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

MINUTES OF THE 4th Meeting of Working Group 3

Vienna, Austria November 15 to 16, 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 .

In mid 2005 the Programme activities entered the final phases. To co-ordinate the effort, A WG leaders and secretaries meeting was organized by the Agency and hosted by PNNL at its Seattle office, 26-29 September 2005. The objectives of the meting were:

- to review and consolidate the outcomes of the activities conducted within the Programme to date,
- to co-ordinate the preparation of the Final Working Group Reports,
- to initiate the development of the Final Programme Report, and,
- to establish a basis for a Safety Guide on long term operation.

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

2. MEETING SUMMARY

Mr. Ervin Liszka, the Programme Scientific Secretary, opened the meeting, and outlined the expected outcomes from the meeting which were:

- Provide the WG3 members an overview of the results of the WG Leaders/Secretary meeting held in Seattle
- Review the final draft of the Working Group 3 report and develop a resolution for any conflicting opinions
- Review and comment on the Table of Contents for the Final Program report
- Provide input to IAEA on potential follow-on activities and
- Agree to a schedule to complete the final draft by November 23 in order to submit the final draft to the IAEA secretary by December 5, 2005.

2.1 Review of the Draft Working Group 2 Report

Mr. Duchac lead the discussion during the review of the draft WG3 report. The review was conducted by discussing each section of the report.

These meeting minutes will discuss the results of the review by section below. These meeting minutes document the changes in content to the final report and do not reflect editorial comments that were discussed.

Introduction

Mr. Duchac clarified that the Working Group reports were to be stand alone separate reports and as such should contain an introduction. Mr. Erwin indicated that a common Introduction would be developed for all working group reports.

1.0 Requirements

There were no significant comments on Section 1.0 – Requirements.

2.0 Scoping of Systems, Structures and Components

Section 2.1 – Background

Paragraph eight of this section was revised as follows.

> A flowchart depicting the Scoping process that was agreed to in the framework of the SALTO project is provided in Appendix I. It provides for general guidance to identify the minimum list of SSCs subject of LTO:
>
> 1. All safety-related SSC that are important to the fundamental safety functions:
> − the control of the reactivity;
> − the removal of heat from the fuel; and
> − the confinement of radioactive materials and control of operational discharges, as well as limitation of accidental releases.

2. All non-safety related systems, structures, and components whose failure could prevent satisfactory accomplishment of, or initiate challenges to, any of the safety functions defined above.

3. SSC that are important to ensure a specific functional purpose that may be essential to safe LTO of the plant and to prevent/mitigate events contributing to the core melt frequency , such as:

− fire protection,
− environmental qualification,
− pressurized thermal shock,
− anticipated transients without scram,
− severe accident management, and
− station blackout.

During discussion of Section 2, working group members agreed that a Glossary of terms should be added to the report and that the definitions in the glossary should be consistent with IAEA definitions.

Section 2.4 Recommendations was revised as follows.

Working group 3 members recommends that the scoping process that was agreed to in the framework of this SALTO project should be used to identify system, structures and components for LTO evaluations. It should provide for general guidance to identify a minimum list of systems, structures and components for inclusion in LTO scope. The general guidance should be augmented by an appropriate set of acceptance criteria to support decision-making path in the scoping process.

Working group 3 members also recommends that more detailed requirements and acceptance criteria should be developed to support the screening and scoping process outlined in Appendix I. One way to develop more detailed guidance is to conduct a pilot study using the process outlined in Appendix I on several power plant designs and documenting the results of the pilot study for use by MS.

Working Group 3 members recommend that the IAEA facilitate training for both plant operators and regulators that helps ensure a consistent approach to implementing scoping and screening processes for LTO among MS.

3.0 Aging Management Programs

Section 3.3, Identification of Future Challenges, was revised as follows.

The following challenges have been identified, such as

- Harmonization of industrial standards and regulatory requirements applicable for ageing management programs could be possible approach to further improve implementation of ageing management programs for example, standards for electrical cables and connections in member state nuclear power plants.
- Gaps in the knowledge, which need to be covered in future research, as they have been identified in [EUR 19843] such as:
  - Life assessment technology and NDE for physical properties altered by ageing

- Improved monitoring techniques,
- Reproducibility of phenomena on test specimens,
- Repair and degradation mitigation technologies.
- Availability of an Aged Materials Database (toughness, mechanical properties of aged materials…)

- Gaps in experience feedback, namely making an allowance for ageing at the design stage and monitoring ageing, the nuclear operator could then find themselves torn between allowing operation to continue in degraded conditions or condoning outage for an extended period.

4.0 Operational Programs

Section 4.1 Maintenance

Section 4.1.3 Identification of Future Challenges was revised as follows.

Working group 3 members identified the following challenge:
Development of minimum criteria for replacement of EQ and non EQ EI&C equipment. While the majority of the EQ program requirements of member states align quite closely, maintaining an accurate inventory of EQ equipment and replacing it according to its expiration schedule presents both a logistical and a financial burden to the utilities. For this reason, it is necessary for the regulator to be exceptionally vigilant in ensuring compliance with replacement schedules of EQ gear.

Section 4.1.4 Recommendations was revised as follows.

Working Group 3 members recommend the following:
IAEA facilitate development of minimum criteria for replacement EQ and non EQ EI&C equipment.
Members States that adopt LTO should consider replacement of E I&C equipment, which belongs to the EQ category, but is not qualified for the period of LTO, or have its qualification extended prior to reaching the aging limits established in the evaluation.
Members States should consider evaluating non EQ E I&C equipment that are used on safety related systems to determine if that equipment should be re-classified and qualified as EQ equipment. Any equipment that is re-classified should have an appropriate testing schedule or replacement program that includes corrective measures that must be implemented to ensure the functionality during the period of LTO.

Section 4.3 Component Functional Tests

Section 4.3.4, Recommendations, was revised as follows.

Working Group 3 members recommend the following:
The IAEA facilitates development of minimum criteria for determining EI&C equipment that will be subject to functional testing. The criteria should include minimum requirements for scheduling, testing methods, procedures and testing devices. The scoping methodology provided in Appendix 1 is recommended as a consensus technique developed by all working groups from the member states.

Section 4.4 Applied Diagnostic Systems: It was agreed to merge the Sections Diagnostic and Prognostic System with Load Monitoring Systems two Sections into Section 4.5. The new section would be titled "**Applied Diagnostic Systems (Including Load Monitoring Systems**)".

The first paragraph of section 4.4.1, Background, was revised as follows.

> Applied diagnostic systems are those systems in a nuclear power plant that aid the plant operator in determining the status of SSCs (including the environment) important to safety during all modes of plant operation. Examples of applied diagnostic and load monitoring systems include, but are not limited to:
>
> - Acoustic Leak Detection Systems that support Leak-before-break analysis
> - Confinement Air Cooler Condensate Monitoring Systems
> - Moisture Leak Detection Systems that help monitor reactor coolant inventory
> - Stratification /thermal fluctuation related temperatures measurement
> - Measurement of Vibrations of Rotating and Electrical Machines within the scope of LTO
> - Noise Analyses of RPV and Reactor Internals
> - Measurement of Temperatures, Stress, Fatigue Cycles and Displacement of Components
>
> Load monitoring instrumentation and systems that measure displacements, thermal fatigue (e.g., Fatigue Pro) provide input into the diagnostic systems.
> Applied Diagnostic systems, if used properly, are essential in detecting the potential failure of machinery in time to permit corrective action before the safety margins are compromised.

Section 4.4.3, Future Challenges, was revised as follows.

> Working Group 3 members identified two major challenges for Applied Diagnostic systems. The first challenge involves developing and adopting technology to reduce the dependence of systems on electrical cables. As an example, fiber optics or wireless technology may replace cables where appropriate.
> The second challenge is related to the first and deals with efficient regulatory acceptance of new technology. While most regulators encourage the development and use of diagnostic and prognostic technologies, many have been slow to accept the touted accuracy as acceptable proof of system or component health. Laboratory developments are therefore difficult to implement in operating nuclear plants.

4.6 .Non-destructive material properties testing

Section 4.6.3, Future Challenges, was revised as follows.

> Non destructive methods as described above are used to detect and monitor degradation of electrical cables. The results are relevant to LTO, The Working group 3 has not identified any challenges on this subject.

Section 4.6.4, Recommendations, was revised as follows.

> The Working group 3 recommends using non destructive testing methods to monitor degradations of materials during LTO.

4.7 Destructive material properties testing

Section 4.7.3, Identification of Future Challenges, was revised as follows.

> Destructive methods as described above are used to detect and monitor degradation of electrical cables. The results are relevant to LTO, The Working group 3 has not identified any challenges on this subject.

Section 4.7.4, Recommendations, was revised as follows.

> The Working group 3 recommends using destructive testing methods to monitor degradations of materials during LTO

Section 5.0 Time Limited Aging Analysis

Section 5.2, Common Elements and Differences, was revised to add a final paragraph as follows.

> The use of TLAA in Europe differs from country to country, analysis similar to TLAAs has been implemented in some European countries (Hungary for example) as part of their license renewal process. Other countries have not adopted TLAA process.

Section 5.3, Identification of Future Challenges, was revised as follows.

> One of the challenges is development of minimum criteria for the acceptance of TLAA.

Section 5.4, Recommendations, was revised as follows.

> Time limited aging analysis appears to be a good example of an analytical process to be followed by LTO applicants in order to demonstrate qualified life of EI&C equipment for LTO and should be appropriately considered in an updated FSAR.

Appendix I: It was agreed to modify flowchart for Scoping and Screening process along with comments provided by WG1.

Appendix II: It was agreed to Change the title of the Column on “Safety Function” to “Function” because the IAEA has very specific definitions of Safety Functions and Working Group 3 members agreed not to setup a potential conflict with IAEA definitions.

Working Group 3 members agreed to thoroughly review the Table and provide any comments in writing to Mr. Duchac by November 23.

2.2. INPUT TO IAEA ON POTENTIAL FOLLOW-ON ACTIVITIES

Working Group 3 members provide the following input to IAEA on potential follow-on SALTO activities. The input is provided by section.

2.0 Scoping of Systems, Structures and Components

Working group 3 members recommend that more detailed requirements and acceptance criteria should be developed to support the screening and scoping process outlined in Appendix I. One way to develop more detailed guidance is to conduct a pilot study using the process outlined in Appendix I on several power plant designs and documenting the results of the pilot study for use by MS.

WG3 members recommend training workshops after the pilot study is completed that reflect the most recent guidance.

3.0 Aging Management Programs

Working Group 3 members recommend that the IAEA facilitate workshops on developing aging and reviewing aging management programs in relation to LTO.

4.1 Maintenance

Working Group 3 members recommend that IAEA facilitate development of minimum criteria for replacement EQ and non EQ EI&C equipment.

4.3 Component Functional Tests

The IAEA facilitates development of minimum criteria for determining EI&C equipment that will be subject to functional testing. The criteria should include minimum requirements for scheduling, testing methods, procedures and testing devices. The scoping methodology provided in Appendix I is recommended as a consensus technique developed by all working groups from the member states.

2.3 ACTION ITEMS

The following action items were agreed to:

- Mr. Duchac agreed to revise the report as agreed during the meeting and sent the revised report to the working group members by Friday November 18.
- Working group members agreed to review the report and provide and final comments to Mr. Duchac by November 23, 2005.
- WG3 Final report will be submitted to the IAEA Scientific Secretary by December 5, 2005.

APPENDIX I.
PROVISIONAL AGENDA

WG 3 – Fourth Working Group Meeting
IAEA, November 15-17, 2005
PROVISIONAL AGENDA

Tuesday 15 November, 2005		
09:30	Opening, Meeting Objectives	E. Liszka
09:40	Chairman summary on WG leader's + Secretarie's co-ordination Mtg. in Seattle: • Schedule of work 2005 – 2006 • New table of content for WG Final Reports • New table of content for Programme Final Report	A. Duchac
10:00	Discussion on the text of WG3 Final Draft Report: • Review of the text based on changes introduced by Seattle Meeting;	A. Duchac, D. Jarell WG Members
10:30	Coffee Break	
11:00	Discussion on the text of WG3 Final Draft Report: • Review of the text based on changes introduced by Seattle Meeting, cont'd;	A. Duchac, D. Jarell WG Members
12:30	Lunch Break	
14:00	Discussion on the text of WG3 Final Draft Report: • Review of the text based on changes introduced by Seattle Meeting, cont'd;	A. Duchac, D. Jarell WG Members
15:30	Coffee Break	
16:00	Discussion on the text of WG3 Final Draft Report: • Review of the content, consistency, tables	A. Duchac, D. Jarell WG Members
17:45	Adjourn	
18:00	Social event	IAEA
Wednesday 16 November, 2005		
09:00	Discussion on the text of WG3 Final Draft Report: • Review of the content, consistency, tables, cont'd	A. Duchac, D. Jarell WG Members

10:30	Coffee Break	
11:00	Discussion on the text of WG3 Final Draft Report: • Example of Scoping exercise for E, I&C active and passive components	A. Duchac, D. Jarell WG Members
12:30	Lunch Break	
14:00	Discussion on the text of WG3 Final Draft Report: • Review of recommendations	A. Duchac, D. Jarell WG Members
15:30	Coffee Break	
16:00	Discussion on the text of WG3 Final Draft Report: • Review of recommendations, cont'd	A. Duchac, D. Jarell WG Members
17:30	Resolve issues of the Final WG Report, accept the content and the recommendations	A. Duchac, D. Jarell
18:00	Adjourn	
Thursday 17 November, 2005		
09:00	Identification of remaining tasks and implementation schedule; Adjustment of the Final Report, Preparation of the minutes	A. Duchac, D. Jarell
12:30	Lunch Break	
14:00	Final Discussion, preparation of the minutes (deadlines and responsibilities)	A. Duchac, D. Jarell
15:00	Closure of the meeting	E. Liszka

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