IAEA-EBP-LTO-06

05-05-04

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

MINUTES OF THE PROGRAMME'S WORKING GROUP 3 FIRST MEETING

10-12 February 2004

IAEA, Vienna, Austria

INTERNATIONAL ATOMIC ENERGY AGENCY

1. INTRODUCTION

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

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

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

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

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

The 1st meeting of WG 3 was held at IAEA in Vienna, 10-12 February 2004. The purpose of the 1st meeting of WG 3 was to review and finalize the respective parts of the draft Workplan [2], and the draft Standard review process [3] and to initiate the WG 3 activities.

The Agenda for the Meeting is provided in Appendix I. The list of participants is provided in Appendix II.

2. MEETING SUMMARY

The meeting was opened by Radim Havel, the Programme Scientific Secretary, who outlined the objectives of the IAEA Extrabudgetary Programme "Safety Aspects of Long Term Operation of Pressurized Water Reactors". Volodymyr Bezsalyy, the WG 3 Chairman, outlined the objectives of the first working group meeting, reviewed the meeting agenda and provided a brief overview of the draft Workplan for WG 3. Robert Moffitt, the WG 3 Secretary then provided a brief overview of the draft Standard Review Process for WG 3.

2.1. National presentations

The meeting continued by presentation of national approaches on general framework on long term operation. The summaries of the national presentations are provided next, the complete presentation handouts are provided in Appendix III.

CZECH REPUBLIC

CEZ – Aging Management and I&C Modernization (Petr Zavodsky)
At the beginning of the presentation Czech party informed that both Czech NPP (Temelin and Dukovany) are now managed under Nuclear Division within Czech power company CEZ. The Temelin plant is going to full Commercial operation this year (both WWER 1000MW units) and the long-term operation is starting with the goal to extend the plant life at least till 2045 (e.g. cable ageing management). The Dukovany plant started operation in 1985-1988 (four WWER 440MW units). The modernization of the I&C systems is ongoing along with other activities like EQ and cable aging management to extend the plant life at least to 2025. To support safe long-term operation, CEZ established SALTO/PLEX working groups inside the company. There are 5 working groups, where the group 1-4 cover the same topics as IAEA WG and the supporting Group No. 5 covers "Analysis and Assessments". First task of the working group is to prepare data for SALTO National Report.

Electrical and I&C Equipment Qualification and Ageing Management at CEZ NPPs (Jan Fridrich)
Equipment Qualification (EQ) programmes exist at both CEZ NPPs. Electrical and I&C equipment classified as "important to safety" are subject to: environmental, seismic and EMC qualification with the same required qualified life of the component as the plant design life.
EQ principles are based on current international practices described in IEC, IEEE standards and IAEA guides. Czech regulatory guide exists since 1998. EQ list comprises not only electrical and I&C but also mechanical equipment.
For equipment identified as needing EQ, the environmental, operational conditions, safety function and mission time had to be established.
Electrical and I&C equipment in harsh environment had to be qualified by type tests and EQ documentation (EQ specification, test plan, test reports, EQ final reports) have to be available till the end of qualified life. Type test are preferred also for environment and seismic EQ, but analysis, operational experience, QA, maintenance are acceptable.

Cable ageing management programme started on both NPPs with:

- Environmental monitoring on cables hot spots
- Installation of cable samples into the cable deposits on the plants
- Periodical environmental and condition monitoring of cable samples in the deposits.

SWEDEN

I&C Modernization in Sweden (Lars-Olof Ståhle)
Mr. Stahl provided a brief overview of the electrical generation situation in Sweden. Because of low water levels in the reservoirs the imports of electricity have been big in 2003, and the prices doubled compared to the previous year.
A short presentation was made of a major modernization in all NPPs in Sweden. The major modernization was made in Oskarsham 1 in 2002.

A whole new safety package was installed, based on IEC 1226.
A new RPS system, new building with all safety equipment and separate cabling in 4 divisions were the main subjects.
In Ringhals 2 they are going to change all the electrical I&C equipment at one time.
The reason for this big modernization is

- Obsolete equipment
- It can not follow the new requirements from the government
- No spare parts
- Lack of knowledge of the equipment

Operational experience in Sweden
All international experiences, for example from WANO, go to a special organization KSU.
KSU assesses if the experience is relevant for the Swedish utilities.
All domestic experiences and the ones from KSU go to ERF-ATOM (group of people from Westinghouse and the Swedish utilities). They make a technical assessment and send the information on to the utilities.
Each utility has its own operational experience review group and this group determines if the experience should be followed up within the utility and who is responsible to follow up.

UKRAINE

(A. Manko Energoatom)
All NPPs submit to the National Energy Generation Company (NEGC), “Energoatom” the list of equipment subject to life extension. The equipment referred to in these lists undergoes inspection during the preventive planned maintenance (PPM) period. The scope and frequency of inspections complies with the “Equipment Inspection Programme”, developed on the basis of documents approved by the regulator.
The programme contains a typical set of operations, but the volume of work varies depending on the equipment complexity. Here is shown the sequence, the analysis of reliability is carried out, the conclusion is made and the decision on life-time extension on the defined term is taken depending on the technical state of the equipment. Recommendations on replacements are also given. The assignment of measures preventing the decrease of reliability of equipment operation is obligatory.
The programme contains the following elements:

- Circuit of electrical equipment and I&C.
- Plans of tests of the equipment.
- Forms of the certificate of technical inspection with the recommendations and conformity of the equipment to the requirements of the project and operational documentation.
- Form of the protocols of tests with obligatory conclusion about possibility of extension of equipment lifetime.
- Lists of separate elements of the structure (for complexes or systems).
- List of reference documentation.

(V. Bezsalyy - SNRCU)
Operating organization developed and agreed with the regulator the programme for qualification of equipment of operating units. This programme includes several sections, one of which relates to SSK Elec. and I&C. In 2003 regulatory document NP 306.5.02/2.068-2003 was ratified. This document defines the requirements for the order and scope of activities which are performed to prove the capability of SSK and I&C related to safely perform their functions after their design life expires.
For SSK, which belongs to the safety control systems it is a requirement to demonstrate their stability to seismic impacts and maximum design-basis accidents (LOCA). Fulfilment of these requirements is connected to the equipment qualification programme.
Ukrainian NPPs are taking active part in the process of modernization of SSK and I&C. Replacement of obsolete systems is currently under process:

- Control rods controlling system
- Neutron flux control system
- The system to control reactor internals
- Feed-water supply system
- Radiation conditions monitoring system

We have also started activities aimed at replacement of emergency protections. All the new equipment is subject to qualification prior to operation.

USA

License Renewal Process in the United States (Bob Moffitt)
Nuclear power plant licenses were originally issued for 40 years and are allowed to be renewed for an additional 20 years. A 40 year term was selected upon the basis of economic and antitrust considerations, not technical limitations. However, once the license term was selected, individual plants may have been engineered for an expected 40 year life.

The US NRC license renewal process establishes the technical and administrative requirements for renewal of operation power plant licenses. The US NRC regulation of the extended period of operation for a renewed license has three major considerations or assumptions. These are:

- Existing regulatory process is adequate for ensuring safety of operating plants
- Current licensing basis (CLB) is adequate and carries forward into the period of extended operation
- Issues relevant to the current operation of plants will be addressed by the regulatory process, which will carry forward into the period of extended operation.

The process used in the U.S. to review license renewal applications contains two major parts. One review considers the environmental issues specified in 10 CFR Part 51 and the other considers the safety issues specified in 10 CFR Part 54. When addressing the safety issues of 10 CFR Part 54, a license renewal application must provide the NRC with a technical evaluation that demonstrates that the applicant has identified aspects of plant aging and has implemented (or will implement) Programmes that will adequately manage aging degradation for the period of extended operation. The NRC reviews the application and verifies the safety evaluations through on-site audits and inspections.

The U.S. NRC has established a license renewal review process that is documented in the following three publications – Generic Aging Lessons Learned Report (GALL), Regulatory

Guide 1.188 and the Standard Review Plan (SRP). These documents are available to the public and currently include resolution of public comments. The license renewal review focuses on passive, long-lived structures and components of the plant that are subject to the effect of ageing. The license renewal rule requires an applicant, in part, to:

1. perform a scoping review to identify the structures, systems, and components within the scope of license renewal based on criteria delineated in the rule and
2. perform an integrated plant assessment to identify the structures, systems and components that are subject to ageing management, to justify the methodology used, and to demonstrate that analyses that are based on the current operating term have been evaluated and shown to be valid for the period of extended operation.
3. demonstrate that time-limited ageing analysis used for current operation have been evaluated and are valid for the period of extended operation

It was also noted that the Maintenance Rule (10 CFR-50.65) was an important element of the regulations that greatly facilitated the License Renewal process. The Maintenance Rule specifies that the utilities establish Programmes for monitoring and assessing the performance of SSCs and establish performance criteria for those SSCs. This allows both the utilities and the NRC to track the performance of SSCs for aging related effects and ensures there is a process for addressing those aging effects.

EC-JRC

(Brian Farrar)
The institute for Energy is one of 7 institutes of the European Commission Joint Research Centre. The IE provides scientific and technical support for the conception, development, implementation and monitoring of community policies related to energy. It conducts activities on both nuclear and non-nuclear energy systems. The institute provides technical and scientific support for the implementation and management of TACIS nuclear safety assistance projects financed by the European Commission mainly in Russia, Ukraine, Armenia and Kazakhstan. Three main areas of the TACIS programme are on-site assistance, regulatory authority assistance and design safety. On-site assistance is provided through Western European nuclear operators working at specific NPPs in the beneficiary states. These operators provide training and transfer of know-how related to NPP operational safety. They also work with the local NPP operator to identify and implement equipment upgrade projects. Currently emphasis has moved to large plant improvement projects. Relevant examples are replacement of reactor protection systems based on digital technology for Novovoronezh, Kalinin and Khmelnitsky NPPs. TACIS assistance is also provided to strengthen the local regulator and its technical safety organizations for the licensing of these Plant Improvement Projects. A large number of projects have also been implemented in the area of design safety. There has been significant work performed on WWER 440 RPV embrittlement and on application of the LBB approach to improve the assurance of primary circuit integrity. Also a number of projects on accident analysis and PSA have been implemented. Related to PLIM, there have been several projects on ISI, component qualification and on maintenance.
The institute for Energy operates the SAFELIFE project, focussing on PLIM. The project is operated through a number of networks, bringing together key experts in the technical fields to establish consensus R&D issues and promote best practices, and covering issues such as ageing materials, inspections and qualification and structural component evaluation. The SENUF project (Safety of Easter European Nuclear Facilities) is also part of the SAFELIFE project. The objective is to promote operational safety improvement by technical exchange between operators. A working group has been established on NPP maintenance comprising 9 institutes from Eastern and Western Europe.

A large number of joint European Research projects are being implemented in the EU 5th and 6th framework programmes with subjects related to plant life management.

IAEA

Periodic Safety Reviews and I&C Modernization (Ki-Sig Kang)
Mr. Ki-Sig Kang, NPES, presented and explained the different features of I&C/electric components compared with passive equipments. Most I&C and electric equipment are active components and are replaceable with various degrees of difficulty. For example, a Resistance Temperature Detector (RTD) that is installed in a thermowell in the primary coolant system of a Pressurized Water Reactor (PWR) is easily replaced while I&C cables are not as easily replaced, although some plants have successfully managed these changes. In either case, aging is of concern not only for non-replaceable SSCs but also for replaceable SSCs for long term operation of NPPs.

A brief summary of the IAEA's activities in the I&C area are included in the following publications:

- TECDOC–1252 (2001.11): Integration of information in control room and technical offices in NPPs
- TECDOC–1284 (2002.4): IT Impact on the Design Process and Plant Documentation
- TECDOC –1327 (02.12): I&C licensing requirements harmonization
- TECDOC–1328 (02.12): Scientific basis and engineering solutions for cost effective assessment of software based I&C system
- Effective management of NPP I&C modernization projects, including development of a database: Under printing (2003)
- Plant life cycle and ageing management using improved I&C maintenance (2003)

Mr. Kang also provided the participants with following material to support the preparation of country report for I&C ageing and obsolesces management.

- IAEA- TECDOC –1327 (2002.12): I&C licensing requirements harmonization:
- IAEA –TECDOC –XXX : Plant life cycle and ageing management using improved I&C maintenance
- CD-ROM for IAEA–TECDOC–1016: I&C modernization strategy and IAEA-TECDOC –1066 : Specification of requirement for upgrades using Digital I&C.
- US NRC Maintenance Rule (10 CFR 50.65)
- IEC Standard for I&C modernization
- Lifetime extension and safety upgrade resulting from Modernization of the first generation WWER-440 NPPs (Novovoronzeh NPP unit 3)

2.2 Discussion of the Workplan and SRP

The working group members discussed both the work plan and SRP. Changes to the work plan were recorded in the document as the working group members reached a consensus on each issue. There was considerable discussion on the Workplan which allowed all the members to better understand the scope of activities and what is expected. However, there were only a few changes to the Workplan to further clarify the activities. The latest revision of the work plan is documented in IAEA-EBP-LTO-02 [2]. There was also quite a bit of discussion regarding the SRP, in particular Appendix I. The latest version of the SRP is documented in IAEA-EBP-LTO-03 [3].

For the future activities of WG-3, the following schedules were agreed with all participants.

1. TASK 1
   - Country Report
     - Initial report: 31 July 2004
     - Final report: 30 September 2004
   - Meeting for review process:
     - 24- 26 May 2004 or 30 August - 1 September 2004 at Kiev, Ukraine

2. TASK 2 : Staring date : 1st of October 2004
   - Analysis report
     - Initial report : 31 May 2005
     - Final report : 30 September 2005
   - Meeting for review of weakness and consolidation of information
     - 13-15 June 2005 (place is not fixed)

3. ACTION ITEMS

The following actions items resulted from the meeting.

1. Mr. Moffitt agreed to develop and distribute a draft of the meeting minutes by February 20, 2004.
2. Mr. Moffitt agreed to work with Mr. Taylor (WG 2) to develop and distribute a draft Country report that may be used as a template by March 30, 2004.
3. Mr. Havel agreed to revise the Work Plan of Working group 3 to reflect IAEA definitions of fundamental safety functions to ensure consistency between all working groups.

4. REFERENCES

[1] Minutes of the Programme's 1st Steering Committee Meeting, IAEA-EBP-LTO-01, Vienna, 2003 (internal EBP report).
[2] Minutes of the Programme's Planning Meeting, IAEA-EBP-LTO-02, Vienna, 2004 (internal EBP report).
[3] Standard review processIAEA-EBP-LTO-03 Vienna, 2004 (internal EBP report).

APPENDIX I.
PROVISIONAL AGENDA

Tuesday, 10 February 2004		
09:00	Opening, Meeting objective	R.Havel, Ki-Sig Kang
09:15	EBP SALTOPWR WG 3-Work Plan, SRP	V. Bezsalyy, R. Moffitt
10:30	*Coffee break*	
11:00	National presentations (7 MSs)	
11:00	Sweden	Lars-Olof Ståhle
11:45	Czech Republic	Petr Zavodsky
12:30	*Lunch break*	
14:00	Ukraine	Oleksii Manko
14:45	Hungary	Zoltan Ferenczi
15:30	*Coffee break*	
16:00	USA	Robert L. Moffitt
16:45	Discussion on national approaches	
17:30	Adjourn	
18:00	Wine and Cheese Reception	VIC Restaurant
Wednesday 11 February 2004		
9:00	European commission	Brian Farrar
9:45	Discussion on national approaches	
10:30	*Coffee break*	
11:00	Discussion on national approaches	V. Bezsalyy, R. Moffitt
12:30	*Lunch break*	
14:00	WG 2 Workplan	V. Bezsalyy, R. Moffitt
15:30	*Coffee break*	
16:00	WG 3 Standard Review Process	V. Bezsalyy, R. Moffitt
17:30	Adjourn	
Thursday, 12 February 2004		
09:00	WG 3 Standard Review Process	V. Bezsalyy, R. Moffitt
10:30	*Coffee break*	
11:00	Final discussion	V. Bezsalyy, R. Moffitt
12:30	*Lunch break*	
14:00	Adjourn	V. Bezsalyy, R. Moffitt

APPENDIX II.
LIST OF PARTICIPANTS

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APPENDIX III.
PRESENTATIONS HANDOUTS

IAEA EBP
on
SAFETY ASPECTS OF LONG TERM OPERATION OF PRESSURIZED WATER REACTORS

1st Meeting of Working Group 3

IAEA, Vienna, 10-12 February 2004
Radim Havel

EBP BACKGROUND

- Scoping meeting – March 2003 (RF, SWE, USA)
- 1st SC meeting – May 2003 (BUL, CR, FI, H, RF, SR, SP, SWE, UKR, USA, EC) + (F, UK); IAEA-EBP-LTO-01; EBP overall Workplan incl. Objective, exp. outcome, and approach (SC+4WGs)
- Planning meeting – August 2003 (WG chairs + secs + SC chair); IAEA-EBP-LTO-02; WG 1-4 draft Workplans, initiated SRP development
- EBP: May 2003 – November 2006; RB 2007 onwards

EBP OBJECTIVE

- SC: IAEA-EBP-LTO-01
- Assist PWR operators and regulators:
  - to ensure the required safety level is maintained during long term operation
  - to provide generic tools to support the identification of safety criteria and practices applicable to long term operation at national level
- Develop an internationally agreed common framework to support safe long term operation including related processes and practices
- SC nominated WG chairpersons/secretaries

WGs OBJECTIVE

- 4 areas:
  - General LTO framework,
  - Mechanical components and materials,
  - Electrical components and I&C,
  - Structures and structural components
- Tasks:
  - Compile/collect info (national summary reports)
  - Review and compare info
  - Reconcile info
  - Formulate final reports
- Standard review process (uniformity and compatibility, PSR index)
- Homework assignments (meetings…co-ordination)

1st WG 3 MEETING OBJECTIVE

- Finalize Workplan incl. schedule (mtgs., outcomes, plan WG meetings to facilitate scheduling SCMs, etc.)
- Finalize SRP (WG 3 part)
- Initiate collection of information, etc.
- Homework assignments (whole EBP)
- Future meetings-where&when
- Deadlines
  - next SC meeting: 16-18 March 2004
  - final WG 3 drafts (Workplan+SRP): 1 March 2004
    (WG1: 13-15 Jan; WG2: 4-6 Feb; WG4: 3-5 Mar)
- Meeting minutes
- Volodymyr to ‘sell’ WG results (LTO-02, 03, and 06)

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WORKPLAN
WORKING GRUP-3
(E\I&C)

First Meeting of WG-3

06.05.2004

Content

- **General information**
- **Scope of activities**
- **Tasks**
- **Milestones and Deliverables**
- **Conduct of WG-3 Activities**
- **WG-3 schedule (proposal)**

General information

- **WG-3** (Electrical Components and Instrumentation and Control Systems)- 10 members from 6 countries + EC(JRC)
- **Objective** - develop tools (procedure and recommendations) for:

1. identification of safety criteria and practices for E\I&C associated with LTO PWR
2. Assist Regulators and Operators in ensuring that the required safety level is maintained during LTO

Scope of activities

- Safety related SSC (E\I&C) important for:
  - Integrity of the reactor coolant pressure boundary;
  - reactor shut down, maintain the safe shat down condition;
  - Prevent or mitigate the consequences of accidents

- Nonsafety-related SSC whose failure:
  - Could prevent satisfactory accomplishment,
  - or initiate challenges to,

  safety functions defined above;

Scope of activities (cont.)

- Other areas, inclusive SSC (E\I&C), essential for safe operation of the plant, such as:
  - fire protection;
  - environmental qualification;
  - pressurized thermal shock;
  - anticipated transients without scram;
  - severe accident management;
  - station blackout.

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Scope of activities (cont.)

E\I&C SSC important for perform the function, described above (examples):

- Electrical power supply supporting systems and components (invertors, generators, motors, batteries, circuit breakers, motor control centers, cables, etc.);
- I&C systems and components (sensors, trnsducers, electronic modules, controlers, cables, etc)

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Tasks

- **Task 1** (Collect information)
  - collect available information related ageing and ageing management of E\I&C (laws, regulatory requirements, processes and practices, operational experience, readily available research);
  - agreement the format and content of the final documentation *(separate meeting)*
  - develop SRP, which will consist (in general):
    - sorting the information,
    - review and compare information for identify similarities and differences,
    - investigate the reasons for those differences

Tasks (cont.)

- **Task 2** (Review and compare information)
  - review in accordance with SRP:
    - agreement on the format and content of the documentation (separate meeting);
    - each WG-3 member will prepare their findings and forward to Chairman and Secretary;
    - after review they (C&S) distribute findings for other WG-3 members;
  - agreement on the integrated review results (separate meeting);
  - reported to the Steering Committee the compilation review results and distribute to the WG members.

Tasks (cont.)

- **Task 3** (Develop recommendations and guidelines - final report)
  - One part - summarize the regulatory requirements, approaches and laws;
  - One part - summarize the operational approaches? Processes, practices and experience (strengths and weaknesses)
  - One part - summarize the research activities;
  - One part will:
    - provide recommendations about effective program to manage aging for E\I&C;
    - explain how it coordinate with regulations;
    - describe way for jointly (Regul.&Oper.) activities

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Milestones and Deliverables

- **Task 1**
  - Milestones
    - Complete draft SRP;
    - Finalize SRP and submit to Steering Committee;
    - Complete information collection process;
  - Deliverables
    - report outlining the SRP (to SC);
    - report on collection of information (to SC).

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Milestones and Deliverables (cont.)

- **Task 2**
  - Milestones
    - Complete initial analysis and identify needed additional information;
    - Complete individual WG members review;
  - Deliverables
    - individual reviews completed and entered on web-site;
    - All individual reviews results compilation and reported to SC.

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Milestones and Deliverables (cont.)

- **Task 3**
  - Milestones
    - Complete WG-3 draft report;
    - Finalize Report parts ;
  - Deliverables
    - Final Report (4 parts);
      - One part - summarize the regulatory requirements, approaches and laws;
      - One part - summarize the operational approaches? Processes, practices and experience (strengths and weaknesses)

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Milestones and Deliverables (cont.)

- One part - summarize the research activities;
- One part will:
  - provide recommendations about effective program to manage aging for E\I&C;
  - explain how it coordinate with regulations;
  - describe way for jointly (Regul.&Oper.) activities

Conduct of WG-3 Activities

- Use electronic communication as mach as possible;
- IAEA will be set and manage web pages:
  - for finalized information (open access);
  - for exchange of working information among WG members (password access);
- Number WG-3 meetings are limited, important fully preparedness each member for business;
- Translation of large amount of documents is impractical.
- Not expected reviewed all information each member.
- Important to follow the SRP;

Conduct of WG-3 Activities (cont.)

- For disagree resolve it required the members offer;
- It possible involving additional experts;
- Important that members provide input to the Chairman and Secretary in a timely manner ;
- The members should provide their input to the Chairman and Secretary at least one month prior to the indicated in the overall WG schedule

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WG-3 schedule (proposal)

- **Task 1** 16.09.2003 - 30.06.2004
  - Kick-of-Meeting in Vienna - 10.02.2004 - 12.02.2004
  - Data coll.Mtg. Vienna - 03.05.2004 - 05.05.2004
- **Task 2** 01.07.2004 - 30.06.2005
  - Anal. Info. Mtg. US - 09.08.2004 - 13.08.2004
  - Anal. Info. Mtg. Kyiv - 01.04.2005 - 15.04.2005
- **Task 3** 01.07.2005- 30.06.2006
  - Res. SC comm. Mtg. Vein. - 17.10.2005 - 21.10.2005

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I&C-Modernisation

Presentation at IAEA
Vienna Febr. 10-12 2004

OKG/ Lars-Olof Ståhle

NPP's in Sweden

- **Oskarshamn 1**- 1972 BWR- 500MW
- **Oskarshamn 2** – 1974 BWR –622 MW
- **Oskarshamn 3** – 1985 BWR – 1200 MW

- **Ringhals 1** – 1973 BWR - 750 MW
- **Ringhals 2** –1978 PWR- 900 MW
- **Ringhals 3** – 1980 PWR – 980 MW
- **Ringhals 4** – 1982 PWR – 980 MW

NPP's in Sweden

- **Barsebäck 2** – 1977 BWR- 622 MW

- **Forsmark 1** – 1980 BWR - 1000MW
- **Forsmark 2** – 1981 BWR - 1000MW
- **Forsmark 3** – 1985 BWR- 1200 MW

Modernisation at O1

-1979 Cable separation including new cooling pumps

- **New buildings**
- **Relay Technologies**
- **New signals to RPS**

Modernisation at O1

- 2002 One year Outage for modernization of Safety Systems

A modern Safety Concept including:

- New RPS
- New ESFAS
- New Neutron Flux Instrumentation
- New I&C for Rod Control

A modern Safety Concept including:

- 2 new diesel engines and upgrading of the old ones
- New building with 9 floors
- New seismic qualified Control Room (back-up)
- New Switchgears for Safety Systems

New Safety Report

- New System Descriptions
- New Safety Analysis
- New PSA the goal was to reach less than 10^{-5}

Engineering

- The Safety Concept by Framatome The Hardware from ABB-Atom later Westinghouse building
- The Building and Process changes from Framatome
- Succeeded to find cable routes (4 divisions) from the new building to the reactor systems in the containment and in the reactor building.

Modernisation at O2

- So far no bigger modernization steps.
- Have change the Turbine Regulator 1994
- Separate the Auxiliary Feed Water Pumps from ordinary electrical buildings

Planning to change:

- Turbine Logic and Sequence system 2007
- Feed water- and Power regulators 2005
- Rod control 2007
- Generator Auxiliary Generator Systems 2006
- Excitation system 2005

The Safety Systems will probability be upgraded 2010-2013 depending on the new directions from the Authorities

LOS 2004-05-06 11

OSKARSHAMN 3

- 2001 New Neutron Flux Systems
- 2004 New Feed water and Power control

LOS 2004-05-06 12

Planning to upgrade the Power from 109-125% 2008 –2010

New Turbine
New Generator
New Transformers

In money 2/3 of the investments can also be categorized as changes because of aging.

Ringhals 1

New Reactor Protection System 2005 or 2006.

Shall work in parallel with the old relay based system

Ringhals 2

Total change of all electrical and I&C systems.

Installation 2008

ABB AC 160 in the RPS

Westinghouse Ovation for the Non 1E systems

BARSEBÄCK 2

The Plant equal as Oskarshamn 2 and have more or less make the same action as in Oskarshamn.

Also planned to change the Turbine Logics and Sequence in 2007

FORSMARK 1 AND 2 (twins stations)

- Have change the Turbine island in steps.
- Have installed a common platform ABB Advant
- Problems with different versions. Decided to upgrade and than freezing the platform for about 5 years.

LOS 2004-05-06 17

FORSMARK 3(same design as Oskarshamn 3)

- Control Rod
- Turbine Regulator

LOS 2004-05-06 18

RINGHALS 3 AND 4

The planning is unknown.

SALTO – WG 3
IAEA 10÷12 Feb 2004

MS: The Czech Republic

WG member: Petr Závodský
ČEZ, a. s. – Nuclear Energy Division
zavodp1.ete@mail.cez.cz

The Czech Republic & ČEZ, a. s.

ČEZ, a. s.

- **Installed power capacity:**
  - The Czech Republic ~16 300 MW
  - ČEZ ~11 100 MW
- **ČEZ production in 2003 - 60,9 TWh (2002 54,1 TWh)**
  - NPPs 25,9TWh (i.e. 42,5%)

    (compared to 34,6% in ´02)

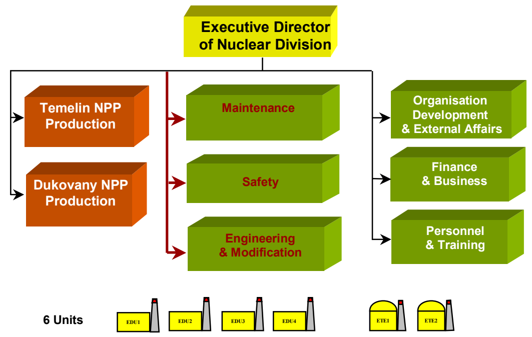
    2004 the goal is 26,6 TWh

Nuclear Energy Division Strategic Goals

- **Short-term goals is:**
  - Stabilised the operation of NPP Temelin
  - Dukovany NPP will be among the top 20 percent of the best operating nuclear power plants world-wide
  - Optimization of organization structure and proceses until 2005
- **Long-term is:**
  - Continue the Dukovany station operating until at least 2025
  - Continue the Temelin station operating until at least 2045

ČEZ, a. s. – Nuclear Division

- As of 1st January 2004 the new organisation structure has been implemented;



PLEX/SALTO in ČEZ

- Working group inside the ČEZ has been established.
- There are 5 working groups, where the groups 1÷4 cover the same topics as IAEA WG and the Group No. 5 covers „Analysis and Assessments“.
- There is nominated leader of each group, Each Group constitutes of up to 9 members.
- First task is to prepare data for SALTO National Report.

IAEA EXTRABUDGETARY PROGRAMME ON SAFETY ASPECTS OF LONG TERM OPERATION OF PWRs

Working Group 3

IAEA, Vienna, Austria, 10-12 February 2004

ELECTRICAL AND I&C EQUIPMENT QUALIFICATION AND AGEING MANAGEMENT AT CEZ NPPs

MS: CZECH REPUBLIC
WG Member: Jan Fridrich
Nuclear Research Institute Rez near Prague (e-mail: fri@ujv.cz)
Representing: Regulatory Body (SUJB, Czech Republic)
TSO

Objective

- Electrical and I&C Equipment qualification programmes at Dukovany and Temelin NPPs
  - Scope
  - Methods
  - Current status
- Cable ageing management programmes at Dukovany and Temelin NPPs

CEZ NPPs Operational Status

- Dukovany NPP
  - 4 units PWR type WWER440 V213
  - Operation since 1985 – 1988
  - Design life 30 years
  - Strategic goal – operation till 2025
  - EQP started in 1995
- Temelin NPP
  - 2 units PWR type WWER1000 V320
  - Operation since 2002 – 2003
  - Design life 30 years
  - Strategic goal – operation till 2045
  - EQP started at design stage

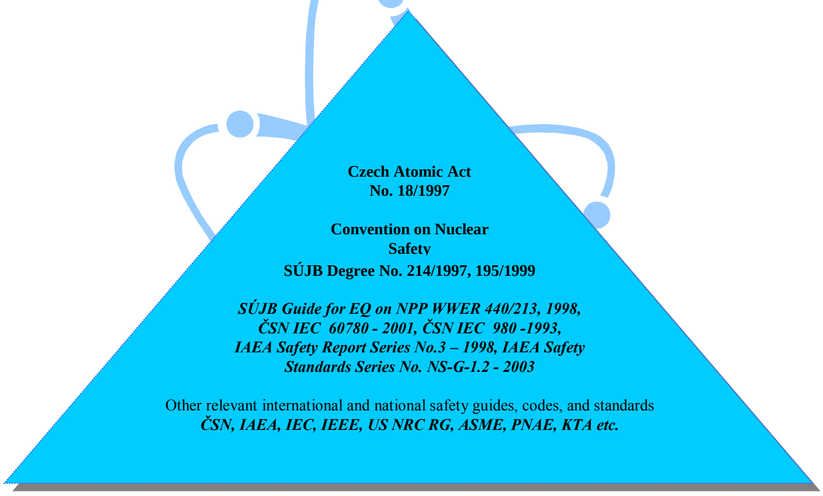
Scope of EQ Programmes

- Electrical, I&C and mechanical equipment important to safety:
  - Environmental qualification
    - Mild
    - Harsh
  - Seismic qualification
- EMC qualification of electrical and I&C equipment

Generic Principle of EQP

- Qualification tests preferred
  - Initial reference tests
  - Functional operating limit tests
  - Ageing tests (thermal, operational, irradiation)
  - DBA and post DBA (seismic, irradiation, thermodynamic)
- Analysis
- Operating experience

EQ Requirements, Codes and Standards



Environmental Qualification

Standards, Regulatory Guides:

- **CSN IEC:** 60780 - 2001, CSN EN 60068-1 to 5 – 1995 to 2002
- **IAEA:** IAEA Safety Report Series No. 3 – 1998
- **IEEE:** Std 323-1983, Std 382-1996 (1985), Std 383-1974, Std 627-1980,…
- **ASME:** QME-1-2002, (1996) Qualification of Active Mechanical Equipment in NPPs
- **Russian:** OTT-87, (82) General technical conditions for nuclear valves
- **KTA:** 3503, 3504, 3505, 3703
- **US NRC:** RG 1.89, RG 1.131, RG 1.156

Seismic Qualification

Standards, Regulatory Guides:

- **CSN IEC:** 980 – 1993 (or IEC 980-89)
- **IAEA:** IAEA Safety Standards Series No. NS-G-1.6 - 2003
- **IEEE:** Std 344-1987 (1975), Std 382-1996 (1985)
- **ASME:** BPVC Section III, Division 1 and QME-1-2002,
  Russian: PNAE G-7-002-86 (or equivalent IAE standards), OAG 130-003, OTT-87
- **KTA:** 2201.4
- **US NRC:** RG 1.100,

EMC Qualification

- **Czech Government Order No. 169/97 establishing EMC requirements for product manufacturing. The regulation is derived from EU guideline 89/336/EHS. The regulation states that:**
  - **Electric and electronic equipment must be made to generate only electromagnetic interference within the permissible levels allowed for radio-communication, telecommunication or other instruments**
  - **Equipment shall have a required resistance to the electromagnetic interference to allow an operation in a compliance with the considered purpose and specification.**

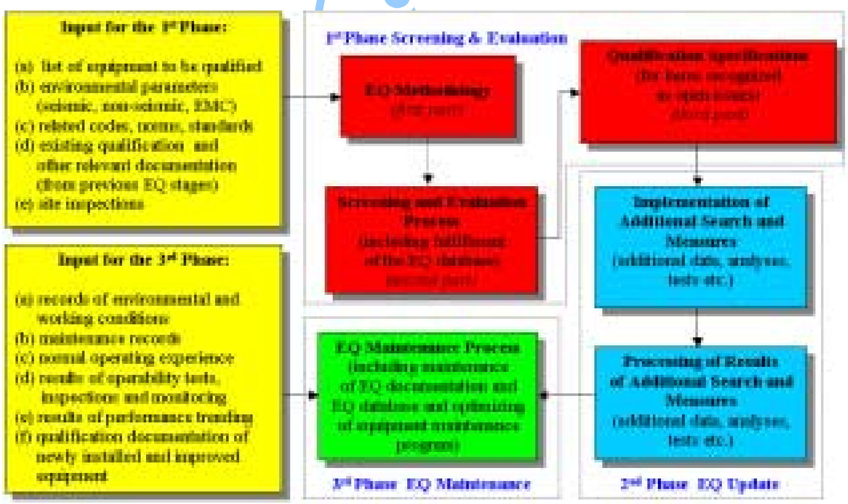
Standards for equipment EMC immunity

EMC test/criteria	ČSN/IEC Standard	FSAR Contract
ESD Immunity	ČSN EN 610004-1,2 IEC1000-4-2	IEC801-2
Radiated RF EM Immunity	ČSN EN 610004-3 IEC1000-4-3	IEC801-3
EFT/B for I/O Cables and EFT/B for Power Supplies	ČSN EN 610004-4 IEC1000-4-4	IEC801-4
Combination Wave Surge for Power Supplies	ČSN EN 610004-5 IEC1000-4-5	ANSI/IEEE C62.41
Power Frequency Magnetic Field	ČSN EN 610004-8 IEC1000-4-8	----
Pulse Magnetic Field	ČSN EN 610004-9 IEC1000-4-9	----
Damped Oscillatory Magnetic Field	ČSN EN 610004-10 IEC1000-4-10	----
Oscillatory Wave Surge for Power Supplies and for Output Signal Lines	ČSN EN 610004-12 IEC1000-4-12	ANSI/IEEE C62.41

Standards for equipment EMC environment monitoring

- **CSN IEC 816 Guide on networks of measurement of short duration transients on low voltage power and signal lines**

NPP Temelin EQ Proces general flow chart



NPP Temelin evaluation of EQ status

(A) Documentation in which seismic, environmetal and EMC requirements are specified	(B) Documentation in which the conformance with specific requirements are documented
a) design specifications (so-called technical conditions issued from the beginning of 80's) b) individual quality assurance programs for NPP Temelin equipment c) preliminary and final design documents (drawings, reports) d) special documents prepared by EGP (list of equipment to be qualified with their classification, environmental parameters – seismic, non-seismic, EMC) e) initial EQ documents prepared by Westinghouse f) programs of pre-operational testing	a) existing qualification and other relevant documentation (mainly from previous EQ stages) – specific qualification reports – prototype test reports (material, type, production and certification tests) – analyses reports – technical passports of equipment b) quality assurance documents c) documentation of pre-operational testing d) summary reports about seismic adequacy and EMC reports (protocols)

Equipment item is qualified when the conformance with requirements specified in the documentation (A) is clearly demonstrated in the documentation (B) without any deficiencies.

NPP Temelin Summary of Open Issues

- **Environmental and seismic**
  - **Some MOV actuators located in harsh environment qualified in accordance with OTT-87 (the documentation is not complete according to the currently valid requirements)**
  - **Equipment (1 sensor, 1 transmitter, 1 fan driver) located in harsh environment but qualified only for mild conditions**
  - **Corrective measures necessary, no impact on nuclear safety for a limited time period demonstrated and documented**
- **EMC EQ completed and documented**

NPP Dukovany EQ Programme

- EQ List, Analysis of accident conditions, Methodology, EQ Groups, Qualification requirements
- Initial EQ status
- Equipment Type tests, EQ documentation files
- Requirements for procurement of new equipment
- EQ documentation data management

NPP Dukovany Mild Environment and Seismic Qualification

- Environmental qualification by aging simulation tests, walk down inspections, in site measurements, survailance, maintenance, QA evaluations and operating experiences
- Seismic qualification by
  - SMA calculations for verification of integrity of mechanical equipment
  - Screening verification and walk downs as required in the GIP modified for VVER
  - Verification of functionality, anchorage and seismic interaction
  - Seismic tests for electrical and I&C equipment

NPP Dukovany Results of Seismic Qualification

- Good seismic resistance of small electrical components and I&C (switches, relays, circuit breakers, etc.)
- Insufficient anchorage to the building for the most of electrical and I&C cabinets, racks, transformers and part of mechanical equipment

NPP Dukovany Harsh Environment Qualification

- EC Phare Project 2.03/95 – (1998-1999)
- Managed by Tecnatom, S.A., Spain and IVO Power Eng. Ltd, (now Fortum), Finland
- Qualification of safety-related I&C equipment located in the confinement which must withstand accident conditions
- EQ technology transfer to local organizations
- Review results of the work previously performed in EQP

NPP Dukovany Phare Activities and Benefit

- Initial EQ training course and on the job training:
  - Current EQ practices
  - EQ engineering - Specification,Testing procedures, QA inspection point programs
- Master List of I&C equipment review
- Environmental parameters evaluation
- Equipment type testing
  - 15 cable types
  - Rebuild cable penetrations, solenoid valves, connection boxes
  - Thermocouples with compensation boxes and connectors
  - MOV actuators
- EQ documentation
  - Final Qualification Report, EQ Files

NPP Dukovany Results of EQP

- Current EQ status for approx. 2100 equipment per unit within EQ list established
- All equipment from EQ list classified in following categories
  - Qualified
  - Qualified if specified conditions are fulfilled
  - Non qualified
- EMC qualification mostly on the level of requirements valid at the time of design and construction

NPP Dukovany EQP Current Activities

- Preserving EQ status for qualified equipment
  - Surveillance and maintenance
  - Cable ageing management programme
- Corrective measures for others
  - Implementation of qualified spares in the in-plant installed solenoid valves and connection boxes
  - Rebuilding of the in-plant installed cable penetration
  - Modification, upgrading, rebuilding, protection or requalification
- Long terrm Project of upgrading of I&C
  - Complete replacing of control and protection systems for digital, qualified for LTO

Cable Ageing Management Programme (CAMP)

- No national I&C specific ageing managements guidelines – IAEA Programmatic Guidelines and TECDOCs as 1188 for I&C cables used
- Uncertainties in the qualified life prediction (high acceleration factors for TA, RA, dose rate effect, design environmental parameters)
- Environmental monitoring on cables hot spots
  - T and RH data loggers , IR dosimeters, Co or Ni foils for neutron fluxes
- Preageing of cable samples in the low intensity irradiation chamber to an equivalent period of 17 years in operation for Dukovany NPP
- Installation of the preaged samples into the cable deposit on the plant
- Periodical environmental and condition monitoring of cable samples in the deposit
- LOCA survival tests depending on samples conditions
- Preparation of software for residual life assessment of safety related cables and cable database

CAMP at Temelín NPP

- Cable deposits
  - 4 ring shape near SG
  - 5 others
- 13 representative cable types installed in deposits
- Environmental monitoring
- Initial values of condition indicators determined:
  - Mechanical (EAB, indentor)
  - Electrical (OIT/T)
  - Physical – chemical properties (density, gel content)
- Periodical condition assessment
- Software for cable lifetime assessment

General presentation of the NPP lifetime extension in Ukraine

- ACTIVITIES
- PERSPECTIVE. STRATEGY
- DIAGRAM
- STRUCTURE.

ACTIVITIES

At present, our company operates 13 power units on 4 nuclear plants in Ukraine, which are equipped with reactors of WWER-1000 and WWER-440 type. The installed capacity of NPPs accounts for 22.7% of the overall power structure in Ukraine. In 2002 the NPPs generated 77 990 M kW-h of electricity, or 45.1% of the total electricity output in Ukraine. Now the lifetime of the most part of nuclear power units in Ukraine has exceeded a half of their design term. For all NPPs that are in operation, the design life term will expire by 2025.

PERSPECTIVE. STRATEGY

The lifetime of different types of electrotechnical equipment, including E, I&C of power unit is given in passports and specifications (manufacturer's documents) for these elements (10, 12, 15 or 20 years for many of them). Established lifetime (term of operation) implies periodic service, control and repairing.

To extend the lifetime of power unit it is necessary to carry out grounding works (inspection) and to set the new lifetime for elements of unit or to replace elements with expired residual lifetime and further to manage operational characteristics of these elements.

Diagram 1

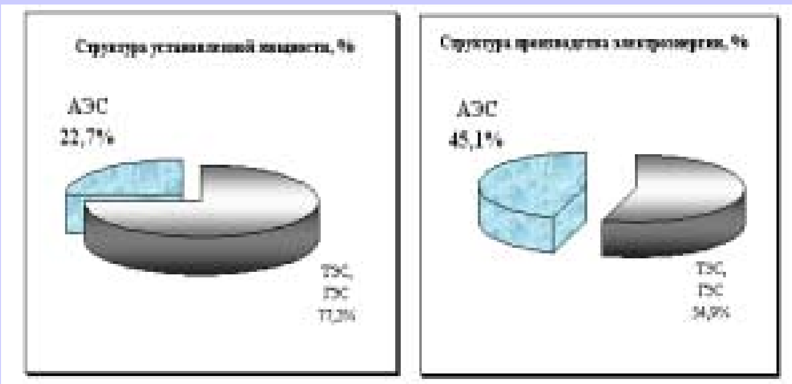
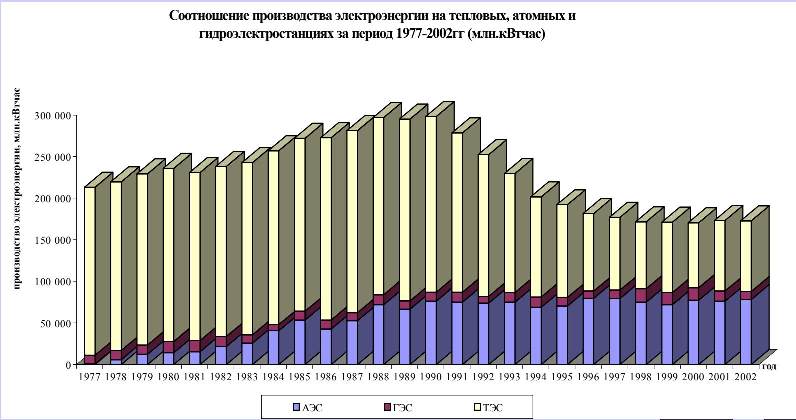


Diagram 2



STRUCTURE.

My department is called “The management of lifetime extension”. Within the frame of this direction the department operates and coordinates work on the equipment aging management (Decision on the equipment lifetime extension).

The work is carried out according to the requirements of a Regulating body (RB) – Ukrainian State Committee of Nuclear Regulation.

Document structure

Conducting of inspection of equipment technical condition according to the "Program..." includes the following stages:

- **Security measures and condition of conducing of work;**
- **Check of technical specifications;**
- **Check of observance of operational conditions;**
- **Check of observance of technical service and repair regulations;**
- **Volume, sequence and methods of conducing of tests;**
- **Check of completeness and condition of SPI;**
- **Conducting of the analysis of operational reliability;**
- **Criterion of an opportunity of lifetime extension;**
- **Requirements to the registration of the documents of work results and on lifetime extension.**

The program contains all necessary attachments:

-Circuit of electrical equipment, E,I&C;

-Plans of tests of the equipment;

-Form of the certificate of technical inspection with the recommendations and conformity of the equipment to the requirements of the project and operational documentation;

-Form of the protocols of tests with obligatory conclusion about possibility of extension of equipment lifetime;

-Lists of separate elements of the structure (for complexes or systems);

-List of reference documentation.

Table 1

The name of operation of the test (check)	Number of item of "Program..."
1 External survey	6.3.
2 Measurements of electrical resistance of insulation	6.7
3 Checks of functioning of the power unit at decreased entrance voltage and increased feeding power supply	6.8
4 Checks of formation of an outlet signal at decreased resistance of insulation	6.9
5 Checks of functioning of an auxiliary power supply unit	6.10
6 Checks of formation of calling signal during functioning of blocks in equipment boxes	6.11
7 Checks of functioning of the block in the mode of insulation control at voltage "+ 48 V"	6.12

U. S. License Renewal Process

Developed by P.T. Kuo

Presented to Working Group 3 –

Safety Aspects of Long Term Operation

February 10, 2004

by

Bob Moffitt,

Pacific Northwest National Laboratory

Battelle

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Presentation Outline

- Background and overview
- License Renewal Rule (Rule)
- Guidance Documents
  - Generic Aging Lessons Learned (GALL) Report
  - Standard Review Plan for License Renewal (SRP-LR)
  - Regulatory Guide 1.188
  - NEI 95-10
  - Interim Staff Guidance
- Summary

What is License Renewal?

- Atomic Energy Act of 1954
  - 40-year license to operate
  - Allows for renewal
- License Renewal Rule allows new license to be issued to operate for up to 20 years beyond the current term
- Application submittal requirements
  - Not earlier than 20 years before expiration of current license
  - Not later than 5 years before expiration of current license for timely renewal provisions

Significant Basis of Life Extension

- Existing regulatory process is adequate for ensuring safety of operating plants
- Current licensing basis (CLB) is adequate and carries forward into the period of extended operation
- Issues relevant to the current operation of plants will be addressed by the regulatory process, which will carry forward into the period of extended operation.

License Renewal Regulations

- Safety Review of Renewal Application
  - Safety Evaluation
  - Hearing Opportunity
  - Advisory Committee on Reactor Safeguards (ACRS) review
  - Inspection Verification
  - Commission approval
- Environmental Impacts of Renewal Application
  - National Environmental Policy Act (NEPA)

Principles of License Renewal

- The regulatory process is adequate to ensure that the licensing bases of all currently operating plants provide and maintain an acceptable level of safety, with the possible exception of the detrimental effects of aging.
- Plant-specific licensing basis must be maintained during the renewal term in the same manner and to the same extent as during the original licensing term.

Scope of the License Renewal Rule

- Safety-related systems, structures and components relied upon to:
  - Maintain integrity of the reactor coolant pressure boundary
  - Ensure capability to shut down and maintain a safe shutdown condition
  - Prevent or mitigate offsite exposures comparable to 10 CFR part 100 offsite dose analyses for siting
- Nonsafety-related systems, structures and components whose failure could prevent safety-related function as outlined above

Scope of the License Renewal Rule

- Systems, structures and components relied upon for compliance with regulations:
  - Fire protection (10 CFR 50.48)
  - Environmental Qualification (10 CFR 50.49)
  - Pressurized thermal shock (10 CFR 50.61)
  - Anticipated transients without SCRAM (10 CFR 50.62)
  - Station blackout (10 CFR 50.63)

Integrated Plant Assessment (IPA)

- Identify and list structures and components subject to an aging management review (AMR)
- Describe/justify methods to identify structures and components subject to an AMR from those systems, structures, and components within the scope of the rule
- Demonstrate effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation

Time-limited Aging Analyses (TLAAs)

- Definition
  - Involve systems, structures and components within the scope of the rule (not limited to passive and long-lived),
  - Consider the effects of aging,
  - Involve time-limited assumptions defined in the current operating term,
  - Determined by licensee to be relevant in safety determination,
  - Involve conclusions related to performance of intended functions, and
  - Contained or incorporated by reference in CLB

TLAAs (continued)

- Applicants are required to provide a list of TLAAs in the LRA
- The TLAAs demonstrate that
  - Analyses remain valid for the period of extended operation,
  - Analyses have been projected to the end of the period of extended operation, or
  - Effects of aging on the intended functions will be managed during the period of extended operation

Other Requirements of the License Renewal Rule

- Final Safety Analysis Report (FSAR) Supplement
  - Summary description of the programs and activities for managing the effects of aging and evaluation of TLAAs
- Technical Specification Changes
  - Changes and their justification necessary for managing the effects of aging during the period of extended operation

Standards for Issuance of Renewed License

- Actions have been or will be taken to
  - Manage the effects of aging during the period of extended operation on the functionality of structures and components
  - Evaluate TLAAs that required review
- Reasonable assurance that activities authorized by the renewed license will continue to be conducted in accordance with the CLB

GALL Report

- Catalog of generic aging management evaluations
  - Builds on previous aging studies
  - Reviews aging effects
  - Identifies relevant aging programs
  - Evaluates program attributes to manage aging effects
- Evaluation Conclusion
  - Program is adequate and no further evaluation is needed, or
  - Program should be augmented or new program considered

GALL Report (continued)

- Table of Contents

Standard Review Plan (SRP-LR)

- Guidance is consistent with NUREG-0800 Format
- Includes guidance for the following review sections
  - Areas of Review
  - Acceptance Criteria
  - Review Procedures
  - Evaluation Findings
  - Implementation
  - References

SRP-LR (continued)

- Provides staff guidance in reviewing license renewal applications
- References GALL report for generic aging evaluations
- Focuses on areas where programs should be augmented
- Incorporates lessons learned from initial license renewal reviews

Program Attributes (SRP-LR, Section A.1)

- Scope of program
- Preventive actions
- Parameters monitored or inspected
- Detection of aging effects
- Monitoring and trending

Program Attributes (continued)

- Acceptance criteria
- Corrective actions
- Confirmation process
- Administrative controls
- Operating experience

Regulatory Guide 1.118 & NEI 95-10

- RG 1.188 endorses NEI 95-10, Revision 3, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule"
- NEI 95-10 provides guidance to applicants in preparing their license renewal applications
  - Standard format of license renewal application
  - Active/passive component determination table (Appendix B to 95-10)
  - Consistency with other license renewal guidance documents

Interim Staff Guidance (ISG)

- Provides guidance on generic, technical issues that emerge between revisions of the license renewal guidance documents
- Contain guidance that current or future applicants need to address
- May have to be addressed by licensees with renewed license
- Currently:
  - 5 ISGs approved
  - 15 (roughly) ISGs in review
- Approved ISGs are available on the NRC web site

ISG Process

- Provides a structured approach to developing interim staff guidance
- Allows for stakeholder input
- Addresses implementation for future and current applicants
- Addresses FSAR update for newly identified information for plants with renewed licenses

Summary

- License renewal is a proven option for meeting power demands while maintaining public health and safety
- Stable and predictable
- Allows for public scrutiny and participation
- Meets agency goals of
  - Maintaining public health and safety
  - Enhancing public confidence
  - Increasing effectiveness and efficiency
  - Reducing unnecessary regulatory burden

EUROPEAN COMMISSION
Joint Research Centre

Joint Research Centre

EC Contribution
to Nuclear Safety & Nuclear Power

by
Brian FARRAR (EC/JRC-IE)

IAEA Extrabudgetary Programme on Safety Aspects of Long Term Operation of Pressurised Water Reactors	***Electrical Components and I&C WG3***

Institute for Energy

EUROPEAN COMMISSION
Joint Research Centre

Joint Research Centre

Summary

- *About the EC/JRC-IE*
- *Activities in the “sector”*
- *Component classification & qualification*
- *ISI and NDE techniques*
- *Maintenance*
- *Ageing*

EUROPEAN COMMISSION
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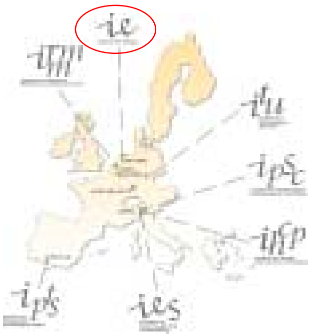
Joint Research Centre

About EC/JRC-IE

- *IE is one of the 7 Institutes of the JRC, located in Petten (NL)*



Nuclear Energy
HFR
Nuclear safety in the enlarged EU
New nuclear energy systems
Support to TACIS & PHARE

Non-Nuclear Energy
Energy from waste and biomass
Waste incineration
Alternative fuel storage and distribution
Fuel cell performance

Sustainable Energy Technologies Reference and Information System (SETRIS)

- The Institute for Energy provides scientific and technical support for the conception, development, implementation and monitoring of community policies related to ENERGY
- Special emphasis is given on the security of energy supply and sustainable and safe energy production

ie Institute for Energy

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About EC/JRC-IE (Cont[d])

HFR and Reactor Applications
- Fuel & Material irradiation
- New systems
- Materials ageing
- Medical applications
- Neutron methods

Technical & Scientific Support for TACIS & PHARE (TSSTP)
- Design safety
- On-site assistance
- Regulatory authorities and TSOs
- Industrial radioactive waste manag[nt] and decommissioning
- Dissemination of projects results

✓ Assistance to PM cycle (AIDCO / ELARG)
✓ Performance of Projects (DIS./RPV)

Nuclear Safety
- Structural integrity
- Inspection management
- Accident analysis
- PSA / risk assessment
- Computational fluid dynamics
- Advanced reactor concepts
- Data management & dissemination

SAFELIFE
An Integrated JRC-IE Approach to Plant Life Management

Perfect IP & NoE

ie Institute for Energy

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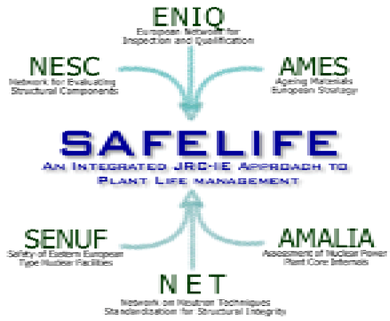
Joint Research Centre

Activities in the sector

- *SAFELIFE focuses on PLIM & includes:*
  - ***Networks**, used to bring together the key players in technical fields, to establish consensus R&D issues and promote best practices*
  - ***Contributions to related Shared-Cost R&D Actions (Integrated Projects and/or Networks of Excellence)***
  - ***Promoting actions to ensure best integration of Acceding Countries (Training & Collaboration)***
  - ***Maintain and Develop the JRC research capabilities & R&D tools (HFR-LYRA, Neutron diffraction & radiography, TEM, SANS)***



10-12/2/2004

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Activities in the sector (Cont^{d})

EURATOM
TREN – RTD
FWP 5 & 6

- *SAFELIFE - Focus (2004 -) & SCAs/IP-NoE*

RPV →
Piping Systems →
Internals →
Weldments →

Integrity assessment
Fracture mechanics
Residual stresses
Thermal fatigue
(Re)-Embrittlement & ageing
In-service inspection
Maintenance

NDE methods for monitoring degradation →
Risk management for PLIM →
Safety culture management for PLIM →
Others →

➢ **Integrated approach to R&D activities on critical issues for PLIM of ageing NPPs (both western and Russian-type)**

➢ **European best-practices and guidelines for deterministic and risk- informed structural integrity assessment of key components**

- ✓ **COBRA (VVER 440 RPV Surveillance temperature & Dosimetry (in-situ)**
- ✓ **GRETE (Round-Robin of NDT for ageing monitoring)**
- ✓ **ATHENA (PLIM/PLEX, VVER 440 RPV embrittlement & re-embrittlement, PRIMAVERA)**
- ✓ **PISA (Phosphorus role on embrittlement)**
- ✓ **FRAME (Fracture toughness trend curve validation)**
- ✓ **REDOS (Reactor dosimetry optimisation)**
- ✓ **THERFAT (Thermal fatigue assessment)**
- ✓ **SMILE (Warm-Prestressing effect)**
- ✓ **FITNET (Neutron techniques for microstructures examination)**
- ✓ **INTERWELD (Irradiation effects on Stainless Steel HAZ)**
- ✓ **ADIMEW (Integrity assessment of dissimilar welds)**
- ✓ **ENPOWER (Optimisation of weld repairs)**
- ✓ **SPIQNAR (Signal Processing & Improved Qualification)**
- ✓ **NURBIM (Risk-based [Informed] Inspection Methodology)**
- ✓ **VOCALIST (Constraint-based structural integrity methodology)**
- ✓ **PERFECT** (Irradiation damage modeling / microstructure > integrity)

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Activities in the sector (Cont[d])

RELEX
AIDCO – ELARG
(1991 -)

JRC – Scientific & Technical Support:
- ✓ Project selection
- ✓ Project Description
- ✓ Specifications (Service & Supply)
- ✓ Tender evaluations
- ✓ Project Management
- ✓ Project Results evaluation & dissemination

- *TACIS / PHARE Nuclear Safety Programmes*

TACIS (2004-06)
- ➢ Enhancing the Safety Culture, both at Regulator & Operator level
- ➢ Addressing Issues related to nuclear waste and spent fuel, including North-West Russia
- ➢ Contribution to relevant EU-supported international initiatives (Chernobyl Shelter Fund, MoU with Ukraine, NDEP Fund, Medzamor)
- ➢ Addressing Safeguards and Off-site Emergency Preparedness issues

- ➢ On-Site Assistance: Contribution to implementation of upgrading / modernisation measures, including licensing
- ➢ Design Safety: Comprehensive Assessment of physical phenomena of structures, systems & components of VVER & RBMK Reactors, PLIM, SR upgrading
- ➢ OSEP: Emergency Crisis Centres Upgrading, including Radiological & Meteorological Monitoring and Data exchange
- ➢ Waste Management & Safeguards: Long-term waste strategies & repositories, decommissioning, NUMAC
- ➢ Regulatory Authorities & TSO: Implementation of the legal and procedural Basis, documentation building & trainig

PHARE (2003)
- ➢ Enhancing the Regulatory Authority Effectiveness
- ➢ Increasing Radiation Protection
- ➢ Improvement of Radioactive Waste Management
- ➢ Heightening On & Off-Site Emergency Preparedness

- RPV embrittlement
- Primary circuit integrity (LBB)
- NDE / ISI
- QA & Component certification
- Maintenance
- RLT assessment

- Reactor core safety analysis
- Accident analysis & management
- Operating procedures & Personnel training

Activities in the sector (Cont[d])

TACIS On-Site Assistance (1)

Enhance operational safety through promotion of an effective safety culture

- *'Soft' on-site assistance:*
  - ***Organisation and management of operational safety***
  - ***Maintenance of systems and equipment***
  - ***Training and quality assurance***
  - ***Operational diagnostics, testing and monitoring of equipment***

- *Upgrading/replacement of systems and equipment:*
  - ***Identification***
  - ***Technical Specification preparation***
  - ***Tendering and procurement***
  - ***Project follow-up***

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Activities in the sector (Cont[d])

TACIS On-Site Assistance (2)

Equipment supply

- *Large number of implemented projects over 10+ years (150+):*
  - ***Some relevant examples:***
    - ***Diagnostic systems, Leak detection, Breakers, Batteries, Fire protection (including cables fire protection), Valves***
- *More recently: large Plant Improvement Projects*
  - ***Russia:***
    - ***Novovoronezh:*** *Unit 5:* ***Replacement digital Reactor Protection System (contracted)***
    - ***Balakovo:*** *Units 1&2:* ***Replacement CIS/SPDS (contracted)***
    - ***Kalinin:*** *Unit 2:* ***Replacement CIS/SPDS***
      Unit 1&2: ***Replacement digital Reactor Protection System***
  - ***Ukraine:***
    - *Khmelnitsky:* *Unit 1:* ***Replacement digital Reactor Protection System***
    - ***Rovno:*** *Units 1&2:* ***Primary circuit overpressure protection system***

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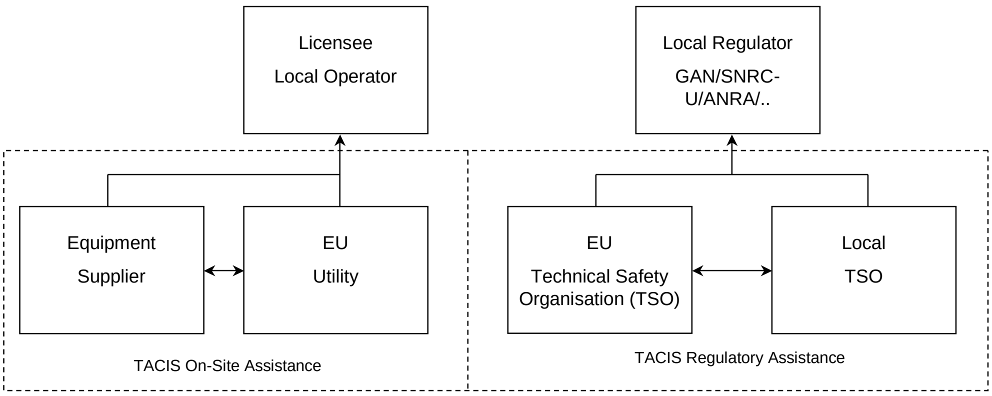
Activities in the sector (Cont[d])

TACIS Regulatory Assistance

Licensing of Plant Improvement Projects using the "2+2" approach



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Activities in the sector (Cont[d])

TACIS Design Safety

Large number of projects implemented. Main areas:

- *RPV embrittlement*
- *Primary circuit integrity (LBB application)*
- *Accident analysis, PSA (including code development/transfer)*
- *Also applicable to PLIM, number of projects on:*
  - ***NDE/ISI***
  - ***QA and component qualification***
  - ***Maintenance***

Component Classification & Qualification

- *TACIS / PHARE*

➢ **Updated Functional & Seismic Classification of Safety Related Components (mechanical & electrical)**

➢ **Re-assessment of Seismic Loading**

➢ **Ad'hoc ageing effects during operation**

➢ **Re-assessment of accidental environment conditions (pressure, temperature, radiation)**

✓ **Re-assessment of accident environmental conditions within the "confined zones" (VVER 440) and containment (VVER 1000), including benchmarking of containment codes (CONTAIN, COCOSYS, WAVCO, MARCH)**

✓ **Reassessment of seismic spectra for component qualification purposes**

✓ **Ad'hoc "Bubble Condenser" qualification tests (EREC)**

✓ **Accident analysis and containment codes upgrading (heat transfer, condensation and hydrogen behaviour models)**

✓ **Elaboration of appropriate qualification programmes for operating NPPs, including:**

- **Random on-site leak tests for piping sections,**
- **Random laboratory tests on typical (removed) sensors,**
- **Systematic laboratory tests on representative spare parts for instrumentation & power cables'**
- **ad'hoc replacement with qualified new components**

✓ **Functional tests of main Safety related Equipment (SG Safety Valves)**

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ISI and NDE techniques

- *TACIS / PHARE*

Main Areas of Activities

- Comparisons of methodologies (East / West)
- Definition and delivery of Qualification blocs / samples and contribution to ISI systems qualification
- Development of automated inspection systems for circular piping welds
- Evaluation of ISI effectiveness / reliability
- Definition of training requirements
- Contribution to the creation of national NDE centres for training, qualification and certification
- Elaboration of improved ISI programmes
- Preparation of technical specifications for ISI equipment and tools
- Procurement of ISI equipment and tools

Main Components

- ✓ VVER 440/213: RPV, Pressuriser (junction to MCL, surge line & nozzle/nozzle dissimilar weld), SG (transition weld, feed-water nozzle transition weld), MCP (inlet circumferential weld, outlet circumferential weld & longitudinal weld in the outlet elbow) & MCL circumferential welds
- ✓ VVER 1000: RPV (core shells, threaded holes), MCL circumferential welds & SG (collector ligaments & tube bundles)
- ✓ RBMK: Fuel Channels & Primary circuit

Main Non Destructive Techniques

- Surface (Visual, Camera, Eddy Current)
- Trough Thickness (Ultrasonic, Radiographic)

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Maintenance

- *SENUF*

✓ New "Forum" promoting *Safety of Eastern European Type Nuclear Facilities* by providing communication between Eastern European Nuclear Operators in Candidate Countries themselves and relations with Major Western European Nuclear Operators

✓ Main objective :Promote safety upgrading by technical exchange between operators

✓ Area of interest: Operational safety (Maintenance is selected as a prime topic)

✓ Working Group on NPP maintenance established (Collaboration Agreement signed by 9 institutes)

Task 1: Advanced strategies to optimise NPP maintenance (Status Report)

- To collect and analyse existing optimisation strategies (e.g. condition based, reliability centred, risk-informed maintenance)
- To identify differences and commonalities in the Western and Eastern European practice
  - *Maintenance management*
  - *Types of maintenance*
  - *Maintenance optimization*
  - *Intolerance of equipment problems*
  - *Long range focus*
  - *Maintenance personnel knowledge and skills*
  - *Efficient and effective work management system*
  - *Maintenance procedures*
  - *Maintenance facilities, tools, equipment*
  - *Procurement of parts, materials and services*
  - *Maintenance history*
  - *Area for improvement*

Task 2: Advanced and special tools, equipment, materials and processes (Database)

- Existence, parameters, experiences, contact person concerning the tools…

Anticipated Reports:

- NPP maintenance in CIS and CEEC (Evaluation report)
- Life management of VVER NPPs (Status report)

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Maintenance (Cont^d)

- *TACIS / PHARE*

43 (+ 2) Projects

- **Countries**
  - Armenia (1)
  - Czech Republic (3)
  - Hungary (1)
  - Kazakhstan (1)
  - Lithuania (1)
  - Russian Federation (23 +2)
  - Ukraine (13)

- **Major Topical Issues**
  - Maintenance management (organisation, optimisation, …)
  - Maintenance personnel training
  - Condition monitoring, Diagnostics
  - Repair technologies
  - Special maintenance tools
  - Maintenance information and management system

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Ageing

- *SAFELIFE*

RPV

- VVER 440 (high P%): Re-embrittlement studies & experiments (Contribution to PRIMAVERA)
- VVER 1000 (High Ni-Mn%): Tailored materials characterisation (as received / after irradiation)
- Recommended procedure for assessment of shallow defects
- Report of 2nd ENIQ pilot study (cladding)

Piping

- Thermal Fatigue: Crack initiation & propagation data evaluation, Plasticity model assessment, Progress report on the Harmonised European Assessment Procedure
- Dissimilar welds: ISI round robin results, Integrity Assessment Report, Status report on advances crack modelling techniques under mixed mode loading, including residual stresses evaluation aspects

RPV internals

- Start-up of the new high pressure / high temperature water chemistry loop (IGSCC)
- Evaluation of the potential experimental capabilities including validation of fracture toughness measurements (Cv / mini Cv / 3-point bend)
- Industrial needs for IASCC

Non Destructive Investigations

- Material damage and stress field evaluation by Non Destructive Methods
- Validation of portable experimental methods (round robins) for various techniques & development of physical (damage) / analytical (stress field) models
- New facilities (SANS / Neutron Radiographie)

New Methodologies and expertise for material characterisation

- Dynamic Toughness Testing
- TEM

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Ageing (Cont^d)

- *TACIS / PHARE*

RPV

- VVER 440/240: Direct Characterisation – Annealing Embrittlement & Re-embrittlement experiments (KZD / NVZ)
- VVER 440/213: Toughness reference curves
- VVER 1000: Nickel effect – Dosimetry benchamarking – Surveillance Programme (SS) Assessment
- VVER 1000 & 440/213: RPV integrity re-assessment including SS results upgrading (RF+U)

Piping (LBB)

- VVER 440/240: Feasibility studies (KZD / NVZ) & Detailed assessment for Medzamor
- VVER 1000: Detailed assessment including material characterisation on mock-ups and preparation of a reference methodology

RPV internals

- Preliminary Safety assessment of aged RPV internals
- Material characterisation and contribution to the understanding of IASCC phenomena

Other aspects

- Cable Ageing: Activation energy characterisation & prediction models
- Lifetime assessment: General approaches on secondary systems (NVZ)

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