IAEA-EBP-LTO-03

21-05-04

EXTRABUDGETARY PROGRAMME ON SAFETY ASPECTS OF LONG TERM OPERATION OF WATER MODERATED REACTORS

STANDARD REVIEW PROCESS

INTERNATIONAL ATOMIC ENERGY AGENCY

1. INTRODUCTION

The number of Member States giving high priority to extending the operation of nuclear power plants beyond their initial license is increasing. Decisions on long term operation (LTO) involve the consideration of a number of factors. While many of these decisions concern economic viability, all are grounded in the premise of maintaining plant safety. The IAEA recognized this new industry initiative; therefore, in the 1990's, it developed comprehensive generic guidance on how to manage the safety aspects of physical ageing. It was recognized, however, that internationally agreed-upon, comprehensive guidance was needed to assist regulators and operators in dealing with the unique challenges associated with the LTO issue.

In response, the IAEA initiated this Extrabudgetary Programme (Programme) on 'Safety aspects of long term operation of water moderated reactors' (original title was 'Safety aspects of long term operation of pressurized water reactors'). The Programme's objective is to establish recommendations on the scope and content of activities to ensure safe long term operation of water moderated reactors. The Programme should assist regulators and operators of water moderated reactors, and, in particular WWERs, in ensuring that the required safety level of their plants is maintained during long term operation, should provide generic tools to support the identification of safety criteria and practices at the national level applicable to LTO, and should provide a forum in which MS can freely exchange information.

The Programme activities are guided by the Programme Steering Committee (SC), follow the overall SC Programme Workplan and SC Terms of Reference, [1], and implemented in 4 Working Groups (WG). The WGs focus on:

- general LTO framework;
- mechanical components and materials;
- electrical components and I&C;
- structures and structural components.

Further detailed information on the Programme could be found at: http://www-ns.iaea.org/nusafe/s_projects/salto_int.htm .

The Working Group Leaders and Secretaries developed during the Programme Planning Meeting held in August 2003 detailed Workplans and Programme schedule for each of the 4 WGs in line with the Programme SC recommendations [2]. The need of consistent structure for the work across the four WGs, which would facilitate coherent reporting of the results, was also discussed. It was agreed to follow an Standard Review Process (SRP), provided in this report, in the Programme activities. This SRP was drafted by the WG leaders and secretaries, subsequently reviewed and finalized to accommodate the differences between WG 1 and WG 2-4, and finally approved by the SC. This SRP along with the finalized and approved Workplans [4] serve as the Terms of Reference for the WGs activities in the frame of this Programme.

2. OBJECTIVE

The objectives of this SRP are to:

- ensure a well defined, uniformly structured and comprehensive approach to the collection of information and review processes;
- facilitate communication among the Programme participants;
- define a scope of activities that clearly identifies the specific elements of LTO that this Programme addresses

This SRP specifies, in general terms, the information to be supplied by MS participating in this Programme, its structure, format and contents (WG specific) and the requirements for the review. The use of this SRP will assist in achieving the overall Programme objectives, in particular establish an internationally agreed document that will provide MS with specific guidance for long term operation.

3. SCOPE OF REVIEWS

As stated in the introduction, LTO of a nuclear power plant involves consideration of a number of factors to ensure plant safety during LTO operation. The Steering Committee agreed in its May 2003 meeting [1], to use the IAEA Safety Guide on Periodic Safety Review of Nuclear Power Plants (PSR) [3] as a reference to define the common terms associated with plant safety. The Safety Guide [3] introduces the concept of fourteen safety factors (and a number of associated elements), covering the whole scope of overall plant safety.

The scope of activities of this Programme does not cover all the safety factors/elements listed in the Appendix of [3]. Each WG will identify those safety factors and elements, for which information needs to be collected, reviewed, and reconciled to meet the WG objectives as specified in [4]. Appendix I of this SRP provides a reference that clearly identifies the safety factors/elements that each working group will address in the frame of this Programme.

The Steering Committee also recognized the essential role of two other processes, the design basis management and configuration management. The interaction of design basis management, periodic safety review (or current licensing basis), configuration management and long term operation are shown in the Fig. 1. below with a brief explanation.

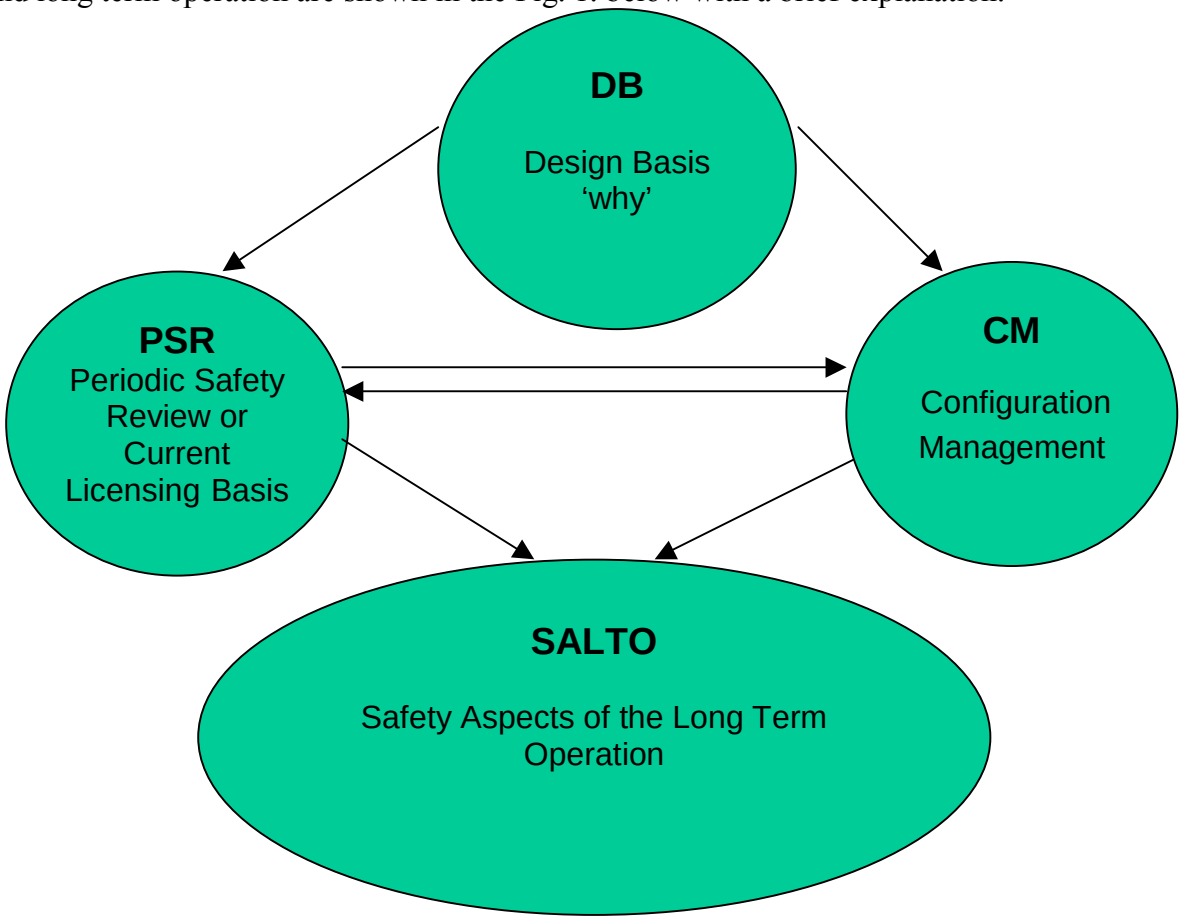


FIG. 1. Key elements for successful LTO programme

Periodic safety review (PSR) or current licensing basis and configuration management (CM) are complementary programmes. A plant must be able to retrieve design, operating and safety informations that is accurate and reflects the actual configuration. It is the CM program's goal to ensure that the infrastructure to make that happen is in place. CM is an integrated program (total site) to collect and manage plant configuration information from conceptual design through its operating lifetime, including all changes made.

4. REQUIRED INFORMATION

This section of the document describes the minimum information that must be gathered for each of the WG to meet its objectives [4] as well as overall Programme objectives and outcomes [1].

4.1. GENERAL LTO FRAMEWORK – WORKING GROUP 1

The objectives of WG 1 are to:

- Identify pre-conditions for LTO;
- Review regulatory approaches to LTO in participating MS;
- Reach a consensus on a regulatory approach and safety criteria for LTO on the basis of deterministic, probabilistic or a combination of deterministic and probabilistic analyses;
- Identify necessary information contained in design and safety basis documents to establish a baseline for LTO;
- Identify attributes of acceptable plant upgrading and aging management program for LTO;
- Establish guidance on approaches to LTO;
- Discuss future challenges.

Working Group 1 will require information that describes the following topical areas to complete its objectives.

- Laws and regulations relevant to LTO.
- Current design basis requirements including any design codes and standards used. In particular, maintenance practices, EQ, QA practices, FSAR update, ISI programs, and TLAA should be highlighted.
- Any upgrading of design basis requirements performed, including PSRs.
- Any considerations given to, or activities planned or taken for, LTO
- Existing plant programs that are directly related to LTO.
- Available research results and operating experiences that are directly related to LTO.
- Compilation of a list of reference documents from which the above information was collected.

Table I. shows typical information sources that may be used to develop or retrieve the topical information described above. There may be information sources available to MS that are not identified in Table I. and these sources should be considered as well.

TABLE I. SAMPLE LISTING OF WG 1 POTENTIAL INFORMATION SOURCES

Updated Final Safety Analysis Report including, Periodic Safety Review documents, or any other reports that established the design basis for the plant operation.
Documents of governing laws and regulations relevant to LTO and the implementation process of the laws and regulations.
Documents of plant's operating experience history or database.
Design basis requirements documents.
Design codes and standards used in all areas of design associated with LTO.
Documents that describe existing plant programmes, including, but not limited to, QA programmes for selected structures, systems and components in-service inspection, environmental qualification of mechanical and electrical equipment, and maintenance as well as time limited ageing analysis.
Research reports that contain ageing information of structures and components within the scope of LTO.
Documents on the process and basis used to scope the structures, systems and components for the purpose of LTO.
Documents that were issued to the operators by the authority or regulatory body and that contained requirements relevant to LTO (e.g., requirements for ageing management).
Documents that were submitted to the authority or regulatory body and that contained the operator's commitments for plant LTO (e.g., evaluation of system interaction.

4.2. MECHANICAL COMPONENTS AND MATERIALS – WORKING GROUP 2

The objective of Working Group 2 on Mechanical Components and Materials is to develop tools to support the identification of safety criteria and practices for the area of mechanical components and material associated with the long term operation (LTO). Providing such tools will assist regulators and operators of NPPs in ensuring that the required safety level of their plants is maintained during LTO.

Working Group 2 will require information that describes the following topical areas to complete its objectives.

- The process used in developing the scope of systems, structures and components (SSCs) that are subject to the long term operation (LTO) review.
- Design basis information verified by configuration management (The intent is not to collect design basis information but rather to verify that the design basis is properly controlled through configuration management).
- In-service inspection and surveillance practices for passive and active components, including any augmented inspection programs that address issues such as erosion/corrosion, augmented inspection of steam generator tubing or augmented inspection for specific degradation mechanisms such as intergranular stress corrosion cracking, thermal fatigue due to stratification, etc.
- Condition monitoring or surveillance to mitigate degradation mechanisms
- Maintenance practices for active components
- Applicable aging effects on structure and component intended function(s)
- Aging management programs
- Plant-specific safety analyses which may have been based on an explicitly assumed plant life or operating period, number of cycles, cumulative load, etc. (for example, aspects of the reactor vessel design may assume a 40 year life or a limit on neutron fluence on the vessel wall)
- Information from applicable research projects
- Operational experience

Table II. shows typical information sources that may be used to develop or retrieve the topical information described above. There may be information sources available to MS that are not identified in Table II. and these sources should be considered as well.

TABLE II. SAMPLE LISTING OF WG 2 POTENTIAL INFORMATION SOURCES

Requirements for periodic safety review or safety evaluation report
Verified databases of operational experience (a database that is subject to administrative controls to assure and maintain the integrity of the stored data or information)
Updated final safety analysis reports (UFSAR)
Piping and instrument diagrams (P&IDs)
Operations and training handbooks
Design basis documents and design drawings
General arrangement or structural outline drawings
Quality assurance plan or program
National in-service inspection codes
Design basis event evaluations
Residual life assessments reports
Correspondence with the regulator
System interaction commitments
Technical specifications
Regulatory compliance reports (including safety evaluation reports)
Research reports

4.3. ELECTRICAL COMPONENTS AND I&C – WORKING GROUP 3

The objective of Working Group 3 on electrical components and I&C (E/I&C) is to develop guidance and information to support the identification of safety criteria and practices for E/I&C associated with the LTO. Providing this guidance and information will assist regulators and operators of NPPs in ensuring that the required safety level of their plants is maintained during LTO.

Working Group 3 will require information that describes the following topical areas to complete its objectives.

- the regulatory requirements, approaches and laws (if applicable) associated with aging and aging management of E/I&C essential to safe LTO in the MS (including requirements for SAR, PSR, SAR for modernization project and for safety evaluation report and regulatory compliance reports, corrective action reports, etc.);
- operators approaches, processes, practices (experiences) associated with aging and aging management of E/I&C essential to safe LTO in the MS (including existing operators/plant programs, procedures, quality assurance plan or programs, aging management programs, technical specifications, verified databases of E/I&C operational experience etc., related to E/I&C LTO);
- available research activities (results and existing programs) that are directly related to E/I&C LTO.

Table III. shows typical information sources that may be used to develop or retrieve the topical information described above. There may be information sources available to MS that are not identified in Table III and these sources should be considered as well.

TABLE III. SAMPLE LISTING OF WG 3 POTENTIAL INFORMATION SOURCES

Requirements for periodic safety review or safety evaluation report
Verified databases of E/I&C operational experience (a database that is subject to administrative controls to assure and maintain the integrity of the stored data or information)
Regulatory compliance reports (including safety evaluation reports)
Safety analysis reports or assessments for I&C modernization
Operators ageing management plan or program for E/I&C SSC
Technical specifications
National ageing management guidelines
E/I&C SSC design basis event evaluations
Reports on national research programmes related to ageing of E/I&C SSC
Qualification program for E/I&C
National Rules and Regulations for repair, replacement and upgrading

4.4. STRUCTURES AND STRUCTURAL COMPONENTS – WORKING GROUP 4

The objective of Working Group 4 is to develop tools to support the identification of safety criteria and practices for structures and structural components associated with the LTO. Providing such tools will assist regulators and operators of NPPs in ensuring that the required safety level of their plants is maintained during LTO.

Working Group 4 will collect and process information in relation to the following areas:

1. Regulatory position
    - Collect regulatory docs: only those relevant to structures
2. Scope of the LTO program
    - Table with the items included in the LTO program
    - Criteria for selection of items in the scope of this report. Suggested items are:
        a. Containment/confinement/pressure boundary structures and including the spent fuel pool;
        b. Structures inside the pressure boundary (compartment box, reactor box, etc.) including anchorages, penetrations, hatches, etc.;
        c. Other safety classified buildings;
        d. Water intake structures including buried pipelines;
        e. Foundations;
        f. Other structures where significant degradation has been recorded.
3. Reference degradation mechanisms. The following mechanisms should be described:
    - Only those mechanisms which are life limiting
    - Mechanisms considered in general in the operating experience of your country
    - Mechanisms from R&D

- Mechanisms particularly important for the LTO of your plants: their most significant effects, their location, how they affect the LTO of the plant

4. MS&I
    - ISI, monitoring and surveillance practice
    - Periodical test practices (integrity, leak tightness, etc.) (both current practice and R&D)
5. Trend analysis and evaluation of the safety margin
    - Analytical and numerical methods (both current practice and R&D)
    - Assessment techniques for existing structures
6. Maintenance practice, mitigation measures and repair technology
7. AMP characteristics
    - Organizational, management issues and interfaces with other plant processes
8. References

Table IV shows typical information sources that may be used to develop or retrieve the topical information described above. There may be information sources available to MS that are not identified in Table IV and these sources should be considered as well.

TABLE IV. SAMPLE LISTING OF POTENTIAL INFORMATION SOURCES

Requirements for periodic safety review or safety evaluation report
Verified databases of operational experience (a database that is subject to administrative controls to assure and maintain the integrity of the stored data or information)
Updated final safety analysis reports
Design basis documents and design drawings
General arrangement or structural outline drawings
Ageing management plan or program of the operating companies
National in-service inspection codes, guidelines
National ageing management guidelines
Design basis event evaluations
Emergency operating procedures
Reports on national research programmes related to ageing of structures and structural components
System interaction commitments
Technical specifications
Regulatory compliance reports (including safety evaluation reports)

5. REVIEW GUIDELINES

WGs will review the *Country information report* submitted by each MS participating in this Programme. The reviews will be conducted to permit conclusions concerning the following topics:

- Identify and define the common elements of national practices in maintaining safe operation during LTO.
- Identify and define differences of national practices in maintaining safe operation during LTO.
- Identify generic challenges (LTO related) to be resolved.
- Develop guidance on developing and improving programmes and practices to support safe LTO.

6. REPORTING

6.1. COUNTRY INFORMATION REPORTS

Each MS participating in the EBP will submit a *Country information report* that provides the information agreed upon in Sections 4.1 through 4.4. of this SRP. These reports will summarize available detailed national requirements, practices and approaches including a list of underlying references. The individual MS *Country information report* should conform to the respective task formats agreed within WGs and should be developed in line with the table of contents provided in Appendix II of this report.

6.2. WG FINAL REPORTS

The *WG Final Reports* table of contents should conform to Appendix III of this SRP. Under each technical item (heading) in the *WG Final Reports*, the following subsections will be included:

- One subsection will summarize the applicable laws, regulatory requirements and operational approaches to regulating and managing the long term operation;
- One subsection will define the differences between the applicable laws, regulatory requirements and operational approaches;
- One subsection will identify potential safety issues where additional regulatory and/or operational development may be needed, unresolved safety issues and future challenges that need to be resolved.
- One subsection will contain related recommendations and conclusions.

6.3. PROGRAMME FINAL REPORT

The *Programme Final Report on Recommendations on the Scope and Content of Programmes for Safe Long Term Operation of Water Moderated Reactors*, will consist of a introductory part, inputs by each WG based on the WG Final Reports summary, and overall conclusions and recommendations.

7. REFERENCES

[1] Minutes of the Programme's 1st Steering Committee Meeting, IAEA-EBP-LTO-01, Vienna 2003 (internal EBP report).

[2] Minutes of the Programme's Planning Meeting, IAEA-EBP-LTO-02, Vienna 2003 (internal EBP report).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Periodic Safety Review of NPPs: A Safety Guide, No. NS-G-2.10. IAEA, Vienna (2003).

[4] Programme's Working Groups Workplans, IAEA-EBP-LTO-08, Vienna 2004 (internal EBP report).

GLOSSARY

Ageing

General process in which characteristics of a structure, system or component gradually change with time or use.

Ageing Management

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

- Examples of engineering actions include design, qualification, and failure analysis. Examples of operations actions include surveillance, carrying out operational procedures within specified limits, and performing environmental measurements.

- **life management (or life cycle management)** is the integration of ageing management with economic planning to: (1) optimize the operation, maintenance and service life of structures, systems and components; (2) maintain an acceptable level of performance and safety; and (3) maximize return on investment over the service life of the facility.

Configuration Management

The process of identifying and documenting the characteristics of a facility's structures, systems and components (including computer systems and software), and of ensuring that changes to these characteristics are properly developed, assessed, approved, issued, implemented, verified, recorded and incorporated into the facility documentation.

Current Licensing Basis (CLB)

For example in the USA is the set of US NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect. The CLB includes the NRC regulations contained in 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 54, 55, 70, 72, 73, 100 and appendices thereto; orders; license conditions; exemptions; and technical specifications. It also includes the plant-specific design-basis information defined in 10 CFR 50.2 as documented in the most recent final safety analysis report (FSAR) as required by 10 CFR 50.71 and the licensee's commitments remaining in effect that were made in docketed licensing correspondence such as licensee responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations or licensee event reports.

Design Basis

The range of conditions and events taken explicitly into account in the design of a facility, according to established criteria, such that the facility can withstand them without exceeding authorized limits by the planned operation of safety systems. Any combination of the specifications, criteria, codes, standards, analyses, constraints, qualifications and limitations which determine the functions, interfaces, and expectations of a facility, structure, system or component. The Design Basis identifies and supports "WHY" design requirements are established. Calculations are typically considered part of design basis. Calculations

generally translate design basis into design requirements or confirm that a design requirement supports the design basis.

Design Requirements

An engineering requirement reflected in design output information (document and/or data) that defines the form, fit and function, including capabilities, capacities, physical sizes and dimensions, limits and set points, specified by the design authority for a structure, system or component of the facility. Each design requirement has a design basis, documented or not.

Items Important to Safety

See plant equipment.

Licensing Basis

A set of regulatory requirements, applicable to a nuclear facility. Those aspects of the facility design basis relied upon by the agency, which authorises or licenses the facility operation (sometimes called authorisation basis). These aspects are considered to be important to the safety of facility operation. The licensing basis is described in the licensing documents.

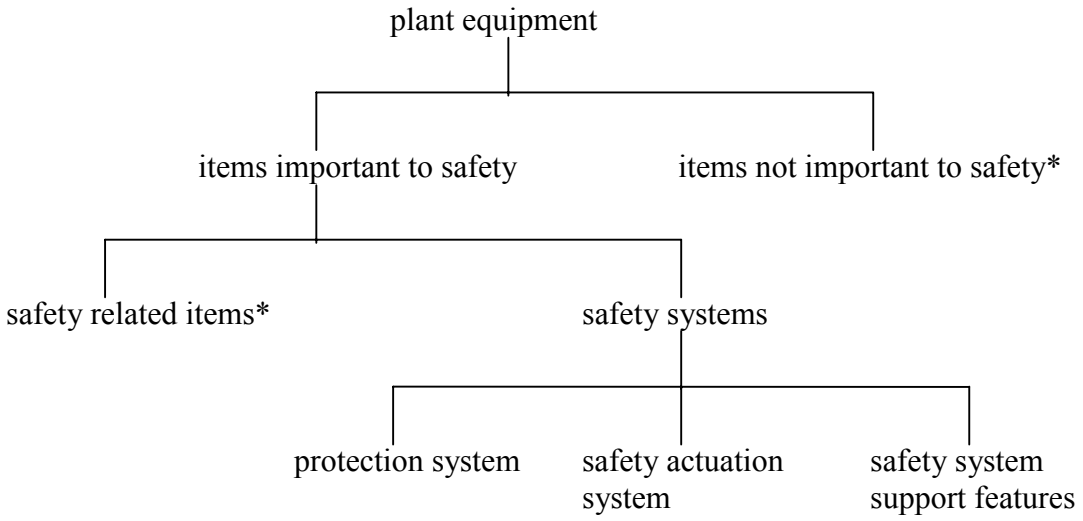
Long Term Operation

Operation beyond an established timeframe (licence, design, etc.), which was derived considering life limiting processes and features for SSCs.

Periodic Safety Review

A systematic reassessment of the safety of a nuclear power plant carried out at regular intervals to deal with the cumulative effects of ageing, modifications, operating experience, technical developments and siting aspects that is aimed at ensuring a high level of safety throughout plant service life.

Plant Equipment



* In this context, an ‘item’ is a structure, system or component.

item important to safety: An item that is part of a safety group and/or whose malfunction or failure could lead to radiation exposure of the site personnel or members of the public.

- Items important to safety include:
  - those structures, systems and components whose malfunction or failure could lead to undue radiation exposure of site personnel or members of the public;
  - those structures, systems and components which prevent anticipated operational occurrences from leading to accident conditions; and
  - those features which are provided to mitigate the consequences of malfunction or failure of structures, systems or components.

protection system: System which monitors the operation of a reactor and which, on sensing an abnormal condition, automatically initiates actions to prevent an unsafe or potentially unsafe condition.

- The "system" in this case encompasses all electrical and mechanical devices and circuitry, from sensors to actuation device input terminals.

safety actuation system: The collection of equipment required to accomplish the necessary safety actions when initiated by the protection system.

safety related item: An item important to safety which is not part of a safety system.

safety system: A system important to safety, provided to ensure the safe shutdown of the reactor or the residual heat removal from the core, or to limit the consequences of anticipated operational occurrences and design basis accidents.

- Safety systems consist of the protection system, the safety actuation systems and the safety system support features. Components of safety systems may be provided solely to perform safety functions or may perform safety functions in some plant operational states and non-safety functions in other operational states.

safety system support features: The collection of equipment that provides services such as cooling, lubrication and energy supply required by the protection system and the safety actuation systems.

Time Limited Ageing Analyses

For example in the USA as defined in the 10CFR54.3, are those licensee calculations and analyses that:

- Involve systems, structures, and components within the scope of license renewal;
- Consider the effects of aging;
- Involve time-limited assumptions defined by the current operating term, for example, 40 years;
- Were determined to be relevant by the licensee in making a safety determination;
- Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended functions; and
- Are contained or incorporated by reference in the CLB.

APPENDIX I.

This Appendix is intended to help clearly define the specific safety factors/elements that each WG and hence the program will address in the frame of this Programme. As agreed upon by the Steering Committee this Appendix will be used to help organize the collection and review of information during the conduct of this programme. The mark '■' indicates that the respective WG considers this factor/element important for LTO and intends to address it in the frame of this Programme.

SAFETY FACTOR/ELEMENT	WG			
	1	2	3	4
Plant				
PLANT DESIGN				
A detailed description of the plant design, supported by layout, system and equipment drawings.		■	■	■
List of SSCs important to safety and their classification.	■	■	■	■
Documented design basis (original and updated).	■	■	■	■
Significant differences (strengths and shortcomings) between the present plant design and the current standards (used for comparison).	■	■	■	■
Safety significance of the identified shortcomings relating to the implementation of defence in depth.	■		■	
ACTUAL CONDITION OF SYSTEMS, STRUCTURES AND COMPONENTS				
List of SSCs important to safety and their classification.	■	■	■	■
Information about the integrity and functional capability of SSCs important to safety, including material case histories.		■	■	■
Information on existing or anticipated obsolescence of any SSCs important to safety.		■	■	■
Findings of tests which demonstrate the functional capability.		■	■	■
Results of inspections.		■	■	■
Maintenance records.		■	■	■
Description of the present condition of SSCs important to safety.		■	■	■
Description of the support facilities available to the plant both on and off the site, including maintenance and repair shops.		■	■	■
EQUIPMENT QUALIFICATION				
List of equipment covered by the equipment qualification programme and a list control procedure.	■	■	■	
Qualification report and other supporting documents (e.g. equipment qualification specifications, qualification plan).		■	■	
Verification that the installed equipment matches the qualified equipment.			■	
Procedures to maintain qualification during the installed life of the equipment.	■	■	■	
Mechanisms for assuring compliance with these procedures.	■	■	■	
Surveillance programme and a feedback procedure to ensure that ageing degradation of qualified equipment remains insignificant.	■	■	■	
Monitoring actual environmental conditions; identification of "hot spots".		■	■	■
Analysis of the effect of equipment failures on equipment qualification and appropriate corrective actions to maintain equipment qualification.	■	■	■	
Protection of qualified equipment from adverse environmental conditions.		■	■	
Physical condition and functionality of qualified equipment (confirmed by walkdowns).		■	■	
Records of all qualification measures taken during the installed life of the equipment.		■	■	
AGEING				
Programme policy, organization and resources.	■	■	■	■
Documented method and criteria for identifying SSCs covered by the ageing management programme.	■	■	■	■
List of SSCs covered by the ageing management programme and records which provide information to support management of ageing.		■	■	■
Evaluation and documentation of potential ageing degradation that may affect the safety functions of SSCs.		■	■	■
The extent of understanding of dominant ageing mechanisms of SSCs.		■	■	■
Availability of data for assessing ageing degradation including baseline, operating and maintenance history.	■	■	■	■
Effectiveness of operational and maintenance programmes in managing ageing of replaceable components.		■	■	■
The programme for timely detection and mitigation of ageing mechanisms and/or ageing effects.		■	■	■
Acceptance criteria and required safety margins for SSCs.		■	■	■
Awareness of physical condition of SSCs, including actual safety margins, and any life limiting features.	■	■	■	■
Safety Analysis:				
DETERMINISTIC SAFETY ANALYSIS				
A compilation of the existing deterministic safety analyses and its assumptions.	■	■	■	
Limits and permitted operational states.	■	■	■	
Anticipated operational occurrences.	■	■	■	
Postulated initiating events (for the existing safety analyses and a comparable list for a modern nuclear power plant),[6].	■	■	■	
Analytical methods and computer codes used in the existing deterministic safety analyses and comparable methods for a modern nuclear power plant, including validation.		■		
Radiation dose and release limits for accident conditions.	■			

Guidelines for deterministic safety analyses, including for single failure criterion, redundancy, diversity and separation.	■	■-	■	
PROBABILISTIC SAFETY ANALYSIS				
Existing PSA and its assumptions.	■	■	■	
Updating of PSA to reflect the current plant status.	■	■	■	
Postulated initiating events (for the existing PSA and a comparable list for a modern nuclear power plant).	■	■		
Analytical methods and computer codes used in the existing PSA and comparable methods for a modern nuclear power plant, including validation.				
Guidelines for PSA of operator action, common cause events, cross-link effects, redundancy, and diversity.				
Consistency of accident management programme for beyond design basis accidents with PSA results.				
HAZARD ANALYSIS				
Internal hazards:				
– fire (prevention, detection, suppression)				
– flooding				
– pipe whip				
– missiles				
– steam release				
– spray				
– toxic gas				
– explosion.				
External hazards:				
– changes in site characteristics				■
– flooding, including Tsunami				
– high winds				
– temperature extremes				
– seismic				
– airplane crash				
– toxic gas				
– explosion.				
Performance and feedback of experience:				
SAFETY PERFORMANCE				
System for identifying and classifying safety related incidents (incident reporting).	■	■	■	■
Arrangements for root cause analysis of incidents and implementation of results.	■	■	■	■
Methods for selecting and recording safety related operational data, including those for maintenance, test and inspection.	■	■	■	■
Trend analyses of safety related operational data.		■	■	■
Feedback of safety related operational data into the operating regime.		■	■	
Analyses of safety performance indicators such as:		■	■	
– the frequency of unplanned trips while a reactor is critical		■	■	
– the frequency of selected safety system actuation/demands		■	■	
– the frequency of safety system failures		■	■	
– safety system unavailability		■	■	
– the collective radiation dose per year				
– failure cause trends (operator errors, plant problems, administration, control problems)		■	■	
– the backlog of outstanding maintenance		■	■	
– the extent of repeat maintenance			■	
– the extent of corrective (breakdown) maintenance		■	■	
– the frequency of unplanned operator actions in the interests of safety and their success rate		■		
– the rate of arisings of nuclear waste				
– the quantities of stored nuclear wastes.				
Records of the integrity of physical barriers for radioactivity containment.		■		■
Records of radiation doses to persons on site.				
Records of off-site radiation monitoring data.				
Records of the quantities of radioactive effluents.				
USE OF EXPERIENCE FROM OTHER PLANTS AND OF RESEARCH FINDINGS				
Arrangements for feedback of experience relevant to safety from other nuclear power plants and other relevant non-nuclear plants.	■	■	■	■
Assessments of and actions on the above experience.		■	■	■
Arrangements for the receipt of information on the findings of relevant research programmes.	■	■	■	■
Assessments of and actions on the research information.		■	■	■
Plant modifications resulting from the above.			■	■
Management				
ORGANIZATION AND ADMINISTRATION				
Safety policy, which states that safety takes precedence over production and its implementation.	■			■
Mechanism for setting of operating and safety targets.	■			■
Documented roles and responsibilities of individuals and groups.				■
Procedures for the feedback of experience to the staff, including the experience relating to organizational and management failures.	■			■
Mechanisms for maintaining configuration of the nuclear power plant and its documentation.	■			

Formal arrangements for employing external technical, maintenance or other specialist staff.				
Staff training facilities and programmes.				
QA programme and regular QA audits involving independent assessors.	■			
Compliance with regulatory requirements.	■			
Comprehensive, readily retrievable and auditable records of baseline information, operational and maintenance history .	■			■
Programme for continuous improvement/self-assessment.	■			
Arrangements for control of any changes to organizational structure or resources of the operating organization that may affect the nuclear power plant safety.				
PROCEDURES				
Formal approval and documentation of all safety related procedures.	■	■		
Formal system for modification of a procedure.	■	■		
Understanding and acceptance of these procedures by management and on-site staff.	■			
Evidence that these procedures are followed.		■		
Adequacy of these procedures in comparison with good practice.				
Arrangements for regular review and maintenance of these procedures.	■	■		
Clarity of procedures taking into account human factor principles.				
Compliance of these procedures with the assumptions and findings of the safety analysis, plant design and operating experience.	■			
Symptom based emergency operating procedures for restoring critical safety functions.				
HUMAN FACTORS				
Staffing levels for the operation of the nuclear power plant recognizing absences, shift working and overtime restrictions.				
Availability of qualified staff on duty at all times.				
Policy to maintain know-how of the plant staff.				
Systematic and validated staff selection methods (e.g. testing for aptitude, knowledge and skills).				
Programmes for initial, refresher and upgrade training, including the use of simulators.				
Training in safety culture, particularly for management staff.				
Programmes for feedback of operating experience for human performance failures/errors that contribute to safety significant events, and of their causes and corrective actions.				
Fitness for duty guidelines relating to hours of work, health and substance abuse.				
Competence requirements for operating, maintenance, technical and managerial staff.				
Human-machine interface: control room and other work station design; analysis of human information requirements and task workload; linkage to PSA and deterministic analyses.				
Style and clarity of procedures.				
EMERGENCY PLANNING				
Accident mitigation studies.				
Strategy and organization for emergencies.				
Plans and procedures for emergencies.				
On-site equipment and facilities for emergencies.				
On-site emergency centres.				
Communications.				
Emergency training, exercises and records of experience.				
Interactions of relevant organizations such as the regulatory body, police, fire departments, hospitals, ambulance services, local authorities, public welfare authorities and the information media.				
Arrangements for regular reviews of emergency plans and procedures.				
Security arrangements for emergencies.				
Environment:				
RADIOLOGICAL IMPACT ON ENVIRONMENT				
Potential sources of radiological impact.				
Effluent release limits.				
Records of effluent releases.				
Off-site monitoring for contamination and radiation levels.				
Alarm systems to respond to unplanned effluent releases from on-site facilities.				
Publication of the environmental data.				
Changes in the use of areas around the site.				

APPENDIX II.
COUNTRY INFORMATION REPORTS OUTLINES

Working Group 1 – General LTO Framework

1.0 Laws and regulations relevant to LTO
2.0 Current design basis requirements including design codes and standards used.
- 2.1 General – Design codes and standards used structures and components
- 2.2 Maintenance practices
- 2.3 Environmental qualification (EQ) for electrical and mechanical equipment
- 2.4 Quality assurance (QA) practices
- 2.5 Final Safety Analysis Report (FSAR) update
- 2.6 In-service inspection (ISI) program
- 2.7 Time limited ageing analysis (TLAA)

3.0 Past upgrading of design basis requirements performed, including PSRs
4.0 Considerations given to, or activities planned or taken for, LTO
5.0 Existing programs that are directly related to LTO
6.0 Available research results and operating experiences that are directly related to LTO
Compilation of a list of reference documents from which the information were collected

Working Group 2 - Materials and Mechanical Components

1.0 Applicable Laws Specific to Materials and Components for Long Term Operation
(This Section may be deleted based upon Specific Input from WG 1)
1.0 Regulatory Requirements Applicable to Long Term Operation
- 1.1 The process used in developing the scope of systems, structures and components (SSCs) that are within the long term operation (LTO) review.
- 1.2 Configuration Control Practices used to Control Design Basis
- 1.3 Aging Management Programs
  - 1.3.1 Research/ Process Providing Basis for Applicable Aging Effects on Structure and Component Intended Function(s)
  - 1.3.2 Ageing mitigation measures applied in NPP (change of operation parameters, component design change, component material change, material properties recovery methods applied)

2.0 Operational Approaches Applicable to Long Term Operation
- 2.1 Normal Operational Practice/Programs Applicable to Ageing Management
  - 2.1.1 In-service Inspection Practices for passive Components
    - 2.1.1.1 Augmented inspection programs that address issues such as erosion/corrosion,
    - 2.1.1.2 Augmented inspection of steam generator tubing or
    - 2.1.1.3 Augmented inspection for specific degradation mechanisms such as Intergranular stress corrosion cracking
  - 2.1.2 Maintenance Codes or Practices for Active Components
  - 2.1.3 Equipment Qualification Practices
  - 2.1.4 Component function tests,
  - 2.1.5 Applied diagnostic systems,
  - 2.1.6 Surveillance specimen programmes (irradiation damage, corrosion loops),
  - 2.1.7 Nondestructive material properties tests (hardness measurement etc.),
  - 2.1.8 Destructive tests and material research carried out during NPP operation,

2.1.9 Special loading measurement systems (temperature, deformation etc.) combined with damage calculation (e.g. on-line and off-line fatigue monitoring)

2.1.10 Chemical regimes monitoring

2.2 Plant-specific safety analyses which may have been based on an explicitly assumed plant life or operating period

3.0 Compilation of a list of reference documents from which the above information was collected

Working Group 3 – Electrical and Instrumentation & Control Components

1.0 Applicable Laws Specific to Materials and Components for Long Term EI&C Operation *(This Section may be deleted based upon Specific Input from WG 1)*

2.0 Regulatory Requirements Applicable to Long Term Operation

2.1 The process used in developing the scope of systems, structures and components (SSCs) that are within the long term operation (LTO) review.

2.2 Configuration Control Practices used to Control Design Basis

2.3 Aging Management Programs

2.3.1 Research/ Process Providing Basis for Applicable Aging Effects on E,I&C Intended Function(s) Focused by component

2.3.2 Ageing mitigation measures applied in NPP

3.0 Operational Approaches Applicable to Long Term Operation

3.1 Normal Operational Practice/Programs Applicable to Aging Management

3.1.1 I&C testing and Monitoring Practices for passive Components

3.1.1.1 Augmented inspection programs that address issues such as cable neutron embrittlement in conjunction with thermal flexing.

3.1.1.2 Augmented inspection of motor operated valves or

3.1.1.3 Augmented inspection for specific degradation mechanisms such as corrosion in exposed MCCs.

3.1.2 Maintenance Codes or Practices for Active Components

3.1.3 Equipment Qualification Practices

3.1.4 Component function tests,

3.1.5 Applied diagnostic systems and prognostic systems,

3.1.6 Surveillance specimen programmes (irradiation damage, thermal loops),

3.1.7 Nondestructive material properties tests (Megger for electrical resistivity, etc.),

3.1.8 Destructive tests and material research carried out during NPP operation,

3.1.9 Special loading (stressor) measurement systems (temperature, deformation etc.) combined with damage calculation (e.g. on-line and off-line fatigue monitoring)

3.1.10 Chemical regimes monitoring (Battery S.G. testing)

3.2 Plant-specific safety analyses which may have been based on an explicitly assumed plant life or operating period

4.0 Compilation of a list of reference documents from which the above information was collected

1.0 Applicable laws specific to structures and structural components for long term operation *(this section may be deleted based upon specific input from WG 1)*

2.0 Regulatory requirements applicable to LTO

- 2.1 Criteria for selection of items in the scope of Structures and Structural Components in the LTO program
- 2.2 Ageing management programs – organizational, management issues and interfaces with other plant processes

3.0 Operational approaches applicable to LTO

- 3.1 Reference degradation mechanisms

Mechanisms which are life limiting and particularly important for the LTO, their effects and location

- 3.2 Monitoring, surveillance and inspections
  in-service inspections and periodical test practices (integrity, leak tightness, etc.)
- 3.3 Maintenance practice – ageing mitigation measures and repair technology
- 3.4 Assessment techniques for existing structures. Trend analysis and evaluation of safety margin. Practices used to control design basis.

4.0 Compilation of a list of reference documents from which the above information was collected

APPENDIX III.
WG FINAL REPORTS OUTLINES

Working Group 1 – General LTO Framework

1.0 Laws and regulations relevant to LTO
- 1.1 Summary of laws and regulations relevant to LTO in participating MS
- 1.2 Common elements and differences among participating MS
- 1.3 Reconciliation of the differences and identification of challenges
- 1.4 Recommendations for laws and regulations pertinent to LTO

2.0 Current design basis requirements including design codes and standards used
- 2.1 General – Design codes and standards used for structures and components
  - 2.1.1 Summary of current design basis requirements including design codes and standards used for structures and components
  - 2.1.2 Common elements and differences among participating MS
  - 2.1.3 Reconciliation of the differences and identification of challenges
  - 2.1.4 Recommendations for design basis requirements including design codes and standards
- 2.2 Maintenance practices
  - 2.2.1 Summary of maintenance practices in participating MS
  - 2.2.2 Common elements and differences among participating MS
  - 2.2.3 Reconciliation of the differences and identification of challenges
  - 2.2.4 Recommendations for maintenance practices
- 2.3 Environmental qualification for electrical and mechanical equipment
  - 2.3.1 Summary of environmental qualification approach in participating MS
  - 2.3.2 Common elements and differences among participating MS
  - 2.3.3 Reconciliation of the differences and identification of challenges
  - 2.3.4 Recommendations for environmental qualification approach
- 2.4 Quality assurance practices
  - 2.4.1 Summary of quality assurance approach in participating MS
  - 2.4.2 Common elements and differences among participating MS
  - 2.4.3 Reconciliation of the differences and identification of challenges
  - 2.4.4 Recommendations for quality assurance practices
- 2.5 Final safety analysis report update
  - 2.5.1 Summary of final safety analysis report update procedures
  - 2.5.2 Common elements and differences among participating MS
  - 2.5.3 Reconciliation of the differences and identification of challenges
  - 2.5.4 Recommendations for final safety analysis report update
- 2.6 In-service inspection programs
  - 2.6.1 Summary of in-service inspection program in participating MS
  - 2.6.2 Comment elements and differences among participating MS
  - 2.6.3 Reconciliation of the differences and identification of challenges
  - 2.6.4 Recommendations for in-service inspection programs
- 2.7 Time limited ageing analysis
  - 2.7.1 Summary of time limited ageing analysis status in participating MS
  - 2.7.2 Common elements and differences among participating MS
  - 2.7.3 Reconciliation of the differences and identification of challenges
  - 2.7.4 Recommendations for time limited ageing analysis

3.0 Past upgrading of design basis requirements performed, including PSRs
- 3.1 Summary of past upgrading of design basis requirements among participating MS
- 3.2 Common elements and differences among the participating MS
- 3.3 Reconciliation of the differences and identification of challenges

3.4 Recommendations for upgrading of design basis requirements

4.0 Considerations given to, or activities planned or taken for, LTO
- 4.1 Summary of considerations given to, or activities planned or taken for, LTO in participating MS
- 4.2 Common elements and differences among participating MS
- 4.3 Reconciliation of the differences and identification of challenges
- 4.4 Recommendations for considerations given to, or actions planned for, LTO

5.0 Existing programs that are directly related to LTO
- 5.1 Summary of existing programs directly related to LTO in participating MS
- 5.2 Common elements and differences among participating MS
- 5.3 Reconciliation of the differences and identification of challenges
- 5.4 Recommendations for existing programs directly related to LTO

6.0 Available research results and operating experiences that are directly related to LTO
- 6.1 Summary of research results and operating experiences directly related to LTO in participating MS
- 6.2 Common elements and differences among participating MS
- 6.3 Reconciliation of the differences and identification of challenges
- 6.4 Recommendations for available research results and operating experiences directly related to LTO

7.0 List of references

Working Group 2 - Materials and Mechanical Components

1.0 Applicable Laws Specific to Materials and Components for Long Term Operation
(This Section may be deleted based upon Specific Input from WG 1)
- 1.1 Summary of Laws from Each Country participating in SALTO Project
- 1.2 Common elements and Differences Among Country Legal Approach to Long Term Operation
- 1.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
- 1.4 Recommendations for Legal approach to LTO

2.0 Regulatory Requirements Applicable to Long Term Operation
- 2.1 The process used in developing the scope of systems, structures and components (SSCs) that are within the long term operation (LTO) review.
  - 2.1.1 Summary of Scoping Processes from Each Country participating in SALTO Project
  - 2.1.2 Common elements and Differences Among Country Scoping Processes to Long Term Operation
  - 2.1.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
  - 2.1.4 Recommendations for Regulatory approach for LTO
- 2.2 Configuration Control Practices used to Control Design Basis
  - 2.2.1 Summary of Configuration Control Practices from Each Country participating in SALTO Project
  - 2.2.2 Common elements and Differences Among Country Configuration Control Practices to Long Term Operation
  - 2.2.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
  - 2.2.4 Recommendations for Regulatory approach for LTO
- 2.3 Aging Management Programs

2.3.1 Research/ Process Providing Basis for Applicable Aging Effects on Structure and Component Intended Function(s)
2.3.2 Ageing mitigation measures applied in NPP (change of operation parameters, component design change, component material change, material properties recovery methods applied)
2.3.2.1 Summary of Aging Management Programs from Each Country participating in SALTO Project
2.3.2.2 Common Elements and Differences Among Country Aging Management Programs to Long Term Operation
2.3.2.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
2.3.2.4 Recommendations for Regulatory approach for LTO

3.0 Operational Approaches Applicable to Long Term Operation
3.1 Normal Operational Practice/Programs Applicable to Aging Management
3.1.1 In-service Inspection Practices for passive Components
3.1.1.1 Augmented inspection programs that address issues such as erosion/corrosion,
3.1.1.2 Augmented inspection of steam generator tubing or
3.1.1.3 Augmented inspection for specific degradation mechanisms such as Intergranular stress corrosion cracking
3.1.2 Maintenance Codes or Practices for Active Components
3.1.3 Equipment Qualification Practices
3.1.4 Component function tests,
3.1.5 Applied diagnostic systems,
3.1.6 Surveillance specimen programmes (irradiation damage, corrosion loops),
3.1.7 Nondestructive material properties tests (hardness measurement etc.),
3.1.8 Destructive tests and material research carried out during NPP operation,
3.1.9 Special loading measurement systems (temperature, deformation etc.) combined with damage calculation (e.g. on-line and off-line fatigue monitoring)
3.1.10 Chemical regimes monitoring
3.2 Summary of Operational Approaches Applicable to Long Term Operation from Each Country participating in SALTO Project
3.3 Common Elements and Differences Among Country Operational Approaches Applicable to Long Term Operation
3.4 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
3.5 Recommendations for Regulatory approach for LTO
3.6 Plant-specific safety analyses which may have been based on an explicitly assumed plant life or operating period
3.6.1 Summary of Approaches from Each Country participating in SALTO Project
3.6.2 Common Elements and Differences Among Country Approaches Applicable to Long Term Operation
3.6.3 Identification of Potential Safety Issues Where Additional Regulatory Develop may be Necessary
3.6.4 Recommendations for Regulatory approach for LTO

4.0 Compilation of a list of reference documents from which the above information was collected.

1.0 Applicable Laws in Specific to Materials and Components for Long Term EI&C Operation *(This Section may be deleted based upon Specific Input from WG 1)*
- 1.1 Summary of I from Each Country participating in SALTO Project
- 1.2 Common Elements and Differences Among Country Legal Approach to Long Term Operation
- 1.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
- 1.4 Recommendations for Legal Regulatory approach for LTO

2.0 Regulatory Requirements Applicable to Long Term Operation
- 2.1 The process used in developing the scope of systems, structures and components (SSCs) that are within the long term operation (LTO) review.
  - 2.1.1 Summary of Scoping Processes from Each Country participating in SALTO Project
  - 2.1.2 Common Elements and Differences Among Country Scoping Processes to Long Term Operation
  - 2.1.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary
  - 2.1.4 Recommendations for Regulatory approach for LTO
- 2.2 Configuration Control Practices used to Control Design Basis
  - 2.2.1 Summary of Configuration Control Practices from Each Country participating in SALTO Project
  - 2.2.2 Common Elements and Differences Among Country Configuration Control Practices to Long Term Operation
  - 2.2.3 Identification of Potential Safety Issues Where Additional Regulatory Develop may be Necessary
  - 2.2.4 Recommendations for Regulatory approach for LTO
- 2.3 Aging Management Programs
  - 2.3.1 Research/ Process Providing Basis for Applicable Aging Effects on E,I&C Intended Function(s) Focused by component
  - 2.3.2 Ageing mitigation measures applied in NPP (change of operation parameters, component design change, component material change, material properties recovery methods applied).
    - 2.3.2.1 Summary of Aging Management Programs from Each Country participating in SALTO Project.
    - 2.3.2.2 Differences Among Country Aging Management Programs to Long Term Operation.
    - 2.3.2.3 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary.
    - 2.3.2.4 Recommendations for Regulatory approach for LTO

3.0 Operational Approaches Applicable to Long Term Operation
- 3.1 Normal Operational Practice/Programs Applicable to Aging Management
  - 3.1.1 I&C Testing and Monitoring Practices for passive Components
    - 3.1.1.1 Augmented inspection programs that address issues such as cable neutron embrittlement in conjunction with thermal flexing.
    - 3.1.1.2 augmented inspection of motor operated valves or
    - 3.1.1.3 augmented inspection for specific degradation mechanisms such as corrosion in exposed MCCs.
  - 3.1.2 Maintenance Codes or Practices for Active Components
  - 3.1.3 Equipment Qualification Practices

3.1.4 Component function tests,
3.1.5 Applied diagnostic systems and prognostic systems,
3.1.6 Surveillance specimen programmes (irradiation damage, thermal loops),
3.1.7 Nondestructive material properties tests (Megger for electrical resistivity, etc.),
3.1.8 Destructive tests and material research carried out during NPP operation,
3.1.9 Special loading (STRESSOR) measurement systems (temperature, deformation etc.) combined with damage calculation (e.g. on-line and off-line fatigue monitoring)
3.1.10 Chemical regimes monitoring (Battery S.G. testing)

3.2 Summary of Operational Approaches Applicable to Long Term Operation from Each Country participating in SALTO Project

3.3 Common Elements and Differences Among Country Operational Approaches Applicable to Long Term Operation

3.4 Identification of Potential Safety Issues Where Additional Regulatory Development may be Necessary

3.5 Recommendations for Regulatory approach for LTO

3.6 Plant-specific safety analyses which may have been based on an explicitly assumed plant life or operating period

3.6.1 Summary of Approaches from Each Country participating in SALTO Project

3.6.2 Common Elements and Differences Among Country Approaches Applicable to Long Term Operation

3.6.3 Identification of Potential Safety Issues Where Additional Regulatory Develop may be Necessary

3.6.4 Recommendations for Regulatory approach for LTO

4.0 Compilation of a list of reference documents from which the above information was collected.

Working Group 4 – Structures and Structural Components

1.0 Applicable laws specific to Structures and Structural Components for Long Term Operation (*This section may be deleted based upon specific input from WG 1*)

1.1 Summary of laws from each country participating in SALTO

1.2 Common elements and differences among approach to LTO

1.3 Identification of potential safety issues where additional regulatory development may be necessary

1.4 Recommendations for legal approach to LTO

2.0 Regulatory Requirements Applicable to LTO

2.1 Criteria for selection of items in the scope of structures and structural components in the LTO program

2.1.1 Summary of scoping processes from each country

2.1.2 Common elements and differences of country scoping processes for LTO

2.1.3 Identification of potential safety issues where additional development may be necessary

2.1.4 Recommendations for regulatory and operational approaches

2.2 Ageing management programmes-organizational, management issues and interfaces with other plant processes

2.2.1 Summary of ageing management programmes

2.2.2 Common elements and differences of ageing management programmes to LTO
2.2.3 Identification of potential safety issues where additional development may be necessary
2.2.4 Recommendations for regulatory and operational approaches

3.0 Operational Approaches Applicable to LTO

3.1 Reference degradation mechanisms

Mechanisms which are life limiting and particularly important for the LTO, their effects and location

3.1.1 Summary of approaches to the selection of degradation mechanisms important for LTO
3.1.2 Common elements and differences
3.1.3 Identification of potential safety issues where additional development may be necessary
3.1.4 Recommendations for regulatory and operational approaches

3.2 Monitoring, Surveillance and Inspections

In – Service Inspections and periodical test practices (integrity, leak tightness, etc.)

3.2.1 Summary of MS&I practices from each country
3.2.2 Common elements and differences among country MS&I practices
3.2.3 Identification of potential safety issues where additional development may be necessary
3.2.4 Recommendation for regulatory and operational approaches

3.3 Maintenance practice – ageing mitigation measures and repair technology

3.3.1 Summary of maintenance practices from each country
3.3.2 Common elements and differences of maintenance practices
3.3.3 Identification of potential safety issues where additional development may be necessary
3.3.4 Recommendations for regulatory and operational approaches

3.4 Assessment techniques for existing structures. Trend analysis and evaluation of safety margin. Practices used to control design basis.

3.4.1 Summary of assessment techniques and trend analyses approaches from each Country
3.4.2 Common elements and differences
3.4.3 Identification of potential safety issues where additional development may be necessary
3.4.4 Recommendations for regulatory and operational approaches

4.0 Compilation of a list of reference documents from which the above information was collected