IAEA-EBP-LTO-19
150605

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

MINUTES OF THE PROGRAMME'S THIRD WORKING GROUP 3 MEETING

30 May-2 June 2005

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 are implemented in 4 Working Groups (WG). The WGs focus on:

- general LTO framework (WG 1);
- mechanical components and materials (WG 2);
- electrical components and I&C (WG 3);
- structures and structural components (WG 4).

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

The purpose of the third meeting of WG 3 was to:

- Discuss Scoping Process and Agree upon Timeline to complete the Final WG reports.
- Using the First Draft Report of WG4 as a template – Discuss what information is missing from CIRs - If possible provide a list of questions to Country Representative and agree when the information will be forth coming.
- Assign action items (finalising the report on Task 2; elaboration of Final Working Group Report)

The Agenda for the Meeting is provided in Appendix I. The list of WG2 and 3 participants is provided in Appendix II and the presentations made during the meeting are provided in Appendix III.

The third WG 3 meeting was organized jointly with the third WG 2 meeting and hosted at Oskarshamn, Sweden by the Swedish International Project Nuclear Safety and the Oskarshamn NPP, 30 May to 2 June 2005. During the meeting, a plant visit and a visit to the SKB spent fuel storage facility CLAB and the hard rock laboratory was also organized.

2. MEETING SUMMARY

2.1. OPENING PLENARY SESSION

Mr. Radim Havel, the Programme Scientific Secretary, opened the meeting, which started as a joint session of WG 2 and WG 3. Mr. Havel provided an overview of the Programme's status and outlined the expected outcomes from the meeting.

Mr. Havel stated that, with 18 months to go it appears that the program is in principle on schedule. Currently we have:

- Completed the Country Information Reports (CIR)
- Completed the initial CIR reviews

For the completion of the program we must yet:

- Complete the CIR review and draft the final WG reports
- Develop the Programme Final Report for review by the Steering Committee (SC)

Mr. Havel also reported that Netherlands had joined the Programme and Japan considers joining (participated at the last SC meeting as an observer). The specific expectations and tasks identified by the SC in its April 2005 meeting for the WGs are:

- Identify the LTO pre-conditions
- Define the LTO Scoping Process
- Define the attributes of an acceptable LTO programme
- WG 2,3,4 to define and develop a list of Aging Management Programme (AMP) attributes
- Develop a consensus definition of LTO
- Produce uniform and consistent Final WG Reports by 5 December 2005
- Both Final WG Reports and the Programme Final Report should be focused on LTO aspects; these should address water moderated reactor LTO and distinctions necessitated by the design or materials of PWR, VVER or BWR designs should be noted as necessary, but should not necessitate separate guidelines
- CIRs are to remain restricted, no general revisions should take place, only missing information is to be requested on a case by case basis where applicable.address information relative to LTO only

Mr. Havel then stated that the Working Groups need to have a schedule developed and an associated action plan by the end of the meeting (Thursday). At that point he turned the meeting over to Mr. Tom Taylor, the new Working Group Leader for WG2 who then chaired the remainder of the joint session.

Mr. Taylor presented the work to date of WG2 including a general presentation of the scoping process flowchart derived at the previous SC meeting. The agreed upon objective of this process is to have a consistent set of SSCs that will be reviewed for LTO in each country.

Mr. Duchac then provided a slide overview of the WG 3 status of reviews of the Country Information Reports (CIRs) and preparation of the WG3 Final Report. All CIRs have been received and have been given an accelerated review (Duchac and Jarrell). Full WG3 participation will follow. Principal findings are that there is no consistency in the definition of LTO or the listing of SSCs generated for application of LTO in each country. There is a similar Equipment Qualification (EQ) practice for TLAAs, but they are done on differing equipment lists.

It was agreed that each working group would review the set of system functional descriptions given in the presentation.

The Working Groups then split into individual sessions to proceed with their afternoon agendas.

2.2. WORKING GROUP 3 MEETING SUMMARY

Discussion summary

At the beginning of the WG 3 meeting, Mr.R.Havel announced organizational changes. Mr. Volodymyr Bezsalyy, who was serving as the WG 3 leader since the Programme initiation, resigned from the regulatory body and informed the Agency that he will not take part in the future activities of the Programme. The Agency has requested Mr.Alexander Duchac, EC, to serve as the WG 3 leader, and Mr. Duchac kindly accepted. Mr. Robert Moffitt also cannot take part in the future Programme activities and Mr. Don Jarrell, PNNL, agreed to serve as the WG 3 secretary. Mr. Havel thanked on behalf of the Agency to Messrs. Bezsalyy and Moffitt for the excellent work done and introduced Alexander Duchac and Don Jarrell to the WG3 members as the new group leader and secretary respectively. A review of each participating Working Group member's professional affiliation and background expertise then followed.

A general discussion of the LTO process and particularly the scoping relative to the E I&C equipment was provided as a starting point by the WG3 leader. A discussion of the review of the CIRs followed. WG3 conclusions on Final Report content mirrored the summary statements from WG2.

Following the LTO Scoping Process discussion, the WG3 members filled in the tables for E-I&C equipment that should be included in LTO. The results of this exercise are presented in three tables in Appendix V (a, b, c) and represents a consensus of the MS of WG3. Individual MS will fill in any blank fields in these tables according to the applicable materials and aging effects for their country's reactors.

The Environmental Qualification (EQ) approach has been discussed among MS. This discussion provided for better understanding of the scooping process and involved examples of EQ components, as well as examples of non EQ components of the E I&C that are normally considered in the scope of LTO.

Appendices III and IV contain a draft diagram of the scoping and screeneing process.
Appendix V contains description of systems in the scope of LTO.
Appendix VI (a,b,c) contains System Summary Tables for specific E I&C systems and components in the scope of LTO.

Final WG 3 Report preparation

The members of Working Group 3 agree that the content of the Final Report for WG 3 in each section (see Appendix V) should be revised as follows:

Chapter 1 (Regulations)

The following has been decided:

- The chapter is kept. However, it will be shortened in order to include only regulations on SSCs relevant to WG3 and LTO. If there are no specific regulations identified, this chapter will be deleted with reference to WG1 part of the final report.
- The differences among the country practices should be highlighted
- The need for a minimum regulations in the field of LTO should be identified

Chapter 2 Scope of LTO

The following has been decided:

- The final report will contain a written description of the of the Scoping and Screening Logic diagram that has been developed and provide a statement explaining that the logic diagrams were developed as a result of the large variability noted in the CIRs when Scoping was discussed.
- The chapter will not be arranged into subchapters since all most all of the Groups of SSCs are the same between VVERs and PWRs for WG3. Notes on type specific differences will be included as necessary.
- The definition of the following E I&C functions that are with in the scope of LTO will be clearly identified.
    1. To ensure integrity of reactor coolant pressure boundary,
    2. To ensure the capability to shut down the reactor and maintain it in a safe shutdown condition, and
    3. To ensure offsite radioactive exposures less than, or comparable to, limits specified in the regulations of individual MS by preventive or mitigate measures.
    4. Non-Safety related SSCs whose failure impacts safe operation

Chapter 3 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 connector corrosion, insulation cracking or discoloration

The members of WG3 agree with the following conclusions that would be included in the final report for Section 3.1.1.

- All applied country-specific ISI systems are based on common safety approaches
- Basic requirements for the in-service inspections are available in Rregulatory Guides. The range, periods, methods, evaluation etc. of in-service inspections are mostly defined in a deterministic way coming from designer, manufacturer and utilities experience by specific NPP rules.
- EI&C-ISI procedures are applicable to define "more reasonably" the scope and periods of ISI (mainly cabling). EI&C-ISI is broadly and successfully utilized in USA. In Europe Sweden and Finland adopted this approach in their regulatory documents and operation practice.
- Future effort should be concentrated on damage mechanisms understanding, new ISI detection and evaluation methods and systems development and the development of the application of the EI&C- ISI.
- The programs covering insulation resistance damage mechanisms are highly developed and broadly and successfully applied at present.

Other augmented inspections are carried out in case when standard inspections provide unsatisfactory results or new damage phenomenon occurred. Methods are different depending on actual problem.

Action Items

The following action items for WG 3 were agreed:

1. August 15, the first draft of the Final WG 3 report, to be prepared by WG Leader and Secretary and distributed to the WG members for comments.

2. September 30, WG members provide their comments on draft Final WG report as well as compile required information in tables as in Appendix VI for their countries.
3. October 30, WG member's comment resolution, and finalization of the Final WG3 Report.
4. December 5, submission of the Final WG report to the Programme Secretary (IAEA).
5. WG members agreed to hold another WG 3 meeting in Vienna, November 14-17, 2005. The objective of the meeting will be (i) to discuss any pending issues related to the Final WG report, and (i) to finalize the Final WG report.

2.2. CLOSING PLENARY SESSION

The revised scoping and screening processes were discussed between Working Groups and agreed upon.

The definition of LTO was also discussed and it was agreed to maintain the original LTO definition as provided in the report IAEA-EBP-LTO-03, Rev.1, since the new proposals both from SC as well as from WGs did not provide further clarification or better definition ('what') but rather elaborated on 'how' should LTO be conducted (safely, in line with national requirements).

APPENDIX I.
AGENDA

29 May 2005
Arrival to Stockholm, transfer of participants to Oskarshamn (at 18:00)

30 May 2005 (Monday)

	Joint Meeting of WG2 and WG3	
9:00 – 9:30	Opening, 3rd Steering Committee Mtg. results	(R. Havel)
9:30 – 10:30	Discussion of Status of CIRs and Action Items from April Steering Committee - Definition of LTO - SSC table – an example of approach	(T. Taylor and A. Duchac)
10:30 – 11:00	Coffee Break	
11:00 – 12:30	Develop Joint Agreement for Content of WG2 and WG3 Final Reports	(All)
12:30 – 14:00	LUNCH	
	After Lunch Each Working Group will meet separately	
14:00 – 14:20	Presentation of the short CIRs review	(A.Duchac, D.Jarell)
14:20 – 15:30	Discussion of Scoping process Identification of Potential Problems and information for Final Report	
15:30 – 16:00	Coffee Break	
16:00 – 16:45	Continue discussion of Scoping process	
16:45 – 17:30	Discussion of Final WG report TOC	

31 May 2005 (Tuesday) Break out Sessions for WG3

9:00 – 12:30	Break out Sessions for Review Groups 2, and 3 Development of System Summary Tables for E, I&C equipment
10:30 – 11:00	Coffee Break
11:00 – 12:30	Continue Break out Sessions
12:30 – 14:00	LUNCH
14:00 – 15:30	Continue Break out Sessions
15:30 – 16:00	Coffee Break
16:00 – 17:30	Provide Working Group Leaders and Secretaries with Detailed Outline and List of Actions items that have been agreed to with WG members
17:30 – 18:30	Resolve issues with missing Information in CIRs and reconcile any approach to Appendix of Final WG Report

1 June 2005 (Wedneesday)

9:00 – 17:00	Plant visit
	Joint Meeting of WG2 and WG3
17:30 – 18:30	Resolve issues with missing Information in CIRs and reconcile any approach to Appendix of Final WG Report

2 June 2005 (Thursday)

9:00 – 12:30	Discuss any remaining issues for Final WG Report	
10:30 – 11:30	Coffee Break	
11:45 – 12:30	Action Items for the next period	
12:30 – 14:00	LUNCH	
14:00 – 16:00	Wrap Up Discussion; Agree	(A. Duchac, T. Taylor)
16:00	Departure to Stockholm	

3 June 2005 (Friday)

9:00 – 12:30	Optional session (will be held if necessary depending on the results the meeting)

APPENDIX II.
LIST OF PARTICIPANTS

CZECH REPUBLIC

Mr. Petr Zavodsky
Temelin NPP
37305 Temelin
Czech Republic
Tel.: + 420 385782151
Fax: + 420 385783815
E-mail: zavodp1.ete@mail.cez.cz

Mr. Jan Fridrich
UJV a.s.
25068 Rez
Czech Republic
Tel.: +420 266172618
Fax: +420 220940519
E-mail: fri@ujv.cz

HUNGARY

Mr. Zoltan Ferenczi
Veiki-VNL
Vasgolyo u. 2-4
1158 Budapest
Hungary
Tel.: +36 1 417 3157
Cell: +36 302414214
E-mail: ferenczi@VNL.hu

Mr. Laszlo Pekanovics
Veiki-VNL
Vasgolyo u. 2-4
1158 Budapest
Hungary
Tel.: +36 1 417 3157
Fax: +36 1 417 3163
E-mail: pekanovics@vnl.hu

RUSSIAN FEDERATION

Mr. Boris A. Mordovin
OKB Gidropress
Ordzhonikidze street 21
142103 Podolsk
Moscow
Russian Federation
Tel.: +7 0967 652671
Tel.: +7 0967 620874 (home)
Fax: +7 095 7159783
E-mail: mordovin@grpress.podolsk.ru

Mr. Victor Samovichev
Rosenergoatom
Bolshaya Ordynka 24/26
109017 Moscow
Russian Federation
Tel.: +7 095 710 4022
Fax: +7 095 710 4047
E-mail: samovichev@rosenergoatom.ru

SLOVAK REPUBLIC

Mr. Miroslav Lukac
VÚJE, Trnava, a.s.
Okruzna 5,
91864 Trnava
Slovak Republic
Tel.: +421 33 599 1300
Fax: +421 33 599 1178
E-mail: lukac@vuje.sk

SWEDEN

Mr. Lars-Olof Ståhle
OKG
Oskarhamn NPP
SE-572 83 Oskarshamn
Sweden
Tel.: +46 491-786754
Fax: +46 491-786865
E-mail: lars-olof.stahle@okg.sydkraft.se

UKRAINE

Mr. Oleksii Manko
NAEK "Energoatom"
Vetrova, 3
Kiev-01032
Ukraine
Tel.: +380 44 294 48 92
Fax: +380-44294 48 75
E-mail: A.Manko@direkcy.atom.gov.ua

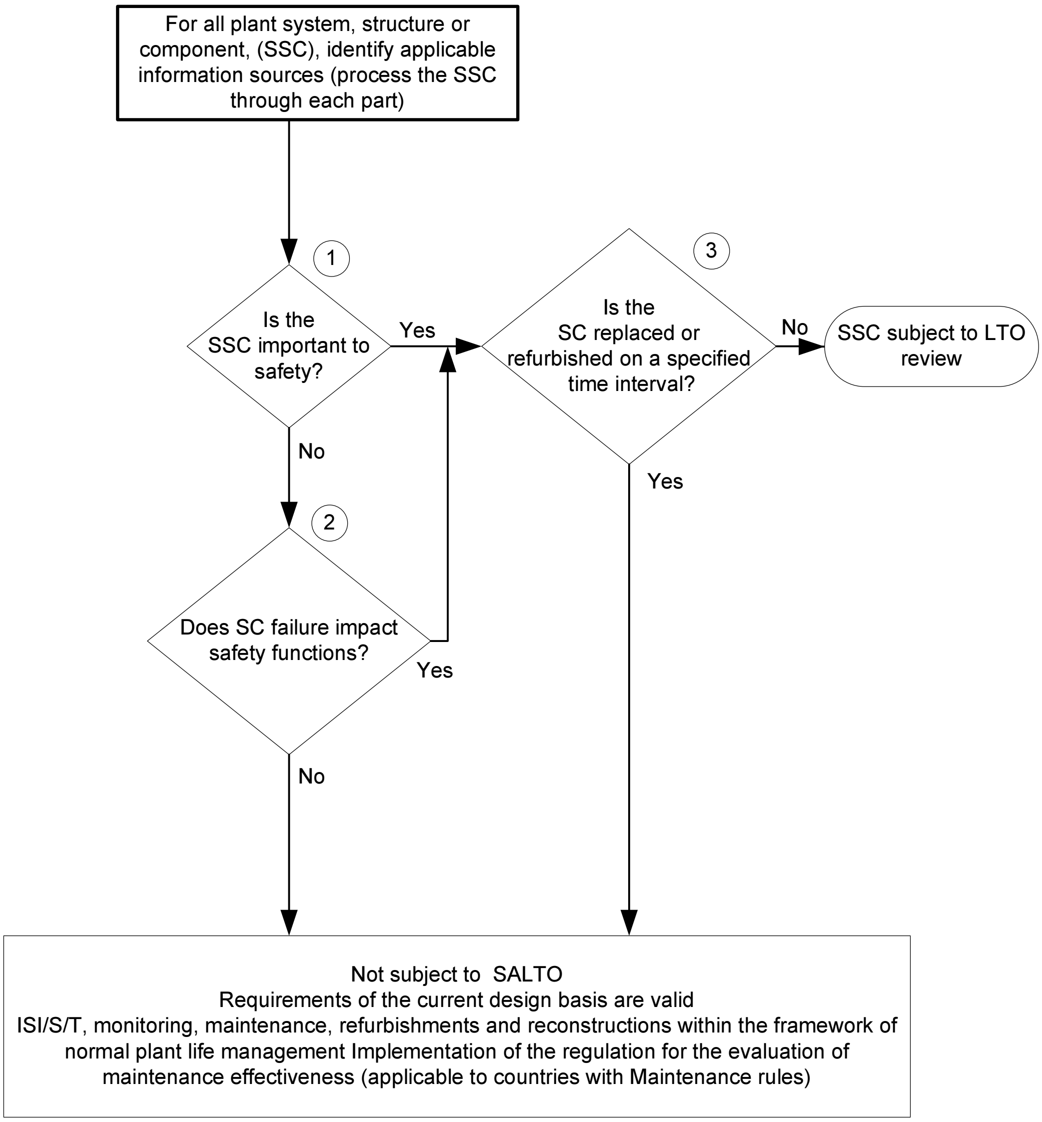
USA

Mr. Donald Jarrell ***Secretary***
Pacific Northwest National Laboratory (PNNL)
902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
USA
Tel.: +1 509 372-4096
Fax: +
E-mail: Don.Jarrell@pnl.gov

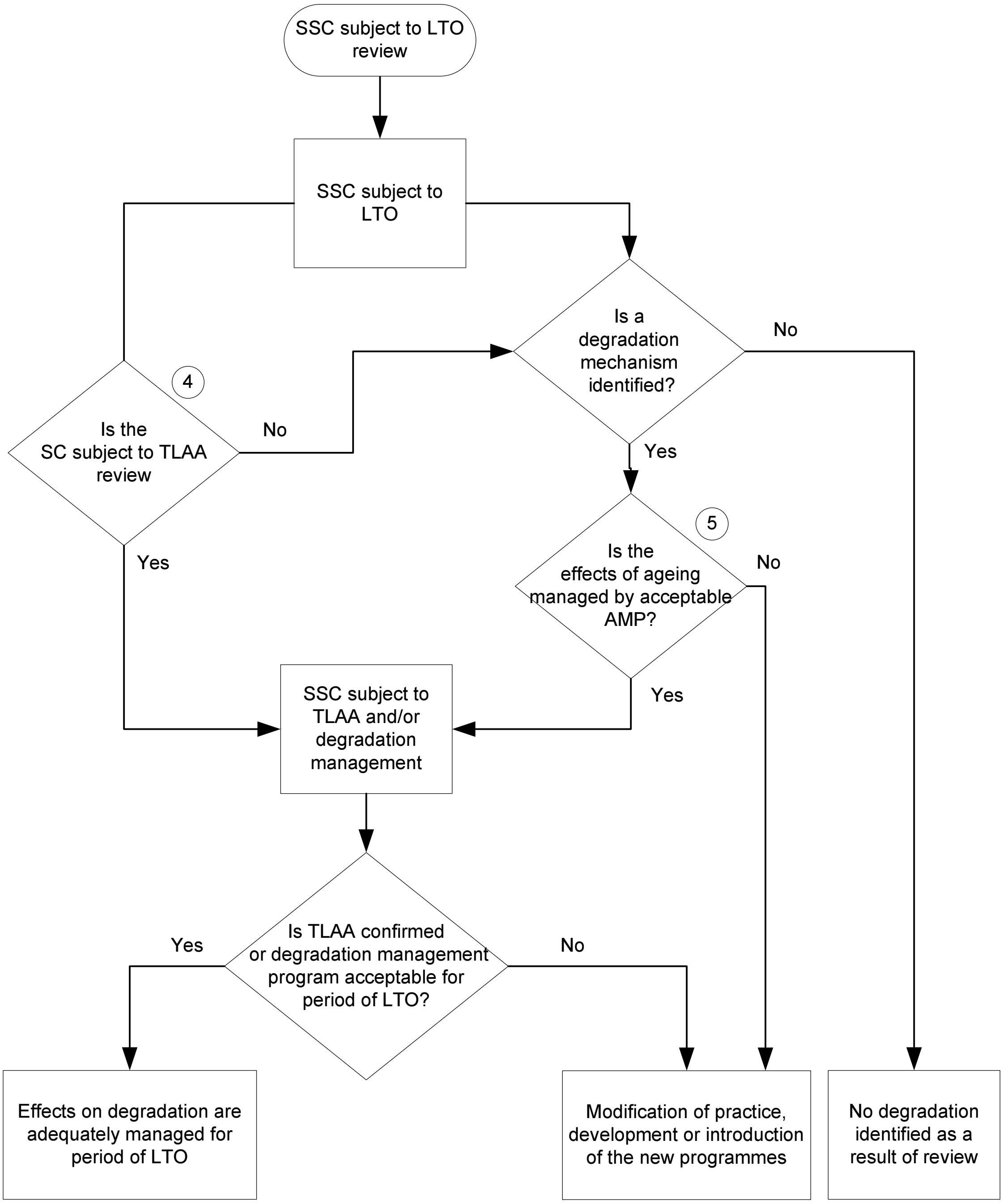
EUROPEAN COMMISSION

Mr. Alexander Duchac ***Leader***
EC, Directorate General JRC
Westerduinweg 3
P.O. Box 2
1755 ZG Petten
The Netherlands
Tel.: +3122 4565
Fax: +3122 4565
E-mail: alexander.duchac@jrc.nl

APPENDIX III.
SCOPING PROCESS FOR LTO



APPENDIX IV.
SCREENING PROCESS FOR LTO



SCOPING AND SCREENING FLOW CHARTS NOTES

1. SAFETY-RELATED SSC

SSCs that perform the following functions:

1. To ensure integrity of reactor coolant pressure boundary,
2. To ensure the capability to shut down the reactor and maintain it in a safe shutdown condition, and
3. To ensure offsite radioactive exposures less than, or comparable to, limits specified in the regulations of individual MS by preventive or mitigate measures.

2. NON SAFETY SSCS WHOSE FAILURE IMPACTS SAFETY FUNCTION

The function of a safety system, structure or component may be compromised by failure of a non-safety related structure or component. One example is the failure of fire protection piping that leads to electric failure of an electrical panel that controls the current to a motor operated valve performing a safety engineered function, where the fire protection piping is a non-safety related component and the electrical panel is a safety component. The selection criterion includes but not limited to SSCs which perform a function to satisfy the requirements for the following:

Anticipated transient without scram (ATWS)
Station blackout (SBO)
Pressurized Thermal Shock (PTS)
Environmental Qualification (EQ)
Fire Protection (FP)

3. IS THE SC ON A REPLACEMENT SCHEDULE OR REFURBISHMENT SCHEDULE

For SSCs are replaced based on a qualified life or specified time period; it is not necessary to include the SSCs in an aging management review or subject the SSCs to an Aging Management Program.

4. TIME LIMITED AGING ANALYSIS (TLAAS)

Time Limited Aging Analysis (TLAAs) are plant calculations and analyses that consider the effects of aging, involve time-limited assumptions defined by the current operating term, for example, 40 years; and involve conclusions or provide the basis for conclusions related to the capability of a system, structure, or component to perform its intended function(s).

5. ACCEPTABLE AGEING MANAGEMENT PROGRAMS

An acceptable ageing management program should contain the following attributes:

1. A defined program scope,
2. Identification of preventive actions or parameters to be monitored or inspected,
3. Detection of ageing degradation /effects,
4. Monitoring and trending including frequency and methodologies,
5. Pre-established acceptance criteria,
6. Corrective actions if a component fail to meet the acceptance criteria,
7. Confirmation that required actions have been taken,
8. Administrative controls that document the program’s implementation and actions taken, and
9. Operating experience feedback.

APPENDIX V.
DESRIPTION OF SYSTEMS IN THE
SCOPE OF LTO

SSCs THAT ENSURE INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY

The PWR Reactor Coolant Pressure boundary has three (3) major functions:

- Transfer the heat from the reactor for the steam generator
- Maintain the pressure within acceptable limits
- Maintain the continuity of the pressure boundary

The Reactor Coolant System consists of the following major components other than the reactor:

- Reactor Pressure Vessel
- Reactor Control Drive Housing & Control Rod Drive
- Reactor Pressure Vessel Internals
- Instrumentation Nozzle
- Hot Leg Piping Welds between the Reactor and the Steam Generator
- Steam Generator
- Piping Welds between the Steam Generator and the Reactor Coolant Pump
- Reactor Coolant Pump
- Piping Welds between the Reactor Coolant Pump and the Reactor
- Piping Welds between the Hot Leg and the Pressurizer (Surge Line)
- Pressurizer
- Piping Welds between the Cold Leg Piping of both Reactor Coolant Loops and the Pressurizer
- Piping Welds in Auxiliary and Safety Systems which are under Primary Pressure
- Relief line Piping on top of the Pressurizer.
- Pressurizer Relief Valve
- Containment Isolation Valves (should be in safety systems)
- Loop isolation valves (VVER 440 only)

Reactor Pressure Vessel -The reactor vessel is designed to contain the fuel assemblies, direct the flow of coolant around the fuel assemblies to prevent uncovering of the fuel assemblies.

Reactor Coolant Primary Piping – The primary piping is designed and manufactured such that it will withstand all loadings arising from power station operation, while remaining within safety limits.

Reactor Coolant Pump - The **Reactor Coolant Pump** circulates the water through the Reactor Coolant System.

Steam Generator - The function of the steam generator is to transfer the heat from the reactor cooling system to the secondary side of the tubes which contain feedwater. As the feedwater passes the tube, it picks up heat and eventually gets converted to steam. The steam generators may also contain a steam separation region, described below.

Pressurizer – The pressurizer has three main functions:

- maintain a constant primary pressure during normal operation,
- limit and compensate for variations in primary pressure during operation,
- ensure the integrity of the primary circuit by means of the safety valves connected to the top of the pressurizer.

In summary, this includes all sensors, controls and cabling for instrumentation and power supply for all of the reactor coolant system.

SSCs THAT SHUT DOWN THE REACTOR AND MAINTAIN IT IN A SAFE SHUTDOWN CONDITION (Including Emergency Systems)

Residual Heat Removal - The RHR is designed to perform the following functions:

- ensure, once the reactor has been sufficiently cooled and the coolant pressure has been reduced, that the reactor gradually is brought to cold shutdown condition prior to removal of the reactor vessel head. The RHR is designed to maintain this condition during fuel unloading and loading and maintenance operations,
- ensure, once the reactor has been sufficiently cooled and the coolant pressure has been reduced, that the reactor is gradually brought to cold shutdown condition after a small LOCA or a steam line break.
- circulate reactor coolant during startup operations until minimum required NPSH conditions are achieved for reactor coolant pump operation, transfer the refueling water from the reactor cavity to the refueling water storage tank (not applicable to VVER),

Main Steam System - The function of the main steam piping is to convey the required steam flow from the steam generators to the turbine, and remove normal and residual (via the GCT system) heat from the reactor coolant system.

Condensate - Feedwater Systems - The Safety function of the Feedwater System is to provide adequate high quality water to the steam generator for removal of excess heat from the reactor core.

Auxiliary Feedwater System (Emergency Feedwater system) - The Safety function of the Auxiliary Feedwater System is to provide adequate high quality water to the steam generator for removal of excess heat from the reactor core in the event that the main feedwater system fails.

Chemical Volume Control System - The major functions are:

- Controlling slow variations in reactivity by adjusting the boron (soluble poison) concentration in the reactor coolant. These adjustments are carried out in conjunction with the reactor boron and water make-up system (REA),
- keeping coolant volume at preset levels during steady-state operation and controlling reactor coolant volume changes under transient conditions (e.g., during reactor startup),
- maintaining proper coolant chemistry including control of pH and dissolved oxygen, in conjunction with the REA system,
- limiting reactor coolant radioactivity levels arising from both activation products and fission and daughter products that may escape from the fuel; this is done via filtration and through fixation of radioactive materials on mixed and cat ion bed demineralizers,
- cooling reactor coolant pump lower bearings,
- controlling seal leakage of reactor coolant pumps

Fuel Handling System - The fuel handling system consists of the mechanisms and tools used in handling new, spent fuel, and changing fuel assembly inserts during first fuel loading and subsequent refueling operations. This ensures the effective cooling necessary for the removal of the residual heat of the assemblies; in addition it allows visual checking of the progress of the operation, whilst affording protection against radiation. Soluble boron in the water ensures sub-criticality at all times.
Associated Sensing and Controls, cabling for instrumentation and power supply for the reactor shutdown.

Emergency Safety Systems Defense in Depth

Emergency Core Cooling - An emergency core cooling system (RIS) is provided to cope with any loss of coolant accident due to a pipe rupture in the primary coolant system. Abundant cooling water is available in such an emergency case to transfer heat from the core at a rate sufficient to maintain the core in a coolable geometry

Reactor Protection - The Reactor Protection Systems are designed to shutdown the reactor and maintain it shutdown when needed. These systems are automatically actuated and may be manually actuated. The Engineered Safety Feature Actuation Systems are designed to provide cooling for the reactor and to reduce the potential for offsite releases of radioactive materials. These systems are automatically actuated and may be manually actuated.

Accident Monitoring Instrumentation - The function of the Accident Monitoring Equipment is to provide accurate indication for the operator following design basis events.

Cooling Water Systems - Service Water Systems at any power plant have one major function which is to cool the multitude of heat exchangers or coolers. In this function the service water system may cool many essential safety related pieces of equipment. This system is referred to by a variety of names - Service Water, Cooling Water , Salt Water. Sometimes the system is broken into separate building systems as Turbine Building, Auxiliary Building, Reactor Building. Often the system is broken into safety and non-safety portions. For a number of plants the safety portion is referred to as the Essential Service Water System. The equipment in the safety portion of the system is powered by independent sources, e.g. diesel-driven pumps and diesel generators to supply electrical power.

Emergency Ventilation - The function of this system is to exhaust air from the penetration areas separating the reactor building from the fuel building, the nuclear auxiliary building, and the electrical building. This system prevents the uncontrolled release of airborne fission byproducts from the reactor building in the event that a containment overpressure condition occurs concurrently with a loss of containment integrity.

Vacuum Building - The single function of these systems in to remove the heat and reduce the pressure in the containment building during a postulated accident.

Containment Spray System -

Essential electricity Power Supplies

Auxiliary power supply (transformers)

SSCs TO ENSURE OFFSITE RADIOACTIVE EXPOSURES ARE WITHIN LIMITS

Air Removal System and Reactor Building Ventilation System - This system prevents the uncontrolled release of airborne fission byproducts from the reactor building in the event that a containment overpressure condition occurs concurrently with a loss of containment integrity.

Post Loss of Coolant Hydrogen Control – The function of this system is to prevent the collection of hydrogen and thus the possibility of a hydrogen explosion after a Loss of Coolant Accident

Liquid Radioactive Waste System – This system prevents the uncontrolled release of liquid fission products.

Gaseous Radioactive Waste System – This system prevents the uncontrolled release of airborne fission byproducts.

Spent Fuel System - The spent fuel system serves 2 purposes:

- It serves as a shield to reduce the radiation levels that people working above may be exposed to.
- It cools the fuel assemblies that continue to produce heat (called decay heat) for some time after removal.

Associated Sensing and Controls, cabling for instrumentation and power supply for radiation protection

NON SAFETY SSCs WHOSE FAILURE IMPACTS SAFETY FUNCTION

Fire Protection – The function of the fire protection system is to detect and prevent the spread of fire.

Diesel Generator Mechanical System – The function of the diesel generator is to provide emergency electrical power in the event that all offsite electrical power is lost

Component Cooling Water System – the function of the component cooling water system is to cool the multitude of heat exchangers or coolers in the power plant.

Associated Sensing and Controls, cabling for instrumentation and power supply for non safety SSC

APPENDIX VIa
Working Group 3
System Summary Table for LTO (including Degradation Mechanisms and Current Practice)

SSCs THAT ENSURE INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY

Component Grouping	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Vessel							
In core neutron monitoring system	Prevent overpower of the rector core			Yes		BWR only Other reactors - Information system only	Repair by replacement (BWR 10 years) (VVER 4-7 years)
Ex-core neutron monitoring system	Reactor over power protection			Yes		Measure neutron flux and limit the core power	Calibration, repair by replacement 10 years
Ex core Instrumentation (level, pressure, delta p, flow, temperature)	Limit the core power, keep the RCS in the design conditions			Yes		Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Control and signal cables, connectors and junction boxes	Supporting the instrumentation output		Radiation, temperature, humidity,	Yes		Measure electrical and physical parameters (BWR) Power and reactivity control (PWR)	Insulation resistance, partial discharge, ageing management program, visual inspection, accelerated ageing testing
Compensation and connection boxes	Supporting the instrumentation output to RPS		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Control rod drives	Limit the core power, keep the RCS in the			Yes		Measure electrical and physical parameters (BWR)	CRD insertion rate testing, motor current, torque, insulation

Component Grouping	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
	design conditions					Power and reactivity control (PWR)	resistance
CRD power cables and connectors (0.4kV)	Supporting power supply		Radiation, temperature, humidity,	Yes		Measure electrical and physical parameters (BWR) Power and reactivity control (PWR)	Insulation resistance, partial discharge, ageing management program, visual inspection, accelerated ageing testing, TDR
Loops inside containment							
Loop instrumentation (pressure, delta p, flow, temperature)	Limit the core power, keep the RCS in the design conditions			Yes		Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Control and signal cables, connectors and junction boxes	Supporting the instrumentation output		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters (BWR) Power and reactivity control (PWR)	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Reactor Coolant Pump							
Motor	Non safety						
Power cables	Non safety, high voltage power supply		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters (BWR) Power and reactivity control (PWR)	Insulation resistance, partial discharge, ageing management program, visual inspection, accelerated ageing testing
Control and signal cables, connectors and junction boxes	Supporting the instrumentation output to RPS		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters (BWR) Power and reactivity control (PWR)	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing

Component Grouping	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Steam generator							
SG instrumentation (pressure, delta p, level, temperature)	Limit the core power, keep the RCS in the design conditions		Radiation, temperature, humidity	Yes		NO SG for BWR, Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Pressurizer and pressurizer safety valves							
Pressurizer instrumentation (pressure, level, temperature)	Limit the pressure, keep the core covered		Radiation, temperature, humidity	Yes		NO pressurizer for BWR, Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Pressurizer solenoid valves	Pressure relieve		Radiation, temperature, humidity	Yes		Protect reactor pressure boundary	ISI testing,
Pressurizer heaters and sprays	No safety functions						
Pressure relief valves (BWR) MOVs	Pressure relieve		Radiation, temperature, humidity	Yes		Protect reactor pressure boundary	ISI testing,
Pressure relief valves (BWR) solenoid valves	Pressure relieve		Radiation, temperature, humidity	Yes		Protect reactor pressure boundary	ISI testing,
Control and signal cables, connectors and junction boxes	Supporting the instrumentation output to RPS		Radiation, temperature, humidity	Yes		No pressurizer (BWR) Power and reactivity control (PWR)	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing

APPENDIX VIb

Working Group 3
System Summary Table for LTO (including Degradation Mechanisms and Current Practice)

SSCs THAT SHUT DOWN THE REACTOR AND MAINTAIN IT IN A SAFE SHUTDOWN CONDITION (Including Emergency Systems)

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Vessels and Tanks							
ECCS and Refueling Water Storage Tank Instrumentation (pressure, delta p, flow, temperature)	Emergency Water Storage Supporting the instrumentation output for reactor core cooling	Stainless steel	Temperature, humidity	Yes	Should be provided based on Ageing guidelines	Maintain calibration	Calibration, repair by replacement
Hydroaccumulators (PWR only) instrumentation (pressure, delta p, flow, temperature)	Supporting the instrumentation output for reactor core cooling		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Condensate Storage Tank(PWR, BWR) Instrumentation (pressure, delta p, flow, temperature)	Emergency Water Storage Supporting the instrumentation output for reactor core cooling		Temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Piping, fittings and miscellaneous items							
Containment spray system	Supporting the instrumentation output for containment pressure		Temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
	suppression and cooling						
Heat Exchangers							
Heat exchanger Instrumentation (pressure, delta p, flow, temperature)	Supporting the instrumentation output for process monitoring			Yes		Maintain calibration	Calibration, repair by replacement
Pumps, Fans,, Duct heaters							
Motor, heater element, solenoid	Actuation control mechanism		Temperature, humidity	Yes		Environmental control	ISI program
Power cable	Supporting power supply		Radiation, temperature, humidity,	Yes		Measure electrical and physical parameters	Insulation resistance, partial discharge, ageing management program, visual inspection, accelerated ageing testing, TDR
Instrumentation and transmitter cable	Supporting the instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Connectors and connection boxes	Supporting the instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Sensors	Supporting the Instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Switches	Actuation control		Radiation, temperature,	Yes		Measure thermal and hydraulic	Calibration, repair by replacement

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
	mechanism		humidity			parameters within required limits to maintain design basis	
Valves							
Motor, Solenoid	Actuation control mechanism		Radiation, temperature, humidity	Yes		Environmental control	ISI program
Power cable	Supporting power supply		Radiation, temperature, humidity,	Yes		Measure electrical and physical parameters	Insulation resistance, partial discharge, ageing management program, visual inspection, accelerated ageing testing, TDR
Instrumentation and transmitter cable	Supporting the instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Connectors and connection boxes	Supporting the instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure electrical and physical parameters	Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Sensors	Supporting the Instrumentation output to reactor shutdown		Radiation, temperature, humidity	Yes		Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement
Switches	Actuation control mechanism		Radiation, temperature, humidity	Yes		Measure thermal and hydraulic parameters within required limits to maintain design basis	Calibration, repair by replacement

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Bus bars							
Bus bar	Electrical support function		Moisture, temperature			Prevent corrosion	Visual and IR inspection, megger checks
Switchyards	N/A						
Auxiliary transformer	Active component						
Diesel generator	Active component						
Breakers	Active component						
Essential uninterruptible power supply	Active component						

APPENDIX VIc
Working Group 3
System Summary Table for LTO (including Degradation Mechanisms and Current Practice)

SSCs TO ENSURE OFFSITE RADIOACTIVE EXPOSURES ARE WITHIN NATIONAL LIMITS

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Piping, fittings and miscellaneous items							
Auxiliary and Radwaste Area Ventilation System Instrumentation (pressure, delta p, flow, temperature)	Containment of Radioactive waste Supporting the instrumentation output for Containment function		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Spent Fuel Pool Instrumentation (level, temperature)	Supporting the instrumentation output for Safe Storage of fuel that has completed the burn cycle		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Ducts							
Ducts, access doors and, airlocks Instrumentation (differential pressure, position switches, interlocks)	Supporting the instrumentation output for Containment and filtering of airborne radioactive contamination		Temperature, humidity	Yes		Maintain calibration	Calibration and testing, repair by replacement
Filters							

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
Spent Fuel Pool Instrumentation (pressure, differential pressure, flow, temperature)	Supporting the instrumentation output for Safe Storage of fuel that has completed the burn cycle		Temperature, humidity	Yes		Maintain calibration	Calibration and testing, repair by replacement
Air Handler Heating/Cooling							
Already covered							
Heat Exchangers							
Already covered							
Pumps							
Already covered							
Valves							
Already covered							
Cable penetrations							
Power and instrumentation cable penetrations	Containment tightness, supporting power supply		Radiation, temperature, humidity, pressure, flooding	Yes		Measure electrical and physical parameters	Leak tightness testing, Insulation resistance, ageing management program, visual inspection, accelerated ageing testing
Containment environmental monitoring							
Instrumentation (pressure, differential pressure, temperature, radiation)	Containment isolation		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Combustible gas							

Component Group	Safety Function	Materials	Environment or Stressors	EQ	Degradation Mechanism/Aging Effect	Safety Strategy	Practice for Inspection or Testing
systems							
Oxygen and hydrogen monitoring	Supporting the instrumentation output for the containment integrity		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement
Actuation system for hydrogen combustion	Supporting the instrumentation output for the containment integrity		Radiation, temperature, humidity	Yes		Maintain calibration	Calibration, repair by replacement