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REPORT

PEER REVIEW SERVICE ON SAFE LONG TERM OPERATION (SALTO PEER REVIEW SERVICE)

SALTO PEER REVIEW MISSION FOR TIHANGE NUCLEAR POWER PLANT UNIT 1 IN BELGIUM

Tihange, Belgium
13 – 22 January 2015

and

FOLLOW-UP MISSION

6 – 9 December 2016

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY
Division of Nuclear Installation Safety
SAFE LONG TERM OPERATION REVIEW SERVICES (SALTO)

SALTO PEER REVIEW MISSION FOR TIHANGE NUCLEAR POWER PLANT UNIT 1 IN BELGIUM

REPORT TO THE GOVERNMENT OF BELGIUM

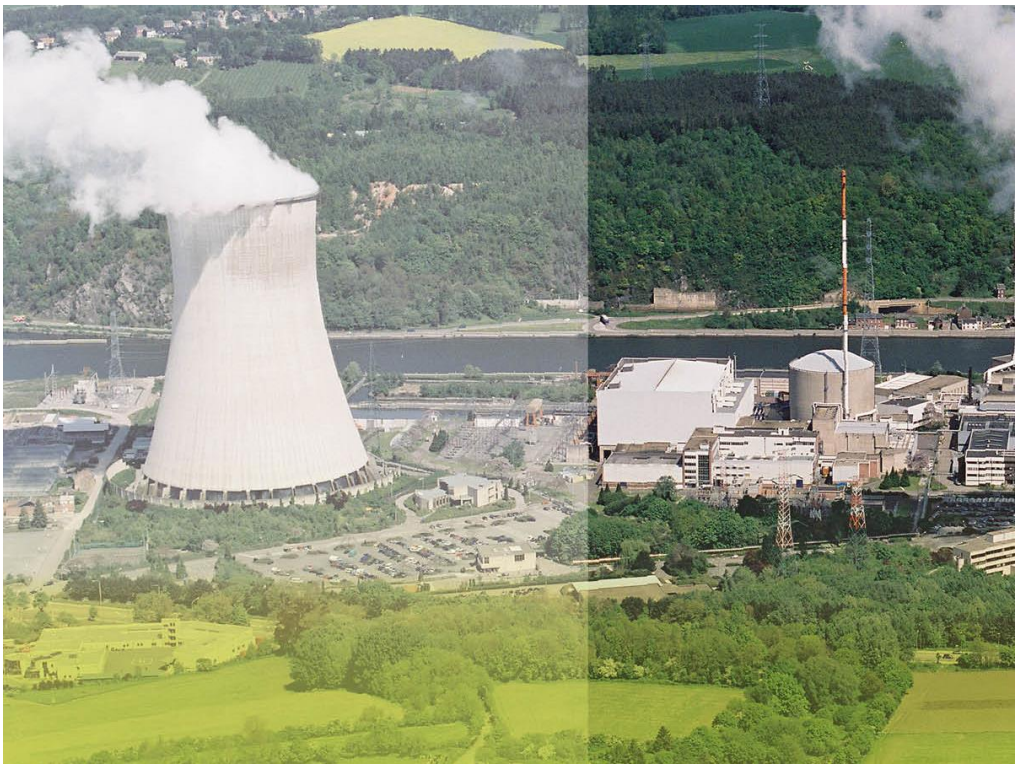
Mission date: 13 – 22 January 2015

Follow-up mission date: 6 – 9 December 2016

Location: Tihange, Belgium

Installation: Tihange 1 Nuclear Power Plant

Organized by: International Atomic Energy Agency (IAEA)
Tihange Nuclear Power Plant



"*Findings, conclusions and recommendations resulting from the IAEA Programme are intended only to assist national decision makers who have the sole responsibility for the regulation and the safe operation of their nuclear power plants. Moreover, they do not replace a comprehensive safety assessment which needs to be performed in the framework of the national licensing process.*"

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EXECUTIVE SUMMARY

Upon the invitation of the Belgian Government and the Federal Agency for Nuclear Control (FANC), a peer review mission on safe long term operation (SALTO) was provided to review programmes/activities of the Tihange Nuclear Power Plant Unit 1 (further referred as "the plant").

The administrative address of the plant is Avenue de l'Industrie 1, 4500 Tihange. The plant is located in the southern part of Belgium, on the river Meuse. The turn-key contracts were awarded to TRABEL (Tractebel) and ELECTRICITE DE FRANCE for the design, to the temporary association A.C.L.F, headed by FRAMATOME (AREVA), BELGONUCLEAIRE, GROUPEMENT ATOMIQUE ALSACIENNE ATLANTIQUE, CAMPENON BERNARD and C.F.E. for the construction. The initial start-up operation of the plant 1 was awarded to ELECTRABEL. The plant is a pressurised water reactor power plant. Its nuclear steam supply system was provided by the temporary association A.C.L.F and is located in a double containment concrete building. Its reactor output is 2,873MWth and the electrical output of the turbine generator is 960MWe. The turbine sets were supplied by Alsthom.

The plant started its commercial operation in October 1975. The unit will be 40 years old in October 2015, reaching the lifetime foreseen in the 2003 Nuclear Phase-out Act. Given the intention of the Belgian government to grant a 10-year life extension to the plant, LTO evaluation was required by the Federal Agency for Nuclear Control (FANC). At the end of 2011 ELECTRABEL GDF-SUEZ submitted its LTO-file to the FANC which was approved in June 2012.

The plant is required to perform an LTO assessment to demonstrate the safety level of the plant for 50 years of operation. This SALTO mission reviewed details related to this LTO assessment. A preparatory meeting was held in August 2014. The scope of the SALTO mission was agreed on and defined in the Terms of Reference issued in August 2014. The review team was organised accordingly; it comprised two IAEA staff members and five external experts covering all disciplines stated in the Terms of Reference.

The mission reviewed completed, in-progress and planned plant activities related to LTO, including activities involving the ageing management of systems, structures and components (SSCs) important to safety and revalidation of time limited ageing analyses (TLAA).

Through the review of available documents, including the Advance Information Package and other plant documents, presentations and discussions with counterparts as well as with other members of the plant staff, the IAEA team concluded that the plant has worked extensively in the field of long-term operation and ageing management. Based upon the observations of this SALTO review, the team finds good preparation for the long-term operation of the plant. We have found the plant staff very professional, open and mostly receptive to suggestions for improvement. Numerous walk-downs showed that the power plant is in a good condition.

The SALTO team concluded that plant management is committed to improving plant preparedness for LTO. In addition, the team noticed the following good practice:

- Management of critical suppliers.

Taking into account the above mentioned points, the team recognised that the plant approach and preparatory work for safe LTO generally follows the IAEA Safety Standards and international practices.

The team identified areas for further improvement. Ten issues were raised:

- The plant does not have a programme in place for carrying out ageing management activities for the LTO period;
- AMPs are not fully implemented in and addressed by the plant organization and responsibilities are not clearly defined in plant processes;
- The process for evaluating preventive and predictive maintenance programmes for active mechanical components is not comprehensive;
- The demonstration that mechanical equipment qualification will remain valid over the LTO period is not clear;
- The time span of operating experience and the range of references used are not sufficiently comprehensive for AMR;
- There are no planned periodic and documented condition visual inspections and tests during the LTO period aiming at preserving cable system qualification and functionality (cables, cable trays and connections);
- The current approach to the testing of containment structural integrity is not fully consistent with IAEA Safety Standards;
- Loss of concrete durability due to leaching Calcium Hydroxide has not been appropriately addressed in the plant;
- The design intent of cable tray support anchoring is not performed as required by the design;
- Competence and knowledge management processes are not fully integrated into the line organisation for LTO.

The status of issues from the Pre-SALTO Mission in 2012 was also assessed. The team concluded that the plant performed a significant amount of work to solve those issues but resolution of several of issues must be still finalized. The resolution degree was determined separately by the team for each issue sheet, with results as follows:

- 0 issue - insufficient progress to date;
- 7 issues - satisfactory progress to date;
- 6 issues - issue resolved.

A summary of the review was presented to plant management during the exit meeting held on 22 January 2015. Plant management expressed a determination to address the areas identified for improvement, and indicated its intention to invite a “Follow-up SALTO peer review mission” in December 2016 to complete the review of the plant preparation for LTO. The follow-up mission will review progress in solving issues raised during this mission.

Appendix III of this report includes the team's comments and conclusions related to issues raised during the 2012 Pre-SALTO Mission. Appendix IV of this report includes the team's detailed recommendations and suggestions arising from this mission.

FOLLOW-UP MISSION

A follow-up mission was organized from 6 to 9 December 2016 and the team consisted of one IAEA staff member, two external experts and two observers. Participating experts from France were members of the Pre-SALTO and SALTO teams in 2012 and 2015. Observers from Sweden and Mexico were also actively contributing members of the follow-up team. The SALTO follow-up report is the original report from the SALTO mission in 2015 supplemented with the "counterpart actions" and "follow-up assessment by the IAEA review team". The "counterpart actions" provided in issue sheets` section 4 are reviewed by the follow-up IAEA review team prior to the follow-up mission and confirmed in the field during the visit. "Follow-up Assessment by the IAEA Review Team" is then added in light of the follow-up mission into issue sheets` section 5. The IAEA conclusion is produced in issue sheets` section "Resolution Degree". "Status at follow-up SALTO mission" is prepared by the IAEA team for each review area. This resulting document is therefore an overall report of both the SALTO mission and the SALTO follow-up mission.

During the SALTO peer review mission in January 2015, ten issues were defined in six reviewed areas. The follow-up team reviewed the progress in issues solving for each of these issues separately.

The team concluded that the plant has made significant progress to resolve most of the issues. The resolution degree was determined by the team for each issue sheet separately, with the following results:

- 2 issues were assessed as satisfactory progress to date;
- 8 issues were assessed as issue resolved.

The detailed evaluation of plant actions is provided in Appendix IV of this report in a section 5 of each individual issue sheet. Additional evaluation is provided for each review area in a "Status at follow-up SALTO mission" subsection of each review area.

1. INTRODUCTION

1.1. SUMMARY OF IAEA SALTO PEER REVIEW SERVICE

IAEA Member States give a high priority to safe, continuing operation of nuclear power plants (NPPs) beyond their original design life (e.g. 30 or 40 years) as an alternative to decommissioning. In this respect, LTO is defined as nuclear power plant operation beyond an established time frame originally set forth by the licensing term, design limits, standards or regulations. LTO is justified by a safety assessment that considers life limiting processes and features for SSCs.

The peer review approach has proven to be a very effective mechanism to perform safety reviews of complex issues, and to evaluate the safety performance of an entire NPP organization. This is confirmed by on-going positive experiences with Operational Safety Review Team (OSART) Reviews.

The SALTO peer review is a comprehensive operational safety review service addressing strategy and key elements for safe LTO of NPPs.

1.2. SUMMARY INFORMATION ON THE PLANT

1.2.1. General information

Electrabel is a subsidiary of the GDF-SUEZ group. In Belgium, Electrabel has a production capacity of 9000 MW. Of this, 4428MW are provided from the share of Electrabel in the 7 nuclear reactor it operates in Belgium.

The plant has the following characteristics:
Reactor type: PWR
Thermal power: 2873 MW (th)
Electric power output: 960 MW(e) netto
Number of primary loops per unit: 3 loops
Volume of the primary circuit: 273 m3
Pressure in the primary circuit: 15,5 MPa (a)
Average temperature of the primary coolant: 321,9 °C (out), 283,4 °C (in)
Length/ inner diameter of the vessel: 12,3 m (with vessel head) /3,987 m
Fuel enrichment: 4,32%
Fuel quantity per unit: 81765 kg ea
Number of turbines per unit: HP:2, LP:4
Pressure of secondary circuit main steam line: 63,2 kg/cm2 (100% Pnom)

1.2.2. Regulatory framework

The license period of nuclear power plant is limited to 40 years under the current legal framework in Belgium (law on nuclear phase out of 2003). It is mandatory for the utility to conduct PSRs for its operating nuclear power plants at ten-year intervals and submit PSR reports for regulatory

review and approval. In case of national shortages with electricity supply, the law also makes provision for extension of a nuclear plant operation beyond its design lifetime.

In 2009 the government expressed the intent to prolong the lifetime of the oldest NPPs in Belgium (Doel 1 & 2 and Tihange 1) by 10 years. Therefore the national nuclear regulator, FANC, issued a "strategic note on Long Term Operation", outlining the process to be followed.

The strategic note of the Federal Agency for Nuclear Control (FANC) is considered by Electrabel as the point of reference for applicable regulations.

1.2.3. LTO Context

A. FANC's strategic note: general conditions:

FANC determines the general conditions

> *[...] in order to continue the operation of the Doel 1&2 and Tihange 1 nuclear power plants, where a high level of design and operational safety must be guaranteed, in the eventuality that a political decision were taken to authorise the operation of existing nuclear power plants beyond 40 years.*

In this strategic note, Electrabel identified the following areas of concern:

1. Preconditions for long-term operation
2. Management of equipment and structure ageing
3. Design re-evaluation
4. Management of skills, knowledge and behaviour

In this strategic note FANC also determined a timetable. Electrabel is committed to completing its LTO project in accordance with this timetable, taking into account the following expectations of FANC and Electrabel:

FANC's requirements (see strategic note)	Electrabel's expectations	Target date
The operator submits the LTO-Reporting file with proposals for design upgrade and improved ageing management (in accordance with 10 CFR part 54) to the Belgian safety authorities.	–	End of 2011
Definition of an Agreed Design Upgrade (the list of actions and/or modifications proposed by the operator within the framework of the LTO-Reporting file is analysed by the safety authorities with a view to defining, after consulting the operator, the scope of the agreed design	Position to be taken by FANC on the LTO-Reporting file before mid-2012 so that Electrabel can implement the corrective measures and action plans included in the LTO-Reporting file in a timely manner.	Mid 2012

FANC's requirements (see strategic note)	Electrabel's expectations	Target date
improvements, i.e. the Agreed Design Upgrade).		
The operator submits a revision of or annex to the safety report (description of ageing management, implementation of LTO action plan and results of TLAA reviews, etc.) Implementation of ageing-management programmes.	Final confirmation of extended operation from the Belgian authorities, based on the summary report of the Fourth Periodic Safety Review (PSR) of Tihange 1 and Doel 1&2.	2015
Design modifications completed.	-	< 2020

B. FANC's strategic note: Fourth Periodic Safety Review

The following conditions should also be noted:

The long-term operation (LTO) of Belgian nuclear power plants must be evaluated within the framework of the (fourth) Periodic Safety Review of Belgian nuclear power plants.

The fourth Periodic Safety Review at Doel 1/2 and Tihange 1 will have to pay specific attention in particular (but not exclusively) to the two following aspects:

- Ageing management through a plant ageing-management programme in accordance with the provisions of 10 CFR54 and the IAEA guidance in SRS 57.

- Design re-evaluation, through a plant modernisation and upgrade programme ('agreed design upgrade') based on an evaluation of the design safety of these old units.

It should be mentioned that, in accordance with the new approach to Periodic Safety Reviews, an overall safety assessment will have to be performed during the fourth Periodic Safety Review, which will entail the evaluation of other aspects in addition to the two mentioned above ('ageing' and 'design').

C. Incorporating the conclusions of stress tests conducted in Belgium

The European Commission took the initiative of organising these stress tests in the wake of the Fukushima accident. On October 28, 2011, Electrabel submitted the report on the stress tests conducted in Belgium to FANC. At the request of FANC, the actions identified in this report relating to long-term operation of the plants were also incorporated into the LTO project.

D. Recommendations of the Scientific Council

In an annex to FANC's strategic note, the Scientific Council for Ionising Radiation issued a number of recommendations, which were taken into account and incorporated into the framework of the LTO project.

E. Additional aspects

The general approach adopted by Electrabel fully complies with FANC's strategic note. The approach is not, however, limited to this note alone.

Electrabel, which strives to achieve the highest possible level of safety, also takes account of international best practices and standards, which are usually issued by the International Atomic Energy Agency (IAEA) and the United States Nuclear Regulatory Commission (USNRC).

The requirements and directives published by the USNRC form the basis for the design and operating authorisations for nuclear power plants in Belgium. These requirements mainly apply to the LTO-ageing strand: in the past, a large number of US nuclear power plants that use the same type of reactors as the Belgian units were evaluated as part of the process for managing ageing and long-term operation of their facilities. During this evaluation process, general methodologies were established, the main reference points for which are document 10 CFR part 54 and the GALL Report (NUREG-1801).

As regards design re-evaluation, methodologies were developed on the basis of the following IAEA document: Safety of Nuclear Power Plants: Design (NS-R-1), as well as the underlying guidelines relating to design adopted by the IAEA.

1.3. OBJECTIVES

The objective of this service is to review the current status and future plans for safe LTO programme/activities performed in the plant, based on related IAEA Safety Standards and guidance documents and internationally accepted practices, and provide support for preparation for safe LTO. It was decided during the preparatory meeting held on 20-21 August 2014 in Tihange [24, 25], that this peer review would be a "SALTO Peer Review Mission for Tihange Nuclear Power Plant Unit 1 in Belgium".

1.4. SCOPE

As agreed during the preparatory meeting, the SALTO peer review for the plant focuses on the scope of a standard SALTO peer review, which should include areas in accordance with section 3 of IAEA SALTO Guidelines [21], divided as follows:

- A: Organization and functions, current licensing basis (CLB), configuration/ modification management;
- B: Scoping and screening and plant programmes relevant to LTO;
- C: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for mechanical components;
- D: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for electrical and I&C components;
- E: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures;
- F: Human resources, competence and knowledge management for LTO.

1.5. CONDUCT OF THE MISSION

1.5.1. Basis for the review and review methodology

The following documents and information were used as a basis for the review:

- IAEA Safety Standards;
- IAEA Safety Reports and Review Guidelines;
- Advance Information Package [26];
- Technical experience of the team.

The IAEA Safety Guide NS-G-2.12, Safety Report Series No. 57 and Safety Report No. 82 [13, 18, 30] are the basic references for the peer review, supported by Safety Guide on "Periodic Safety Review" [11] addressing some aspects of the preconditions to LTO and other technical documents presenting technical aspects of ageing management [20] and equipment qualification [17]. The final programme report of the IAEA Extra Budgetary Programme on Safety Aspects of Long Term Operation of Water Moderated Reactors [22] was used as a generic reference.

1.5.2. Conduct of the mission

The list of participants in the mission, including their functions during the SALTO mission and contact information, is given in Appendix I, while the mission programme is presented in Appendix II of this report.

The mission was conducted through review of plant documentation, meetings and discussions between the IAEA Review Team and counterpart specialists from the plant. The meetings were held at the plant. Plant walk-downs were also arranged as part of the mission.

Plenary sessions and parallel discussions were organized as needed. The discussions were conducted in parallel for all the areas assigned to the experts. Each expert had a plant counterpart, responsible for the area under review.

1.5.3. Conduct of the follow-up mission

The follow-up mission was organized to review appropriateness and progress of solutions of the SALTO mission issues. The plant provided Advance Information Package, describing counterpart actions to address recommendations and suggestions made previously, one month before the follow-up mission to the IAEA review team. Four days follow-up mission included introductory presentation of the plant, discussions and interviews of responsible counterparts. These were the basis for assessment of status of issues as presented in the report of the SALTO mission in 2015. This resulting document is an overall report of both the original SALTO mission and the follow-up mission.

2. MISSION RESULTS

2.1. GENERAL CONCLUSIONS

The plant has been in commercial operation since 1975. The company plans to extend their operation to 50 years which means until 2025.

Through the review of available documents, including the AIP and other plant documents, presentations and discussions with counterparts as well as with other members of the plant staff, the IAEA team concluded that the plant has worked extensively in the field of long-term operation and ageing management. Based upon the observations of this SALTO review, the team finds good preparation for the long-term operation of the plant.

The SALTO team concluded that plant management is committed to improving plant preparedness for LTO. The most significant areas of good practices and good performances by the team are:

- The plant uses a comprehensive approach to select the SSCs that are to be considered for the Ageing Management evaluation. The plant methodology is described in a policy document which has been discussed and agreed with the Safety Authority. The document provides clear guidance for scoping in mechanical, electrical and civil structures areas in accordance with the IAEA expectations. (good performance in area B);
- In the store, the expiring date of electrolytic capacitors for class 1E equipment is clearly marked on the label itself as well as on an additional colored sticker. (good performance in area D);
- The plant uses a comprehensive and well implemented approach to the management of critical suppliers which includes a dependency/criticality matrix, with clear criteria, to identify critical knowledge/equipment suppliers. These actions have already led to an increase of knowledge in key areas by plant staff and avoided the time and resources needed to find alternative suppliers in certain cases (good practice in area F).

The team encourages plant management to facilitate appropriate implementation of all remaining LTO related activities. There are some areas which should be improved to reach the international good practice level. The team offered ten recommendations and suggestions for improvement. The most significant recommendations include the following:

- The programme for LTO and AM related activities should be followed-up in a systematic manner to ensure that required safety functions of systems, structures and components are fulfilled over the plant's entire LTO period (in area A);
- The plant should clarify the process to demonstrate that mechanical equipment qualification will remain valid over the LTO period (in area B);
- The plant should extend the time span of operating experience and the range of references used for AMR (in area C).

An evaluative section of each reviewed area is contained within the following relevant subsections of section 2.2. Ten issues have been raised. Recommendations and suggestions are stated in section 2.2 and described in details in individual issue sheets in Appendix IV.

The plant management expressed a determination to address the areas identified for improvement, and indicated the intention to invite a "Follow-up SALTO peer review mission" in December 2016 to complete the review of the plant preparation for LTO. The follow-up mission will review progress in solving issues raised during this mission.

2.2. DETAILED CONCLUSIONS

2.2.1. Organization and functions, current licensing basis (CLB), configuration/ modification management

The review area covered:

- Related regulatory requirements, codes and standards;
- Organizational structure for LTO;
- Plant policy for LTO;
- LTO implementation programme;
- Current safety analyses report and other current licensing basis documents;
- Configuration/modification management including design basis documentation (DBD).

The basic document issued by the regulator, the Federal Agency for Nuclear Control (FANC), for the purposes of long-term operation (LTO) of nuclear units in Belgium, is entitled "Strategic Note – Long-term operation of Belgian nuclear power plants; Doel 1,2 and Tihange 1". This document includes the requirements for evaluating the LTO of NPPs as part of the plant's fourth Periodic Safety Review (PSR). A PSR must be performed by the plant every ten years, and this PSR shall include specific LTO files. The plant has undertaken comprehensive work in this area and a lot of detailed information is or will be describing the various safety factor statuses. The team **encourages** the plant to keep its focus on the main objectives of the PSR, which is a report on status of the plan in respect of adequacy of the arrangements that are in place to maintain plant safety until the next PSR or the end of plant lifetime; and the safety improvements to be implemented to resolve the safety issues that have been identified.

However, the plant does not have a programme in place for carrying out ageing management activities for the LTO period. A **recommendation** is given to the plant by the team that the programme for LTO and AM (ageing management) related activities should be followed-up in a systematic manner to ensure that required safety functions of SSCs are fulfilled over the plant's entire LTO period.

With the specific importance of ageing management in respect of safe continued operation of the plant, the key issue is the timely and comprehensive implementation of ageing management programmes (AMP). Therefore, the **suggestion** of the team is that the plant should consider finalizing the implementation of AMPs in the plant organization and clearly defining responsibilities for the relevant activities in plant processes.

Documents and information used during the review were:

- AIP – IAEA SALTO peer review mission Tihange 1 – January 2015
- Periodic Safety Review Tihange 1- Scope and methodology, March 2013, TN-PSR-204 v 2.0;
- SF-1 – Identification des bases de conception de circuits important pour la sûreté a Tihange 1, Folio 13- PSR2/4NT/0135938/013/01;
- PSR2 Extension to KCD124/CNT13 Technical Note, SF-1 Plant Design – CNT1 Assesment Report;
- Liste de Notes liées aux Bases De Conception Tihange 1 Archives; NT/ESP/924/2014;

- Liste des notes mentionnées dans les paragraphes "références" du rapport du sûreté de Tihange 1, NT/ESP/925/2014;
- Internal Procedure – Organisation du rôle de "Design Authority" – REF/00/032;
- Internal Procedure - "Organisation Programme of LTO", Ref/OGZ/126;
- Presentation by the plant PSRII – Tihange 1&3, SF2, SF4, 14/01/2014;
- Presentation by the Plant – Periodic Safety Review – SALTO Tihange;
- Policy document – Document management process – ST.100010043316.000.02 ;
- Policy document – Processing and Managing QA documents –ZST.10010223289.000.01
- Demonstration of modification process handling in SAP.

Status at SALTO follow-up mission

There were two issues presented by the review team in 2015, A1 'Lack of programme for sustainable management of ageing for LTO' and A2 'Inadequate implementation of ageing management programmes'.

A recommendation that 'The programme for LTO and AM related activities should be followed-up in a systematic manner to ensure that required safety functions of systems, structures and components are fulfilled over the plant's entire LTO period' was raised within the **A1 issue**.

Policy 'Ageing Management Program for LTO Units' was developed on a corporate level. The objective of the document is to ensure that the ageing management philosophy will be properly taken over by the line organization. In accordance with this document, scoping and screening results will be continuously updated. Periodic update of AMR is not clearly described in this document. AMPs and TLAAs will be reviewed and updated every 5 years or in case of important operating experience. There is a plan to modify the structure of plant programmes (maintenance, ISI, EQ, surveillance, chemistry) in accordance with nine attributes in 2017. Obsolescence is also covered by the procedure, by references to knowledge management programme, proactive technological obsolescence programme (in development) and obsolescence of standards and regulations. PSR is not mentioned as a suitable tool for managing obsolescence of standards and regulations despite it being used at the plant.

Procedure 'Living AMPs & TLAAs watch & scoping – AMR review: AP Programme' is a corporate procedure describing scoping, AMR, AMP and TLAA living process. IGALL is used as an operating experience source to improve AMPs. Currently, it is stated in this document that only IGALL AMPs for passive SCs will be considered for the plant AMPs improvement. But it has already been decided that IGALL AMPs for active SCs will also be reviewed and considered. AMR will be updated in case of changes in the scope of SSCs and as a result of condition assessment performed by system health engineers (component engineers are not established yet) in cooperation with AMP owners. In section Deliverables, updating of AMR is not required and described. For TLAAs, international experience is monitored (e.g. IGALL) to identify missing TLAAs or latest approaches in TLAA revalidation. General approach for future revalidation of TLAAs in not described in corporate documents, e.g. when to initiate further revalidation of TLAAs for Tihange 1 or when initiate revalidation of TLAAs for other units.

'Programme for managing ageing specific for Tihange Units in LTO' (the first version approved on 16 November 2016) is a plant specific programme which defines roles and responsibilities. AMPs and TLAAs were already transferred from the LTO team to new owners in Engineering

Department in 2016. Pilot training of the plant staff on 'Ageing Management' is in preparation with a pilot session planned in January 2017. A training plan for all staff involved in ageing management activities described above will be developed based on results of this pilot session in 2017.

Proactive obsolescence programme is in development. Identification and prioritization of obsolete items is in progress. Decisions for first solutions for the most critical obsolete items are expected in the second quarter of 2017.

Conclusion: Satisfactory progress to date.

A suggestion that 'The plant should consider finalizing the implementation of AMPs in the plant organization and clearly defining responsibilities for the relevant activities in plant processes' was raised within the **A2 issue**.

A first step of the resolution of this issue was to finalize generic and plant-specific AMPs. All AMPs were developed in 2015 in the same format of generic and plant-specific AMP, by LTO team. Transfer of AMPs to Engineering Department was done in the beginning of 2016. AMP owners, including their responsibilities in connection with AMP performance, are clearly defined.

Procedure 'Living AMPs & TLAAs watch & scoping – AMR review: AP Program' provides guidance on development of plant-specific AMPs. It requires the same structure of generic and plant-specific AMPs in a format of nine generic attributes of effective ageing management programme. Several generic and plant-specific AMPs were reviewed and they fulfil the requirement of an effective AMP.

The results of some AMPs are recorded in System Health Reports (SHR), others within the SIMEO tool and others within the inspection report system in SAP.

Minor improvements of the methodology for development of generic and plant-specific AMPs and for reporting of AMPs results are mentioned in the issue sheet.

Conclusion: Issue resolved.

2.2.2. Scoping and screening and plant programmes relevant to LTO

The review area covered:

- Methodology and criteria for scoping and screening of SSCs for LTO;
- Plant programmes relevant to LTO (maintenance, equipment qualification (EQ), in-service inspection (ISI), surveillance and monitoring, monitoring of chemical regimes etc.)

The plant uses a comprehensive approach to select the SSCs that are to be considered for the Ageing Management evaluation. The plant methodology is described in a policy document which has been discussed and agreed with the Safety Authority. The document provides clear guidance for scoping in mechanical, electrical and civil structures areas in accordance with the IAEA expectations. The scoping criteria are precisely defined, including those for SSCs not important to safety. In some circumstances, scoping sub-criteria are defined for including a SC not important to safety. Any system containing at least one SC important to safety has been considered as a whole in the scoping process. A cross check is implemented among specialities in order to guaranty

consistency between the "mechanical" "E-I&C" and "civil structures" areas. The scoping report includes a list of systems, P&IDs with boundaries marked in colours depending on criteria, lists of SCs and details for each of them such as safety function classification and criteria being used to select them. If needed, components have been split into sub-components to indicate which part of the component must fulfil which safety function. The team considers this process as a **good performance**.

The screening methodology is precisely described in the LTO ageing methodology Doel 1&2 and Tihange 1 umbrella document. In order to do the ageing management evaluation, commodity groups have been defined and boundaries between LTO teams are clearly defined. Results are documented in AME system reports and commodity group IPA reports. The team considers this process as a **good performance**.

The process for evaluating preventive and predictive maintenance programmes for active mechanical components is not comprehensive and outstanding evaluation tasks are still to be performed by Maintenance Department. The team **suggests** that the plant review its process for evaluating preventive and predictive maintenance programmes for active mechanical components.

During the scoping process, gaps were identified in E-I&C equipment with respect to EQ requirements. The plant has decided to replace those components with new ones. The deadlines have been discussed and agreed with the Authority:

- Approximately 1500 Train S1 components in 2014/2015;
- Approximately 1500 Train S2 components in 2016.

In addition, during the scoping process, other gaps were identified in the classification list. Approximately 100 monitoring channels have to be added or have to change their categorisation. The team **encourages** the plant to implement all of these corrective actions.

The demonstration that mechanical equipment qualification will remain valid over the LTO period is not clear. The team **recommends** the plant to clarify the process to demonstrate that mechanical equipment qualification will remain valid over the LTO period.

The plant has implemented a comprehensive evaluation of the in-service inspection in-service inspection, surveillance and monitoring, monitoring of chemical regimes programmes. When necessary, new actions have been implemented as part of projects and commitments managed in the collaboration room. The team considers this process as a **good performance.**

New actions created to address LTO requirements are clearly flagged in the SAP data base, using the "R21" code in order to secure them. The plant is considering implementing the same methodology for in-service inspection actions already existing and important for LTO. The team **encourages** the plant to implement such a methodology and to consider it for other plant programmes relevant for LTO.

Documents and information used during the review were:

- DTS/4NT/0134950/000/08, Scoping methodology;
- TIS/4NT/0296570/000/00, Procedure for Baseline Inspections;
- DTS/4NT/0169851/000/02, Boundaries definition;
- 10010201211 v0.2, LTO-ageing: Specific methodology Doel 1 & 2 and Tihange 1;

- NT/LTO/Ageing/EIC/25, Commodity groups definition;
- 10010198608 v04, LTO-ageing: Guideline specific to active mechanical AME;
- Memorandum of understanding between LTO project and RCM-project PC-06 (lettre de mission);
- Active mechanical AME for CAE, CAU and CIS systems;
- LTO preconditions, Equipment qualification in Tihange 1, reference NT/LTO/ENGT/PRE/103 v0;
- 10010252272/000/01 18/12/2014, PSR2 SF3 Equipment qualification assessment report for Tihange 1;
- 10010256019, Guideline for the preparation of RSQ recommendation notes;
- CRR/RCM 14-01 Minutes of the RCM committee meeting held on 06/07/14;
- GDI/SHR/008, Tihange SHR process;
- CRR/ESH/153/2014/SHR Minutes of the RCM committee meeting held on 17/09/14;
- GDI/SHR/013 Tihange RCM process;
- TIS1/4NT/0296570/000/00 Baseline inspection guideline.

Status at SALTO follow-up mission

There were two issues presented by the review team in 2015, B1 ‘Lack of comprehensive evaluation of active mechanical components’ and B2 ‘Unclear demonstration of mechanical equipment qualification’.

A suggestion that ‘The plant should consider reviewing its process for evaluating preventive and predictive maintenance programmes for active mechanical components’ was raised within the **B1 issue**.

The plant has defined a methodology in 2015, in order to check gaps between the LTO and the RCM approaches. The gaps identified were related to maintenance preventable functional failure. The plant decided, for evaluating preventive and predictive maintenance programmes, to check corrective maintenance work orders that were selected through active mechanical AME (Ageing Management Evaluation) documents.

As a result of this evaluation, three corrective actions have been identified. They were related to packing box leak management, spray pumps lubricating system leak management, vibration monitoring of fans. Actions were decided, managed with the LUDIKS system (Action Management System) and the maintenance programs are now modified.

The process for evaluating preventive and predictive maintenance programmes for active mechanical components is performed by SHR evaluation. This is done by SHR Engineers. Each system is reviewed every 3 months and the conclusions are approved in the SHR Committee. The I-FIAB software is used by SHR Engineers and AMPs owners as well. This system is used in order to collect and share information (for instance living information from SAP system) and is used for SHR and AMPs analysis.

Conclusion: Issue resolved.

A recommendation that 'The plant should clarify the process to demonstrate that mechanical equipment qualification will remain valid over the LTO period' was raised within the **B2 issue**.

The plant has defined a methodology to demonstrate that mechanical equipment qualification will remain valid over the LTO period. This methodology is based on SRS-03 definitions. The objective is to ensure that the mechanical active components will be able to fulfil their safety function under harsh conditions.

A specific scoping has been done, taking into account mechanical active components that are activated:

- By electricity, pressurized air or hydraulics;
- By a fluid (safety valves, non-return valves);
- Manually during harsh condition (post-accident liquid sampling system).

P&IDs and information coming from electrical EQ List has been used to support scoping.

The methodology includes equipment conditions. A review of events encountered by mechanical active components has been done to ensure that none of them experienced harsh service conditions in the past.

The plant has performed screening of mechanical active components, in order to detect items that could be vulnerable during the LTO period. Those vulnerable items include polymers, grease, etc. All active mechanical components have now been addressed.

The EQ Review process is currently ongoing. The EQ files have been issued for all the pumps. The other equipment (e.g. valves) are planned to be addressed in January 2017.

The plant intention is to address conclusions of the evaluation with the methodology already in place for electrical components.

Conclusion: Issue resolved.

2.2.3. Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for mechanical components

The review area covered:

- Area-specific scoping and screening of SSCs for LTO;
- Ageing management review;
- Review of ageing management programmes;
- Obsolescence management programme;
- Existing time limited ageing analyses;
- Revalidation of time limited ageing analyses;
- Data collection and record keeping.

The time span of operating experience and the range of references used are not sufficiently comprehensive for ageing management review (AMR). Deficiencies in addressing all relevant

information relating to ageing management review may have an impact on identification and management of ageing effects. The team **recommends** that the plant extend the time span of operating experience and the range of references used for AMR.

The corporate note on Ageing Programme states that a proactive obsolescence management programme should be put in place. However, in the plant, there is no fully implemented proactive obsolescence management programme in place for mechanical components to cope with risks to plant reliability and availability during LTO. The team **encourages** the plant to consider implementing a proactive obsolescence management programme for mechanical components.

Some piping sections of the CEB systems were replaced using a new material made of epoxy resin reinforced fiberglass (GRE). The plant identified erosion as the only ageing effect to be managed, and consequently defined relevant maintenance programmes, but without considering whether other ageing effects such as cracking or blistering also should be managed. The team **encourages** the plant to verify effectiveness and consider any relevant modification of the selected AMP (M20) in regards with ageing effects other than erosion.

For LTO, the plant has identified a Time Limited Ageing Analysis (TLAA) for CCV heat exchanger type components. This TLAA does not take into account the projected number of transients up until 50 years of operation. Moreover, in a broader way, the TLAAs do not contain clear identification of acceptance IGALL criteria. This may impact the definition of appropriate corrective or compensatory measures for managing ageing effects during LTO. The team **encourages** the plant to clarify revalidated TLAAs.

The plant's 4th PSR scope and methodology includes interfaces between all PSR safety factors, however in an inconsistent way. As the interface of safety factor (SF) 9 (OPEX) with SF4 (ageing) is missing in SF9, the connection between ageing and OPEX is not clearly identified. The team **encourages** the plant to identify all interfaces between PSR safety factors in a consistent and comprehensive way.

The corporate note on Ageing Programme describes the ageing programme intended to be implemented on all units of the fleet, including the plant's unit 1. However, this note is not fully consistent with the LTO process already implemented by the plant, e.g. TLAAs are not identified as deliverables or missing references. Based on this corporate ageing program, new plant organizations should be implemented after the time when the plant will enter the period of extended operation, which are not defined yet. This may have an impact on the way the plant will manage ageing, e.g. update of AMPs at generic or site level, during LTO. The team **encourages** the plant to clarify interactions and sharing of responsibilities for ageing management with the corporate entity when implementing the corporate ageing program.

Documents and information used during the review were:

- LTO ageing: specific methodology Doel 1&2 and Tihange 1 – SAP number: 10010201211 v0.2;
- SAP number 10010424313/000/01, Periodic Safety review Tihange 1- scope and screening methodology;
- DTS/4NT/0139629/000/05, LTO-ageing – Mechanical – Doel 1&2 – Tihange 1: Guideline AME passive mechanical;

- SAP number 10010198608 version 04, LTO-ageing: Guideline specific Ageing Management Evaluation of Active Mechanical components;
- NT/LTO/AGEING/MEC/004 version 01 Engineering document témoin- LTO ageing - AME - Passive - Mechanical - Tihange 1: CEB;
- NT/LTO/AGEING/MEC/013 version 01 LTO ageing - AME - Passive - Mechanical - Tihange 1: CRP;
- SAP number 10010235189 version 01, LTO ageing – Doel 1&2 – Tihange 1: List of standardized AMPs (including the AMP organization);
- DTS/4NT/0152730/000/05 and DTS/4NT/0152730/000/00, Draft generic and site application AMPs M1: ASME Section XI Inservice inspection, subsections IWB, IWC and IWD;
- DTR/DC1/4NT/82723/000/02, A3: Evolution du code ASME-OM : comparaison entre les versions 1992/2001 + propositions de modification du programme actuel
- DTS/4NT/0131020/000/04 and DTS/4NT/0131020/001/00, Draft generic and site application AMPs M11: Nickel-Alloy nozzles and penetrations;
- DTS/4NT/0173987/000/02 and DTS/4NT/0173987/001/00, Draft generic and site application AMPs M19: Steam generator tube integrity;
- DTS/4NT/0152154/000/01 and DTS/4NT/0152154/001/00, Draft generic and site application AMPs M31: Reactor vessel surveillance;
- SAP number 100010230901 version 02, Ageing program.
- DTS/4NT/0174008/000/03 and DTS/4NT/0174008/001/00, Draft generic and site application SAMPs M102: Steam generators – Components other than tubes;
- SAP number 10010413022, SG tubes 2013 inspection results: Tihange 1 – Générateurs de vapeur – rapport d'inspection 2013;
- DTS/4NT/0142509/000/05, LTO-ageing – Mechanical – Doel 1&2 – Tihange 1: TLAA overview;
- DTS/4NT/0142509/000/05, Tihange 1 - LTO Pré-conditions -TLAA;
- DTS/4NT/0173898/007/02, LTO ageing - TLAA - Mechanical - Tihange 1: Fatigue - nozzle of CCV 3" charging line on RCL;
- DTS/4NT/0159611/000/04, LTO ageing - TLAA - Mechanical - Tihange 1: Fatigue - Fatigue analyses covering 50 years of operation without considering environmental effects;
- SAP number 1001189033 version 02, comptabilisation des transitoires CCV depuis la mise en service de la tranche 1;
- SAP number 10000762462 version 05, Suivi des transitoires d'exploitation;
- CNT-KCD/4NT/8108/042/01, Ageing summary 042: Cracking of the Steam generator divider plates;
- CNT-KCD/4NT/8108/043/01, Ageing summary 043: Steam generators' tube support plates clogging;
- CNT-KCD/4NT/8108/044/01, Ageing summary 044: PWSCC in steam generators drains;

– SAP number 10001439212 version 07, draft, liste des dossiers de modification de cat.1 (MNI), cat.2 (NMNI) et cat.3 (DML) depuis le premier fonctionnement à 100% PN (au 06/02/13).

Status at SALTO follow-up mission

There was one issue presented by the review team in 2015, C1 'Lack of completeness for the ageing management programmes'.

A recommendation that 'The plant should extend the time span of operating experience and the range of references used for AMR' was raised within the **C1 issue**.

The plant has made a review of OE events from 1975 to 2015 in order to select those events relevant for ageing and LTO. 89 events have been selected and are documented in a specific data base with an evaluation of their impact on ageing. Most of these events are managed with respect to the current AMPs in the plant and 2 events are currently being analysed by Laborelec.

The plant decided to transfer the ownership of AMPs from the LTO Department to the Engineering Department from the beginning of 2016. An owner is designated in the Engineering or the Chemical Department for each AMP. The AMP owner is in charge of integrating OE into the AMPs. The manager of the SHR department is in charge of providing the required OE information to the AMPs owners. Feedback from Operating Experience actions are managed in the general management action list (LUDIKS), which is monitored by the management of the plant, and priorities are decided in the SHR monthly Committee meeting.

The range of references needed in AMPs has been decided at the corporate level. For instance, it has been decided to use IGALL 2014 as a reference. For pump and valve testing, ASME OM version 2004 with addendum 2006 is used; ASME XI 2007 is used with addendum 2008. Tractebel and Laborelec representatives participate in international groups in order to update their knowledge of international events and research programmes.

An analysis of the gaps between IGALL and the AMPs developed at the corporate level has been established. As a conclusion, 13 AMPs have to be created, 6 AMPs need major modification and 13 need minor modifications. An action plan has been developed to address by 2019. The impacts on maintenance programs and equipment qualification files (RSQ) used in the plant are identified.

Conclusion: Issue resolved.

2.2.4. Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for electrical and I&C components

The review area covered:

– Area-specific scoping and screening of SSCs for LTO;
– Ageing management review;
– Review of ageing management programmes;

– Obsolescence management programme (particularly for I&C systems and components);
– Existing time limited ageing analyses;
– Revalidation of time limited ageing analyses (including EQ);
– Data collection and record keeping.

Setpoints are currently in different documents and procedures. There is a setpoint database at a very early stage of preparation. Only a note with 5 possible areas (radiation protection, motor operated valves, operating time of valves, reactor protection and power distribution) is available. It is important to have one integrated setpoint database with a clear CCM (Configuration and Change Management). The team **encourages** the plant to establish such a database.

The plant configuration (functional location, equipment number, equipment type, serial number as well as classification and qualification) is part of the SAP and the Q-list (list of qualified SCs). Whenever any equipment is replaced, the new configuration must be added in both databases. There is a risk of inconsistencies between SAP and the Q-list. The team **encourages** the plant to use the SAP configuration as a master and to establish a link with the Q-List.

The cable depository for the Cable Ageing Management Programme and Equipment Qualification is well organised and in accordance with the international state of the art. The team considered this as a **good performance**.

In the store, the expiring date of electrolytic capacitors for class 1E equipment is clearly marked on the label itself as well as on an additional coloured sticker. The team considered this as a **good performance**.

A **suggestion** is made to the plant which should consider establishing a periodic preventive condition inspection and test programme for cables, cable trays and its connections in the 1E cable system.

Documents and information used during the review were as follows:

– Q- List;
– SAP, plant configuration management and maintenance;
– List of RSQ for the radiation monitoring system CNT-KCD/4NT/11032/002/01;
– Maintenance responsibilities: MAINT/00/065 29.11 2013;
– Cable-trays - condition and actions: TIS1/4NT70308355/001/00 12.05.2014;
– Terminal box anchorages: P.00583.1011-CNT1 07.04.2014;
– Results of plant structure basic inspection: TIS1/4NT/0319707/000/00 13.06 2013;
– Status of screw connections: NT/LTO-T1/EIC/27;
– Action list for cable trays, Technical note: TIS1/4NT/0303855/001/00;
– PVC cable qualification results LBE 04104439-0.1;
– Project EI28 : Cable qualification results Bel-V17/09/2014;
– Class 1E connections: NT/LTO-T1/EIC/27 13.01.2015;
– AMP plug contact tests for LTO: DTS/4NT/0282389/00/01.

Status at SALTO follow-up mission

There was one issue presented by the review team in 2015, D1 ‘Insufficient preservation of 1E cable-system qualification and functionality during LTO’.

A suggestion that ‘Consideration should be given to establishing a periodic, preventive condition inspection and test programme for cables, cable trays and its connections in the 1E cable system‘ was raised within the **D1 issue**.

During the 2015 SALTO mission, it was stated that there are no planned periodic and documented visual condition inspections and tests during the LTO period, aiming at preserving cable system qualification and functionality (cables, cable trays and connections).

The plant implemented a requalification process with a formal dedicated document and inspection documents with sheet for records during the visit. The following particular aspects have been implemented:

- Inspection of cables in hotspots area: operational inspections are written;
- Crimp connections: test procedures and test results;
- Grounding connection: an inspection programme;
- Cable tray: the cable trays are a part of the metallic structures inspection programme; this programme now includes particular aspects of cable trays such as an examination of sharp edges that could potentially damage the cables.

Based on activities described above, the team concluded that visual inspections and tests during the LTO period aiming at preserving cable system qualification and functionality are properly implemented.

Conclusion: Issue resolved.

2.2.5. Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures

The review area covered:

- Area-specific scoping and screening of SSCs for LTO;
- Ageing management review;
- Review of ageing management programmes;
- Obsolescence management programme;
- Existing time limited ageing analyses;
- Revalidation of time limited ageing analyses;
- Data collection and record keeping.

During plant walk down, the team noticed improper anchoring of supports in the relay room of electrical building, which is part of cable tray support strengthening. The design intent of cable

tray support anchoring is not performed as required by the design. The plant is **encouraged** to ensure that the design intent of the cable tray support anchoring modification is properly implemented.

The team performed a walk-down inside the spent fuel storage building (BAN) where replacement of anchorage system was in progress. To prevent foreign material entering the spent fuel pool and to facilitate safe working, an elaborate pool covering, platform with scaffolding arrangement has been arranged over the pool. The team finds this work as a **good performance.**

The team noted that software has been developed and is in place for ageing management of civil structures. The software covers inspection reports, Ageing management programme, database, assessment, proposal of action, scoring system for action to be taken and monitoring of ageing effects. The team finds this work as a **good performance**.

During the walk down around a natural draught cooling tower, the team observed brown colour water marks on the shell above the ring beam level. These brown colour water marks are due to reinforcement corrosion. Plant is **encouraged** to examine the degradation of concrete due to reinforcement corrosion.

The team noticed that the plant ground water level is high with an increasing trend, which is a concern for the underground structures with respect to durability. The **suggestion** is given by the team to carry out a detailed study to assess the reason for the increase in ground water level and its effect on plant structures (especially safety related structures) with respect to durability.

The plant has planned to construct a new SUR building (emergency shutdown system – second level) to take over control room actions which will address e.g. loss of fire barrier due to cracks in masonry walls during a seismic event. The planning has been defined in the "Agreed Design Upgrade" and approved by Authorities. The plant is **encouraged** to speed up the construction of the SUR, which is still in the tendering stage.

Documents and information used during the review were:

- Doc. no. OXAND ETU/2010/116/B, General methodology for Integrated Plant Assessment specific to Civil eng. structures;
- Doc. No. OXANDETU/2010/103/D, Integrated Plant Assessment (IPA) document for double containment;
- Doc. No. OXAND ETU/2010/80/C, Integrated Plant Assessment for ageing mechanism, score grade of the impact on the intended function;
- GALL AMPs, for containment, liner, Internal structures;
- Doc. No. DTS/4NT/0173947/000/01, Loss of pre-stress in Primary containment;
- Doc no. F1-LTO-T1-GC-04-DM, Re-instrumentation of primary containment;
- Doc. No. CNT1/4NT/6643/006/R-0, 2006, Primary containment pre-stress monitoring;
- Doc. No. DTS/4NT/0142509/000/Loss of pre-stress in containment;
- Doc. No. OXAND ETU/2010/97/C, Integrated Plant Assessment (BAN East);

- Doc. No. TIS1/4NT/0343220/000/00 dated 23/12/2014 Stress corrosion in anchorages and bolting etc.;
- Project note no. NT/LTO-T1/GC/B-GC-09 (SAP no. 10010484737) dated 09/01/2014.
- TIS1/4NT/0297092/000/00, Safety and design criteria report;
- Doc. No. TIS1/4NT/0312974/000/00, Inspection procedure report for physical separation of cables and fire barriers;
- Doc. No. TIS/4NT/0284320/000/00 dated 05/06/2013. Summary note on Seismic Margin Review of masonry walls in various safety related buildings of Tihange 1 to 3;
- Doc. No. 541497/627/NT/0009 – Electrical building – Seismic calculation of masonry walls.
- Sketch nos. SPIE 01 to 03, 05, 07, 09, 11, 13 15, 17 and 22, Support details for cable tray strengthening;
- Sketch SKIPN, Detail of anchor plate for cable tray strengthening;
- Avis 11502744, Inspection report of basement concrete of cable tunnel;
- Doc. No. TIS/4FR/162175/000/R-0 14-06-2010, Inspection report of stressing gallery of reactor building;
- Data on ground water table inside and outside plant area.

Status at SALTO follow-up mission

There were three issues presented by the review team in 2015, E1 ‘The plant approach to confirmation of containment integrity’, E2 ‘Leaching of Calcium Hydroxide on the floor slab of electrical building basement’ and E3 ‘Improper anchoring of supports in relay room of electrical building’.

A suggestion that ‘the plant should consider verifying that the existing methodology for demonstrating the structural integrity of containment is consistent with IAEA Safety Standards’ was raised within the **E1 issue**.

During the 2015 SALTO mission, it was stated that the current approach to the testing of containment structural integrity is not fully consistent with IAEA Safety Standards. In fact, this statement is related to two documents: NS-G-2.10 related to the Design of Containment System and the IGALL Safety Report (which refers to RG 1.90 rev 2 via AMP 302).

These two documents are not considered as a Current Licence Basis for Tihange 1 because other documents such as RG 1.90 rev 1 are taken into account for both the previous period of operation, and the future LTO period for containment.

Nevertheless, the authors of updates RG 1.90 have pointed out in a technical publication that the risk of corrosion of grouted tendons has to be addressed. So, if the plant does not perform a full pressure test periodically, findings presented during the review should be increased in order to constitute a complete technical justification.

Conclusion: Satisfactory progress to date.

A suggestion that ‘the plant should consider taking measures to manage Calcium Hydroxide leaching’ was raised within the **E2 issue**.

During the 2015 SALTO mission, it was stated that loss of concrete durability due to leaching Calcium Hydroxide had not been appropriately addressed in the plant. This was due to white patches that were observed on the floor of the basement of the electrical building during a walk-down at the plant.

The plant performed chemical analysis that gave evidence that these patches were not due to concrete leaching but were due to previous internal local flooding that left patches after evaporation.

Nevertheless, concrete structures AMP and inspection procedures already address the risk of leaching as can be seen in an existing document. In addition, a specific corrective action has been launched in order to limit as far as possible water ingress to the underground part of the nuclear building, and in particular the galleries.

Conclusion: Issue resolved.

A suggestion that 'the plant should consider ensuring that the design intent of the cable tray support anchoring modification is properly implemented' was raised within the **E3 issue**.

During the 2015 SALTO mission, it was stated that cable tray support anchoring is not performed as required by the design, so the team undertook during the follow-up mission a detailed verification of the final report related to the modification done for the cable tray supports, and carried out a site tour to confirm the then current status.

The modification final report included control points dedicated to anchoring. Walk-down confirmed that many cable trays have been retrofitted in galleries. A specific yellow coating has been applied on anchorings to check the presence and the conformity of the anchoring bolts.

In addition, an inspection has been performed in all nuclear islands in order to have a clear view on both conformity aspects (number of bolts) and ageing effects. The 'initial' inspection has already been performed and a significant number of corrective actions have been identified and described in a dedicated document for the work carried out on site. Today, all the corresponding work has been completed.

Conclusion: Issue resolved.

2.2.6. Human resources, competence and knowledge management for LTO

The review area covered:

- Human resources policy and strategy to support LTO;
- Competence management for LTO and recruitment, training, and qualification processes for personnel involved in LTO activities;
- Knowledge management and knowledge transfer for LTO.

The plant has implemented many changes and upgrades to their human resources, competence and knowledge processes and procedures since the pre-SALTO mission in 2012. However, many of these changes are still in progress and the team **suggests** that completion of implementation of newly developed competence and knowledge management processes should be expedited.

In particular, the knowledge grids and expert charts being implemented to manage team and individual competence and knowledge transfer will be of great benefit to line managers once fully implemented. These tools are comprehensive in nature and are considered a **good performance** by the team.

Every staff movement (promotion, transfer, and exit) triggers a requirement for the line manager to decide if a formal knowledge transfer is required. This decision must be reviewed and confirmed by Human Resources. If the decision is yes then the formal knowledge transfer process is implemented; this approach is considered a **good performance** by the team.

Considering the amount of experience being gained internationally in the area of LTO, the plant is **encouraged** to take more opportunities to share and learn from the experience of other plants and organization.

The plant has implemented a comprehensive process for the management of critical suppliers (knowledge or equipment related) and the team recognizes that this is a **good practice.**

- ZST.10010366104, Rev S01, 07/08/2014, LTO Programme organisation;
- ZST.10010426013.000 Vers 00, 16/06/2014, LTO job certificate;
- 10010308244 Vs00.00, February 2012, Competence development;
- ZST.10010043570.000 Vers 02, 04/12/2012 Competence Management;
- 10010308244 Vs00.00, February 2012: Competency Development Policy statement;
- ZST.10010491180.000 Vers 00, 23/12/2014; Competence and Knowledge management;
- ZST.10010043379.000_02, 21/01/2013; Knowledge Management (Group);
- ZST.10000763227.000 Vers 03, 22/12/2014; HR Organisation;
- ZST.10010043359.000 Vers 02, 06/06/2013:Recruitment;
- ZST.10010043360.000 Vers 02, 30/06/2014; Staffing;
- ZNO.10010451005.000 Vers 00, 12/03/2014; Tihange 1 2014, Project organisation;
- ZNO.10010489561.000 Vers 00, 0212/2014; Definition and implementation of required levels of design basis knowledge;
- ZNO.10010090630 000 Vers 03, 28/04/2014; Safety Passport – Individual certificate, Level 2;
- ZNO.10010226645 000 Vers 03, (no date); Safety Passport – Individual certificate, Level 4
- HR database (SAP);
- Staffing database;
- Succession database;
- Recruitment statistics;
- Retirement forecasts;
- Long term planning scenarios.

Status at SALTO follow-up mission

There was one issue presented by the review team in 2015, F1 'Incomplete implementation of competence and knowledge management processes'.

A suggestion that 'Consideration should be given to expediting the completion of implementation of newly developed competence and knowledge management processes' was raised within the **F1 issue**.

During a SALTO mission in January 2015, processes of competence management, knowledge management and an interactive human resource process map were developed but not implemented inside the operating organization.

Currently, the knowledge transfer process is established and fully implemented at the plant. Human resources business partners monitor changes inside the organization and provide information to CTC (Competence and Training Centre). CTC requests line managers to decide if knowledge transfer is needed. Knowledge transfer tool is available on the plant web site. The line manager has to determine the appropriate type of knowledge transfer methods, e.g. knowledge grid, knowledge expert chart, yellow sticky, one to one, other methods. CTC is responsible for the follow-up of the process. Knowledge grids are prepared for approximately 75% of employees (but not for LTO project team members); knowledge expert charts are developed for important experts. Management and transfer of knowledge from LTO team members into the line organization are performed using yellow sticky or one to one method. CK&HR (Competence, Knowledge and Human Resources) Committee has regular monthly meetings performing follow-up of the activity status.

The competence management procedure describes overall processes, e.g. key knowledge identification - knowledge grid, knowledge expert chart, knowledge transfer, team and individual development plan (OJT, behaviour, skills, shadowing), training, long-staffing needs and follow-up on new staff.

An interactive human resource process map was made available for the plant employees on the plant intranet and provides an overview of processes and links to procedures.

Conclusion: Issue resolved.

2.3. GOOD PRACTICES

2.3.1. Review area - Human resources, competence and knowledge management for LTO

Management of critical suppliers

The plant uses a comprehensive and well implemented approach to the management of critical suppliers which includes a dependency/ criticality matrix, with clear criteria, to identify critical knowledge/equipment suppliers. The following criteria are used to determine the dependency/criticality of suppliers:

Dependency:
- Monopoly supplier/ original equipment manufacturer;
- Electrabel main supplier;
- Replacement cost;
- Acceptance of Electrabel requirements.

Criticality:
- Technical competences;
- Technical documents;
- Financial health;
- Compliance with 10CFR50;
- Availability of goods/ obsolescence.

The plant originally identified approximately 40 suppliers of which, using the above criteria, 20 were confirmed to be critical. For each of these 20 a more detailed review was conducted and an action plan developed.

When a critical supplier has been identified, a range of tools are used including:

- A formal contract to transfer knowledge into the plant (happening in 5-6 cases);
- Incentives for knowledge transfer within the contractor (especially in the case of contractor staff retirement, where the plant pays the contractor to conduct knowledge transfer between a retiring employee and an identified/recruited replacement); and
- Incentives to enhance contractor capability, for example providing technical and financial support to a small local contractor to enhance and secure their documentation for equipment supplied to the plant.

These actions have already led to an increase of knowledge in key areas by plant staff and avoided the time and resources needed to find alternative suppliers in certain cases.

3. ISSUE SHEETS

3.1. PRESENTATION AND PROCESSING OF THE SAFETY ISSUES

In Appendix III of the report, the issues of the peer review performed by the IAEA Review Team are presented in detail, following a standard format. Each "issue sheet" consists of the sections described below.

For the limited scope or full scope mission on the subject:

- Issue Identification;
- Issue Clarification;
- Assessment by the IAEA Review Team.

In the Issue Clarification, Section 2, of each "issue sheet," a fundamental overall problem is defined and a clear reference to the IAEA safety standards or other reference documents used for the review is indicated.

The purpose of Section 3 of each issue sheets is to reflect the discussions with the counterpart`s experts, to record the facts, discuss safety consequences, issue possible recommendations and suggestions, and record documents reviewed.

For follow-up missions on the same subject, information is added pertaining to:

- (4) Counterpart actions;
- (5) Follow-up Assessment by the IAEA Review Team.

The purpose of Section 4 of the Issue Sheets is to reflect the views of and the measures taken by the counterpart for the issue resolution, including the self-assessment.

The purpose of Section 5 of the Issue Sheets is to reflect the discussions with the counterpart`s experts, to record the facts, to record documents reviewed, and decide on resolution degree at the time of the follow-up mission. The status of the issue is assessed, and the respective "resolution degree" is assigned to reflect the judgment of the IAEA review team. The degree is scaled from 1 to 3 as follows.

1. Insufficient progress to date: Actions taken, or planned, do not lead to the conclusion that the issue will be resolved within a reasonable time frame. This category applies to recommendations on which no action or inadequate action has been taken.
2. Satisfactory progress to date: The implemented actions partially meet the intent of the recommendation or suggestion of previous SALTO mission.
3. Issue resolved: The intent of the recommendation or suggestion of previous SALTO mission is fully met. Issue closed.

If, as an outcome of a follow-up mission, a new safety issue appears with respect to the previous ones, a new "issue sheet" should be generated. Issue sheets are numbered in sequential order for further reference.

3.2. OVERVIEW OF THE REVIEWED ISSUES

The following six (6) main "*Review Areas*" are considered to group the issues identified during the IAEA peer review missions:

Issue No.	**Fundamental Overall Problem**	**Rec.**	**Sug.**
Reviewed Area A: Organization and functions, current licensing basis (CLB), configuration/ modification management			
A-1	The plant does not have a programme in place for carrying out ageing management activities for the LTO period.	1	-
A-2	AMPs are not fully implemented in and addressed by the plant organization and responsibilities are not clearly defined in plant processes.	-	1
Reviewed Area B: Scoping and screening and plant programmes relevant to LTO			
B-1	The process for evaluating preventive and predictive maintenance programmes for active mechanical components is not comprehensive.	-	1
B-2	The demonstration that mechanical equipment qualification will remain valid over the LTO period is not clear.	1	-
Reviewed Area C: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for mechanical components			
C-1	The time span of operating experience and the range of references used are not sufficiently comprehensive for AMR.	1	-
Reviewed Area D: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for electrical and I&C components			
D-1	There are no planned periodic and documented condition visual inspections and tests during the LTO period aiming at preserving cable system qualification and functionality (cables, cable trays and connections).	-	1
Reviewed Area E: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures			
E-1	The current approach to the testing of containment structural integrity is not fully consistent with IAEA Safety Standards.	-	1
E-2	Loss of concrete durability due to leaching Calcium Hydroxide has not been appropriately addressed in the plant.	-	1
E-3	The design intent of cable tray support anchoring is not performed as required by the design.	-	1
Reviewed Area F: Human resources, competence and knowledge management for LTO			

F-1	Competence and knowledge management processes are not fully integrated into the line organisation for LTO.	-	1

Complete set of issue sheets is presented in Appendix III of this report.

4. REFERENCES

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5. GLOSSARY FOR THE MISSION

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 ageing degradation and wear of structures, systems or components, within acceptable limits.

- Examples of engineering actions include design, qualification, and failure analysis. Examples of operational activities include surveillance, carrying out of operational procedures within specified limits, and performance of environmental measurements.
- Life management (or life cycle management) is the integration of ageing management with economic planning in order to: (1) optimise the operation, maintenance and service life of structures, systems and components; (2) maintain an acceptable level of performance and safety; and (3) maximise return on investment over the service life of the facility.

Design Basis

The range of conditions and events taken explicitly into account in the design of a facility, according to established criteria, so that the facility can withstand them without exceeding authorised limits by the planned operation of safety systems.

Design life

The period of time during which a facility or component is expected to perform according to the technical specifications to which it was produced.

Licensing Basis

A set of regulatory requirements applicable to a nuclear installation.

Periodic Safety Review

A systematic reassessment of the safety of an existing facility (or activity) carried out at regular intervals to deal with the cumulative effects of ageing, modifications, operating experience, technical developments and siting aspects, and aimed at ensuring a high level of safety throughout the service life of the facility (or activity).

Analysis using time-limited assumptions (TLAA)

Plant specific calculations and safety analysis (Time-limited Ageing Analysis or Residual Life Assessment) using time-limited assumptions that are based on an explicitly assumed time of plant operation or design life. The licensee calculations and analyses:

- Involve systems, structures, and components within the scope of license renewal or life extension;
- Consider the effects of ageing;
- 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 Current Licensing Basis.

APPENDIX I - LIST OF PARTICIPANTS

I.1. IAEA SALTO REVIEW TEAM

IAEA STAFF MEMBER:		
[redacted]	[redacted]	[redacted]
IAEA EXTERNAL EXPERTS:		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
OBSERVERS:		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

I.2. SALTO PLANT AND OTHER ORGANIZATIONS

TIHANGE NUCLEAR POWER PLANT – COUNTERPARTS:		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

I.3. IAEA SALTO FOLLOW-UP REVIEW TEAM

IAEA STAFF MEMBER:		
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

OBSERVERS:		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

I.4. SALTO FOLLOW-UP PLANT AND OTHER ORGANIZATIONS

TIHANGE NUCLEAR POWER PLANT – COUNTERPARTS:		
[redacted]	[redacted]	[redacted]
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APPENDIX II - MISSION PROGRAMME

I.1. SALTO MISSION PROGRAMME

Day 1, Monday, 12 Jan	**PM**	Arrival of team members to the Brussels Airport before 4 p.m. 16:00 Transportation from the airport to the plant organized by counterpart 19:30 IAEA team briefing in the hotel, preparatory activities Pre-meeting with counterparts
Day 2, Tuesday, 13 Jan	**AM**	07:15 Departure from the hotel 08:00 – 09:00 Entrance procedure at the plant 09:30 – 12:30 **IAEA team training**
	PM	14:00 – 15:30 **Entrance meeting** Opening of the mission – host plant peer NPP expectations - plant manager Regulatory authority expectations Objective and schedule – team leader Introduction of participants – both sides Methodology of review – team leader LTO activities – host plant peer 16:00 – 18:00 **Initial sessions in review areas** – general presentations of counterparts, planning with counterparts for Wednesday 18:00 Departure to the hotel
Day 3, Wednesday, 14 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Parallel sessions in review areas – interview and discussion 11:30 – 12:00 Information meeting of PM and TL
	PM	13:00 – 16:00 Parallel sessions in review areas – interview and discussion 16:00 – 16:30 Debrief with counterpart and preparation for Team meeting 16:30 – 17:30 Team Meeting with host plant peer 18:00 Departure to the hotel
Day 4, Thursday, 15 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Parallel sessions in review areas – interview and discussion 11:30 – 12:00 Information meeting of PM and TL
	PM	13:00 – 16:00 Parallel sessions in review areas – interview and discussion 16:00 – 16:30 Debrief with counterpart and preparation for Team meeting 16:30 – 17:30 Team Meeting with host plant peer 18:00 Departure to the hotel
Day 5, Friday, 16 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Parallel sessions in review areas – interview and discussion 11:30 – 12:00 Information meeting of PM and TL
	PM	13:00 – 16:00 Parallel sessions in review areas – interview and discussion 16:00 – 16:30 Debrief with counterpart and preparation for Team meeting 16:30 – 17:30 Team Meeting with host plant peer 18:00 Departure to the hotel 20:00 Team training in the hotel – development of issues and good practices

Day 6, Saturday, 17 Jan		Free day
Day 7, Sunday, 18Jan	**AM**	08:00 – 11:00 Team meeting in the hotel - discussion of potential issues and good practices 11:00 – 12:00 Team training in the hotel – development of evaluative section of report
	PM	13:00 – 18:00 Drafting of Working Notes, issues, good practices and evaluative section of report – bilateral discussions with TL
Day 8, Monday, 19 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Parallel sessions in review areas – interview and discussion 11:30 – 12:00 Information meeting of PM and TL
	PM	13:00 – 16:00 Parallel sessions in review areas – interview and discussion 16:00 – 16:30 Debrief with counterpart and preparation for Team meeting 16:30 – 17:30 Team Meeting with host plant peer 18:00 Departure to the hotel 20:00 Team meeting in the hotel – discussion of issues and good practices Consultation with TL and DTL in the hotel – development of issues, good practices and evaluative section of report
Day 9, Tuesday, 20 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Parallel sessions in review areas – interview and discussion 11:30 – 12:00 Information meeting of PM and TL
	PM	13:00 – 16:00 Finalizing of draft issues, preparation of evaluative part of report 15:00 Send issues and good practices to the IAEA for "cold body review" 16:00 – 16:30 Debrief with counterpart and preparation for Team meeting 16:30 – 17:30 Team Meeting with host plant peer - discussion of draft issues 18:00 Departure to the hotel 20:00 Team training in the hotel - exit speeches Consultation with TL and DTL in the hotel – development of issues, good practices and evaluative section of report
Day 10, Wednesday, 21 Jan	**AM**	07:15 Departure from the hotel 08:00 – 12:00 Team meeting with host plant peer – issues, good practices and evaluative section of report presentation, discussion and agreement by team - counterparts review the issues, good practices and evaluative section of report simultaneously
	PM	13:00 – 15:00 Discussion of issues, good practices and evaluative part of report with counterparts 13:45 – 14:30 Information meeting of PM and TL 14:30 – 15:15 TL Debriefing with regulatory authority 15:00 – 16:00 Revision of the draft based on counterpart's comments 16:00 – 17:00 Agree the issues, good practices and evaluative section of report with counterparts 17:00 Deadline for any changes in draft report

		17:00 – 18:00 Preparation of exit meeting speeches 18:00 Departure to the hotel
Day 11, Thursday, 22 Jan	**AM**	07:15 Departure from the hotel 08:00 – 10:00 Rehearsal of exit meeting speeches, "cleaning" of offices 10:30 – 11:30 **Exit meeting** - (including plant management) Opening by the host plant peer Description of Mission scope - team leader – 3 minutes Detail findings (each reviewer) - 6 * 5 (30) minutes Observers remarks and lesson learned: 4 * 2 (8) minutes Main finding and conclusions - team leader – 5 minutes Host plant peer's remark (comparison against initial expectation) - 5 minutes Regulatory authority speech - 5 minutes Speech by a plant manager- 5 minutes Closing by the plant manager
	PM	13:00 Transportation of the team to the airport organized by counterpart Departure of team members from to the Brussels Airport after 4 p.m.

Plant Walk-down will be organized as optional for reviewers based on their requests.

Reference timetable:
AM: 8:00-11:30
PM: 12:30-16:00
Preparation for team meeting including arrangement for the next day with counterpart: 16:00-16:30
Daily IAEA team meeting with representative counterpart (max. 2 persons): 16:30-17:30

I.2. SALTO FOLLOW-UP MISSION PROGRAMME

Day 1, Monday 5 December	**PM**	Arrival of team members to Brussels Airport before 4 p.m. 16:00 Transportation from the airport (meeting point) to the hotel organized by counterpart 19:00 IAEA team briefing in the hotel, preparatory activities
Day 2, Tuesday 6 December	**AM**	07:30 Departure from the hotel 08:00 – 09:00 Entrance procedure in the plant 09:00 – 10:00 **IAEA team training** 10:30 – 12:00 **Entrance meeting** Opening of the mission – Host plant peer Plant manager - Plant expectations Regulatory authority speech Objective and schedule – Team Leader Introduction of participants – both sides Methodology of review and IAEA LTO activities – team leader LTO activities – Host plant peer
	PM	13:00 – 17:00 **Parallel sessions** – reviewers and counterparts 17:00 – 17:15 Preparation for Team meeting 17:15 – 18:00 **Team Meeting** with host plant peer 18:00 Departure to the hotel
Day 3,	**AM**	07:30 Departure from the hotel

Wednesday 7 December		08:00 – 12:00 **Parallel sessions** – reviewers and counterparts
	PM	13:00 – 17:00 **Parallel sessions** – reviewers and counterparts 17:00 – 17:15 Preparation for Team meeting 17:15 – 18:00 **Team Meeting** with host plant peer 18:00 Departure to the hotel
Day 4, Thursday 8 December	**AM**	07:30 Departure from the hotel 08:00 – 12:00 **Parallel sessions** – reviewers and counterparts
	PM	13:00 – 14:00 **Updating of issue sheets** 13:45 – 14:15 Debriefing for regulatory uthority 14:30 – 15:00 Information meeting of PM and TL 14:00 – 15:00 **Agree the updated issues with counterparts** 15:00 – 18:00 Finalization of draft report 18:00 Departure to the hotel
Day 5, Friday 9 December	**AM**	07:30 Departure from the hotel 08:00 – 09:00 Finalization of draft report and preparation of exit meeting speeches 09:00 Deadline for any changes in draft report 09:30 – 10:00 **Rehearsal of exit meeting speeches**, "cleaning" of offices 10:30 – 11:30 **Exit meeting -** (including plant management) Opening by the host plant peer Description of Mission scope and detail findings - team leader – 5 minutes Detail findings (each reviewer): 2 * 5 (10) minutes Observers remarks and lesson learned: 2 * 2 (4) minutes Main finding and conclusions - team leader – 5 minutes Host plant peer's remark (comparison against initial expectation): 5 minutes Regulatory authority speech: 5 minutes Plant manager`s speech: 5 minutes Closing by the plant manager
	PM	11:40 Transportation of the team to the airport organized by counterpart 15:30 or later – Return flights from the Brussels Airport

APPENDIX III - ISSUE SHEETS FROM PRE-SALTO MISSION IN 2012

1. ISSUE IDENTIFICATION	**Issue Number: A - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Organization and Functions, Configuration/Modification Management	
Issue Title: Design Authority Function	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The plant and the involved entities do not have a clear role with regards to the design authority function.

2.2 – IAEA BASIS:

INSAG 19, Chap 3, par 11
An operating organization must set up internally a formal process to maintain the design integrity as soon as it takes control of the plant. This may be achieved by setting up a design capability within the operating organization, or by having a formal external relationship with the original design organizations or their successors. There must be a formally designated entity within the operating company that takes responsibility for this process. This entity needs to formally approve all design changes. To do this, it must have sufficient knowledge of the design and of the overall basis for safety. In addition, it must have access through a formal process to all the underlying design knowledge to ensure that the original intent of the design is maintained.

SRS No. 65, 4.1.3
The design authority, as the owner of the design basis, should identify and capture sources of volatile knowledge and develop ways to systematically retain critical undocumented knowledge.

SRS No. 65, 3.1.2
As part of the implementation of modifications, the plant design authority should adjust any deterministic safety analysis and probabilistic safety analysis (PSA), as appropriate, using the current plant configuration, updated codes and design inputs. When performing modifications, the plant design authority should review the design basis of all affected systems and examine the influence of modifications on the system's design basis, taking into account interfacing between the systems.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) The site manager is formally in charge of design authority. The plant internal procedure "Organisation of role of design authority" describes the design authority function, the objectives and responsibilities as well as the delegation of the function to the head of the Engineering Department. However, the department's newly established internal Safety Project and Design Section as designated entity for supporting the design authority function still has no clear role and function nor proper staffing and resources. The function has only been in place for approximately 6 months and it is expected to support the design authority function, i.e. to carry out the preparation work for the process of approval of design changes, the review of the design basis of all affected systems and the assessment of the influence of modifications on the system design basis. There is no evidence that such capacity currently exists.

F2) The design authority must make sure that an independent control is performed and be able to have a full understanding of the results. The practical performance of the function is in the early stage and there is a lack of staff with adequate qualifications and resources (codes and certification of personnel) to be able to independently assess design modifications, changes and supporting calculations and finally advise on their applicability. The function was historically fulfilled by an independent advisory group of experts under Tractebel, which supports all the Electrabel units regarding issues related to design changes, focusing on safety classified equipment. There is no evidence of how the coexistence of the plant's new internal function and external expertise will be managed.

F3) The license holder Electrabel and Tractebel have signed a long-term framework agreement defining principles and roles in the activities related to design and other types of services. Since the beginning of nuclear industry development in Belgium, Tractebel has been playing the role of "responsible designer". It is also involved in the process of design changes, having archived and retained a significant part of the original design basis data. The plant itself also owns part of the design documents in the archives on site. In view of this, it is unclear how the design authority, as owner of the design basis, should organize and identify as well as capture sources of knowledge and develop ways to systematically retain important data.

F4) The license holder Electrabel and Tractebel have no intention of performing any design basis reconstitution or even simply reviewing and locating key design basis data. Therefore the design authority function, which consists in recognizing sources of important information and systematically working on critical undocumented knowledge important for LTO, can be jeopardised.

F5) Tractebel was historically considered as the "responsible designer" but it is not clear what its involvement, if any, will be in the design authority function. Tractebel does not have delegated responsibilities in the plant procedures.

F6) The role of an independent design review concerning the potential impact of a modification on the design basis is unclear.

3.2 – SAFETY CONSEQUENCE:

A safety consequence of an improper design authority function can be the unavailability and

lack of important design data, which can compromise the credibility of the safety analysis results and, in the case of LTO, the future safe operation of the plant.

3.3 – RECOMMENDATION/SUGGESTION:

R1) The plant should reassess the overall strategy of the design authority function in order to clearly define and assign the roles of the plant and of the involved entities regarding the design authority.

3.4 – DOCUMENTS REVIEWED:

- AIP – Limited scope Salto peer review mission Tihange 1- Nov 2012;
- Internal Procedure – Organisation du rôle de "Design Authority" – REF/00/032.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The essential roles of "Design Authority" and "Responsible Designer" have been defined. The role of "Design Authority" is assigned to the Engineering Department, while the role of "Responsible Designer" is assigned to Tractebel Engineering. These roles have been implemented in a more formal way.

The internal plant reference procedure REF/00/032 "Organisation du role "Design Authority" describes the necessary elements needed for the final objectives specifying :

1. What are the necessary processes in order to maintain the unit configuration "As Is" ?
2. How are potential deviations taken into account?
3. How are the design modification evaluated?

In order to accomplish the first item, the role of "Design Authority Advisor" has been defined. This role is assigned to specific functions within the existing organization. The main goal is to supervise the existing configuration ("As Is"). The site "Design Authority" has informed the concerned staff of their specific role in their concerned processes.

For the points 2) and 3), the Design Engineers of the Service "Engineering Safety Projects" handle in collaboration with Tractebel Engineering ("Responsible Designer") the management of potential safety gaps and verify the modification proposals to the plant. The competence level of the Design Engineers should enable them, using the hypotheses handled by the original designers and the applicable rules, standards and regulations, to analyze in a critical and functional way these modification proposals. By "original designers", one should understand the Tractebel Engineering experts in their different disciplines. These experts, when needed, can rely on the experience of the original constructors like AREVA or Westinghouse, or on the expertise of companies specialized in specific domains. The competence with regard to the calculation, the use of the codes, the design of the SSCs is not a competence of Electrabel (in charge of the operation of the units), but of Tractebel Engineering and its subcontractors who have the role of "Responsible Designer".

In addition, in order to ensure that the needed "Design" knowledge exists within the organization and that the adequate competences are available, 4 different levels of knowledge

and competences regarding Design have been defined. These level are applicable for the whole plant and the necessary competences are (will be) acquired by the concerned staff members (via training, experience, etc.) and tracked in the SAP-system.

The issues related to the documentation are treated in the pre-SALTO-issue B-1.

The planning for the implementation is as follows :

The activities necessary for the formal implementation of the role of "Design Authority" will be finalized by the end of 2014. The identification of the "Design basis" knowledge gaps of the staff with regard to the required level, and the implementation of the needed actions will be finalized in 2015.

The first "Self-Assessment" of the process of "Design Authority" is planned in 2015.

Reference procedures are:

- REF/00/032, Organisation du rôle "Design Authority";
- SUR/00/057, Processus PSI (Potential Safety Issue),
- Organisation du service ESP;
- MOD/00/006, Processus "Modifications" à la CNT;
- MOD/00/001, Processus "Modifications" à la CNT;
- TIASIT/4N/0311344, Independent review process of proposed NPP modifications;
- NUCLEAR/4N/0003497, Responsible Designer at TE;
- GP/GPGT/005, Processus "Projets";
- NT/ENG/999/2014/LTO, Définition et mise en œuvre des niveaux exigés de connaissance des bases de conception;
- SAP n° 10010426303, Project Technical Review.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) INSAG 19 has been used as a basic reference of the design authority for establishment of scope and organization of work. A corporate level guide exists where a formal design authority function is established, with functions dedicated to the plant. The plant has a document in place that formalizes the "design authority" function (Organisation du Role de "Design Authority"). This document includes a table with related procedures needed for management in this area. A working group was established to create this table and a periodic review of the design authority process will be conducted every 2 years. The first one will take place in September 2015.

F2) Modification management by design engineering

The plant performs an evaluation at 2 different levels basically, i.e. modification specification and compatibility study. An independent review is also done by Tractebel at initial level of the modification.

The plant resorts to dedicated engineers for cooperation with Tractebel, where specific calculations are made by Tractebel as the responsible designer. The plant itself does not use any technical support organizations but for example cooperates directly with the supplier AREVA, if necessary.

F3) Communication **w**ithin the plant Design Engineers in the "Engineering Safety Projects" department is handled with Tractebel Engineering ("Responsible Designer") for the management of potential safety gaps and verification of modifications suggested to the plant.

The responsible designer function is fulfilled by Tractebel, which cooperates with plant level design engineering and is also in charge of managing major strategic projects at corporate level.

F4) A training programme for staff members dealing with design basis and modification issues is in the final stage of preparation. This training will also establish introductory knowledge for newcomers. This ensures the necessary staff knowledge level and information (e.g. OEX).

5.2 – DOCUMENTS REVIEWED:

- Organisation du Role de "Design Authority", Engineering Procedure Operationnelle, REF/00/032; SAP 10000763189, Ver. S02;
- AIP – Salto peer review mission Tihange 1- Jan 2015.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: A - 2**
NPP: Tihange	**Unit: 1**
Reviewed Area: Organization and Functions, Configuration/Modification Management	
Issue Title: Configuration management documentation	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The process of the modifications documentation as part of the current physical configuration documentation of the plant is not properly carried out.

2.2 – IAEA BASIS:

SSR- 2/2
Requirement 10: Control of plant configuration - The operating organization shall establish and implement a system for plant configuration management to ensure consistency between design requirements, physical configuration and plant documentation.

4.38. Controls on plant configuration shall ensure that changes to the plant and its safety related systems are properly identified, screened, designed, evaluated, implemented and recorded.

SRS No. 65
1.1. A sound approach to configuration management relies on the need for equilibrium between design requirements, the facility configuration documentation and physical configuration in the plant.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) In the QA process, SAP is used for modification implementation. However there is a weak point in the timely and proper documentation of the plant modifications. The QA problem is mainly the backlog which is caused by delay in the timely performed changes and finalization of documentation after full acceptance of the implemented modification.

F2) The documentation of the modifications and master hard copies are split between the responsible departments (maintenance, operation, etc.), each department keeping its own part. The documented changes and modifications existing in "red marked" master copies are sometimes tolerated for excessively long periods because of a lack of means and resources. This can result in the risk of losing control of the plant physical configuration. In addition to the QA aspect, it could also be an indicator of a potential safety culture issue. As the plant is aware of the concern, mitigating actions have already been introduced.

F3) SAP and the modification database give full information about the management and the status of a modification, the accessibility of the original/master copies of the documents, the responsible person, the exact location, etc. The presented example of a modification was the replacement of a pressure relief valve to the atmosphere on main steam lines of Unit 1. The modification was implemented in 2011 with a deadline for document update by end of last year. The status of an I&C scheme is still "red marked" (non-updated master copy).

F4) The status of the plant modifications under progress is followed in the plant KPI and the number of unfinished activities due to incomplete documentation is one of the parameters. Nevertheless, for unit 1 for instance, there are currently 71 implemented but unfinished modifications. This generates an increasing unnecessary workload, which has to be taken care of by the organization.

3.2 – SAFETY CONSEQUENCE:

Important safety aspects in the plant operation could be compromised if the processing of the documents related to the plant's physical configuration is not improved. Besides the current

situation being an indicator of a safety culture issue, it is important that this be resolved considering the necessary measures to be taken prior to LTO approval.

3.3 – RECOMMENDATION/SUGGESTION:

S1) Consideration should be given to the improvement of the modifications documentation process as part of the current physical configuration documentation of the plant.

3.4 – DOCUMENTS REVIEWED:

- Presentation by the plant given 09/11/2012– modification process;
- Policy document – document management process – ZST.100010043316.000.02;
- Policy document – Processing and Managing QA documents– ZST.10010223289.000.01;
- Demonstration of modification process handling in SAP – 09112012.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

A specific project "Modifexpress" has been organized. The goal of this project was to close out a modification in one month using multi-disciplinary team dedicated to this task.

Every 3 months a selection of the modifications to be closed out was proposed to the safety authorities for approval.

At the beginning of each month during the Modifexpress-project, specific kick-off meetings was organized with the different people involved for the selected modifications. During the kick-off meeting a specific action plan is made up and approved for execution. After approval, the planning is strictly followed-up by the Portfolio Management team of the Engineering Department.

The implementation of this project was started in October 2013. At that time, the plant had a backlog of 144 modifications. One year later, the backlog decreased to 39 modifications (decrease of 73%).

The main target of the project is to limit the backlog at the end of 2014 to a maximum of 50 modifications and to maximum 5 modifications at the end of 2015.

In order to manage in a more appropriate way the documentation flow, a new tool ("Compilo") has been developed. These tools will help the project managers in the future to improve the documentation management. Using this tool, the documentation updating will be "forced" at each phase of the modification implementation process, so that new additional backlog can be avoided.

The combination of "Modifexpress" and the implementation of "Compilo" will help to manage the documentation related to the modifications in a sustainable way. The backlog will be eliminated, new backlog should be prevented.

Other additional actions in order to avoid backlog due to modifications have been taken. More in particular:

- The documentation strictly needed for the operation of the modification (i.e.

commissioning by the Operations Department) are requested in "Draft"-status before the implementation of the modification. If not available, the approval sequence of the modification is interrupted.

– All the modifications are linked to actions in the central action database. Each action is linked to a specific "action owner".

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) Systematic work was initiated in 2012 and has been ongoing since that date. The goal was to handle the large amount of backlog projects.

F2) An extensive effort has been initiated trying to speed up the process of implementing a final version of long-standing project documents, and the plant backlog has now been reduced from 71 projects in 2012 to 9 projects in January 2015.

F3) 250 project members on the plant have followed thorough training on the modification methodology, which has led to a new mind-set among the project members when it comes to understanding the importance of updating project documentation.

F4) The plant implementation phase of a project now has a stronger focus than before when it comes to continuously updating all project documents in a draft version, before the completion of the project.

5.2 – DOCUMENTS REVIEWED:

– Presentation from Engineering Department 2015-01-19 of the methodology of project modification;

– Monthly progress reports from 2014 presented by Engineering Department.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Safety analysis reports and existing plant programmes relevant for LTO	
Issue Title: Design Basis Documentation	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Design basis documentation for the plant is difficult to obtain.

2.2 – IAEA BASIS:

SSR 2/1
5.3. The design basis for each item important to safety shall be systematically justified and documented. The documentation shall provide the necessary information for the operating organization to operate the plant safely.

NS-G-2.12
2.7. Understanding the ageing of a structure or component, as illustrated in Fig. 1, is the key to its effective ageing management. This understanding is derived from knowledge of:

- The design basis (including applicable codes and standards);
- Safety functions;
- …

SRS No. 57
5.1. …An adequate engineering assessment requires knowledge of:
(a) The design, including applicable codes and regulatory requirements, the design basis and design documents, including the safety analysis...

3. ASSESSMENT BY THE IAEA REVIEW TEAM

Date: 14/11/2012

3.1 – FACTS:

F1) While most design basis documentation for the plant is believed available, the plant maintenance personnel indicated that some design basis documentation is difficult to find.

F2) Some design basis information exists only in paper form that cannot be searched electronically using key word.

F3) Design basis information is maintained in different locations. For example, some design basis information used for scoping for the essential water service system was found in FSAR and some was found in functional notes maintained by operations department.

F4) Plant has not performed a global design basis reconstitution project or a comprehensive design basis cataloguing project.

F5) Design basis documentation is not maintained in a single comprehensive system or location. Some plant design basis documentation is maintained at the plant and some is maintained at the facilities of the design engineering support organization (Tractebel).

3.2 – SAFETY CONSEQUENCE:

Without readily accessible design basis documentation for each item important to safety, the operating organization may have difficulty in timely accessing the information necessary during the period of LTO.

3.3 – RECOMMENDATION/SUGGESTION:

S1) The plant should consider improving the organization and usability of design basis documentation.

3.4 – DOCUMENTS REVIEWED:

- Volume Pré-conditions Projet LTO – Tihange 1;
- Technical Note LTO Ageing – Scoping – Mechanical – Tihange 1: Piping system analysis CEB;
- Ti 1 Rapport de sûreté;
- NF-053-CEB Notice de fonctionnement circuit d'eau brute;
- NF-047-CEB Notice de fonctionnement circuit d'eau de nappe.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

In order to respond to this issue, it has been decided to create a specific work group, compose by members of the following departments/services:

- Document management;
- TNPP Engineering;
- Tractebel Engineering;
- Nuclear Assets and Projects (Corporate Engineering Department).

The objective of this working group was to make the design basis documents more accessible. This was accomplished by the realization of the following action list:

- Define a process in order to make the plant design basis documents at the plant more accessible. Define the main types of documents of the design basis documentation and establish guidelines allowing detailed search in the information;
- Define a process in order to make the plant design basis documents available at Tractebel Engineering more accessible. List the main archived documents and establish guidelines allowing detailed search in the information;
- Draft an inventory of all design basis documents available at the plant archives and store these documents in the SAP document management database;
- Complete the digital Tractebel Engineering archives database with any design basis document existing on paper or other sources.

The deliverables of this working group are:

- Document EBL NT/ESP/929/2014 "Liste des types de documents faisant partie des bases de conception des unités de la CNT". It has to be noted that the objective of this

document is not to describe the information constituting the design basis documentation, but merely to facilitate the identification of the document where information regarding the design basis can be retrieved.

– Document TIS1/4N/322342 (Tractebel Engineering). The document describes what documents are available at Tractebel Engineering regarding the plant, starting from the initial design to the actual status. The document also describes how the available information can be consulted. The document lists the main documentation sources with regard to the design basis documentation, namely the "general design criteria", "design basis function", "design basis value", "bounding conditions, "engineering design basis, etc.

The planning is as follows:

– The activities necessary in order to reach the set objective are finalized;
– It has to be taken into consideration that a communication with regard to the existence of the search guidelines has been accomplished at Tractebel Engineering. A similar communication will be done at Electrabel before the end of 2014.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) Document EBL NT/ESP/929/2014 gives information about all accessible design basis related documents at the plant. A guidance document has been issued, with search functions prepared for easy access to the necessary document or data. The objective of this document is not to describe the information making up the design basis documentation, but merely to facilitate identification of the document in which information on design basis can be retrieved.

F2) In addition to the plant, Tractebel has also prepared its design document overview in a standard format. The list includes which documents on the plant are available at Tractebel Engineering, starting from initial design to current status. It lists the available data. It also lists main documentation sources with regard to design basis documentation, namely "general design criteria", "design basis function", "design basis value", "bounding conditions, "engineering design basis, etc.

F3) The exchange of information on design basis between the responsible designer, Tractebel and the plant is performed via a so called "collaboration room" function for current or future major projects. Access is also given to information on specific documents or design data availability.

5.2 – DOCUMENTS REVIEWED:

– Document EBL NT/ESP/929/2014 "Liste des types de documents faisant partie des bases de conception des unités de la CNT";
– AIP – Salto peer review mission Tihange 1- Jan 2015.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B - 2**
NPP: Tihange	**Unit: 1**
Reviewed Area: Safety analysis reports and existing plant programmes relevant for LTO	
Issue Title: Plant System Monitoring	
2. ISSUE CLARIFICATION	
2.1 – FUNDAMENTAL OVERALL PROBLEM: The system health reporting process in the plant surveillance and monitoring programme does not include the appropriate SSCs within the scope of LTO.	
2.2 – IAEA BASIS: NS-G-2.6 7.6. …Monitoring the reliability and performance of the plant for ageing related degradation should therefore be a feature of the safety management programme, and an appropriate preventive maintenance programme should be in place. 7.8. In order to manage ageing processes, the MS&I programme should include, but should not be limited to, the following aspects: – ….. – adequate and up to date methods for detecting and monitoring ageing processes, – the keeping of appropriate records to enable the ageing process to be tracked, – methods of taking corrective actions in order to mitigate and/or prevent the effects of ageing, ….	
3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012
3.1 – FACTS: **F1)** A system health monitoring programme is an important element of MS&I programmes for monitoring plant reliability and performance to ensure the effects of ageing are adequately managed. System health monitoring programme includes the elements identified in IAEA references.	

F2) The plant system health monitoring programme does not include the appropriate systems within the scope of LTO. The SHR procedure in effect today addresses only eight systems. [GDI/SHR/008 Processus SHR, Version S 02] Revision is planned to include additional systems within the scope of the LTO evaluation. The revision of the implementing procedure to incorporate the necessary changes is in draft status.

F3) Based on interview with counterpart, the system health monitoring programme is staffed by only three members of the permanent plant staff. While additional contract personnel are staffing the organization, contract personnel typically do not provide the continuity in the position that is necessary to achieve a level of knowledge sufficient to effectively monitor systems.

F4) To support RCM program, the effectiveness of maintenance is assessed through the use of KPIs (key performance indicators). The maintenance policy procedure at the plant indicates that system health reporting is a mechanism that provides feedback to monitor the effectiveness of maintenance. Version 02 of the system health reporting procedure does not specify providing equipment performance feedback to the RCM programme.

3.2 – SAFETY CONSEQUENCE:

Without an effective monitoring programme for assessing the condition of SSCs during the planned period of LTO, the plant will be unable to provide reasonable assurance that the effects of ageing will not prevent SSCs from maintaining their capability to perform the required intended functions.

3.3 – RECOMMENDATION/SUGGESTION:

R1) The plant should establish an effective system health monitoring process that includes the applicable systems within the scope of the LTO evaluation.

3.4 – DOCUMENTS REVIEWED:

- Volume Pré-conditions Projet LTO – Tihange 1;
- Procedure for system health reporting process GDI/SHR/008;
- Draft procedure revision for system health reporting process;
- Procedure for reliability centered maintenance GDI/SHR/013;
- Maintenance policy procedure MAINT/SR/053.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The SHR organisation is now implemented in the ESH service (part of Engineering). Procedure GDI/SHR/008 is reviewed, meaning:

- The team composition is 1 ESH head, 10 ISHR (System Engineers), 3 Data Technicians;
- The scope was extended from 12 systems to the LTO scope; 52 systems followed for Ti1;

- 4 CoSHR (SHR committee) are organized per year, where the health reports of each system is presented twice a year and corrective actions are validated. This actions could be procedure modifications, PM adaptation, hardware modifications;
- KPI are defined for all systems, this set was already reviewed to improve his efficiency;
- A software is under construction to get all the data the most automatically way possible and to prepare them for analyze by the ISHR;
- System Engineers are owner of some multidisciplinary problems related to their systems;
- System Engineers analyze and comment every modification related to their systems. In some case they are the demander of them;
- System Engineers are involved as experts in transversal processes like Ageing, Periodic Safety Review, PRA, OE.

In practice, the implementation means:

- Monitoring, analysing almost on-line and editing of 52 System Health Report twice a year for Ti1 (163 for the site);
- The System Health analyzes had opened corrective actions. On end october2014 they are 29 open corrective actions for Ti1 and 24 common corrective actions for Ti1-2-3 (123 for the site), managed in the Action data base;
- 2 walk downs per systems had to be done end of 2014. Status on 30/10/14, 82 walk downs on Ti1 systems are made (244 for the site).

The next steps for improving the process are :

- Put the software in service to be able to analyse more quickly the collected data and be more on line with the operating organization. This will give us also the opportunity to adapt the Health Report presentation planning depending on the status of the systems;
- On a long term, develop the technical expertise of the ISHR and increase the visibility of ESH in the organization.

Note: A test case for implementing an AP913 process is ongoing in Tihange, Doel and Corporate to validate the method. An evaluation is foreseen in early 2015.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

5.1 – FACTS:

F1) A system health monitoring programme is an important element of maintenance and surveillance programmes for monitoring plant reliability and performance to ensure adequate management of ageing effects. The system health monitoring programme implemented at the plant includes the elements identified in IAEA references.

F2) The plant system health monitoring programme had extended its scope in order to cover

52 systems, including appropriate systems within the scope of LTO. An SHR committee, which meets four times a year, is in place to validate the SHR reports. The LTO team sits on this committee.

F3) The system health monitoring programme is now staffed by: 1 head, 10 System Engineers and 3 Data Technicians.

F4) To support the RCM programme, the effectiveness of maintenance is assessed through the use of KPIs (key performance indicators); KPIs are analysed by the SHR committee. If needed, actions are agreed during the committee meetings and documented in the report. The requirements are specified in version 5 of the SHR process guideline.

F5) Continuous improvement of the SHR process is still ongoing. A new software programme will be implemented in order to facilitate data communications between stakeholders.

5.2 – DOCUMENTS REVIEWED:

- GDI/SHR/008 v5- SHR process guideline for Tihange NPP;
- CRR/ESH/153/2014/SHR – SHR committee report, 17/09/2014 meeting.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: C - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Review of Ageing Management and other LTO related activities for mechanical components	
Issue Title: Ageing Management Programs´ attributes completeness	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Ageing management programmes (AMP) do not address all generic IAEA AMP attributes.

2.2 – IAEA BASIS:

SSR-2/2
Requirement 14: Ageing management
The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components

are fulfilled over the entire operating lifetime of the plant.

NS-G-2.12
4.26. The results of the ageing management review should be documented in an appropriate report... In addition, recommendations should be provided for the application of results of the ageing management review in plant operation, maintenance and design.

4.31. A specific programme for the ageing management of each structure, component or group of structures and components selected by the screening process should be developed and documented...

4.33. Every ageing management programme should have the generic attributes presented in Table 2.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) Generic attributes of AMPs were reviewed based on NUREG-1801 (GALL) AMP attributes (10) regarding the document "Developing of standardized AMPs" (10010235189/000/00). Some attributes were grouped in the AMPs, and an analysis was carried out in the AMP to establish that the plant AMP attributes meet the GALL attributes.

F2) There is no explicit attribute for "mitigating ageing effect"; however, in some AMP there is some action regarding this attribute. AMP M18 deals with cleaning the bolts in 2.3.2. Detection of ageing effects, as AMP34 deals with mitigation of soil corrosion in 2.3.2.

F3) There is an attribute for "Quality management", referring to general plant guidelines on nuclear safety, but there is no real "Confirmation process", regarding the AMP effectiveness evaluation. "Indicators to facilitate evaluation and improvement of the ageing management programme" (NS-G-2.12, Table 2) are missing in the AMPs.

F4) The plant carried out an ageing management review in accordance with the IPA (Integrated Plant Assessment) process, which mostly covers requirements NS-G-2.12, however some conclusions of the review are incorporated in the AMPs too. There is no clear relationship between "Conclusions" in the AMPs and AME Reports.

F5) In the "operating experience" attribute, references are missing in some AMPs; only a few cases are mentioned.

F6) There is no clear relationship between AMP M34 "Buried piping and tank surveillance" and operational programs.

F7) There are no provisions in the plant maintenance procedures to ensure that inspections required in AMP M34 are performed, when components are exposed for maintenance activities.

F8) There is no trending or monitoring of the visual inspections in AMP M34.

F9) AMP M10 (boric acid corrosion) contains programme enhancement element in the part "Conclusion"; however "Indicators to facilitate evaluation and improvement of the ageing management programme" (NS-G-2.12, Table 2) are missing in AMP attributes.

F10) TLAA for thermal ageing embrittlement of CASS is in the scope of LTO; however the AMP M12 thermal ageing embrittlement of CASS exists, containing in "Conclusion": "components in primary loop are non-susceptible to thermal ageing embrittlement and no additional inspection or evaluation is required".

F11) AMP M36 "Monitoring and trending" refers to SHR reports; however there are SHRs only for a few systems.

F12) AMP M104 in 2.3.1. Parameters monitored or inspected contains: "In some cases, systematic replacement is foreseen". There are no real acceptance criteria in M104.

3.2 – SAFETY CONSEQUENCE:

Without properly implemented and documented AMPs, the plant will not be able to ensure that the required safety functions of SSCs will be fulfilled over the entire operating lifetime of the plant.

3.3 – RECOMMENDATION/SUGGESTION:

S1) Consideration should be given to assure that all activities reflected in IAEA AMP attributes are addressed in existing AMPs and newly generated AMPs.

3.4 – DOCUMENTS REVIEWED:

- NT/LTO/AGEING/MEC/003;
- DTS/4NT/0133390/000/02;
- AMP M1 DTS/4NT/0152730/000/04;
- AMP M18 LBE01756811;
- SAMP102 10010257867/000/01.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

During the LTO-study-phase different AMPs were developed, using GALL rev. 1 as reference document. The drafting of the AMPs was supervised by the LTO teams, the applicability, the analysis of the plant and the definition of the actions plans were performed by the LTO-study teams on DNNP and plant sites.

After the pre-SALTO audit, the issued AMPs have been reanalyzed. An broader action plan was defined to take into account two major issues:

- Rewrite the AMPs considering the pre-SALTO remarks (9 attributes) is such way that they can also be implemented for the other units of the Electrabel GDF Suez fleet;

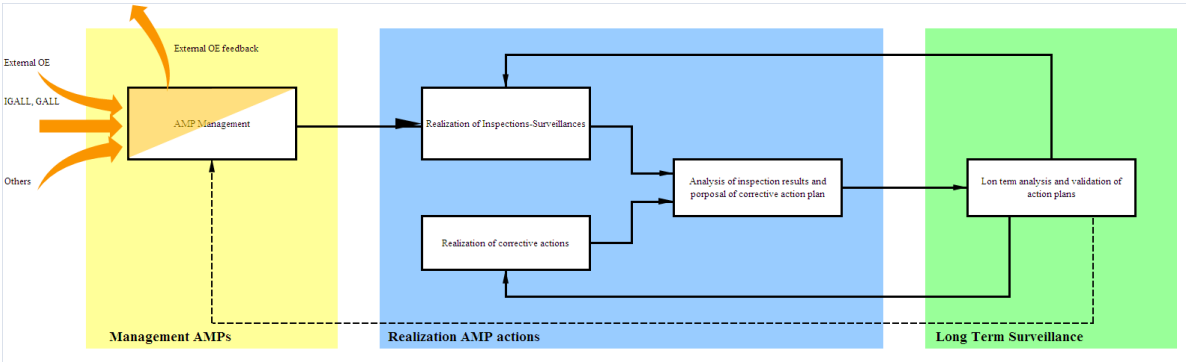
– Define a process (including roles and responsibilities) to turn the AMP-process into a "living process".

In integrated approach was applied: since the global "Ageing Management" strategy is defined on corporate level, the management of the AMPs had to be in line with this approach. This means that AMPs defining the ageing mechanisms of the different SSCs are defined and managed on corporate level. The application to the site specific SSC is managed by the Site Engineering Department.

More specifically, the existing AMPs of the LTO-study-phase have been re-issued taking into account the suggestion of the pre-SALTO mission. That is, rewrite using the AIEA template including the 9 AMP items. The general AMP describes the ageing mechanisms in general: how does a specific SSC age in a given environment and for general operating conditions. This AMP is applicable to both the TNPP and DNPP site. The application of the AMP to is specific unit is managed on site-level and referenced in a specific AMP applicable to the plant.

These elements were taken into account while redrafting the AMPs, leading to "generic" AMPs and applied AMPs to the specific plant.

The AMP management process is also based on this two phase principle: general items are handled on corporate level, while the detailed application to the plants is managed on site. A simplified AMP management scheme is given in the following figure.



The above figure represents the implementation process of the AMPs, the trending, the implementation of potential action plans. The yellow box in the figure represents the management of the AMP document (corporate and site level – orange triangle in figure).

The AMPs have been reissued: generic AMPs and their application to the plant are drafted (based on the LTO-study phase scoping analysis results).

The existing process for ageing management has been improved by the integration of the AMPs in the global Ageing management process. The corporate ageing Management procedure is validated. The adaption on site level is ongoing and will be finalized before the start of LTO in September 2015.

5. FOLLOW-UP ASSESSMENT BY THE IAEA	**Date:** 22/01/2015

REVIEW TEAM	

5.1 – FACTS:

F1) Both generic and specific AMPs address generic IAEA attributes.

F2) Reviewed latest versions of AMPs are mostly in draft.

F3) Nevertheless in some AMPs, actions included in some attributes are not fully implemented:

- Preventive and corrective actions (attribute 2 and 7) are defined in generic AMPs but no further actions are foreseen or provided in specific AMPs.
- The use of ageing summaries vs. AMP is not clearly defined in the corporate ageing programme. There is no feedback to the AMP for improvement and no criteria for the effectiveness of implementation. It is not defined the initiation of AMP update or modification (attribute 9).

5.2 – DOCUMENTS REVIEWED:

- DTS/4NT/0131020/000/04 AMP M11 "Ni alloy nozzles and penetrations" (draft version);
- DTS/4NT/0131020/001/00, Tihange 1 AMP M11 "Ni alloy nozzles and penetrations" (draft version);
- DTS/4NT/0173987/000/02 AMP M19 "Steam Generators tube integrity" (draft version);
- DTS/4NT/0173987/001/00, Tihange 1 AMP M19 "Steam Generators tube integrity" (draft version);
- DTS/4NT/0152730/000/05, AMP M1 "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD" (draft version);
- DTS/4NT/0152730/001/00, Tihange 1 AMP M1 "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD" (draft version);
- DTS/4NT/0152154/000/01, AMP M31 "RPV Surveillance" (draft version) ;
- DTS/4NT/0152154/001/00, Tihange 1 AMP M31 "RPV Surveillance" (draft version) ;
- CNT-KCD/4NT/0008108/012/09, Ageing Summary 012 : Stress corrosion Cracking in Cover Head Penetrations (P03).

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: C - 2**

NPP: Tihange	**Unit: 1**
Reviewed Area: Review of Ageing Management and other LTO related activities for mechanical components	
Issue Title: Data Management in scoping and screening of SSCs	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Data collection and record keeping do not ensure the consistency and update of data for scoping and screening of SSCs.

2.2 – IAEA BASIS:

SSR-2/2
4.54. The comprehensive programme for long term operation shall address:
(b) Setting the scope for all structures, systems and components important to safety

NS-G-2.12
4.10. The operating organization should establish a data collection and record keeping system that is defined by the ageing management programme and that supports it.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) Completeness of the scoping and screening of mechanical SSCs is based on the comparison of SAP database (as "master list") with P&I schemes. This verification was carried out, but is not referenced.

F2) The results of the scoping and screening of mechanical SSCs is documented for every system at component level. Data was collected from SAP (as "master list"), and divided into excel sheets, the first 2 columns originating from the SAP database. There was no control after reviewing the Excel sheets, that none of the components listed from SAP was missing, due to a lack of connection between different databases (Excel sheets and SAP "master list").

F3) For electrical and I&C components, the plant has two databases with information about plant configuration: integrated database SAP and for LTO Q-List (Excel). There is no connection for transferring the plant configuration data from the SAP, such as tags, equipment, article, type, fitting date, scheduled replacement, classification, qualification etc. into the Q-List.

F4) There are two databases for the plant configuration, SAP and excel. Some information is redundant. It is high risk to get data inconsistency after some time.

F5) There is no process for LTO/AMP scope data updating since the AMP scoping.

3.2 – SAFETY CONSEQUENCE:

Without an approved and continuously updated scope for LTO the plant is unable to demonstrate completeness of scoping and screening of SSCs for LTO.

3.3 – RECOMMENDATION/SUGGESTION:

S1) Consideration should be given to ensure consistency and update of data for scoping and screening of SSCs.

3.4 – DOCUMENTS REVIEWED:

- DTS/4NT/0134950/000/08;
- DTS/4NT/0118719/009/05;
- NT/LTO/AGEING/MEC/013;
- NT/LTO/AGEING/GEN/1200;
- RSQ ASCO JOUCOMATIC (RSQ 031.01).

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

During the mechanical systems analyses of the LTO-study-phase, databases were created per system for the phases of scoping/screening and the ageing management review.

For the scoping phase, the working methodology (specific project guideline) demanded the use of the information available in the SAP-system. For each analyzed system, a listing of available SSC was established. The first stage of the scoping phase consisted of identifying every component of the SAP-list on the P&IDs and to complete the listing with the P&ID information (= cross analysis). Identified differences were analyzed and database updated if needed. Finally, the scoping documents were controlled internally by the Safety departments (independent control) and externally by the regulating authorities (Bel-V).

During the screening AMR phase, the scoping database was used as starting point and completed with the required information for the evaluation of ageing phenomena. For the analyzed system, the total volume of mechanical SSC was reviewed and incomplete or incorrect information of the scoping was corrected. If needed, the scoping databases have been amended.

During the cross check between the different LTO domains, the mechanical systems databases have been compared to the databases of the mechanical structures domain and the E I&C domain. The methodologies in the different domains, the continuous alignment between the domains the completeness check and the final cross-check between the LTO domains have given the necessary conviction regarding the scoping exhaustiveness.

The information gathered in these individual databases during the LTO-study-phase has to be kept up to date and to support the implemented ageing management programs. In order to

accomplish this task, Electrabel is currently working on the following issues:

- Identify in the databases the information to be kept up to date in a reference database, and compile the most relevant information of the scoping/screening databases and the ageing management review databases;
- Introduce a process to keep the reference database up to date (taking also into account the interfaces with SAP).

The compilation of the available information is carried out, integrating also the necessary independent controls during the retrieval of the LTO data. The following information sources are also used during this step:

- Analysis of the SAP data related to modified functional locations since 2009;
- Analysis of eventual gaps identified during the implementation of the LTO action-plans.

At this moment, it is planned to realize this step system by system. A pilot exercise has been realized for the CAE and EAS systems at the end of 2014. The complete set of systems in the LTO scope will be analyzed before the end of April 2015.

The process used for the updating of the reference database will be inspired on the process used for the updating of the Q-list in the E I&C domain. The definition of the process is scheduled by the end of May 2015, its roll-out is scheduled before end September 2015.

The described ongoing activities tend to consolidate the available information of mechanical systems in a single reference database where each SSC is linked to one or more AMPs. Every future evolution of the ageing management will therefore easily be linked to the concerned equipment. The process for updating the database will also allow to update the scope of the AMPs specific to the plant, and therefore insure that the requested follow-up is correctly managed.

The necessary data will not be tracked in the SAP systems: like the Q-list (E I&C) a parallel database updating will be necessary. It is the main objective of the process to be developed that all databases are kept in line in the future.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

5.1 – FACTS:

F1) For mechanical components, the plant decided to merge the scoping excel database and the screening/ AMR excel databases in one reference ageing database, which will also contain updated information from the SAP system.

F2) For mechanical components, this database merging has been performed for two systems (CAE and EAS) out of 40 systems.

F3) The deadline for finalizing the complete and updated reference database is mid-2015.

F4) A process for updating the reference database for mechanical components will be defined.

Its deadline is mid-2015.

F5) Q-list (EI&C) is still redundant with SAP system and a project is organized to build a link between Q-list and SAP.

F6) The plant has not taken the formal decision to integrate the reference ageing database in SAP system for mechanical components in the near future.

5.2 – DOCUMENTS REVIEWED:

- New merged Excel database for mechanical components;
- Q-list.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: D - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Review of Ageing Management and other LTO related activities for electrical and I&C components	
Issue Title: Cables and cable trays and electrical connections	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The cable system (cables, cable trays, electrical connections) has a lack of EQ for LTO.

2.2 – IAEA BASIS:

SRS No. 57
3.3.1 Maintenance programmes for LTO clearly identify the links with ageing management programmes, including the frequency of maintenance activities and specific information on the tasks and records and on their evaluation and storage.

3.3.2 Equipment qualification establishes that equipment, while being subject to environmental conditions, is capable of performing its intended safety functions or that it will be replaced/repaired so that its intended safety functions will not be compromised during the planned period of LTO.
Equipment qualification also demonstrates whether the environmental and seismic

qualification of equipment will remain valid over the expected period of LTO. The demonstration supports the technical justification that the material degradation and ageing effects will be managed effectively.
… A plant specific list that specifies environmentally qualified cables and connectors on safety related equipment, as well as cables and connectors on non-safety related equipment that has an impact on the performance of safety related systems, is updated regularly.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) In room E601 (I&C Cabinets), the cable trays condition ("passerelle de câbles") are as follows:

- overloaded cable trays;
- cables outside the tray;
- bent and damaged trays.

F2) A preventive and documented re-tightening of all 1E classified electrical screw connections (Power and I&C) after 37 years of plant operation is not scheduled. After that time electrical connections could become loose (due to clamping force relaxation) and generate a contact problem in a function chain or a power distribution/supply.

F3) The following cable families in the Q- List constitute LTO issues: 1EB mild and 1EC. The number of cables is around 1,000. The test parameters are written in a test specification. The pre-age testing with used cables from the plant has not started yet. In the case of the negative test results, the plant has no corrective action scheduled.

3.2 – SAFETY CONSEQUENCE:

Without a valid seismic qualification of the cable trays and without reliable electrical connections and without appropriate EQ (cable tests), the plant will not be properly prepared for LTO.

3.3 – RECOMMENDATION/SUGGESTION:

R1) The plant should establish a corrective programme in order to properly evaluate the lack of EQ for the cable systems for the period of LTO.

3.4 – DOCUMENTS REVIEWED:

- Maintenance instruction 6 kV Distribution 532350/EF/001;
- Test specification DTS/4FG/0254470/000/00;
- LTO, Q-List;
- SAP: Plant configuration part.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The issue sheet D-1 covers with issues regarding the "Cable"-systems based on the following items:

- Structural resistance of the cable trays;
- Qualification programme of 1EB and 1EC qualified cables;
- Re-tightening of 1E qualified connections.

The cable trays in scope of LTO have been identified during the study phase. The project Struc-03 has defined an action plan in order to adapt the concerned maintenance policy. The final situation is the implementation of AMP S06 to the concerned structures. The initial baseline inspections have been performed. Some problems of mild corrosion and tray overload have been identified. The corrective actions have been taken in regard to the corrosion issue. Regarding the cable tray overload, complementary analysis and reinforcement will start at the beginning of 2015. During the corrective actions, cables outside of the cable trays will be re-arranged correctly. In order to avoid issues with overloaded cable trays in the future, both the Engineering and Maintenance Department are now fully aware of the problem, and verification o the remaining load capacity of the cable tray will be performed.

As for other cables, the issue sheets mentions the test programme to qualify the 1EB and 1EC cables for the period of LTO. At the moment of the pre-SALTO, the programme had not begun. At this moment, the accelerated testing programme has successfully been performed. The results of the programme have been presented to the authorities and accepted by them (see also project EI-29).

Finally, the conformity of the connection and the cabinets for the period of LTO is analyzed in the project EI-62. The ageing degradation phenomenon of the connections on the components is taken into account in the qualification of the specified component. As for the connections on the different racks, it is verified during periodic maintenance activities or during spot verification. Finally, is has to be noted that the newer generations of 1E qualified components are equipped with screw locking devices.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) The plant has an action programme designed to re-qualify all of the LTO cable trays. This information is in Technical Note TIS1/4NT/0303855/001/00.

F2) With regards to 1EA cables, the plant has replaced all cables except three I&C cables in the containment by 1EA qualified EUPEN cables. The three remaining I&C cables will be replaced during the 2015/16 outages. Concerning the 1EB cables, based on radiation requirements, the plant will replace around 38 cables by qualified 1EA EUPEN cables.

F3) All other 1EC cables are requalified for over 40 years (PVC cable qualification LBE

04104439-0.1).

F4) The plant investigated the condition of screw contacts and plug connection type PIDG, trade name AMP and established a list of actions linked to scheduled equipment replacements.

5.2 – DOCUMENTS REVIEWED:

- Action List for cable trays, Technical Note TIS1/4NT/0303855/001/00;
- PVC Cable Qualification Results LBE 04104439-0.1;
- Project EI28 document : Cable Qualification Results Bel-V17/09/2014.
- Class 1E connections, NT/LTO-T1/EIC/27 13.01.2015;
- AMP plug contact tests for LTO DTS/4NT/0282389/00/01.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D - 2**
NPP: Tihange	**Unit: 1**

Reviewed Area: Review of Ageing Management and other LTO related activities for electrical and I&C components

Issue Title: Data management for LTO (Q-List)

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The LTO database containing results of ageing management and environmental qualification (Q-List) is not complete.

2.2 – IAEA BASIS:

NS-G-2.12
4.10. The operating organization should establish a data collection and record keeping system that is defined by the ageing management programme and that supports it.

4.11. Such a data collection and record keeping system should be established early in the lifetime of a plant (ideally, data should be collected from the construction stage onwards) in order to provide information for the following activities:

- Identification and evaluation of degradation, failures and malfunctions of components

caused by ageing effects;
- Decisions on the type and timing of maintenance actions, including calibration, repair, refurbishment and replacement;
- Optimization of operating conditions and practices that reduce ageing degradation;
- Identification of new emerging ageing effects before they jeopardize plant safety, production reliability and service life.

4.28. For the development of plans for effective ageing management, the actual condition of a structure, a component or a group of structures and components selected by the screening process should be determined on the basis of background information provided by the output of the ageing management review.

4.38. As part of the implementation of the ageing management programmes, appropriate data should be collected and recorded to provide a basis for decisions on the type and timing of ageing management actions.

SRS No. 57
5.1 An engineering assessment of the current status of SCs within the scope of LTO is carried out. An adequate engineering assessment requires knowledge of:
(a) The design, including applicable codes and regulatory requirements, the design basis and design documents, including the safety analysis;
(b) …

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) The result from the conclusion of the LTO cross-check is written in NT/LTO/AGEING/GEN/1200. There is no reference number to the checklist from the cross-check.

F2) Many items in the Q-List (6,500) have missing information concerning LTO (EQ and AM). It needs a lot of experienced manpower to add the information in a timely manner.

F3) In the Q-List for solenoid operated valves information is missing concerning energised (self-heating) or not energised coil, during the plant operation. It is not easy to determine the state of the coil from the existing documentation. This information is important for determining the qualified life (RSQ 031.01).

F4) There is no general database for all important setpoints (I&C, protection for: reactor, power supply, motors; torque switches for valve, alarm points for radiation monitoring). The information is distributed in different hard copy documents. It is not possible to select from a database.

3.2 – SAFETY CONSEQUENCE:

Without the completeness of all important LTO information in the Q-List it is difficult to go

into the LTO phase. Also the documentation must be easily traceable to all LTO related documents for further reviews and plant modifications. Inconsistencies and missing information could be the source of wrong decisions and conclusions about LTO and, for specific equipment, could be a risk of early failure.

3.3 – RECOMMENDATION/SUGGESTION:

S1) Consideration should be given to making the Q-list complete.

3.4 – DOCUMENTS REVIEWED:

- Cross-check conclusion NT/LTO/AGEING/GEN/1200;
- RSQ ASCO Joucomatic (RSQ 031.01).

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The analysis in the E I&C area has been done in several stages (see also issue sheet C-2):

- Scoping with the continuous alignment with other areas;
- Implementation of a completeness check in the EI & C area before the finalized the transverse cross check at the level of the 3 ageing areas.

The end result of this analysis is compiled into the database according to LTO-studies. This database take into account the various components related to the ageing study, while specifying the criteria for which the SSC is in the LTO scope.

In a second phase, the LTO database was used as input to the EI&C components database: the Q-list. Therefore, this database contains information regarding the management of ageing, completed with information on the environmental qualification (RSQ).

In addition to this study and in order to ensure consistency with all information sources (safety report, decennial revisions concerns (topics), SAP, …), the LTO EI-22 project has been focused on gathering all this information, questioning for establishing a clear, completed and validated reference document for classified functions. The reference information is integrated into the procedures REF/OGZ/024 and SUR/00/046 as well as in the safety report for the new operating period of 10 years.

This is the final cross-check on which the Q list is based to identify all the I&C components related to "criterion 1" safety functions.

1. The reference document is available (criterion 1);
2. We are busy to identifying all the components related to the “criterion 1” safety functions”;
3. At the same time, we are finalizing the environmental repository (normal conditions/incidental conditions) and we make the link with the qualification file of each component to check his compatibility with all the requirements.

The phases 2 & 3 are ongoing and will be finished by the end of June 2015.

Following the creation of a specific organization within the Engineering Department, the database (The Q-list) is now considered as the reference. New information is consolidated in this one, the Q-list is kept up to date.

The update of the Q-list concerns the equipment qualification as well the component list . A process and a specific organization has been set up. The goal is to complete it both qualitatively and quantitatively (i.e. during installation and/or identification of new SSCs). Only the complete knowledge of the system allows the ageing management while respecting the qualification requirements.

That's why the Q-list has also to take into account information regarding operating conditions (energized / no energised), mostly for the solenoid valves. It's foreseen to integrate this parameter (for the solenoid valves) because of its importance for the ageing management as well for the qualification process.

Regarding the general database for all the important set-points (I&C, protection for : reactor, power supply, motors; torque switches for valve, alarm points for radiation monitoring) : one task-force has been set up in order to:

4. Make the inventory of the documents related to the set points;
5. Propose a solution to manage the set-points, to get one reference (one document).

The first step is ongoing, the second one will be fulfilled by June 2015.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

5.1 – FACTS:

F1) The Q-database currently has 22,000 LTO related items. 14,000 are class 1E items. Out of which 10,000 have a reference to an RSQ (Qualification Summary Report) and 4,000 are covered by a replacement project. This was demonstrated by running selections (class 1E items with an RSQ reference and remaining items with a project reference).

F2) The plant transferred the class 1E database (high level master) into the Q-List. This means all safety system components are in the LTO programme.

F3) Regarding solenoid operated valves included in the Q-List, it is not clear whether the qualified life is based on energised (self-heating effect) or non-energised valves. Missing this information can lead to a wrong interpretation of the qualified life.

5.2 – DOCUMENTS REVIEWED:

- Q-Database, Reviewed on 19.01.2015.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: E - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Review of Ageing Management and other LTO related activities for civil structures	
Issue Title: Structures requalification	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Fire protection of cables and masonry partitions qualification has not been revalidated in the LTO process.

2.2 – IAEA BASIS:

NS-G-2.12
2.7. Understanding the ageing of a structure or component, as illustrated in Fig.1, is the key to its effective ageing management. This understanding is derived from knowledge of:

- The design basis (including applicable codes and standards);
- Safety function;
- The design and fabrication...;
- Equipment qualification (where applicable);
- Operation and maintenance...

SRS No. 57
3.3.2. Equipment qualification
Equipment qualification also demonstrates whether the environmental and seismic qualification of equipment will remain valid over the expected period of LTO. The demonstration supports the technical justification that the material degradation and ageing effects will be managed effectively. Equipment designed in accordance with earlier standards is reviewed and requalified, if necessary, under a comprehensive programme.

5.1. ASSESSMENT OF THE CURRENT PHYSICAL STATUS OF THE PLANT
An engineering assessment of the current status of SCs within the scope of LTO is carried out. An adequate engineering assessment requires knowledge of:
(a) The design, including applicable codes and regulatory requirements, the design basis and design documents, including the safety analysis;
(b)…

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) The scoping document about fire protection clearly identifies fire barriers comprising specific plates which are placed under cables and a coating applied to the cables themselves in order to avoid or delay fire propagation.

F2) The qualification information given in AME and AMP documents mentioned a delay fire propagation function (without any information about the duration of the delay before the function is lost).

F3) The team has performed a walk-down through the plant in the Electrical Building to see the actual fire protection of the cables. The team noticed cables from Train 1 passing through Train 2 room with these two fire protection devices in place. The coating was very thin and also the plate was only located under the cable (and neither on the sides nor on the top). The qualification review of these devices has not been performed.

F4) Numerous partitions in the electrical building are made of non-reinforced masonry.

F5) Most of the masonry panels are very large (> 3m x 3m) and may develop significant stress due to out-of-plane bending induced by an earthquake perpendicularly to the panel: these out-of-plane effects have to be combined with in-plane effects if standard design criteria are not met.

F6) International feedback shows that large non reinforced masonry panels are weak points and can affect fire area separation or material near these panels (spatial interaction): the qualification of these large non reinforced masonry panels relies on old codes.

F7) The interview with a Tractebel specialist revealed that 2 re-assessments of these partitions have been performed. They are based on a complete seismic recalculation of the building.

F8) The methodology explained by this specialist is based on a "decoupling" criterion which only relies on compression considerations and not on traction considerations (some partitions are linked to the upper slabs by a framework of secondary beams). This methodology has not been re-assessed for LTO.

3.2 – SAFETY CONSEQUENCE:

Without a comprehensive qualification of structures which are necessary to assure an intended function, safety may be affected during the LTO period.

3.3 – RECOMMENDATION/SUGGESTION:

R1) The plant should reassess the qualification validity of the fire protection of cables; and correctly document the seismic qualification of masonry partitions for LTO.

3.4 – DOCUMENTS REVIEWED:

- Scoping of structures;
- AME of structures;
- AMP of structures;

– Scoping of fire protection;
– AME of fire protection;
– AMP of fire protection.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The issue sheet identifies 2 distinct potential issues:

– Fire protection of the cables;

– Loss of fire resistance capacity of masonry walls.

The first point is related to the fire resistant plates installed between cable tray (fire barrier), the "Flamastique" fire protection of the cables and the qualified lifetime of fire protections. The ageing of fire resistant barriers is analyzed in the plant project Struc-02. This project concerns baseline inspections that will lead to an improved maintenance program, but also covers upgrading of processes and corrective actions.

Due to the baseline inspections (including on cable trays – see issue sheets D-1), some deficiencies have been identified, but they do not compromise the safety function of the protected components. These deficiencies will be solved in the framework of project Struc-03.

Concerning the lifetime qualification of fire resistant barriers, analysis of OE showed that only barriers where silicone foam is used are subjected to ageing. All fire resistant barriers containing this type of product have been replaced in the plant.

Finally, a new inspection procedure for fire resistant barriers has been established. This procedure takes into account objective criteria for the complete range of ageing degradation mechanisms (cracks, shrinkage,...) This procedure is being used during the baseline inspection of the fire resistant barriers and is the reference procedure for the Maintenance Department.

The issue of seismic resistance of masonry walls is not an ageing related issue. However, the problem is handled in the framework of a larger project (managed on corporate level) dealing with the Fire Hazard Analysis. It has also to be specified that the seismic resistance of the masonry walls has been demonstrated in the framework of the BEST project (Belgian Stress Tests), after the Fukushima accident.

Finally, the LTO-Design domain deal with some issues related to fire protection. The project DS-02 deals with the fires of major amplitude. Additional fire protection and detection systems will be installed as part of the Agreed Design Upgrade. The Agreed Design Upgrade also plans a new "Ultimate" building called "SUR-étendu" (project DS-01).

For this specific issue, in case of a seismic event, combined with a major fire (i.e. fire partitioning is lost due to masonry walls collapse and the fire propagates throughout the plant), the control of the plant will be switched to this building, and the plant will be brought to safe shutdown situation.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) The project is covered under Struct-02 and Struct-03: Fire barriers.

F2) The Safety & Design criteria report and inspection procedure reports were reviewed.

F3) During the walk down, it was observed that strengthening of cable trays (Struct-03) and provision of fire resistant barrier over the cables were in progress in all buildings.

F4) It is planned to complete the project in December 2015.

F5) During PSR review, seismic re-evaluation of the electrical building was taken up for PGA value of 0.17g as against PGA=0.1g as considered in the original design. Additional reinforcement was provided for lateral stability. However, cracks may develop in these masonry walls.

F6) In case of loss of fire barrier of masonry walls due to cracks, a new building, SUR (Emergency shutdown system – second level), will be built and commissioned to take over control room actions.

F7) The design of the SUR building has been completed. Tendering is in process. Construction work is yet to start.

5.2 – DOCUMENTS REVIEWED:

- Safety and design criteria report TIS1/4NT/0297092/000/00 dated 08/11/2013 R-0;
- Inspection procedure report for physical separation of cables and fire barriers;
- Doc. No. TIS1/4NT/0312974/000/00 dated 22/04/2014 R-0;
- Doc. No. TIS/4NT/0284320/000/00 dated 05/06/2013. Summary note on Seismic Margin Review of masonry walls in various safety related buildings of Tihange 1 to 3;
- Doc. No. 541497/627/NT/0009 – Electrical building – Seismic calculation of masonry walls.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: E - 2**
NPP: Tihange	**Unit: 1**

Reviewed Area: Review of Ageing Management and other LTO related activities for civil structures

Issue Title: Potential stress corrosion cracking of high-grade steel bolting

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The Ageing Management Evaluation of components and structures anchorages does not address potential stress corrosion cracking of high-grade steel bolting.

2.2 – IAEA BASIS:

NS-G-2.12
2.7 Understanding the ageing of a structure or component, as illustrated in Fig.1, is the key to its effective ageing management. This understanding is derived from knowledge of:

- The design basis (including applicable codes and standards);
- Safety function
- The design and fabrication ...
- Equipment qualification (where applicable)
- Operation and maintenance...

SRS No. 57
3.2. PRECONDITIONS FOR LONG TERM OPERATION
The existing nuclear power plant programmes and documentation are essential in developing the foundation for successful LTO. The existence of the following nuclear power plant programmes and documentation, which impact upon all SCs of nuclear power plants and all areas of safe plant operation, is considered a precondition for LTO:
(a) Plant programmes as detailed …;
(b) A management system that addresses quality assurance and configuration management;
(c) Original safety analyses involving time limited assumptions;
(d) Current safety analysis report or other licensing basis documents.

5.1. ASSESSMENT OF THE CURRENT PHYSICAL STATUS OF THE PLANT
An engineering assessment of the current status of SCs within the scope of LTO is carried out. Adequate engineering assessment requires knowledge of:
(a) The design, including applicable codes and regulatory requirements, the design basis and design documents, including the safety analysis;
(b) …

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) GALL rev2 (NUREG-1801, Rev. 2) indicates "High strength closure bolting (actual yield strength greater than or equal to 1,034 MPa (150 ksi) may be subject to stress corrosion cracking".

F2) International feedback on stress corrosion of anchorage bars and others high strength bolts is not good (especially in the internal environment of the reactor building).

F3) The GALL AMP related to bolting (M18) recommends a volumetric examination of high-grade steel bolts: this recommendation is applicable for anchorage bars made of high-grade steel and not just bolts, because the physical phenomenon is the same. This NDT can be avoided if justified. This recommendation is based on steel-grade criteria and not on pre-stress criteria.

F4) A Tractebel specialist confirmed that certain anchorages are pre-stressed. The same Tractebel specialist argued that these types of anchorages have been screened out because the steel grade of these pre-stress bars is not high enough to cause stress corrosion.

F5) The AME document for LTO dedicated to anchorages does not contain any technical trace of this screening process for stress corrosion. Also, the team has no evidence that the screening process has been carried out on the basis of steel grade criteria only or a criteria based on double criteria (steel grade + formal pre-stress).

F6) During the walk-down in the Spent Fuel Building, the team noted that a heavy-duty crane for spent fuel container handling was anchored by high-strength bars the steel grade of which depends on the design and actual supplier data.

3.2 – SAFETY CONSEQUENCE:

Without taking the SSC failure mode into account for ageing management evaluation of every bolting and anchorages, the safety functions may be not be fully met for LTO.

3.3 – RECOMMENDATION/SUGGESTION:

S1) Consideration should be given to reviewing the evaluation of the potential impact of stress corrosion cracking of anchorages of all structures and components.

3.4 – DOCUMENTS REVIEWED:

- Scoping of anchorages;
- CA of anchorages;
- AME of anchorages;
- AMP of anchorages;
- Drawings of fuel pool heavy duty crane anchorages.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The LTO-Ageing management review is based on GALL rev1, as requested by the Belgian

Safety Authorities. However for the analysis, external operating experience was taken into account. In this context, the potential of Stress Corrosion Cracking was identified for all anchoring components. The formalization of the analysis of the decennial reviews was found not sufficiently exhaustive.

In order to solve this issue, an additional document has been established by Tractebel Engineering. Based on the list of mechanical structures in the LTO scope, this document concludes that the specified type of steel is not installed in the plant.

In addition, it must be pointed out that the baseline inspections, performed in the framework of project Struc-01, did not identify any form of SSC relative to the anchoring of those components (no cracks in the concrete, no anchors presenting clean fracture, etc.)

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) The project is covered under Struct-04.

F2) Tractebel engineers reviewed all steel bolting and anchorages for stress corrosion cracking to make sure that a particular category of steel grade, which may cause stress corrosion, had not been used on the plant, except in the BAN building.

F3) The replacement of pre-stressing bars anchors in the BAN building has started under GC-09 project.

F4) Currently, the work is in progress for GC-09.

F5) During plant walk down, it was observed that detailed scaffolding work has been completed over the spent fuel pool.

5.2 – DOCUMENTS REVIEWED:

- Doc. No. TIS1/4NT/0343220/000/00 dated 23/12/2014 Stress corrosion in anchorages and bolting etc;
- Project note no. NT/LTO-T1/GC/B-GC-09 (SAP no. 10010484737) dated 09/01/2014;
- Original Drawings dated 22/02/1974;
- Construction Dossier of Freyssinet system dated May 1976.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: F - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Review of competence management, knowledge management and behaviour	
Issue Title: Staffing of the LTO project organization	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Staffing of the LTO project is not adequate.

2.2 – IAEA BASIS:

GS-R-3
4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.
4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills, knowledge and experience to ensure their competence. …

GS-G-3.1
4.1. Senior management should ensure that the resources that are essential to the implementation of the strategy for the management system and the achievement of the organization's objectives are identified and made available.

NS-G-2.4
3.7. The operating organization should be responsible for providing all equipment, staff, procedures, training and management practices necessary for safe operation….. Reliability in the long term should not be served by compromising safety in the short term.
5.10. The operating organization should ensure that adequate resources are available to implement the safety policy. This should include the provision of safe operating plant, the necessary tools and equipment, and a sufficient number of competent staff (supplemented as necessary by consultants or contractors, including plant vendors). In particular, sufficient resources should be ensured to carry out activities in a safe manner, avoiding undue physical or mental stress on individuals.
6.11. A long term staffing programme tied to the long range objectives should be developed by the operating organization to anticipate future personnel needs. This plan should be reviewed and updated periodically to ensure that it is consistent with and supports the long range objectives of the operating organization and the needs of the plants. The staffing programme should include anticipated changes in authorized staffing levels, job assignments for the development of professional and managerial experience and a forecast of personnel

needs, losses due to retirement and attrition being taken into account. The long term staffing plan should allow sufficient time for individuals to turn over job responsibilities and should allow for continuity in the conduct of duties.
6.12. On the basis of the objectives, functions and responsibilities of the operating organization, a proper definition and detailed analysis of tasks and activities to be performed should be made; the appropriate staffing and qualification requirements at the different levels in the organization should be determined…
6.14. Staffing arrangements should take into account:

- the need to involve the operating organization in the review of activities, including those that are conducted during the design, construction and commissioning stages;
- the minimum number of persons necessary for performing all functions with respect to plant operation and emergency situations, with a view to avoiding excessive loads being placed on individuals;
- the statutory requirements on working conditions; —the turnover of personnel in the operating organization;
- long term personnel needs for future projects;
- ….

6.15. Recruitment should start early enough to permit the establishment and proper implementation of selection methods and the timely availability of personnel for preparatory training.

NS-G-2.12
4.3. An illustration of the organizational arrangements, including participating organizations and their roles and interfaces.
4.4. Senior management should designate a coordinator for the ageing management programme with responsibilities. The coordinator should be a part of the operating organization, such as the operations, maintenance, engineering or quality management unit; a task force consisting of members of different units of the operating organization and external experts if necessary; or a dedicated ageing management programme unit.
4.6. … The participants of ageing management teams should include experts from operations, maintenance, engineering, equipment qualification, design and research and development, depending on the evaluations necessary. In addition to the ageing management teams, external organizations may be requested to provide expert services on specific topics, e.g. condition assessments, research and standards development.
4.7. Different units of the operating organization of the nuclear power plant (e.g. operations, maintenance and engineering) should be responsible for the implementation of structure specific or component specific ageing management programmes and for reporting on the performance of structures and components. …

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) All the LTO activities and areas are well covered by the proposed plant organizational structure of the LTO programme. It involves other organizations such as Tractebel and the

whole programme is overlooked by a steering committee. A major refurbishment for LTO is included in the overall planning of annual outages for the coming years 2013 and 2014. However, the urgent and major problem is the allocation of staff to the programme organization which is currently missing experienced and qualified personnel. Therefore this is seriously jeopardizing the final deadline for the LTO preparation of the unit.

F2) At the moment the LTO Project organization has 25 vacant positions. A recruitment campaign started in August 2012 and over 90 applications were received. Evidence was shown that there were not enough qualified and suitable candidates for these positions. Out of the 90 applications, only around 10 of the candidates were suitable (for different reasons) and 2-5 out of those were available for vacant LTO positions. Existing departments need to continue their current activities, and can only provide a limited amount of staff for LTO and this was one main reason why several internal replacements were not possible or cancelled.

F3) LTO electricity and I&C teams are not able to start the actions needed for the LTO programme because of a lack of 15 competent people. At the moment there are 323 open actions in 60 projects awaiting implementation.

F4) Evidence was shown that at the moment some key people taking part in the LTO project have also commitments in several other projects which increases the risk of overloading them.

F5) The lack of adequate human resources in the LTO project organization is recognized in the plant but no efficient action is taken in order to change the situation. The team noticed that only a very limited number of plant personnel are involved in the LTO project**.** The operating organization (in all levels) is not showing a strong commitment to the LTO programme and this is reflected in the lack of suitable resources.

3.2 – SAFETY CONSEQUENCE:

Without adequate and competent human resources in place, the plant will seriously jeopardize the implementation of a safe LTO programme in a timely manner.

3.3 – RECOMMENDATION/SUGGESTION:

R1) The plant should staff the LTO project organization with competent resources.

3.4 – DOCUMENTS REVIEWED:

- LTO organization chart;
- HR database (SAP);
- LTO Q-list (database);
- LTO Staffing plans;
- Recruitment statistics;
- Retirement forecasts;
- Proposal of Decision - Operational Procedure – Organization of programme function "Realization of LTO at Tihange" – REF/OGZ/126;
- AIP of the limited scope SALTO mission, Tihange NPP unit 1, November 2012;

– "Volume Gestion des connaissances, des attitudes et du comportement et développement des compétences". Project LTO – Tihange 1.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The issue is based on the situation at the beginning of the LTO implementation. The methodology was to be defined, the risks to be identified, the necessary tools to be developed.

The team in charge of roll-out at the pre-SALTO review also had to deal with the close-out of the LTO-study-phase. At the beginning of 2013 (after the formal close-out of the study phase), detailed analyses started: list of projects, risk analysis, resources analysis and planning (see methodology paragraph 15). Based on this information, the organization described in paragraph 14 was implemented. Projects were defined and organized under the supervision of the LTO team. Their implementation is distributed over the LTO team ("Lead") and the operational organization ("Follow").

The LTO team was staffed so that the overall supervision and the implementation of the "LEAD"-project could be correctly handled. The team is composed of a mixture of new and experienced collaborators. These collaborators got recruited internally and externally. All new staff members of the project were given a specific training (customized in function of role in the organization). At this moment, the staff of the LTO team is composed of approximately 80 staff members.

The tools developed for the follow-up of the projects indicate that the implementation of the LTO-Programme is on track. Although slightly behind schedule, the implemented methodology allows a correct and transparent follow-up of the project with a flexible use of available resources if needed. The different KPIs given to the Generation Management are useful tools to manage the overall priorities of the Fleet and the LTO-Program.

In conclusion, based on the implemented LTO organization and the follow-up of the effectiveness, the plant considers this recommendation to be under control.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) The LTO project team is established as an additional department fully integrated into the plant organisational structure, using standard Electrabel/Tihange procedures in the conduct of its activities. It is fully staffed with 70+ team members who have been recruited using regular HR procedures, from a combination of plant line staff and some personnel from Tractebel.

F2) All line vacancies created as a result of staff transferring to the LTO team have been permanently filled.

F3) In addition to the staffing of the LTO organisation, an analysis of the additional workload in the line organisation due to the planned implementation of LTO related activities was conducted and 17 additional staff have been recruited into the line organisation (10 in

maintenance, 6 in operation and 1 in CARE). On a site level numbers have increased from approximately 800 to 1080 in the last 5 years, much of this due to LTO requirements.

F4) Plant management indicated that they had enough competent resources for LTO.

5.2 – DOCUMENTS REVIEWED:

- SAP on-line HR data;
- ZST10010043570 000 Vers 02, 4/12/2012, Competence Management.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: F - 2**
NPP: Tihange	**Unit: 1**
Reviewed Area: Review of competence management, knowledge management and behaviour	
Issue Title: Competence and Knowledge Management	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Systematic approach for Competence and Knowledge management is not implemented for long term operation of the plant.

2.2 – IAEA BASIS:

GS-R-3
4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.
4.2. The information and knowledge of the organization shall be managed as a resource.
4.3. Senior management shall determine the competence requirements for individuals at all levels and shall provide training or take other actions to achieve the required level of competence. An evaluation of the effectiveness of the actions taken shall be conducted. Suitable proficiency shall be achieved and maintained.
4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills,

knowledge and experience to ensure their competence. Training shall ensure that individuals are aware of the relevance and importance of their activities and of how their activities contribute to safety in the achievement of the organization's objectives.

GS-G-3.1
4.1. Senior management should ensure that the resources that are essential to the implementation of the strategy for the management system and the achievement of the organization's objectives are identified and made available.

GS-G.3.5
4.10 Knowledge management is an integrated, systematic approach to identifying, acquiring, transforming, developing, disseminating, using, sharing and preserving knowledge that is relevant to achieving specified objectives. Knowledge management consists of three fundamental components: (i) individuals, (ii) processes and (iii) technology. Knowledge management focuses on individuals and organizational culture to stimulate and nurture the sharing and use of knowledge; on processes or methods to find, create, capture and share knowledge; and on technology to store knowledge and make it accessible and to allow individuals to work together without needing to be in the same place. Individuals are the most important of these components, because managing knowledge depends on the willingness of individuals to share and reuse knowledge.
4.11. With regard to information, the full information needs of those carrying out tasks and the ways in which the information is to be provided to the user should be considered in formulating the instructions for each task. The day to day responsibility for ensuring that such information is used effectively lies with the immediate supervisors of the individuals performing tasks. …
4.12. Information relating to safety should not be regarded as intellectual property but rather should be shared freely within the nuclear community. Sharing may be achieved through the contribution of information to databases, the sharing of reports, participation in conferences and seminars and benchmarking visits.
4.13. For an organization to be able to provide critical information, it should manage pertinent knowledge so that it is easily accessible to those who may need it for carrying out their tasks. An organization should have an integrated, systematic approach to identifying, capturing, managing and sharing its knowledge and, in so doing, enable groups of individuals to acquire 'new' knowledge collectively to help achieve the objectives of the organization. Such a knowledge management system helps an organization to gain insight and understanding from its own experience.
4.14. Knowledge management should be used to capture knowledge (both tacit and explicit) from individuals before they leave the organization, so that it can be retained and transferred to others who need the knowledge for the performance of their jobs or tasks. The organization should assess any risk that is posed by the loss of critical knowledge and should take mitigatory action if necessary. The organization should have the knowledge base necessary to facilitate the assimilation of new workers and to enhance the skills and knowledge of existing workers.

NS-G-2.4
3.7. The operating organization should be responsible for providing all equipment, staff, procedures, training and management practices necessary for safe operation, …. Reliability in the long term should not be served by compromising safety in the short term.

3.15. To improve human performance, senior managers in each organization should understand and support the need to develop the management and technical skills of all individuals involved in plant activities to the extent necessary to perform their assigned tasks. This support should be in the form of modelling the new behaviours and providing resources including adequate funds to develop and implement management and technical skills programmes.
5.10. The operating organization should ensure that adequate resources are available to implement the safety policy. This should include the provision of safe operating plant, the necessary tools and equipment, and a sufficient number of competent staff (supplemented as necessary by consultants or contractors, including plant vendors). …
6.11. A long term staffing programme tied to the long range objectives should be developed by the operating organization to anticipate future personnel needs. This plan should be reviewed and updated periodically to ensure that it is consistent with and supports the long range objectives of the operating organization and the needs of the plants. The staffing programme should include anticipated changes in authorized staffing levels, job assignments for the development of professional and managerial experience and a forecast of personnel needs, losses due to retirement and attrition being taken into account. The long term staffing plan should allow sufficient time for individuals to turn over job responsibilities and should allow for continuity in the conduct of duties.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) Knowledge management (KM) is the process through which organizations generate value from their intellectual and knowledge-based assets. However, the KM and Competence management (CM) are not well understood by the plant and because of that the implementation of the KM and CM activities is low (expect formal training activities). CM and KM are mainly understood to be synonyms of training activities and not as a strategic approach which includes a systematic way of identifying, acquiring, transforming, developing, disseminating, using, sharing and preserving knowledge relevant to achieving specific objectives.

F2) The plant is carrying out several activities in the area of KM and CM but the overall approach and the links between these activities are not clear. Activities are not followed in a systematic way and the responsibility for the activities is split into several teams/individuals.

F3) Some Knowledge transfer (KT) programmes (mainly mentoring programmes) are in place but those are not followed or documented at a detailed level. KT programme documents lack information about progress, the process is not described and the actions to implement during the programme are missing.

F4) Descriptions of activities in the Knowledge transfer (KT) programmes are at a very high level. No references to technical documentation are provided and the role or goals of the activities are not identified in detail. Most KT programmes are relying on the motivation and willingness of the individuals and are not actively driven by the HR department and/or training department and/or line hierarchy. The participants in the KT programmes are developing their own unofficial supporting documents and checklists and the tacit knowledge captured during these programmes is not collected or shared in order to increase the

"corporate / organizational memory".

F5) Formal training plans are well organized and the implementation of the new "training passports" is in progress. However, On-Job-Trainings (OJT) which are part of the official training plans are not fully developed. The level of implementation of the OJT programmes is not very high but implementation is in progress and it should be completed by the year 2014.

F6) The training records are documented in two different databases. At the moment, it is not possible to track the future plans and history information from the same training records. Once a year, supervisors and individuals are informed about and involved in the planning process but they do not have online access to the database. Because of that, the Training Consultants (TC) and the training department are seen as the sole owners of the CM and KM activities.

3.2 – SAFETY CONSEQUENCE:

Without shared understanding, proper development and implementation of Competence and Knowledge management (incl. Knowledge transfer) programmes, the plant is facing an increasing risk of losing critical knowledge related to its safe LTO.

3.3 – RECOMMENDATION/SUGGESTION:

S1) The plant should consider defining CM and KM (incl. knowledge transfer) processes as well as the responsibilities and roles of these processes, the links between different actions and the improvement of the documentation for KM and CM processes and their outputs.

3.4 – DOCUMENTS REVIEWED:

- Statistics provided by HR department;
- HR Database (SAP);
- Recruitment database;
- Training records database;
- Safety and work related passports;
- "Transfert des connaissances" documents;
- Draft document: Assessment of the Human Factor SF12. Assessment as part of PSR-II;
- "Volume Gestion des connaissances, des attitudes et du comportement et développement des compétences". Project LTO – Tihange 1;
- AIP of the limited scope SALTO mission, Tihange NPP unit 1, November 2012.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The facts mentioned in this issue sheet are covered by the project CB-03 (detailed description in paragraph 16.5).

1. Processes related to HR are reviewed and updated. Links between all HR processes are described as well as roles and responsibilities of all actors for each sub process. This item is covered by Long term organizational needs (5);
2. KT transfer process is described including roles and responsibilities. Specific tool for KT is developed. For each movement (pension, promotion, mutation,...), a question is sent to the

line manager. "KT needed for this employee?" LM has to answer. New process was launched in June 2014. Since then 66 questions were sent to LM. A comity Competence, Knowledge,K&B is following the process on a monthly base. The comity discusses issues and uses REX to improve the process. This item is covered by the sub process Knowledge transfer (2);

3. OJT's are a part of the Passeport Métier. Development of specific OJT is on-going. For Atelier Ecole over 30 scenarios are already developed. This item is covered by Tracks and Planning (4);
4. All development tracks (Passeport Safety, Passeport Métier, Semaine RCQ, Astreinte) are integrated in SAP as a sole and unique database. Planning and organization of training will be done in SAP. This item is covered by Planning and tracks (4). Manager will have on-line access to the development plan of his team. Who has still to follow (planned and to plan), has followed which training and an up to date status. Manager has on-line access to training history of his team members. This item is covered by Team Development (3);
5. KM and CM will be done in a proactive way. Knowledge grid identifies key knowledge in a team (especially in Maintenance). LM can base the development plan of his team on his grid. So the development plan is based on the real team needs LM can simulate on future changes in his team (pension, mutation,...). LM can thus anticipate and avoid loss of knowledge in his team. For expert functions a knowledge chart is developed. This serves as input to future replacement of the expert and as a base to do knowledge transfer. This item is covered by Key Knowledge (1).

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

5.1 – FACTS:

F1) The plant has implemented a new HR project, comprising 6 different components, which includes the development of 'key knowledge grids', to be implemented at team level. These identify the key skills, and equipment knowledge requirements, and how many team members need these key skills and knowledge. These are used by team leaders/line managers to ensure they retain the required level of expertise within their teams. Line managers are supported by technical consultants (TC) and HR advisers in this work.

F2) For isolated and expert functions an 'Expert Chart' is used to capture key knowledge and competences and these serve as a guide for replacement of the expert.

F3) The plant uses a combination of succession planning, long-term scenario forecasting (on-going process), team level key knowledge grids, expert charts and critical contractor analysis to assess and confirm the required resources for LTO; but many of these processes are quite new (release 2014) and still being rolled out and not fully embedded across the plant. However, they are working well where they have been fully implemented.

F4) Each time a staff movement is confirmed a Knowledge Transfer Questionnaire is sent to the line manager to determine if formal knowledge transfer is required. Under the current process, 43 formally recorded and managed knowledge transfers have been completed and 24 are in progress. Plant allows 12 months for a formal knowledge transfer and a variety of tools are used including: knowledge grids, expert charts, 1 on 1 discussions and 'yellow sticky'

question and answer exercises for tacit knowledge sharing.

F5) The plant has developed an integrated HR processes overview document (also available as an interactive tool within HR, but not yet available to line managers) which references a specific KM process document which describes the key KM processes in the plant. Those processes are currently being implemented.

F6) All training records and CM/KM actions are now contained in SAP. A new tool 'Reglearn' which is a licensed 'add-on' for SAP is used to manage and schedule training and track individuals but this uses data directly from SAP and returns data into SAP.

5.2 – DOCUMENTS REVIEWED:

- ZST 10010491180,Rev 0, 23/12/2014, Competence and Knowledge management;
- ZST.10010043379.000 **********, Knowledge Management.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: F - 3**
NPP: Tihange	**Unit: 1**

Reviewed Area: Review of competence management, knowledge management and behaviour

Issue Title: Staffing for the period of long term operation

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Staffing plans for the long term operation of the plant are not adequate.

2.2 – IAEA BASIS:

GS-R-3
4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.
4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills, knowledge and experience to ensure their competence. Training shall ensure that individuals

are aware of the relevance and importance of their activities and of how their activities contribute to safety in the achievement of the organization's objectives.

GS-G-3.1
4.1. Senior management should ensure that the resources that are essential to the implementation of the strategy for the management system and the achievement of the organization's objectives are identified and made available.

NS-G-2.4
3.7. The operating organization should be responsible for providing all equipment, staff, procedures, training and management practices necessary for safe operation, including the fostering of an environment in which safety is seen as a vital factor and a matter of personal accountability for all staff. Reliability in the long term should not be served by compromising safety in the short term.
5.10. The operating organization should ensure that adequate resources are available to implement the safety policy. This should include the provision of safe operating plant, the necessary tools and equipment, and a sufficient number of competent staff (supplemented as necessary by consultants or contractors, including plant vendors). In particular, sufficient resources should be ensured to carry out activities in a safe manner, avoiding undue physical or mental stress on individuals.
6.11. A long term staffing programme tied to the long range objectives should be developed by the operating organization to anticipate future personnel needs. This plan should be reviewed and updated periodically to ensure that it is consistent with and supports the long range objectives of the operating organization and the needs of the plants. The staffing programme should include anticipated changes in authorized staffing levels, job assignments for the development of professional and managerial experience and a forecast of personnel needs, losses due to retirement and attrition being taken into account. The long term staffing plan should allow sufficient time for individuals to turn over job responsibilities and should allow for continuity in the conduct of duties.
6.12. On the basis of the objectives, functions and responsibilities of the operating organization, a proper definition and detailed analysis of tasks and activities to be performed should be made; the appropriate staffing and qualification requirements at the different levels in the organization should be determined, and the selection, training and retraining requirements should be specified.
6.14. Staffing arrangements should take into account:

- the minimum number of persons necessary for performing all functions with respect to plant operation and emergency situations, with a view to avoiding excessive loads being placed on individuals;
- the statutory requirements on working conditions; —the turnover of personnel in the operating organization;
- long term personnel needs for future projects;
- …..
- the need for training and retraining of plant personnel.

6.15. Recruitment should start early enough to permit the establishment and proper implementation of selection methods and the timely availability of personnel for preparatory training.

NS-R-2
2.6. The document describing the plant's organizational structure shall indicate the staffing arrangements within the categories of direct line operating personnel and supporting personnel. Clear lines of authority shall be established to deal with matters bearing on plant safety. The extent to which the support functions are self-sufficient or dependent upon services from outside the plant organization shall be demonstrated by means of functional organizational charts which include personnel resource allocations and specify the duties and responsibilities of key personnel.

NS-G-2.12
4.3. An illustration of the organizational arrangements, including participating organizations and their roles and interfaces.
4.4. Senior management should designate a coordinator for the ageing management programme with responsibilities. The coordinator should be a part of the operating organization, such as the operations, maintenance, engineering or quality management unit; a task force consisting of members of different units of the operating organization and external experts if necessary; or a dedicated ageing management programme unit.
4.6. … The participants of ageing management teams should include experts from operations, maintenance, engineering, equipment qualification, design and research and development, depending on the evaluations necessary. In addition to the ageing management teams, external organizations may be requested to provide expert services on specific topics, e.g. condition assessments, research and standards development.
4.7. Different units of the operating organization of the nuclear power plant (e.g. operations, maintenance and engineering) should be responsible for the implementation of structure specific or component specific ageing management programmes and for reporting on the performance of structures and components. …

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/11/2012

3.1 – FACTS:

F1) No recruiting was carried out during the years 1995-2003 and in the last 5-6 years the plant recruited more than 370 new staff members. No evidence was shown that the Human Resource Management (HRM), Competence Management (CM) and Knowledge Management (KM) processes are advanced enough to handle this kind of changes in the number of recruitments.

F2) 455 out of 972 plant staff members are now over 46 years old (46%). 145 (~15%) out of the 455 are now over 55 years old and they will retire in the next few years.

F3) Succession planning is currently taking place mainly at executive level. Key positions are perceived to be at "executive level" and no evidence was shown that the key positions (for example technical experts, foremen, technicians) are identified from the LTO point of view.

F4) Evidence was shown that at the moment some key people have commitments in several projects which increase the risk of overloading them.

3.2 – SAFETY CONSEQUENCE:

Without continued deployment of adequate and competent human resources, the operating of the plant during the whole life time may be difficult.

3.3 – RECOMMENDATION/SUGGESTION:

S1) The plant should consider evaluating existing human resource plans and define how they will ensure competent and adequate human resources for the whole life time of the plant.

3.4 – DOCUMENTS REVIEWED:

- LTO organization chart;
- HR database (SAP);
- Training database;
- Training passports;
- LTO Staffing plans;
- Recruitment statistics;
- Retirement forecasts;
- Proposal of Decision- Operational Procedure – Organization of programme function "Realization of LTO" at Tihange – REF/OGZ/126;
- AIP of the limited scope SALTO mission, Tihange NPP unit 1, November 2012;
- "Volume Gestion des connaissances, des attitudes et du comportement et développement des compétences". Project LTO – Tihange 1.

4. COUNTERPART ACTIONS	**Date:** 12/12/2014

The facts mentioned in this issue sheet are covered by the project CB-03 (detailed description in paragraph 16.5).

1. Succession Plan is performed on a yearly base for all exempts and on a two year base for all other personnel. This item is covered by Long term organization needs (5);
2. Recruitment is still ongoing to anticipate future departures. Recovering period is described in Staffing Procedure. This item is covered by Long term organizational needs (5);
3. Project needs will be defined in terms of competences needed for a project at the beginning of the definition of a project. When staffing problems project will be reported to a later stage. Is described in Staffing procedure. This item is covered by Long term organizational needs (5);
4. An exercise on the long term organizational needs based on different scenarios is on-going. What are the competences needed in case of nuclear stop in 2025? Competences needed in case of the stop of 1 unit, stop of 2 units, dismantling,... Results of this exercise will afterwards also be done on a corporate level for all nuclear activities of the company. They then need to be translated in number of people needed for each scenario. This item is covered by Long term organizational needs (5).

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/ 2015

5.1 – FACTS:

F1) Manpower planning at the level of forecasting staffing needs is conducted on short (1 year) and medium (5 year) term. Long term needs (10 years) are based on varying scenario forecasts but are based on skills needs, rather than numbers. Currently there are no firm plans beyond 2025 according to Belgian Law, to phase out all nuclear power by that date.

F2) In addition to the staffing of the LTO organisation, an analysis of the additional workload in the line organisation due to the planned implementation of LTO related activities was conducted and additional staff have been recruited into the line organisation. On a site level numbers have increased from approximately 800 to 1080 in the last 5 years, much of this due to LTO requirements.

F3) Plant conducts an annual "People & Position" review to identify critical positions; ensure the continuity of the activities; determine key people and identify their development needs; analyse the needs of specific populations; have a view on organizational mobility and/or voluntary mobility; and to prepare the succession planning. Exempts (personal contract holders) are reviewed annually for succession purposes and employees are now reviewed on a two yearly basis (industrial relations considerations).

5.2 – DOCUMENTS REVIEWED:

- HR database (SAP);
  - Staffing database;
  - Succession database;
  - Recruitment statistics;
  - Retirement forecasts;
- Long term planning scenarios.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

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APPENDIX IV - ISSUE SHEETS FROM SALTO MISSION IN 2015

1. ISSUE IDENTIFICATION	**Issue Number: A - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Organization and Functions, Configuration/Modification Management	
Issue Title: Lack of programme for sustainable management of ageing for LTO	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The plant does not have a programme in place for carrying out ageing management activities for the LTO period.

2.2 – IAEA BASIS:

SSR-2/2;
Requirement 14 - The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

SSR-2/2
4.53. The justification for long term operation shall be prepared on the basis of the results of a safety assessment, with due consideration of the ageing of structures, systems and components. The justification for long term operation shall utilize the results of periodic safety review and shall be submitted to the regulatory body, as required, for approval on the basis of an analysis of the ageing management programme, to ensure the safety of the plant throughout its extended operating lifetime.

SSR 2/2
4.50. The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components. The ageing management programme shall be coordinated with, and be consistent with, other relevant programmes, including the programme for periodic safety review. A systematic approach shall be taken to provide for the development, implementation and continuous improvement of ageing management programmes.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) In the current LTO programme, an element is missing on systematic periodic review and reassessment of AMPs efficiency. Furthermore, there is no periodic re-evaluation of the actual ageing management programme, which should be a continuous process with vital importance

throughout LTO.

F2) Even if the maintenance programmes have been properly evaluated for LTO, there is no evidence that a periodic evaluation will be performed in order to pursue ageing management throughout LTO.

F3) The LTO and implementation of currently ongoing projects in the area of E I&C are scheduled to be completed by 2016. There is no evidence that a periodic evaluation or systematic follow-up of AM and LTO matters will continue and will be in place after 2016.

F4) The new process for AMP (corporate and plant specific) may be positive but currently there is no formalized description as to how it will be implemented in near future between the corporate level (Tractebel, Laborelec, etc.) and the site.

F5) There is no evidence that a plant programme or organizational measures exist to address the AMP-methodology after the majority of LTO-projects within the LTO programme are finished 2016.

F6) There is a requirement by the regulatory body that ageing management of SSC has to be implemented on a permanent basis and regularly evaluated if the operation of the plant is extended.

3.2 – SAFETY CONSEQUENCE:

Without continuous management of ageing effect on SSCs, the plant safety can be challenged during LTO period.

3.3 – RECOMMENDATION/SUGGESTION:

R) The programme for LTO and AM related activities should be followed-up in a systematic manner to ensure that required safety functions of systems, structures and components are fulfilled over the plant's entire LTO period.

3.4 – DOCUMENTS REVIEWED:

- Organisation Fonctionelle du programme "Réalisation LTO" a Tihange, REF/OGZ/126; 07082014;
- Ageing Program; Policy Document, SAP DMS number10010230901 (Ver 01, 15/11/2014);
- LTO programme Organizational Chart.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

This issue sheet deals with the implementation of a completed and sustainable Ageing Management programme during the LTO-period, dealing with both physical and non-physical ageing.

In order to ensure safe and reliable operation during the LTO-period in compliance with the IAEA standards, and thus respecting the constraints in the FANC Strategic Note, a Policy document for Ageing Management applicable for NPPs in Long Term Operation has been

issued. This document describes the actions to be implemented to ensure effective ageing management, the roles and responsibilities of the different actors involved in the process.

The effectiveness of the policy is periodically analysed, corrective actions will be implemented when needed.

At the moment, the Engineering-Maintenance Organization on site is being reorganized. A detailed analysis is also performed at Corporate level. A gap analysis is performed with respect to the Ageing Management expectations, i.e. the Ageing Management Policy, and the current status of the organization.

The results of the analysis are being implemented: processes are being enhanced and clarified, the organization modelled for improved ageing management.

The current objective is to have the preliminary organization set-up and operational by the end of 2016.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) 'ZST.100106293334.000_00, Policy, Ageing Management Program for LTO Units, October 2016' was developed at corporate level. The objective of the document is to ensure that the ageing management philosophy will be properly taken over by line organization.

In accordance with this document, scoping and screening results will be continuously updated. The periodic update of AMR is not clearly described in the document. AMPs and TLAAs will be reviewed and updated every 5 years or in case of important operating experience. EQ will become a living process assuring continuous validity of qualification.

Plant programmes (maintenance, ISI, EQ, surveillance, chemistry) were checked against nine attributes. There is a plan to modify the structure of these programmes in accordance with nine attributes in 2017.

Obsolescence is also covered by the procedure by reference to knowledge management programme, proactive technological obsolescence programme (in development) and obsolescence of standards and regulations. PSR is not mentioned as a suitable tool for managing obsolescence of standards and regulations despite being used at the plant.

F2) 'ZST.100106293332_00, Procedure, Living AMPs & TLAAs watch & scoping – AMR review: AP Program, October 2016' is a corporate procedure describing scoping, AMR and TLAA living process. IGALL is used as an operating experience source to improve AMPs. Currently, it is stated in this document that only IGALL AMPs for passive SCs will be considered for the plant AMPs improvement. But it has already been decided that IGALL AMPs for active SCs will also be reviewed and considered.

AMR will be updated in case of changes in the scope of SSCs and as a result of condition assessment performed by system health engineers (components engineers are not established yet) in cooperation with AMP owners. In section Deliverables, updating of AMR is not required and described.

For TLAAs, international experience is monitored (e.g. IGALL) to identify missing TLAAs or

latest approaches in TLAA revalidation. General approach for future revalidation of TLAAs is not described in corporate documents, e.g. when to initiate further revalidation of TLAAs for Tihange 1 or when to initiate revalidation of TLAAs for other units.

F3) '10010656599, Programme for managing ageing specific for Tihange Units in LTO, 6 December 2016' (the first version approved on 16 November 2016) is a plant specific programme which is based on corporate level documents which were approved in October 2016. The main specificity of plant-specific programme is a definition of roles and responsibilities.

AMPs and TLAAs were already transferred from the LTO team to new owners in the Engineering Department in 2016 and thus new owners of AMPs are defined. Pilot training of the plant staff on 'Ageing Management' is in preparation with a pilot session planned in January 2017. The training session will cover all topics as described in corporate level documents on ageing management. A training plan for all staff involved in ageing management activities described above will be developed based on results of this pilot session in 2017.

F4) Proactive obsolescence programme is in development based on IGALL TOP401 programme. Draft of Technological obsolescence programme was developed in 2016. Identification of obsolete items is already performed for safety-related SSCs by Tractebel every three years. Inputs from ENUOG are also considered since June 2016 for identification of obsolete items. Prioritization of obsolete items is in progress with objective to have TOP 10 obsolete items identified in March 2017. Decisions for first solutions for the most critical obsolete items are expected to be decided in a second quarter of 2017.

5.2 – DOCUMENTS REVIEWED:

- ZST.100106293334.000_00, Policy, Ageing Management Program for LTO Units, October 2016;
- ZST.100106293332_00, Procedure, Living AMPs & TLAAs watch & scoping – AMR review: AP Program, October 2016;
- 10010656599, Programme for managing ageing specific for Tihange Units in LTO, 6 December 2016;
- Draft of Technological obsolescence programme, 20 July 2016.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: A - 2**
NPP: Tihange	**Unit: 1**

Reviewed Area: Organization and Functions, Configuration/Modification Management

Issue Title: Inadequate implementation of ageing management programmes

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

AMPs are not fully implemented in and addressed by the plant organization and responsibilities are not clearly defined in plant processes.

2.2 – IAEA BASIS:

NS-G-2.12

3.15. A systematic approach to managing ageing (see para 2.6) should be applied during plant operation. Application of a systematic approach to managing ageing will assist the operating organization in establishing an appropriate programme for ageing management of each specific structure or component.

3.16. Feedback of operating experience (both generic and plant specific operating experience, including operating experience from non-nuclear industrial plants) to learn from relevant ageing related events;

SRS No. 15

2.1. The closed loop of the generic ageing management process indicates the need for continuous improvement of an SSC specific AMP based on the current understanding of SSC ageing and on the results of self-assessments and peer reviews.

3. ASSESSMENT BY THE IAEA REVIEW TEAM

Date: 22/01/2015

F1) Results of AMR are recorded in AME, and AMP implementation started in 2012. However, the majority of latest versions of AMPs are still in draft version to this date.

F2) AMPs have a structure of generic (corporate) and/or specific plant AMP. Based on the issue from 2012, AMPs are being improved (9 attributes) but not completed.

F3) Many AM activities are performed as one-time actions within the LTO programme. Periodic activities are being implemented while the ownership of future performance is unclear.

F4) The SIMEO tool currently under preparation by the LTO programme for future implementation is not fully ready for operation. In June 2015, a final verification of data transferred from AMPs to SIMEO, i.e. one time inspections and routine periodic inspections, should be performed. But results of one-time inspections, evaluation of these inspection results and impact on further activities are mostly not available in the SIMEO tool yet.

F5) Requirements for routine performance of inspections of AMPs, evaluation of results and trends are described in an AMP procedure. However, responsibilities for the continued maintenance of AMPs in the LTO phase have not yet been defined.

F6) The plant document containing the AMP list is sufficient for creation of AMPs. However, there is no indication on the periodic revision of the AMP list (e.g. revised attributes).

F7) There is no relation established between the maintenance programmes and AMPs for mechanical components, thus there is no evidence of periodic AMP upgrades.

F8) The results from inspections and tests are reviewed by System Health Report (SHR) and/or Engineering Department which can also make an analysis on the ageing effects, and these analyses are included in ageing summaries. However, even if some corrective actions can be taken (repair, replacement) there is no feedback to the AMPs for improvement, no indicators of effectiveness and implementation estimation.

F9) The reference for EPRI secondary water chemistry guideline in the draft of generic AMP (M19) is not the latest revision. The draft site AMP has the latest revision.

F10) Preventive actions are defined but the conditions for their implementation have not been defined (e.g. draft AMPs M11, M31).

3.2 – SAFETY CONSEQUENCE:

Without the AMPs fully implemented and addressed, the plant would not be able to effectively manage ageing effects.

3.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider finalizing the implementation of AMPs in the plant organization and clearly defining responsibilities for the relevant activities in plant processes.

3.4 – DOCUMENTS REVIEWED:

- Civil Works – PSP S2: Concrete Containment Programme (draft version);
- 100010230901 version 02 dated 15/11/2014 Ageing programme;
- DTS/4NT/0131020/000/04 (draft version);
- DTS/4NT/0131020/001/00, AMP M11 "Ni alloy nozzles and penetrations" (draft version);
- DTS/4NT/0173987/000/02 (draft version);
- DTS/4NT/0173987/001/00, AMP M19 "Steam Generators tube integrity" (draft version).

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheets deals with the fact that the AMPs drafted to manage the ageing phenomena during the LTO period have not been fully implemented. The main concerns for this issue are:

- The re-drafting of the AMPs in accordance with the 9 IAEA attributes has to be finalized (generic and reactor AMPs);
- The organization managing the AMPs has to be implemented (roles and responsibilities, overview…) both on site and at Corporate level.

In order to respond to this issue sheet, the action plan (review of the AMPs and living AMPs process), initiated in 2013 due to the suggestion C-1 of the 2012 pre-SALTO mission, needs to be finalized. The main objectives of the action plan were:

- Re-drafting the AMPs in accordance with the 9 IAEA attributes;
- Clarification of the roles and responsibilities of Corporate and Site for the management of the Generic AMPs and the Reactor AMPs;
- Set-up of a database of AMPs concerned SSCs (part of living AMPs);
- Description of a model for keeping the AMPS up to date (living AMPs) at Corporate level (Generic AMPs) and at Site Level (Reactor AMPs).

The reviewing of the AMPs, the clarification of the process and the set-up of the AMPs database have been finalized at the end of 2015. The AMPs are "officialized", and handed over to the operational organizations (Nuclear Assets and Projects Department on Corporate and Engineering Department on site). A formal handover has been performed with the new AMP-owners, roles and responsibilities have been clarified.

As the handover has been finalized, the operational organizations are in charge of the "Living AMP process".

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) A first step of the resolution of this issue was to finalize generic and plant-specific AMPs. Example of ‘10010475574, part 000, AMP M18, Bolting Integrity, 06/2014’ contains description in a format of nine attributes. Example of unit-specific AMPs ‘10010475574, part 011, Application Tihange 1 AMP M18, Bolting Integrity, 12/2015’ has also the structure of nine attributes. All AMPs were developed in 2015 in the same format of generic and plant-specific AMP by LTO team.

F2) Transfer of AMPs to the Engineering Department was done in the beginning of 2016. Owners of each AMP are described in ‘10010625001, Engineering organization for the LTO AMPs of Tihange 1, June 2016’. It includes also a list of responsibilities of each AMP owner in connection with AMP performance.

F3) ‘ZST.100106293332_00, Procedure, Living AMPs & TLAAs watch & scoping – AMR review: AP Program, October 2016’ provides guidance on development of plant-specific AMPs in section 8.1.3. It requires the same structure of generic and plant-specific AMPs but it does not provide guidance on how to refer from plant-specific AMP to generic AMP, e.g. if information remains the same - copy the text from generic AMP or refer to generic AMP; if information changes - copy the text from generic AMP and modify it or only write modified parts.

F4) Results of some AMPs are recorded in System Health Reports (SHR), other within SIMEO tool and other within inspection report system in SAP. Format of the report and place for archiving is not prescribed in AMPs.

F5) '10010475577, part 000, AMP M19, Steam Generator Tube Integrity, 11/2015' and '10010475577, part 011, Application Tihange 1 AMP M19: Steam Generator Tube Integrity, 12/2015' were reviewed as another example. AMP result reports are developed after each campaign. Reports are archived in SAP.

F6) '100104475690, part 011, Application Tihange 1 AMP S2: Concrete Containment Programme, 12/2015' was also reviewed. Reports of results are created and saved as a part of inspection programme in SAP or SIMEO database.

F7) '100104475555, part 011, AMP M10 Boric Acid Corrosion, 12/2015' was also reviewed. Reports of results are created and saved as a part of SHR in SAP.

5.2 – DOCUMENTS REVIEWED:

- 10010475574, part 000, AMP M18, Bolting Integrity, 06/2014;
- 10010475574, part 011, Application Tihange 1 AMP M18, Bolting Integrity, 12/2015;
- 10010625001, Engineering organization for the LTO AMPs of Tihange 1, June 2016;
- ZST.100106293332_00, Procedure, Living AMPs & TLAAs watch & scoping – AMR review: AP Program, October 2016;
- 10010475577, part 000, AMP M19, Steam Generator Tube Integrity, 11/2015;
- 10010475577, part 011, Application Tihange 1 AMP M19: Steam Generator Tube Integrity, 12/2015;
- 100104475690, part 011, Application Tihange 1 AMP S2: Concrete Containment Programme, 12/2015;
- 100104475555, part 011, AMP M10 Boric Acid Corrosion, 12/2015.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Scoping and screening and plant programmes relevant to LTO	
Issue Title: Lack of comprehensive evaluation of active mechanical components	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The process for evaluating preventive and predictive maintenance programmes for active mechanical components is not comprehensive.

2.2 – IAEA BASIS:

SSR-2/2

4.54: The comprehensive programme for long term operation shall address [...] review of ageing management programmes in accordance with national regulations.

NS-G-2/12

6.2. The in-depth review of ageing management should ensure that plant programmes and practices that will be used to support the management of ageing effects during long term operation are reviewed [...].

SRS No. 57

3.3.1. Maintenance programmes are reviewed and evaluated for effectiveness in maintaining the intended function of each SSC within the scope of LTO. The review provides a technical basis that demonstrates whether the degradation mechanisms will be adequately managed by the proposed activities.

3. ASSESSMENT BY THE IAEA REVIEW TEAM

Date: 22/01/2015

3.1 – FACTS:

F1) The Strategic Note, issued by the FANC stipulates that "the result of the LTO ageing approach has to be a comprehensive and systematic programme for monitoring and managing ageing of the plant active and passive systems, structures and components".

F2) The policy document that describes the methodology used in the plant, states that the evaluation for active components is to be done in interraction between LTO processes and the RCM process, operationg experience, maintenance, etc.

F3) The plant has reviewed is preventive and predictive maintenance programmes for active mechanical components using the RCM (reliability-centred maintenance) methodology. The RCM process handles critical and non-critical components differently. The plant AME guideline for active mechanical components does not provide detailed guidance for effectiveness review of actions implemented on monitoring and managing ageing of critical and non-critical components.

F4) Evaluation tasks still to be addressed by the RCM team have been detected in several

active mechanical AME reports, such as CAE, CAU and CIS.

F5) The memorandum of understanding between the LTO project team and the RCM team does not include information on AME evaluations to be done by the RCM team.

F6) The process used by the RCM team to manage requirements coming from other entities only includes changes to maintenance programme and does not include evaluation tasks.

3.2 – SAFETY CONSEQUENCE:

Without comprehensive evaluation of maintenance programmes, it is not possible to prove that ageing effects will be completely managed.

3.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider reviewing its process for evaluating preventive and predictive maintenance programmes for active mechanical components.

3.4 – DOCUMENTS REVIEWED:

- LTO-ageing: Specific methodology Doel 1 & 2 and Tihange 1, SAP number 10010201211 v0.2;
- LTO-ageing: Guideline specific AME active mechanical components, SAP number 10010198608 v04;
- Memorandum of understanding between LTO project and RCM-project PC-06 (lettre de mission);
- Active mechanical AME for CAE, CAU and CIS systems.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

This issue sheet deals with the non-exhaustive integration of all available operating experience into the RCM analysis and the potential consequences on system availability.

It was pointed out that the RCM analysis, used to define the maintenance policy of components, used the operating experience existing up to the year of analysis (between 2006 and 2012). The AME analysis performed during the LTO study phase used the information available between 2004 and 2010.

This means that significant operating experience used for the AME analysis may not have been taken into consideration during the RCM analysis and maintenance activities justification.

An analysis has been performed to identify operating experience used during the LTO analysis and to ensure that it has been taken into consideration in the RCM exercise. Identified gaps (operating experience not taken into consideration) have led to a review of the maintenance activities (type of maintenance and frequency).

The result of this exercise was that only 3 additional actions were needed to be integrated in the periodic maintenance and surveillance activities.

As a result, not only the concerned maintenance plans will be updated, but also the operating experience taken into consideration covers a larger time span.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The plant defined a methodology in 2015 (10010606149/000/00), to check gaps between the LTO and RCM approaches. As gaps identified in the AMEs are related to MPFF (maintenance preventable functional failure), the plant decided to check the corrective maintenance work orders considered in the active AME documents, in comparison with the corrective maintenance work orders considered by RCM.

F2) As a result of action in F1, preventive and predictive maintenance programmes for active mechanical components have been reevaluated. 3 corrective actions have been identified in LUDIKS (Action Management System) and are now resolved. They were related to packing box leakage management, spray pumps lubricating system leakage management, vibration monitoring of a ventilator.

F3) The process for evaluating preventive and predictive maintenance programmes for active mechanical components is performed by SHR evaluation by ESH service (Engineering System Health) Engineers (10001487897/000/05). Each system is reviewed every 3 months and the conclusions are approved in the SHR Committee.

F4) The I-FIAB software is used by SHR Engineers and AMPs owners. This system is used in order to collect and share information (for instance living information from SAP system) used for SHR and AMPs analysis.

5.2 – DOCUMENTS REVIEWED:

- 10010606149/000/00, Intégration des analyses AME dans RCM, 23/08/2016;
- 10010537311/000/00, MAINT/STR/069 Gestion du Cycle de vie des PMP, 24/06/2015;
- 10001487897/000/05, Processus SHR à la CNT GDI/SHR/008, 29/12/2014.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B - 2**
NPP: Tihange	**Unit: 1**

Reviewed Area: Scoping and screening and plant programmes relevant to LTO

Issue Title: Unclear demonstration of mechanical equipment qualification

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The demonstration that mechanical equipment qualification will remain valid over the LTO period is not clear.

2.2 – IAEA BASIS:

SSR-2/2

§ 4.48: Appropriate concepts and the scope and process of equipment qualification shall be established, and effective and practicable methods shall be used to upgrade and preserve equipment qualification. A programme to establish, to confirm and to maintain required equipment qualification shall be launched from the initial phases of design, supply and installation of the equipment. The effectiveness of equipment qualification programmes shall be periodically reviewed.

SRS No. 57

§ 3.3.2: Equipment qualification also demonstrates whether the environmental and seismic qualification of equipment will remain valid over the expected period of LTO. The demonstration supports the technical justification that the material degradation and ageing effects will be managed effectively.

3. ASSESSMENT BY THE IAEA REVIEW TEAM

Date: 22/01/2015

3.1 – FACTS:

F1) The active mechanical equipment qualification for the LTO period has been addressed as part of the LTO precondition study. The specific report (LTO preconditions, Equipment qualification in the plant) states that the qualification assessment the LTO period partly relies on AMEs (ageing management evaluations) to be carried out.

F2) The policy document (LTO-ageing: Specific methodology Doel 1 & 2 and Tihange 1) that describes the methodology used in the plant for LTO assessment does not stipulate that the mecanical equipment qualification has to remain valid over the LTO period.

F3) For mechanical equipment installed during commissioning, qualification data can be found in the archives of the construction period. For mechanical equipment modified since the first 10-year outage in 1987, qualification data is documented in modification package reports. A stand-alone set of documents similar to RSQs (qualification synthesis reports), meeting E-I&C equipment qualification requirements, does not exist for mechanical equipment. It is

difficult to have an overview of the documentation status and of the equipment status.

F4) An equipment qualification assessment is in the study phase as part of the PSR2-SF3 project. The 1st outcome of the PSR2-SF3 assessment (PSR2 SF3 Equipment qualification assessment report for the plant) proposes the implementation of RSQs for active mechanical equipment. The plant is considering issuing RSQs for active mechanical components as part of the PSR action plan which has to be completed by 2020.

3.2 – SAFETY CONSEQUENCE:

Without a clear demonstration that mechanical equipment qualification will remain valid over the LTO period, the correct functioning of equipment (i.e. the correct execution of the intended function during adverse conditions) cannot be fully guaranteed during the LTO period.

3.3 – RECOMMENDATION/SUGGESTION:

R) The plant should clarify the process to demonstrate that mechanical equipment qualification will remain valid over the LTO period.

3.4 – DOCUMENTS REVIEWED:

- LTO preconditions, Equipment qualification in Tihange 1, reference NT/LTO/ENGT/PRE/103 v0;
- LTO-ageing: Specific methodology Doel 1 & 2 and Tihange 1, SAP number 10010201211 v0.2;
- PSR2 SF3 Equipment qualification assessment report for Tihange 1, doc n° 10010252272/000/01 18/12/2014.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheet B-2 deals with the preserving of the EQ of active mechanical components during the period of LTO and more specifically with the way this is demonstrated through process descriptions, procedures and instructions being applied, and EQ documentation. Certainly not in a way this can be shown for EI&C components by RSQ.

Additionally, the EQ upgrade was fully included in the specific Ageing Management Evaluation approach in the EI&C domain for both active and passive components, as this distinction is not relevant in the EI&C RSQ approach, whereas the dimension of EQ was not included in the Ageing Management Evaluation approach in the mechanical domain, as it was considered to be sufficiently covered as subject of the assessment associated with "LTO Precondition : EQ Plant Program".

Following on this SALTO-issue, the IAEA-documents referenced for EQ, were analyzed for a better understanding of the IAEA essentials and the context of the issue. A fit/gap analysis between these expectations and, on the one hand the applied LTO Ageing Methodology and on the other hand the CNT Plant Program Practices, has led to the finding of some potential gaps with the EQ process phase "Preserving EQ of active mechanical components", as defined

by the IAEA.

Firstly, the methodology for specific AME of active mechanical components, based on a RCM based maintenance programme verification, do not consider the potential performance of mechanical components under harsh service conditions due to the occurrence of a PIE (Postulated Initiating Event). Secondly, it should admitted that the EQ Plant Program for active mechanical components as described in the LTO Preconditions assessment report, cannot easily be shown in a convincing way, due to the fragmentation of the knowledge of this programme across organization's entities and persons, and of the EQ documentation.

An action plan to resolve these gaps is proposed. This plan is twofold and proposes two categories of actions connected with:

1. Extension of the LTO Ageing methodology for active mechanical equipment;
2. Enhancement of plant program activities sustaining the EQ process, and to consider as in a scope of the 4th PSR SF-1 and SF-3:

It should be emphasized that the issue has been mainly interpreted as follows:

- Mechanical equipment is read as active mechanical equipment or component. We consider this issue as irrelevant for passive mechanical components. The components and the items of these components ensuring the pressure retaining boundary function are not in scope of this evaluation. Most parts are metallic and not susceptible to harsh service conditions, or is related with sealing, what should be covered by adequate maintenance program.
- A clarification on how the EQ of active mechanical components is managed need to be available to demonstrate that the required level of qualification can be guaranteed during the LTO period.
- A comprehensive overview of the EQ process across the different CNT business processes cannot be shown.
- Mechanical equipment qualification should be read as functional equipment qualification.
- Mechanically connected structures e.g. silent blocks for the Diesel, important for the performance of the active component, are submitted within the domain Structures to an AME. Consequently these are out of scope for this evaluation.

In order to respond to the issue, an additional scoping of concerned SSC's has been performed. The drafting of the EQF of the concerned active mechanical components is on-going and should be finalized by June 2016. As the EQF are validated, the verification of the exhaustivity of the required maintenance programs is also established.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The plant has defined a methodology to demonstrate that mechanical equipment qualification will remain valid over the LTO period. This methodology is based on SRS-03

definitions. The objective is to ensure that the mechanical active components will be able to fulfil their safety function under harsh conditions.

F2) A specific scoping as been done, taking into account mechanical active components that are activated:

- By electricity, pressurized air or hydraulics (information is coming from electrical Q List);
- By a fluid (safety valves, non-return valves);
- Manually during harsh condition (post-accident liquid sampling system).

P&ID has been used to support scoping.

F3) The methodology includes equipment conditions, a review of events encountered by mechanical active components has been done to ensure none of them experienced a harsh service condition in the past.

F4) The plant has performed a screening in order to detect vulnerable items (polymers, grease), during the LTO period.

Current status: all active mechanical components have been addressed.

F5) The EQ Review process is currently ongoing. EQ files have been issued for all the pumps. The other equipment (valves ...) are planned to be addressed in January 2017.

F6) The plant intention is to address conclusions of the evaluation with the methodology actually existing for electrical components.

5.2 – DOCUMENTS REVIEWED:

- 10010552219/NOTE T1-15/024 S01, EQ of active Mechanical Components Methodologie, 31/03/2016;
- 10010656642/000/00, Liste des composants avec EQ review (report of scoping and screening);
- CNT-KCD/4NT/0030634/001/00, PSRII CNT1-EQF of active mechanical components-049-013-0016 Pompes d'aspersion directe P01Ba, 28/09/2016;
- CNT-KCD/4NT/0030633/001/00, PSRII CNT1-EQF of active mechanical components-049-010-001 Pompes ISHP, 02/12/2016;
- CNT-KCD/4NT/0030672/001/00, PSRII CNT1-EQF of active mechanical components-046-013-001 Pompes SALMSON 100-250-C3 circulation de la piscine de désactivation, 14/12/2016;
- 10010651900/000/S00, Procedure d'organisation EQO (engineering qualification obsolescence) REF/OGZ/133, 21/11/2016;
- 10010256019/000/S02, Methodologie pour la rédaction des notes de recommendation RSQ, 31/03/2015.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	

2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: C - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for mechanical components	
Issue Title: Lack of completeness for the ageing management programmes	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The time span of operating experience and the range of references used are not sufficiently comprehensive for AMR.

2.2 – IAEA BASIS:

GS-R-3

6.16. Potential non-conformances that could detract from the organization's performance shall be identified. This shall be done: by using feedback from other organizations, both internal and external; through the use of technical advances and research; through the sharing of knowledge and experience; and through the use of techniques that identify best practices.

NS-G 2.12

2.7. Understanding the ageing of a structure or component is the key to its effective ageing management. This understanding is derived from knowledge of:

- The design and fabrication (including the material, material properties, specific service conditions, manufacturing inspection/examination and testing);
- Equipment qualification (where applicable);
- Operation and maintenance history (including commissioning, repair, modification and surveillance);
- Generic and plant specific operating experience.

SRS No.15

3.3.1. Maintaining a living programme. During the service life of a nuclear power plant, there is a need to provide for continuous improvement of the AMP. It is prudent to periodically

update ageing evaluations;

SRS No.57

Section 2. In a broader sense, plant surveillance, inspection and maintenance programmes, and consideration of feedback on operating experience, play an essential role in ensuring the safe operation of nuclear power plants in the current design period as well as in LTO.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) Unlike the other departments, the LTO department is not formally part of the Operational Experience (REX) process, is not represented on the REX committee and relies on getting information via other departments and other documents. This method is not fully effective; for example, plant LTO engineers were not aware of some recent international accidents or incidents relevant to LTO.

F2) Although some exchange of experience may have taken place during the study phase and although the plant has access to EdF experience through their on-site interface, there has been no significant experience sharing/exchange with other organisations/countries undertaking LTO in the implementation phase.

F3) The plant policy document states that potential ageing mechanisms are limited to those listed in US documents. The AMR flowchart in the AME passive mechanical components guideline is incomplete ("stop", when ageing is not in NUREG or EPRI documents). However, the AME reports for Essential Raw Water system (CEB) and Reactor Coolant system (CRP) address other ageing effects based on plant experience and case-by-case analysis.

F4) The AME guideline for the active mechanical document states that failures (corrective maintenance) occurred during the 5 last years will be checked. The AME guideline for passive components states that the condition assessment process will address the operating and maintenance history of the 5 last years. The AME reports for passive mechanical components (CEB and CRP) cover a longer period, but only from 01/01/2004 to 30/06/2010. Moreover, the AME reports for CEB and CRP written in October 2012 have not been updated since.

F5) The appendix 3 of plant guideline on ageing for passive mechanical components does not mention all inputs (e.g. fiches d'expérience - experience sheets, experience from knowledgeable staff in other departments) taken into account for condition assessment.

F6) The draft generic AMP M19 (steam generator tube integrity) does not address comprehensive operating experience, especially international one (San Onofre, Cruas), even if some OPEX sheets and ageing summaries exist. For example, SG tubes NDE for detecting tube support plates (TSP) clogging is currently being developed by the plant but it is not mentioned in this AMP.

The draft site AMP M19 addresses operating time only until March 2010.

F7) The plant used GALL report rev. 1 (2005) for its LTO project. Some items from AMR for SG in GALL report rev. 2 (2010) are not currently managed (tube plugs, tube-to-tubesheet

welds).

F8) Draft generic and the plant AMPs M1 (ASME XI ISI) are based on ASME code edition 1992. In spite of the comparison with more recent editions by the plant, these draft AMPs indicate that the code edition to be used for the next interval, beginning this year and ending in 2024, is still unknown (a specific working group not related to the 4th PSR and LTO has been set up pending the corporate decision for all fleet units).

F9) The plant intends to use IGALL as reference; no consistency analysis had been performed so far by the plant. This mention of IGALL AMPs is just for information in the draft plant AMPs, pending a future corporate decision.

3.2 – SAFETY CONSEQUENCE:

Without formally addressing all relevant information relating to ageing management review, potential ageing effects cannot be adequately managed.

3.3 – RECOMMENDATION/SUGGESTION:

R) The plant should extend the time span of operating experience and the range of references used for AMR.

3.4 – DOCUMENTS REVIEWED:

- LTO ageing: specific methodology Doel 1&2 and Tihange 1 – SAP number: 10010201211 v0.2;
- DTS/4NT/0139629/000/05, LTO-ageing – Mechanical – Doel 1&2 – Tihange 1: Guideline AME passive mechanical;
- SAP number 10010198608 version 04, LTO-ageing: Guideline specific Ageing Management Evaluation of Active Mechanical components;
- NT/LTO/AGEING/MEC/004 version 01 Engineering document témoin- LTO ageing - AME - Passive - Mechanical - Tihange 1: CEB;
- NT/LTO/AGEING/MEC/013 version 01 LTO ageing - AME - Passive - Mechanical - Tihange 1: CRP;
- SAP number 10010235189 version 01, LTO ageing – Doel 1&2 – Tihange 1: List of standardized AMPs (including the AMP organization);
- DTS/4NT/0152730/000/05 and DTS/4NT/0152730/000/00, Draft generic and site application AMPs M1: ASME Section XI Inservice inspection, subsections IWB, IWC and IWD;
- DTS/4NT/0131020/000/04 and DTS/4NT/0131020/001/00, Draft generic and site application AMPs M11: Nickel-Alloy nozzles and penetrations;
- DTS/4NT/0173987/000/02 and DTS/4NT/0173987/001/00, Draft generic and site application AMPs M19: Steam generator tube integrity;
- DTS/4NT/0152154/000/01 and DTS/4NT/0152154/001/00, Draft generic and site application AMPs M31: Reactor vessel surveillance;
- DTR/DC1/4NT/82723/000/02, A3: Evolution du code ASME-OM : comparaison entre

les versions 1992/2001 + propositions de modification du programme actuel
- CNT-KCD/4NT/8108/043/01, Ageing summary 043: Steam generators' tube support plates clogging;
- SAP number 100010230901, version 02, Ageing programme.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

This issue sheet deals with the risk of insufficient integration of Operating Experience in the Ageing Management Programmes, leading to a potential incomplete follow-up of Ageing Management issues.

The main concerns to be addressed are:

- Finalize the AMPs redrafting , taking into consideration all relevant Operating Experience for the concerned AMPs;
- Set up the "living AMP" process in such way that relevant Operating Experience is taken into consideration for reviewing the AMPs.

As indicated in the action plan for issue sheet A-1, the redrafting of all the AMPs for the LTO period started in 2013 as a result of the issue sheet C-1 of the 2012 pre-SALTO mission.

During this review, not only the 9 attributes have been addressed, but the AMPs (both generic and reactor) have been updated taking into consideration all available information (Scope extensions, new ageing phenomena and Operating Experience).

For the area of Operating Experience, a cross- check has been performed with the existing databases in order to confirm that existing information had been analyzed and integrated when required.

At the moment, the AMPs have been handed over to the operational organizations, who will keep the documents live during the LTO period. Formally, the review of AMPs due to the new Operating Experience is formalized on Corporate and on site level. It has been decided to implement progressively the IGALL AMPs for the units. The analysis and the potential review of the concerned AMPs will be performed by the new organizations in charge of the "Living AMPs".

Finally, these operational organizations are formally integrated in the Operating Experience process.

The complete roll-out of these actions is currently finalized. The follow-up of occurrences will prove the effectiveness of implemented programmes, and the correct integration of existing Operating Experience.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The plant has made a review of OE events from 1975 to 2015. 89 events have been collected by Laborelec (10010594244/000/00). These events are documented in a specific

data base with an evaluation of their impact on ageing:

- 28 are out of the component scope;
- 24 are in control in regard of the current AMP;
- 2 are under analysis in Laborelec.

The others OE events are not related to ageing. But there is no formalized document to drawa conclusion for this analysis.

F2) The plant decided to transfer the ownership of AMPs from the LTO Department to the Engineering Department since the beginning of 2016. (10010625001/000/S.01). The connection of OE events into the AMP is described in this document. An owner is designated in the Engineering Department for each AMP, but for AMP M2 (water chemistry), the owner belongs to the Chemical Department. The AMP owner is in charge of integrating OE into the AMPs.

F3) The manager of the SHR department is in charge of collecting the required OE information from the OE Tihange Committee, in order to provide it to the AMPs owners. (10010654036/000/S00)

F4) ROE actions are managed in the general management action list (LUDIKS), monitored by the management of the plant. Priorities are decided in the SHR monthly Committee meeting.

F5) The range of references needed in AMPs has been decided at the corporate level. For instance, it has been decided to use IGALL 2014 as a reference. For pump and valve testing, ASME OM version 2004 with addendum 2006 is used, ASME XI 2007 is used with addendum 2008 (CNT-KCD/4NT/24398/000/00). Vessel embrittlement NES ASTM E900-15 and ASTM E1921/97 (CNT-KCD/4NT/0008108/011/07).

F6) Tractebel and Laborelec representative participate in international groups in order to update the knowledge of international events and research programs. For instance, they participate in PWROG, FROG, IASCC Research Program, PLIM-PLEX, EPRI. These representatives are involved in generic AMPs elaboration. (CNT-KCD/4NT/24398/000/00).

F7) An analysis of the gaps between IGALL and the AMPs developed at the corporate level has been established. As a conclusion, 13 AMPs have to be created, 6 AMPs need major modification and 13 need minor modifications. An action plan is developed to address this till 2019. (IGALL application for AMR/AMP/TLAA for Doel 1-2 and Tihange 1 LTO). The impacts with maintenance programs and RSQ used in the plant are identified.

5.2 – DOCUMENTS REVIEWED:

- 10010594244/000/00, Project Ageing, P80/S80 – PLIM 2015 – List of failure analyses performed by Laborelec for Doel and Tihange, 15 Feb 2015;
- 10010625001/000/S.01, Organisation mise en place par ENG pour accueillir les AMPs développées dans le cadre du LTO de CNT1, 18/11/2016;
- 10010654036/000/S00, Ageing Management Program spécifique pour les Unités de CNT en LTO, 28/11/2016;
- CNT-KCD/4NT/24398/000/00, Evaluation of IGALL application for AMR/AMP/TLAA for Doel 1-2 and Tihange 1 LTO, 23/11/2016;

– 10010655768.000.00, Evaluation of IGALL application for AMR/AMP/TLAA for Doel 1-2 and Tihange 1 LTO, 02/12/2016; – IGALL application for AMR/AMP/TLAA for Doel 1-2 and Tihange 1 LTO, 02.12.2016.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses	
Issue Title: Insufficient preservation of 1E cable-system qualification and functionality during LTO	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

There are no planned periodic and documented condition visual inspections and tests during the LTO period aiming at preserving cable system qualification and functionality (cables, cable trays and connections).

2.2 – IAEA BASIS:

NS-G-2.6

8.1. Structures, systems and components important to safety should be included in the preventive maintenance programme. The operating organization should review the programme as appropriate in order to ensure that items important to safety have been properly identified and classified, and that the applicable requirements of the regulatory body have been met. For further guidance on the classification of SSCs in accordance with their importance to safety, see Refs [6, 10].

8.4. Preventive maintenance should be of such a frequency and extent as to ensure that the levels of reliability and functionality of the plant's SSCs important to safety remain in accordance with the design assumptions and intent. It should also ensure that the safety status of the plant has not been adversely affected since the commencement of operation. In establishing the frequency and extent of preventive maintenance, the following aspects should be considered:

– the importance of SSCs to safety;
– designers' and vendors' recommendations;
– relevant experience available;
– results of condition monitoring;
– the probability of failure to function properly;
– on-line maintenance;
– the necessity of maintaining radiation doses as low as reasonably achievable.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) Crimp connections covered with a shrinking tube:
Inside the containment, connections from cables to pigtails at the penetration feedthrough are performed with crimps. After 40 years of operation, there is a risk of corrosion between the wire and crimp contact. This corrosion has a negative effect on I&C channels. Furthermore, self-heating could impact power connections (examples: RTD, TC, transmitter channel, pressuriser heater, motors, energised SOV, etc.)
The plant has established no diagnostic method to detect such contact issue for the class 1EA equipment inside the containment.

F2) After outage, the plant does not have a documented visual inspection programme in place in the containment, annulus and turbine-hall, using checklists for potential hotspot impact on electrical-equipment, cable trays and ducts.

F3) The plant has no general periodic visual inspection programme using checklists for cables inside trays outside the containment.

F4) The plant has established no periodic inspection plan and programme for cable tray structures, anchorages in the concrete and conditions of grounding connections and covers.

F5) Behind the control room: a grounding connection screw was poorly tightened in a cabinet. In case of voltage grounding, this could have a negative impact on personnel safety and protection device.

F6) Behind the control room: at 2 locations, a cable bent over an unprotected sharp edge of the cable tray. During a seismic event, the cable jackets could be damaged.

3.2 – SAFETY CONSEQUENCE:

Without 1E cable system functionality and qualification, a safety system functionality (1E) cannot be guaranteed.

3.3 – RECOMMENDATION/SUGGESTION:

S) Consideration should be given to establishing a periodic, preventive condition inspection

and test programme for cables, cable trays and its connections in the 1E cable system.

3.4 – DOCUMENTS REVIEWED:

- Maintenance responsibilities MAINT/00/065 29.11 2013;
- Cable tray condition and actions TIS1/4NT70308355/001/00 12.05.2014;
- Terminal box anchorages P.00583.1011-CNT1 07.04.2014;
- Results of a structure basic inspection by the plant TIS1/4NT/0319707/000/00, 13.06 2013;
- Condition of screwed connections NT/LTO-T1/EIC/27.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The issue sheet deals with the periodical validation of the boundary conditions for the validity of the AMPs in the E I&C area.

In order to define the precise corrective actions, an inventory of the periodical inspections has been established. This inventory has been compared to the periodical inspections to be implemented in order to maintain the validity of the AMPs. When specific direct surveillance or inspection methods were not available, alternative methods based on national and international practices have been developed.

At this moment, the inventories of existing inspection and surveillances have been established, as well as the inventory of required inspections and surveillance to maintain the validity of the AMPs boundary conditions. A gap analysis has been performed. Currently, the procedures of the missing inspections are being established, the required periodical maintenance plans are being drawn up.

The finalization of the action plan is scheduled for the end of 2016. The implementation will be immediately effective and will be performed by the operational organizations (Engineering as the AMP-owner and Maintenance as the department in charge of the execution of the AMP).

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The CMP (Cable Management Programme) strategy for LTO is described in the document NO/ENG/35/2016/CMP: The CMP takes an inventory of the different families of cables in the harshest environments. The objective is to ensure periodic follow-up to detect possible degradation related to a family. Based on the results of inspections, if necessary engineering defines an action plan.

F2) The document DTS/4NT/0284330/000/00 presents the strategy for cable qualification for LTO.

F3) The AMR for cables led to an extension life process for several types of cables depending on the material and depending on the original qualification content as explained in the

document DTS/4NT/0284330/000/00.

F4) This process of cable requalification led to either requalification itself or replacement of cables that could not be requalified: so as an example the document DTS/4NT-309170/001 is the formalisation of a part of the cables that could be requalified. Another one is the document CNT-KCD/4NT/0012532/000/03 for another type of cables.

F5) The cables are also inspected and/or tested depending on the type and the function: for example, the document LBE02904946-4.0 contains an inspection sheet that shows what to inspect and what to record during inspection.

F6) A specific inspection procedure (583352/SM/001) has been written in order to check the correct installation of heat insulation (inappropriate installation can lead to hotspots accelerating ageing phenomena of the cables).

F7) This procedure 111000/SM/002 dedicated to metallic structures which includes cable trays inspection has already been validated (through SAP application that is in force in Tihange) and implemented on site as it could be seen on an inspection document that this one had been filed and signed.

F8) The procedure related to metallic structures inspection (111000/SM/002) have been modified taking into account the 3 following points:

- Conditions of grounding;
- Absence of sharp edge next to the cables;
- Cable trays not used neither as access ladder nor scaffoldings.

F9) The updated procedure have been validated in the SAP system which is the documentation saving system in force in Tihange NPP

F10) A campaign of verification of the grounding connection of the doors of the electrical cabinets has been launched (for example: EI-17 DM L1/14/29).

F11) The perimeter of grounding verification is the following one:

- Instrumentation room (E703);
- Control Room (E701);
- Relay rooms;
- All the modifications related to stop 2015 and AT 2016;
- During visual inspection of 6 KV and 380V switchgears.

F12) The verification of effectiveness of crimp connections has been launched as stated in document (for example: 642302/EF/628).This verification is based on the test of the resistance/ reflectometry of these connections with a specific procedure as described in the same document. These tests are related to both type SMOE and Grayboot connections.

F13) This verification is related to a sample of 25 elements for every type of connection and 1/3 of this sample is tested at every cycle (cycles of 18 months); this sampling is consistent with IAEA IGALL AMP 206.

F14) If the connection is considered as "with defect" (quantified criteria), then the measurements are extended to the next cycle percentage (anticipation of following test, and so one more if needed)

F15) 1/3 of connections of Grayboots type sample and 1/3 of connections of SMOE type sample have already been tested and no defects have been found.

F16) The data of these tests have been recorded in the "SIMEO" application on site and this information can be checked on "SIMEO" application on site; SIMEO software is used in Tihange 1 and developed by Electrabel Corporate as an Ageing Management data base for trending results.

5.2 – DOCUMENTS REVIEWED:

- 583352/SM/001, SALTO Inspection des calorifuges à proximité des câbles;
- NT/LTO-T1/GC/struct-01, LTO-T1 : projet struct-01- Note de synthèse – Pérennisation structures mécaniques;
- 111000/SM/002, inspection des structures métalliques selon AMP S6;
- EI-17 DM L1/14/29, inspection report - vérification serrage des connexions des tresses de masse des portes en salles de commande Ti1, 3/6/16;
- 643202/EF/628, Détection de défaut par mesure de résistance et réflectrometrie sur les connexions et les câbles de la chaine de contrôle-commande;
- NO/ENG/35/2016/CMP, Cable Management Program : note d'organisation du CMP à la CNT;
- DTS/4NT/0284330/000/00: AS8, 13, 116, note de stratégie de qualification des câbles;
- DTS/4NT-309170/001, qualification des câbles Charleroi 1ère génération;
- CNT-KCD/4NT/0012532/000/03, RSQ 352.00, Qualification 1E Equipement Electr et Instrumentation (niveau 1EB + 1RR);
- IGALL AMP 206, electrical cable connections not subject to environmental qualification requirements,
- LBE02904946-4.0, Procédure CMP : fiche d'inspection local.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: E - 1**
NPP: Tihange	**Unit:1**
Reviewed Area: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures	
Issue Title: The plant approach to confirmation of containment integrity	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

The current approach to the testing of containment structural integrity is not fully consistent with IAEA Safety Standards.

2.2 – IAEA BASIS:

NS-G-1.10

Structural integrity tests
5.19. Periodic structural tests should be conducted to demonstrate that the containment structure continues to perform as intended in the design. The test pressure should be the same as in the pre-operational test and as required by the applicable design codes. In the design, attention should be paid to the additional stresses imposed by the tests, and margins should be included to prevent the tests from causing any degradation of the containment structure. A leak test should be performed during any structural integrity test. …

3. ASSESSMENT BY THE IAEA REVIEW TEAM

Date: 22/01/2015

3.1 – FACTS:

F1) All the containment pre-stressing tendons are grouted and cannot be directly inspected for corrosion or loss of pre-stress.

F2) Loss of pre-stress in the primary containment is addressed in a Time Limited Ageing Analysis (TLAA). The TLAA report has been prepared based on recommendations of Eurocode-2 and USNRC regulatory guide RG-1.90. Rev-1. The regulatory guide provides two acceptable alternative methods inspecting containment structures with grouted tendons (1) an inservice inspection programme based on monitoring the prestress level by means of instrumentation, and (2) an inservice inspection programme based on pressure testing the containment structure. The plant has opted for approach (1).

F3) Testing frequency at the plant is 10 years. This meets the requirement of RG-1.90 for Alternative A which is the case for the plant containment.

F4) The containment is currently tested for leakage at 0.5 times P_A for demonstrating containment leak tightness, based on the conclusion of 1985 working group comprising plant, regulator and Tractebel staff.

F5) The plant will conduct a leak tightness test at 0.5 times P_A in 2016. The plant will use this opportunity to verify the functionality of the containment instrumentation, which will be used to support approach (1) described above.

F6) The containment has been tested at 1.15 times the design basis accident pressure prior to plant commissioning. Over time, there is a loss of force in the pre-stressed tendons, which is monitored to confirm the extent of the theoretical loss of prestress.

F7) The plant submitted that this approach has been analysed by a team with regulatory participation. This approach has been agreed and confirmed by the regulator.

F8) In the year 2010, gallery of reactor building was inspected. The following was observed:

- The report indicates that there is Calcium Hydroxide leaching on the roof and side walls of the gallery. Calcium Hydroxide imparts alkalinity to concrete;
- Water seepage on the floor of the gallery;
- Ends of the pre-stressing cables were exposed.

The above degradation mechanisms may increase the permeability and decrease the alkalinity of concrete; the alkalinity of concrete is the passive protection to reinforcement and pre-stressing cables. Furthermore, this may lead to reinforcement corrosion and corrosion initiation from the exposed ends of pre-stressing cables.

F9) The plant has a high ground water table with increasing trend which is a concern for the underground structures with respect to durability.

F10) The plant informed the team that a gallery inspection had been done in December 2014 but the report is not available for review.

F11) A specific TLAA has been developed by the plant to demonstrate the structural integrity of the containment for the LTO period. It is based on visual inspections, data monitoring and results from destructive testing of representative concrete beam samples.

3.2 – SAFETY CONSEQUENCE:

Without comprehensive analysis of the differences between IAEA and plant-applied standards, it cannot be demonstrated that the structural integrity of containment at design basis accident conditions during LTO has the same level of performance.

3.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider verifying that the existing methodology for demonstrating the structural integrity of containment is consistent with IAEA Safety Standards.

3.4 – DOCUMENTS REVIEWED:

- DTS/4NT/0173947/000/01 dated 12/09/2012, Report on Loss of pre-stress in Primary containment under TLAA;
- TIS/4FR/162175/000/R-0 dated 14/06/2010, Inspection report of gallery of reactor building.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheets deals with the concern of maintaining the structural integrity of the reactor building during the entire LTO period.

It has to be indicated that the structural integrity of the plant is monitored since the construction of the plant. Several parameters are used in order to prove this integrity:

- Test of the mechanical properties of pre-stressed concrete beams (stored in the turbine hall), fabricated during the construction of the building and representative of the reactor building;
- Follow-up of the loss of pre-stress using a monitoring system;
- Periodical visual inspection of the primary containment via the containment annulus;
- Validation of all available results, including the evolution of the parameters during the pressurized containment tests, in a specific TLAA of the reactor building structure for the period of Long Term Operation.

During the SALTO mission, it was suggested that it should be confirmed that the testing value of ½ of the accident pressure is sufficient to validate the results of the TLAA, including the supporting tools, and thus the structural integrity of the building.

In order the verify this issue, contacts have been made with the experts involved in the working group NS-G-1.10 "Design of Reactor Containment Systems for Nuclear Power Plants". It was concluded that their assessment of the issue is similar to the ENGIE Electrabel analysis. The position paper on regulatory monitoring RG 1.90 has been revised, taking into account NS-G-1.10. Monitoring carried out in Belgium is an alternative recognized as envisaged in the various reference documents including NS-G-1.10.

Therefore, it can be concluded that the Belgian approach is correct and sufficient to guarantee the structural integrity of the reactor building during the LTO period.

Concerning the underground structures, the following investigations/analysis have been performed :

- Subsidence risks and loss of stability related to changes in water circulation and water levels in the underground galleries and buildings;
- For each gallery: Inspection Report of cracks;
- For each gallery: Status and trends over time.

These analyzes revealed no impact on the structures challenging their function.
Repairs are currently ongoing.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The last revision of NRC guide about ISI of concrete containment with grouted tendons is RG 1.90 rev 2: 'In service Inspection of Prestressed Concrete Containment Structures with Grouted Tendons, Regulatory Guide 1.90, USNRC, Washington DC, 2012'. This text details in page 10, that for both alternative "A" and "B", the pressure test should be performed at P=Pa (accident or design pressure). Despite this RG 1.90, Tihange NPP proposes to perform the periodic pressure test (once every 10 years) at P = Pa/2.

F2) The history of the plant is as follows:

1. The primary containment has been designed in 1969, long before the publication of RG 1.90 Rev. 0 (1974). The ISI program from this original revision of RG 1.90 refers only to: (§ C.1) lift-off tests, periodic reading of instrumentation for determining concrete prestress level and visual inspection, and do not indicate any kind of pressure testing. Pressure testing for ISI purposes was introduced later as an alternative B in RG 1.90 Rev. 1 (1977), *"when the data obtained from instrumentation readings are found to be questionable"* (§ B.2.a). Even for RG 1.90 Rev. 1, the main method for giving evidence that the primary containment fulfills its structural requirements remains, therefore alternative A, i.e. monitoring only.

2. From 1994 on, the plant decided to organize the ISI as much as possible in accordance with the American regulation, i.e. RG 1.90 Rev. 1 and ASME XI/1/IWL, recognizing that full compliance with the American regulation is nevertheless not possible due to the discrepancy between its requirements and the existing technical provisions (DTS / 4TN/ 0173947, § 3.2.2).

F3) As discussed and agreed during the audit, the first purpose of the "type A" test was to give evidence about the primary containment leak-tightness only. "Type A" tests were therefore not to be considered as structural integrity tests. During these tests, readings from the monitoring system are nevertheless taken, giving evidence of its proper working.

F4) RG 1.90 Rev. 1 was still in force at the time of issuing TLAA document (DTS / 4TN/ 0173947). The plant position has been detailed in document (CNT-KCD/4NT/0018657/000/01).

F5) The previous revision of RG 1.90 (rev 1 from 1977) lets the door open for pressure test equal to a value inferior to Pa in case of alternative "A". "A" is the alternative developed for containment with the monitoring system. The plant uses the fact that in the new version of RG 1.90, it is stated that "*Applicants and licensees may voluntarily use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified regulations as long as their current licensing basis remains unchanged. The acceptable guidance may be a previous version of this regulatory guide".*

F6) The authors of the last revision of RG 1.90 (rev 2) have published a communication document in the 2015 SMIRT framework with the document SMIRT 2011 ID 769 that

explains one of the targets of this new revision*:" the life of the structure depends on the functional reliability of the structure's principal strength elements. Thus, any significant deterioration of the prestressing elements caused by corrosion may present a potential risk to public safety. It is important that any system for inhibiting the corrosion of prestressing elements must possess a high degree of reliability in performing its intended function*". And later it is stated:" *The major concern in containment structures with grouted tendons is the possibility that corrosion of the tendon steel may occur and remain undetected and once grouted; the tendons cannot be retensioned or replaced".* So whatever is the interpretation, from a safety point of view, the point to address is the risk of corrosion of pre-stressed tendons.

The cited paper highlights what is already clearly stated in RG 1.90 Rev. 2 about the widespread corrosion concern. However, a full pressure testing would not necessarily provide any clear information about the existence of detrimental effects due to corrosion phenomena.

The plant presented the TLAA document DTS / 4TN/ 0173947 that demonstrates that the prestresses losses due to creep and shrinkage of concrete are acceptable: this document does not cover the risk of corrosion.

The periodic inspection report of the containment (TIS/4NT/0006643/015/00) gives a suitable summary of the state of the containment, but without addressing the risk of corrosion of the tendons.

F7) The risk of corrosion of tendons is partially addressed by prestressed beam that are now stored in the turbine hall in order to simulate the ageing of the material (the beams have be erected at the same time as at the erection of the plant. These beams are periodically tested in a destructive way in order to verify the presence of corrosion: until now no evidence of corrosion has been found.

F8) Neither the shape, nor the size of these specimen are representative of the actual ducts of the tendons: the size of the specimen is 5,7 M, but on one hand the order or magnitude of the actual ones is around 80 m and on the other hand, many actual tendons are vertical, or with a"gamma" shape or with large deviation such as the ones around the equipment hatch: so the representability cannot be proven.

1. The test beams are stored in an environment with conditions that have been recognized as similar to those prevailing in the annular space.

During the inspection of a beam with not grout in the tendons duct, no corrosion has been observed on the tendons: this inspection took place in 2016 (2BG/CM): the inspected beam was also stored in the turbine hall.

F9) There are several tendons inside the raft and this raft is under the underground water level, and environment conditions in this part of the building may be critical if the tendons themselves are not properly protected. The following points have been highlighted, with explicit reference to document (DTS / 4TN/ 0173947):

- The "critical" part of the raft is the connection with the wall. At that location, tendons

are nevertheless located at the upper part of the 2 m thick slab. Tendons are therefore not directly exposed to water ingress at that location.
- Grouted tendons are self-anchored after a certain anchorage length.
- The post-tensioning gallery acts as a drainage gallery at the location of the critical section.
- Post tension compressive concrete stresses in the raft are significantly lower than for the wall and the dome.
- While not being monitored through extensometers, the behavior of the raft of Unit 1 can be compared with the behavior of the raft of Units 2 and 3 that are monitored. Results from these Units could be considered as representative of the behavior of Unit 1 raft. Refer to § 3.3.5 of DTS / 4TN/ 0173947 for further details.
- A full pressure testing would not provide relevant information about raft tendons potential corrosion. See above for the effective post-tension ratio of the raft.

1. For these reasons, full pressure testing is not an effective way for tracing defects due to possible corrosion phenomena of the raft post-tension.

F10) A document relative to injection of tendons ducts in the erection period has been presented (MG/GL/19.800): this document shows that the sedimentation phenomenon has been taken into account for the vertical tendons. Additional analysis has not has not been given by the plant.

F11) The plant did not show other documents, such as actual data of the construction (ratio between the injected volume of duct compared to the theoretical volume of the duct), nor data about the quality of the grout itself, nor the procedure of grouting itself which is a key point to manage the corrosion risk. So the plant was not in a position to demonstrate that the risk of corrosion is under control.

5.2 – DOCUMENTS REVIEWED:

- IGALL AMP 302, In-Service Inspection For Concrete Containment IAEA, Vienna, 2014;
- RG 1.9 rev 2 In Service Inspection of prestressed concrete containment structures with grouted tendons, November 2012;
- RG 1.90 rev 1 In Service Inspection of prestressed concrete containment structures with grouted tendons NRC, August 1977;
- SMIRT 2011 ID 769, Approach to Ensuring Safety of Prestressed Containments with Grouted Tendons;
- DTS / 4TN/ 0173947, Loss of pre-stress in primary containment;
- DTS/4NT/0173947/000/01, LTO Ageing TLAA Structures – Tihange1: Loss of pre-stress in primary containment;
- TIS/4NT/0006643/015/00, CNT SITE relevés topométriques;
- TE Note N° CNT-KCD/4NT/0018657/000/01 – 27-11-2015 – Veille réglementaire en sûreté nucléaire – RG 1.90 – Rev. 2, Analysis (Rev. 0 of TE note 27-11-2013 with

basically an identical conclusion, November 2012;
- 2BG/CM, Vinçote Controle visual poutre témoin N2 3200;
- Précontrainte – Note sur l'injection des câbles verticaux et verticaux avec retour sur le dôme. MG/GL/19.800 du 27 décembre 1972.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: E - 2**
NPP: Tihange	**Unit:1**
Reviewed Area: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures	
Issue Title: Leaching of Calcium Hydroxide on the floor slab of electrical building basement	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Loss of concrete durability due to leaching Calcium Hydroxide has not been appropriately addressed in the plant.

2.2 – IAEA BASIS:

NS-G-2.12

4.17. A review of the management of ageing for each structure, component or group of structures and components selected by the screening process should be performed in order to acquire information and knowledge about the following three essential elements:

(i) Understanding ageing;

(ii) Monitoring ageing;

(iii) Mitigation of ageing effects.

Annex III gives examples of significant ageing mechanisms and susceptible material and components.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) During the field visit in the electrical building basement, ground water seepage was observed on the basement floor and side walls.

F2) At many places, leaching marks (as white patches) of Calcium Hydroxide were seen on the floor. Calcium Hydroxide imparts alkalinity to concrete.

F3) Leaching of Calcium Hydroxide makes concrete porous and permeable leading to carbonation of concrete which may lead to degradation of reinforced concrete basement floor in the electrical building which impacts the intended function.

F4) The plant has a high ground water table with an increasing trend.

F5) No visible reinforcement corrosion could be seen on the surface in the electrical building.

F6) The plant stated that project GC-11 includes an assessment of concrete degradation risks due to water level fluctuations or leaching phenomenon along cracks or joints in the tunnels and/or building basements.

F7) Plant informed that the leaching effect has been taken into account in ageing management programmes.

3.2 – SAFETY CONSEQUENCE:

Without managing loss of concrete durability due to leaching Calcium Hydroxide, the integrity of civil structures important to safety may be impacted.

3.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider taking measures to manage Calcium Hydroxide leaching.

3.4 – DOCUMENTS REVIEWED:

- No document was available for review. Observations were made during field visit.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheets deals with the concern of the durability of concrete structures due to the potential inadequate monitoring of the groundwater level. This issue might jeopardize the qualification of the concrete structures during the LTO period.

In order to assess the problem, the following actions were performed:

- Characterization of the "leaching" phenomenon by chemical analysis;
- Cleaning of the floor and regular monitoring of water/humidity presence;
- Based on the previous observations, determination of the potential impact on the concrete durability of the BAE building and preparation of an adequate action plan.

The expert report concluded that the observed white deposits did not come from a water path from bottom to top (leaching) but from stagnant water from different sources located in the basement.

Moreover, monitoring water seepage in buildings (underground parts) is the subject of GC-11 project. The results of the performed studies show that infiltrations have no impact on the integrity of galleries and buildings :

- Concrete ageing risk related to water level variations and leakage in concrete structures;
- Subsidence risks and loss of stability related to changes in water circulation and water levels in the underground galleries and buildings.

The infiltrations were monitored and, when accessible, they are being repaired in the GC 11 project.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) The report (TIS1/4NT/04000937/000/00) demonstrates that the origin of the white patches on the floor is not leaching but due to other water coming from inside (internal networks).

F2) AMP S9 (NT/ENG/AGEING/AMP/EME 609) covers also leaching effects (page 4) specifically for galleries and the applicable procedure linked to this AMP is the document (111000/SM/001). The target of this second document is to record any defect due to ageing in the structures (important for safety). This document shows how to record:

- Cracks;
- Water presence;
- Corrosion of reinforcement;
- Coating defects;
- Anchorages.

F3) As a generic defect has been detected for galleries (generic water infiltrations), a corrective action has been undertaken for water infiltrations: this point led to the specific project “GC11” dedicated to water infiltrations as described in document (NT/LTO-T1/GC/B GC). The scope of this project is the underground part of the buildings (nuclear island) and the galleries. On the one hand, this project addresses the safety risks (building and galleries settlements and durability) related to water infiltrations and on the other hand this project aims to repair these infiltrations as far as possible.

F4) Several inspections have already been performed for all galleries as described, e.g. in documents (TS1/4NT/0349237/002/02) and (TIS1/4NT/0349237/004/02) in order to judge the state of cracks in galleries depending on time for galleries G02 and G04. So, to date, the corrective actions of this project in order to improve the tightness of the galleries can be considered as implemented.

5.2 – DOCUMENTS REVIEWED:

- TIS1/4NT/04000937/000/00, Diagnostic des dépots présents sur le sol de la cave du bâtiment des auxilliaires électriques – Rapport d'expertise;
- NT/ENG/AGEING/AMP/EME 609, Application Tihange 1 SAMP9: Buried and above ground concrete piping and gallery program;
- 111000/SM/001, Procedure d'inspection visuelle de l'état du béton des bâtiments et des structures génie civil du site de Tihange dans le cadre de l'ISI;
- NT/LTO-T1/GC/B GC, LTO T1 – Project GC-11 : investment Note – réparation infiltrations galeries et bâtiments;
- 100010605958/000/00, Rapport d'expertise TE – Risque de vieillissement lié aux variations de niveaux d'eau et aux infiltrations dans les structures en béton ;
- 10010528103/000/00, Rapport d'expertise TE - Risque de tassements et de perte de stabilité lié aux variations de niveaux d'eau et circulations de l'eau dans le sous-sol des galeries et bâtiments ;
- TS1/4NT/0349237/002/02, LTO – T1 – GC11: rapport d'inspection des fissures des galeries – Etat des lieux et évolution en fonction du temps – Galerie 2;
- TS1/4NT/0349237/004/02, LTO – T1 – GC11: rapport d'inspection des fissures des galeries – Etat des lieux et évolution en fonction du temps – Galerie 4.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: E - 3**
NPP: Tihange	**Unit:1**
Reviewed Area: Ageing management review, review of ageing management programmes and revalidation of time limited ageing analyses for civil structures	
Issue Title: Improper anchoring of supports in relay room of electrical building	
2. ISSUE CLARIFICATION	
2.1 – FUNDAMENTAL OVERALL PROBLEM: The design intent of cable tray support anchoring is not performed as required by the design.	

2.2 – IAEA BASIS:

NS-G-2.3

2.11. Plant modifications should be performed in accordance with established procedures, with due consideration given to quality assurance provisions. Installation of modified systems and/or equipment should be performed in accordance with the work control system and appropriate testing procedures for the plant.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) As part of LTO, strengthening of cable trays was in progress in the relay room of the electrical building (BAE). Anchorage plates were being fixed on the side face of the beam using anchors.

F2) The anchorage plate of the cable tray support has four holes for anchoring on the side. As per design, the plate should be fixed to the beams with at least two anchors providing for maximum bending moment capacity.

F3) The design drawings were verified and it was observed that at least two anchors (one at the top and one at the bottom) are required in order to develop the maximum load carrying capacity, which is the design intent.

F4) However, at many locations, two anchors were installed but both were fixed to the anchorage plate in a different way not meeting the design intent without any justification.

F5) During the field visit, it was explained that since reinforcement bars were present at the location of the top or bottom holes, anchor locations were changed without considering the design intent.

F6) The plant informed that all the support plates will be inspected for correctness with respect to design intent and execution persons will be trained to consider the design intent during work execution.

3.2 – SAFETY CONSEQUENCE:

Improper anchoring of plates leads to reduced load carrying capacity of the entire support system and thereby will potentially impact the function of related system.

3.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider ensuring that the design intent of the cable tray support anchoring modification is properly implemented.

3.4 – DOCUMENTS REVIEWED:

- Observation during field visit;
- Drg. Nos. SPIE 01 to 03, 05, 07, 09, 11, 13 15, 17 and 22;

– Detail of anchor plate – SKIPN.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheets deals with the concern of the quality assurance of the plans and their potential impact on ageing management of civil work structures.

After analysis of the problem, its potential impact, the consequences in case of generalization, it was decided that no further action other than what was planned and included in project documentation is required :

– BPE-plans (OK for execution) approval by TE (seismic approval by expert) before execution of work;
– QA Check of "As Built" installation (conformity, anchorages, supporting systems…) by LTO and TE; if needed corrective actions are defined and executed.

Monitor corrections if necessary.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) In the framework of the seismic retrofitting of cable trays, a final work report is written in order to record every control point that has been previously identified. For example, the type of anchorage and the number of anchorage points and the quality of tightening. In addition, the fact that locations of anchorage points are correct is checked. These points have been checked on document 74256/5301069269.

F2) The project "STRUC-01" is dedicated to improvement of the ageing management of a category of structures including doors, cables trays, other metallic structures, handling system, penetrations and small items that are not included neither in mechanical component nor in electrical equipment (for example an item the failure of which, in case of an earthquake, could damage another equipment important for safety). This project is described in NT/LTO-T1/GC/S STRUC-01.

F3) Inspection procedure for these items is written (TIS1/4NT/0370875/000/01) and contains inspection sheets. The organisation of this inspection sheet is based on "one sheet per room" and every one should be recorded on the same sheet (that can include appendixes). Each type of item, such as cable trays, is gathered in a single table where points to be checked are written: anchorages and other connections are addressed by dedicated lines in this table. Explanation about how to fill in the table is given in the main body of the procedure: the text in the main body may not seem to be accurate enough, but inspectors attended a training course.

F4) The training courses for the inspectors are written in the document TIS1/4D0/0416650/000/00: this document contains flowcharts that have been commented during the training. The potential lack of bolt is addressed by slide page 13 of this document.

F5) A first visit has been performed on the basis of procedure TIS1/4NT/0296570/000/00. The results of this first visit have been recorded in document TIS1/4NT/0319707/000/00. The

main results are gathered in one single table for each building. In this table, for each building, we can see if corrective actions have been necessary or not. For example, for reactor building (Appendix A of this results report), 12 lines are dedicated to connections or anchorages that had to be repaired.

F6) The repair itself is described in a dedicated document. An example of repair description is given by CNT1 LTO – STRUCT -02 -03. This document will become a contractual document for the company in charge of the repairs (with additional documents).

5.2 – DOCUMENTS REVIEWED:

- 74256 / 5301069269, Rapport d'intervention N° 5800300 passerelles a câbles / PC11-BAT-E ;
- NT/LTO-T1/GC/S STRUC-01, LTO: projet STRUC-01-Note de synthèse – pérennisation structures mécaniques;
- TIS1/4NT/0296570/000/00, LTO Ageing – Structures – Tihange 1 :S6 – Procédure pour les Baseline Inspections;
- TIS1/4NT/0319707/000/00, STRUCT 01 – Structures mécaniques – résultats de la baseline inspection;
- CNT1 LTO – STRUCT-02-03,Tenue structurelles des passerelles à câbles dans les galeries de Tihange 1: Note de synthèse.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: F - 1**
NPP: Tihange	**Unit: 1**
Reviewed Area: F – Human Resources, Competence and Knowledge Management	
Issue Title: Incomplete implementation of competence and knowledge management processes	

2. ISSUE CLARIFICATION

2.1 – FUNDAMENTAL OVERALL PROBLEM:

Competence and knowledge management processes are not fully integrated into the line organisation for LTO.

2.2 – IAEA BASIS:

SSR-2/2

3.10. The operating organization shall be responsible for ensuring that the necessary knowledge, skills, attitudes and safety expertise are sustained at the plant, and that long term objectives for human resources policy are developed and are met.

GS-R-3

4.2. The information and knowledge of the organization shall be managed as a resource.

GS-G-3.1

3.12. Senior management should demonstrate its commitment to all the policies through its actions and should provide firm and unambiguous support for the implementation of these policies. Its actions should foster a corresponding commitment to high levels of performance by all individuals. All individuals should be expected to demonstrate their commitment to the policies. Adequate resources should be made available to implement all the policies. This includes provision of the necessary:

- Tools, equipment and material;
- Sufficiently competent individuals;
- Knowledge resources;
- Financial resources.

4.2. To improve the performance of the organization, consideration should be given to the way resources are managed. This should include:

- Effective, efficient and timely provision of resources in the context of the opportunities and constraints;
- Management of tangible resources such as support facilities;
- Management of intangible resources such as intellectual capital;
- Inclusion of resources and mechanisms to encourage continual innovative improvement;
- Consideration of organizational structures, including needs for project and matrix management;
- Use of information management, knowledge management and the corresponding technology;
- Enhancement of competence by means of focused training, education and learning;
- Development of leadership skills and profiles for future managers of the organization;
- Use of natural resources and consideration of the impact of the use of resources on the environment;
- Planning for future resource needs, for example by analysing completed projects and by using such tools as predictive models for workloads.

4.4. Data should be converted to information for the continual development of an organization’s knowledge, and senior management should treat information as a fundamental resource that is essential for making factually based decisions and stimulating innovation. To

manage information and knowledge, senior management:

- Should identify the organization's information needs;
- Should identify and access internal and external sources of information;
- Should convert information to knowledge of use to the organization;
- Should use the data, information and knowledge to set and meet the organization's strategies and objectives;
- Should ensure appropriate security and confidentiality;
- Should evaluate the benefits derived from the use of the information in order to improve the management of information and knowledge;
- Should ensure the preservation of organizational knowledge and capture tacit knowledge for appropriate conversion to explicit knowledge.

NS-G-2.4

4.8. The operating organization should contain an adequate number of personnel, with the knowledge, training and skills necessary to supervise and evaluate the work of contractor personnel. Staff of the operating organization required to supervise contractors or other temporary support staff should be clearly identified.

3. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 22/01/2015

3.1 – FACTS:

F1) There is a plant level policy statement on competence management, but there is no reference to knowledge management.

F2) A list of key expert positions have been identified for the plant but these are based on group criteria which do not take account of plant specific needs and the list does not take account of recent organisational changes (e.g. system health).

F3) A Competence, Knowledge and Behaviour (C, K & M) Committee has been established (June 2014) to manage on-going competence but it only includes training/ human resource staff and line departments are not represented.

F4) An interactive human resource process map has been developed showing all main human resource processes at the plant level, and their relationship, but this is not available to line managers where it would greatly assist in their day to day work.

F5) Several new competence/ knowledge management process and tools have been developed and are being implemented but they are quite new (launched in 2014), and are not yet fully implemented in the line organisation (e.g. long-term planning, knowledge grids). All activities are planned to be completed during 2015.

F6) Reglearn add-on to manage training processes and data through SAP is still in the implementation phase, to be completed May 2015.

F7) Although the LTO department is now fully staffed, LTO specific job descriptions were generally not used and little or no specific LTO training was provided for the implementation team.

3.2 – SAFETY CONSEQUENCE:

If competence and knowledge are not properly managed, knowledge which key to safe LTO may be lost.

3.3 – RECOMMENDATION/SUGGESTION:

S) Consideration should be given to expediting the completion of implementation of newly developed competence and knowledge management processes.

3.4 – DOCUMENTS REVIEWED:

- ZST.10010366104, Rev S01, 07/08/2014; LTO Programme organisation;
- 10010308244 Vs00.00, February 2012; Competence development;
- ZST.10010043570 000 Vers 02, 04/12/2012 Competence Management;
- 10010308244 Vs00.00, February 2012: Competency Development Policy statement;
- ZST.10010491180 000 Vers 00, 23/12/2014; Competence and Knowledge management;
- ZST.10010043379.000_02, 21/01/2013; Knowledge Management (Group);
- ZST.10000763227 000 Vers 03, 22/12/2014; HR Organisation;
- ZST.10010043359 000 Vers 02, 06/06/2013:Recruitment;
- ZST.10010043360 000 Vers 02, 30/06/2014; Staffing;
- HR database (SAP);
- Staffing database;
- Succession database;
- Recruitment statistics;
- Retirement forecasts;
- Long term planning scenarios.

4. COUNTERPART ACTIONS	**Date:** 28/10/2016

The SALTO issue sheets deals with the concern of the anchoring of knowledge in the different parts of the operational organization during the period of LTO. More specifically, the issue deals with the finalization of the action plan that was initiated after the 2012 pre-SALTO Mission.

After the SALTO review which was performed in January 2015, the decision was taken to work on the further implementation of all new processes which were developed after the pre-SALTO of 2012. These processes are assessed on a regular basis and are followed through the C, K & HR Committee. So they can be kept up-to-date.

A further decision was taken to give an answer to all the facts identified in issue sheet F-1 SALTO reviewed in January 2015. Each of these facts was translated into actions and up

today all these facts are solved, except fact F6 which is still under implementation.

5. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 09/12/2016

5.1 – FACTS:

F1) During a SALTO mission in January 2015, processes of competence management, knowledge management and an interactive human resource process map were developed but not implemented inside the operational organization.

F2) Knowledge transfer process is established and fully implemented at the plant. When an employee of the plant changes position or plans to leave the plant, the line manager is responsible to define if there is a need of knowledge transfer from the original employee to a new employee (10010468432, Description of the knowledge process in Tihange, 10/09/2015).

F3) Human resources business partners monitor changes inside the organization and provide information to CTC (Competence and Training Centre). CTC requests line managers to decide if knowledge transfer is needed (12 months in advance for retirement and 3 months in advance for changes of positions). The knowledge transfer tool is available on the plant web site. The line manager has to determine appropriate type of knowledge transfer methods (10010468432), e.g. knowledge grid, knowledge expert chart, yellow sticky, one to one, other methods (e.g. shadowing). CTC is responsible for follow-up of the process which means CTC sends request (form and documents) to the line manager to perform knowledge transfer and provide a report on completion of knowledge transfer.

F4) Knowledge grids are prepared for all teams in maintenance, chemistry, radiation protection, fuel, waste etc. (app. 75% employees covered, developed between 2013 and 2015). Knowledge expert charts are developed for some Engineering Department experts and some other experts providing a more detailed description of selected experts` knowledge (app. 20 charts developed at the plant). The rest of the plant (e.g. operation licensed staff) is not covered by knowledge grids and knowledge expert charts as their knowledge is defined by regulations.

F5) Knowledge grid is not developed for LTO project team members. Management and transfer of knowledge from LTO team members into line organization is performed using yellow sticky or one to one method.

F6) CK&HR Committee has regular monthly meetings performing a follow-up of the activity status. 126 knowledge transfer processes were completed since 2014 (43 in progress) as reported in CK&HR report '10010651036, Summary of the meeting of the CK&HR Committee' from 27/10/2016. The report also includes the method used.

F7) CTC monitors the quality of knowledge transfer. There is also an independent quality assurance which monitors the quality of knowledge transfer. But there is no formal process to systematically (for each case) evaluate the effectiveness of the knowledge transfer process to provide feedback in order to improve the process.

F8) Competence management is described in procedure '10010491180, Description of the processes for Competence and Knowledge Management, 23/12/2014'. It describes overall processes, e.g. key knowledge identification - knowledge grid, knowledge expert chart,

knowledge transfer, team and individual development plan (OJT, behaviour, skills, shadowing), training, long-staffing needs and follow-up on new staff.

F9) An interactive human resource process map was made available for the plant employees on the plant intranet and provides overview of processes and links to procedures.

5.2 – DOCUMENTS REVIEWED:

- 10010468432, Description of the knowledge process in Tihange, 10/09/2015;
- 10010651036, Summary of the meeting of the CK&HR Committee, 27/10/2016;
- 10010491180, Description of the processes for Competence and Knowledge Management, 23/12/2014.

5.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X