspections related to physical security systems are covered along with routine inspections, security related observations and the report should be kept fully confidential. Similarly the observations regarding proprietary items need not be reported. Lead inspector/team leader should take necessary precautions.

2.8.3 Lead inspector/team leader should exercise due care while reporting on the health of plant personnel as this may create unwarranted apprehensions among plant personnel. Similarly matters, which may create administrative problems to the plant management, may have to be avoided. However, these matters should be dealt with separately.

2.9 The Responsibilities of a Consentee for Regulatory Inspection

2.9.1 The consentee should extend full co-operation for carrying out the regulatory inspection of project/ plant. The nature of co-operation to be extended to the inspection team is elaborated in the following paragraphs.

2.9.2 The consentee should make the following arrangements:

i) Provide access to any area of the NPP/RR and its site, for inspection purpose; however, consentee should inform the inspectors to follow special procedures while accessing hazardous areas, if any.

ii) All personnel at the NPP/RR be made available for discussion and should ensure that they properly respond to the queries of inspectors or to provide assistance in obtaining the appropriate response from concerned persons.

iii) Provide access to all relevant documents.

iv) Provide access to other associated and required facilities including those of vendors and contractors.

v) Arrange for the inspection teams to observe exercises, tests, measurements, surveillance and major maintenance activities that are in progress.

2.9.3 The consentee should provide the logistics to the inspectors including equipment, assistance and support as may be necessary for carrying out their functions. This may include:

- access to means of communication;
- photography, photocopy and/or sketch of reports, records/measurements, copies of documents, location/building/equipment for the purpose of reporting;
- radiation protection equipment and other safety equipment as required; and
- on-site office facilities to prepare the reports in time.

2.9.4 Documents to be made available

Typical examples of documents and reports to be submitted to inspection team for review are listed below. The list is not exhaustive and may include other documents required by the team members for review.

2.9.4.1 Unit under Construction and Commissioning

- Level I, II, and III project schedules.
- Project QA manual and QA manual for civil, mechanical, electrical and I&C construction activities and relevant QA reports.
- QA manual of various major vendors/contractors stationed at the project site.
- Records of equipment manufacture, receipt, storage and preservation (pre and post installation).
- DCRs raised for various SSCs and approvals obtained.
- Specifications for construction phase.
- Piping and equipment erection procedures and reports.

- Reports of civil construction.
- Construction completion certificates (CCCs) and system transfer documents (STD).
- Commissioning reports including test reports such as pneumatic test, hydro tests, helium leak tests and valve/damper testing etc
- Containment proof tests and leak rate test procedures/reports and individual penetration test procedures/reports.
- Any other document required by the team member for his review, like contingency plan for fire and flood etc
- Radiological emergency response plan for multiple unit sites.
- Special tests/certificates/inspection reports e.g. electrical installation, switchyard specifications.
- Status of implementation of statutory requirements.
- Security aspects.
- Reports of instrument calibration.
- Follow-up of safety committee recommendations, AERB stipulations and observations/ recommendations from earlier regulatory inspections.
- Industrial and fire safety reports.
- Job hazard analysis reports.
- List of non-conformance reports and reporting of safety related ones to regulatory body.
- Construction safety manual and construction methodology document.

2.9.4.2 Operating Unit

Operations

- Document on availability of adequate qualified manpower.
- Station logbooks for the period from previous inspection period or as desired by inspecting officials within the specified retention period.
- Jumper registers/books.
- Operating procedures for equipment/systems.
- Engineering drawings, operational flow sheets (ref document).
- Emergency core cooling system (ECCS) routine test reports.
- Record of ON-POWER ENTRY in Reactor Building.
- Emergency operating procedures.

QA and Technical Auditing

- Station QA manual.
- Quality assurance history dockets for safety related SSCs.
- NDT related documents, radiographs etc. PSI/ISI status.

- ECNs/FCNs list, and status, implementation and testing.
- Technical audit's report on follow-up of implementation of recommendations of safety committee, AERB directives and previous regulatory inspection.
- Internal and external (corporate QA) audit report.

Technical Services

- Record of thermal/stress cycles (number of crash cooling, reactor trips etc.).
- Test data on primary shutdown system, secondary shutdown system and liquid poison addition system.
- Performance monitoring of regulating system under its surveillance programme.
- Fuel performance reports.
- Authorisation obtained from various departments and AERB (ref document).
- Incident reports, root cause analysis reports, minutes of SORC meetings, SERs, performance indicators.
- Surveillance reports for various systems.
- Records of emergency exercises carried out so far, if any and feedback reports.
- Nuclear safety and physical protection system documents.

Maintenance and FHU

- Relief valve test reports for important safety systems.
- Safety related equipment maintenance reports.
- Battery test reports.
- Class I, II and III power supply test, maintenance and performance reports.
- Seismic instrumentation surveillance test reports.
- HEPA filters test procedures, reports and records.
- Instrument calibration records.
- Records of fuelling operations and related logbooks.
- Fresh fuel test data.
- Maintenance reports of civil structures important to safety.

Health Physics, Chemistry, Reactor Physics, Waste Management and Industrial Safety

- HP, waste disposal, ESL/ERL, meteorological data and relevant records.
- Aspects related to radiation protection training and records of individual exposure.
- Reactor physicist's logbook and core management records.
- Chemistry data and records for various systems.

- Storage/disposal records for liquid and solid radioactive waste.
- Waste disposal line test reports.
- Industrial and fire safety reports.

Training

- Documents like training manuals, DBRs, DM, FSAR, and technical specifications.
- EDs, operational flow sheets.
- Training programme of various trainees and their progress reports.
- Simulator functioning and related documents.
- Other training courses conducted for O&M personnel.

3. REGULATORY INSPECTION PROGRAM

3.1 General

3.1.1 In order to meet the requirements set out in section 2.1 of the manual, following criteria should be used while selecting the type of inspection and the inspection areas for formulating the regulatory inspection program. The lead inspector/team leader should go through the history of the plant to be inspected and related documents to identify areas of inspection prior to proceeding for inspection and finalise the inspection program. A typical list of reference documents is as follows:

Unit Under Construction and Commissioning:

- QA documents/reports related to construction/fabrication/erection.
- Responses to the comments/observations based on in-house safety review within regulatory body.
- Responses to earlier inspection reports and recommendations.
- Minutes of the meetings and recommendations of safety committees.
- Compliance reports addressing the directives of regulatory body and recommendations of safety committees.
- Records to confirm adherence to applicable codes and guides of the regulatory body.
- Current status reports of construction and commissioning of the NPP/RR.
- Monthly progress report of the project.
- Major structural construction (raft, PC dome etc) and safety-related equipment erection documents.
- Commissioning documents related to testing of structures, systems and components (specific to pressurised heavy water reactor (PHWR) based NPPs are hydro test of PHT, hot conditioning and light water commissioning of systems, pre-stressing of PC proof test and ILRT of PC, ECCS integrated test, tests on DGs, power failure test, integrated testing of C&I and computer systems and phase-B and C commissioning tests, report on emergency exercises for multi unit site etc.,)
- Operational health physics aspects - demonstration.
- Industrial and fire safety reports.
- Construction and commissioning feedback and inspection findings from other NPPs/RRs.
- Reports on status of radiation protection requirements during criticality and power operation.
- The checklist for inspection of NPPs/RRs under construction (ref. Annexure-1and 3A).

Operating Unit:

- Responses to earlier inspection reports and recommendation.
- Responses to the comments/recommendations based on in-house safety review within regulatory body.

- Minutes of the meetings and recommendations of the safety committees and station response.
- Minutes of the station operation review committee (SORC) and other reports issued by NPP/RR.
- Compliance reports addressing the directives of regulatory body and recommendations of safety committees.
- Records to confirm the adherence to the regulatory body safety documents such as various codes and guides as applicable.
- Monthly performance report of NPP/RR.
- Significant event reports (SER), event reports (ER) of NPP/RR within India and abroad and related technical documents of IAEA.
- Health physics quarterly and annual reports.
- Operational experience feedback and inspection findings from other stations.
- List of areas identified to cover and surveillance activities identified to be witnessed during annual shutdown; separate checklist may be prepared as appropriate.
- Industrial and fire safety report.
- The checklist for inspection of operating NPPs/RRs (ref. Annexure 2, 3B and 4).
- Documents related to emergency exercises.

3.1.2 Preparations for Inspection

Divisions of the regulatory body responsible for safety review of units under construction or operating units should inform the site at an appropriate time regarding the inspection program, areas of inspection, documents required for inspection and arrangement/provision of other logistic supports along with the list of team members.

The lead inspector/team leader should hold a meeting to brief the members of the inspection team about previous inspection and discuss the current inspection program and areas to be covered. A working checklist may be prepared if required. The inspectors should carry with them relevant reference documents to facilitate effective inspection.

3.2 Classification and Objectives of the Inspections

3.2.1 Classification:

The inspections are of three types based on their nature and requirements.

- Regulatory Inspection : Planned and announced inspections
- Special Inspection : Reactive and announced inspections
- Surprise Inspection : Reactive and un-announced inspections

3.2.2 Objectives

3.2.2.1 Regulatory Inspections

The main objective of regulatory inspections is to cover all the activities of NPP/RR periodically to check compliance with statutory requirements, overall procedures and various requirements laid down in safety

documents like codes and guides, technical specifications, safety analysis report and QA manuals etc. These inspections are carried out in line with the approved checklists. Normally the inspection schedule is intimated to all the NPP/RR at the beginning of the year as an annual program. The details of the inspection program should be intimated to NPP well in advance so that inspection can be made effective and fruitful. These inspections are carried out by a group of inspectors (preferably 4 to 8 inspectors for unit under construction and 6 to 8 inspectors for operating plant) led by lead inspector/team leader.

3.2.2.2 Special Inspections

The main objective of special inspections is to conduct reactive type of inspections depending on the importance and urgency. These inspections should be conducted normally as announced ones and the inspection program may be intimated at short notice if felt necessary. The number of these special inspections may vary depending upon the situations prevailing in an NPP/RR and also based on the decisions of the regulatory body.

In a construction unit or in an operating unit special inspections are initiated in response to significant events including natural events. These events should be reviewed for their safety significance, impact on the personnel, the public and the environment and the adequacy of corrective actions.

Special inspections are also conducted in response to a generic problem encountered at the NPP/RR or another NPP/RR or identified by the review and assessment of commissioning test results or operational problems.

Special inspections may be initiated during special maintenance activities in an operating plant and during construction/commissioning stage whenever major activities are planned.

The regulatory body may conduct special inspections arising from any other requirement identified during the course of design safety review. A group of inspectors may be needed to carry out such inspections, actual number being decided based on scope of the inspection to be carried out.

Illustrative examples of some special activities and unusual incidents/events that may call for special inspections are listed below:

Unit under Construction:

Special activities	Significant events/other events
• Inspections prior to/after issue of any consent as required • Site excavation and its completion • First pour of concrete and other major pours of safety related buildings • Construction of ring beam for reactor building • Calandria and end shield erection • Coolant channel installation • Installation of identified safety related SSCs • Pre stressing of PC • Proof test and ILRT of PC • Hot conditioning of PHT, ECCS integrated test • Class IV failure test and DGs performance • Regulating and protection devices testing and integrated tests	• Fire in safety related and other buildings • Fatalities or serious injuries • Natural event, which can cause damage to the plant such as internal/external flooding and/or seismic event. • Incidents of theft and/or sabotage involving radioactive source

Unit under Construction (Contd.):

Special activities	Significant events/other events
• Emergency preparedness exercises • First approach to criticality and Phase-C commissioning	

Operating Unit:

Special activities	Significant events/other events
• Primary system component inspection • Reactor internal inspection • ILRT of primary containment • Turbine major overhaul • Off-site emergency exercises • Commissioning of any new safety related equipment • Reactor start-up after shutdown enforced due to violation of safety limits.	• Downgrading of PHT and/or moderator • Actuation of SSS and/or LPIS • Reactor building box-up and/or LOCA, actuation of ECCS • Class IV power failure leading to unavailability of safety/safety related systems • Station black out, non availability of Class-I and/or Class II power supplies • Natural event, which can cause damage to the plant such as internal/external flooding and/or seismic event. • Significant fire incident. • High levels of radiation and contamination • Incidents of theft and/or sabotage involving radioactive source • Fatalities or serious injuries

3.2.2.3 Surprise Inspections

The main objective of surprise inspections is to carry out reactive inspections depending on the safety review, safety implications, violations of safety, prevailing unsafe situations pertaining to industrial and fire and/or radiation safety practices by NPP/RR sites. These inspections should be conducted mostly as unannounced ones based on the importance and urgency felt by the regulatory body. Inspection program should be intimated after reaching the plant/project just before starting the inspection to check the prevailing situations. This will enable an inspector to get first hand and realistic information about the status of plant documentation and systems. One or two inspectors should carry out these inspections for a day or two.

3.2.3 Areas of Coverage of Regulatory Inspections and Frequency

Inspection areas during various stages of NPP are covered in detail in Appendix-1. Areas of coverage and frequency for a unit under construction and operating unit are covered in the following paragraphs.

Unit Under Construction :

Regulatory inspections are carried out as per the inspection program and are scheduled in advance normally with a frequency of about once in three months (depending on the stage of construction) for units under construction/commissioning. The inspections may be more frequent in a particular year and will usually be linked to schedule of completion of certain activities at various stages of construction.

During the construction phase, as a minimum requirement, installation of each safety related structure, system and component that may become inaccessible for inspection after fuel loading/unit operation, equipment of reactor protection system and engineered safety features should preferably be covered in inspections.
These inspections are to confirm safety in NPPs/RRs and identify potential problems, if any, at an early stage. These inspections should consider amongst others, the following:

a) Status of implementation of safety committee's recommendations and regulatory body's stipulations.

b) Compliance with AERB safety codes and guides.

c) Industrial and fire safety measures taken.

d) Review of the PSI activities and QA in all areas of plant construction and commissioning.

e) CCC and STDs status, design concessions, regularisation and their implications.

f) Cases of non-conformance, their resolution and implications.

g) Storage and preservation of equipment (pre and post installation).

h) Training of O&M personnel.

i) Preparation of O&M documents including 'construction QA'.

j) Emergency preparedness exercises related to radiological and industrial safety at multi-unit sites.

Normally following specific areas should be covered in a construction unit during the regulatory inspections and the frequency of inspection is tentatively fixed at four times in a year based on previous experience, importance and status of construction/commissioning activities. Regulatory body may increase the frequency of inspections depending on the status of project construction activities. However, the inspectors are free to cover any other area during the inspection, and bring out serious deficiencies, if any, to the notice of the lead inspector/team leader to take necessary action and follow-up.

Areas of coverage
Recommendations of safety committees including site evaluation committee
Design and commissioning
Documentation including CCC/STD
Storage and preservation of equipment (pre and post installation)
Compliance with AERB safety documents
Health physics, waste management, ESL, emergency preparedness plan.
Reactor components and accessories
Civil engineering aspects
Electrical equipment installations
Piping and mechanical equipment erection
Instrumentation and control, computers and communication and control rooms
QA and PSI
Training of construction, inspection, QA and O&M personnel. Simulator, O and M activities
Industrial and fire safety measures

Frequency of inspection for all the aspects of construction phase (civil construction, piping and equipment erection etc.,) is automatically reduced with the start of commissioning phase and after first approach to criticality of NPP/RR, inspections should address the O&M aspects in detail.
Operating Unit :

Regulatory inspections are carried out as per the inspection program and are scheduled in advance. Frequency of once in six month is normally followed for an operating NPP. For research reactors the frequency may be reduced depending upon design features. Regulatory body may increase the frequency of these inspections at any time for a particular unit or group of units based on safety review.

These inspections provide an opportunity for examination of the consentee's activities in order to confirm safety in NPP/RR performance and to identify potential problems, if any, at an early stage. These inspections should consider amongst others, the following:

a) Implementation of safety committee's recommendations and regulatory body's directives/ stipulations.

b) Compliance with the AERB safety codes and guides.

c) Safety significance of the areas to be inspected (i.e. reactor shutdown devices, ECCS, containment and associated system/equipment, containment special and normal tests, fuel transfer operation including in SFSB, radiation hot spots etc.)

d) Operational experience, generic problems and lessons learnt at the NPP/RR and other NPPs/RRs.

e) Radioactive liquid, gaseous and solid waste management and discharges to environment.

f) Operational and maintenance aspects.

g) Seriousness of the reported and non-reported incidents and overall safety practices.

h) Pending surveillance requirements, and stations response to comply with the same.

i) Review of the PSI/ISI activities and QA in all areas of plant operation.

j) Industrial safety and fire protection measures.

k) Radiation protection practices and emergency preparedness

l) Training and qualification of personnel. Documents related to operating personnel are checked before allowing them to appear for final interview and may be reported separately.

m) Safety culture

Normally, following areas should be covered in an operating unit during the regulatory inspections and the frequency of inspection of various areas is tentatively fixed based on the previous experience and importance. However, the inspectors are free to cover any other area during the inspection, and bring out any serious deficiencies to the notice of the lead inspector to take necessary action and follow-up.

Areas of coverage	Tentative Frequency
Operation and FHU	Twice in a year
Safety committee recommendations	Twice in a year
Technical audit and surveillance, and system reliability/failure data review	Twice in a year
Health physics, emergency preparedness plan and radiation protection procedures	Twice in a year
AERB safety documents, life management (if required)	Once in a year
Reactor physics	Once in a year
Waste management	Once in a year
Electrical maintenance	Once in a year
Mechanical maintenance	Once in a year
Control and instrumentation	Once in a year
Technical unit, QA and ISI	Once in a year
Training and qualification	Once in a year
Industrial and fire safety	Once in a year
Civil structures review	Need basis and prior to reauthorisation
Nuclear safety and security (if required)	Once in a year

3.3 Annual Planning of Regulatory Inspection

3.3.1 The annual schedule/plan for inspection with established frequency, for the various units, should be drawn towards the end of the previous year, and approved by the competent authority, in the format given in Annexure-6. The approved schedule should be intimated to all sites. Generally the inspections are to be planned for completion within 2-4 days with an additional day for feedback/exit meeting and report preparation/submission if necessary.

3.4 Inspection Team Formation and Correspondence

3.4.1 The lead inspector/team leader of the respective project/unit will submit the composition of a proposed inspection team, for due approval by the responsible officer of the division reviewing the safety of unit under construction/operation in the prescribed format. Typically, the number of inspectors in the team may be 4 to 8 for unit under construction/commissioning depending on the status of the project and 6 to 8 for an operating NPP/RR. The area of coverage during the inspection should be clearly mentioned. A specimen format for regulatory inspection team formation and the program is given in Annexure-7 for NPP/RR under construction and in Annexure-8 for an operating NPP/RR.

3.4.2 The lead inspector/team leader should normally follow the approved schedule of regulatory inspections (Ref 3.3.1), unless any request for change from respective project/units is received or due to other possible constraints faced by regulatory body itself. Selection of inspectors should be based on the areas of inspection. It is better to have a panel of inspectors authorised for each area of inspection so as to maintain uniformity and quality in inspections. During the formation of the inspection team, the

frequency of coverage of an area based on para 3.2.3 of this manual and operational feedback from the particular unit in the previous six months or from any other site should be considered.

3.4.3 The above approved inspection program should be expeditiously communicated to the project/operating unit both by electronic means (e-mail) as well through normal channels (Fax). The inspection program should be communicated to each member of the inspection team and to concerned divisions (either within regulatory body or other technical support organisations) whose representatives are required, for the inspections as necessary.

3.5. Intimation to Plant Management by Lead Inspector/Team Leader

The lead inspector/team leader should intimate the project/plant management in advance, regarding the inspection/travel programme, team members and the areas of inspection. He should also send requisition for providing necessary logistics support (transport arrangements, security clearances and entry to radiation areas) and other arrangements needed for conducting the regulatory inspection.

For surprise inspections, site is to be informed only by phone or facsimile for the purpose of obtaining logistics support and the program should be intimated at short notice.

Lead inspector/team leader should conduct a meeting of inspection team members to discuss the areas to be covered.

3.6 Documentation for Regulatory Inspection and Enforcement

Regulatory body should maintain the following documents for future inspections, follow-up and enforcement actions:

i) Inspection reports and the corresponding station responses should be available with lead inspector/team leader and also at the centralized documentation cell and data bank.

ii) A master file containing relevant inspection related documents such as inspection program, correspondence, completed check-lists, draft findings, notes, documents, charts, data collected at site etc. may be retained for a limited period.

iii) Pending recommendations of safety committee and AERB stipulations.

iv) Event reports and station reports of concerned unit with lead inspector/team leader.

v) Pending items from previous inspections and their current status based on site response, with lead inspector/team leader.

vi) Latest approved technical specifications of all plants.

3.7 Documents/Equipment to be Carried by Inspectors

i) Latest approved technical specifications of the respective plant.

ii) Inspection reports and station/project response.

iii) Safety committee's pending recommendations.

iv) Atomic Energy (Factories) Rules, 1996.

v) Required safety documents including fire standards.

vi) Atomic Energy (Radiation Protection) Rules, 2004.

vii) AERB safety manual 'Radiation Protection for Nuclear Facilities' 2005

viii) Checklist for regulatory inspections.

ix) Telephone numbers/ directory of important officials of regulatory body.

x) TLDs issued by AERB for radiation exposure monitoring.

xi) Photographic equipment as permitted.

xii) Laptop computer (if available).

xiii) Required stationery and computer CDs and floppies.

4. METHODOLOGIES AND REPORTING OF REGULATORY INSPECTION

4.1 General

Regulatory inspections of an NPP/RR can be made more effective and achieve its objective by adopting proper methodology during the conduct of inspection and preparation and issue of the inspection report. The lead inspector/team leader should be aware of this aspect.

4.2 Preparation for the Inspection

4.2.1 Administrative Aspects

The lead inspector/team leader should co-ordinate all the necessary administrative arrangements for conduct of an inspection from planning stage to issue of final inspection report. All steps shall be followed and completed as a part of the preparations for the inspection as brought out in sections 2 and 3. Lead inspector/team leader should ensure the availability of authority card/letter issued by the competent authority, delegating the powers to conduct the inspection and for enforcement.

4.2.2 Technical Aspects

The lead inspector/team leader should study various site reports/documents as and when received in AERB and other relevant documents and make appropriate observations to discuss with the inspectors. The lead inspector/team leader should identify the items which need to be followed-up by various inspectors based on site response to previous inspection reports. Compliance with safety committee's recommendations by site should also be scrutinised. Similarly the lead inspector /team leader should identify the generic or specific issues based on national and/or international experience that may be relevant during inspections at site.

4.2.3 Exhaustive Study by the Inspectors

Each inspector should study the relevant technical documents in order to understand the present condition of the plant systems under the specific area of inspection assigned to him. The documents are:

Unit under Construction and Commissioning :

- Recommendations contained in minutes of safety committee meeting
- AERB stipulations made during earlier clearances
- PSAR, relevant AERB codes and guides as applicable
- QA manuals of respective sections
- Previous inspection report and response of project authorities
- Current status of construction/commissioning from monthly progress reports
- Reports on industrial and fire safety
- Design basis reports and manuals
- Technical specifications during commissioning stage
- Any feedback from national/international NPPs/RRs under construction and commissioning.
- Updated JHA reports

Operating Unit:

- Monthly performance reports of the last 6 months
- Event reports and significant event reports
- Minutes of SORC for the last six months
- Recommendations contained in minutes of safety committee meetings
- Previous inspection report and station response
- Health physics reports
- Reports on industrial and fire safety, safety hazard evaluation and occupational health status reports
- Technical specifications for operation
- FSAR, relevant AERB operational guides
- QA manuals of concerned unit
- Flow sheets
- Operating experience feedback from national/ international NPPs/RRs.

4.2.4 Inspection Team Meeting at Head Office or Site

The lead inspector/team leader should call a meeting of all inspectors of the team prior to departure from head quarters to brief them about the various areas of coverage and any important items based on his/ her review (refer sub-section 4.2.2 of this manual.) If it is not possible to conduct this meeting at head quarters, it should be conducted at site, prior to inspection. During the meeting, areas of inspections of each inspector should be earmarked if not done earlier and the regulatory concerns, if any, on that subject are to be discussed. Based on this meeting, a detailed programme indicating the areas of inspection and issues, if any, to be looked at and list of other documents needed etc, are to be intimated to site by lead inspector/team leader.

4.2.5 Working Checklists

The regulatory inspection checklist for NPPs/RRs under construction/commissioning for all areas except for civil engineering aspects is given in Annexures-1 and 3A and for civil engineering aspects it should be prepared based on the requirements mentioned in section 4 of the AERB manual, 'Inspection during construction of Civil Engineering structures important to safety of nuclear facilities (AERB/SM/CSE-4)'. The regulatory inspection checklist for operating NPPs/RRs for all areas including civil engineering aspects is given in Annexures-2, 3B and 4. During the inspections, the inspectors should use these checklists and also add new items if required based on sections 4.2.3 and 4.2.4, for making his/ her observations / recommendations if any, and submit the report to lead inspector/team leader at the end of the inspection as a record for future reference.

4.3 Inspection Methodology

4.3.1 Meeting with the Plant Management

An introductory meeting with the plant management should be arranged on the first day. The management may present the status of the project works/plant operations and the status of implementation of

recommendations from the previous inspection. The lead inspector/team leader should introduce all the inspectors of the team to the site personnel indicating the areas being covered by each inspector. Project/ Plant will introduce their representatives who will co-ordinate with inspectors. The schedule for feedback/ exit meeting should be tentatively fixed, which can be changed, if required depending on the progress of the inspection.

4.3.2 Time Management

After the introductory meeting, each inspector should plan his/her activity based on the importance and nature of inspection. The time spent during each inspection should be properly managed and it should be divided accordingly considering the following aspects.

- field visit;
- safety audit/review of documents;
- interview of plant personnel; and
- consolidation of the findings and report preparation.

4.3.3 Field Visits

During field visits, inspectors should follow procedures and use protective measures as applicable and move with project/plant representatives only and should be alert all the time. This helps in protecting one self from radiation and industrial hazards and also in identifying problems. Field visit should be made randomly and can be either with or without prior notice to the plant personnel in order to assess the situation, as it exists. In a construction and commissioning unit, check the preservation methods and condition of the equipment before and after installation. During field visits, readings of pressure and level gauges and other instrumentation should be specifically checked and correctness of the values may be verified subsequently. Housekeeping measures and safety practices being followed should be observed.

4.3.4 Control Room Visits (during commissioning and operation)

Inspectors should visit the control room to watch the system status, operator's activities, computer printouts, shift changeover processes and general work practices followed by the staff etc,. Important control room parameters may also be noted and verified for their correctness as compared to field readings. Functioning of computerised maintenance management system should be reviewed to confirm the effectiveness of work permit system with respect to the station protection code.

Positions of control switches should be observed for their appropriate use. Any deviations or abnormalities should be discussed with SCE/ASCE to assess the situation. If any surveillance/test is in progress, inspectors should observe the activities and verify compliance with approved procedures. Readings and computer print outs may be checked to confirm satisfactory completion of the tests.

Under any circumstances, the inspector should never carryout any operation himself and also should not force the operators to carryout any operations unless appropriate permissions are taken from unit head.

4.3.5 Witnessing the Field Activities

During the inspections, field activities should be observed to check compliance with procedures (examples

are given for illustrative purpose).
Unit under Construction and Commissioning:

- Civil construction related activities.
- Fabrication processes in reactor, turbine and control buildings (i.e. cutting, edge preparation, welding, grinding, pipe-fitting etc.).
- Installation of equipment like end-shield, calandria, steam generator, PHT pumps, coolant channel.
- Quality control by NDE (DPT, ECT, VT,UT, RT, MPE etc.)
- Qualification of welders and NDE inspectors.
- Post installation preservation of equipment/system.
- ECCS integrated tests.
- Reactor shutdown tests and tests on reactivity mechanisms.
- Containment box-up test, PC proof and leakage tests and SC leakage tests.
- PSI of safety related equipment.
- Industrial and fire safety measures.

Operating Unit:

- ECCS monthly/six-monthly tests.
- Reactor shutdown tests and tests on reactivity mechanism.
- Containment box-up test.
- Containment ILRT, HEPA filter efficiency tests.
- Fire and communication exercises.
- Plant/site emergency exercises.
- ISI activity of safety related equipment.
- Industrial and fire safety.

4.3.6 Tests and Measurements

Inspectors should review the documents to verify satisfactory completion of tests and measurements. In case gross deficiencies are noticed in the testing procedures, test results and equipment used, a repeat test should be recommended to be carried out and if necessary in presence of the inspector. If it is not feasible to carryout the test immediately, appropriate enforcement action should be taken in consultation with regulatory body.

The tests or measurements may include:

- tests on safety systems (e.g; protective systems testing, ECCS logic tests and valve timing measurements);
- sampling of boron in liquid poison of a shutdown system;
- drop time measurement for primary shutdown system rods and poison injection timings of other shutdown systems during reactor shutdown;

- testing for setting of a relief valve in the shop or on line as the case may be;
- measurement of area temperatures;
- measurement of radiation field and air activity levels in accessible areas and inaccessible areas;
- sampling and activity measurements in main outfall at final discharge point; and
- tests on containment and related engineered safety features.

If the results are of concern and unit operation is found to be unsafe, the lead inspector/team leader should be informed for taking appropriate enforcement actions as envisaged in 5.4.

4.3.7 Examination of Records and Documents

The inspectors should select documents randomly for review. While reviewing the documents, appropriate sequence should be maintained.

Unit under Construction and Commissioning :

QA plans, procedures and reports, construction test reports, installation/erection procedures, construction completion certificates, system transfer documents, design concessions/NCRs raised and their dispositions, commissioning test reports, storage and preservation reports, PSI records, industrial safety records etc, should be reviewed.

While reviewing the document, visits to various areas and shops should be made to assess the status of the systems under question to identify the violations/deficiencies. Discussions with various sections may be required before finalising the observations. Xerox copy of the relevant part of the document should be obtained and if required attached to the report.

Operating Unit :

Station logbooks, area logbooks (DG test reports), logbooks of reactor physicist and health physicist, jumper register, emergency communication register, special work permits, event sequence recorder printouts, on-power entry register, technical audit engineer's reports, technical unit records/document, maintenance records, NDE records, training section documents etc. may be reviewed.

While reviewing the document, visits to the control room, maintenance shops, reactor buildings and other areas should be made to assess the status of the systems under question to identify the violations/deficiencies. Discussion with various sections may be required before finalising the observations. Xerox copy of the relevant part of the document should be obtained and attached to the report.

4.3.8 Discussions with the Plant/Project Personnel

Observations made during inspection should be discussed with concerned plant personnel to arrive at a common understanding and proposed corrective action. The sequence of queries should start from history of an event, corrective measures taken and the present status. The inspector should get himself/herself appraised by the project/plant personnel about the correctness/authenticity of his/her observation and inform them to take required corrective measures for improving the situation. Important deviations

observed should be reconfirmed/verified for correctness.

4.3.9 Recording of Inspection Findings

Necessary assistance for documenting/recording the inspection findings and collection of evidence should be provided by project/plant officers who are coordinating the inspection. In case of any difficulty, inspectors should bring the matter to the notice of the lead inspector/team leader who should immediately sort out the problem with the plant management.

While making the observations it is always a good practice to quote the findings from various station documents with references. Similarly while giving the recommendations or conclusions, it is always good to quote the requirements from codes/standards/guides, technical specifications, approved procedures, station norms, safety committee recommendations, regulatory body stipulations/directives etc; to be complied with by project/plant to overcome the observed deficiencies.

4.4 Inspection Report Preparation

4.4.1 Findings of the regulatory inspection have to be documented for the following purposes:

- to document and record an assessment of safety practices of consentee;
- to record the information gathered during inspection;
- to record any findings and the recommendations of the inspectors;
- to record the recommendations, if any, for future action by the consentee or by safety committees and regulatory body;
- to provide the basis for notifying the consentee of the inspection findings, and of any requirements, to be complied with;
- to bring out any good practices and achievements beyond the mandatory requirements aimed at improving the safety of NPPs/RRs; and
- to highlight any non-compliance/deficiencies/violations for proper corrective actions.

4.4.2 Contents of Inspection Report

While deciding the scope and contents of inspection report, following are taken into consideration:

- type of NPP/RR and the consenting stage;
- venue of the inspection, i.e. plant site or vendor site or other places; and
- the type of the inspection, i.e. whether routine, special or surprise.

Inspection reports may typically contain:

(a) the purpose, type and date of inspection and project/plant specific unique number;

(b) details of NPP/RR areas, activities, processes, systems, or components that were inspected, assessed or reviewed;

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

(d) criteria used in the assessment;

(e) compliance status of earlier inspection findings;

(f) a record of the status of earlier enforcement actions;

(g) a record of any deficiency or violation found during regulatory inspections;

(h) reference to consent requirements and relevant statutory provisions;

(i) a record of the results of checks for compliance with the terms and conditions of the consent for the NPP/RR;

(j) a record of actual or potential problems relating to safety;

(k) a record of on the spot regulatory action taken by inspectors and any consequent action taken by the consentee during the period covered by the report;

(l) a record of relevant discussions held with staff, management and other persons of NPP/RR, including response of NPP/RR management on points of concern found during inspections/exit meeting;

(m) a record of recommendations for future action; and

(n) copy of documentary evidences, if any, as enclosures to the report.

A specimen format of an inspection report for NPPs/RRs under construction and operating NPPs/RRs is given in Annexures-9 and 10 respectively.

4.4.3 A section wise draft report should be prepared at the end of the inspection at site itself and should be consolidated by the lead inspector/team leader after discussing with the inspectors. The draft copy of regulatory inspection report is given to project/plant authorities prior to start of the feedback/exit meeting. Any documentary evidence shown before the exit meeting should be considered. Tabling of any documents by the utility during the exit meeting should be discouraged unless having importance.

4.4.4 Categorisation of observations/recommendations in the inspection report for further review and follow up

To facilitate follow-up review, enforcement and corrective actions, observations and recommendations made during the inspection should be categorised generally based on their safety significance and follow-up of the required measures. The lead inspector in consultation with each inspector of the team (if needed) should categorise each observation along with relevant recommendation. The categorisation should help the utility in submitting the detailed and in depth responses giving full credence to the category level. Project/station management should be asked to take the corrective measures immediately and submit their response to the reported observations/deficiencies/ recommendations of inspection report within a month to regulatory body intimating the implementation of the recommendations or giving the proposed target dates for completion. Recommendations related to industrial and fire safety are not categorised. However, recommendations with respect to industrial and fire safety are to be attended immediately. The recommendations can be categorised at head quarters of regulatory body prior to sending the inspection report along with enforcement letter.

The findings of the inspection team are to be categorised in 5 categories (I to V) based on the guidelines given below:
Unit under Construction and Commissioning :

Category-I:

- Violation of AERB safety directives and/or safety committee stipulations/ recommendations.
- Non compliance with the requirements of AERB codes/ standards/rules and other consent stipulations.
- Deviations from technical specifications for operation and safety report requirements during commissioning stage.

Category-II :

- Deficiencies in QA and construction procedures and their compliance with, for safety and safety related systems.
- Deficiencies in procedures and compliance with PSI requirements for operation during commissioning stage.
- Deficiencies in other important procedures to meet the requirements of technical specification for operation during commissioning stage.
- Observations/recommendations requiring safety review.

Category-III :

- Shortcomings noticed in the design of safety, safety related and safety support systems, during construction/ commissioning phase, including generic design deficiencies.
- Deficiencies in implementation of design and/or lack of design provisions related to safety, safety related and safety support systems.

Category-IV :

- Procedural inadequacies and non-compliance during construction/ commissioning:
  - Organisational
  - Managerial
  - QA of non-safety related systems

· Procedural inadequacies and non-compliance during commissioning:

  - O & M procedures
  - Training and qualification
  - Emergency preparedness

Category-V :

· General observations/deficiencies regarding

  - Housekeeping
  - Good practices

Specimen format of a categorisation sheet along with enforcement / follow-up and review required for a unit under construction is given in Annexure-9.
Operating Unit

Category-I :

- Violation of AERB safety directives and safety committee recommendations.
- Deviations from technical specification stipulations and safety report requirements.
- Non-compliance with the requirements of AERB operation code/ standards/rules.
- Non-compliance with consent stipulations/licensing conditions.

Category II :

- Deficiencies and degradations in systems, structures, components of safety and safety related systems.
- Deficiencies in surveillance procedures/practices/ QA.
- Deficiencies in other important procedures to meet the requirements of technical specification for operation.
- Deficiencies in implementation of design and/or lack of design provisions.

Category-III :

- Shortcomings identified in the design of safety, safety related and safety support systems, based on operating experience including generic deficiencies.

Category-IV :

- Procedural inadequacies and non compliance in :
    - Station policy
    - Organisation
    - Management
    - QA of non-safety related systems and ISI
    - O&M procedures
    - Training and qualification
    - Radiation protection procedures
    - Waste management
    - Emergency preparedness
    - Industrial and fire safety

Category-V :

- General observations/deficiencies regarding

- Housekeeping

Specimen format of a categorisation sheet along with enforcement / follow-up and review required for operating unit is given in Annexure-10.

4.5 Exit Meeting with the Plant Management

At the end of the inspection, when the draft report is ready, an exit meeting with the plant management is desirable though not mandatory. The purpose of this meeting is to brief the management about the strengths and weaknesses noticed during the inspection, and also to get additional information, if any, from the management, to finalise the observations and recommendations made in the report. In the meeting, the lead inspector may ask the members of the team to present their respective findings from the report or may present the report himself/ herself.

Cordial atmosphere should prevail in the meeting and the deliberations should be professional. The inspection team should compliment the plant management for the observed good practices, which help in improving nuclear and industrial safety and these observations may be mentioned in the report.

On deficiencies of serious concern, the inspecting team should take a firm stand and quote the requirement laid down in various documents.

When the management response is convincing, the team may accept it and appropriately modify the relevant portions of the report. In case of disagreement, the lead inspector/team leader will take final decision in consultation with the Headquarters of AERB.

4.6 Report Submission and Utility Response

Final inspection report should be prepared and as far as possible the advance copy may be issued at plant site. Project/station management should be asked to take the corrective measures immediately and submit their response to the reported observations/deficiencies/ recommendations of inspection report within a month to regulatory body intimating the implementation of the recommendations or giving the proposed target dates for completion.

The first copy of regulatory inspection report should be submitted to the division of regulatory body responsible for safety review of project/ operating unit as the case may be.

Formal inspection report will be issued within 15 days along with enforcement letter by the concerned division of AERB. The second copy (advance copy) may be handed over to project/station authority for taking corrective action. The project/station should be informed that the responsible division of the regulatory body would issue the formal inspection report along with the enforcement letter shortly.

Issuing authority, may modify any of the inspection findings recommendation and/or the categorisation if felt necessary before issuing the final report. However, items, which are not discussed in exit meeting, should not be added.

The copy of the inspection report should be distributed to project/station authority and utility's head office, respective safety committee and inspection team members for information.

4.7 Reporting of Confidential Matters

Although it may be the practice to include all the observations and findings in the inspection reports, lead inspector/team leader may decide to omit some information from reporting. Such information may be

withheld due to security reasons or to use in connection with future regulatory actions or these may be personal or medical information relating to individuals or information proprietary in nature. Such confidential matters may be dealt with separately instead of being included in the report.

4.8 Publication of Inspection Findings

In order to inform the public about the safety of nuclear installations and about the effective functioning of the regulatory body, findings of inspection and regulatory decisions may be made public through AERB annual reports and/or newsletters etc.

5. ENFORCEMENT ACTIONS

5.1 General

5.1.1 The regulatory body (AERB) has been empowered by government to enforce compliance with the requirements as laid down in relevant statutes for radiological safety in the country and industrial safety in DAE units. This includes the authority to enforce the consentee to modify, correct or curtail any activity/aspect of a NPP/RR operation, procedures, practices, systems, structures or components as necessary to ensure the required level of safety.

5.1.2 The regulatory body has delegated the responsibility to divisions within AERB for enforcing nuclear, industrial and fire has safety in the units under construction and operating units. These divisions should ensure that the consentee has effectively carried out corrective actions to comply with the recommendations included in the inspection report. The consentee is required to rectify the non-compliance, in an agreed time frame and take all necessary measures to prevent a recurrence. These divisions should carry out enforcement actions either directly or through competent authority as brought out in subsequent paragraphs. Lead inspectors/team leaders are also given certain limited powers of enforcement.

5.1.3 Enforcement actions are designed to address non-compliance with specified conditions and requirements. These actions shall be commensurate with the seriousness of the non-compliance. Thus there are different kinds of enforcement actions, from written warnings to imposing penalties and ultimately, recommending to the competent authority for withdrawal/suspension of the consent.

5.2 Consideration for Enforcement Actions

The factors to be considered in deciding what enforcement action is appropriate in a particular case should include:

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

(b) whether the violation of less serious nature has been repeated;

(c) whether there has been a deliberate or wilful violation of the prescribed limits and conditions of technical specifications for operation, relevant statutes[2] and/or safety directives;

(d) lack of safety culture;

(e) whether the violation is identified and reported by consentee or regulatory body and others;

(f) the past performance of the operator and trend in performance;

(g) the need for consistency and transparency in the treatment of operators.

5.3 Methods of Enforcement and Normalisation

Various enforcement methods available are:

- sending an enforcement letter for the deficiencies found during inspection;

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2. The NPP/RR under construction or operating NPP/RR has to comply with various requirements stipulated by other statutory organisations like Pollution Control Board etc. and their compliance is checked during the inspections. In case of non-compliance to any issue pertaining to the stipulations by any such organisation, regulatory body is not involved in enforcement activity since it is out of its purview.

- issue of written directives[3]
- orders to curtail[4] activities or;
- modification, suspension or revocation of consents or authorisations; and
- initiation of other penal actions.

5.3.1 Sending an Enforcement Letter :

Soon after the lead inspector/team leader submits the inspection report, the responsible divisions dealing with safety of NPPs/RRs under construction or operating NPPs/RRs should send enforcement letter to consentee asking for responses for the inspection report within a month. The issuing authority may modify any of the inspection findings/recommendations and the categorisation if felt necessary before issuing the inspection report. The consentee should be asked to submit expeditiously the response for any issue of concern depending upon severity. A specimen enforcement letter for NPPs under construction and operating NPPs/RRs is given in Annexures-11 and 12 respectively.

Consentee's response to the inspection report should be reviewed to:

- discuss the important items of inspection report having safety significance, in the respective safety committee for NPPs under construction and unit safety committees for operating NPPs;
- decide further enforcement actions; and
- identify items to be referred to the competent authority for his directive regarding further enforcement actions

5.3.2 Written Directives

In case of deviations or violation of consent requirements or unsatisfactory situations during any phase of the NPP's life cycle, the responsible division should issue a written directive to the NPP after intimating the competent authority.

The written directive should specify the nature of and the regulatory basis for each violation, deviation or unsatisfactory situation; it should also specify a time period for taking corrective actions and may provide guidance on the nature of the corrective action.

5.3.3 Orders to Curtail Specific Activities

The division of regulatory body responsible/dealing with the safety of NPP/RR under construction or operating NPP/RR should recommend to the competent authority to direct the consentee to curtail specific activities, in the event of:

- apparent deterioration of the NPP/RR's structures, systems or components and/or

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3. Regulatory body informs in writing to the consentee to submit a significant event report (SER) in case it was not submitted or the event itself was not in reported in detailed report for the observed deviations from consent stipulations, technical specification requirements, radiological protection procedures, deviations with respect to industrial and fire safety and/or any unsatisfactory situations/incident along with corrective actions required to be taken within a specified period.

4. An order issued by the regulatory body to the consentee to curtail the authorised activity in order that the observed deterioration in systems, structures and components, and/or serious violations do not pose an imminent radiological hazard, industrial and fire safety hazard to the site personnel, public and environment.

- serious violations which create unsafe situations or an imminent radiation hazard to the site personnel or the public and the environment.
- any serious non compliance observed during all phases of NPPs life-cycle .
- unsafe acts/unsafe practices.

During the construction phase, for example, this could mean suspension of construction activity. Similarly during the operational phase, for example, this could mean requiring reduction of power, pressure, temperature or other relevant parameters, including, if necessary, shutting down of the NPP/RR.

5.3.4 Modification, Suspension or Revocation of Consents/Authorisations

In the event of chronic or extremely serious non-compliance, repeated failures of safety systems, fatalities, highly deteriorated condition or significant contamination of the environment due to serious malfunction or damage to the NPP/RR, the regulatory body (AERB) may modify, suspend or revoke the consent (registration/license/authorisation) depending on the nature and severity of the situation.

5.3.5 Other Penal Action

For serious violations, wilful or repeated, but of a less serious nature or for deliberate non-compliance of the applicable provisions of the Atomic Energy Act, 1962 and the Rules issued there under, and of the requirements stipulated by the regulatory body, penal action may be initiated as prescribed in section 24 of the Atomic Energy Act, 1962.

5.3.6 Normalisation:

5.3.6.1 The regulatory body may lift the enforcement and authorise the consentee for resumption of particular activity after ensuring the following as applicable (list is for illustration only):

- successful completion of identified corrective measures by the consentee;
- successfully carrying out the required inspections, tests by the consentee;
- satisfactory actions taken by the consentee to prevent recurrence of same or similar issue/ situation;
- special regulatory inspections by AERB or its authorised representatives to check compliance to all directives and to confirm measures, taken to improve safety, are satisfactory; and
- completion of safety review by appropriate safety committees as applicable and if required, by the Board of AERB.

5.3.6.2 The process of normalisation for each of the enforcement action is mentioned in the subsequent paragraphs. AERB may follow any or all of the measures listed below on a case-by-case basis for normalising the different enforcement actions already taken:

(i) Enforcement Letter

The regulatory inspection report is sent to the consentee along with the enforcement letter for compliance. The response to the enforcement letter and the to the recommendations made in regulatory inspection report submitted by the consentee is reviewed in the respective divisions of AERB. If the responses along with corrective actions are satisfactory, the issue is closed. The compliance is verified in the next inspection. In case the issue has already been referred to safety committee or would be referred to safety committee based on the response, the recommendations

of the safety committee will be continuously followed up in subsequent inspections till the issue is resolved. Based on the findings of the inspection and/or the review in safety committees, if any major modifications are carried out, the same are reviewed/verified during the next inspections to ensure satisfactory implementation.

(ii) Written Directives

In general, for written directives issued by AERB, the consentee's responses are reviewed first in the respective divisions of AERB and appropriate safety committees as the case may be. The corrective measures suggested by the safety committees are followed up during the subsequent inspections. If required, special inspections are conducted either before or after normalising the enforcement.

In case, on the spot enforcement actions are taken by the lead inspector or inspector with permission from Chairman/Vice Chairman, then the normalisation of enforcement action and final clearance to resume the activity would be under the directive of Chairman AERB based on satisfactory verification of compliances and through special inspections, if required.

In case a written directive is issued for non-reporting of events or significant events, the explanatory response and the event report submitted by the consentee should be studied in the respective divisions of AERB and if required, by the appropriate safety committees. Further a review of the general performance of the facility and the steps taken to prevent recurrence of such issues in future is also done, before normalising the written directive.

In case a written directive is issued for non-compliance to certain stipulations of the consent, the explanatory response submitted by the consentee, bringing out the corrective measures taken to prevent recurrence of such issues should be studied in the respective divisions of AERB and if required, by the appropriate safety committees. Review of the general performance of the facility is done before normalising the written directive.

(iii) Curtailment

In case of any specific activity was curtailed based on non-compliance with the stipulations of the consent (registration/licencse/authorisation), AERB will review the consentee's response and carry out special inspections to check that all the safety related deficiencies noticed earlier are addressed fully and also will ensure that there is no radiological, industrial and/or fire hazard to the site personnel, public and the environment. The concerned division may investigate, in detail, to understand the reasons that took place in the utility and resulted in any one of the following:

- deterioration of structures, systems and components,
- serious violations,
- non-compliance of safety culture,
- non-compliance of security requirements, and
- unsafe act or practices.

The investigation includes checking the corrective actions taken and incorporation of lessons learnt in the specific utility (and others, if applicable). Based on satisfactory compliance to all the regulatory requirements, and clearances from appropriate safety committees, the AERB may take up the issues in Board of AERB to grant the relevant clearances/authorisations.

When it is determined that the reasons, on which curtailment was ordered are satisfactorily addressed and responded to, letter for normalising of curtailment may be issued. After all the above reviews, AERB may issue either the relevant clearance to resume the specific activity or the full consent or stage wise consent as a precautionary measure and may carry out additional inspections to check the performance during such operations. If required, additional tests/ experiments are asked for and they are to be conducted in the presence of authorised AERB personnel as appropriate before permitting normal operations.

(iv) Modifications, Suspension and Revocations

In case of modification or suspension or revocation of the consent (registration/license/ authorisation) issued depending on the nature and severity of the situation, then AERB may set up a special task force for carrying out detailed review to:

- determine the root cause for particular occurrence/event,
- arrive at corrective actions to prevent recurrence, and
- review implementation of all lessons learnt.

While modification and suspension of consent can be normalised after the above steps, thought has to be given in the case of revoking of consent, whether any of the earlier reviews done during the issue of initial consent need to be repeated in view of changed circumstances.

(v) Penal Action

Since the penal action is envisaged after invoking the section 24 and 26 of the Atomic Energy Act, 1962 by court of law, penal action will be normalised as per the directives of court. However, accompanied enforcement actions, if any taken along with the penal actions, may be normalised as per the guidelines given above.

5.4 Delegation of Powers to Lead Inspector/Team Leader

During an inspection, if some serious unsafe conditions are observed and require immediate enforcement, powers are delegated to the lead inspector/team leader to take necessary action on the spot. The directive is enclosed as Annexure-5 which specifies

- the extent of authority delegated to the lead inspector/team leader to take on the spot enforcement actions or
- whether the lead inspector/team leader is not permitted to take on-the-spot enforcement action and is required only to inform his/ her superiors of the situation and to propose necessary action.

In case on the spot enforcement is not permitted, communication should be prompt and shall match the urgency of the situation so that necessary actions are taken in time. There could be instances where the lead inspector/team leader is not able to contact his superiors, in such case the lead inspector/team leader should report the findings indicating the safety implications clearly and submit it to the consentee who should accept the letter and acknowledge the same. Specimen format is enclosed in Annexure-13.

The notification 'Empowerment of Inspectors - Power to stop the work in case of unsafe conditions at the work-spots' issued by competent authority in November 2004 allows the inspector to take on the spot enforcement actions. The notification delegates the power to inspectors to stop the work if minimum safety precautions and requirements set for working at height, excavation works, material handling operations, portable electric equipment, fire safety, personal protective equipment and working in confined areas are not followed.

Similar notifications may be issued empowering the inspectors to take on the spot enforcement to improve nuclear safety. Till such time the methodology for on the spot enforcement by lead inspectors/ team leaders is not standardised, guidelines as explained in the above paragraphs should be followed.

5.5 Enforcement Procedure

5.5.1 All enforcement decisions shall be intimated to the consentee in writing and records of the same shall be maintained.

5.5.2 On the spot enforcement actions by lead inspector/team leader if authorised, are appropriate only in unusual situations based on a case-by-case basis (For example weaknesses found in containment, spread of contamination to outside area etc).

5.5.3 In normal situations, the concerned division of regulatory body shall take enforcement actions particularly those involving curtailment of activity or suspension of consents and other punitive actions in consultation with competent authority.

5.5.4 A special inspection should be planned to check whether:

(a) the consentee has complied with the recommendations/stipulations within the time period specified in the regulatory and enforcement measures; and

(b) the enforcement measures intended to protect the personnel, the public and the environment from an imminent radiological hazard and industrial and fire safety hazard have been implemented by the consentee even if the consentee intends to appeal against the decision of the regulatory body to the Board of AERB.

APPENDIX-A

INSPECTION AREAS

A.1 General

Inspection requirements during various stages of NPP consent are described briefly in the subsequent sections based on AERB safety guide, 'Regulatory Inspection and Enforcement in Nuclear and Rediation Facilities' (AERB/SG/G-4). Inspection areas for PHWR based NPPs are given in general. Similarly inspection areas for PFBR and PWR based NPPs are to be prepared. Detailed inspection checklists for construction, commissioning and operation stages are prepared and similar checklist for siting, design and decommissioning may be prepared as and when required.

A. 2 Siting

A.2.1 Site preparation activities undertaken by the consentee, including verification of site characteristics, and authorised excavation and earthwork should be inspected.

A.2.2 Regulatory inspections during siting are aimed to verify that:

- the consentee is undertaking siting activities in full conformity with existing regulatory requirements;
- the site preparation work does not proceed beyond the consent in force;
- the site characteristics remain consistent with the information presented by the consentee in its application and in the subsequent supporting documentation. (This is vital for waste disposal sites since the migration of radionuclides is dependent on the site characteristics);
- the implementation of the recommendations of relevant committees for site evaluation and the stipulations mentioned by regulatory body while issuing the consent;
- any new information being revealed as a result of the activities during the site preparation, which will be useful in making subsequent consenting decisions; and
- progress of site specific meteorological and radiological data collection and subsequent studies on activity dispersion.

A.2.3 Detailed checklist for inspection during siting should be prepared before each inspection as it is not a routine inspection and will be site specific.

A.3. Design and Construction

A.3.1 Regulatory inspections during design and construction are aimed to verify that:

- site-specific data such as soil investigation report, hydrology, earth resistance etc. are acceptable and appropriately incorporated in design;
- safety related systems, structures and components (SSCs), conform to the requirements of relevant codes and standards and/or established good practices;
- construction activities associated with fabricating and installing these SSCs are conducted in accordance with the regulatory requirements and in conformity with general safety objectives;

- design concession records and concurrence obtained by various agencies along with safety review if applicable;
- QA, inspection system and procedures of designer, manufacturer and contractor are adequate to ensure the conformance of equipment/components to the technical details/specifications;
- preservation (pre and post installation) techniques, procedures and documentation being followed at location and stores;
- emergency preparedness is in vogue at multiple unit site and the construction labour camp is located appropriately;
- satisfactory preparations of construction completion certificate (CCC) and system transfer document (STD); and
- various safety committee recommendations/stipulations as given in relevant consents are complied with.

A.3.2 Following areas should be inspected closely during the construction stage, on account of inaccessibility and/or the difficulty of detecting and correcting deficiencies once fissile and radioactive material has been loaded.

(i) Foundation strata of safety related structures after excavation.

(ii) Mixing and placement of concrete and its reinforcement, especially in;

- foundation, and
- safety related structures, particularly containment structures and stack.

(iii) Construction of cooling water intake, discharge canal and the ultimate heat sink.

(iv) Installation of safety related components particularly:

- the reactor coolant pressure boundary;
- the vessel internals including calandria tube, pressure tube and reactivity mechanism;
- reactor auxiliaries including end shield and calandria vault;
- containment and shielding boundaries including calandria vault; and
- the equipment to be used in radioactive areas (such as spent fuel inspection/handling equipment, failed fuel detection equipment).

(v) Installation of safety related control, protection and power systems and computer-based systems.

(vi) Systems and components embedded in the foundation or building structures like cabling and piping penetrations.

(vii) Housekeeping in respect of safety related SSCs.

(viii) Storage of process chemicals/fluids/system components.

(ix) Safety valves/safety devices.

(x) Stability of structures and provision of escape routes (emergency exists).

(xi) Effluent treatment plant.

(xii) Storage areas like spent fuel storage bay construction.

(xiii) Industrial and fire safety aspects including job hazard analysis reports etc,.

A.3.3 Detailed inspection checklist for construction stage of PHWR based NPP is given in Annexure-1 and for civil engineering aspects it should be prepared based on the requirements mentioned in section 4 of the AERB manual, 'Inspection during Construction of Civil Engineering Structures Important to Safety of Nuclear Facilities (AERB/SM/CSE-4)'. For other type of reactors (LWR, PFBR) similar areas should be identified for inspections during construction stage.

A.4 Commissioning

A.4.1 Activities associated with commissioning of the NPP/RR 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 phase activities. Based on review of the commissioning program, certain hold points may be identified by safety review committees to be covered by inspections prior to issue of consent for the next stage.

A.4.2 Performance during certain key pre-operational tests performed on systems, structures and components should be witnessed and/or reviewed to confirm that

- they prevent unsafe conditions or mitigate the consequences of anticipated operational occurrences and accident conditions; or
- any failure to operate the systems properly result in required action from one or more of the safety related systems and components.

The number and type of the tests to be reviewed and/or directly to be witnessed depend on whether the NPP/RR being commissioned is the first of its kind or one of a series of similar plants.

A.4.3 Following stages are identified for inspection during the commissioning of an NPP/RR and further details are given in A.4.4 of this manual and AERB safety guide, 'Regulatory Inspection and Enforcement in Nuclear and Rediation Facilities' (AERB/SG/G-4) and AERB safety guide, 'Commissioning Procedures for Pressurised Heavy Water Reactor Based Nuclear Power Plants'(AERB/SG/O-4):

(a) testing before introduction of fissile and radioactive material (In PHWR units the stage is hot conditioning and light water commissioning and draining);

(b) initial introduction of fissile and radioactive material;

(c) testing of operations involving fissile and radioactive material (tests during FAC and low power physics experiments);

(d) power ascension and performance tests at various power levels; and

(e) other commissioning activities including

- the ability of the consentee's management structure to switch over from construction to operation,
- management's preparedness for implementing the emergency plan and training and qualification of the O and M staff; and
- hold points before full operational phase etc.

A.4.4 Inspection areas during commissioning of PHWR based NPPs and RRs

The commissioning of a PHWR based NPPs and RRs is generally planned in phases as brought out in AERB safety guide, 'Consenting Process for Nuclear Power Plants and Reserch Reactors' (AERB/NPP & RR/SG/G-1). Inspections should cover important activities listed in each phase of commissioning (phase-A, phase-B, and phase-C) and also to witness and/or review the following tests. For other type of reactors (LWR, PFBR) similar areas should be identified for inspections during commissioning.

A.4.4.1 Light water commissioning (hot conditioning) of primary heat transport (PHT) system

Inspections should cover to ensure:

- availability of qualified manpower,
- availability of approved technical specifications for operations is desirable
- availability of clearances obtained from various regulatory authorities (Ministry of Environment and Forests, Central Boiler Board etc.),
- availability of updated safety analysis reports and design manuals,
- availability industrial and fire safety measures and staff,
- arrangement for preservation of installed components/equipment, instrumentation etc. for a commissioned system,
- availability of construction completion certificates related to PHT,
- compliance with QA requirements for the construction of structures, erection of equipment and installation of components,
- commissioning procedures and test reports for all the systems identified as pre-requisites for hot conditioning and light water commissioning tests,
- history dockets for safety-related structures, systems and components supplied by the manufacturers/erection and construction agencies,
- acceptance reports for the design concession requests and its safety significance,
- safety related engineering change notices,
- review of deficiency reports, corrective actions/plans with their follow-up,
- 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.),
- commissioning and performance of annulus gas monitoring system (AGMS) for coolant tube leaks monitoring,
- QA records for verification and validation of computer based systems for hardware as well as software,
- pre-service inspection base-line data of PHT system and reactor components
- housekeeping and adequacy of spares, and
- special tests conducted to demonstrate the functional adequacy of the safety/safety related

systems should be witnessed or reviewed

- reactor shutdown systems,
- compressed air failure tests,
- ECCS integrated tests,
- containment proof and leak rate tests,
- PHT instrumented relief valves opening test,
- availability of all classes of power supplies,
- class-IV power supply failure tests,
- 230V DC control power supply failure tests,
- feed and bleed valve failure tests,
- diesel generator acceptance tests,
- battery discharge tests,
- PHT pumps trip test and flow coast down test, and
- Reactor building ventilation and cooling, vapour recovery system performance.

A.4.4.2 Fuel loading in the core

Inspections should cover the activities and tests performed before fuel loading to confirm that:

- the stipulations laid for light water commissioning and draining have been completed and system drying is completed,
- documents/procedures to verify compliance to safety review recommendations exists,
- establishment of clean room condition for fuel loading,
- the demonstration of components, systems and structures to function properly and meet the design requirements,
- inspections and acceptance criteria of fresh fuel followed and availability of fuel loading procedures, and
- reviewing/witnessing of the following:
  - safety system tests (ECCS and shutdown systems);
  - the integrity of the reactor coolant pressure boundary (e.g. hydraulic systems);
  - the susceptibility of structures and components to vibration or to other design loads;
  - garter springs positioning, PSI data of coolant channel etc,
  - containment integrity (e.g., proof and integrated leak rate tests);
  - emergency power systems;
  - communication capabilities;
  - ventilation systems;
  - integrated hot functional tests from main control room;
  - instrumentation and control systems;
  - access control and implementation of radiological protection;

- emergency preparedness and demonstration of the emergency plan;
- systems for monitoring radioactive releases and meteorological measurements;
- fuel loading pattern and criticality calculations;
- actual fuel loading;
- radiation protection system;
- neutron flux monitoring systems; and
- compliance to the requirements of nuclear security before fuel loading.

A.4.4.3 Heavy water addition to PHT and moderator systems

Before the addition of heavy water to PHT and moderator systems, inspections should cover:

- availability of approved procedures for heavy water addition and their compliance;
- availability of approved technical specifications for operations in the control room and its compliance;
- commissioning reports of reactor shutdown systems, core cooling systems and engineered safety features (viz., containment and ECCS);
- healthiness of the safety systems;
- adequacy of boron in the moderator to prevent inadvertent criticality;
- enforcement of radiological protection procedures;
- operability of radiation instruments/monitors and functioning of operating island;
- availability of decontamination centre and health physics laboratory
- functioning of chemical laboratory for analysis purposes;
- commissioning of waste management facilities;
- emergency preparedness response plan and carrying out the emergency exercises;
- compliance with stipulations laid down by regulatory body for hot conditioning, fuel loading and heavy water additions;
- compliance with pre-requisites for heavy water addition;
- reactor power monitors;
- regulating systems;
- shutdown systems; and
- security systems.

A.4.4.4 First approach to criticality (FAC) and low power physics tests and experiments

Safety committee representatives or inspectors of regulatory body should be present during FAC and should observe all the low power physics tests and experiments at site to review and evaluate the physics results to confirm the worth and functioning of various reactivity mechanisms and shut down systems. Inspection during this stage should cover:

- checking of compliance with approved procedures for first approach to criticality and low power physics tests and experiments;
- fencing of site boundary and exclusion zone requirements;

- demonstration of plant, site and off-site emergency preparedness by conducting emergency exercises;
- commissioning of health physics and waste management facilities fully;
- healthiness of radiation monitors and meteorological instruments;
- commissioning of seismic instrumentation;
- commissioning of environmental survey and meteorological lab;
- performance of communication systems;
- compliance with technical specifications;
- integrity and operability of containment systems and containment box-up logic;
- availability of emergency core cooling system;
- integrated testing of adjusters and shutdown systems;
- coolant tube leak detection system (annulus gas monitoring system) operation;
- beetle monitoring system;
- operability of ventilation systems and dryers;
- performance of computer based systems;
- functioning of main and supplementary control room;
- availability of adequate licensed/qualified man power;
- status of radiation protection qualification for O&M personnel;
- operating island and radiation zoning;
- enforcement of radiological protection procedures;
- availability of ultimate heat sink;
- availability of DG sets;
- operation of control instrumentation in the control room and field observations;
- access control;
- compliance with pre-requisites for first approach to criticality;
- availability of primary containment controlled discharge, vapour suppression and heavy water recovery systems for controlling the release of radionuclides and energy during design basis accidents;
- all classes of power supplies after completing the required tests; and
- availability of nuclear security systems.

A.4.4.5 Power ascension and performance tests at various power levels

After first criticality but before reaching authorised power levels, systems, structures 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 the tests at increasing power levels, recording and analysis of data is carried out relating to temperatures, pressures, flows and variations in reactivity as well as other relevant parameters. Following activities/tests should be reviewed/witnessed by regulatory inspections:

- to assess the safety aspects of procedures for conducting power ascension tests;

- to verify that the test results are acceptable by examining the test documentation and inspection results;
- to confirm satisfactory performance of several power ascension tests, including the one which involves tripping of turbo-generator from full power. Important power ascension tests related to:
  - main coolant pump trip,
  - steam turbine trip,
  - performance of steam relief and containment isolation valves,
  - shutdown of reactor from supplementary control room,
  - load rejection tests,
  - reactor setback tests, and
  - loss of off-site power.

Additional tests of safety significance should be identified, depending on the type of plant being commissioned.

A.5 Operation Stage

A.5.1 Once the NPP/RR has attained the authorised operation stage, an inspection program to verify consentee's compliance with regulatory requirements and conformance to general safety objectives and to detect potential safety problems should be implemented. This verification should consist of direct observation of activities, interviews with plant personnel including managers, review of qualification of the personnel; and a sample documentation review. 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 important in providing confidence in long term safety.

A.5.2 Following areas of operating unit should be inspected to check the requirements as brought out in AERB safety guide, 'Regulatory Inspection and Enforcement in Nuclear and Rediation Facilities' (AERB/SG/G-4). Detailed checklist to inspect all areas including civil engineering aspects during operating stage of PHWR based NPP is given in the Annexure-2 and 4. For other type of reactors (LWR, PFBR) similar areas are to be identified for inspection during operating stage.

- Plant management (safety culture, organisational aspects etc,);
- Operations and fuel handling;
- Effectiveness of management systems;
- Radiation protection and occupational radiation exposure records;
- Emergency preparedness;
- Performance of safety and safety related systems;
- Main and supplementary control room operations;
- NPP's training program;
- Access control;
- Radioactive waste management;
- All maintenance activities (mechanical, electrical, I&C etc,) and stores;
- Environmental monitoring;

- Engineering and technical services;
- Quality assurance program and in-service inspection; and
- Reactor physics.

A.6 Industrial and Fire Safety

Various requirements as laid down in Factory Act 1948, the Atomic Energy (Factories) Rules, 1996, other directives of AERB and other applicable Acts/Rules like Environment Act, 1986 and its rules etc. should be checked at each NPP during all stages of authorisation. Certificates issued by other statutory authorities dealing with industrial activities may be checked to ensure compliance by NPP.

Fire safety requirements as per AERB fire standard and AERB safety guide 'Fire Protection in Pressurised Heavy Water Based Nuclear Plants' (AERB/SG/D-4) should be checked at each NPP/RR during all stages of NPP/RR operation. The checklist in Annexure-3 A and 3B covers these requirements.

A.7 The Decommissioning Stage

A.7.1 Decommissioning of a NPP is taken up before releasing the NPP from regulatory control. Regulatory inspection should be carried out during decommissioning stage to confirm that residual radioactivity has been reduced to specified acceptable levels for general public use. Detailed checklist for inspection during and after decommissioning of NPP has to be prepared at the time of job execution. However following activities should be covered:

- the removal of fissile material from core;
- transfer/safe storage of radioactive fissile material;
- the management strategy for handling and storing of radioactive material;
- the depressurizing and draining of any fluid;
- the decontamination and dismantling activities;
- the waste management strategy for the treatment, conditioning, storage and disposal of all radioactive wastes;
- the physical condition of the NPP, especially the surveillance of the integrity and/or availability of relevant NPP's structures, systems and components, including protective barriers and appropriateness of the procedures at each stage of decommissioning;
- adequacy and monitoring of shielding of active SSCs
- the characterisation of the residual activity;
- physical security, safeguards and access control;
- radiological monitoring and surveillance, including occupational and public protection plan;
- the adequacy and maintenance of instrumentation and control systems for long term safety;
- environmental monitoring;
- making the equipment free from all chemicals; and
- storage and disposal of hazardous materials/chemicals.

ANNEXURE-1

REGULATORY INSPECTION CHECKLIST DURING CONSTRUCTION/ COMMISSIONING STAGE OF PHWR BASED NPPs/RRs

CONTENTS

Section No.	Title of the Section
I	**Quality Assurance -General**
I-A	Typical Checklist for Procedures, Work Instructions and Directives
II	**Receipt and Storage of Materials - General**
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II-B	Typical Checklist for Receipt and Storage of Calandria
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III	**Installation/Construction/Erection - General**
III-A	Typical Checklist for Installation/ Construction /Erection of Piping Components
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III-C	Typical Checklist for Installation/Erection of End Shields
IV	**General Checklist for Installation/Construction of Electrical and I&C**
IV-A	Typical Checklist for Commissioning of Electrical and I&C
V	**General Checklist for Pre-Commissioning**
VI	**General Checklist for Commissioning**
VI-A	Typical Checklist for Phase A Commissioning of NPP
VI-B	Typical Checklist for Phase B commissioning of NPP

ANNEXURE-1 (Contd.)

Checked by _____

I Quality Assurance - General

1. Organisation chart of the project indicating important positions and lines of command and communication within the organisation and outside organisation including head quarters.

2. Responsibility and role clearly to be defined.

3. Authorisation to execute works

4. Organisational setup available for the following groups

   Reactor erection
   Field engineering
   Industrial and fire safety
   Piping and mechanical equipment
   Electrical and instrumentation & control
   Quality assurance
   Site planning
   Contract and material management
   Operation and maintenance

5. Interface /liaison established with the following agencies.

   Head office
   Design organisation
   Corporate QA
   Contractors
   Health, safety and environment group
   Operation and maintenance group
   Security, administration and accounts
   Medical units
   Commissioning group and regulatory body
   State government, state and district authority
   Pollution control board
   Electricity Board
   Irrigation department
   Department of explosives for licensed material
   Boiler inspectorate
   Ministry of environment and forests

ANNEXURE-1 (Contd.)

Checked by _____

I-A Typical Checklist Procedures, Work Instructions and Directives

1. Updated approved site QA manual with revision number and date
2. Planning of construction activities in proper sequence including Level 1,2 and 3-network diagram
3. Documentation of construction activities in proper sequence
4. Availability of approved QA plan defining responsibilities of agencies
5. Methodology for approving contractors and sub-contractors (vendor qualification system).
6. Formulation, approval and periodic review of written procedures, work instructions, drawings and other relevant documents (checklist etc.)
7. Formulation of equipment storage and preservation procedures
8. Availability of cleanliness standards for items stored, installed or constructed
9. Identification and marking of clean zones (dust free, humidity and temperature controlled)
10. Procedures for maintaining clean zones (air changes, change station etc.)
11. Procedure for inward inspection of parts and components received at site
12. Procedure for segregation of materials/rejected/repaired/accepted parts and components during storage
13. Availability of procedures, instructions for handling of materials, parts and components
14. Procedures for cleaning, drying and preservation of fluid systems and associated components
15. Procedures for surface cleaning and application of protective coatings and their qualification aspects
16. Procedures for identification, calibration requirements and calibration frequency of measuring and test equipment
17. List of types of measuring and test equipment and calibration record
18. Procedure for training and qualification of personnel for installation, inspection, testing, and records of trained/qualified personnel with validity date of qualification
19. Procedures for dealing with non-conformance and corrective action and records
20. Procedures for generation, identification, distribution and maintenance of QA records at site
21. Provision for review of QA program, frequency thereof, follow-up action and records thereof.
22. Procedure for conducting contractor and subcontractor's audits
23. Procedure for maintenance and storage of equipment history docket (EHD)

ANNEXURE-1 (Contd.)

Checked by ———

II Receipt and Storage of Materials - General

1. Availability of the QA manual for site under construction

2. Availability of QAP for receipt and storage

3. Availability of approved storage and preservation procedure

4. Classification of storage, grouping criteria with respect to

   4.1 Unit
   4.2 System
   4.3 Equipment/type of material
   4.4 U S I/ coding used for the plant
   4.5 P.O. number
   4.6 Supplier's name
   4.7 Manufacturer's name.

5. Record of checking of the following on receipt of material at site

   5.1 Identification/markings
   5.2 Cleanliness
   5.3 Acceptance certificate / shipping release by accepting agency
   5.4 Equipment history document
   5.5 Any non-conformance during manufacture and corrective action if any
   5.6 Protective covers, coating and preservatives
   5.7 Physical damage due to transport, environment and improper handling
   5.8 Inert gas blanketing and condition of desiccant.

6. Manufacturer's instruction on handling and storage

7. Fulfillment of condition of shipping release if materials have been accepted on some condition

8. Condition of storage

   8.1 Condition of protective cover and seals and coatings on materials in storage
   8.2 Access to storage, controlled/uncontrolled
   8.3 Cleanliness of storage area
   8.4 List of equipment (category wise) stored
   8.5 Approved procedure for document preservation
   8.6 Adequate and appropriate storage facility to avoid degradation
   8.7 Codification used
   8.8 Traceability of stored materials and inventory management
   8.9. Prevention of foreign material intrusion in pipes, tubes, tanks and other equipment.

ANNEXURE-1 (Contd.)

Checked by _____

II Receipt and Storage of Materials - General

9. Verification of shelf life of material

10 Periodic verification of storage & preservation and quality control check points

11. Issue procedure, credit procedure, scrapping procedure

12. Fire protection facility at storage area

13. Verification of storage as per QAP

II-A Typical Checklist for Receipt and Storage of Piping Components

1 Incoming inspection and storage of piping materials

2 Identification of component as per the coding used for the plant

3 Piping material (pipe, pipe fitting, valves, etc. as per coding used)

4 Sizes

5 Procurement specification (item accepted by the unit and inspected at site by QA)

6. Procurement specification and the unit QA's inspection report available at site

7. Typical, cross verification of material with heat number (check procurement specification, heat number and adequacy of material test certificates)

8 Storing of procured piping materials

9 Storing requirement specified

10 Storing method adequacy

11 Housekeeping/cleanliness in storage area

12 Re-test of valves carried out in case required

13 Protective coating on materials

ANNEXURE-1 (Contd.)

Checked by _____

II-B Typical Checklist for Receipt and Storage of Calandria

1. Receiving inspection of calandria Unit No — USI No —-
2. Name of the supplier and purchase order No.
3. Procurement specifications are available at site
4. Test reports are available at site
5. Test reports of materials of construction
6. Reports on tests/examinations conducted during manufacturing like weld examination, dimensional checks, etc.
7. Acceptance certificate/shipping release issued by the accepting agency is available
8. Documentation of disposition of non-conformances during manufacture (in the form of DCRs) is available at site
9. Whether the calandria was received as per the packing/shipping requirement and no shipping damage observed
10. History docket for calandria
11. Availability of storage procedure
12. Storage of calandria (prior to installation)
13. Access to storage area controlled/not controlled
14. Frequency of inspection of storage
15. Cleanliness of the storage area
16. Fire protection facilities in the storage area
17. Whether protective measures during storage have been maintained
18. Condition of protective covers and seals
19. Inert gas blanketing present or not
20. Availability of approved installation procedure

ANNEXURE-1 (Contd.)

Checked by _____

II-C Typical Checklist for Receipt and Storage of End Shields

1. Receiving inspection of end shields Unit No. — USI No.
2. Name of the supplier and purchase order No.
3. Procurement specifications are available at site.
4. Test reports are available at site
   (Test reports of materials of construction, test/examination reports during manufacturing like weld examinations, dimensional checks etc.)
5. Documentation of disposition of non-conformances during manufacture (in the form of DCRs) is available.
6. Whether the end shields were received as per the packing/shipping requirement and no shipping damages were observed
7. Storage of end-shields (in case end shields are still under storage)
8. History docket for end shields
9. Availability of storage procedures.
10. Access to storage area controlled/not controlled
11. Cleanliness of the storage area
12. Fire protection facilities in the storage area
13. Condition of protective covers and seals
14. Inert gas blanketing present or not
15. Frequency of inspection of storage
16. Detailed handling procedure is available (Procedure should take account of weight, size, surface finish, prescribed handling points, orientation)
17. List of special handling equipment and their reports
18. Pre-installation checks on the end shield.
19. Whether protective measures during storage have been maintained.

ANNEXURE-1 (Contd.)

Checked by _____

III Installation/Construction/Erection - General

1 Agency for installation

2. Organisation and line of command

3. Review of compliance and corrective action

4. Availability of approved installation procedure

5. Availability of following documents

   5.1 Approved engineering drawings and specifications

   5.2 Approved installation procedure/special instruction

   5.3 QA/inspection report on receipt at site

   5.4 Manufacturer's instruction/manual

6. Adequate number of experienced, qualified manpower identified for installation/erection is available

7. List of tasks for each group/section

8. QA plans for installation activity

9. Quality control check points, and hold points as defined in QAP

10. Availability of TSD net work diagram for

    L—1 project level, L—2 group level,
    L—3 section level and L—4 engineer level

11. Detailed handling procedure is available (Procedure should take account of weight, size, surface finish, prescribed handling points, orientation)

12. List of special handling equipment and their test reports.

13 Whether installation preparations including removal of packaging, preliminary positioning and cleaning are documented

14. Warning and safety notices appropriate to the activity are posted.

15. Protection from adjacent construction is provided.

16. Protection from rain is provided.

17. Approved welding procedure is available.

18. Welding procedure qualification records seen and results are satisfactory

ANNEXURE-1 (Contd.)

Checked by _____

III Installation/Construction/Erection - General

19. Welders' performance qualification records seen and results are satisfactory

20. Weld inspection reports are properly documented and available

21. Penetrant examination of weld joints satisfactory.

22. Radiographic examination of weld joints satisfactory.

23. Remarks on examination of sample radiographs.

24. Any non-conformance report raised during installation

25. Accessibility for inspection and maintenance

26. Equipment earthing and clearance is as per procedure

27. Fire protection provision

28. Approved preservation procedure followed after installation

29. Stage by stage QA audit

30. Contractor's work procedure and QA program

31 Availability of trained and qualified man power with contractor

32. Preservation of contract documents; procedure, facilities, responsibilities

33. Pre installation checks records

34 Release of equipment for installation

35. Installation preparation records

36. Post installation check records

37. Clearance of area for installation of equipment

38 List and presentation of governing documents for installation/construction

39. Site field engineering functional

40. Change modification procedure; ECN/FCN, temporary change, jumpers, documentation, approving authority

ANNEXURE-1 (Contd.)

Checked by _____

III Installation/Construction/Erection - General

41. Correction of relevant drawings/corrected drawing revision issued

42. Site planning /library /EDP established with adequate facilities

43. Responsibility structure for CCC/STD preparation, review, acceptance, audit

44. CCC/STD submitted to commissioning group

45. Acceptance of CCC/STD by commissioning group and their comments if any

46. 100% checks for active components before installation

47. Approved preservation procedure for installed equipment

48 Routine tests and inspections followed after installation

49 Preservation documentation

50 Classification, methodology for transfer to commissioning group

III-A Typical Checklist of Installation/Construction/Erection of Piping Components

1. Unit

2. System

3. USI No./Plant specific coding

4. Agency carrying out fabrication

5. Approved piping fabrication procedure, including repair procedures available

6 Approved spool pieces drawing available with number and latest revision

7. Approved piping inspection and test procedures with acceptance criteria

8. Welding procedure specification available

9. Welding procedure qualification carried out

10. Welders' performance qualification carried out
(check name, position qualified, thickness qualified, validity with respect to date of qualification and acceptance by site QA)

ANNEXURE-1 (Contd.)

Checked by _____

III-A Typical Checklist of Installation/Construction/Erection of Piping Components

11. Proficiency of pipe fitters (previous experience, etc)

12. Acceptability of welding consumables (filler wires. insert rings, backing rings, welding electrodes, purity of shielding and cover gas)

13 Welding inspectors qualified

a) Fabrication agency
b) Site QA

14 Quality control on pipe welds

a) Weld liquid penetrant examination results (verify from records that results are satisfactory for all joints)
b) Weld radiographic examination results (verify from records that results are satisfactory for all joints)
c) Final piping dimensional checks carried out
d) Final piping hydrostatic tests carried out as per procedure
e) Valves re-test carried out if required

15. Approved procedure for calibration of test and measuring instruments are available

16. Test and measuring instruments are calibrated as required (check calibration records)

17. Fabricated spool approved by site QA

18. Housekeeping - in fabrication area

19. In case of stainless steel components, segregation of stainless steel from carbon steel

20. Field erection of fabricated spools. (System, USI No.)

21. Agency carrying out field erection

22. Approved procedures including repair procedures

23. Approved inspection and test procedures with acceptance criteria

24 Approved drawings for field erection available.

25. Piping supports provided as per drawings

26. Approved procedure for cleaning of erected piping available

ANNEXURE-1 (Contd.)

Checked by _____

III-A Typical Checklist of Installation/Construction/Erection of Piping Components

27. Strainers if required and drain points for cleaning the pipes are confirmed

28. Approved procedure for drying and preserving the erected piping available

29. Records showing pipe cleaning after fabrication is carried out as per procedure

30. Record showing pipe preservation carried out as per procedure

31. Final erected piping verified as per drawing details by site QA

32. Documentation of piping fabrication

33 Pipe, pipe fittings, valves, welding consumables procurement specifications available at site

34. Acceptance certification of the above available at site including designer's justification for any non-conformance (DCRs)

35. Site inspection report of the above materials available.

36 Approved fabrication procedures, approved inspection and test procedures, spool piece drawings, final field erection drawings and final approved as built drawings available.

37. Liquid penetrant examination for each joint of every system documented

38 Radiographic examination report for each joint available at site (for which radiography is mandatory)

39. Radiographic film transferred by fabrication and transferred to site QA agency

40. The radiographs of each weld put in a separate cover with weld joint numbers marked and properly stored

41 Hydrostatic test reports for spools and finally erected pipe

42. Cold setting details of variable load hangers

43. Record showing external protective coating applied for piping

44. Any ECNs carried out properly documented in the drawings

45. Records of non-conformances and their disposition like DCRs

ANNEXURE-1 (Contd.)

Checked by _____

III-B Typical Checklist for Installation/Erection of Calandria

1. Detailed handling procedure is available (covering weight, size, surface, finish, prescribed handling points and orientation)
2. List of special handling equipment and their test reports.
3. Pre-installation checks on the calandria
4. Protection measures during storage have been maintained.
5. Approved procedures for installation are available
6. Experienced/qualified personnel for installations identified
7. Installation preparation, including removal of packaging, cleaning and preliminary positioning are documented.
8. Equipment for handling the calandria has been tested
9. Warning and safety notices appropriate to the activity are posted.
10. Calandria vault civil construction is complete and cleared for installation of calandria. Protection from adjacent construction is provided
11. Protection from rain is provided
12. The calandria vault is inspected and cleared for the installation of the calandria
13. Alignment of calandria nozzles within specified limits. In case not within limits, DCR obtained
14. Sag measurements on the calandria are within limits

ANNEXURE-1 (Contd.)

Checked by _____

III-C Typical Checklist for Installation/Erection of End Shields

1. Experienced/qualified personnel for installation identified
2. Approved procedures for installation are available
3. Installation preparations, including removal of packaging, cleaning and preliminary positioning are documented.
4. Equipment for handling the end shield has been tested
5. Warming and safety notices appropriate to the activity are posted
6. Calandria vault civil construction complete and cleared for installation of the end shield
7. Protection from adjacent construction provided
8. Protection from rain is provided
9. Adequate clearances are available for transporting the end shield to the calandria vault
10. Permanent supports for end shields installed and provisions for temporary supports are available
11. The calandria vault is inspected and cleared for the installation of the end shields.
12. Installation of end shields
13. Survey of EPs and cavity where end sheilds will be installed is completed
14. Establishment of the centre line of the reactor, North-South, and different elevations of the end-shield in the calandria vault.
15. Procedure for mild steal (MS) ball filling inside end shield available
16. Visual inspection of the steel balls carried out and diameter is as per requirement
17. Ball filling completed and the packing density is as per specification

18 Radiometry of the end shield completed and results are satisfactory

19 The man hole and hand hole covers are installed and welding completed as per procedure

20. Penetrant and radiographic examination completed satisfactorily on the cover weld
21. North and South end shields installed in the respective cavities
22. Grouting of end shields completed and support installed

ANNEXURE-1 (Contd.)

Checked by _____

IV General Checklist for Installation/Erection of Electrical and Instrumentation and Control

1. Availability of Documents:

a) Approved drawings/specifications/manuals for installation
b) Installation procedures/special instructions
c) Coding, colouring and tagging practices
d) Procedure for copper/SS instrument tubing erection
e) Procedure for instrument tube joining and welding
f) Procedure for electrical termination of control cables
g) Procedure for erection of instruments, panels etc,
h) Procedure for cable laying and splicing. approved load and cable schedule
i) Erection procedures for transformers, HV motors, switchgears, batteries, circuit breakers, isolators and electrical panels
j) Testing Procedure
k) Procedure for containment wall cable penetration cable laying,
l) Sealing and testing
m) Earthing and lightning protection procedure
n) Supplier manual / instructions
o) Installation procedures
p) Flow sheets
q) Electrical drawings
r) Wiring drawings
s) Check list

2. Installation:

a) Installation of hydraulic, pneumatic and vacuum systems are as per procedure
b) Installation of penetration assemblies are as per procedure
c) Cable pulling, splicing and terminating done as per procedure
d) Cable separation and segregation is as per approved standards
e) Non-conformance reports raised during equipment installation
f) Severity of non-conformance and follow up
g) Seismic requirements during installation as per specifications are met
h) Accessibility for inspection and maintenance
i) Equipment earthing and discharge clearance is as per procedure
j) Installation of fire stops and barriers is as per procedure
k) Location of safety and protection instruments
l) Is the equipment environmentally qualified to be used in radiation, high temperature and humidity

ANNEXURE-1 (Contd.)

Checked by _____

IV General Checklist for Installation/Erection of Electrical and Instrumentation and Control

3. Jumpers:

a) Absence of short circuits, grounds
b) Presence of jumpers and appropriate documentation
c) Instrument set points revised for testing and documentation

4. Instrument Calibration and Testing Facility:

a) Availability of calibrated tools and instruments, including radiation sensors/instruments
b) Are the instruments calibrated against the national standards?
c) Are the personnel qualified for testing/checking the installed equipment?
d) Electrical test results like IR, WR etc. are OK
e) Correct polarity, proper grounding and shielding
f) Calibration details of process instrument
g) Fluid levels, pressures, leaks and integrity
h) Direction of rotation, vibration and noise of rotating equipment during test
i) Housekeeping, ventilation
j) Temporary connections such as jumpers are documented
k) Temporary changes in set point of control equipment are documented
l) Connected instrument performance during test and any adverse remarks from the test reports
m) Any damage during installation
n) Battery pre commissioning test reports
o) Battery C-10 and service test specified for C-1/2 hour or C-1
p) Remarks and follow up

5. Tests and Reports:

a) Leveling and alignment, clearance and tolerances
b) Circuit continuity and polarity check as per electrical drawings
c) Voltage breakdown test results and chemical analysis of liquid insulation (transformer oil)
d) Over potential (high voltage) test as specified, and results are OK.
e) Insulation resistance and winding resistance
f) Pneumatic and hydro pressure tests of instrument connection, connected to electrical equipment and instruments
g) Chemical analysis of lead acid solution of batteries prior to use.
h) Test report of safety valve, IRV, RD etc. for acceptance
i) Earthing resistance results and grounding provisions
j) Documents
k) Non-conformance report. Findings and follow up

ANNEXURE-1 (Contd.)

Checked by _____

IV-A Typical Checklist for Commissioning of Electrical and Instrumentation and Control

6. Verifications of Documents:

1. Jumpers provided are removed, documents for the same
2. Set points for instruments are restored back to normal
3. Tests are carried out in line with approved commissioning procedures
4. Approvals taken for procedural deviations and documented
5. AERB guidelines/recommendations/stipulations followed during commissioning
6. Inspection documents
7. Evaluation of test results and commissioning reports
8. Are design intent/requirements met
9. Remarks made by QA and commissioning group and follow up

7. Verification of Instrument Calibration:

1. Performance of the connected instruments was OK during the tests (Monitors, transducers meters, recorders, relays, lamps, alarms, computers, controls and interlocks)
2. Calibration of instrumentation and control channel and devices is satisfactory
3. Are the instruments calibrated against the national standards?
4. Precautions taken if the equipment testing precedes system commissioning
5. Documentation to verify

8. Harmonics:

1. Measurement of unwanted or harmful effects of conducted or induced electrical noise (harmonics, circulating currents, etc.)
2. Effect of harmonics if more than permitted is found in the system
3. Non-conformance report findings

9. Installation and commissioning documents to be seen along with field visits for:

9.1 Switchyard:

1. 220 kV and 400 kV breakers and isolators and GCB
2. Switchyard control room
3. Power supply of 220V DC and 48V DC.
4. Protective systems
5. Fire prevention methods
6. Housekeeping
7. Communication

ANNEXURE-1 (Contd.)

Checked by _____

IV-A Typical Checklist for Commissioning of Electrical and Instrumentation and Control

9.2 Transformers:

1. Generator transformer
2. Startup transformer
3. Unit auxiliary transformer
4. Auxiliary (6.6kV, 415 V etc) and other transformers specific to project
5. Protection systems
6. Fire detection and protection system

9.3 Switch gear of 6.6KV, 415 V in:

1. Service building
2. Turbine building
3. Control building
4. Safety related pump house

9.4 Class I & Class II system:

1. Power UPS
2. Control UPS
3. 48VDC, 220 VDC switch gear in various buildings
4. UPS and switch gear in supplementary control room
5. Plant communication system
6. Check for any grounding alarm in control room

9.5 Batteries in:

1. Power UPS
2. Control UPS
3. Switchyard control room
4. Plant communication
5. Emergency control centre
6. Diesel fire water pump

9.6 Diesel Generator System:

1. Diesel generator
2. Diesel oil system
3. Exciter and protection circuit
4. Control panel, enclosures and mountings
5. Cooling systems (oil and water)
6. Exhaust systems

ANNEXURE-1 (Contd.)

Checked by _____

IV-A Typical Checklist for Commissioning of Electrical and Instrumentation and Control

9.7 Cables:

1. Cabling as per applicable code/standard
2. Cable trays in various areas of turbine, reactor and service buildings
3. Verification of cable segregation and separation by distance.
4. Cable and cable tray numbering
5. Cable supports from seismic point of view

9.8 6.6. KV and 415 V Motors of Safety Related Systems:

1. Installation verification reports
2. Commissioning test reports
3. Preservation prior to final hook up to system and records
4. Maintenance of the motors
5. Performance during final system commissioning

9.9 Lightning Protection for:

1. Various buildings
2. Structures (transmission towers etc,)
3. Equipment (transformers)

9.10 Earthing Systems:

1. Availability of approved procedures
2. Method and standards used for earth resistance measurement
3. Step potential measurement/ calculations.
4. Earth resistance and step potential values are within design values
5. Steps being taken to improve the above values if found unacceptable
6. Soil resistivity

9.11 Lighting System

1. Normal lighting in safety related building/areas
2. Emergency lighting in safety related areas and control room
3. Aviation lighting

9.12 Instrumentation along with their Sensors

1. Control room
2. Supplementary control room
3. Various areas of safety related systems
4. Functioning of radiation sensors and controlling devices

ANNEXURE-1 (Contd.)

Checked by _____

IV-A Typical Checklist for Commissioning of Electrical and Instrumentation and Control

9.13 Computer or PLC Based System along with Interfaces:

1. PDCS/CRCS
2. SCADA/ESCADA
3. MIAS/IAM
4. Disturbance analyser
5. Event sequence recorder
6. EMTR and ATS
7. Load shedding and load sequencer schemes
8. Any other system specific to plant

9.14 Valves:

1. Motor operated valves of safety related systems
2. Pneumatic operated valves of safety related systems
3. Test reports of valves

9.15 Instrument and Primary Sensing Devices

1. Orifices
2. Flow nozzle
3. Venturi tubes
4. Reference columns
5. RTD/ thermocouples
6. Sensing lines and process root valves
7. Transducers

9.16 Instrument Tubing and Piping

1. Hydraulic instrumentation
2. Pneumatic instrumentation
3. Vacuum instrumentation

ANNEXURE-1 (Contd.)

Checked by _____

V General Checklist for Pre-commissioning of a NPP

1. Following documents are available

   1.1 QA manual for commissioning and commissioning network diagram
   1.2 Design basis reports, design manuals (original and revised one as per built-in- design of plant components and systems)
   1.3 Operational flow sheet, operating and maintenance manuals/procedures
   1.4 Station norms on various needs are ready and available
   1.5 Governing documents for commissioning identified and arranged
   1.6 CCC submitted and system equipment released for pre - commissioning
   1.7 No. of ECN/ECR in the system
   1.8 Status of compliance of ECN/FCN and technical bulletin issued
   1.9 Clearances obtained from various regulatory authorities (ministry of Environment & forest etc.,)
   1.10 Electrical & control schematic diagram /ED, flow sheet updated as built
   1.11 Test records of connected systems (electrical, control, service water, compressed air)
   1.12 Commissioning pre-requisites identified and listed
   1.13 QA action plan, commissioning procedure and checklists

2. Maintainability and testability established for the installed system

3. Handling arrangement for equipment installed

4. Adequate and suitably experienced and qualified manpower identified

5. Micro commissioning reports and records available

6. System layout checked as per design and flow-sheet

7. Reports on installation of mechanical and electrical equipment and C & I logics

8. Results of air hold/flushing/helium leak check available as required for the system/equipment

9. Record of removal of the temporary arrangements and connections made for air hold, flushing, helium leak check etc.

10. Tagging of equipment, pipelines, ducts, tubes, identification status

11. Status of painting as per approved colour code

12. Compliance with AERB/ACPSR/PDSC recommendations, if any

13. Quality control procedure and checklists

14. Check for specifications of equipment as specified by designers for piping tubing's valves, instruments etc.

15. Designer's comment on commissioning procedure

16. Policy for transfer of concerned equipment and systems including all accessories and civil works related to commissioning and responsibilities for acceptance

ANNEXURE-1 (Contd.)

Checked by _____

V General Checklist for Pre-commissioning of a NPP

17. Follow up on PSI data, responsibilities

18. SORC decisions and their status and technical audit engineer in place and functional

19. Industrial and fire safety measures and staff availability

20. Field status of fire fighting equipment and systems including

    a. Fire detection system
    b. Availability of portable fire fighting equipment
    c. Availability of sprinkler system
    d. Operational check of fire detection system/instruments

21. Status of radiological emergency preparedness

ANNEXURE-1 (Contd.)

Checked by _____

VI General Checklist for Commissioning of a NPP

Documents

1. Commissioning organisation with role and responsibilities

2. Appropriate experience and trained manpower identified
   a. Availability of qualified manpower
   b. Availability of licenced manpower

3. Governing documents identified, listed and arranged
   3.1. Following TSDs prepared and available (Level-1, Level-2, Level-3 and Level-4)
   3.2. Following documents are ready and available as applicable
   Safety reports, PSAR, FSAR, DBR, Design manuals
   Approved commissioning procedures with QA and designers review
   Availability of construction completion certificate (CCC) and system transfer document (STD)
   Any observation and deficiencies noticed in CCC/STD
   DCR/Non-conformance report issued
   Remarks made by QA and commissioning group

4. Following approved contingency plans available
   a. emergency response preparedness plan
   b. flood contingency plan
   c. fire contingency plan
   d. security contingency plan
   e. cyclone contingency plan
   f. seismic contingency plan

5. Interfacing procedure for acceptance of connected systems such as electrical, controls, civil etc.

6. Availability of approved technical specification for operations

7. Status and reports of PSI (piping, weld joints, heat exchangers coolant channels etc.)

8. SORC constituted and functional, MOM

9. Change /modification control for ECN/FCN/drawing

10. Safety related equipment guidelines, criteria and list available

11. Updating of drawings after field verification as a parallel job

12. ESL is established and functional

13. Check test results of water flushing and air drying as the case may be

14. Approvals taken for procedural deviations and documented.

ANNEXURE-1 (Contd.)

Checked by _____

VI General Checklist for Commissioning of a NPP

15. AERB guidelines/recommendations/stipulations followed during commissioning.

16. Inspection documents.

17. Evaluation of test results and commissioning reports

18. Is design intent/requirements are met

19. Remarks made by QA and commissioning group and follow up

Physical Verification

1. Physical check of completeness of system erection and layout as per design; operating island established and physical protection system made operational

2. SORC constituted and functional, review MOM

3. Change /modification control for ECN/FCN/drawing

4. Updating of drawings after field verification as a parallel job

5. Zoning and escape routes identified and established

6. Radiation monitors, hand and foot counters, contamination monitors in place and functional

7. ESL is established and functional

8. Training section is established to meet station training requirement

9. Supports and hangers

10. Identification, tagging and paintings as per colour code

11. Insulations as and where required

12. Any seepage and water logging

13. Bathrooms, toilets and change room operational

14. Protective clothing shoes etc. supplied to employees

15. Laundry functional

16. Exclusion boundary established

17. Emergency preparedness rallying points and shelters identified.

18. Off site emergency (preoperational) exercise conducted

19. Emergency control centre established

20. Fire/smoke sensing indicators and alarm installed and tested

ANNEXURE-1 (Contd.)

Checked by _____

VI-A Typical Checklist for Phase A Commissioning of a NPP

1. Station lighting commissioned
2. Communication systems
3. Review commissioning report of electrical system
4. Review commissioning report of process water systems
5. Review commissiong report of compressed air system
6. Fire fighting system commissioning test
7. Hydro-test of systems and results
8. Check test results of water flushing and air-drying as the case may be
9. Reactor building ventilation system commissioning test
10. Review commissioning report of water treatment plant
11. Safety systems (ECCS, PSS, SSS, LPIS, etc.)
12. Emergency power systems (Class I, II, III systems)
13. Loss of off-site power (class IV failure tests).
14. Emergency DG performance tests
15. Containment related system tests (proof test, ILRT, PCFPB, SCFPB)
16. Pump trip (PCP etc.)
17. PHT pressure decay test
18. Shut down from control room and supplementary control room
19. Decay heat removal systems from supplementary control room
20. Examination of the test results to verify compliance
21. Tests are carried out in line with approved commissioning procedures
22. Compressed air pressure decay test
23. Calandria vault cooling system
24. End shields cooling system
25. Auxiliary feed pump and system
26. Feed water system test
27. Moderator system circulation test

ANNEXURE-1 (Contd.)

Checked by _____

VI-A Typical Checklist for Phase A Commissioning of a NPP

28. Heavy water addition and transfer system test
29. PHT ion exchange system commissioning test
30. Moderator ion exchange system commissioning test
31. PHT leakage collection system commissioning test
32. AGMS commissioning test
33. PHT hydro test and its performance
34. PHT hot conditioning and its performance
35. Helium leak test and result as and where applicable
36. Floor drains commissioned
37. Safety related equipment guidelines, criteria and list available

VI-B Typical Checklist for Phase B Commissioning of a NPP

1. Check that phase-A commissioning tests are completed
2. All radiation measuring instruments/equipment commissioned and functional
3. Inter zonal contamination monitors commissioned and functional
4. TLD given to employees
5. Relevant radiation safety requirement including radiological safety procedures are applied
6. Core cooling is appropriate, verify from data sheet and commissioning report
7. Reactivity control system tested and certified satisfactory
8. Radiation shielding is appropriate
9. Review phase B physics measurement report
10. Reactor physics parameters certified satisfactory
11. Ensure that there is no significant disagreement between Reactor physics measured value and those used in safety reports
12. Satisfactory capability of fuelling/re-fuelling of reactor core at least up to rehearsal facility before approach to criticality
13. Review fuel-loading reports
14. Addition of D_2O in PHT, after recirculation check sample for isotopic purity and chemistry
15. Review moderator system heavy water addition commissioning report
16. Review start up neutron monitoring equipment, calibration and test report
17. Review reactor criticality reports

ANNEXURE-2

REGULATORY INSPECTION CHECKLIST FOR OPERATING NPPs/RRs

CONTENTS

Section No.	Title of the Section
General	USI for PHWR systems
I	Operation and Fuel Handling
II	Reactor Physics, Core and Fuel Management
III	Technical Audit and Surveillance
IV	Maintenance Units
IV.1	Electrical Maintenance
IV.2	Mechanical Maintenance
IV.3	Control and Instrumentation
V	Quality Assurance / Technical Services and ISI
VI	Training and Qualification
VII	Health Physics and Environment Survey
VIII	Radioactive Waste Management

ANNEXURE-2 (Contd.)

General USI Numbers for PHWR Systems

No.	USI	TITLE
1.	21000	Containment
2.	30000	Reactor Components
3.	32000	Moderator System and Auxiliaries
4.	33000	PHT System and Auxiliaries
5.	34000	Reactor Auxiliaries
6.	35000	Fuel Handling System
7.	36000	Secondary Steam
8.	37000	Fuel
9.	34930	D_2O Management and Upgrading
10.	40000	Turbine Generator and Auxiliaries
11.	50000	Electrical System
12.	60000	Instrumentation & Control Systems
13.	71300	Cooling Water System (Process Water)
14.	71400	Fire Water System
15.	71720	Active Drainage Water System
16.	73000	Reactor Building Ventilation System
17.	75100	Compressed Air System
18.	79000	Waste Management

ANNEXURE-2 (Contd.)

Checked by _____

I Operation & Fuel Handling Unit (FHU)

1. Organisation and Administration

1.1 Availability of licensed personnel and minimum staff requirement
1.2 Manning of control room (FHU during refuelling)
1.3 Arrangement for handing over during
Shift change over
During tea/lunch break etc.
Routine field inspections by SCE/ASCE
Fuelling operations (during refuelling)
1.4 Assumption of duties by licensed personnel after long leave and related records
1.5 Lines of communication (during normal and off-normal conditions)

2. Availability of Latest Revised Documents/Procedures

2.1 Technical specifications for operation

2.2 Operating manuals with index

2.3 Special operating instructions/memos and office orders

2.4 Operating flow sheets, process and instrumentation diagrams, including ECNs

2.5 Station emergency plan

2.6 Emergency operating procedures (EOPs)

2.7 Contingency plans for:

Fire
Cyclone
Flood
Earthquake
Terrorist attacks
Workers strike/public unrest

2.8 Following documents should be available mainly in library and in the offices of senior operation engineers and optional in control room

Electrical drawings and control schematics
Safety analysis reports
Design manuals
Training manuals
Commissioning (Pre-operational) reports

ANNEXURE-2 (Contd.)

Checked by _____

I Operation & Fuel Handling Unit (FHU)

3. Documents to Review with Area Visits:

3.1 Log books of SCE/ASCE/CE/ Fuel handling unit & SCR

3.2 Refueling authorisations, data sheets, procedures

3.3 Temporary jumpers in safety related equipment/systems
Availability of jumper register
No. of jumpers existing in : Unit-1/2/Common
Jumpers pending for more than a year and follow up
Jumper approvals format being followed
Periodic review of existing jumpers by jumper review committee and its observations
Sample verification done
Jumpers pending for implementation

3.4 Engineering changes
Availability of list of ECNs completed
Technical bulletins
Sample verification of revised flow sheets/procedures as called for

3.5 Effectiveness of permit systems
Functioning of computerised maintenance management system (CMMS)
Order to operate (OTO)
Work permit procedure, entries during issue and clearing
Radiological work permit
Cutting and welding permit
Fire stop/ fire barriers work permit

3.6 Startup and shutdown procedures/checklists and refuelling period operations
All steps followed
Approvals for procedural deviations
Neutron monitoring system response
Chemistry data/results
Safety systems availability / performance

3.7 Heavy water management - vapour recovery dryers performance
Boiler room dryers
Purge dryers
Fuelling machine vault dryers
Calandria vault dryers
Fuelling machine service area dryers
Moderator room dryers
Accessible area dryers
Dryer condensate collection system

ANNEXURE-2 (Contd.)

Checked by _____

I Operation & Fuel Handling Unit (FHU)

3.8 Heavy water management: - Upgradation system:
D_2O recovery system performance
D_2O collection efficiency
D_2O upgradation systems performance (% of IP)
D_2O storing
Waste management in upgrading plant
Area housekeeping
Radiological conditions

3.9 Chemistry control
Records for all technical specification related parameters of moderator, PHT, feed water systems etc.
Trend analysis of important parameters
Instrument air dew point measurements
Housekeeping

4. Operating Area Field Visits:

4.1 Safety related systems :
Systems status and any off-normal operation.
Caution tag display, records, technical specifications, requirement
Authorisations for off normal operations
Review the overall system operation

4.2 Functioning of communication networks from control room
Local network
DAE crisis management, AERB and NPC HQ network
Satellite links availability
Records of communication exercises and deficiencies

4.3 Standby equipment related to safety systems:
(ABFPs, ACEPs, process water pumps, fire fighting water pumps and shutdown cooling pumps etc.,)
Availability of standby equipment
Equipment routine testing
Performance during testing and on demand

4.4 Review the alarms persisting in control room, FHU and SCR

4.5 Operability of all the instruments, recorders, monitors, (PDCS,CRCS,COIS,SCADA,Disturbance analyser, ESR etc,)

4.6 Housekeeping, ventilation, cleanliness and lighting in all areas

4.7 Emergency lights performance, testing and records

ANNEXURE-2 (Contd.)

Checked by _____

I Operation & Fuel Handling Unit (FHU)

4.8 Execution of OTO forms in the field, equipment isolation/tagging

4.9 Fresh fuel storage room
Inspection process
Proper storage of accepted/rejected fuel
Records

4.10 Spent fuel storage bay area (including AFR in TAPS and RAPS)
Pool water clarity
General radiation and contamination levels
Housekeeping and ventilation
Water level and temperature monitoring
Surveillance for siphon break device if any

4.11 Containment
Access control
Control room indications/key positions
Boiler room (PHWR) and drywell (BWR) area temperatures
MAL/EAL/FMAL doors closed, operable and seals are healthy
Doors in various areas on manual operation are closed
Back up air to MAL/EAL available

4.12 Waste treatment plant, demineraliser plant and chlorine plant area:
General housekeeping
Acid leaks and floor condition
Condition of chlorine system piping
Measures to handle acid/ chlorine leaks

4.13 Supplementary control room
Review of routines, tests performed, log book and alarms persisting
Operability of all the instruments, recorders, monitors
General housekeeping, ventilation, cleanliness and lighting
Functioning of communication networks, records
Emergency lights performance, testing and records

5. Fire Systems Safety

5.1 Performance of jockey/electrical/diesel firewater pumps during tests and on demand

5.2 Hydro-pneumatic system performance, fire water system header pressure and healthiness

5.3 Automatic sprinkler system for GT/SUT/UT testing, availability and records

5.4 Non-automatic sprinkler system availability for different areas and testing

5.5 Performance of CO_2 system for MOT/TOT/DG areas

5.6 Performance of CO_2 system for recirculation pumps in TAPS

ANNEXURE-2 (Contd.)

Checked by _____

II Reactor Physics

1. Documents Review:

1.1 Log books
1.2 Start up procedures, and criticality data, deviations, if any, during criticality
1.3 Authorised and actual power level (thermal power, FPD and MWD)
1.4 Computer outputs for CALIB, COMETG, TAPS 4, and TIP traces, bundle power and burn up details (TAPS)
1.5 TRIVENI print outs, reactivity calculations, bundle power calculations and specified limits (PHWR)

2. Reactor Shutdown and Control Systems Performance during Operation:

TAPS 1-2 : CRD (Both) & Liquid Poison System (Shutdown)

RAPS/MAPS : Moderator Level Control (Both) , Adjusters (Control)

NAPS & KAPS : PSS, SSS, GRAB , ALPAS (Both) and Adjusters (Control)

KAIGA onwards : PSS, SSS, LPIS, Adjusters and ALPAS (Control)

TAPS 3-4 : SDS#1, SDS#2, Control and Adjuster Rods, ZCCs and MLPAS

2.1 Tank levels, boron content and liquid boron concentration requirements as per technical specifications (SSS/SDS#2, ALPAS/MLPAS, GRAB/LPIS in PHWR and liquid poison system in TAPS)

2.2 Boron removal from moderator if any - reasons

2.3 Boron concentration expected and measured

2.4 ALPAS/MLPAS operation in CAM mode and in BAM mode

2.5 Performance and indications of regulating systems (Adjusters in 220 Mwe PHWR, Adjusters and ZCCs in TAPS 3&4 and CRDs in TAPS-1&2).

2.6 Performance of reactor regulating systems during Reactor set back / step back/trip and abnormal operations if any

2.7 Performance of shutdown systems during reactor trips
CRDs in TAPS-1&2
Moderator level settings and dumping time (RAPS/MAPS)
PSS/SSS (NAPS onwards)
SDS#1 and SDS #2 for TAPS 3-4

2.8 Reasons and trend for reactor trip/scram, poison-out and shutdown

ANNEXURE-2 (Contd.)

Checked by _____

II Reactor Physics

2.9 Performance of shutdown systems during reactor trip tests:

CRDs timing and indications,scram dump tank filling and draining times (TAPS 1-2)
Moderator dumping time, tank level dropping (level versus time) and dump ports operation (RAPS/MAPS)
PSS drop timings and indications, SSS banks actuation timing and tank level dropping versus time (NAPS onwards)
SDS#1 drop timings, SDS#2 injection time in TAPP 3&4

3. Instruments Performance

3.1 Neutron monitoring instrumentation performance: ion chambers, calandria vault counters, SPNDs (PHWR); fission counters and ion chambers (TAPS 1-2)
During shutdown
During criticalities
During start up
During power operation
During auto/manual power changes
During refuelling

3.2 Measurements of shutdown system worth and reactivity devices worth at specified intervals

3.3 Instrumented channel flows and their inlet and outlet temperatures

3.4 Review and analyse the CFM/CTM data

Number of channels deviating from average CTM values
Number of CTM channels not available
Number of channels in alarm state and reasons
Number of channels deviating from ZMTDs
Comparison of CTM with TRIVENI
Performance of instrumented channels

3.5 Review DNM and failed fuel data

Number of SVs defective or passing
Number of readings with predicted failed fuel
Number of channels due to be refulled
global iodine activity
PHT iodine activity operating average
PHT iodine activity shutdown average
PHT iodine activity peaks during shutdown

3.6 Collection of TAPE 5 & TAPE 17 for verification of computer results at TAPS

ANNEXURE-2 (Contd.)

Checked by _____

II Reactor Physics

4. Core and Fuel Management

4.1 Refueling programme and performance of various types of fuel used (natural uranium, depleted uranium, thorium and MOX fuel etc.)

4.2 Data on pre-simulations before refueling of a channel and are they in agreement

4.3 Iodine activity in PHT (PHWR)/ reactor water (BWR) during reactor operation

4.4 Maximum bundle power location and reasons for the same

4.5 Fuel burn-up details, failed fuel detection, removal and reasons for failure

4.6 Authorisations for refueling during shutdown (PHWR)
Procedures followed and number of channels fuelled, review the programme

4.7 Channel power details, reasons for high channel power, if any

4.8 Neutron monitors trip points during shutdown and refueling (TAPS 1-2)

4.9 No. of fuel bundles discharged including failed fuel, re-load pattern, (TAPS 1-2)

4.10 Depletion of control blades and their replacement (TAPS 1-2)

4.11 Performance of LPRMs in the previous cycle and plan for replacement (TAPS 1-2)

ANNEXURE-2 (Contd.)

Checked by _____

III Technical Audit & Surveillance

1. Organisation and Administration

1.1 Station organisation as per technical specification requirement and availability of staff at all levels as per station QA Manual.
1.2 Availability of minimum staff for round the clock shifts as per technical specifications
1.3 Qualification of senior management personnel as per AERB/SG/O-1
1.4 Availability of authorisation from competent authority and its validity

2. Review of Previous Regulatory Inspection Reports and Station Responses

Review the actions taken for completed items
Verify the completed action plans for satisfactory implementation
Status of the pending items and target dates for completion
Any important items to be included in the present inspection report

3. Document Status and Review:

3.1 Monthly / annual performance reports

3.2 Incident reports/first information reports/ significant event reports (SER) and event reports

3.3 SORC minutes

3.4 Significant event reports

Procedures available for follow up
Person identified for follow up
Required communications sent to AERB in time
SERs filed in stipulated time with relevant data
Filing of reports (IR/ER/SER etc.)
Technical analysis report (TAR) and follow up
Incidents discussed in SORC
Status of SORC recommendations

3.5 Technical audit engineer's quarterly reports

Status of SORC pending recommendations
Status of systems off-normal operation
Status of jumpers
Technical specification non-compliance
ECN/DCN/FCN status
Status of SC/SARCOP/AERB recommendations
On power entries and reasons

3.6 Technical specifications./station policy deviations / condonations sought from AERB/NPC-HQ respectively and SORC actions

ANNEXURE-2 (Contd.)

Checked by _____

III Technical Audit & Surveillance

4. Review the performance of Safety and Safety Related Systems based on

Equipment malfunctioning
Procedural inadequacies
Human errors
Lack of maintenance
Spares unavailability
Ageing related deficiencies
Meeting the design and technical specification requirements

5. Review of Root Cause Analysis Reports:

Root cause analysis committee reports for important incidents including fire and industrial incidents
Action taken by the management to avoid recurrence
ASSET review, if any

6. Reliability Analysis of Engineered Safety Features

Reliability analysis of engineered safety system.
Reliability analysis of safety related system
Adverse trend observed for safety and/or safety related systems
Computation of reliability data and results of updated PSA
Improvements planned, if any, based on PSA results
Management actions to improve the reliability

7. Review of Surveillance Procedures, Tests, Compliance with Stipulations and Results

7.1 Availability of latest approved procedures for surveillance tests
7.2 Compliance with surveillance schedule as per technical specification and station policy requirement
7.3 List of surveillance checks not done - reasons
7.4 Follow up action for 7.3 above and management view
7.5 SARCOP clearance/condonation has been obtained for not performing required surveillance checks
7.6 Review surveillance results and the timings wherever important (PSS Rods, SVs in SSS, Actuation of SSS when PSS not poised, SDS#1 and SDS#2, IRVs opening, ECCS valve opening etc.)
7.7 Relief valve calibration, testing.
7.8 Monitoring the condition of the exclusion boundary
7.9 Compliance with fire drill/exercise requirements and performance evaluation reports

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.1 Electrical Maintenance Unit

1. Organisation and Administration

Availability of required staff
Maintenance records (logbooks, history cards and PM records)

2. Document Review:

2.1 Preventive maintenance of safety related equipment (SRE)

List of SREs
PM programme for SREs drawn up and followed
Method of verification/reporting
List of SREs for which PM is due and reasons for the same
Management view for not doing PM
Spare parts availability/control for SREs
Data collection for evaluation and review of availability/reliability of safety related systems/equipment

2.2 Condition monitoring of SREs

Condition monitoring programme
Predictive maintenance carried out based on condition monitoring and reasons

2.3 Breakdown maintenance of SREs

List of SREs, which underwent breakdown maintenance
Reasons for break down, corrective steps taken
Is any common cause identified
Quality of spares and adequacy of tools
Are the maintenance procedures adequate?
Any human errors identified ?
Lack of training and/or supervision noticed
Management actions to avoid recurrence of breakdown of SREs

2.4 Post maintenance quality assurance checks, functional checks and records

2.5 Availability and usage of standard maintenance procedures and check sheets for preventive and breakdown maintenance of SREs

2.6 Procedure to give priority for attending to deficiencies on SREs

2.7 Procedure for identifying the deficiency prone equipment/components affecting performance of safety related systems

2.8 Maintenance and surveillance records for fire barriers, fire stops and flood barriers etc. verify the healthiness during area visit

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.1 Electrical Maintenance Unit

2.9 Maintenance of emergency lights, and testing; verify records

2.10 Maintenance of aviation lights on stack and NDCT, verify records

2.11 Performance of various oil transformers, oil sampling and their results

2.12 Standard instruments used in EMU are calibrated against the standard instruments whose records are traceable to national lab

2.13 Earth resistance measurements and condition of various earth pits, verify records

2.14 Condition of lightning arresters and earthing conductors at transformers, towers, structures and buildings. Verify through records and visits

3. Performance Evaluation of Safety Related and Other Important Equipment

3.1 Class I battery systems

Review the condition and performance of Class I batteries of different systems
Performance of 48 V DC system batteries and battery charger
Compliance with various routines
Review the battery capacity test results
Availability of spare cells
Local conditions of battery chargers and batteries
Hydrogen detection in the battery rooms
Ventilation and general condition of the area

3.2 Class II systems

Maintenance of MG sets, and relays calibration and testing
ACVR and maintenance of their relays
Maintenance of uninterrupted power supply units (PUPs and CUPs)
Performance of all the above systems
220 V control UPS system performance, maintenance
Performance of control batteries and battery chargers

3.3 Class III & Class IV

Switchgear maintenance
Circuit breaker maintenance of different SREs
Maintenance/calibration of protective relays of different SRE breakers
Maintenance/calibration of protective relays of safety related systems
Maintenance/calibration of relays in EMTR, ATS etc.
Logic circuit checks and testing

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.1 Electrical Maintenance Unit

3.4 Switchyard

Maintenance and general condition
Local control room general condition
Functioning of communication networks
Batteries, compressed air; performance
Performance of ABCB, GICB, SF_6 breakers

3.5 Performance of ABCB, GICB, SF breakers

DC ground monitoring and reasons for any DC ground in a particular system/equipment/cable etc.

3.6 Safety related standby equipment

PM done and are kept in poised state
Reasons if required maintenance not done
Performance of these equipment during testing

3.7 Performance of motor operated valves of safety related systems and reasons for any inoperable valves

3.8 Performance of diesel generator

After routine maintenance
After annual maintenance
During the endurance test
After any breakdown; reasons for breakdown

3.9 Periodicity of testing and results of

Auto transfer scheme (ATS),
Emergency transfer scheme (EMTR) and
Loss of class IV power test

3.10 DG performance, during the above tests mentioned in 3.8 and 3.9

3.11 Ensure absence of hostile environment of high temperature, high humidity or corrosive environment and fire hazards etc, which could degrade the performance of SREs

3.12 Maintenance of starting batteries of diesel fire pump and DGs (if applicable) and records. Capacity test and condition of the above batteries

3.13 Storage of safety related spares in stores. Precautions taken against possibility of degradation and/or deterioration during storage

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.2 Mechanical Maintenance Unit

1. Organisation and Administration

Availability of required staff
Maintenance records (logbooks, history cards and PM records)

2. Document Review :

2.1 Preventive maintenance of safety related equipment (SRE)

List of SREs
PM programme for SREs drawn up and followed
Method of verification/reporting
List of SREs for which PM is due and reasons
Management action for not doing PM
Spare parts availability/control for SREs
Data collection for evaluation and review of availability/reliability of safety related systems/equipment

2.2 Condition monitoring of SREs

Condition monitoring programme
Predictive maintenance carried out based on condition monitoring and reasons

2.3 Breakdown maintenance of SREs

List of SREs, which underwent breakdown maintenance
Reasons for breakdown, corrective steps taken
Is any common cause identified?
Quality of spares and tools adequate
Are the maintenance procedures adequate?
Any human errors identified
Lack of training and/or supervision noticed
Management actions to avoid recurrence of breakdown of SREs

2.4 Post maintenance quality assurance checks, functional checks and records

2.5 Availability and usage of standard maintenance procedures and check sheets for preventive and breakdown maintenance of SREs

2.6 Procedure to give priority for attending to deficiencies on SREs

2.7 Procedure for identifying the deficiency prone equipment/components affecting performance of safety related systems

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.2 Mechanical Maintenance Unit

3. Performance Evaluation of Safety related and other Important Equipment

3.1 Relief valves testing / calibration

Availability of annual programme
Procedure availability and adherence
Acceptance criteria for instruments and testing instrument
Records and test certificates verification
Conditions at valve testing area/lab

3.2 Ensure absence of hostile environment of high temperature, high humidity or corrosive environment and fire hazards etc., which could degrade the performance of SREs

3.3 Preventive replacement of valve diaphragms in heavy water system and other important systems

3.4 Safety related system equipment (valves, motors etc,) overhauling and internal inspection reports and their performance reports

3.5 Diesel generators

Maintenance records
Performance during testing and on demand
Diesel oil quality and sampling

3.6 Safety related standby equipment

PM done and are kept in poised state
Reasons for not doing the required maintenance
Performance of these equipment during testing

3.7 Condition of inspection tools, testing equipment and special equipment for remote handling. Verify the records

3.8 Material handling equipment (cranes, fork-lift) maintenance, testing and records

3.9 Storage of safety related spares in stores. Precautions taken against possibility of degradation and/or deterioration during storage

3.10 Procedural adherence at equipment decontamination facility

3.11 Welder qualification programme for carrying out important works

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.3 Control Maintenance Unit

1. Organisation and Administration

Availability of required staff
Maintenance records (logbooks, history cards and PM records)

2. Document Review:

2.1 Preventive maintenance of safety related equipment (SRE)

List of SREs
PM programme for SREs drawn up and followed
Method of verification/reporting
List of SREs for which PM is due and reasons
Management action for not doing PM
Spare parts availability/control for SREs
Data collection for evaluation of availability/reliability of SREs and systems

2.2 Condition monitoring of SREs

Condition monitoring programme
Predictive maintenance carried out based on condition monitoring and reasons

2.3 Breakdown maintenance of SREs

List of SREs, which underwent breakdown maintenance
Reasons for breakdown, corrective steps taken
Is any common cause identified?
Quality of spares and tools adequate
Are the maintenance procedures adequate?
Any human errors identified
Lack of training and/or supervision noticed
Management actions to avoid recurrence of breakdown of SREs

2.4 Post maintenance quality assurance checks, functional checks and records

2.5 Availability and usage of standard maintenance procedures and check sheets for preventive and breakdown maintenance of SREs

2.6 Procedure to give priority for attending to deficiencies on SREs

2.7 Procedure for identifying the deficiency prone equipment/components affecting performance of safety related systems

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.3 Control Maintenance Unit

3. Performance evaluation of safety related and other important equipment

3.1 Safety related systems instruments for PHWRs are listed below. For other units similar systems should be checked.

Verify whether the calibration results and calibration dates of the instruments are as specified from the maintenance shop for each instrument.

Verify whether the instruments are being checked for their operability at their scheduled interval from the station operation group.

Verify whether the functional capability of the instruments are being checked from the station technical unit.

List the instruments verified along with the deficiencies noticed.

- Meteorological Instrument (USI: 61100)
- Off-Site Radiation Monitor (USI: 61210)
- On-Site Radiation Monitor(USI: 67870) and Contamination Instrumentation
- Seismological Instruments(USI: 61300)
- PDCS System, PLCs
- Fire Alarm and Detection Systems (USI: 62200)
- Access Control System (USI: 62400)
- Channel Flow Monitoring System(USI: 63110)
- Channel Temperature Monitoring System (USI: 63120)
- Delayed Neutron Monitoring System (USI: 63132)
- Ion Chambers (USI: 63190)
- Reactivity Mechanism (USI: 6314)
- Annulus Gas Monitoring System (USI: 63470)
- Reactor Regulating System (USI: 63711)
- Flux Tilt Control System (USI: 63712)
- Start-up Instrumentation (USI: 63716)
- Reactor Protective System (USI: 63720)
- Reactor Secondary Shutdown System (USI: 63730)
- Beetle Monitoring System (USI: 63811)
- D_2O to H_2O Leak Detection System (USI: 63812)
- D_2O to Air Leak Detection System (USI: 63813)
- FM Vault Atmosphere (USI: 67312)
- RB Primary Containment Ventilation System (USI: 67314)
- Primary Containment Ventilation System (USI: 67314)
- PCFPB System (USI: 67315)
- Secondary Containment Ventilation System (USI: 67316)
- Stack Loss Monitoring System and Ventilation Duct Radiation Instrumentation
- Area and Process Activity Monitoring (USI: 67871)

ANNEXURE-2 (Contd.)

Checked by _____

IV Maintenance

IV.3 Control Maintenance Unit

3.2 Performance and maintenance record of reactor protection system instruments and adherence to technical specifications requirements

3.3 Standard instruments used are calibrated against the standard instruments whose records are traceable to national lab

3.4 Performance and maintenance of communication system

3.5 Performance and maintenance of computers

3.6 Performance of annunciation systems
(Window annunciation, CRCS, COIS, SCADA , RA,PIS etc,.)

3.7 Performance and testing records of :

Hydrogen leak detection system
Chlorine leak detection system
H_2S leak detectors where applicable (RAPS Site)

3.8 Control room indications, indicators and recorders etc., for reactor control and protection and shutdown systems.

ANNEXURE-2 (Contd.)

Checked by _____

V. Technical Services, ISI and Quality Assurance

1. Technical Services:

1.1 Availability of required qualified staff

1.2 Reasons for reactor trip/scram, poison out and shutdown trend monitoring of occurrences

1.3 Procedures for reviewing, analysing and reporting unusual occurrences and SER/ERs. Actions taken to avoid recurrence.

1.4 Reliability analysis (procedure, reports and results) for SREs and related systems

1.5 Containment related tests

Last test conducted and due date for next test
Leak rate test results and comparison with the previous test results
V_1-V_2 integrity test and the results
MAL/EAL tests and the results
RB and other isolation damper tests and results
Embedded parts (electrical/piping) testing and results
Instrument air in-leakage test last conducted and results

1.6 Ventilation - verify performance

RB ventilation / exhaust system
SB ventilation / exhaust system
Primary containment control discharge system
Primary containment filtration and pump back system
Secondary containment filtration and purge system
Control room survival ventilation system
Contaminated ventilation system
HEPA / iodine filter testing results

1.7 Engineering/Design change notice-Configuration management

Availability of formal procedure and station instructions
Availability of list of ECNs implemented
Availability of list of pending ECNs and status of review and implementation
In-house review of new proposals
Proposals pending with SORC
Safety related proposals pending with SC/SARCOP
Proposals pending for preparation of ECNs & FCNs
ECNs & FCNs pending for implementation
ECNs pending for issuing technical bulletin
QA checks in procurement/construction/commissioning
Surveillance checks and performance of completed ECN and any abnormality
Electrical drawings, flow sheets, operating procedures/manuals and technical specifications are updated/revised accordingly
Methodology for converting long pending jumpers to ECNs

ANNEXURE-2 (Contd.)

Checked by _____

V. Technical Services, ISI and Quality Assurance

1. Technical Services:

1.8 Interactions with the outside agencies for managing water supply (water availability in lake, river, dam etc.), maintaining good grid conditions

1.9 Library and documentation maintenance, update
Electrical drawings, flow sheets and P&I diagrams
Safety analysis reports
Design and training manuals and other documents

2. In-service Inspections

2.1 Availability of approved ISI manual and date of issue

2.2 Qualified staff for carrying out different NDT procedures

2.3 ISI schedule and reports for equipment/piping

2.4 ISI on reactor components, pressure vessels and connected primary piping. Adherence to schedules, records and reports)

2.5 System/procedure for evaluating the ISI results of safety related equipment, critical equipment, (SGs, HXs and system piping) and findings

2.6 Percentage of planned ISI work completed in the particular year against 10 year cycle/period. Areas not covered, their impact and safety implications

2.7 Unacceptable degradation of equipment/piping etc. observed, plan for repair, safety assurance till repair is completed.

2.8 Safety related system isolating valves internal inspection schedule and reports

2.9 Internal inspection schedule and its adherence for various relief valves, reports

3. Quality Assurance

1. Organisational set up and availability of qualified staff as per approved QA manual

2. Availability of approved QA manual

3. Performance/quality assurance checks (procedures, schedules, records, reports, availability and up-keep).

4. Internal auditing

Procedures/ schedule to conduct internal auditing
Sections covered and pending and important findings

ANNEXURE-2 (Contd.)

Checked by _____

VI Training & Qualification

1. Organisation and Administration:

Availability of qualified staff for imparting training.

2. Training Programme (Classroom and On-the-job) for

Engineering graduates
Diploma holders
Technicians

3. Licensing/ Qualification Programme

Latest checklist / task list for various levels of licensing/qualification
System checklists / task list completed before written exams
Latest panel of officers authorised for clearing checklists
and for conducting walkthrough test

4. Retraining Requirements for Level I&II Licensed Operators

Retraining programme prior to re-qualification
Process of authorising the licensed operators joining duty
after a long leave/deputation

5. Records of Individual Trainees and Licensed Personnel

(Qualifications, experience, training, different
authorisations and required medical certificates)

6. Training Programme for Trainers, Records

7. In-house Human Resources Development Programmes

8. Radiation Safety Training Aspects and Related Programme

Records of training and re-training of station personnel
Public awareness programme on radiation emergency exercises
Radiation protection for contractor workers
Green dot qualification

9. Training Programme, Procedures, Authorising Process and Records for

220 KV switchyard operations
Electrical breakers operation
Over head cranes, and steam boilers etc.,

ANNEXURE-2 (Contd.)

Checked by _____

VI Training & Qualification

10. Personnel Safety Training Aspects and Programme

Industrial safety
Fire fighting
First aid
Handling Cl_2, H_2S leakage etc.
Civil defence

11. Adequacy of Training Facilities (laboratories, workshops, mock-up facility etc.)

12. Simulator Training

Availability of staff
Simulator training and re-training programme
Schedule and duration of training
Number of trainees covered (individual and as a team basis)
Frequency of coverage for personnel at different levels
Attendance of the participants
Type of simulations carried out and availability of latest documents
Evaluation of effectiveness of the training
Check the performance of trainees and trainers during simulations
Time for which simulator is available for actual training
Difficulties being faced if any, in maintaining the simulator

13. Configuration Management at Simulator Facility

Procedures followed for configuration management to be in line with plant changes
Communication with reference plant
Implementation and verification of modifications
Documentation and training programme update to reflect the changes

14. Availability of Latest Revised Documents:

Technical specifications for operation
Operating manuals
Operating flow sheets/P&IDs with ECNs included
Electrical drawings and control schematics
Station emergency plan
Emergency operating procedures (EOPs)
Commissioning / pre-operational reports
Safety analysis reports
Design manuals
Contingency plans for (fire, cyclone, flood, and earthquake)
Training manuals

ANNEXURE-2 (Contd.)

Checked by _____

VII Health Physics and Environmental Survey

1. Organisation and Administration

Availability of adequate trained manpower as per approved document

2. Availability of Latest Approved Documents

Emergency preparedness manual
AERB issued radiation protection manual
Plant radiation protection manual

3. Adherence to Procedures

Radiation work permit procedure, violations and their consequences
Personnel movement and contamination control procedures
Zonal philosophy to control the spread of contamination and compliance

4. Review the following Records and Reports of Occupational Radiation Exposure

4.1 HP logbook for off normal situations, wrong practices and violations of rediation protection procedure (RPP) and their follow up

4.2 HP quarterly and annual reports, corrective measures taken by management and their effectiveness

4.3 Radiation and contamination survey records for any observed abnormal conditions

4.4 Air sampling / air monitor records. Trend monitoring and analysis

4.5 Calibration and maintenance records of radiation and contamination monitors including portal monitor

4.6 Personnel dose records, up-keep and computerisation of the data, including past exposure history of workers

4.7 External / internal and over exposure investigation reports and trends

4.8 Over exposure investigation status

Number of cases exceeding 10 mSv/month, 20 mSv/year, 30 mSv/year and 100 mSv in 5 years block
Are all the cases investigated
Review the minutes of the over exposure investigation committee meetings and status of implementation of recommendations.

4.9 Annual medical check-up records including review of the reports of workers crossing 0.5 Sv cumulative lifetime dose

4.10 Station ALARA committee functioning/effectiveness

4.11 Bio-assay sampling compliance, results and trends

ANNEXURE-2 (Contd.)

Checked by _____

VII Health Physics and Environmental Survey

4. Review the following Records and Reports of Occupational Radiation Exposure

4.12 TLD/DRD discrepancies

Statistics of discrepancies
Investigation and resolution of discrepancies as per the approved procedure
QA checks on TLD/DRD and their calibration records

4.13 Collective dose

Actual P Sv (man Sv) against budgeted estimate
Reasons if budgeted value is exceeded
SARCOP clearance for exceeding the budgeted value
Management actions and plans to control in future

4.14 Bore hole sampling data, trend analysis and identification of sources

5. Review of Radiological Safety Practices, Protective Equipment along with Area Visit

5.1 Display of radiation signboards for active components

5.2 Maintenance of rubber stations, TLD racks

5.3 Radiation and contamination conditions (shielding, cordoning and tagging of high radiation areas)

5.4 Storage of radioactive waste in transit waste storage area

5.5 Radiation / contamination survey of areas outside operating island. Results and precautions to control ground releases

6. Review of Emergency Preparedness, Surveillance Programme

6.1 Number of plant, site and off-site emergency exercises conducted. Adequacy with regard to frequency stipulated by regulatory body

6.2 Review of reports and feed back from observers. Common recurring deficiencies and reasons for non-rectification

6.3 Maintaining exclusion boundary fencing/barrier, check the condition and status

6.4 Management interaction with local population and district authorities, conducting of public awareness programmes

ANNEXURE-2 (Contd.)

Checked by _____

VII Health Physics and Environmental Survey

6. Review of Emergency Preparedness, Surveillance Programme

6.5 Radiation emergency vehicle at plant site

Vehicle condition
Availability of communication network, functioning of equipment
Condition of mobile survey van and protective equipment
Routine checks on equipment and vehicle; records

6.6 Radiation Emergency Control Centre

Housekeeping
Availability and functioning of instruments
Protective clothing
Decontaminating agents
Functioning of Communication network
First aid equipment
Area maps, emergency manuals
Iso-dose curves
Emergency power supply availability
Availability of prophylactic (potassium iodide) tablets
Status of periodic stock taking registers

7. Review of Environmental Monitoring and Protection Programme

7.1 Area covered under environmental sampling program and mapping
Frequency of sampling and types of samples collected
Maintenance of records and trend analysis

7.2 Availability of instruments for routine and emergency monitoring
Adequacy of calibration of instruments
Communication equipment and its functioning

7.3 Condition of survey vehicle and communication equipment

7.4 Emergency power supply availability

7.5 Internal monitoring by whole body counting
Compliance by regular and contractor's workers
Maintenance of records and trends

7.6 Off site area maps/records with latest population figures
computerised meteorological data pertaining to site

7.7 Submission of quarterly/ annual reports; remarks / findings

ANNEXURE-2 (Contd.)

Checked by _____

VII Health Physics and Environmental Survey

8. Hospital and First Aid Facility

8.1 Medical check up records for radiation workers, compliance

8.2 Special medical check up for licensed operators and crane operators

8.3 Number of persons covered in medical check up
If all radiation workers are not covered, reasons for the same

8.4 Number of ambulances available and their road-worthiness
(at plant site and at hospital)

8.5 Contaminated casualty decontamination and treatment center

General condition of the facility and approach road
Familiarity of staff with operating procedure
Availability of calibrated contamination-monitoring instruments
Prophylactic tablets and decontamination and treatment agents
as stipulated by regulatory body
Adequacy of radiation protection training for doctors, paramedical staff
Maintenance of periodic stock taking registers, and records
Effluent collection system and its functioning
Segregation of contaminated persons
Periodic exercises and functioning of the center

8.6 Emergency power supply availability at the hospital

ANNEXURE-2 (Contd.)

Checked by _____

VIII Radioactive Waste Management

1. Organisation and Administration

Availability of adequate trained manpower

2. Procedures and Document Status for

Segregation of solid waste
Solid waste transfer
Conditioning of solid waste
Assaying of solid waste (activity content)
Segregation of liquid waste
Liquid waste transfer
Liquid waste treatment
Liquid waste disposal
Calibration and testing of off-gas monitoring system

3. Review of Records and Reports of Effluents and Radioactive Waste Disposal

3.1 Handling of solid radioactive waste

Receipt and transfer records
Disposal and transfer permits
Disposal records, trend studies and results
Process problems in solid waste transfer/ conditioning/disposal

3.2 Handling of liquid radioactive waste

Receipts / transfer records
Pre-treatment analysis records
Post-treatment analysis records
Disposal / transfer permits (availability of sufficient dilution water)
MOF activity analysis records
Disposal records, trend studies and results
Report on pressure testing of transfer lines
Report on testing of storage tanks
Process problems in liquid waste transfer/treatment and disposal

3.3 Handling of gaseous effluents

Sampling analysis records
Disposal records, trend studies and results

3.4 Report on performance testing of HEPA filters and activated charcoal filters

3.5 Any off-normal situation prevailing due to non-disposal of liquid and solid radioactive waste

3.6 Temporary storage of liquid / solid waste
Reasons for storage, precautions and control

ANNEXURE-2 (Contd.)

Checked by _____

VIII Radioactive Waste Management

3.7 Solid/liquid and gaseous radioactive waste disposal/transfer

Are the discharges within AERB authorised limits
Are the discharges within technical specification limits
Reasons for non-compliance, justifications and
condonations sought from the regulatory body in case of violations of above

3.8 Monthly records of radioactive waste disposals and transfers

3.9 Verification of quarterly/half-yearly/ annual waste disposal / transfer returns submitted to regulatory body

3.10 Any returns to be sent to other relevant statutory bodies

4. Evaluation of Procedures, Methods of Radioactive Waste Treatment and Transportation and Field Visits

4.1 Solid waste handling - status at

Interim storage area
Conditioning systems and associated areas
Disposal area

4.2 Liquid waste handling - status at

Collection systems and associated areas
Pre-treatment storage system and areas
Treatment systems and areas
Post-treatment storage system and areas
Effluent monitoring system functioning

4.3 Status of RB exhaust and stack release monitoring system in control room

4.4 Status of stack discharge monitoring system

5. Environmental Survey Reports: Analyse

5.1 Report on air, aqueous and soil samples around plant site

5.2 Report on bore-well samples around the solid waste disposal area

5.3 Report on bore-well samples around the radioactive liquid waste storage area

5.4 Monitoring of unauthorised discharges like from storm water.
If activity observed, steps taken to prevent it and accountability of activity discharged

5.5 Report on activity levels in suppression pool water. Trend studies

5.6 Report on activity levels in drinking water

5.7 Activity levels in lake/river water etc.

ANNEXURE-3A

REGULATORY INSPECTION CHECKLIST FOR FIRE AND INDUSTRIAL SAFETY AT NPPs/RRs UNDER CONSTRUCTION

CONTENTS

Section No.	Title of The Section
A	Organisation and Administration
B	Safe means of Access
C	First-Aid
D	Painting
E	Electricity
F	Excavation, Earth Removal
G	Housekeeping
H	Scaffolding
I	Hand Tools and Portable Power Tools
J	Ladders
K	Hoists and Lifts, Lifting Machines, Cranes
L	Machine Guarding
M	Roofing
N	Personal Protective Equipment (PPE)
O	Welding and Gas Cutting
P	Fire
Q	Motor Vehicles and Machines
R	Blasting Operation
S	Documents

ANNEXURE-3A (Contd.)

Checked by _____

A Organisation and Administration

1. Name of the project under construction

   Number of shifts and number of employees working
2. Details about fire and safety organisation
3. Does the unit have an industrial safety organisation manual?
4. Does the unit have a written policy on safety ?
5. If yes, is the policy reviewed periodically ?
6. Is the safety policy written down and circulated?
7. Have the responsibility and accountability been assigned ?
8. Is the safety officer authorised to stop the work if he finds that unsafe practices are being followed and/ or unsafe conditions exist?
9. Is there a safety committee? Does the safety committee meet regularly
10. Are the meetings documented properly and records of safety meetings kept regularly?
11. Are regular inspections made, of plant areas, facilities, buildings, machinery, equipment, tools and work methods for identifying accident hazards ?
    By whom ?
    How frequently ?
    How extensively ?
    How processed ?
12. What injury records are kept ? By whom ?
13. Are standard methods used for computing frequency and severity rates ?
14. Is there written procedure of accident investigation and analysis.
15. Are all accidents and near misses thoroughly investigated?
16. Is the 'accident register' up to date and accurate?
17. Is job hazard analysis carried out for the different activities?

B Safe Means of Access

1. Is adequate and safe means of access and exit provided for all work places?
2. Are all workers working at height and exposed to risk of falling down, using safety belts, safety nets etc.
3. Are all openings suitably fenced/barricaded to prevent fall of persons

C First Aid

1. Is a first aid center available in the premises?
2. Is it functioning in all the shifts?
3. Are suitable and sufficient number of stretchers available and maintained?
4. Are workers trained in first aid ?
5. Individual responsible to take care of the first aid box identified
6. Is an ambulance parked in a proper location and is it road-worthy and available?

ANNEXURE-3A (Contd.)

Checked by _____

D Painting

1. Are only adults (above 18 years age) employed on the work with lead paint?
2. Are supplied air respirators provided when paint is applied in the form of a spray or when a surface having dry lead paint is scraped off?
3. Are overalls and facilities to wash provided after the cessation of work?

E Electricity

1. Are competent or licensed electricians available to install temporary wiring and to make any changes that are needed?
2. Are untrained persons prohibited from making changes or extensions?
3. Are ELCB's being used?
4. Are all connections made by using appropriate plugs, receptacles or enclosures?
5. Are there any make shift connection, bare wires or damaged cables?
6. Are extension cords regularly inspected and protected from damage in service?
7. Are there any overhead electric power lines on site?
8. Can mobile cranes or workman on scaffold or ladder, come close to live lines?
9. Are all terminal boxes equipped with proper covers?
10. Are all 3 phase equipment provided with double earthing?
11. Is the complete installation of each contractor tested regularly and especially before onset of monsoon (insulation resistance, earth continuity, etc.)?
12. Is space of 90 cm maintained in front of distribution boards?
13. Is material or earthwork allowed to dump below bare overhead lines?
14. Are provisions in safety guide for works contract enforced?

F Excavation, Earth Removal

1. Is excavation shored or barricaded and is this inspected daily before work is resumed?
2. Is there safe access to the excavation site and do means of escape conform with regulations?
3. Are proper ladders, ramps provided where needed?
4. Is earth from the excavation piled well away from the edge?
5. Are open excavations suitably fenced off?
6. Is the stability of excavation being disturbed by vehicles passing too close to it?
7. Are adequate lighting and warning lights provided for excavation pits?
8. Is permission of ENC taken for removal of earth from an earth mound?
9. Is the slope maintained equal to the angle of repose of the earth?

G Housekeeping

1. Are containers for refuse (waste) and trash emptied at the end of every day or as soon as they are full?
2. Are nails removed from scrap lumber or bent over?

ANNEXURE-3A (Contd.)

Checked by _____

G Housekeeping

3. Are all floors in good condition? Are all spills cleaned up promptly?
4. Is the site kept free of empty food containers, wrappers, or discarded food that could attract rats or vermin?
5. Are unused slings, hoses, and pallets properly stored to prevent them from obstructing traffic or becoming a tripping hazard?
6. Are bricks and unloaded timber stacked in a safe manner?
7. Is there adequate lighting and ventilation in all work areas?
8. Are roads or truck routes well marked and clearly separated from the walk-ways that workers must use?
9. Do barriers protect open trenches and excavations? Are they marked with lights if there is any traffic after dark (night)?
10. Are cables of welding and other equipment routed properly to permit safe traffic?

H Scaffolding

1. Are all scaffolds designed and erected by competent persons?
2 Are the scaffolds inspected every day before work begins?
3. Has proper access been provided to the various working levels?
4. Are ladders securely clamped or lashed in place?
5. Do they extend at least three feet above the working level?
6. Are the scaffolds at height? If yes, is netting provided?
7. Is minimum width of platform provided?

I Hand Tools and Portable Power Tools

1. Are proper tools being used for the job?
2. Are damaged tools repaired or replaced promptly?
3. Is there a proper grounding for tools?
4. Are tools and cords in good condition?
5. Is the metallic part of power tool having double insulation?
6. Is regular testing of portable power tools carried out?

J Ladders

1. Are all ladders free from split rails, loose rungs, knots, cracks, all other obvious defects and are inspected regularly?
2. Are ropes and metal parts of extension ladders in good condition?
3. Are damaged ladders that are to be discarded cut up immediately to prevent them being used?
4. Are ladders set up at the proper slope?
5. Are metal ladders used around electrical systems?

ANNEXURE-3A (Contd.)

Checked by _____

K Hoists and Lifts, Lifting Machines, Cranes

1. Are new cranes used by contractor inspected by ENC before, putting into use?
2. Is the register maintained to record particulars of examination of hoists and lifts , lifting machines, chains, ropes and lifting tackles?
3. What is the periodicity for examination of crane?
4. Are the records of inspection maintained?
5. Is the safe working load clearly marked?
6. Are people kept away from under moving loads?
7. Are crane booms kept clear off power lines at all times?
8. Are slings, chains, pulleys and hooks inspected regularly?
9. Are all equipment properly lubricated and maintained?
10. Are adequate gates or safe accesses provided at all landings?
11. Are they kept shut except when the hoist is at the landing? If the hoist is for materials only, is there a notice on the cage prohibiting people from riding on it? Is the notice obeyed?
12. Is safe means of access provided to the driver's cabin and to all locations where persons engaged on inspection, repair and lubrication of the crane have to work?
13. Are all the tests like deflection test, over load test, and tests on limit switches, and checking the correctness of all circuits and interlocks, and satisfactory operation of all protective devices, done regularly?
14. Is the repair work carried out with written authority (work permit system)?
15. Has the person employed to operate crane, fork-lift, or to give signals to crane operator been medically examined for eye sight and colour vision ?
16. Is the frequency of eyesight and colour vision examination, at least once in a period of 12 months up to the age of 45 years and once in every six months beyond that age ?

L Machine Guarding

1. Are all moving parts and points of operation of machinery adequately guarded?
2. Are all mechanical safe guards in working order?
3. Are dangerous parts such as saw blades, gears belts and shaft couplings adequately guarded?
4. Are all fixed guards securely bolted in position and in good condition?

M Roofing

1. Are crawling boards, lifelines and safety belts etc. provided on sloping roofs where needed?
2. Are there weak spots, skylights, or deteriorated asbestos-cement boards through which a worker might fall?
3. Is a safety net installed under roof?

ANNEXURE-3A (Contd.)

Checked by _____

M Roofing

4. Is the worker trained to work on roof? Does he wear suitable clothing and foot wear with non-slip soles, made preferably from rope
5. Is the worker examined medically to detect any defect of equilibrium before being engaged as a roofer?

N Personal Protective Equipment (PPE)

1. Types of PPE and their adequacy
2. Are effective screens or suitable goggles provided for the protection of persons employed in or in the immediate vicinity of process of grinding, turning of metals, drilling, welding & cutting, chipping and work involving risk to eye?
3. Are all PPE provided to the workers conforming to the relevant Indian Standards?
4. Use of PPE and awareness among employees

O. Welding and Gas Cutting

1. Is the welding machine earthed properly and checked for any leakage of current by an authorised electrician ?
2. Are there extinguishers provided with all welding carts?
3. Is hot work permit system introduced?
4. Are oxygen and acetylene hoses protected from damage or kinking while in use?
5. Are power cables undamaged and protected?
6. Are PPE available and used?
7. Are all the flammable materials at safe distance from welding stations?
8. Are the combustible materials that cannot be moved, protected and covered?
9. Is adequate ventilation provided while welding in confined space?
10. Are cables of welding and other equipment routed properly as to allow safe traffic by all concerned?

P Fire

1. Are, areas designated, where smoking is not permitted?
2. Are 'NO SMOKING' stickers or posters displayed near fire prone areas?
3. Are fire extinguishers of appropriate size and type suitably located?
4. Are workers trained to use them?
5. Is there a local fire department? Are phone numbers of fire department adequately displayed?
6. Is any fire fighting training given to employees?
7. Are fire extinguishers checked regularly?
8. Are highly flammable liquids stored in a properly located and constructed enclosure?

ANNEXURE-3A (Contd.)

Checked by _____

P Fire

9. Are compressed gases such as LPG and acetylene isolated from possible sources of ignition?
10. Are cylinder valves kept closed unless gas is being used?
11. Have all fires been thoroughly investigated, regardless of whether serious damage to property or injury were involved?

Q Motor Vehicles and Machines

1. Are vehicles and machines kept in good condition? Who checks them?
2. Are drivers qualified and having licence?
3. Do workers check steering, brakes and operating controls in every shift?
4. Do workers understand the dangers to which they are exposed when working behind dump trucks, unloading pipe or performing similar task?
5. Have bridges over which heavy trucks must pass been inspected and approved for the appropriate permissible load?
6. Are any oversize loads to be moved to the site?
7. If so, are permits required? Do they restrict the route, the time of day or day of the week when the load may be moved?
8. Are rules against unauthorised riders enforced?
9. Is every motorised tool or motor vehicle parked in a safe position and securely locked to prevent operations by unauthorised persons?
10. While backing what precautions are taken to prevent injury to people or damage to property?
11. Are warning horns, braking lights etc. checked?

R Blasting Operations

1. Is the blaster qualified and competent for blasting work?
2. Is he aware of the dangers involved?
3. Is he kept informed about the progress and scheduling of other work at site?
4. Have other workers and residents of adjacent property been informed about the blasting so that they will not be unnecessarily disturbed by it?
5. Is trained watchman on duty when needed?
6. Are explosives and blasting equipment safe from theft?
7. Is the stock book kept accurate and maintained?
8. Is the grit blaster wearing facial respirator with clean air supply to avoid inhalation of free silica?
9. Are the explosives transported in specially designed vehicles bearing a special sign or inscription entitled 'DANGER EXPLOSIVES' and detonators separated from other explosives by transporting them in separate compartment?
10. Are the explosives stored, distributed and handled safely?

ANNEXURE-3A (Contd.)

Checked by _____

R Blasting Operations

11. Is a license obtained for storage of explosives as per Explosive Act, 1984?
12. Is care taken that the blasting point is free of detonating gas, inflammable substances, sparking or damaged wiring system, stray currents and static electricity and well protected against unauthorised entry ?

S Documents:

Check the availability of the following documents:

1. Safety policy
   Industrial safety organisation manual, safety manual
2. Regulatory body construction clearance
   ACPSR/PDSC recommendations
3. Standing fire order
   Safety and fire organisation chart
   Fire incidents log book and investigation records
   Inspection / testing of fire fighting appliances, fire extinguishers, sprinklers including fire hydrants
4. Approval of competent persons for industrial safety
   Approval of certifying surgeon# for medical examination of occupational workers
5. Records of periodical medical examination of employees
   Status of first-aid centre and ambulance
6. Minutes of meetings of safety committees
   Statistics of accidents, near miss incidents and their investigation reports etc.
   Job hazard analysis
   Material safety data sheets (MSDS)
   Records of testing of cranes, hoists and lifts etc.
   Safety work permit system – general / electrical
   Portable power tools testing record etc.
   Record of calibration of safety related instruments
   Data on illumination levels
   Measurement of noise level, and records
   Storage data of hazardous chemicals
   Inventory of personal protective equipment
7. Compliance status of recommendations of previous regulatory inspection
8. Records of training including first-aid training
9. Internal safety inspection / audit records

 # Certifying Surgeon (specific to this document) :

The medical officer of the factories concerned authorised by AERB.

ANNEXURE-3B

REGULATORY INSPECTION CHECKLIST FOR FIRE AND INDUSTRIAL SAFETY AT OPERATING NPPs/RRs

CONTENTS

Section No.	Title of The Section
A	Organisation and Administration
B	Housekeeping
C	Electricity
D	Welding and Gas Cutting
E	Pressure Vessels and Plants
F	Hoists and Lifts, Lifting Machines, Cranes
G	Personal Protective Equipment (PPE)
H	Fire Protection, Prevention and Fighting
I	Scaffolding
J	Hand Tools and Portable Power
K	Machine Guarding
L	Ladders
M	Colour Coding
N	Hazardous Chemicals
O	First Aid
P	Canteen
Q	Noise
R	Gas cylinders
S	Safety Work Permit System
T	Training
U	Documents

ANNEXURE- 3B (Contd.)

Checked by _____

A Organisation and Administration

1. a. Name of the plant
   b. Year of commissioning
   c. Number of shifts
   d. Number of employees
   e. Check the details about fire and safety organisation

2. Does the plant have a written policy on safety?
   If yes, is the policy reviewed periodically?

3. Is the safety policy written down and circulated?

4. Have the responsibility and accountability been assigned?

5. Has environmental safety been taken into account in the policy?

6. Is the safety officer authorised to stop the work if he finds unsafe practices are being followed and/ or unsafe conditions exist?

7. Is there a safety committee? Does the safety committee meet regularly?

9. Are the safety meetings documented properly and record kept properly?

10. Are regular inspections made, of plant areas, facilities, buildings, machinery, equipment, tools and work methods for identifying accident hazards ?
    By whom ?
    How frequently ?
    How extensively ?
    How processed ?

10. What injury records are kept ? By whom ?

11. Are standard methods used for computing frequency and severity rates?

12. Is there written procedure of accident investigation and analysis?

13. Are all accidents and near misses thoroughly investigated?

14. Is the 'accident register' up to date and accurate?

B Housekeeping :

1. Are containers of refuse (waste) and trash emptied at the end of every day or soon after they are full?

2. Are rags or wipers (cotton waste) that are contaminated with flammable or toxic materials disposed off into designated safe containers immediately after use?

3. Are those containers emptied regularly in approved manner?

4. Are all floors in good condition?

ANNEXURE- 3B (Contd.)

Checked by _____

B Housekeeping :

5. Are all spills cleaned up promptly?
6. Are unused slings, hoses etc. properly stored to prevent them from obstructing traffic or becoming a tripping hazard?
7. Are roads or truck routes well marked and clearly separated from the walkaways that workers must use?

C Electricity

1. Are competent or licensed electricians available for electrical work?
2. Are untrained persons prohibited from making changes or extensions?
3. Are all connections made by using appropriate plugs, receptacles or enclosures?
4. Are fuses provided?
5. Are there any make shift connections, bare wires or damaged cables?
6. Are electrical equipment in good condition?
7. Are extension cords regularly inspected and protected from damage in service?
8. Are metallic parts prohibited where contact with live wires might be possible?
9. Are there any overhead electric power lines on site? Are mobile cranes or workman reach from scaffold or ladder, come close to these live lines?
10. Is separate safety work permit issued for electrical work?
11. Are earth connections checked periodically?

D Welding and Gas Cutting

1. Is the welding machine earthed properly and checked for any leakage of current by an authorised and trained electrician ?
2. Are extinguishers provided with all welding carts?
3. Is hot work permit system introduced?
4. Are oxygen and acetylene hoses protected from damage or kinking while in use?
5. Are power cables undamaged and protected?
6. Are PPE available and used?
7. Are all the flammable materials at safe distance from welding spark?
8. Are the combustible materials, which cannot be moved are protected and covered?

ANNEXURE- 3B (Contd.)

Checked by _____

D Welding and Gas Cutting

9. Is adequate ventilation provided while welding in confined areas?

10 Are cables of welding and other equipment routed properly, so as to allow safe traffic by all concerned?

E Pressure Vessels and Plants

1. Is there a programme for periodically testing each pressure relief device and regulator ?

2. Is each container, which holds a flammable, toxic, corrosive or otherwise dangerous fluid suitably identified and marked ?

3. Is each pressure vessel tested regularly (ISI / hydro-test)?

F Hoists and Lifts, Lifting Machines, Cranes

1. Is a register maintained to record particulars of examination of hoists and lifts , lifting machines, chains, ropes and lifting tackles?

2. What is the periodicity for examination of crane? Are the records of inspection maintained?

3. Is the safe working load clearly marked?

4. Are people kept away from moving under loads?

5. Are crane booms kept clear from power lines at all times?

6. Are slings, chains, pulleys and hooks inspected regularly ?

7. Are all equipment properly lubricated and maintained?

8. Are adequate gates or safe accesses provided at all landings?

9. Are these gates kept shut except when the hoist is at the landing?

10. If the hoist is for materials only, is there a notice on the cage prohibiting people from riding on it? Is the notice obeyed?

11. Is the safe means of access provided to the driver's cabin and to every locations where the person engaged on the inspection, repair and lubrication of the crane has to work?

12. Are all the tests like deflection test, over load test, limit switches, correctness of all circuits and interlocks, satisfactory operation of all protective devices, done regularly?

13. Is the repair work carried out with written authority (work permit system)?

ANNEXURE- 3B (Contd.)

Checked by _____

F Hoists and Lifts, Lifting Machines, Cranes

14. Has the person employed to operate crane, fork-lift, or to give signals to crane operator been medically examined for eye sight and colour vision ?

15. Is the frequency of eye sight and colour vision examination, at least once in a period of 12 months up to the age of 45 years and once in every six months beyond that age adopted ?

G Personal Protective Equipment (PPE)

1. Type of PPE and their adequacy

2. Are effective screens or suitable goggles provided for the protection of persons employed in or in the immediate vicinity of the processes of grinding, turning of metals, drilling, welding, and cutting, chipping and work involving risk to eye?

3. Are all PPE provided to the workers conforming to the relevant Indian Standards?

4. Use of PPE and awareness among employees

H Fire Protection, Prevention and Fighting

1. Check identification of fire compartments, which contain reactor safe shutdown equipment or systems or high fire load

2. Check identification of locations where separation by distance is provided, fire load in the area, basis for separation distance and that separation are free from combustibles and ignition sources

3. Check identification of locally applied separating elements, fire rating and their qualification

4. Check categories of fire detectors are appropriate for the hazard area and for qualification of fire detection equipment

5. Check detection system design and installation, standard followed, primary and secondary power supplies and adequacy of fire detectors for each area

6. Check if local (audible and visible) annunciation and remote annunciation is provided at a location, which is always manned

7. Check that the work involving ignition sources is controlled by a work permit System

8. Check creation of fire squads amongst operating personnel and their training and mock drills. Also check whether list of fire squad members is displayed at prominent locations

ANNEXURE- 3B (Contd.)

Checked by _____

H Fire Protection, Prevention and Fighting

9. Check familiarity of fire personnel with plant layout, equipment layout and fire potential in different areas

10. Check existence of mutual aid scheme

11. Check availability of communication system in fire station and locations to which it can be directly communicated from the fire station

12. Check maintenance records of fire fighting equipment including mobile, first aid and fixed types

13. Check application of fire retardant coating on critical cables and fire stop seal for cable penetration to control room and other strategic locations

14. Check availability of fire order and its review procedure, with respect to assigning of clear cut responsibility

15. Check adequacy and frequency of fire drills

16. Check that buildings containing safety-related systems are protected from exposure to spill fires involving outdoor oil-filled transformers

17. Check indoor transformers are of dry type

18. Check. personal access and escape routes are provided for each fire area

19. Check that buildings and plants are so laid out and roads, passage ways etc. so maintained as to permit unobstructed access for fire fighting

20. Check that the floor drains are sized to remove expected fire fighting water flow without flooding safety-related equipment

21 Check that each branch line to a separate building has at least two independent connections to the fire water main loop

22. Check that automatic water sprinkler system is provided for oil filled transformers above 5MVA rating, manually operated water sprinkler system are provided for transformers with a rating of 1 MVA to 5 MVA and adequate provision of fire hydrants near the transformers are made for transformers below 1 MVA rating

23. Check adequacy and type of water supply and main source of water

24. Check whether two separate reliable water sources are available

25. Check supply and distribution pipe design and installation standard for protection against mechanical damage, ground movement and corrosion

26. Check that the fire water main loop is not connected with service or sanitary water system piping

ANNEXURE- 3B (Contd.)

Checked by _____

H Fire Protection, Prevention and Fighting

27. Check the redundancy provided in the fire pumps and availability of alarms in control room

28. Check if automatic CO_2 systems are used, which are equipped with a pre-discharge alarm system and a discharge delay to permit personnel evacuation

29. Check that smoking is prohibited in designated areas and 'NO SMOKING' signs are appropriately displayed

30 Check adequate numbers of self-contained positive pressure breathing apparatus with full face positive pressure mask are provided in fire station and control room. Check for proper training of personnel in the use of SCBA

31. Check that the plant emergency lighting system illuminates the fire access routes with light having an intensity of not less than 1.0 foot-candle

32. Check that high temperature piping is properly insulated to exclude it as an ignition source

33. Check that adequate fire water hydrant system with riser pipes to cope up with fire risks at any height in the operating plant is installed

34. Check minimum number of people available for response

35. Check training program and syllabus, regular hot fire practice for fire brigade personnel

36. Check frequency of drills, whether some are unannounced, whether performed in night shift, all areas covered including those containing safe shutdown equipment

37. Check availability and adequacy of documented pre-fire fighting strategies especially for areas containing safe shutdown equipment and their use in drill

38. Check manual fire fighting capability including availability of pre-fire, fire fighting strategies

39. Check type number of extinguishers, appropriateness and suitability of fire extinguishers

40. Check access to fire fighting equipment

I Scaffolding

1. Are all scaffolds designed and erected by competent persons?

2. Are scaffolds inspected every day before work begins?

ANNEXURE- 3B (Contd.)

Checked by _____

I Scaffolding

3. Has proper access been provided to the working levels?
4. Are ladders securely clamped or lashed in place?
5. Do they extend at least three feet above the working level?
6. Are the scaffolds at height.? If yes, is a netting provided?
7. Is minimum width of platform provided?

J Hand Tools and Portable Power Tools

1. Are proper tools being used for job?
2. Are damaged tools repaired or replaced promptly?
3. Is there proper grounding for tools?
4. Are tools and cords in good condition?
5. Is the metallic part of power tools having double insulation?
6. Is regular testing of portable power tools carried out?

K Machine Guarding

1. Are all moving parts and points of operation of machinery adequately guarded?
2. Are all mechanical safeguards in working order?
3. Are dangerous parts such as saw blades, gear belts and shaft couplings adequately guarded?
4. Are all fixed guards securely bolted in position and in good condition?

L Ladders

1. Are all ladders free from split rails, loose rungs, knots, cracks, all other obvious defects and are all inspected regularly?
2. Are ropes and metal parts of extension ladders in good condition?
3. Are ladders tied off near the top even when used for only a short time?
4. Are damaged ladders that are to be discarded, cut up immediately to prevent their being used?
5. Are ladders set up at the proper slope?
6. Are metal ladders used around electrical systems?

ANNEXURE- 3B (Contd.)

Checked by _____

M Colour Coding

1. Are the pipe lines for water, air, oil and gas, colour coded?

N Hazardous Chemicals

1. Are material safety data sheets available?
2. Are all containers clearly, indelibly identified?
3. Are all chemicals stored as per safety regulations?
3. Are the store rooms, tanks, bins and vessels of highly flammable liquids marked 'Highly Flammable'?
4. Is adequate natural ventilation provided in the store room?

O First Aid

1. What first aid facilities, equipment, supplies, and personnel are available in all shifts ?
2. What are the qualifications of the people responsible for the first aid program ?
3. What emergency first aid training and facilities are provided when normal first aid personnel are not available ?
4. What facilities are available for transportation of the injured to hospital ?
5. Are the names of the persons working within the precincts of the factory who are trained in first aid treatment available?
6. Are suitable and sufficient stretchers provided and maintained?
7. Are workers trained in first aid training?
8. Individual responsible to take care of the first aid box identified
9. Is ambulance parked in proper place and is it available whenever required?
10. Is periodical medical examination carried out?

P Canteen

1. Ensure no canteen building is situated at less than 15 meters from any boiler house, cool stacks, ash dumps and any other source of dust, smoke or obnoxious fumes
2. Ensure the ventilation and illumination in the canteen building is adequate
3. Ensure annual medical examination for fitness of each member of the canteen staff who handle food stuff, is carried out

ANNEXURE- 3B (Contd.)

Checked by _____

Q Noise

1. Check if there are any very noisy machines or tools
2. Check whether noise level survey has been conducted and records are maintained
3. Check for any sudden noises of over 140 dBA produced by any tool or equipment
4. Check if audiometry test is conducted for persons working in high noise level areas; and check the records

R Gas Cylinders

1. Availability of protective caps for cylinders
2. Availability of chlorine kit for chlorine tonners
3. Colour coding is followed for cylinders
4. Proper storage of cylinders(segregation, protection from sunlight, etc.)

S Safety Work Permit System

1. Availability of work permit system for , work at height, excavation, work on fragile roof, hot work, work in confined spaces etc.
2. Availability of procedures for above jobs
3. Are confined spaces defined?
4. Is the safety division involved before starting work and informed after work is completed?

T Training

1. Regular industrial, fire and first aid training is provided
2. Contract workers are provided safety training
3. Workers have adequate knowledge about the hazards involved in the job, safety precautions etc.

U Documents

Check the availability of the following documents:

1. Safety policy
   Safety manual

ANNEXURE- 3B (Contd.)

Checked by _____

U Documents

2. Standing fire order
Safety and fire organisation chart
Fire incidents log book and investigation records
Inspection / testing of fire fighting appliances, fire extinguishers, sprinklers including fire hydrants

3. Licenses from the regulatory body
Consents from chief controller of explosives
Consents from state pollution control board for emissions and effluents
Authorisation for management and handling of hazardous wastes

4. Approval of competent persons for industrial safety
Approval of certifying surgeon[#] for medical examination of occupational workers

5. Records of periodical medical examination of employees
Status of first aid centre and ambulance

6. Minutes of meetings of safety committee
Statistics of accidents, near miss incidents and their investigation reports etc.
Analysis reports of gaseous emission, liquid effluents etc.

7. Material safety data sheets (MSDS)
Records of testing of cranes, hoists and lifts etc.
Safety work permit system – general / electrical
Portable power testing record etc.
Record of calibration of safety related instruments
Data on illumination level
Measurement of noise level
Storage data of hazardous chemicals stored and records
Inventory of personal protective equipment

8. Compliance status of recommendations of previous regulatory inspection

9. Records of training including first aid training

10. Internal safety inspection / audit records

 # Certifying Surgeon (specific to this document):

The medical officer of the factories concerned authorised by AERB.

ANNEXURE-4

REGULATORY INSPECTION CHECKLIST FOR CIVIL ENGINEERING ASPECTS OF OPERATING NPPs

CONTENTS

Section No.	Title of The Section
A	General requirements and Documentation
B	Concrete Surfaces
C	Concrete Surfaces Lined by a Metallic or Non-metallic Liner
D	Areas around Embedments in Concrete
E	Joints, Coatings, and Non-structural Components
F	Pre-stressing Systems
G	Steel Structures
H	Under ground and Hydraulic structures
I	Inner Containment
J	Non-conformance
K	Feedback and Technical Upgradation

ANNEXURE-4 (Contd.)

Checked by _____

A General requirements and Documentation

1. Does any well defined maintenance programme with sufficient documentation supported by adequate staff/equipment exist for civil engineering structures/facilities?

2. Does the programme cover maintenance procedures, responsibilities, work control system, preventive maintenance, outage maintenance, in-service inspection and predictive maintenance?

3. Is there any document-defining organisation and staffing structure of maintenance unit with defined responsibilities of different sections/ persons in maintenance unit?

4. Is there any training and qualification programme for civil maintenance personnel with minimum essential knowledge about problems related to civil maintenance and diagnostic/repair procedures, adequate knowledge about the plant, familiarity with various plant systems, radiation and industrial safety and work permit procedures?

5. Is there effective control of co-ordination with other maintenance sections, operation and technical support divisions?

6. Whether all safety related civil engineering structures are included in ISI programe?

7. Whether documentation for the following exist

   a. Maintenance activities
   b ISI activities
   c. Frequency of inspection
   d. Inspection records

8. Whether the baseline data with which inspection and test results of the ISI programme may be compared is available?

9. Whether the frequency at which ISI/maintenance conducted is in conformance with the requirement of respective ISI/maintenance manuals?

10. Whether frequency considers the aggressiveness of environmental conditions?

11. What is the frequency of checking the integrity of any pre-stressing system employed at a plant, including anchorage hardware, effectiveness of corrosion inhibiting material (grease or grout), and level of pre-stress, where feasible?

12. Check the frequency of inspection of following structures

    Reactor building containment
    Internal structures of reactor building
    Spent fuel storage bay, reactor auxiliary building
    Spent fuel transfer duct (PHWRs)
    Stack

ANNEXURE-4 (Contd.)

Checked by _____

A General requirements and Documentation

12. Check the frequency of inspection of following structures

    Embedded parts (EPs) and penetrations
    Steel structures exposed to external environment
    All remaining structures and buildings

13. Is seismic tripping (if provided) and other seismic instrumentation checked for its functionality?

14. Whether data are recorded at specified periods from instrumentation for structural/corrosion monitoring?

15. Is there a monsoon gear-up plan?

B. Concrete Surfaces

1. Presence of leaching and chemical attack
2. Presence of abrasion, erosion and cavitations
3. Presence of poorly consolidated concrete areas
4. Presence of pop outs and voids
5. Presence of scaling
6. Presence of spalling
7. Presence of any signs of corrosion in reinforcing steel system or anchorage components
8. Presence of passive/active cracks
9. Presence of deflections, settlements, or other physical movements in excess of design serviceability criteria.
10. Are laboratories and areas where chemicals are handled inspected for damages due to chemical weathering action?

C Concrete Surfaces Lined by a Metallic or Non-metallic Liner

1. Without Leak Detection System
   - (i) Presence of bulges or depressions in liner plate (those appear age-related or created during construction)
   - (ii) Presence of any form of corrosion or other liner damage
   - (iii) Presence of cracking or deterioration of base and weld metal
2. With Leak Detection System
   - (i) Whether detectable leakage observed in leak detection system
   - (ii) Presence of bulges or depressions in liner plate (those that appear age-related as opposed to construction phase related)

ANNEXURE-4 (Contd.)

Checked by _____

D. Areas Around Embedments in Concrete

1. Any concrete surface condition attributes as defined in items B & C above, observed? Presence of corrosion on the exposed embedded metal surfaces and corrosion stains around the embedded metal
2. Presence of detached embedments or loose bolts
3. Presence of degradation signs due to vibratory loads from piping and equipment

E. Joints, Coatings, and Non-structural Components

1. Signs of separation, environmental degradation, or water leakages are present in joints or joint material
2. Loss or degradation in areas of coatings
3. Presence of degradation in any waterproofing membrane protecting below-grade concrete surfaces
4. Whether non-structural elements are serving their desired functions satisfactorily ?

F. Pre-stressing Systems

1. Presence of grease or corrosion inhibiting wax on exposed concrete or steel surface, presence of corrosion on exposed grease cans, bearing plates, anchorages, or other components
2. Configuration of anchorage components changed (as per structural drawings)
3. Presence of concrete degradation around anchorages
4. Signs of corroded, broken or failed pre-stressing elements
5. Loss of pre-stress below acceptable levels established during the design and construction phases (percent maximum loss), as measured by lift-off testing method (where feasible).

G. Steel Structures

1. Presence of any corrosion and pitting.
2. Presence of paint damage.
3. Presence of any debris that may have been left on the surface, particularly on ferrous items such as screws, pop rivets, bolts, sheet metal off-cuts, etc.
4. Presence of sand and dirt, salt deposition, etc. which may result in corrosion in the subsequent phase.

ANNEXURE-4 (Contd.)

Checked by _____

G. Steel Structures

5. Presence of moisture buildup in and around the areas considered unless it is considered in the design originally.

6. Presence of visible damages, such as cracks due to impact of heavy loads or excessive loading, etc.

7. Presence of weld deterioration /separation cracks.

8. Presence of fatigue cracks in welds or in members, particularly those subjected to cyclic loading.

9. Whether bolted connections are intact; any loosened bolted joints are observed; locknuts, if provided, do exist.

10. Presence of deflections in excess of design limits, impairing the serviceability of the structure.

11. Presence of vibrations/resonance in excess of design limits in the structures supporting the vibratory equipment.

12. Presence of buckling.

13. Condition of the handrails, treads and staircases are intact, particularly with respect to weathering of paint, rusting and breakages.

14. Whether the structure is used exactly for the purpose it is intended in the design and no further attachments by way of monorails, pulleys or member extensions have been added; If any of the design/operating conditions are not matching with design basis, whether the structures are further investigated.

15. If any corrosion protection systems other than painting have been resorted to in the original design, whether the effectiveness of such systems or level of damage assessed. Whether thickness measurements done at a sufficient number of locations of the members, based on the member dimension. (subject to a minimum of five measurements for arriving at the average thickness, in case of corrosion).

16. Whether the maximum average decreases in the thickness of the member due to corrosion over any considerable area exceed the corrosion allowance provided in the design calculations.

17. Whether the loss of material is more than allowable? if yes, whether it has been examined using non-destructive methods of examination.

18. Whether parts having failures and requiring repairs studied to ensure continued usage of the parts safely till the next inspection or till the completion of the repair. If no, whether, a warning for not using the same has been recorded and communicated to all concerned; Inspection of cable tray supports, ventilation ducts?

ANNEXURE-4 (Contd.)

Checked by _____

H. Under ground and Hydraulic structures

1. Are basements inspected for underground water leakages, cracking/ spalling of concrete, corrosion of rebars/embedments, expansions/ cracking related to alkali aggregate reactions?
2. Are hydraulic structures inspected for erosion of surfaces, cavitations, leakage, silt deposition, damages due to scouring, settlement of supports and general cleaning of tanks?
3. Are underground trenches/tunnels and roads inspected for water logging problems?
4. Is there instrumentation for monitoring foundation settlement of safety related structures and whether the instruments are functional?
5. Are plant roads/emergency escape roads maintained properly?

I. Inner Containment

1. External surfaces: as mentioned earlier in items B to G
2. Inner surfaces: as mentioned earlier in items B to G
3. Presence of leakage in excess of amounts and flow rates in the original design or technical specification
4. Is there adequate instrumentation for leak monitoring/ deflection monitoring in containment structures and whether checks are conducted to see that these instruments are functional?

J. Non-conformance

1. Whether areas, which do not meet the requirements given in items B to I needs further evaluation using enhanced visual inspection (magnification, etc.), testing or other analytical technique or repair.
2. In detailed evaluation (if carried out), whether original member design conditions are utilised for qualifying the members safe. Whether record of such evaluation available and whether the consent of the design engineer obtained.

K. Feedback and Technical Upgradation

1. Are data obtained during preventive maintenance inspections/repairs analysed to optimise inspections?
2. Are major repairs monitored for in-service performance?
3. Is the technical support staff for civil/structural engineering developed for job related codes, standards, technical specifications, regulations, supervisory skills and software?
4. Are the data obtained from maintenance division analysed for identifying generic problems and root causes?
5. Are the data systematically stored for preparing a data bank on structural performance vis-a-vis ageing studies related to ageing aspects and life extension?

ANNEXURE-5

(Form 1)

SPECIMEN FORMAT FOR AUTHORISATION CARD/LETTER

GOVERNMENT OF INDIA
ATOMIC ENERGY REGULATORY BOARD

AERB/Division/File number/ year Date

Sub: Delegation of Power to Lead Inspector

In pursuance of Section 17(4) of the Atomic Energy Act 1962 and in exercise of the powers vested in me vide paras 3 and 5 of the Government Notification No 25/2.1983-ER dated 15.11. 1983 and as per the provision of (i) Rule numbers 30 and 31 of the Atomic Energy (Radiation Protection) Rules 2004, (ii) AERB safety code: AERB/ SC/G including safety guides and safety manuals issued thereunder, I hereby authorise Smt/ Shri_____, Scientific Officer _____ of AERB, to exercise the powers of lead inspector in connection with the regulatory inspection assigned to him by the AERB.

For implementing on the spot enforcement action the lead inspector shall obtain prior approval from Chairman/ Vice-Chairman, AERB.

Chairman, AERB

Smt/Shri _____

SO/_____, _____Division, AERB

Vice- Chairman, AERB

Director, OPSD/NPSD/IPSD, AERB

ANNEXURE-5 (Contd.)

(Form 2)

SPECIMEN FORMAT AUTHORISATION CARD/LETTER

GOVERNMENT OF INDIA
ATOMIC ENERGY REGULATORY BOARD

AERB/Division/File number/Year Date

Sub: Authorisation of an Inspector

In pursuance of Section 17(4) of the Atomic Energy Act 1962 and in exercise of the powers vested in me vide paras 3 and 5 of the Government Notification No 25/2.1983-ER dated 15.11. 1983 and as per the provision of (i) Rule numbers 30 and 31 of the Atomic Energy (Radiation Protection) Rules 2004, (ii) AERB Safety Code: AERB/SC/G including safety guides and safety mannuals issued thereunder, I hereby authorise Smt/Shri _____, Scientific Officer _____ of AERB, as INSPECTOR to carry out the regulatory inspections in NPPs assigned to him and should report to the LEAD INSPECTOR.

Chairman, AERB

Smt/Shri _____

SO/_____, _____Division, AERB

Vice- Chairman, AERB

Director, OPSD/NPSD/IPSD, AERB

ANNEXURE-6

SPECIMEN FORMAT FOR PROPOSAL FOR ANNUAL INSPECTION PROGRAM

GOVERNMENT OF INDIA
ATOMIC ENERGY REGULATORY BOARD

AERB/ Division/file No./year/ Date.

Sub: Tentative Annual Regulatory Inspection Plan

It is proposed to conduct the routine regulatory inspection of the operating NPPs/ Nuclear Projects under construction as envisaged in regulatory inspection manual. Proposed target frequency for regulatory inspections during the year is TWO for operating NPPs and FOUR for NPPs under construction and ONE for research reactors. The inspection programme is as given below.

The special regulatory inspections will be carried out on as and when required basis.

Annual Inspection Program for Operating NPPs/RRs for the year 20…

Operating NPP/RR Unit	Lead Inspector	Regulatory Inspections Dates	
		First Inspection	Second Inspection

Annual Inspection Program for NPPs under construction for the year 20…

Nuclear Power Project Under Construction	Lead Inspector	Regulatory Inspections Dates			
		First inspection	Second inspection	Third inspection	Fourth inspection

The inspection programme may kindly be approved.

(Officer-in-Charge of safety review of
operating NPP/NPP under construction)

Vice-Chairman, AERB
Chairman, AERB

RI Coordinator/Lead inspectors: For necessary follow up

ANNEXURE-7

SPECIMEN FORMAT FOR APPROVAL OF INSPECTION PROGRAM, MESSAGES AND PREPARATORY MEETINGS FOR NPPs/RRs UNDER CONSTRUCTION

Form 1

Government of India
Atomic Energy Regulatory Board
Nuclear Projects Safety Division

No. AERB/File No. /Division/RI/Project/ Year/ Date:

RI NO. Date of inspection:

Sub: Proposal for Regulatory Inspection of Project Name

Regulatory inspection of Project Name is proposed as follows:

Inspection Program

Plant to be inspected	:	Project Name
Type of inspection	:	
Dates of inspection	:	
Date of report submission and feedback meeting	:	

Proposed inspection team is as follows:

S. No.	Name	Division

Main emphasis of this regulatory inspection will be on aspects related to
1.
2.

Approval for the above inspection is requested.

RI Coordinator
NPSD, AERB

DIRECTOR, NPSD, AERB
CC:
Chairman, AERB
Vice Chairman, AERB
Director, IPSD, AERB
Director, C&SED, AERB
Director, OPSD
Lead Inspector/ Team Leader

ANNEXURE-7 (Contd.)

Form 2

FAX MESSAGE

No. AERB/File No./Division/RI/Project/Year Date:

Sub: Regulatory Inspection of Project Name

FOR : PROJECT DIRECTOR
RPT : QA IN-CHARGE
FROM : DIRECTOR NPSD, AERB

REGULATORY INSPECTION RI NO. ..... OF Project Name BY AERB TEAM IS SCHEDULED FROM ..... TO ..... (.) THE INSPECTION BY AERB TEAM WILL COVER ASPECTS RELATED TO ..... (.) RELEVANT DOCUMENTS MAY KINDLY BE KEPT READY FOR INSPECTION (.)

DETAILS OF THE INSPECTION TEAM, PDSC MEMBERS AND THEIR PROGRAMME WOULD BE INTIMATED TO YOU SHORTLY BY THE LEAD INSPECTOR/TEAM LEADER (.)

CO-OPERATION AND HELP OF Project Name IN CONDUCTING THE INSPECTION AND MAKING NECESSARY ARRANGEMENTS IS REQUESTED (.) ARRANGEMENT FOR SECRETERIAL ASSISTANCE FOR THE TEAM IS SPECIALLY REQUESTED TO FACILITATE ISSUE OF INSPECTION REPORT AT SITE (.)

REGARDS (.)

Date :

DIRECTOR, NPSD, AERB

Government of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

No. AERB/File No./Division/RI/Project/Year Date:

PCC:
1. Project Director
2. Qa In-charge

Copy for information:

AERB
Chairman, AERB
Vice-chairman, AERB
Chairman PDSC
Director, C&SED, AERB
Director, IPSD, AERB
Lead Inspector/Team Leader
All Ri Team Members
Ri Co-ordinator NPSD, AERB

NPCIL
Concerned officers of Design and safety group

ANNEXURE-7 (Contd.)

Form 3

FAX MESSAGE

No. AERB/File No./Division/RI/Project/Year Date:

RI NO. : Date of inspection:

FOR : PROJECT DIRECTOR
RPT : QA IN-CHARGE
FROM : LEAD INSPECTOR/TEAM LEADER, NPSD, AERB

REGULATORY INSPECTION RI NO. .....OF Project Name BY AERB TEAM IS SCHEDULED FROM . .....TO . ..... (.). THE INSPECTION BY AERB TEAM WILL COVER ASPECTS RELATED TO . ..... (.)

Proposed inspection team is as follows:

S.No.	Name	Division

Detailed travel Programme of the RI team members is enclosed herewith as enclosure.

YOU ARE REQUESTED TO KINDLY ARRANGE TRANSPORT FROM _____ TO _____ AND ACCOMMODATION FOR ALL THE RI TEAM MEMBERS IN GUEST HOUSE AND TRANSPORT FROM GUEST HOUSE TO PLANT SITE (.)
REGARDS (.)

(Lead inspector/Team leader)
Date: NPSD, AERB

Government of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

No. AERB/File No./Division/RI/Project/Year Date:

PCC: Project Director
QA In-Charge

Copy for information:
AERB
Chairman, AERB
Vice-chairman, AERB
Director, IPSD, AERB
Director, NPSD, AERB
Director, C&SED, AERB
Officer-in-Charge of DAE units whose help is sought

NPCIL
Concerned officers of Design and safety group

Cc : All Team Members
NPSD, RI Coordinator

ANNEXURE-7 (Contd.)

Enclosure to Form 3

TRAVEL PROGRAM

Onward Journey					
Name	**Date**	**Time**	**From**	**To**	**Train/Bus/Flight**
Note: If any					
Regulatory inspection on **Report submission & feedback meeting on**					
Return Journey					
	Date	**Time**	**From**	**To**	**Train/Bus/Flight**
Note: If any					

ANNEXURE-7 (Contd.)

Form 4

Government Of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

No. AERB/Division/RI/File No./ Project Name /Year/ Date:

RI NO.: Date of inspection:

Sub: Meeting of Team members before proceeding for RI

1. Project to be inspected : Project Name
2. Constitution of team:

S. No.	Members	Present During Meeting

3. RI No.
4. Date (s) of RI:
5. Meeting of team members held on/at
6. Meeting of team members presided by:
7. Review of constraints from the site (if any):
8. Subjects discussed for RI
9. Documents reviewed for RI: (Table of previous RI recommendations and site response to be given to team members along with list of areas to be covered during inspection).
10. Assignment of area of inspection to the team members:

S. No.	Name	Area Assigned

11. Finalisation of travel plan: as given in FORM-3

Lead inspector/Team leader

To : All Team members
Director, NPSD
Director, IPSD
RI coordinator

ANNEXURE-8

SPECIMEN FORMAT FOR APPROVAL OF INSPECTION TEAM AND PROGRAM FOR OPERATING NPPs/RRs

Government of India
Atomic Energy Regulatory Board
Operating Plants Safety Division

No. AERB/OPSD/File No./ Year/ Date

Sub: **Regulatory Inspection of** Units Name
Ref: Schedule of RI for year 20___ approved by Vice-Chairman/Chairman AERB vide No._____ dated _____.

Regulatory inspection of Units Name is proposed to be conducted by AERB from _____to _____, 20____ as per the above referred approved schedule. The composition of the team and the inspection program is as follows. (areas under 1 to 5 are to be covered half yearly and the rest yearly)

INSPECTION TEAM

S. No	Name	Division	Area of specialisation
1.	Shri _____ Lead inspector		Plant/Project management and follow-up of previous inspection reports
2.	Shri _____		Follow-up of SC/SARCOP recommendations
3.	Shri _____		Operations, FHU and chemistry control
4.	Shri _____		Technical audit and surveillance
5.	Shri _____		Health physics
6.	Shri _____		Quality assurance and ISI
7	Shri _____		Mechanical maintenance
8.	Shri _____		Electrical maintenance
9.	Shri _____		Instrumentation and control
10.	Shri _____		Reactor physics
11.	Shri _____		Waste management
12.	Shri _____		Training
13.	Shri _____		Industrial and fire safety
14.	Shri _____		Civil and structural aspects

INSPECTION PROGRAMME

Date	Time	
_____	_____	Departure from Mumbai (By Train/Flight)
_____	_____	Introductory meeting with management
_____	_____	Inspection and reporting
_____	_____	Exit meeting with management
_____	_____	Report finalisation and issue
_____	_____	Leave for Mumbai (By train/Flight)

ANNEXURE-8 (Contd.)

Relevant documents may kindly be kept ready for inspection (.) Co-operation of Units Name in conducting the inspections and arrangements for secretarial assistance for the team is specially requested to facilitate issue of inspection report at site (.)

You are requested to provide transport for the officers and lead inspector will separately request for transport if required (.)

Provision of gate pass and TLDs for the inspection team members for the above period and accommodation at Units Name guesthouse is kindly requested (.)

(Officer-in-Charge of safety review of operating NPP)

Station Director, Units Name :

Chief Superintendent, Units Name :

CC:
Chairman, AERB
Vice-Chairman, AERB

Officer-in-charge of other divisions	:	With a request to relieve Shri _____ for the inspection
Lead inspector	:	With a request to lead and co-ordinate the inspection team and issue the report.
Inspection team members	:	Plan your travel and inform the team leader

ANNEXURE-9

SPECIMEN FORMAT FOR REGULATORY INSPECTION REPORT OF NPPs/RRs UNDER CONSTRUCTION AND COMMISSIONING STAGE ALONGWITH TABLE OF CATEGORISATION

Government of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

AERB/NPSD/File/ Units Name /year Date :

Sub : Regulatory Inspection of Units Name

Inspection report : Units Name : 1 (2) /20____
Inspection dates: _____to _____20...

1.0 General

1.1 Regulatory inspection of Units Name was carried out by AERB team consisting of the following members during the period from ….....to.....,20..... The inspection covered mainly design and commissioning, QA and PSI/ ISI, CCC and STD, civil constructions, reactor components and accessories, piping and mechanical equipment erection. Also electrical equipment installations, instrumentation and control, control rooms, computers and communication, fire and industrial safety, health physics, waste management, ESL, emergency preparedness, training, simulator, O and M activities, design SC, ACPSR and site related pending recommendations were checked (mention the areas covered).

Based on the field observations and review of the project documents, observations of the team were brought out. The inspection findings were discussed with the project personnel and management in the exit meeting held on _____.

1.2 Inspection team

Name	**Division/Organisation**
Shri _____	Lead inspector
Shri _____	Inspector
Shri _____	Inspector

1.3 References

(i) Stage authorisation issued by the competent authority
(ii) Over all QA manual and concerned units QA manual
(iii) Previous regulatory inspection reports issued by AERB and NPP responses issued

1.4 Project Status

NPP, Unit- —- : Stage of construction/commissioning
NPP, Unit- —- : Stage of construction/commissioning
Validity of the authorisation :

1.5 Categorisation of Observations / Recommendations in the Inspection Report for further review and follow up

Following sections include the observations made during the inspection and recommendations of the inspection team. To facilitate follow-up review, enforcement and corrective actions, these observations/ recommendations have been categorised from category I to V generally based on their safety significance and follow-up action required. Table annexed to this format gives the relevant details of categorisation. The category of the observations has been marked in the report with the item number. The details and depth of responses from NPP/NPC-HQ and relevant reporting should be commensurate with the category level. The recommendations related to industrial and fire safety are not categorised, however, project should consider them important and should take immediate action. Project management is expected to correct the deficiencies immediately and submit their response to the reported observations/deficiencies/ recommendations of inspection report **within a month** to regulatory body intimating the implementation of the recommendations or giving the proposed target dates for completion.

(Observations and recommendations of following areas covered during the inspections should be mentioned under separate sections)

1. Design and commissioning
2. QA and PSI/ ISI
3. CCC and STD
4. Civil constructions
5. Reactor components and accessories
6. Piping and mechanical equipment erection
7. Electrical equipment installations
8. Instrumentation and control, control rooms, computers and communication
9. Fire and industrial safety
10. Health physics, waste management, ESL, emergency preparedness
11. Training, simulator, O and M activities
12. Design safety committee, ACPSR and site related pending recommendations.

(Lead inspector/Team leader)

Director, NPSD

CC: The Project Director Units Name

Inspectors of the team

ANNEXURE-9 (Contd.)

Units Name / RI-1(2)/20__

Categorisation of observations/deficiencies brought out during the regulatory inspections of construction/ commissioning of NPP (this is an annexure to the inspection report)

Category	Particulars	Enforcement / follow-up and review required by	Item no. of the RI Report
Category-I (CAT.I)	· Violation of AERB safety directives and/or ACPSR/PDSC/CESC stipulations/ recommendations, · Non-compliance with the requirements of AERB codes/standards/Rules and other licensing conditions · Deviations from technical specifications for operation and safety report requirements during commissioning stage.	Enforcement by : NPSD/AERB Review if required by: PDSC/CESC/ ACPSR	
Category -II (CAT.II)	· Deficiencies and degradations in systems/structures/ components and deficiencies in preservation/ construction procedures /practices/ QA of safety and safety related systems · Deficiencies in procedures and compliance with PSI requirments · Deficiencies in other important procedures to meet technical specification for operation requirements during commissioning stage · Observation / recommendetion requiring sefety review	Enforcement/ Follow-up by : NPSD Review by: PDSC/CESC/ACPSR	
Category–III (CAT.III)	· Shortcomings noticed in the design of safety, safety related and safety support systems, during construction/commissioning phase, including generic design deficiencies. · Deficiencies in implementation of safety, and / or each of design provisions related to safety, safety related and safety support system.	Enforcement/ Follow-up by : NPSD Review by: PDSC/ CESC /ACPSR	
Category–IV (CAT.IV)	· Procedural inadequacies and non compliance during construction/ commissioning: ➢ Organisational ➢ Managerial ➢ QA of non - safety related systems ➢ Procedural inadequacies and non compliance during commissioning ➢ O&M procedures ➢ Training and qualification ➢ Emergency preparedness.	Enforcement/ Follow-up by : NPSD Review if required by: PDSC/CESC	
Category – V (CAT.V)	· General observations/deficiencies regarding ➢ Housekeeping and ➢ Good practices	Follow up by Project Management	

ANNEXURE-10

SPECIMEN FORMAT FOR REGULATORY INSPECTION REPORT OF OPERATING NPPs/RRs ALONGWITH TABLE OF CATEGORISATION

Government of india
Atomic Energy Regulatory Board
Operating Plants Safety Division

AERB/OPSD/File/year Date :

Sub: Regulatory Inspection of Units Name

Inspection Report: **Units Name**: 1 (2) /20____
Inspection Dates: ————- to _____ 20...

1. **General**

1.1 Regulatory inspection of Units Name was carried out from …. to ……., 20... to check plant operation, technical audit and surveillance, reactor physics, maintenance, QA, ISI, training and waste management (mention areas covered). The report is based on the field observations, review of the station documents and discussions held with the station personnel and plant management in the exit meeting held on ____.

1.2 Inspection team

Name	Division
Shri _____	Lead inspector
Shri _____	Inspector
Shri _____	Inspector

1.3 References

i. Authorisation issued by the competent authority
ii. AERB checklist for regulatory inspections of operating NPPs
iii. Technical specifications for operation of Units Name
iv. Previous regulatory inspection reports and Units Name responses to the same

1.4 Plant status

Unit-1: ———————— (Operating/Shutdown)
Unit-2: ———————— (Operating/Shutdown)
Validity of the authorisation :

1.5 Categorisation of observations / recommendations in the inspection report for further review and follow up

ANNEXURE-10 (Contd.)

Following sections include the observations made during the inspection and the recommendations of the inspection team. To facilitate follow-up review, enforcement and corrective actions, these observations/recommendations have been categorised from category I to V generally based on their of safety significance and follow-up action required. Table Annexed to this format gives the relevant details of categorisation. The category of the observations has been marked in the report with the item number. The details and depth of responses from NPP/NPC-HQ and relevant reporting should be commensurate with the category level. The recommendations related to industrial and fire safety are not categorised, however, project should consider them important and should take immediate action. Station management is expected to correct the deficiencies immediately and submit their response to the reported observations/deficiencies/ recommendations of inspection report **within a month** to regulatory body intimating the implementation of the recommendations or giving the proposed target dates for completion.

(Observations and recommendations of following areas covered during the inspections should be mentioned under separate sections)

2. Plant operations
   - 2.1 Documentation
   - 2.2 Fields visits
   - 2.3 Engineered safety features
   - 2.4 Communications
   - 2.5 Housekeeping
3. Reactor physics.
4. Technical audits and surveillance
5. QA , ISI and special inspection if any regarding reactor components and primary systems
6. Maintenance
   - 6.1 Electrical maintenance
   - 6.2 Mechanical maintenance
   - 6.3 Instrumentation and control
7. Health physics and radiation protection, ESL, emergency preparedness, hospital
8. Waste management
9. Follow-up of recommendations of SC/SARCOP/AERB.
10. Training
11. Industrial and fire safety
12. Civil and structural aspects including containment repair and tests

(Lead inspector/Team leader)

Director. OPSD

CC: The Station Director, units name
Inspectors of the team

ANNEXURE-10 (Contd.)

Units Name / RI-1(2)/20___

Categorisation of observations/deficiencies brought out during regulatory inspection (this is an annexure to inspection report)

Category	**Particulars**	**Enforcement / follow-up and review required by**	**Item No.of inspection report**
Category –1 (CAT.I)	· Violation of AERB/SARCOP safety directives · Deviations from technical specifications (safety limit, limiting safety system settings and limiting conditions of operation) and safety report requirements, · Non compliance with the requirements of AERB operation code/standards/rules and licensing conditions · Violation of industrial safety directives	Enforcement by : OPSD/AERB Review if required by: SARCOP	
Category –II (CAT.II)	· Deficiencies and degradations in systems/structures/ components of safety and safety related systems · Deficiencies in surveillance procedures/practices/QA and · Deficiencies in other important procedures to meet technical specification requirements and reporting criteria	Enforcement by : OPSD/SARCOP Follow-up by: OPSD Review by: SC/SARCOP	
Category–III (CAT.III)	· Shortcomings identified in the design of safety, safety related and safety support systems, based on operating experience including generic deficiencies.	Enforcement/ follow-up by : OPSD Review by: SC/SARCOP	
Category–IV (CAT.IV)	· Procedural inadequacies and non compliance in: ➢ Station policy ➢ Organisational, ➢ Management ➢ QA and ISI ➢ O&M procedures ➢ Training and qualification ➢ Radiation protection procedures ➢ Waste management ➢ Emergency preparedness ➢ Industrial and fire safety	Enforcement/ follow-up by: OPSD Review if required by: SC/SARCOP	
Category–V (CAT.V)	· General observations/ deficiencies regarding ➢ Housekeeping and ➢ Good operating practices	Follow-up by: Plant management	

ANNEXURE-11

SPECIMEN LETTER FOR ENFORCEMENT OF INSPECTION FINDINGS OF NPPs/RRs UNDER CONSTRUCTION

Government of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

No. AERB/Division/RI/File No./ Project Name /Year/ Date:

RI No. Period of Inspection

Sub: Regulatory Inspection of Project Name

Regulatory inspection of Project Name was carried out from _____to _____ by AERB inspection team led by _____ . A copy of the inspection report is enclosed herewith. The report brings out observations/recommendations of the inspection team. These were discussed and explained for required actions to be taken by project authorities in a feedback session at the end of inspection.

The recommendations related to industrial and fire safety are not categorised, however, project should consider them important and should take immediate action. Response to the above inspection report should be submitted to NPSD/AERB within a month. The response should indicate status of implementation of recommendations and methodology with target dates for carrying out the required actions. In case project does not concur with any observation/recommendation the same should be clearly brought out.

The inspection report brings out deficiencies noted in various aspects of the project on sample checks. Site should apply these to other areas and make corrections, as relevant, if deficiency of similar nature is observed.

(Director NPSD, AERB)

Encl: As above

Project Director

CC:

AERB

Chairman, AERB
Vice Chairman, AERB
Chairman, ACPSR-PHWR
Director, C&SED, AERB
Director, IPSD, AERB
Officer-in-Charge of DAE units whose help is sought
Chairman, respective PDSC
Lead inspector/Team leader
Member secretary, respective PDSC
RI coordinator, AERB
All RI team members

NPCIL

Concerned officers of design and safety groups

ANNEXURE-11 (Contd.)

Government of India
Atomic Energy Regulatory Board
Nuclear Project Safety Division

No. AERB/Division/RI/File No./ Project Name /Year/ Date:

Ref. 1. Regulatory Inspection Report of Project Name
2. Site Response to AERB regulatory inspection of

Regulatory inspection of Project Name was carried out from _____ to _____. The inspection report ref.1 along with the site response ref.2 is attached herewith. It is requested that the following items of the report may be reviewed in PDSC along with site response.

Item No of RI Report	**Issue**

Director NPSD

Distribution:
Chairman, respective PDSC
Member secretary, respective PDSC
RI-File

ANNEXURE-12

SPECIMEN LETTER FOR ENFORCEMENT OF INSPECTION FINDINGS OF OPERATING NPPs/RRs

Government of India
Atomic Energy Regulatory Board
Operating Plants Safety Division

No. AERB/Division/file No./Year Date:

Sub.: Regulatory Inspection of Units Name

Regulatory Inspection of Units Name was carried out during _____ to _____ , Year_____ by the AERB team lead by lead Inspector's name, AERB. A copy of the inspection report issued to you by the inspection team is enclosed. The report brings out certain observed deficiencies during the inspection and the recommendations of the inspection team. These were also discussed and actions required by Units Name were explained during the exit meeting held on _____.

The recommendations related to industrial and fire safety are not categorised, however, station should consider them important and should take immediate action. Response to these listed items should be **submitted to Director/Head, OPSD, AERB within a month**. Response to the items related to industrial and fire safety should be **submitted separately to Director/Head, IPSD, AERB within a month**. The response should indicate methodology and target date for carrying out the required action. In case Units Name does not concur with any recommendation, the same should be clearly brought out.

Any items of safety concern and importance should be highlighted in the enforcement letter and special response should be obtained along with required corrective action.

1. .....

2. .....

The inspection report and Units Name response, in particular to the above listed important items (if any) may be discussed in Unit SC to firm-up the action plan for further follow-up in OPSD and if required in SARCOP.

Director/Head, OPSD

Encl. as above.

Shri …….....
Station Director, Units Name

CC: AERB
Chairman, AERB
Vice Chairman, AERB
Chairman, SARCOP
Chairman, unit SC
Member-secretary, SARCOP
Member-secretary, Unit SC
(with a request to discuss in SC)
Members of the inspection team

NPCIL:
Concerned officers of operation, design and safety groups

ANNEXURE-13

SPECIMEN LETTER FOR ON THE SPOT ENFORCEMENT BY LEAD INSPECTOR/TEAM LEADER

Government of India
Atomic Energy Regulatory Board

No. AERB/Division/file No./20 Date:

Sub : Regulatory Inspection of Units Name

Dear Sir,

Regulatory inspection of Units name was carried out during .....…. to …....., 20..... by the AERB team. During the inspection on_____day at_____hours the inspection team noticed violation of technical specification clause (s) _____/ unsafe radiological conditions in Unit no # _____while unit was operating at power level of _____MWe. This was brought to the notice of O&M staff and to the plant management personnel. (For NPP under construction, any violation from construction authorisation and unsafe personnel conditions may be included.)

In view of the prevailing unsafe situation in the unit, it is requested that the following corrective measures are taken immediately.

1. .....

2. .....

It is requested that a detailed report / significant event report be submitted along with root cause analysis and corrective measures taken. You are also requested to intimate the status to NPSD/OPSD/SC/ SARCOP immediately.

You are also requested to acknowledge the receipt of this communication.

Lead inspector/Team leader

Shri …….....
Station Director/Project Director, Units Name

(Attach the acknowledgement note)

Director, OPSD/NPSD

Vice-Chairman, AERB

Chairman, AERB

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LIST OF ABBREVIATIONS

AEC : Atomic Energy Commission	IEEE : Institute of Electrical and Electronics Engineers
AGMS : Annulus Gas Monitoring System	MPE : Magnetic Particle Examination
ASME : American Society of Mechanical Engineers	NCR : Non Conformance Report
ACPSR: Advisory Committee for Project Safety Review	NPPs : Nuclear Power Plants
ASCE : Assistant Shift Charge Engineer	NPCIL: Nuclear Power Corporation of India Limited
BWR : Boiling Water Reactor	NDT : Non Destructive Testing
BARC : Bhabha Atomic Research Centre	O&M : Operation and Maintenance
CCC : Construction Completion Certificate	PDSC : Project Design Safety Committee
CESC : Civil Engineering Safety Committee	PSI : Pre-Service Inspection
DAE : Department of Atomic Energy	PHTS :Primary Heat Transport System
DCR : Design Change Request	PC : Primary Containment
DG : Diesel Generator	PWR : Pressurised Water Reactor
DPT : Dye Penetrant Test	PFBR : Prototype Fast Breeder Reactor
ECCS : Emergency Core Cooling System	PHWR: Pressurised Heavy Water Reactor
ESL : Environmental Survey Laboratory	PSAR : Preliminary Safety Analysis Report
ECT : Eddy Current Test	QA : Quality Assurance
ERL : Environmental Radiological Laboratory	RRs : Research Reactors
ER : Event Reports	RT : Radiography Test
FAC : First Approach to Criticality	SCE : Shift Charge Engineer
FSAR : Final Safety Analysis Report	SARCOP: Safety Review Committee for Operating Plants
FHU : Fuel Handling Unit	SORC : Station Operation Review Committee
GSR : Government Statutory Rules	STD : System Transfer Documents
HEPA : High Efficiency Particulate Assembly	SER : Significant Event Reports
HP : Health Physics	SFSB : Spent Fuel Storage Bay
ILRT : Integrated Leak Rate Test	SC : Secondary Containment
ISI : In-Service-Inspection	SSC : Structure, Systems and Components
I&C : Instrumentation and Control	TLD : Thermo Luminescence Dosimeter
INS : Indian Nuclear Society	TSO : Technical Support Organisation
IAEA : International Atomic Energy Agency	UT : Ultrasonic Test

LIST OF PARTICIPANTS

WORKING GROUP

Members of the Working Group Constituted in 2001:

Shri S. N. Rao	:	AERB
Shri P. R. Krishnamurthy	:	AERB
Shri S. A. Khan	:	AERB

Following Specialist Members Helped in Preparing the Area Specific Checklist:

Shri S. A. Sukheswalla	:	AERB
Shri V. V. Pande	:	AERB
Shri A. Ramakrishna	:	AERB
Shri L. R. Bishnoi	:	AERB
Shri P. Vijayan	:	AERB
Shri K. Ramprasad	:	AERB
Shri Fredrick Lall	:	AERB
Shri V. R. Dhotre	:	AERB

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

Dates of meeting	:	Jan 2003
	:	Oct 2003
	:	Jan 9, 2004
	:	June 21, 2004
	:	Mar 29, 2005

Chairman and Members of ACCGORN :

Late Dr. S. S. Ramaswamy (Chairman) (till September 2002)	:	DGFALSI
Shri G. R. Srinivasan, (Chairman)	:	AERB (Former)
Shri A. K .Asrani	:	AERB (Former)
Shri T. N. Krishnamurthi	:	AERB (Former)
Shri P. Hajra (till Feb 2005)	:	AERB (Former)
Dr. S. K. Gupta	:	AERB
Dr. K. S. Parthasarathy	:	AERB (Former)
Dr. Om Pal Singh	:	AERB
Shri S. K. Chande (till July 2004)	:	AERB
Shri R. Venkatraman	:	AERB
Shri P. K. Ghosh	:	AERB
Shri Deepak De (till Nov 2003)	:	AERB (Former)
Shri R. I. Gujarati	:	AERB
Dr. P. C. Basu	:	AERB
Shri S. P. Agarwal	:	AERB
Shri S. T. Swamy (Permanent Invitee)	:	AERB
Shri Y. K. Shah (Member-Secretary)	:	AERB

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

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

AERB SAFETY MANUAL NO. AERB/NPP&RR/SM/G-1

REGULATORY INSPECTION AND ENFORCEMENT IN NUCLEAR POWER PLANTS AND RESEARCH REACTORS

Atomic Energy Regulatory Board
Mumbai - 400 094
India

March 2007

Price:

Order for this manual should be addressed to:

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

FOREWORD

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

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

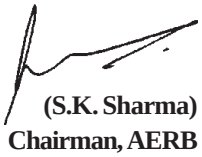
AERB issued a safety code on 'Regulation of Nuclear and Radiation Facilities', to spell out the minimum safety related requirements/obligations to be met by a nuclear or radiation facility, to qualify for the issue of regulatory consent at every stage leading to eventual operation. AERB has also issued a safety guide on the 'Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities' (AERB/SG/G-4), that provides guidance to the regulatory body on its role for regulatory inspection of nuclear and radiation facilities and enforcement action. This safety manual elaborates the organisation, requirements and methods of inspection programme of the nuclear power plants and research reactors. It also covers the suggested types of enforcement actions. It is also intended to assist all the participating agencies in fulfilling the stipulated requirements of the above safety code and guide. In drafting this manual, extensive use has been made of information contained in the relevant documents of the International Atomic Energy Agency (IAEA) under Nuclear Safety Standards (NUSS) program, specially the guide on Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (No.GS-G-1.3).

Consistent with the accepted practice, 'should' and 'may' are used in the manual to distinguish between a recommendation and a desirable option respectively. Appendix is an integral part of the document, whereas Annexures, bibliography and list of participants are included to provide further information on the subject that might be helpful to the user.

For aspects not covered in this manual, national and international standards, codes and guides applicable and acceptable to AERB should be followed. Non-radiological aspects of industrial safety and environmental protection are not explicitly considered in this manual. Industrial safety is to be ensured by compliance with the applicable provisions of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996.

A Working Group consisting of AERB staff has prepared the manual. Experts have reviewed the manual and the relevant AERB Advisory Committee has vetted it before issue.

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



(S.K. Sharma)
Chairman, AERB

DEFINITIONS

Atomic Energy Regulatory Board (AERB)

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

Authorisation

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

Commencement of Operation of Nuclear Power Plant

The specific activity/activities in the commissioning phase of a nuclear power plant towards first approach to criticality, starting from fuel loading.

Commissioning

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

Competent Authority

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

Competent Person

A person, who is having the degree in the discipline mentioned or equivalent, followed by experience as specified in Rule 31 of Atomic Energy (Factories) Rules, 1996, in responsible position in the field and designated by the competent authority.

Consent

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

Consentee

A person to whom 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.

Decommissioning

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

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.

Nuclear Facility

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

Nuclear Power Plant (NPP)

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

Occupier

One who has been given the ultimate control over the affairs of the installations.

Operation

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

Regulatory Body

(See 'Atomic Energy Regulatory Board')

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.

Research Reactor

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

Test

An experiment carried out in order to measure, quantify or classify a characteristic or a property of an entity.

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.

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GOVERNMENT OF INDIA

A E R B S A F E T Y M A N U A L

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