AERB SAFETY GUIDE NO. AERB/SG/O-12

RENEWAL OF AUTHORISATION FOR OPERATION OF NUCLEAR POWER PLANTS

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Atomic Energy Regulatory Board
Mumbai 400 094.

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Orders for this Guide should be addressed to:

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

FOREWORD

Safety of the public, occupational workers and the protection of environment should be assured while activities for economic and social progress are pursued. These activities include the establishment and utilisation of nuclear facilities and use of radioactive sources. They have to be carried out in accordance with relevant provisions of the Atomic Energy Act 1962.

Assuring high safety standards has been of prime importance since the inception of the nuclear power programme in the country. Recognising this aspect, the Government of India constituted the Atomic Energy Regulatory Board (AERB) in November 1983, vide Statutory Order No. 4772 notified in the Gazette of India dated December 31, 1983. The Board has been entrusted with the responsibility of laying down safety standards and framing rules and regulations in respect of regulatory and safety functions envisaged under the Atomic Energy Act of 1962. Under its programme of developing safety codes and guides, AERB has issued four codes of practice in the area of nuclear safety covering the following topics :

Safety in Nuclear Power Plant Siting

Safety in Nuclear Power Plant Design

Safety in Nuclear Power Plant Operation

Quality Assurance for Safety in Nuclear Power Plants

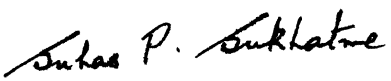
Safety guides are issued to describe and make available methods of implementing specific parts of the relevant codes of practice as acceptable to AERB. Methods and solutions other than those set out in the guides may be acceptable if they provide at least comparable assurance that nuclear power plants can be operated without undue risk to the health and safety of the plant personnel, general public and the environment.

Codes and safety guides may be revised as and when necessary in the light of experience as well as relevant developments in the field. Footnotes and bibliography are not to be considered an integral part of the document. These are included to provide information that might be helpful to the user.

The emphasis in the codes and guides is on protection of site personnel and the public from undue radiological hazards. However, for aspects not covered in the codes and guides, applicable and acceptable national and international codes and standards shall be followed. In particular, industrial safety shall be assured through good engineering practices and compliance with the Factories Act 1948 as amended in 1987 and the Atomic Energy (Factories) Rules, 1996.

This Safety Guide is one of a series of guides which have been prepared or are under preparation as a follow-up to the Code on Safety in Nuclear Power Plant Operation (AERB/SC/O). It prescribes guidelines for the renewal of authorisation for operation of nuclear power plants in India and is intended for their Operating Organisations.

The Safety Guide has been prepared by the staff of AERB and other professionals. In drafting the guide, relevant International Atomic Energy Agency (IAEA) documents under Nuclear Safety Standards (NUSS) programme, especially the Safety Guide on Periodic Safety Review of Operational Nuclear Power Plants (50-SG-O12, 1994) have been used extensively. The Guide has been reviewed by experts and vetted by the Advisory Committees before issue. AERB wishes to thank all individuals and organisations who have contributed in the preparation, review and finalisation of the Safety Guide. The list of persons, who have participated in the committee meetings, along with their affiliations, is included for information.



(Suhas P. Sukhatme)
Chairman, AERB

DEFINITIONS

Acceptable Limits

Limits acceptable to Regulatory Body for accident conditions or potential exposure.

Accident conditions

Substantial deviations from Operational States [1] which could lead to release of unacceptable quantities of radioactive materials. They are more severe than anticipated operational occurrences and include Design Basis Accidents and Severe Accidents.

Ageing Management

The engineering, operations and maintenance actions to control ageing degradation and wear out of systems, structures or components within acceptable limits.

Anticipated Operational Occurrences[2]

All operational processes deviating from normal operation which may occur during the operating life of the plant and which, in view of appropriate design provisions, neither cause any significant damage to Items Important to Safety nor lead to Accident Conditions.

Approval

A formal consent issued by the Regulatory Body to a proposal.

Atomic Energy Regulatory Board (AERB)

An authority designated by the Government of India having the legal authority for issuing regulatory consent for various activities related to the nuclear facility and to perform safety and regulatory functions including enforcement for the protection of the public and operating personnel against radiation.

1 Substantial deviation may be a major fuel failure, a Loss of Coolant Accident (LOCA) etc. Examples of Engineered Safety Features are: an Emergency Core Cooling System (ECCS) and Containment.

2 Examples of Anticipated Operational Occurrences are loss of normal electric power and faults such as turbine trip, malfunction of individual items of control equipment and loss of power to main coolant pump.

Audit[3]

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

Authorisation

A type of regulatory consent issued by the Regulatory Body for all sources, practices and uses involving radioactive materials and radiation generating equipment such as gamma irradiation chambers, radiotherapy and industrial radiography.

It also includes specific stage-wise activities heading to grant of license for a nuclear facility.
(See also Regulatory Consent)

Commissioning

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

Commencement of Operation[4]

The specific activity/activities in the commissioning phase of a Nuclear Power Plant towards first approach to criticality starting from fuel loading.

Construction

The process of manufacturing, testing and assembling the components of a facility, the erection of civil works and structures and installation of components and equipment.

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3 The definition refers to Quality Assurance activity as discussed in Quality Assurance Code and Guides.

4 E.g. fuel loading in case of Light Water Reactors and, in case of Pressurised Heavy Water Reactors, heavy water addition with fuel already loaded.

Decommissioning[5]

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

Examination[3]

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

Full Power

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

Inspection[3]

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 pre-determined quality requirements.

Items Important to Safety

Items which comprise:

(1) those structures, systems, equipment and components whose malfunction or failure could lead to undue radiological consequences at plant site or off-site[6];

(2) those structures, systems and components which prevent anticipated Operational Occurrences from leading to Accident Conditions;

(3) those features which are provided to mitigate the consequences of malfunction or failure of structures, systems or components.

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5 The terms Siting, Construction, Commissioning, Operation and Decommissioning are used to delineate the five major stages of the authorisation process. Several of the stages may coexist e.g. Construction and Commissioning, or Commissioning and Operation.

6 This includes successive barriers set up against release of radioactivity from nuclear facilities.

License

A type of regulatory consent, granted by the Regulatory Body for all sources, practices and uses for nuclear facilities involving nuclear fuel cycle and certain categories of radiation facilities. It also means authority given by the Regulatory Body to a person to operate the above (see Licensed Person and Licensed Position).

Licensed Person

A person who has been licensed to hold certain Licensed Position of a NPP after due authorised procedure of certification by the AERB.

Licensed Position

A position, which can be held only by persons certified by AERB or a body, designated by it. e.g. Shift Charge Engineer, Assistant Shift Charge Engineer, Control Engineer, Assistant Shift Charge Engineer (Fuel Handling Unit) and Control Engineer (Fuel Handling Unit).

Normal Operation

Operation of a plant or equipment within specified operational limits and conditions. In case of nuclear power plant this includes, start-up, power operation, shutting down, shutdown state, maintenance, testing and refuelling.

Nuclear Power Plant

A neutron reactor or reactors together with all structures, systems and components necessary for safety and for the production of power, i.e., electricity.

Nuclear Safety

Protection of all persons from undue radiological hazard.

Operation

All activities following commissioning and before decommissioning performed to achieve, in a safe manner, the purpose for which an installation was constructed, including maintenance.

Operating Organisation[7]

The organisation so designated by responsible organisation and authorised by Regulatory Body to operate the facility.

Operating Personnel

Those members of Site Personnel who are involved in the operation of the NPP.

Operational Limits and Conditions (OLC)

Limits on plant parameters and a set of rules on the functional capability and the performance level of equipment and personnel, approved by Regulatory Body, for safe operation of the facility. (See also Technical Specifications)

Operational States

The states defined under Normal Operation and Anticipated Operational Occurrences.

Periodic Safety Review

A systematic safety assessment of an operational Nuclear Power Plant carried out at regular intervals to deal with the cumulative effects of plant ageing, modifications, operating experience and technical developments and aimed at ensuring a high level of safety throughout plant service life.

Plant Management

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

Prescribed Limits

Limits established or accepted by Regulatory Body for specific activities or circumstances that must not be exceeded.

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7 Organisation structure and not individual names.

Protection System

A part of Safety Critical System which encompasses all those electrical, mechanical devices and circuitry, from and including the sensors up to the input terminals of the safety actuation system and the safety support features, involved in generating the signals associated with the safety tasks.

Qualified Person

A person, who having complied with specific requirement and met certain conditions, has been officially designated to discharge specific duties and responsibilities. [For example, Reactor Physicist, Station Chemist, and Maintenance Person of Nuclear Power Plants are qualified persons].

Quality Assurance

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

Records

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

Regulatory Body

See 'Atomic Energy Regulatory Board (AERB)'.

Regulatory Consent

A written permission issued by the Regulatory Body to perform the specified activities related to the facility. The types of consent are 'License', 'Authorisation', 'Registration', and 'Approval' and will apply depending upon the category of the facility, the particular activity and radiation sources involved.

Reliability

It is the probability that a structure, system, component or facility will perform its intended (specified) function satisfactorily for a specified period under specified conditions.

Responsible Organisation[8]

The organisation having overall responsibility for siting, design, construction, commissioning, operation and decommissioning of a facility.

Safety

See Nuclear Safety.

Safety Actuation System

A part of the Safety Critical System which encompasses all equipment required to accomplish the required safety action when initiated by the protection system.

Safety-Related Systems

Those systems important to safety which are not included in Safety Critical Systems.

Safety Systems (Safety Critical Systems)

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

Safety Support System or Safety System Support Features

Part of Safety Critical Systems which encompass all equipment that provide services such as cooling, lubrication and energy supply (pneumatic or electric) required by the protection system and safety actuation systems.

Severe Accidents

Nuclear Power Plant conditions beyond those of the Design Basis Accidents causing significant core degradation.

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8 In the present context the Nuclear Power Corporation of India Limited (NPCIL) is the Responsible Organisation for Nuclear Power Plants in India.

Site Personnel

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

Specification

A written statement of requirements to be satisfied by a product, a service, a material or process indicating the procedure by means of which it may be determined whether specified requirements are satisfied.

Surveillance[9]

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

Technical Specifications for Operation

A document submitted on behalf of or by the responsible organisation covering operational limits and conditions, surveillance and administrative control requirements for the safe operation of the facility and approved by Regulatory Body.

Testing

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.

Verification

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

9 This includes activities performed to assure that provisions made in the design for safe operation of the NPP continue to exist during life of the plant.

CONTENTS

1. INTRODUCTION

1.1 General

1.1.1 The license for Nuclear Power Plants (NPPs) is issued by the Regulatory Body after satisfactory commissioning of NPP. During the process of this licensing all aspects important to safety are assessed at various stages such as siting, design, construction, commissioning and operation. Preliminary assessment of feasibility of decommissioning of the plant at the end of its design life is also considered during this process.

1.1.2 After completion of the safety review, the license for the nuclear power plant is issued for its design life which typically is in the range of 30 to 40 years. Within the operating license, the Regulatory Body grants initial authorisation for a specified period and renewal of authorisation for further specified periods after assessment of Periodic Safety Reviews (PSR).[1]

1.1.3 During operation, multi-tier approach[2] is adopted for assessment of various operational safety aspects such as adherence to technical specifications for operation, review of plant performance, abnormal occurrences, radioactive releases to the environment, radiation exposures, effluent management, technical and procedural modifications, industrial safety, etc.

1.1.4 For renewal of authorisation, comprehensive safety review of plants is required considering the cumulative effects of plant ageing and irradiation damage, results of in-service inspection (ISI), system modifications, operational feedback, status and performance of safety systems and safety support systems, revisions in applicable safety standards, technical developments, manpower training, radiological protection practices, plant management structure etc. This process of safety review for renewal of authorisation is to be carried out several times periodically during the design life of the NPPs. These comprehensive safety reviews termed as Periodic Safety Reviews (PSR) are intended to further ensure a high level

1 For KAPS authorisation is given for 5 years

2 Currently this approach involves review at 3 levels viz. Station Operation Review Committee (SORC), Unit Safety Committee and Safety Review Committee for Operating Plants (SARCOP)

of safety throughout the service life of the plant. It should be noted that certain specific aspects of PSR may have been covered under 'multi-tier' review as given in section 1.1.3 and are valid. These aspects need not be repeated. While preparing PSR, aspects covered under section 1.1.3 should be integrated in the report.

1.2 Objective

1.2.1 The objective of this Safety Guide is to provide the methodology and guidelines on the periodic renewal of authorisation of operational Nuclear Power Plants by conducting PSRs and submitting the same to the Regulatory Body.

1.3 Scope

1.3.1 This Safety Guide covers the essential requirements to be fulfilled for renewal of authorisation of Operating NPPs.

1.3.2 This Safety Guide supplements provisions of the code of practice for Safety in Operation of NPPs, AERB/SC/O.

1.3.3 While written specifically for renewal of authorisation, this guide can be used as part of special reviews carried out in response to major event of safety significance or for re-licensing beyond design life. This guide, however, does not cover details of all aspects required to be reviewed for extension of plant operation beyond the design life.

2. PERIODIC SAFETY REVIEW(PSR) FOR RENEWAL OF AUTHORISATION

2.1 Objective

The objective of Periodic Safety Review (PSR) is an assessment of safety during operation of a NPP for the period under review and to assure that:

(a) The NPP as a whole (including associated systems and facilities) continues to be capable of safe operation at power levels authorised for the plant within the operational limits and conditions specified in " Technical Specifications for Operation" for a designated period. The review also includes radiological protection, emergency planning, environmental impact and organisational aspects.

(b) All structures, systems and components important to safety of the NPP, have not shown undue signs of deterioration and are capable of reliably performing their intended design functions.

(c) The plant is safe as judged by current safety standards and practices and adequate arrangements are in place to maintain safety. This judgement in terms of current safety requirements does not imply that all requirements are to be met in terms of system hardware, but requires that the plant, as a whole, including the operator response and administrative controls, satisfies current safety requirements.

(d) The management of NPP is alive to safety related problems and the management systems established at the NPP provide prompt response for taking effective measures to resolve the safety related problems.

(e) The NPP has operated in a safe manner during the reporting period and continued operation of the NPP till the next periodic review and renewal of authorisation would not pose undue risk to the plant, plant personnel, public and the environment based on the review of its operation during the assessment period.

2.2 Rationale of PSR

During the period specified in the authorisation, the operational nuclear power plant undergoes routine and special safety reviews, which may have specified scope. PSR however should be more comprehensive and take

into account improvements in safety standards and operating practices, cumulative effects of plant ageing, modifications, feedback of operating experience, and development in science and technology. Therefore it is considered that periodic safety review of safety related aspects for operating NPPs would be appropriate to obtain assurance on safety of plants during their design life span. Such periodic reviews may bring out weaknesses, if any, especially in the older Nuclear Power Plants. Based on findings of PSRs, suitable changes/modifications may have to be incorporated to improve and maintain the required safety level of operating NPPs.

2.3 Schedule for Renewal of Authorisation

2.3.1 The initial authorisation for operation of the NPP at rated power is granted for a specified period, which may range from five to ten years. For a prototype plant where basic changes in design of reactor systems, or power rating have been made, (e.g. NAPS-1, PFBR or 1st unit of 500 MW PHWR), the first authorisation period may be specified for a shorter duration whereas for other cases and for subsequent renewal of authorisation, the period may be for a longer duration (see section 5).

2.3.2 The PSR should be undertaken for every renewal of authorisation, unless there are special grounds for conducting such reviews earlier. Preparation for submission of report on PSR should be initiated sufficiently in advance prior to the end of current authorisation period. PSR should cover a period starting from the end of the period covered in the last PSR (or from the date of initial authorisation in the case of first PSR).

2.3.3 To ensure that sufficient time is available for review and assessment by AERB, PSR documents should be submitted at least six months prior to expiry of current authorisation. Based on the review, if found satisfactory, the authorisation for operation with specific validity period, will be issued. However, in case some of the factors are not found to be totally satisfactory, needing further action, interim authorisation for operation for a shorter duration with stipulations may be considered.

3. SAFETY FACTORS IN PERIODIC SAFETY REVIEW

3.1 General

3.1.1 A comprehensive assessment of plant safety is a complex task and is facilitated by dividing it into a number of factors having bearing on plant safety. They are termed as safety factors in this document. The safety factors considered in the conduct of PSR include:

1. Actual physical condition of nuclear power plant,
2. Safety analysis,
3. Equipment qualification,
4. Management of ageing,
5. Safety performance,
6. Use of experience from other nuclear plants and of research findings,
7. Procedures,
8. Organisation and administration,
9. Human factors,
10. Emergency planning,
11. Environmental impact.

3.1.2 The safety factors listed above should be considered for a comprehensive review of plant safety. All these safety factors are important for operational safety and to a greater or lesser extent for accident prevention and mitigation.

3.1.3 Quality Assurance (QA) is not considered as a separate safety factor because it should be an integral part of every activity affecting safety. It is assessed in its own right as an aspect of organisation and administration. Similarly, radiological protection is not regarded as a separate safety factor since it is related to most factors. The arrangements for radiological protection and their effectiveness should be reviewed as specific aspects of safety performance, procedures and actual physical condition of the NPP.

3.1.4 The review should determine the status of each factor at the time of PSR and whether the established operating regime is capable of identifying, preventing or mitigating potential failures before they could cause a radiological incident or become a threat to a safety barrier. Age-related degradation mechanisms, which could lead to failures of key NPP structures, systems or components and could potentially limit the plant life, should be identified to the extent possible.

3.1.5 Though PSR should demonstrate compliance with current safety standards and practices for each safety factor, the level of plant safety is determined by the combined effect of all safety factors. Necessary and worthwhile corrective actions are determined and implemented. Shortcomings may be individually acceptable, but their combined effect should be reviewed for acceptability.

3.1.6 The eleven safety factors considered in PSR are explained in the following subsections. Some of the elements of review for each safety factor are identified. These elements describe specific topics or activities within the safety factor, which should be reviewed. The elements listed may not cover all topics or activities associated with the safety factor and therefore addressing all of them does not necessarily mean that the particular safety factor is fully covered. The objective, description and major elements of review for each safety factor are given in the following sections.

3.1.7 Wherever the need be, the review should be carried out with the help of appropriately qualified specialists. The organisation may involve external consultants to examine specific elements for an objective review.

3.2 Review Aspects of Safety Factors

3.2.1 Actual Physical Condition of the Nuclear Power Plant

3.2.1.1 Objective

The objective is to assess and determine the actual physical condition of the NPP.

3.2.1.2 Description

(i) With time certain structures, systems and components of power plants might have undergone some changes and some deterioration might have taken place in them due to ageing. Hence it is necessary to determine the actual physical condition of the structures, systems and various components of plants. Status records, as far as possible, in respect of inspection, modifications, developments and maintenance should be checked and updated for review.

(ii) The current record-keeping methods and methodology to determine plant status, even though not available at earlier dates, should be utilised to generate and derive data through special tests or inspection. Proper procedure should be set up to validate existing records to ensure that they accurately represent the status of the plant.

(iii) In case, in certain areas, the actual physical condition of the plant is not possible to be determined due to plant layout or certain operating conditions, such areas should be highlighted and safety significance considered.

3.2.1.3 Major Elements of Review

These should include:

(a) plant performance factors (capacity factor, availability factor etc),

(b) modification to plant layout, structure, system and components,

(c) the in-service inspection report of the structure, system and components,

(d) record of maintenance including condition monitoring on items important to safety,

(e) findings of tests which validate the functional capability of items important to safety,

(f) record of the test and inspection reports indicating the present physical condition of systems, structures and components,

(g) development around off-site characteristics of the plant such as population growth, industrial development and transportation arrangements like road, rail, airports etc,

(h) support facilities available to the plant both on and off the site, including maintenance and repair shops, and

(i) availability of critical spare parts and maintainability.

3.2.2 Safety Analysis

3.2.2.1 Objective

The objective of the review is to check the extent of validity of the existing safety analysis taking into account the actual plant status, expected degradation till the next renewal of authorisation or the end of predicted life and current analytical methods, safety standards and knowledge.

3.2.2.2 Description

(i) The safety analysis shall be reviewed for each system important to safety for its initiating event to confirm the design basis of the system. In addition, the overall safety analysis of the plant shall be reviewed and updated as required for all design basis events to ensure that the plant does not pose any undue hazard to the surroundings.

(ii) During review, it should be ensured that the actual state of the plant, including modifications, is considered. In addition, the completeness of the list of postulated initiating events shall be checked. Current analytical methods including computer codes should be used wherever re-analysis is required. All calculations shall be plant and site-specific. Any shared safety and safety related systems in multi-unit station shall be carefully assessed.

(iii) For accidents having off-site impact, the site characteristics should be reviewed, along with land usage and off-site population growth. The impact of external hazards (fire, floods, earthquakes, explosions, aircraft crashes, etc.) on overall safety should be considered where necessary in both deterministic and probabilistic analyses.

(iv) Although not mandatory for renewal of authorisation, it is recommended that Probabilistic Safety Assessment (PSA) methods are used in review process. A level-1 PSA is adequate to assess the probability of accidents leading to core damage and for identifying

the dominant contributors. Typical applications may include quantification of improvement in safety as a result of modifications/ back-fitting, identification of weaknesses in design, estimation of the probability of faults that might lead to accidents and the probability of failures of safety systems. As a minimum, reliability of safety related systems should be assessed based on plant component failure data.

(v) Accepted rules for analysing operator action, common cause failures, redundancy, diversity, separation, etc. should be used. All input data as far as possible should be based on plant operation.

3.2.2.3 Major Elements of Review

These should include:

(a) compilation of the existing safety analysis and assumptions thereof,

(b) review safety analysis of systems, structures and components important to safety,

(c) limits and permitted operational states (considering ageing, modifications, new findings, etc.),

(d) the postulated initiating events for the existing safety analyses and a comparable list for the latest licensed plant,

(e) analytical methods and computer codes used in existing safety analysis and a comparable list for a modern nuclear power plant, including validation,

(f) radiation dose and release limits for accident condition,

(g) acceptance criteria for the safety analysis of critical safety systems,

(h) site characteristics, particularly flood and seismic, which may pose a hazard,

(i) local meteorological conditions, and

(j) off-site population distribution.

3.2.3 Equipment Qualification

3.2.3.1 Objective

The objective of the review is to determine whether equipment and components important to safety are qualified to perform their designated safety functions throughout their installed/service life.

3.2.3.2 Description

(i) All equipment important to safety should be properly qualified to ensure their capability to perform intended safety functions under postulated service conditions including those arising from natural events and accidents (e.g. floods, earthquake, loss of coolant accident, steam line breaks/leaks etc.). The Equipment Qualification (EQ) requirements/specifications should be based on applicable regulatory guides and codes, national/international or the utility standards (e.g. NPC specifications) as acceptable to AERB.

(ii) Qualification of nuclear power plant equipment important to safety should be achieved through a process that includes generating, documenting and maintaining evidence that equipment can perform its safety functions during its installed life.

(iii) EQ is an ongoing process from plant design to the end of service life and takes into account plant ageing, modifications, repair and refurbishment, equipment failures and replacement and any abnormal operating condition etc. At any stage, EQ is achieved through a process of generating test data to assure that the equipment can perform its safety function throughout and documenting the same.

(iv) The review of EQ should determine: (a) whether assurance of the required equipment performance capability was initially provided and (b) whether equipment performance has been preserved by ongoing application of measures such as scheduled maintenance, testing and calibration. It should be noted that a review relating to (a) may not be necessary if a previous review has concluded that adequate initial EQ was established; and a review relating to (b) should provide assurance that EQ will be satisfactorily preserved in future.

3.2.3.3 Major Elements of Review

These should include :

(a) list of equipment covered in the EQ programme and control procedures used in qualification of this equipment,

(b) qualification/test reports and applicable specifications,

(c) verification that the installed equipment meet the specified requirement,

(d) procedures to maintain qualification during the installed life of the equipment and mechanisms for assuring compliance with procedures,

(e) surveillance programme and the feedback procedure to ensure that ageing degradation remain within acceptable limits,

(f) review of environmental and operating conditions vis-a-vis originally specified conditions and protection of qualified equipment from adverse environmental conditions,

(g) analysis of the effect of equipment failures on EQ and appropriate corrective actions to maintain EQ, and

(h) documentation generated towards qualification measures taken during the installed life of the equipment.

The following additional points may also be considered:

- Residual life estimation programme,
- Re-qualification of components for accident conditions after normal ageing in the plant,
- Comparison of EQ requirements of the plant with current requirements of qualification, and
- Implementation status of the ISI programme.

3.2.4 Management of Ageing

3.2.4.1 Objective

The objective of the review is to determine whether ageing is being effectively managed so that required safety margins be maintained and whether an adequate ageing management programme is in place for future operation of the plant.

3.2.4.2 Description

(i) All structures, systems and components (SSCs) are susceptible to ageing which could eventually lead to impairment in their safety function. The rate of ageing depends on the type of material, environmental and operating stresses including effects of operational transients. It is important to understand, monitor and control/mitigate the ageing of all materials and components which could impair their safety functions.

(ii) Managing the ageing of SSCs means predicting and/or detecting the degradation of a plant component to the point wherein safety margins are eroded to unacceptable levels and taking appropriate corrective or mitigating actions. It is essential that the plant has an established, systematic and effective ageing management programme comprising such relevant activities as surveillance, in-service inspection (ISI) condition monitoring, maintenance, testing of surveillance coupons and surveillance samples (if applicable), chemistry control and feedback of operating experience required to establish adequate safety margin for SSCs important to safety throughout the service life. The plant should have an ongoing assessment of the effectiveness of ageing management programme and a feedback mechanism for its improvement.

(iii) The review of management of ageing should determine whether a systematic and effective ageing management programme is in place, and whether there are adequate arrangements to maintain required safety margins during future plant operation. Both programming aspects (e.g. programme policy, procedures, performance indicators, staffing resources, record keeping, etc.) and technical aspects

(e.g. ageing management methodology, the extent of understanding of relevant ageing phenomena, SSC-specific acceptance criteria, ageing detection and mitigation methods, and actual physical condition of SSCs) of ageing management should be evaluated.

3.2.4.3 Major Elements of Review

These should include:

(a) list of structures, systems and components covered in the ageing management programme and criteria for selection,

(b) extent of understanding of dominant ageing mechanisms for SSCs and their impact on safety functions,

(c) identification of relevant ageing indicators in respect of each component and a programme for timely detection and mitigation of the ageing effects,

(d) acceptance criteria and required safety margins,

(e) analysis of operating experience to identify age related degradation,

(f) awareness of physical condition of SSCs including actual safety margins, and

(g) failure data of components.

3.2.5 Safety Performance

3.2.5.1 Objective

The objective of the review is to determine safety performance of the NPP and its trend from records of operating experience.

3.2.5.2 Description

(i) Safety Performance is usually determined from assessments of operating experience which includes Safety Related Unusual Occurrence Reports (SRUORs), safety system unavailability records, radiation dose data, generation of radioactive wastes and discharge of radioactive effluents.

(ii) Proper records of all safety related incidents and their safety significance should be maintained. Criteria as given in NPP technical specification for operation could be used for identifying an incident as safety related. Root Cause Analysis and International Nuclear Event Scale (INES) could be used to evaluate the safety significance of various safety-related incidents. In addition, records of plant operation, maintenance, testing, inspection and modifications should be regularly evaluated to identify unsafe situations or trends.

(iii) Evaluation results should be suitably summarised to give an overall assessment of safety performance during each year of plant operation. A PSR should review all relevant indicators of safety performance including the results of internal periodic safety assessment and subject them to trend analysis to highlight potential safety problems if any.

(iv) Analysis of radiation dose and radioactive effluent data provides important information on radiation risk to plant personnel and environment. Man-rem consumption, radioactive effluent release/ discharge limits and other performance indicators could be used for assessment of safety performance. Records of radiation doses and radioactive effluents should be reviewed to determine whether these are within prescribed limits, as low as reasonably achievable and adequately managed. In addition, data on generation of radioactive wastes should be reviewed as such wastes contribute to radiation burden on long term basis.

(v) Industrial safety issues should be reviewed by the industrial safety unit of the operating organisation and reported to the regulatory authority. These issues should be reviewed for meeting the intents of current industrial safety standards in addition to Atomic Energy (Factories) Rules, 1996.

3.2.5.3 Major Elements of Review

These should include:

(a) investigation and classification of safety related incidents,

(b) root cause analysis of safety related incidents including deviations from technical specifications and implementation of recommendations arising out of these analyses,

(c) trend analysis of safety related data,

(d) basis for selecting and recording safety related operational data, including those for maintenance, test and inspection,

(e) feedback of safety related operational data into the operating regime,

(f) analysis for safety performance indicators such as :

- the number of unplanned trips per 7000 h of reactor criticality,
- frequency of selected safety system actuation/demands,
- frequency of safety system failures,
- safety system unavailability,
- collective radiation dose per year,
- failure cause trends (operator errors, equipment failure, plant problems, administration, control problems),
- the backlog of outstanding maintenance,
- the extent of repeat maintenance,
- the extent of corrective (breakdown) maintenance,
- the rate of generation of nuclear waste,
- the quantities of stored nuclear waste,
- the frequency of unplanned operator actions in the interests of safety,

(g) records of exposure to persons on site and also exposure to persons in excess of prescribed level,

(h) records of off-site radiation monitoring data,

(i) collective radiation dose during the review period,

(j) implementation status of regulatory recommendations/safety issues, and

(k) records of the quantities of radioactive effluents.

3.2.6 Use of Operating Experience from other Nuclear Power Plants and of Research Findings

3.2.6.1 Objective

The objective of the review is to determine whether an adequate mechanism regarding feedback of safety experience from other NPPs and the findings of research exists at the NPP.

3.2.6.2 Description

(i) Feedback from other nuclear power plants, and sometimes from non-nuclear plants, together with research findings can reveal unknown safety weaknesses or help in the solution of existing problems. In order to ensure this, a method for receiving and assessing the feedback information from various sources[3] should exist at NPP. PSR should review the adequacy of these arrangements and timely implementation of assessment findings.

(ii) Based on these sources, it may be better to have assessment of generic issues applicable to several plants than specific reviews of this factor in PSR for each plant. PSRs would then be limited for this safety factor to reviewing the implementation of site specific requirements from the generic reviews.

3.2.6.3 Major Elements of Review

These should include:

(a) arrangements for feedback of experience relevant to safety from other NPPs,

(b) feedback of experience from other relevant non-nuclear plants whenever feasible,

(c) assessments of and actions on the above experience,

(d) arrangements for receipt of information on the findings of relevant research programmes,

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3 Various sources include COG, WANO, IAEA etc.

(e) assessments of and actions on research information, and

(f) plant modifications resulting from the above.

3.2.7 Procedures

3.2.7.1 Objective

The objective of the review is to determine whether procedures for operation, maintenance, modifications, inspection and testing are of adequate standard and are complied with.

3.2.7.2 Description

(i) Procedures should be comprehensive, unambiguous and formally approved by the designated authority. The procedures should agree with the assumptions, data and findings of the safety report, results of commissioning tests and operating experience.

(ii) Procedures and drawings should be promptly modified based on changes/improvements carried out in the plant design and forwarded to the relevant people. It is necessary that the safety related procedures are reviewed periodically, at least once in five years, even though no change has been incorporated in the plant design. The plant personnel should be trained in use and content of the procedures as a part of their training programme. All O & M jobs should be carried out as per approved procedures.

3.2.7.3 Major Elements of Review

These should include:

(a) availability of updated and approved operating procedures for normal and off- normal conditions (including accident conditions and post accident conditions),

(b) availability of updated and approved maintenance, test, inspection, radiation protection, and work permit procedures,

(c) control procedures for modifications of plant design, procedures and hardware,

(d) arrangements for regular review and maintenance of these procedures,

(e) compliance of these procedures with assumptions and findings of the safety analysis, plant design and operating experience, and

(f) clarity of procedures for ease of understanding and implementation.

3.2.8 Organisation and Administration

3.2.8.1 Objective

The objective of the review is to determine whether the organisation and administration is adequate for safe operation of the NPP and responsive to concerns of the regulatory body as well as the public.

3.2.8.2 Description

(i) Organisation and administration together with human factors play a significant role in ensuring safety culture at the NPP. The review should examine the organisation and administration to ensure that they comply with the requirements of all aspects of management of NPPs for safe operation (refer AERB/SG/O-9).

(ii) Various aspects of review under this safety factor should include management, configuration control, technical support, training, quality assurance, records and compliance with regulatory and other statutory requirements. The organisation should be live to the developments in technology in the field of NPP operation.

(iii) For an objective review and to eliminate subjectivity, it is desirable to associate specialists from outside plant management having appreciation of nuclear safety while reviewing this safety factor.

3.2.8.3 Major Elements of Review

These should include:

(a) document delineating roles and responsibilities of individuals and groups, delegation of powers,

(b) feedback of experience relating to organisational and management functions,

(c) mechanisms for configuration management,

(d) formal arrangements for utilising external technical, maintenance or other specialist staff,

(e) staff training facilities and programmes,

(f) quality assurance programme and regular QA audits involving independent assessors,

(g) availability of readily retrievable comprehensive records on base line information, operations and maintenance,

(h) public concerns in operational safety raised at various fora like court, media etc, and

(i) implementation of the policy that safety takes precedence over production.

3.2.9 Human Factors

3.2.9.1 Objective

The objective of this review is to determine the status of various human factors, essential for safe operation of NPP.

3.2.9.2 Description

(a) Human factors influence all aspects of safety of an operational NPP. They are significant elements of the plant safety culture.

(b) Reviews should examine the status of human factors so that these factors do not present unacceptable contribution to risk. The review should include staffing, selection and training, personnel related issues, the man-machine interface etc (refer AERB/SG/O-1).

3.2.9.3 Major Elements of Review

These should include:

(a) staffing levels for the operation of the NPP recognising absences, shift working and overtime restrictions,

(b) availability of qualified staff on duty at all times,

(c) appropriate selection and licensing methods, which evaluate aptitude, knowledge and skills,

(d) programme for initial, refresher and upgrade training, including the use of simulators,

(e) training in safety culture, particularly for management staff,

(f) mechanism for feedback of operating experience especially for human performance failures,

(g) mechanisms for contributing to fitness/ health of staff such as through provisions of medical check-ups, through avoidance of situations of overwork, stress and fatigue,

(h) competence requirements for operating, maintenance, technical and managerial staff,

(i) man-machine interface, control room and other workstation design, analysis of human information requirements and task workload, and

(j) miscellaneous personnel issues which may affect human performance.

3.2.10 Emergency Planning

3.2.10.1 Objective

The objective of this review is to determine that the operating organisation have adequate plans, staff, facilities and preparedness to deal with emergencies in coordination with local authorities.

3.2.10.2 Description

(i) The design and operation of a NPP should normally prevent release of radioactive substances that could affect the health of site personnel or the public. However, to mitigate the effects of such a release, emergency planning is an essential requirement. The review should ensure that emergency planning at the plant continues to be satisfactory.

(ii) Emergency plan should be prepared/updated and maintained in accordance with current safety analysis and accident mitigation studies taking into account facilities and equipment available with plant management and local authorities.

(iii) Emergency exercises should demonstrate effectiveness of the emergency planning and should identify possible shortcomings in the functioning of on-site and off- site staff, the required functional capability of equipment and the adequacy of the planning.

(iv) during review of on-site and off-site emergency response preparedness, the report from DAE committee on the adequacy of the off-site emergency preparedness and the observation of the AERB observers on the various exercises should also be considered.

3.2.10.3 Major Elements of Review

These should include:

(a) accident mitigation,

(b) strategy and organisation for emergency response,

(c) plans and procedures for emergency response,

(d) on-site equipment and facilities for emergencies and response,

(e) on-site and off-site emergency centres,

(f) transport and communications,

(g) emergency training exercises and experience,

(h) interactions of relevant organization such as the regulatory body, police, fire department, hospitals, ambulance services, local authorities, public welfare authorities and the information media,

(i) arrangements for regular reviews of emergency plans and procedures,

(j) security arrangements for emergencies,

(k) local population distribution, and

(l) local shelters.

3.2.11 Environmental Impact

3.2.11.1Objective

The objective of the review is to determine whether there is an adequate

programme for surveillance and assessment of environmental impact of the NPP.

3.2.11.2 Description

(i) There should be an established and effective surveillance programme that provides radiological data on the surroundings of the plant site.[4] Examples of such data are the concentration of radionuclides in air, water (river, sea, and ground), soil, agricultural products and animals,

(ii) Periodically collected data from the plant surrounding should be compared with the values measured before the NPP was put into operation. The review should examine whether the programme is appropriate and sufficiently comprehensive to check all relevant environmental aspects. Any significant deviation in concentration values than expected values and probable reasons thereof are to be clearly established.

(iii) The radiological impact of the plant on the environment should not be significant compared to that due to naturally occurring sources of radiation.

3.2.11.3 Major Elements of Review

These should include:

(a) records of effluent releases in comparison with permissible limits,

(b) off-site monitoring for contamination and radiation levels,

(c) alarm systems to respond to unplanned effluent releases from on-site facilities,

(d) documentation of environmental data, and

(e) changes in use of land areas around the site.

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4 Presently, the environmental data are collected and analysed by a group reporting to Health Physics Division, BARC.

4. ROLES AND RESPONSIBILITIES

4.1 The responsibility for obtaining renewal of authorisation from AERB for operation of NPP rests with the operating organisation/plant management.

4.2 The Operating Organisation should carry out Periodic Safety Review, as mentioned in Section 3, and submit its report to AERB along with the application for renewal of authorisation as per the schedule given in Section 2. All significant findings should be reported to AERB as they are revealed during the conduct of PSR. AERB will issue renewal of authorisation if the PSR is found satisfactory after appropriate review (refer AERB/SG/G-1 & G-7).

4.3 External assistance from outside the Operating Organisation may be used in certain circumstances where unavailability of sufficient in-house resources or expertise is recognised.

4.4 Certain parts of periodic safety review may have to be carried out by external consultants. An example of this is the review of the organisation, administration and human factors. Such a review can be carried out in a more objective manner by a group, which is independent of the organisation itself.

4.5 AERB may specify and intimate any additional requirements in the light of recent operational experience and safety practices. This may be verified with AERB before initiating a PSR.

5. REVIEW PROCEDURE

5.1 General

5.1.1 A basic procedure for implementing the strategy described in Section 3, which is applicable to all safety factors, is shown in Fig.1. It consists of three major steps: assessment of current plant safety status, interim safety review and an in-depth safety review. The individual steps are further illustrated in Figs. 2, 3 and 4 and are described in the following paragraphs.

5.1.2 Normally the review will cover all factors identified in Section 3. However, if sufficient justification exists, some of the elements could be excluded. Examples of such justifications may be:

(i) the element/issue has already been reviewed with AERB in sufficient depth within the previous three years and there has been no significant change in the applicable safety standards and practices relevant to this issue during this period; and

(ii) the issue has been reviewed with AERB for another similar plant within the previous three years and its conclusions are applicable to the current plant and there has been no significant change in the applicable safety standards and practices relevant to this issue.

However, if any of the issues is to be excluded from the review, the Operating Organisation should obtain prior agreement from AERB.

5.1.3 As mentioned before, the review is to be done against current standards and practices. For this purpose, the standard of comparison will be AERB codes and guides and other relevant national standards and practices used for most recent NPP of the relevant type in India. However, the current safety issues and international experience should be considered to ensure that safety concerns are adequately addressed to. Various stipulations made by AERB and its safety committees shall also be used in this respect.

5.2 Step 1: Assessment of Safety of Nuclear Power Plant under Review by Operating Organisation[5]

In step 1, information on each of the safety factors listed in Section 3 is assessed by current methods and a comparison with current safety

5 Where Operating Organisation is not instituted, these functions are the responsibility of the Responsible Organisation or the Plant Management as delegated by the Responsible Organisation.

standards and practices is made (Fig.2). A list of deviations should be prepared, giving areas where current requirements are exceeded and where they are not achieved. All significant shortcomings should be clearly identified. If there are no shortcomings, further review steps are not necessary.

5.3 Step 2A: Interim Safety Review by Operating Organisation

5.3.1 Any information which reveals a shortcoming should be subjected to an immediate safety review (Fig.3 step 2.1). The intent is that this review should be carried out without delay and therefore it should be done using expert judgment rather than detailed analysis. The report on interim safety review should be submitted to the Unit Safety Committee/SARCOP bringing out all identified shortcomings, the remedial actions/measures taken and the outstanding measures yet to be implemented.

5.3.2 In cases where safety significance is high, immediate remedial action should be implemented. If this action is not feasible, interim compensatory measures should be incorporated. If the situation is judged to be not requiring immediate action, the time frame for remedial action should be specified.

5.3.3 If the safety significance is high and no remedial actions (either permanent or interim) are feasible, the operating organisation shall shut down the plant till a satisfactory solution is implemented and shall submit its report to SARCOP accordingly.

5.4 Step 2B: Assessment of Interim Safety Review by AERB

The next step in the interim review is an assessment by Unit Safety Committee/SARCOP of the adequacy of remedial actions and interim measures against current safety standards and practices. Based on this assessment, the Unit Safety Committee/SARCOP may recommend additional reviews or remedial measures. The assessment will also examine the soundness of Operating Organisation's judgement in continuing the operation of the plant and in case of disagreement, the Unit Safety Committee/SARCOP will give their recommendations to AERB in this regard.

5.5 Step 3A: In-Depth Safety Review by Operating Organisation

5.5.1 The findings/decision reached in step 2 should be evaluated by carrying out an in-depth safety review of all shortcomings, associated remedial actions and interim measures together with plant strengths identified in step 1. This in-depth review should use current techniques to the greatest extent possible and should, as appropriate, take due account of insights provided by PSA, if available, and cost-benefit analyses.

5.5.2 Remedial actions and interim measures implemented for each of the shortcomings identified in step 1 are assessed in step 3.1 (Fig. 4) to determine their adequacy.

5.5.3 If the in-depth review shows that for a particular shortcoming the remedial actions and interim measures have reduced its contribution to the risk associated with continued plant operation to an acceptable level, this shortcoming should be included in the list of resolved shortcomings. If, on the other hand, the interim measures are assessed to be inadequate to bring down the risk to an acceptance level, the feasibility of other permanent corrective actions to deal with the shortcoming should be examined (step 3.2). Those corrective actions which are feasible should be implemented. The remaining shortcomings should be included in the list of unresolved shortcomings.

5.5.4 The risk associated with continued operation in the presence of all unresolved shortcomings for all safety factors should be assessed in their totality in step 3.3. This is important because it is possible that each shortcoming when considered in isolation may appear acceptable, but when taken together with others may prove to be unacceptable. This is particularly relevant when considering human and organizational factors. (Safety culture is represented by the combination of many individual factors, any one of which in isolation may appear unimportant).

5.5.5 The final conclusion regarding acceptability of continued operation of NPP should be recorded, bringing out the shortcomings which have been identified, associated remedial actions and the basis for the overall judgement. This judgement should consider the guideline outlined in Section 7. In case the risk of continued operation is considered too high,

this should be brought out for appropriate decision regarding shutting down of the plant till adequate solutions are implemented. This decision will consider the overall perception of risk, cost and the benefits involved in shutting down of the plant.

5.5.6 The report on in-depth safety review will be submitted by the Operating Organisation to the Unit Safety Committee/SARCOP. This submission could be done progressively in installments to facilitate review in AERB.

5.6 Step 3B: Assessment of In-Depth Review by AERB

The assessment will be done by Unit Safety Committee/SARCOP with a view to granting the re-authorization for continued operation of the plant for specified period. Where desirable, assistance may be sought from appropriate agencies having relevant experience. The recommendations of SARCOP shall be submitted to AERB for consideration. The assessment will consider guidelines given in Section 6 of this document.

6. BASIS FOR ACCEPTABILITY OF CONTINUED PLANT OPERATION

6.1 The procedure described in Section 5 above should identify any differences between the safety status of the nuclear power plant and current safety standards and practices. Some differences may actually be strengths because the safety status of the plant on particular issues may be better than currently required. It is also important to note that the procedure does not require that an operating nuclear power plant meets all current requirements but that it is compared with them. It is recognized that some safety features, such as current seismic features, cannot be back fitted easily, and some design aspects such as plant layout, are difficult to modify. For these cases, the procedure requires only that the risk associated with the shortcomings is assessed and that justification for continued operation is provided.

6.2 Differences classified as shortcomings should be assessed and a 'risk' judgement on the acceptability of continued operation, with the shortcomings remaining after all corrective actions are implemented, is required. Aspects involved in this judgement may include:

(a) Compliance with original safety standards:

Unless the original safety standards in relation to specific shortcoming under review were clearly inadequate, continued operation of the plant may be allowed if the unresolved shortcoming does not cause non-compliance with original safety standards.

(b) Remaining period of operation proposed by the Operating Organisation:

If the period is sufficiently short, the risk associated with continued operation with some shortcomings may be judged acceptable during this period, if adequate remedial measures can be in effect.

(c) Use of PSA:

If the results of an adequate PSA are available and the PSA is acceptable to the regulators it may be used as a measure of the risk posed by each of the unresolved shortcomings. PSA information is

clearly helpful, but uncertainties in data and technique do not allow decisions on continued operation to be made on the basis of PSA results alone.

(d) Deterministic consideration of the total effect on the safe plant operation of all unresolved shortcomings and all corrective actions and strengths identified in step 1:

There is no obvious or verified procedure available at present other than a `standback' review and the use of expert judgement.

7. POST-REVIEW ACTIVITIES

7.1 A PSR is complete when all analyses and required corrective actions such as modifications to the plant or procedures have been implemented. When it is not practicable to complete these analyses and modifications within the time frame of the PSR, schedules of outstanding work should be agreed upon between the Operating Organisation and AERB.

7.2 Documentation from PSR should be stored in a suitable manner, which would allow easy retrieval by the Operating Organisation and the AERB.

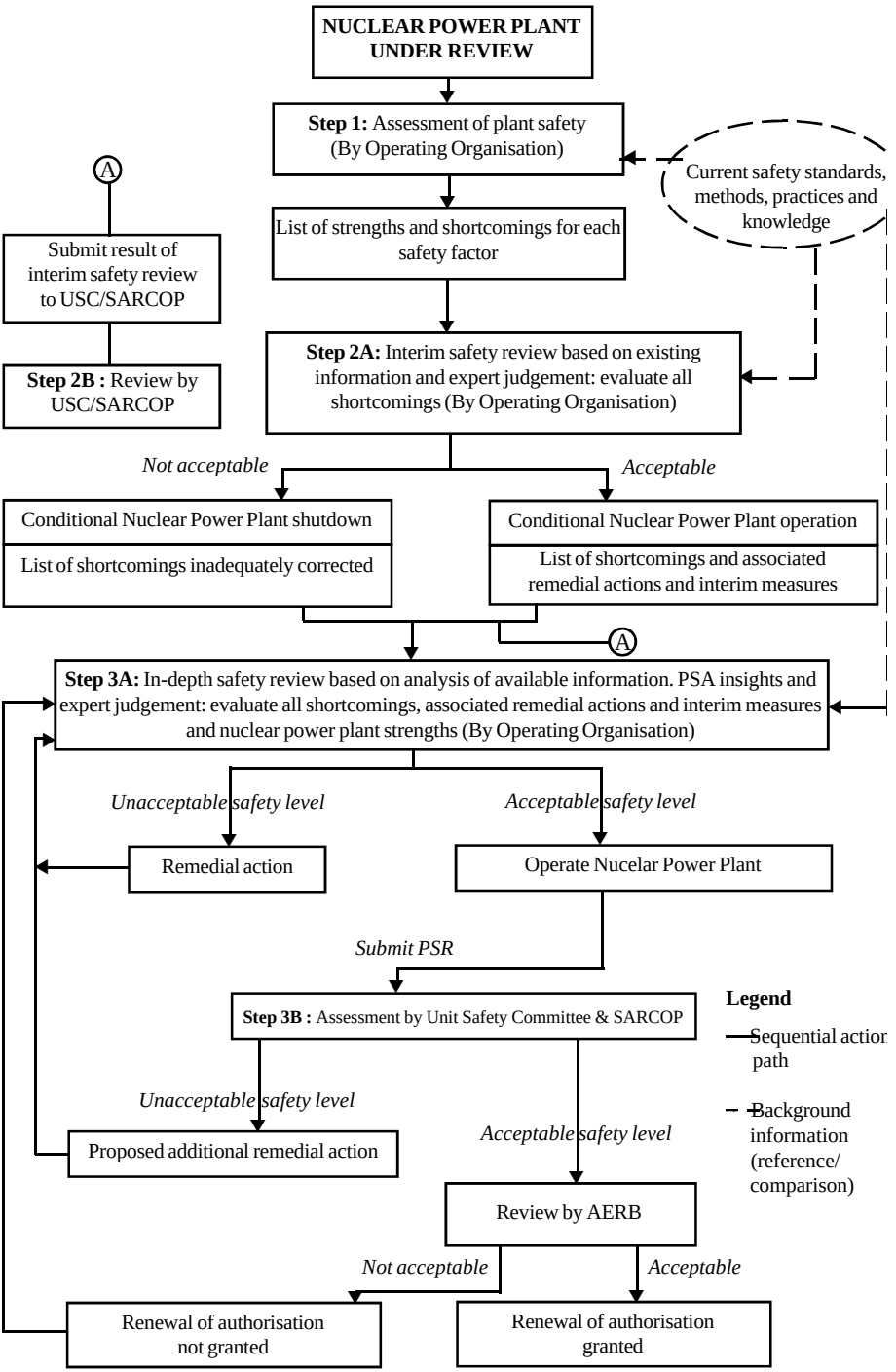

Fig. 1 - PROCEDURE FOR PERIODIC SAFETY REVIEW : FLOW CHART

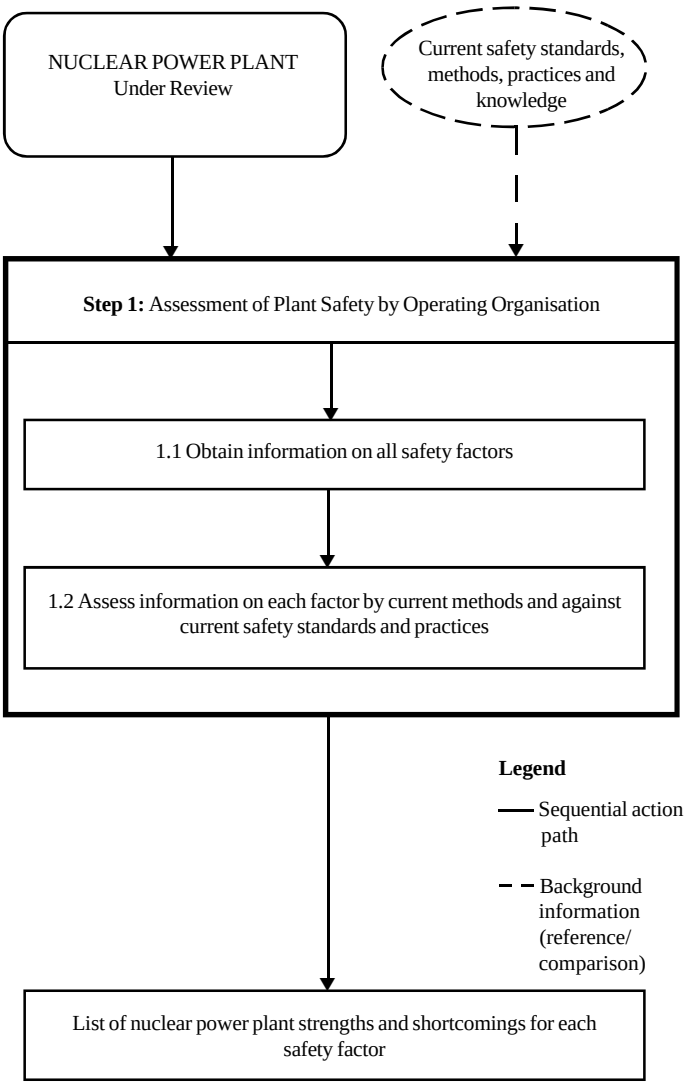

Fig. 2 - STEP 1: ASSESSMENT OF PLANT SAFETY

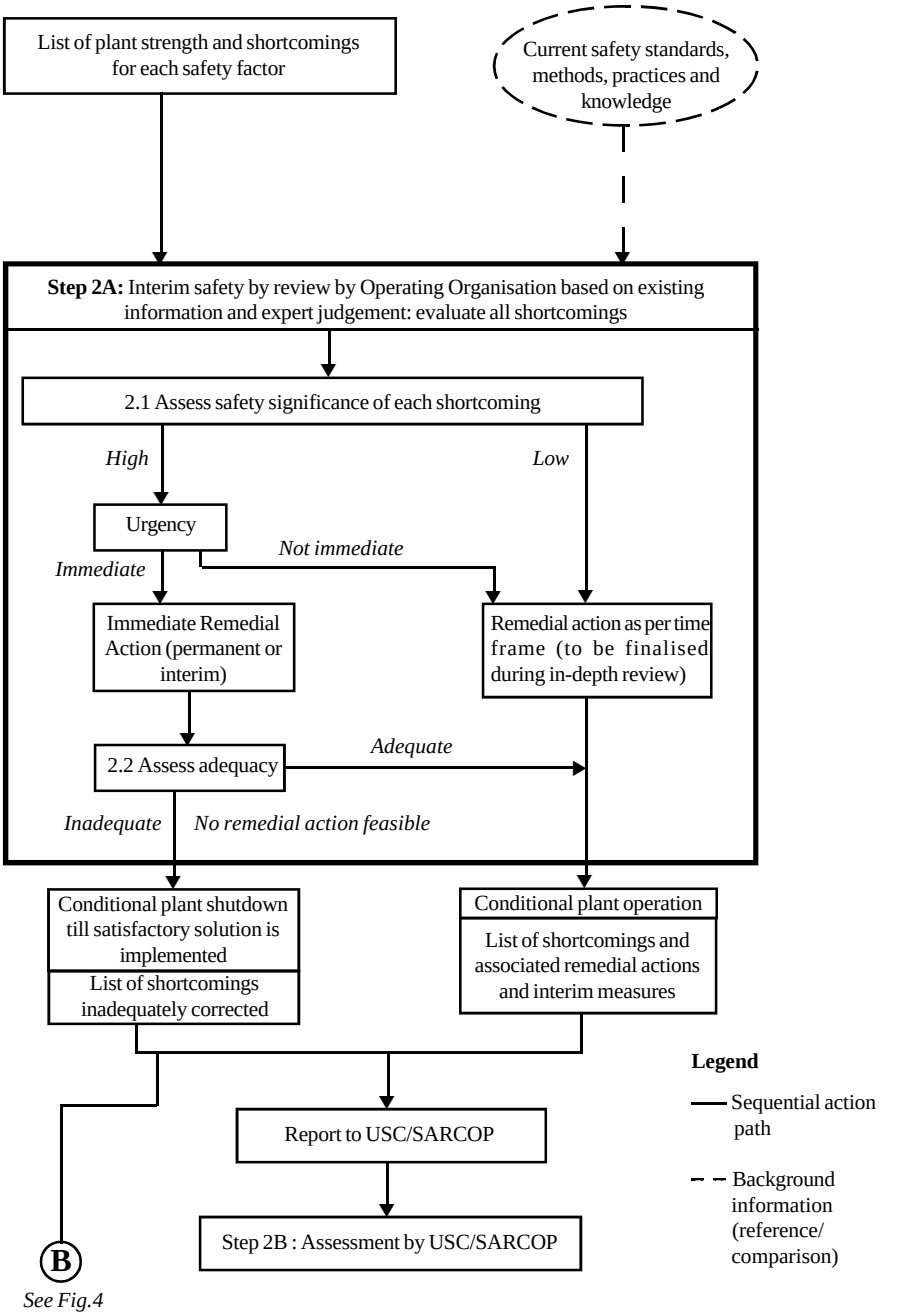

Fig. 3 - STEP 2: INTERIM SAFETY REVIEW

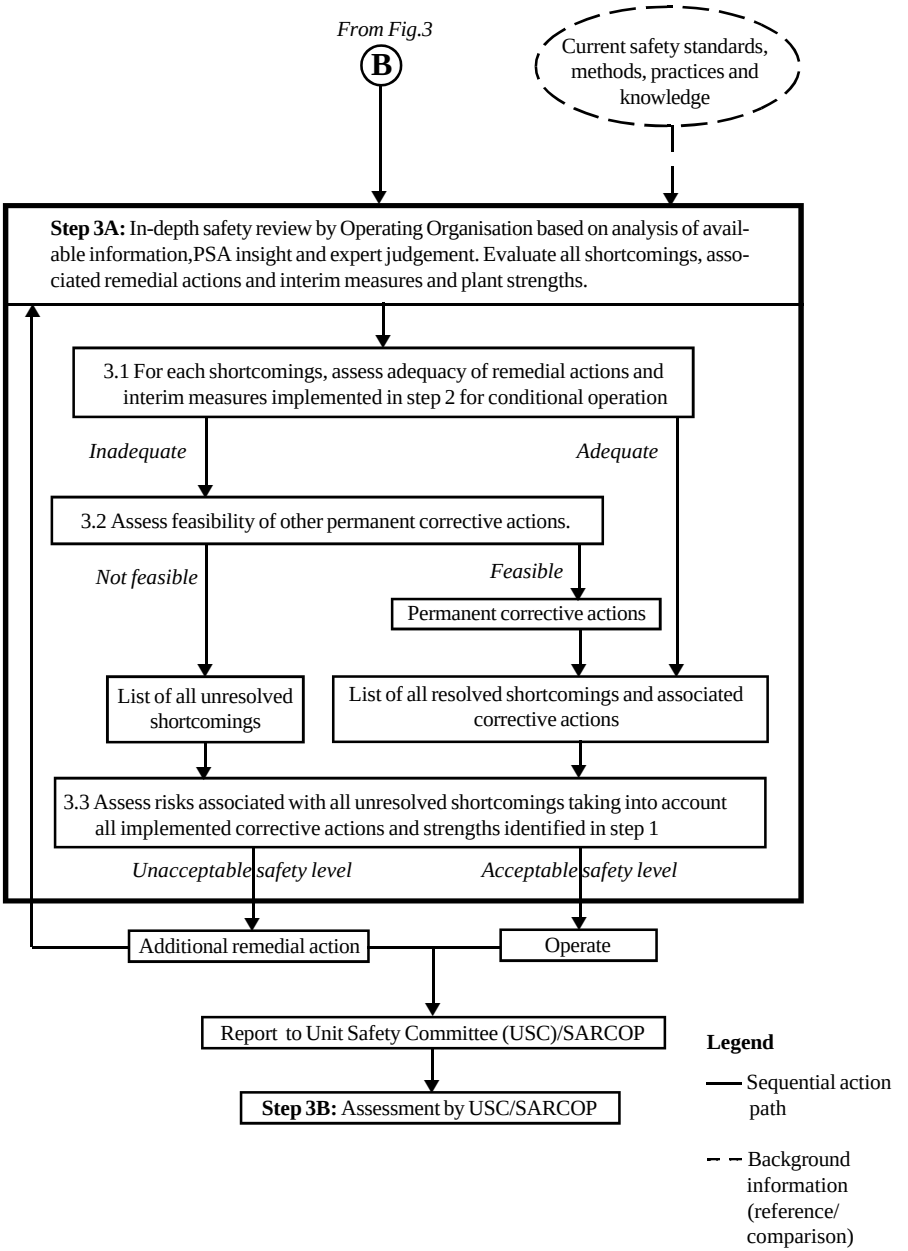

Fig. 4 - STEP 3: IN-DEPTH SAFETY REVIEW

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LIST OF PARTICIPANTS

TECHNICAL EXPERT COMMITTEE (TEC)
(for Preparation of Draft)

Dates of Meeting :

May 5, 1995	September 21, 1995
June 26, 1995	November 15&16, 1995
July 7, 1995	November 19&20, 1995
July 24, 1995	January 25, 1996
July 28, 1995	February 6&7, 1996
August 18, 1995	February 12, 13&14, 1996
September 5, 1995	July 7, 1996
September 11, 1995	

Members and alternates participating in the meeting

Shri V.K. Sharma (Convener)	:	NPC
Shri S.S. Bajaj	:	NPC
Shri R.I. Gujrathi	:	BARC
Shri V.K. Sharma	:	BARC
Shri S.K. Fotedar	:	NPC
Shri S.K. Chande	:	AERB
Shri S.N. Sengupta	:	BARC
Shri S.K. Warrier	:	AERB
Shri K.C. Sahoo	:	BARC
Shri A.K. Babar	:	BARC
Shri G.P. Srivastava	:	BARC
Shri R.S. Yadav	:	BARC
Dr. R.I.K. Moorthy	:	BARC
Shri U.K. Paul	:	AERB

APEX GROUP

(for Review of Draft)

Shri S.K. Mehta (Chairman)	:	Formerly Director, Reactor Group
Shri S.K. Sharma	:	BARC
Shri Ch. Surendar	:	NPC

PARTICIPANTS FOR THE PREPARATION OF REVISED DRAFT

Shri G.K. De	:	AERB
Shri Y.K. Shah	:	AERB
Shri K. Srivasista	:	AERB
Shri S.A.H. Ashraf	:	AERB

ADVISORY COMMITTEE ON CODES, GUIDES AND ASSOCIATED MANUALS FOR SAFETY IN OPERATION OF NUCLEAR POWER PLANTS (ACCGASO)

Dates of Meeting	:	January 16 & 18, 1999. March 26 & 27, 1999.

Members and alternates participating in the meeting:

Shri G.V. Nadkarny (Chairman)	:	Formerly Dir. E&PA, NPC.
Shri K.M. Sinha	:	NPC
Shri Y.K. Joshi	:	NPC
Shri Ravindranath	:	NPC
Shri V.V. Sanath Kumar	:	NPC
Shri Ram Sarup	:	Formerly, AERB.
Shri R.S. Singh	:	AERB.
Shri S.T. Swamy (Co-opted)	:	AERB.
Shri S.K. Warrier (Member-Secretary)	:	AERB.

ADVISORY COMMITTEE ON NUCLEAR SAFETY (ACNS)

Dates of Meeting	:	April 24, 1999 June 26, 1999

Members and alternates participating in the meeting:

Shri S.K. Mehta (Chairman)	:	Formerly Director RG, BARC
Shri S.M.C. Pillai	:	Nagarjuna Power Corporation
Shri U.N. Gaitonde	:	IIT, Mumbai
Shri S.K. Goyal	:	BHEL
Shri Ch. Surendar	:	NPC
Shri U.C. Mishra	:	BARC
Shri S.K. Sharma	:	BARC
Dr. V. Venkat Raj	:	BARC
Shri S.P. Singh	:	Formerly AERB.
Shri G.K. De	:	AERB.
Shri G.V. Nadkarny (Invitee)	:	Chairman, ACCGASO
Shri V.K. Sharma (Invitee)	:	Convenor, TEC
Shri R.S. Singh (Invitee)	:	Member, ACCGASO
Shri S.K. Warrier (Invitee)	:	Member-Secretary, ACCGASO
Shri S.K. Chande (Invitee)	:	Member, TEC
Shri S.S. Bajaj (Invitee)	:	Member, TEC
Shri R.I. Gujarathi (Invitee)	:	Member, TEC
Shri G.P. Srivastava (Invitee)	:	Member, TEC
Shri U.K. Paul (Invitee)	:	Member, TEC
Shri Y.K. Shah (Invitee)	:	AERB
Shri S. A. H. Ashraf (Invitee)	:	AERB.
Shri K. Srivasista (Member-Secretary)	:	AERB

PROVISIONAL LIST OF GUIDES ON OPERATION OF NUCLEAR POWER PLANTS

Safety Series Nos.	Provisional Title
AERB/SG/O-1	Staffing, Recruitment, Training and Qualification of Operating Personnel of NPPs
AERB/SG/O-2	In-Service Inspection of NPPs
AERB/SG/O-3	Operational Limits and Conditions for NPPs
AERB/SG/O-4	Commissioning Procedures for Pressurised Heavy Water Reactor Based NPPs
AERB/SG/O-5	Radiation Protection during Operation of NPPs
AERB/SG/O-6	Preparedness of the Operating Organisation for Emergencies at NPPS
AERB/SG/O-7	Maintenance of NPPs
AERB/SG/O-8	Surveillance of Items Important to Safety in NPPs
AERB/SG/O-9	Management of NPPs for Safe Operation
AERB/SG/O-10A	Core Management and Fuel Handling for Pressurised Heavy Water Reactor Based NPPs
AERB/SG/O-10B	Core Management and Fuel Handling for Boiling Water Reactor Based NPPs
AERB/SG/O-11	Management of Radioactive Wastes Arising during Operation of NPPs.
AERB/SG/O-12	Renewal of Authorisation for Operation of NPPs
AERB/SG/O-13	