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Safety of Nuclear Power Plants: Operation

DRAFT SAFETY REQUIREMENTS
DS 413

Revision of the Safety Standards Series No. NS-R-2 (Rev.2)

IAEA
International Atomic Energy Agency

FOREWORD

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Director General

The IAEA's Statute authorizes the Agency to establish safety standards to protect health and minimize danger to life and property — standards which the IAEA must use in its own operations, and which a State can apply by means of its regulatory provisions for nuclear and radiation safety. A comprehensive body of safety standards under regular review, together with the IAEA's assistance in their application, has become a key element in a global safety regime.

In the mid-1990s, a major overhaul of the IAEA's safety standards programme was initiated, with a revised oversight committee structure and a systematic approach to updating the entire corpus of standards. The new standards that have resulted are of a high calibre and reflect best practices in Member States. With the assistance of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its safety standards.

Safety standards are only effective, however, if they are properly applied in practice. The IAEA's safety services — which range in scope from engineering safety, operational safety, and radiation, transport and waste safety to regulatory matters and safety culture in organizations — assist Member States in applying the standards and appraise their effectiveness. These safety services enable valuable insights to be shared and I continue to urge all Member States to make use of them.

Regulating nuclear and radiation safety is a national responsibility, and many Member States have decided to adopt the IAEA's safety standards for use in their national regulations. For the Contracting Parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by designers, manufacturers and operators around the world to enhance nuclear and radiation safety in power generation, medicine, industry, agriculture, research and education.

The IAEA takes seriously the enduring challenge for users and regulators everywhere: that of ensuring a high level of safety in the use of nuclear materials and radiation sources around the world. Their continuing utilization for the benefit of humankind must be managed in a safe manner, and the IAEA safety standards are designed to facilitate the achievement of that goal.

EDITORIAL NOTE

An appendix, when included, is considered to form an integral part of the standard and to have the same status as the main text. Annexes, footnotes and bibliographies, if included, are used to provide additional information or practical examples that might be helpful to the user.

The safety standards use the form 'shall' in making statements about requirements, responsibilities and obligations. Use of the form 'should' denotes recommendations of a desired option.

CONTENTS

1. INTRODUCTION

BACKGROUND

1.1. The safety of a nuclear power plant (NPP) is ensured by means of proper site evaluation, design, construction and commissioning followed by proper management and operation of the plant. In a later phase, proper transition to decommissioning is required. The organization and management of plant operations shall ensure that a high level of plant safety performance is achieved through effective implementation and control of operations activities.

1.2. Over the past years, new emphasis has emerged in areas such as management system, long term operation, plant ageing, periodic safety reviews, probabilistic safety assessment and risk informed decision making processes. It is therefore necessary to reflect the IAEA's safety requirements in these areas and to correct and/or improve the document based on feedback from its application by the Agency.

1.3. This publication is the revised version of requirements "Safety of Nuclear Power Plants: Operation", which was issued in 2000 as Safety Standards Series No. NS-R-2. The purpose of this revision was: to restructure Safety Standards Series No.NS-R-2 in light of new operational experience and new trends in the industry, to correctly reposition those requirements that were originally located among the recommendations in the Safety Guides for operation of nuclear power plants and to reflect current practice, new concepts and technical developments.

1.4. The present document reflects safety principles # 1, 3, 8 and 9 of the Fundamental Safety Principles [1]. The NS-R-2 is also harmonized with the safety requirements GS-R-3 "Management Systems for facilities and activities" [2].

1.5. Guidance on fulfillment of these Safety Requirements may be found in the appropriate Safety Guides.

OBJECTIVE

1.6. The objective of this publication is to establish the requirements which, in the light of experience and the present state of technology, shall be satisfied to ensure the safe operation of nuclear power plants. These requirements are governed by the safety objective and safety principles that are presented in the Fundamental Safety Principles publication [1].

SCOPE

1.7. This publication deals with matters specific to the safe operation of nuclear power plants. It covers commissioning, operations until the transition to decommissioning, including maintenance, and modifications through the lifetime of the facilities. Normal operation and anticipated operational occurrences as well as accident conditions are taken into account.

STRUCTURE

1.8. This publication consists of 10 sections. Section 2 relates to safety objectives derived from the “Fundamental Safety Principles” [1]. Section 3 relates to the requirements to establish an operating organization. Section 4 deals with the requirements imposed on the operating organization within a good safety management system. Section 5 establishes the requirements for the commissioning programme. Section 6 deals with the requirements related to the daily plant operations. Section 7 establishes requirements for the plant maintenance including testing, surveillance, inspections of power plants to support safe and reliable plant operation. Section 8 presents the requirements which shall be met to ensure proper control of plant modifications. Section 9 establishes requirements for the management of plant configuration while extending the life of the plant operations. Section 10 establishes requirements that have to be defined for the transition phase from operations to decommissioning.

2. SAFETY OBJECTIVES

2.1. Any industrial activity yields benefits and incurs risks. Complex industrial activities, such as the operation of nuclear installations, usually have associated risks of various types. The risks may be borne by the site personnel, by people living near the installation and/or by the whole society. The environment may also suffer harm if radioactive materials are released, particularly under accident conditions. Consequently, it is necessary to limit the risks to which people and the environment are subject for all reasonably foreseeable circumstances.

2.2. Most requirements presented in this publication are derived from the fundamental safety objective, which is to protect people and the environment from the harmful effects of ionizing radiation, and related safety principles #1, 3, 8, 9 [1]. The requirements shall be applied to minimize and control the risks to site personnel, the public and the environment from the effects of ionizing radiation. They are interdependent. The technical aspects are in conjunction with management aspects while procedural measures ensure defense against hazards due to ionizing radiation.

2.3. The remaining requirements are derived from other relevant aspects including industrial hazards or chemical hazards.

3. THE MANAGEMENT SYSTEM OF THE OPERATING ORGANIZATION

GENERAL

3.1. The operating organization shall establish, implement, assess and continually improve a management system that integrates safety, health, environmental, security, quality and economic related elements, according to [2] and [3] covering all processes and activities which may affect the safe operation of the plant. The management system shall also ensure the promotion of a strong safety culture, the regular assessment of safety performances and the application of lesson learned for experience. The principles and methods of management system shall be used systematically in:

- fulfilling management responsibilities;

- providing resources;

- implementing processes; and

- measuring, assessing and improving of management processes and of the adequacy of operational performances

Further guidance on application of management system in operation may be found in [3]l.

FUNCTIONS AND RESPONSIBILITIES

3.2. The licensee (operating organization) shall have the prime responsibility for the safe operation of the nuclear power plant. Authority for the safe operation of the plant may be delegated to the plant management and necessary resources and support shall be provided.

3.3. Functional responsibilities; levels of delegated authority; lines of internal and external communication; for the safe operation of plants in all operational states, shall be clearly defined in writing.

3.4. The management system, as a set of interrelated or interacting components for establishing policies and objectives and enabling the objectives to be achieved in a efficient and effective manner shall include the following items:

(1) policy making, which includes: setting management objectives, establishing policy for nuclear safety, organizational learning, and for safety culture;

(2) allocation of responsibilities with corresponding lines of delegation of authority and communication; allocating resources; providing material and human resources with the appropriate level of education and training; retaining the necessary competencies; approving the contents of management programmes; developing procedures and instructions and having a strict policy to adhere to these sound procedures; setting policies on fitness for duty; and establishing a programme to make the necessary

changes to any of these functions on the basis of the performance in achieving objectives;

(3) operating, which include executive decision making and actions for the operation of a plant in all operational states, including outages and accidents;

(4) support activities which include obtaining, from both on-site and off-site organizations, the technical and administrative services and facilities necessary to perform the operating functions; and

(5) review activities, which include critical monitoring and auditing of the performance of the operating and supporting functions and review of the design on a regular basis. The purpose of monitoring is to verify compliance with the stipulated objectives for safe operation of the plant; to reveal deviations, deficiencies and equipment failures; and to provide information for the purpose of taking timely corrective action and making improvements. Reviewing functions also include review of the overall safety performance of the organization in order to assess the effectiveness of safety management and to identify opportunities for improvement.

3.5. The operating organization shall establish liaison with the regulatory body and with relevant public authorities to ensure a common understanding of, and compliance with, safety requirements;

STRUCTURE OF THE OPERATING ORGANIZATION

3.6. Clear lines of authority shall be established and documented. The documentation describing the plant's organizational structure and the management arrangements for discharging the responsibilities shall be made available to the regulatory body for review. Proposed changes to the structure and associated arrangements, which might be significant to safety, shall be systematically reviewed by the operating organization and shall be submitted to the regulatory body for review and approval where necessary.

3.7. The interfaces, roles and responsibilities, with the external supporting organizations shall be assessed and documented. [2]

3.8. The operating organization shall assign to a design authority the responsibility to set up a formal process to maintain the design integrity.

MANAGEMENT OF HUMAN RESOURCES

3.9. The operating organization shall be staffed with competent managers and sufficient qualified personnel having the proper awareness of the technical and management requirements for safety of the operating organization. Managers shall promote an attitude of safety consciousness of plant staff. Sufficient qualified and experienced staff shall be available to ensure safe operation of the operating organization. [2]

3.10. The operating organization knowledge management process shall be regularly reassessed and updated to ensure that the necessary pool of knowledge, skills, attitudes and safety expertise is sustained and that long term policy objectives for human resources are met.

3.11. The organization, qualifications and number of operations personnel shall be sufficient for the safe and reliable operation of the plant at all operational states. Succession planning shall be an established practice in the operating group.

3.12. The recruitment and selection policy at the operating organization shall be directed to retaining a pool of experienced staff covering all aspects of safe operation. A long-range staffing plan aligned to the long term objectives of the operating organization shall be developed to anticipate the future personnel and skill needs of the operating organization.

3.13. The operating organization shall define a health process to ensure fitness for the duties of the personnel. Special attention shall be paid to minimizing of mental stress, restrictions on excessive overtime and mandatory rest requirements.

3.14. Alcohol and drug use (abuse) shall be prohibited in places where safety related tasks are performed.

HUMAN FACTORS

3.15. Actions related to safety, which are assigned to the operating staff, shall be analyzed. For these actions, it shall be demonstrated that the working environment is adequate, that the information necessary to carry out the actions safely is clear and understandable, and that the operating staff has sufficient time to decide and to act. Attention shall be given to ensuring that oral (verbal) instructions are clearly understood.

3.16. Human factors which influence the working environment and the effectiveness and fitness of personnel for duty (such as workload or fatigue) shall be identified and controlled.

3.17. Human performance enhancement tools shall be used as appropriate to support operating staff responses.

QUALIFICATION AND TRAINING OF PERSONNEL

3.18. All activities that may affect safety shall be performed by suitably qualified and experienced persons. Certain activities may require formal authorization or license.

3.19. The operating organization shall clearly define the qualification and experience requirements to ensure that the personnel performing safety related duties are capable of safely perform their functions.

3.20. Suitably qualified personnel shall be selected and given the necessary training and instruction to enable them to perform their duties correctly for the different operational states of the plant and in accidents, in accordance with the appropriate procedures.

3.21. A suitable training programme shall be established and maintained for the personnel before their assignment to safety related duties. The training shall emphasize the importance of safety in all aspects of plant operation.

3.22. The training programme shall include provisions for periodic confirmation of the competence of personnel and for refresher training on a regular basis. The refresher training shall also include retraining provisions for personnel having had extended absences from the performance of their authorized duties.

3.23. The management of the operating organization shall be responsible for the qualification and the competence of plant staff. Line managers shall participate in determining the needs for training, and in ensuring that operating experience is taken into account in the training. Managers and supervisors shall ensure that production needs do not interfere with the conduct of the training programme.

3.24. Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel. A systematic approach to training shall be used for determining the content of each programme. Training programmes shall promote personnel attitudes which ensure that issues of safety receive the attention that they warrant.

3.25. The training programmes shall be assessed and improved by periodic reviews. In addition, a system shall be in place for timely modification and updating of the training facilities and materials to ensure that they accurately reflect the current plant conditions.

3.26. The operational experience from the plant as well as relevant experiences at other plants shall be appropriately incorporated into the training programme. The programme shall ensure that training is conducted on the root cause(s) of the events and on the identification and implementation of corrective actions to prevent their recurrence.

3.27. The training organization shall be staffed with adequately qualified and experienced persons in all training positions in order to provide valid technical knowledge, skills and credibility with the trainees. Instructors shall be technically competent in their assigned areas of responsibility and have the necessary instructional skills.

3.28. Qualification requirements shall be established for the training instructors who shall also be familiar with the routines and work practices at the work place.

3.29. Adequate facilities including representative simulator shall be used for the training of operating personnel. Simulator training shall incorporate training for operational states and for design basis accidents, as well as for a number of agreed beyond design basis accidents.

INTERFACE WITH THE REGULATORY BODY

3.30. The operational safety of a plant shall be subject to surveillance by a regulatory body independent of the operating organization. Interfaces between the regulatory body and the operators shall be clearly defined and carried out on the basis of the operating license. Further information on the role of the regulatory body can be found in Ref. [4].

3.31. Mutual understanding and respect between the regulatory body and the operating organization, and a frank, open and formal relationship shall be fostered.

3.32. The operating organization shall submit or make available to the regulatory body documents and information in accordance with the regulatory body requirements.

3.33. The operating organization shall submit to the regulatory body for approval a list of activities according to requirements in regulation that may significantly affect safety and which can be planned in advance. The operating organization shall develop and implement a procedure for reporting events to the regulatory body in accordance with established criteria.

3.34. The operating organization shall render all necessary assistance and shall grant access to the plant and documentation to enable the regulatory body to perform its functions. When so required by the regulatory body, the operating organization shall undertake special analyses, tests and inspections.

INTERFACE WITH EXTERNAL SUPPORT ORGANIZATIONS

3.35. Where external supporting organizations play a safety significant role in a nuclear power plant, the management system of the licensee shall consider activities provided by the external support organizations. Overall control, supervision and responsibility for these activities shall stay with the licensee.

3.36. The licensee shall ensure that personnel of external supporting organizations, who perform activities on safety related structures, systems or components, are qualified to perform their assigned tasks. Activities shall be clearly defined in writing and approved prior to commencement of the activity.

4. MANAGEMENT OF OPERATIONAL SAFETY

SAFETY POLICY

4.1. The operating organization shall place special emphasis on safety in operation. A safety policy shall be developed by the operating organization and applied by all site personnel. This policy shall give safety the utmost priority at the plant, overriding the demands of production and project schedules. The policy shall encourage a comprehensive safety culture. The safety policy shall clearly stipulate that the lead in safety matters shall come from the highest levels of management.

4.2. The senior management shall communicate the policy throughout the organization. All personnel in the organization, including contractors, shall be aware of the policy and be aware of their responsibilities for ensuring safety.

4.3. The operating organization shall develop safety performance expectations for activities in all such operational areas. Safety performance standards and management expectations shall be clearly communicated to ensure they are understood by all those involved in their implementation.

4.4. The operating organization shall demonstrate a commitment to achieving improvements in operational safety. The organization's improvement strategy for achieving higher safety performance, and for finding more efficient ways to achieve existing standards, shall be monitored and supported by a well defined programme with clear objectives and targets.

4.5. The operating organization (licensee) shall perform and implement a safety assessment of the plant in accordance with the regulatory requirements throughout its operational lifetime, taking into account operating experience and significant new safety information from various relevant sources including agreed corrective actions and/or implemented safety improvements and reasonably practicable modifications for adherence with current standards. A systematic safety reassessment shall be conducted periodically.

4.6. The operating organization shall secure long term access to the knowledge of plant design and manufacturing throughout the whole life cycle of the plant. This will help to ensure the reliability of future safety analyses.

4.7. When, during operations, there is uncertainty or lack of clarity for performing tasks, operators shall be required to stop and seek advice. Hasty decisions and hurried actions shall be avoided. The operating organization shall encourage operators to make appropriate and conservative actions to minimize risk and maintain the plant in a safe condition, including reducing power or shutting down the reactor.

4.8. The responsibilities and authorities of the control room operators and those directing the shutting down of the reactor in the interests of safety shall be set out clearly in writing. Similarly, the responsibilities and authorities for restarting the reactor after an event leading to a shutdown, scram, major transient or to an extended period of maintenance shall also be clearly established in writing. Investigation shall be carried out and shall determine the cause

of the event to prevent recurrence. Restart conditions and criteria and decision authority shall be established and followed after implementation of the necessary corrective measures in a timely manner.

4.9. Following any event, the operating organization shall revalidate the safety functions and functional integrity of any component or system which was challenged by the event. Necessary remedial actions shall include corrective actions but also inspection, testing and maintenance as appropriate.

PERFORMANCE OF SAFETY RELATED ACTIVITIES

4.10. Appropriate arrangements shall be implemented by the operating organization to ensure that safety related activities are adequately analyzed and controlled to manage the risks to health and safety as low as reasonably achievable. Assessments of the risks to health and safety arising from routine and non routine activities shall be carried out. The level of analysis and control shall depend on the safety significance of the task.

4.11. When using probabilistic assessment of risk for decision-making, the operating organization shall ensure that the risk analysis is of appropriate quality and scope for the respective decision, performed by appropriately skilled analysts and is used in a manner that complements the deterministic decision-making approach in compliance with applicable regulations.

4.12. All activities important to safety shall be carried out in accordance with written procedures. These shall define how the activity can be carried out safely and, where appropriate, identify the steps to be taken in the event of an abnormal situation. All procedures shall be up-dated in a timely manner in the light of the operating experience.

4.13. Specific measures shall be taken and maintained to prevent the unauthorized access to structures, systems and components important to safety. These measures shall include the controlled access to specific rooms or compartments, an effective key control system and/or other measures to prevent unauthorized intervention to safety related valves, breakers or other specified equipment.

MONITORING AND REVIEW OF SAFETY PERFORMANCE

4.14. Operating organizations shall analyze safety significant events to identify root causes including those relating to human factors. The results of such analyses shall be fed back as appropriate into relevant training programmes and use to up-date procedures and instructions. Plant event reports and industrial accident reports shall identify tasks in which inadequate training may be contributing to equipment damage, excessive unavailability, unscheduled maintenance, need for repetition of work, unsafe practices and lack of adherence to approved procedures. This information shall be supplemented by means of interviews, audits or self-assessment of those concerned.

4.15. An adequate audit and review system shall be established to provide the assurance that the safety policy of the operating organization is being implemented effectively and

lessons are being learned from its own experience and from others to improve safety performance.

4.16. Where practicable, suitable objective performance indicators shall be developed and used to enable senior management to discern and react to shortcomings and early deterioration in the performance of safety management.

4.17. The operating organization shall perform systematic self-assessments to identify and address degradation of the safety performance. Self-assessments shall be an integral part of the monitoring and review system. Performance indicators shall be used to support the self-assessment process.

4.18. The appropriate corrective actions shall be determined and implemented as a result of the safety performance monitoring and review. Progress in taking proposed actions shall be monitored to ensure that actions are completed within the appropriate time-scales. The completed corrective actions shall be reviewed to assess whether they have adequately addressed the issues identified in the audits and reviews.

4.19. Plant management shall review personnel performance, safety attitudes, response to safety infringements and violations of operational limits and conditions (OLCs) or procedures. The monitoring of the plant conditions, activities and personnel attitudes shall be supported by systematic walkdowns by the plant management.

PHYSICAL PROTECTION

4.20. The operating organization shall implement, throughout the lifetime of the facility or activity, physical protection measures in order to protect against unauthorized removal of nuclear material, and to protect against sabotage of nuclear material and nuclear facilities. IAEA recommendations for the physical protection of nuclear material and nuclear facilities may be found in Ref. [6] and other documents of the IAEA Nuclear Security Series.

EMERGENCY PREPAREDNESS

4.21. The operating organization shall prepare an emergency plan that covers all activities under its responsibility, to be adhered to in the event of an emergency. This emergency plan shall be coordinated with those bodies having responsibilities in an emergency, including public authorities, and shall be submitted to the regulatory body.

4.22. Emergency preparedness shall cover the capability of maintaining protection and safety by managing accidents; mitigating their consequences if they do occur; protecting the health of site personnel and the public; and protecting the environment [5].

4.23. The emergency plan shall include arrangements for emergencies involving a combination of non-nuclear and nuclear hazards, such as a fire in conjunction with significant levels of radiation or contamination, or toxic or asphyxiating gases in conjunction with radiation and contamination, with account taken of the specific site conditions.

4.24. The operating organization shall establish the necessary organizational structure and shall assign responsibilities for managing emergencies. This shall include: arrangements for prompt recognition of emergencies; timely notification and alerting of response personnel; provision of the necessary information to the authorities.

4.25. Appropriate emergency arrangements shall be established from the time that nuclear fuel is brought to the site, and complete emergency preparedness as described here shall be ensured before the commencement of operation. The emergency plan shall be tested in exercises before the commencement of operation.

4.26. The operating organization shall thereafter at suitable intervals, conduct exercises of the emergency plan, some of which shall be witnessed by the regulatory body. The plans shall be subject to review and updating in the light of experience gained.

4.27. A training programme for emergencies shall be established to ensure that plant staff and staff from other participating organizations possess the essential knowledge, skills and attitudes required for the accomplishment of non-routine tasks under stressful emergency conditions.

4.28. Emergency preparedness exercises shall be designed to evaluate the preparedness of plant staff and staff from external emergency response organizations to perform their tasks and their cooperation in coping with emergencies and improving the efficiency of the response.

4.29. Facilities, instruments, tools, equipment, documentation and communication systems to be used in emergencies shall be kept available and shall be maintained in good operating condition, in such a manner that they are unlikely to be affected by or made unavailable by the postulated accidents.

4.30. The operating organization shall establish, with the involvement of competent authorities, relations with relevant national and international organizations to prepare off-site emergency procedures consistent with national and international agreements.

ACCIDENT MANAGEMENT

4.31. Arrangements and guidance shall be in place before the commencement of operation, which address the actions necessary following beyond design basis accidents including severe accidents.

4.32. The accident management programme shall be established that includes preparatory measures; guidelines; utilization of the available means; safety related or conventional; organization for execution; communication networks and the training necessary for the implementation of this programme.

4.33. In the case of beyond design basis accidents, the operating staff shall have prompt support from the technical support centers or advisory organization. When the conditions exceed specific limits as per station emergency plan an additional organizational structure shall be established to take over the responsibility for long term actions to mitigate effects on the environment.

FIRE PREVENTION AND PROTECTION

4.34. The operating organization shall make arrangements for ensuring fire safety on the basis of a fire hazard analysis which shall be periodically reviewed and updated as appropriate.

4.35. Fire safety arrangements shall include, besides design provisions, operational measures to prevent fires from starting, to detect and to extinguish fires and to prevent the spread of fires by

(1) a strategy for the application of the principle of defense in depth,

(2) assignment of responsibilities, including external support services

(3) assessment of the impact of plant modifications on fire hazard assessment,

(4) control of combustible materials and ignition sources,

(5) inspection, maintenance and testing of fire safety equipment and fire protection measures,

(6) establishment of a manual fire fighting capability, and

(7) the training of personnel.

4.36. The operating organization shall ensure that appropriate procedures are in place to effectively coordinate and cooperate between all fire fighting services involved. Periodic joint fire drills and exercises shall be held to assess the effectiveness of the response capability.

4.37. The operating organization shall pay special attention to cases for which there is a risk of release of radioactive material in a fire. It shall be ensured that such cases are covered in the emergency arrangements for the plant. Appropriate measures shall be taken for the radiation protection of fire fighting personnel.

RADIATION PROTECTION AND RADIOACTIVE WASTE MANAGEMENT

4.38. The operating organization shall establish and implement a programme to ensure that, in all operational states, doses due to exposure to ionizing radiation (hereinafter termed “radiation”) in the plant or due to any planned releases of radioactive material from the plant are kept below authorized limits and are as low as reasonably achievable.

4.39. This programme shall be assessed to ensure that the requirements of the International Basic Safety Standards for protection against ionizing radiation and for the safety of radiation sources (BSS) [7] are met and shall be to the satisfaction of the regulatory body.

4.40. The radiation protection function in the operating organization shall have sufficient independence and resources to enforce and to advise on radiation protection regulations, standards and procedures and safe working practices.

4.41. All site personnel shall have individual responsibility for putting into practice the exposure control measures which are specified in the radiation protection programme. Consequently, particular emphasis shall be given to training all site personnel so that they are aware of radiological hazards and of necessary protective measures.

4.42. The operating organization shall verify, by means of surveillance, inspections and audits, that the radiation protection programme is being correctly implemented and that its objectives are being met. The programme shall be reviewed on a regular basis and updated as necessary.

4.43. All site personnel working in a controlled area or regularly employed in a supervised area shall have their occupational exposures assessed in accordance with the requirements of Ref. [15] [17]. Additional related information could be found in the Safety Standards Ref. [7] [13] [14]. Dose records shall be kept and made available to the personnel on demand and to the regulatory body.

4.44. The radiation protection programme shall provide for health surveillance of site personnel who may be occupationally exposed to radiation to ascertain their physical fitness and to give advice in cases of accidental overexposure. The health surveillance shall consist of a preliminary medical examination, followed by periodic checkups.

4.45. The generation of radioactive waste shall be kept to the minimum practicable in terms of both activity and volume, by appropriate operating practices. Treatment and interim storage of radioactive waste shall be strictly controlled in a manner consistent with the requirements for safe final disposal. [15]

4.46. The chemistry programme shall include control of radiation dose rates coming from systems and components. These dose rates shall be maintained as low as reasonably achievable.

4.47. The operating organization shall establish and implement a programme to manage radioactive waste safely. This programme shall include collection, segregation, treatment, conditioning, on-site transport and storage and dispatch of radioactive wastes and shall be made available to the regulatory body.

4.48. The operating organization shall establish and implement procedures for monitoring and controlling discharges of radioactive effluents. These procedures shall be made available to the regulatory body.

4.49. The operating organization shall ensure that a programme for monitoring the environment in the vicinity of the plant, in order to assess the radiological impacts of radioactive releases on the environment, is established.

INDUSTRIAL SAFETY

4.50. An industrial safety programme shall be established and implemented to ensure that all risks to personnel involved in plant activities, in particular, those activities that are safety related, are kept as low as reasonably achievable.

4.51. All personnel, suppliers, contractors and visitors shall have the necessary knowledge of the industrial safety programme, and shall comply with its safety rules and practices.

4.52. The industrial safety programme shall include arrangements for the planning, implementation, monitoring and review of the preventive and protective measures. The operating organization shall provide support, guidance and assistance for plant personnel in the area of industrial safety.

RECORDS AND REPORTS

4.53. The operating organization shall identify the types of records and reports that are important for the operation of the power plant in accordance with the reference [2].

4.54. The operating organization shall have a documentation process for the control of these records and reports. All records shall be readable, complete, identifiable and easily retrievable. [2]

4.55. Retention times of records and reports shall depend on their level of importance [2].

4.56. Records of operation, maintenance shall be kept starting from the initial energization and operation of each plant system, and they shall be retained by the operating organization in proper archives for periods as agreed with the regulatory body.

FEEDBACK OF OPERATIONAL EXPERIENCE

4.57. The operating organization shall establish and implement a programme to report, collect, screen, analyze, trend, document and communicate operational experiences at the plant in a systematic way.

4.58. The operating organization shall obtain and evaluate information on operational experience at other plants to derive lessons for its own operations.

4.59. The operating organization shall encourage the exchange of experience in order to contribute to national and international systems.

4.60. Plant personnel shall be required to report all events, including “low level events” and “near misses”, potential problems that are linked to equipment failures, human performance problems, procedural deficiencies and documentation inconsistencies relevant to the safety of the plant.

4.61. Events with significant safety implications shall be investigated to establish their direct and root causes including human factors and organizational aspects.

4.62. The investigation shall, where appropriate, result in clear recommendations to the responsible management, which shall take appropriate corrective action in due time to avoid any recurrence of events. Corrective actions shall be prioritized, scheduled, and effectively implemented.

4.63. Operating experience shall be carefully examined by designated competent persons for any precursors or trends of conditions adverse to safety, so that any necessary corrective action can be taken before serious conditions arise.

4.64. Operating personnel shall be promptly briefed on events of relevance and corrective measures taken to prevent recurrence.

4.65. The operating organization shall maintain liaison with supporting organizations (manufacturer, research organization, and designer) involved in the design, with the aim of feeding back information on operating experience and of obtaining, if necessary, advice in case of equipment failure or events.

4.66. Evaluation of the operational experience programme shall be periodically performed to determine its effectiveness and to identify needed improvements.

5. PLANT COMMISSIONING

COMMISSIONING PROGRAMME

5.1. The operating organization (licensee) shall be responsible for the preparation and documentation of the commissioning programme and presenting the programme for approval to the regulatory body. Commissioning phases, safety objectives and acceptance criteria shall be defined in such a way that the programme is reviewable. The commissioning programme shall demonstrate that the plant behaves in compliance with the design assumptions.

5.2. Operating procedures shall be validated to the extent practicable as part of the commissioning programme, with the participation of the future operating personnel.

5.3. Suitably qualified operations personnel shall be directly involved in the commissioning process. Operating personnel and plant technical staff shall be involved in the commissioning process to the extent necessary to ensure proper preparation for the operational phase.

5.4. The commissioning programme shall be sufficiently comprehensive in order to provide "baseline" data on systems and components, which are important for ensuring the safety of the plant and for subsequent safety reviews.

PREPARATION, APPROVAL, CONTROL AND CONDUCT OF TESTS

5.5. The operating organization shall ensure that the commissioning programme includes all the tests necessary to demonstrate that the safety analysis report and limits and conditions are in compliance with the plant as installed. Tests that may place the plant in an unanalyzed condition shall not be performed.

5.6. Specific approvals by the regulatory body shall be required before the start of each testing activities during the commissioning phase. Prerequisites for systems, equipment, documentation and personnel shall be established well in advance of each testing phase. These prerequisites shall be clearly stated and documented on the basis of the safety analysis report and the existing regulatory requirements. Progression from one phase to the next one shall be conditional upon an evaluation of the results of the commissioning tests to ascertain that all objectives and regulatory requirements have been met.

5.7. To confirm the applicability and quality of the operating and test procedures, they shall be verified to ensure their technical accuracy and validated to ensure their usability with the installed equipment and control systems, as far as possible prior to loading fuel into the core. This process shall continue during the commissioning phase. This verification and validation process shall also apply to procedures for the overall operation.

5.8. From the start of commissioning reviewed and approved work control, modification control and plant configuration control arrangements shall be in place in order to meet conditions of the commissioning tests.

5.9. Initial fuel loading shall not be authorized until all pre-operational tests have been performed and results accepted by the licensee and regulatory body.

5.10. Reactor criticality and initial power rising shall not be authorized until all necessary tests have been performed and results accepted by the licensee and the regulatory body.

5.11. Authorization of the licensee to start commercial operation shall be conditional on the successful completion of all tests of the commissioning programme.

INTERFACES WITH OPERATIONS, MAINTENANCE, CONSTRUCTORS AND DESIGN ENGINEERING

5.12. Authorities and responsibilities shall be clearly defined and delegated to the individuals and groups performing the commissioning activities. The interfaces and the communication lines between groups (groups for design; for construction; contractors; groups for commissioning and for operations) shall be clearly defined and controlled.

5.13. From construction to commissioning, and finally to operation, the plant shall be monitored in order to protect plant equipment, to support the testing phases and to maintain consistency with the safety analysis report.

5.14. During the commissioning process, a comparison between the operating plant and its design parameters shall be carried out. A comprehensive process to address non-conformities in design, manufacturing, construction and operation shall be established.

5.15. The operating organization shall ensure that the construction activity is of appropriate quality including full completion and comprehensive baseline data, documentation or information and that the supplied equipment is manufactured under a quality control programme including inspection for proper fabrication, cleanliness, calibration and verification of operability [8].

5.16. The construction organization shall ensure that the installation of structures, systems and components has been completed in accordance with the design requirements and specifications. Any design modifications in order to rectify design deficiencies shall be documented [8].

6. PLANT OPERATIONS

OPERATIONAL LIMITS AND CONDITIONS

6.1. Operational limits and conditions shall be developed as part of ensuring that the plant is operated in accordance with the design assumptions and intent.

6.2. Operational limits and conditions shall reflect the provisions made in the final design as described in the safety analysis report and shall be submitted to the regulatory body for review, assessment and approval before the commencement of operation.

6.3. The operational limits and conditions shall include requirements for normal operation and cover actions to be taken and limitations to be observed by the operating personnel.

6.4. The operational limits and conditions or equivalent shall form an important part of the basis on which the operating organization is authorized to operate the plant.

6.5. Operating personnel directly responsible for the conduct of operation shall be thoroughly familiar with the operational limits and conditions in order to comply with the provisions contained therein.

6.6. The operational limits and conditions shall include the following:

(1) safety limits;

(2) limiting safety system settings

(3) limits and conditions for normal operation;

(4) surveillance requirements;

(5) action statements for deviations from normal operation.

6.7. The operational limits and conditions shall have the purpose of preventing situations which could lead to accidents; and limiting the consequences of any such accidents, if they do occur.

6.8. The operating organization shall ensure that an appropriate surveillance programme is established and implemented to ensure compliance with the operational limits and conditions, and that its results are evaluated and retained.

6.9. The operational limits and conditions shall be based on an analysis of the individual nuclear power plant and its environment, in accordance with the provisions made in the design. The necessity for each of the operational limits and conditions shall be substantiated by a written statement of the reason for its adoption.

6.10. The operational limits and conditions shall be reviewed over the operating life of the plant, in the light of experience, developments in technology and safety, and changes in the plant. The operational limits and conditions shall be modified following this review if this is

required by the regulatory body or if it is considered appropriate by the operating organization and approved by the regulatory body.

6.11. The plant shall be returned to a safe operational state when an event occurs through which the parameters deviate from the limits and conditions for normal operation. Appropriate remedial actions shall be taken. The operating organization shall undertake a review and evaluation of the event. The regulatory body shall be notified in accordance with the established event reporting system.

6.12. A process shall be established to ensure that deviations from operational limits and conditions are documented and reported in an appropriate manner, and that appropriate actions are taken in response.

6.13. The operating organization shall not deliberately exceed the authorized limiting conditions for safe operation. Where circumstances necessitate operation outside the boundaries of the operational limits and conditions, clear proceduralized instructions shall be developed to cater for such operations. These instructions shall include what permissions and authorizations shall be obtained prior to operation outside operating limits and conditions.

6.14. In order to prepare, review and optimize the operating conditions, consideration shall be given to the use of probabilistic safety assessment (PSA) for input to the operating conditions to provide insight into the relative contributions of these conditions to safety of different aspects of the plant.

OPERATING PROCEDURES

6.15. Operating procedures and supporting documentation shall be issued under controlled conditions, approved and periodically reviewed to ensure their adequacy and effectiveness. [3]

6.16. For normal operation, operating procedures shall be developed and used to ensure that the plant is operated within the operational limits and conditions.

6.17. For anticipated operational occurrences and accident conditions, the operating procedures shall provide instructions for either a return to normal operation or the placing of the reactor in a safe shutdown state.

6.18. For design basis accidents, these procedures to keep the plant state within specified limits may be event based or symptom based.

6.19. For beyond design basis accident conditions guidance shall be available that is symptom based; It shall utilize parameters indicating the plant state to identify optimum recovery routes for the operator without the need for accident diagnosis.

6.20. Responsibilities and lines of communication shall be clearly defined in writing for circumstances where the operating personnel discover that the status or conditions of plant systems or equipment are not in accordance with operational limits and conditions.

6.21. If there is a need to conduct a non-routine operation or test, which is not covered by existing operating procedures, it shall be subject to a safety review and a special procedure shall be developed and approved.

OPERATION FACILITIES AND OPERATOR AIDS

6.22. The facilities and equipment used by the operating personnel shall be maintained to support safe and reliable operation of the plant under all operational states.

6.23. The habitability of control rooms shall be maintained in good condition. Where the design of the plant foresees additional or local control rooms which are dedicated to the control of processes that could affect the plant conditions, clear communication lines shall be developed to assure an adequate level of information transfer to the main control room operators.

6.24. The emergency control room / shut down panel and all other operational panels outside the control room shall be kept free of obstructions as well as non-essential material that would preclude immediate operation. Operators shall periodically verify that this emergency control room or panels are in the proper state of operational readiness, including documentation, communications, alarm systems and habitability.

6.25. A management control system shall be established to administer and control an effective operator aids programme. The operator aids control system shall prevent use of non authorized operator aids and any other supportive materials like non authorized instructions or labels of any kind on the equipment, local panels, boards, and measurement devices within the work areas. The operator aids control system shall ensure that operator aids contain correct information, which are updated, periodically reviewed and approved.

6.26. A clear operating policy shall be developed to minimize the use of and reliance on temporary operator aids. Where appropriate, they shall be made permanent plant indications or shall be incorporated into plant procedures.

6.27. A programme shall be established to ensure clearly identified and labeled equipment, good environmental conditions, clear and user friendly information systems as well as adequate and well maintained supporting equipment

OPERATING APPROACHES AND PRACTICES

6.28. The responsibilities and authorities of the operators shall be set out clearly in writing. Similarly, the responsibilities and authorities for restarting the reactor after an event leading to a shutdown, scram or to an extended period of maintenance shall be clearly established in writing.

6.29. After a reactor scram or other major transient a thorough investigation of its causes and consequences shall be carried out prior to restart or resumption of full power operation. This investigation shall determine the cause of the scram to prevent recurrence. Restart conditions and criteria and decision authority shall be established and followed after timely implementation of the necessary corrective measures.

6.30. The operating organization shall confirm that off-normal conditions are easily recognizable by the operators. The number of control room alarms, including process computer alarm messages, shall be minimized, considering the operational states of the plant.

6.31. Suitable arrangements shall be made for locking, tagging or otherwise securing isolation points to ensure safety.

SHIFT ARRANGEMENTS

6.32. The shift team shall be staffed to ensure that sufficient authorized operators are present in accordance with the OLCs. The shift staffing patterns, shift cycles and the controls on working hours shall provide sufficient time for shift personnel training.

6.33. Any distractions to the control room operators shall be minimized. Activities shall be scheduled to reduce simultaneous activities and avoid overloading the control room operators to keep them focused on their reactor safety responsibilities.

MATERIAL CONDITIONS AND HOUSEKEEPING

6.34. Material conditions, housekeeping and cleanliness programmes shall be provided to maintain a high standard of operational conditions in all working areas and for all safety and non-safety equipment.

6.35. These programmes shall confirm that operational premises and equipment are maintained, well lit, and accessible and that temporary storage is controlled and limited.

6.36. A foreign materials exclusion programme shall be implemented and monitored.

6.37. It shall be ensured that leaks, corrosion spots, loose parts, unauthorized temporary modifications and damaged thermal insulation are identified, reported and corrected in a timely manner.

CHEMISTRY

6.38. A chemistry programme shall be in place prior to normal operation and shall provide the necessary chemical and radiochemical support to ensure safe operation.

6.39. A chemistry programme shall ensure that the use of substances and reagents shall not adversely affect equipment or lead to its destruction.

6.40. Chemistry surveillance shall verify the effectiveness of chemistry control in plant systems and verify that SSCs important to safety are operated within the specified chemical limit values.

6.41. Chemistry monitoring and data acquisition systems together with laboratory analyses shall accurately measure and record data and provide alarms for key chemistry parameters. Records shall be available and easily retrievable.

6.42. Laboratory monitoring shall involve sampling and analysis of plant systems for specific chemical parameters, dissolved and suspended impurity concentrations, and radionuclide concentrations.

6.43. The use of chemicals in the plant including those brought by contractors shall be controlled.

CORE MANAGEMENT AND FUEL HANDLING

6.44. The operating organization shall be responsible and shall make arrangements for all the activities associated with core management and on-site fuel handling in order to ensure the safe use of the fuel in the reactor and the safety in its movement and storage on and from the site.

6.45. Provisions shall be made to ensure that in each reactor only fuel whose design and enrichment have been adequately manufactured is loaded in the core. In addition, the fuel design and enrichment shall be in accordance with design specifications and approved by the regulatory body for use with that reactor. For the introduction of fuel of a new design or modified fuel into the core the same requirements shall be applied [8].

6.46. For core management, the operating organization shall prepare and issue specifications and procedures for the procurement, incoming control, loading, utilization, shuffling, unloading and testing of fuel and core components. A fuelling programme shall be established in accordance with the design intent and assumptions and shall be submitted to the regulatory body if required. Following batch refueling, calculations/tests shall be performed before and during start-up to confirm that the core performance meets the design intent. It shall be confirmed that all core alterations comply with the predicted configuration [8].

6.47. The operating organization shall be responsible for establishing a safe reactivity management programme under a strong quality management system. Decisions, planning, evaluation, conduct and control of all operations or modifications affecting the fuel liable to affect the reactivity control shall be undertaken using approved procedures and with the respect of pre-defined core operational limits.

6.48. A comprehensive core monitoring programme shall be established to ensure that the core parameters are monitored, analyzed for trends and evaluated to detect abnormal behaviour; that actual core performance is consistent with core design requirements; and that the values of key operating parameters are recorded and retained in a logical, consistent and retrievable manner [8].

6.49. Reactivity manipulations shall be made in a deliberate and carefully controlled manner to ensure that the reactor is maintained within agreed operational limits and conditions and that the desired response is attained.

6.50. The operating procedures for reactor start-up, power operation, shutdown and refueling shall include precautions and limitations necessary to maintain the fuel integrity and comply with the operational limits and conditions throughout the life of the fuel.

6.51. To ensure that fuel cladding integrity is maintained at all times, either in or out of core operating conditions, radiochemistry data that are indicative of fuel cladding integrity shall be systematically monitored and analyzed for trends.

6.52. Appropriate methods shall be established to identify any anomalous changes in coolant activity and to perform data analysis in order to determine the nature and severity of

fuel defects; the locations of fuel defects; the probable root causes of fuel defects; and the recommended corrective actions.

6.53. For fuel and core components, handling procedures shall be written to ensure radiation safety. These procedures shall include the movement of un-irradiated and irradiated fuel, storage on site and preparation for dispatch from the site. The plans for storage of the un-irradiated and irradiated fuel shall be submitted to the regulatory body for approval if so required.

6.54. The packaging, carriage and dispatching of un-irradiated and irradiated fuel shall be carried out in accordance with the IAEA Regulations for the Safe Transport of Radioactive Material [9][8].

6.55. Before any fuel handling takes place, the operating organization shall ensure that an authorized, trained and qualified person is in place, responsible for the control and handling on the site according to written procedures. Access to the fuel storage areas shall be limited to authorized personnel.

6.56. Detailed auditable accounts shall be maintained as required for the storage, irradiation and movement of all fissile material, including un-irradiated and irradiated fuel, for at least as long as the regulator stipulates.

6.57. Appropriate emergency operating procedures shall be established to manage anticipated operational occurrences and design basis accidents in the handling and storage of irradiated fuel. These procedures shall cover events and accidents arising within the plant (criticality, loss of heat removal, dropped loads, internal fires and floods, operator errors and failures of safety related systems) as well as those external to the plant (seismic events, high winds and tornadoes and loss of off-site electrical power) [10].

PERIODIC SAFETY REVIEW

6.58. The safety review of the plant shall be performed periodically. The scope of the safety review shall include all safety aspects of an operating plant.

6.59. A safety review shall be carried out at regular intervals to deal with cumulative effects of plant ageing and plant modifications, operating experience, technical developments and siting aspects and aimed at ensuring high level of safety throughout the service life of the facility (or activity).

6.60. The licensee shall report to the regulatory body, in a timely manner, the confirmed findings of the safety review affecting the license

6.61. In order to complement the deterministic assessment, the probabilistic safety assessment (PSA) shall be used as part of the design process for input to the safety review to provide insight into the relative contributions to safety of different aspects of the plant.

7. PLANT MAINTENANCE

7.1. The operating organization shall prepare and implement effective programmes of maintenance, testing, surveillance and in-service inspection (MTS&I) of those structures, systems and components (SSCs) which are important to safety. These programmes shall be in place prior to fuel loading and shall be made available to the regulatory body.

7.2. Data on maintenance, testing, surveillance and inspection shall be recorded, stored and analyzed to confirm that the operating performance is in accordance with the design intent and with expectations on equipment reliability and availability.

7.3. The frequency including tolerance period of MTS&I of individual SSCs shall be determined on the basis of:

(1) the importance to safety of the SSCs, including insights from PSA;

(2) their operating reliability and availability;

(3) their assessed potential for degradation in operation and their ageing characteristics;

(4) operational experience; and

(5) vendor recommendations.

7.4. All new approaches to MTS&I that may result in significant changes to the approved MTS&I strategies shall be applied after careful safety consideration and appropriate authorization.

MAINTENANCE PROGRAMMES

7.5. Maintenance programmes shall include predictive, preventive, corrective maintenance activities so as to maintain service life of SSC by controlling degradation or preventing its failure or to restore the capability of a failed SSC to function within acceptance criteria.

7.6. A comprehensive and structured approach to identifying failure scenarios shall be used to ensure proper management of maintenance activities based on probabilistic safety analysis (PSA) methodologies.

7.7. The operating organization shall ensure that maintenance executed under power operation is implemented under adequate defense in depth. In addition PSA methodologies shall be used to demonstrate risk equivalent.

7.8. Corrective maintenance to SSCs shall be performed in compliance with operational limits and conditions. Priorities shall be established with account taken first of the relative importance to safety of the defective SSC.

SURVEILLANCE PROGRAMMES

7.9. The operating organization shall develop surveillance programmes to cover the plant's operating lifetime. The objectives of the surveillance programmes shall be to:

(1) maintain and improve equipment availability;

(2) confirm compliance with operational limits and conditions; and

(3) be used to detect and correct any abnormal condition before it can give rise to significant safety consequences.

7.10. The operating organization shall establish procedures for all testing, surveillance and in-service inspection tasks. These procedures shall be prepared, reviewed, modified when required, validated, approved and distributed in accordance with established management control procedures.

7.11. The operating organization shall ensure that before any system or component important to safety is returned to service after maintenance, integrating tests shall be performed to ensure that the objective of the maintenance has been achieved.

CONDUCT OF MTS&I AND WORK CONTROL

7.12. A comprehensive work planning and control system shall be implemented to ensure that maintenance, testing, surveillance and inspection (MTS&I) work is properly authorized and is carried out safely in accordance with established procedures. Co-ordination shall be established among different maintenance groups (for mechanical, electrical, instrumentation and control, and civil maintenance), and with operations and support groups (groups for fire protection, radiation protection, physical protection and industrial safety).

7.13. The work control system shall ensure that plant equipment is released from service for maintenance, testing, surveillance or inspection with the authorization of designated operations staff and in compliance with the operational limits and conditions.

7.14. An adequate workcontrol system shall be in use for the protection of equipment and the safety of personnel during MTS&I. Transfer of pertinent information shall occur at Operations' shift turnovers and at MTS&I pre- and post-job briefings.

7.15. The work control system shall ensure that permission to return equipment to service, following MTS&I, is issued by the operating personnel only after completion of a documented check that the new plant configuration is within the established operational limits and conditions, and when appropriate, functional tests are performed.

7.16. The system for documenting deficiencies shall be clearly established. The system shall ensure that operating crews are not overly burdened and plant risk is not significantly increased by their cumulative effect.

7.17. The operating organization shall ensure that identification and labeling of safety and safety related equipment, rooms, piping and instruments are accurate, legible and maintained.

SPARE PARTS AND MATERIALS

7.18. The operating organization shall establish suitable arrangements to procure, receive, control, store and issue materials, spare plant items and components for use with systems important to safety [3].

7.19. Spare parts and materials important to safety shall be accompanied by documentation indicating that all requirements specified in the purchase order have been met.

7.20. The operating organization shall be responsible for the procurement and shall ensure that materials and items are obtained only from approved suppliers [11].

7.21. The operating organization shall ensure that adequate storage conditions exist (fire risk prevention, prevention of unauthorized access, specific packaging,) and a requirement for limited shelf-life exists to prevent deterioration [11].

7.22. Plant management shall include steps to initiate, control and record the modification of spare parts following modification of the equivalent items installed at the plant [see chapter 8].

OUTAGE MANAGEMENT

7.23. The operating organization shall ensure the effective performance and control of maintenance activities during planned and forced outages. Outage planning and performance shall take safety as its primary consideration.

7.24. The operating organization shall be responsible for issuing programmes and procedures for outage management and the provision of adequate resources.

7.25. Outage planning shall be a continuing, improving process involving past, current, next scheduled and future outages. Milestones shall be determined and used to track pre-outage work.

7.26. The tasks, authorities and responsibilities of the groups and persons involved in preparing, conducting or assessing outage schedules and activities shall be set out in writing and followed by all involved plant and contractor staff.

7.27. The interfaces between outage responsible group and other groups including on-site and off-site human resources shall be clearly defined. Operating personnel shall be kept informed of current maintenance, modification and testing activities. The responsibility for safety shall remain with the operating organization

7.28. Optimization of radiation protection and industrial safety, waste reduction, control of chemical hazards shall be embedded in outage programmes and planning and well communicated to relevant plant staff and contractors.

7.29. A comprehensive review shall be performed after each outage to capture lessons learned.

8. PLANT MODIFICATIONS

PLANT MODIFICATION PROGRAMME

8.1. An appropriate modification control shall be implemented to handle all technical, human and organizational aspects of modifications. Modification control shall ensure that all modifications are properly identified, screened, designed, evaluated, authorized, implemented, and recorded.

8.2. Modification control shall be applied also to organizational changes. Modifications which are relevant to the safe operation of the plant or relevant for the license shall be reported to the regulatory body and approval obtained if necessary. [2]

PLANT PERMANENT AND TEMPORARY MODIFICATIONS

8.3. Proposed modifications to structures, systems and components important to safety, which affect the bases on which the operating license was issued, to the operational limits and conditions, and to procedures and other documents originally approved by the regulatory body shall be submitted to the regulatory body for prior approval and for introduction of changes to the operating license, if required. Any other proposed modifications shall be submitted to the regulatory body for prior approval if so required. Modifications shall be categorized according to their safety significance.

8.4. Modification control in compliance with the requirements set out in Ref. [8][8] shall ensure proper design, safety assessment and review, control, implementation and testing of all permanent or temporary modifications.

8.5. Temporary modifications shall be limited in time and number. They shall be clearly identified at their location and any relevant control position. The licensee shall establish a formal system of informing personnel in due time on temporary modifications and of their consequences for the operation and safety of the plant.

8.6. The modification control shall include reassessment and updating (if needed) of plant referenced simulator and any computer models used.

8.7. The plant management shall establish a procedure for updating documents as soon as possible after a modification important to safety has been installed and tested. Responsibilities for the revision of all documents shall be clearly assigned.

9. LONG TERM OPERATION, EQUIPMENT QUALIFICATION AND AGEING MANAGEMENT

MANAGEMENT SYSTEM OF PLANT CONFIGURATION AND STATUS

9.1. A plant configuration management system shall be established and implemented to ensure consistency among design requirements, physical configuration, and plant documentation, and to maintain this consistency throughout the life time of the plant [8].

9.2. Plant configuration controls shall ensure that changes to the plant and the safety related systems are properly identified, screened, designed, evaluated, implemented, and recorded. Proper controls shall be implemented to handle changes in plant configuration that result from maintenance, modifications, ageing of components and testing activities, operating experience and technical developments and operational limits and conditions.

LONG TERM OPERATION

9.3. Long term operation (LTO) is operation beyond an established timeframe set forth by license term, design limits, standards, and/or regulations, which has been justified by safety assessment considering ageing of systems, structures and components (SSCs). LTO shall be based on the results of periodic safety review (PSR) and approved by the regulatory body on the basis of the analysis of the ageing management program that will assure plant safety during its extended life time [8].

9.4. A comprehensive LTO program shall be established and implemented. The programme shall address:

(1) preconditions (including current licensing basis, safety upgrading and verification, and operational programmes);

(2) scoping of SSCs (based on safety significance);

(3) screening of SSCs (categorization of SSCs) with respect to degradation and ageing processes;

(4) re-validation of safety analyses that used time limited assumptions;

(5) review of ageing management programmes;

(6) plant implementation programme for LTO.

9.5. Implementation of the LTO process shall be approved by or agreed to by the regulatory body.

9.6. The LTO process shall be implemented and its results made available to the regulatory body before entering LTO.

EQUIPMENT QUALIFICATION (EQ)

9.7. An appropriate programme to establish, confirm and maintain required equipment qualification (EQ) shall be launched from the initial phases of designing, supplying and installation of the equipment. Effectiveness of EQ programmes shall be periodically reviewed [8].

9.8. A systematic assessment shall be conducted in order to provide confirmation that the safety item is capable of the required performance during operational states and accident conditions.

9.9. The details and scope of EQ process, in terms of required inspection area(s), method(s) of non-destructive testing, defects being sought and required effectiveness of inspection, shall be documented and submitted to the regulatory body for review and approval. Relevant national and international experience shall be taken into account.

9.10. A systematic assessment shall be conducted by all necessary methods to provide reliable confirmation that the safety item is capable of the required performance under real operational and accident conditions. Appropriate concepts, scope and the process of EQ shall be established. Effective and practical methods shall be used to upgrade and preserve EQ. Effectiveness of EQ programmes in operational NPPs shall be reviewed.

AGEING MANAGEMENT

9.11. An effective ageing management programme (AMP) of structures, systems and components (SSCs) important to safety shall be implemented to ensure that required safety functions are maintained during the entire plant life cycle, determine their possible consequences, and determine necessary activities in order to maintain the operability and reliability of these SSCs..

9.12. The AMP shall be coordinated and consistent with other relevant programmes.

9.13. A systematic approach shall be used to provide for the development, implementation and continuous improvement of AMPs.

9.14. The details and scope of any qualification process, in terms of required inspection area(s), method(s) of non-destructive testing, defects being sought and required effectiveness of inspection, shall be submitted to the regulatory body. Relevant national and international experience shall be taken into account.

9.15. Long term effects arising from environmental conditions (i.e. temperature, corrosion effects or other degradations in the plant that may affect long term reliability of plant equipment or structure) shall be evaluated and assessed as part of this programme. The programme shall take the safety relevance of the SSCs into account.

10. TRANSITION TO DECOMMISSIONING

10.1. The operating organization (the licensee) shall prepare a decommissioning plan [15] which shall be agreed by the regulatory body well in advance before the beginning of decommissioning or before the operating license of the NPP expires.

10.2. The decommissioning plan shall be updated regularly to reflect regulatory requirements, changes in the plant, advances in the technology and the needs of the decommissioning activities or national policies [15].

10.3. A specific human resource programme shall be developed to ensure that arrangements are in place to ensure that sufficient motivated and qualified human resources are available for safe operation leading to final shutdown, to conduct activities in a safe manner during transition period and to safely carry out the decommissioning of the plant.

10.4. As long as the nuclear fuel is not removed from the facility, the high level of operational safety shall be maintained

10.5. In case of multiple units plant, appropriate measures shall be in place to ensure that common systems and equipment are fully available for safe operation the unit(s) in operation.

10.6. The operating organization shall be aware, over the operating lifetime of the plant, of the needs in respect of eventual decommissioning. Experience and knowledge gained with respect to contaminated or irradiated structures, systems and components in modification and maintenance activities at the plant shall be recorded and retained in order to facilitate the planning of decommissioning. Reviewed and complete information shall be prepared to be transferred to the organization responsible for managing the decommissioning phase.

10.7. The safety impacts of the activities in transition phase prior to commencement of decommissioning shall be assessed and managed so that hazards are managed. [15]

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