IAEA-EBP-LTO-01

18-07-03

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

MINUTES OF THE PROGRAMME'S FIRST STEERING COMMITTEE MEETING

May 2003

INTERNATIONAL ATOMIC ENERGY AGENCY

1. INTRODUCTION

The First Meeting of the Steering Committee (SC) of the IAEA Extrabudgetary Programme on “Safety Aspects of Long Term Operation of Pressurized Water Reactors” (Programme) was held at the IAEA Headquarters in Vienna, Austria, 19- 21 May 2003.

The objectives of the Programme are twofold. First, the Programme should assist regulators and operators of PWRs and, in particular, WWERs in ensuring that the required safety level of their plants is maintained during long term operation (LTO). Second, it should provide generic tools to support the identification of safety criteria and practices at the national level applicable to LTO.

The Programme activities are to be implemented in Working Groups (WG) guided by the Programme Steering Committee (SC).

The purpose of the First Steering Committee Meeting was to initiate the Programme; finalize and approve the Programme Workplan, Appendix I; finalize and approve the Programme Steering Committee Terms of Reference, Appendix II; and, approve a general approach for the Programme implementation.

The Agenda for the Meeting is provided in Appendix III. Minor adjustments were made to the Agenda to accommodate presentation times.

The Meeting was attended by nominated representatives of the participating Member States (MS), and by observers from the Russian Federation and the European Commission. The list of nominated SC members is provided in Appendix IV. The list of attendees of the First Steering Committee Meeting is provided in Appendix V. Copies of the presentation materials are provided in Appendix VI.

2. MEETING SUMMARY

Mr. K. Brockman, Director of the Nuclear Installation Safety Division of the IAEA, opened the Meeting. Mr. R. Havel, the Programme Scientific Secretary, summarized the objectives of the Programme and of the First SC meeting. Mr. F. Gillespie, the SC Chairman, welcomed the participants and started the meeting. The meeting Agenda was adopted without change.

2.1. NATIONAL PRESENTATIONS

Each MS participating in the SCM made a presentation describing the status of its efforts with regard to the LTO of its nuclear fleet, including areas of challenge, and how this EBP can help meet these challenges, Appendix VI. Further, MS representatives provided statements on their country’s views on the EBP and the support they intend to provide.

Ms. Tranteeva stated that Bulgaria supports the Programme and agrees with its objectives as outlined in the Workplan. Bulgaria will provide in kind (experts) and financial contribution to the Programme and is considering hosting a SC meeting. Ms. Tranteeva also agreed to explore the possibility of nominating a leader of the Structural WG.

Mr. Krs stated that the Czech Republic supports the Programme and would appreciate it if the Programme could focus on the exchange of generic information related to PWR LTO issues and on the collection of WWER specific information. Czech Republic will provide in-kind support (cost free experts) and, depending on the final direction of the Programme, is also considering providing financial support. Later on during the discussion, Mr. Krs offered that the Czech Republic will provide an expert to lead the Working Group in the area Mechanical/Materials, but stated priority should be given to the Russian proposal in this area.

Mr. Koponen stated that Finland considers the Programme to be a very important one. Finland will provide in-kind support (cost-free experts).

Mr. Horvath (replacing Mr.Voross during this meeting) indicated that Hungary supports the Programme, and agreed to explore the possibility of nominating a leader of the Structural WG.

Mr. Sorokin stated that the Russian Federation supports the Programme. Later on, the Russian delegation offered a leader for the WG on Mechanical Components/Materials. Mr. Nefedov stated that the Russian Federation would be prepared to provide a cost-free expert to the IAEA to assist with the Programme implementation.

Ms. Ziakova stated that the Slovak Republic supports the Programme.

Mr. Figueras stated that Spain considers the Programme to be an important one and will explore the possibilities of its support.

Mr. Liszka that stated Sweden considers this Programme a very important one and will provide in kind support. Action has been initiated to provide financial contributions to the Programme.

Messrs. Semenov and Shumkov stated the Ukraine is interested in participating in the Programme, and will provide qualified experts to take part in the Programme activities.

Messrs. Gillespie and Reister stated that the U.S. continues to support this Programme and the objectives agreed to by the Steering Committee, and will provide cost free experts to support each of the working groups. The U. S. Government is providing financial contributions. In addition, Mr. Gillespie nominated Mr. P.T. Kuo as the leader for Working Group 1, “General LTO Framework”. Mr. Kuo is the Program Director, License Renewal & Environmental Impacts Program, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission.

France will also participate in the Programme. Mr.D.Queniart, who was nominated to represent France at the SC, could not attend the 1st SC meeting.

2.2. INTERNATIONAL ORGANIZATIONS

International organizations (EBRD, EC, OECD-NEA, and WANO) were invited to attend the meeting with the objective to facilitate co-ordination and avoid duplication of effort.

Messrs. Lopez-Arcos and Bieth presented detailed information on the related activities of the EC, Appendix VI.

WANO representative could not attend the 1st SCM but, indicated that WANO will participate in the future.

The IAEA staff presented to the SC information on IAEA LTO related activities conducted in NSNI (SAS, OSS, and ESS) and NENP (NPES).

2.3. PPROGRAMME IMPLEMENTATION

IAEA proposed a plan to implement the Programme, including tasks, working group structuren, and an accompanying schedule. The Scientific Secretary asked that the SC review and comment on the proposal. After substantial discussion, the SC agreed to initiate the Programme implementation in 4 Working Groups:

WG	Topic	WG lead
WG 1	General LTO framework	USA/P.T.Kuo
WG 2	Mechanical and materials	Russia (Czech Republic)/
WG 3	Electrical and I&C	Ukraine/
WG 4	Structures	Bulgaria/ or Hungary

WG 1 was the main subject of the discussions and a more detailed outline of WG 1 scope was developed and agreed by the SC, Appendix VII.

It was agreed that each participating country would nominate, in principle, one representative in each WG (except Sweden, who intends to participate only in 1 of the WGs).

Before the next SCM, the WG leaders will meet to develop detailed workplans. These Workplans will include objectives and approaches for each WG and a format and structure for the individual WGs to use to facilitate communication among the WGs and provide for coherent reporting (such as the example provided in Appendix VIII.). Other WG members may be called upon to assist WG leaders in this effort. The results will be presented to the next SC for approval.

The next SC meeting will also finalize the schedule of necessary SC meetings during the Programme. Consideration will be given to the needs and availability of individual WGs results. The SC meetings will be held approximately every 9 months.

The SC then reviewed and revised the EBP Workplan and Terms of Reference to reflect the final SC agreements reached, Appendix I and II.

The SC agreed to establish a dedicated Programme web page to promote transparency. The final reports approved by the Steering Committee, including minutes of meetings and approved documents, such as the work scope, will be presented on a openly accessible site. All collected reference materials and draft working group materials will be located on a password-protected site. This will facilitate distribution and coordination. The web pages will be the primary distribution method for materials of general interest.

3. ACTION ITEMS

1. Names of WG leaders will be provided to Mr. Havel by 15 June 2003. Action: USA, Russia, Ukraine, Hungary / Bulgaria.
2. Names of WG members will be provided to Mr. Havel by 15 July 2003. Action: all SC members.
3. Convene the first meeting of WG leaders and, if needed, other WG members before 15 August 2003; if required schedule a second meeting for the mid October 2003 time frame. Action: Mr. Havel.

The 2nd SC Meeting will be held 3-5 December 2003 at the IAEA, Vienna.

The meeting was adjourned at 12:30 pm on May 21, 2003.

APPENDIX I.

WORK PLAN

BACKGROUND

In the1990's, Member States (MS) operating light water nuclear power plants (NPPs) have spent enormous efforts and resources to improve safety of their plants.

Safety improvements were implemented through a number of national, bilateral, and international activities. The IAEA contributed to this effort through its Extrabudgetary Programme (EBP) on the "Safety of WWER and RBMK Nuclear Power Plants".

A common understanding on safety and the safety level to be achieved for these plants for further operation was obtained. This safety level was or is being reached. Current safety standards and recognized international safety practices have been used as a reference to identify safety issues and to develop and implement safety improvements.

Safety concerns identified within the framework of national and international activities were addressed by the safety improvement and modernization programmes established in WWER and RBMK operating Member States. The effort was focused on ensuring adequate levels of safety for operation within the timeframe given by the current licensed period.

A prerequisite for consideration of long-term operation (LTO) is the implementation of the safety improvement programme addressing the safety concerns identified earlier. Similar to several other countries, WWER operators started considering extending plant operation. Russia, the designer of WWERs, took the lead and developed an approach for renewal of the operating licence. This approach was first successfully applied to the oldest operating WWER, and a 5 year licence extension was granted in December 2001 for Novovoronezh Unit 3 (WWER-440/230).

Comprehensive experience on the regulation of LTO has been gathered in the US in the past decade. A regulatory framework was established and successfully applied to renew nuclear power plant operating licences. Some experience related to the safety aspects for nuclear power plant operation beyond the original licence has also been gathered in the UK, Finland, Hungary, and other countries.

While most of the safety concerns related to LTO are understood generically, the current problem is the identification of the vulnerable plant systems, structures, and components (SSC) and the identification of associated safety criteria on a design or reactor type basis.

Decisions on LTO deal with a number of aspects for maintaining plant safety, in particular those related to managing the safety aspects of ageing of items important to safety. The IAEA has recognized the importance of safety aspects of nuclear power plant ageing in the eighties and initiated activities to increase the awareness of the emerging safety concern related to physical ageing of plant SSCs. Numerous publications were issued since that time including guidelines on programmatic aspects, specific components, and ageing management review.

Therefore, the IAEA has initiated this Extrabudgetary Programme to reconcile the regulatory and operational aspects of pressurized water reactors, such as WWERs and PWRs, with regard to LTO. The intention of this programme is to assist MS considering LTO of WWER reactors in establishing licensing frameworks and related processes and practices in countries where such frameworks, processes, and practices are not available, and to promote exchange of information in these areas. An internationally agreed common approach, including regulatory criteria and processes and practices, to support safe LTO, which is not available today, needs to be developed. The common approach will serve as the basis for the Programme, integrating existing best national approaches to identify safety criteria, considering practical applications in MS concerned. The Russian approach for extending the operating license is considered a substantial input to be combined with the experience and expertise of the licence renewal approach of the USNRC and others.

OBJECTIVES

The objectives of the Programme are to assist regulators and operators of NPPs to ensure that the required safety level of their plants is maintained during LTO, and to provide generic tools to support the identification of safety criteria and practices at the national level applicable to LTO.

To achieve this objective, the Programme will:

1. collect available information on the existing approaches to research and development and operational and regulatory aspects related to LTO from the countries participating in the EBP.

2. review and compare existing regulatory approaches and practices to identify common elements, and reconcile differences in safety criteria. Obtain consensus on the main elements of a common framework in connection with LTO by developing and documenting, in a useful format, a corresponding guideline, which could guide development of national licensing requirements and practical applications.

3. Review and compare the existing operator approaches and practices to identify common and most efficient elements. Identify important outstanding issues to be resolved. On the basis of selected common elements, develop corresponding guidelines to assist operators to develop and improve their program and practices needed to support safe LTO.

OUTCOME

The outcome of this Programme will be a Final Report, designed to assist regulators, technical support organizations (TSO), and operators of NPPs in the activities related to LTO, addressing in particular:

1. Review of existing national approaches, practices and experience in all main areas to be considered in decisions on LTO;

2. Guidance for regulators on identification of the applicable safety criteria and establishing guidelines (format and content) for operator submittals needed for the regulation of LTO;

3. Guidance for plant operators on the process and practices needed to support safe LTO.

The success of the cooperative effort will rely heavily on the input of MS having experience in plant design or plant license renewal. The common framework would allow the sharing of approaches against a commonly accepted reference.

APPROACH

The IAEA Safety Guide on Periodic Safety Review of Nuclear Power Plants [1] provides a common understanding of terms, and an appendix that provides a possible example of an index to be used in organizing information and guidelines.

Main tasks of a common framework for LTO

The efforts would focus on the regulation and operation of similar classes of designs. Older western PWRs and WWER-440's would provide information of the greatest near-term value. To support the three objectives described above, the following associated tasks will be implemented for each objective:

1. Collect information

   Each MS participating in this EBP will collect information related to the applicable laws and regulatory requirements, as well as to the processes and practices used to manage ageing effects, related to LTO of NPPs in their respective countries. This will include the identification of information sources. As part of this task, meetings may be held to reach agreement on the format and content of the final documentation. After agreement on the format and content of the documentation, the information will be distributed to all the participants in preparation for Task 2.

2. Review information

   Upon receipt of the information as provided in Task 1, each MS participating in this EBP will review the information from the other MS to determine differences between applicable laws, regulatory requirements and approaches. As part of this task, meetings may be held to reach agreement on the format and content of the final documentation of individual reviews. After agreement on the format and content of the documentation, each participant will distribute its review findings to the other participants in preparation for Task 3.

3. Compare information

   Upon receipt of the information as provided in Task 2, the EBP participants will meet to compare the information assembled in Tasks 1 and 2. This will require meetings to assess and document programmatic and operational differences, clarifying areas of similarity and accurately describing differences. The results of these comparisons will be used in Task 4.

4. Reconcile information

   In Task 4, the EBP participants will reconcile the differences between the regulatory and operational approaches to identify areas where additional information may be needed from individual MS, and identify where additional regulatory and/or operational development may be needed. Documentation of the results achieved in the Working Groups will be incorporated into a draft report for the Steering Committee (SC). Comments and feedback from the SC will be used to prepare the final report.

5.

Based on the information in the final Working Groups' reports, prepare a summary document that describes the various approaches, processes, and practices, including an assessment of strengths and weaknesses. This summary document will (1) provide general guidance to MS with regard to how to set up an effective program to support safe LTO, (2) explain how various programs and practices used by MS need to fit with regulatory criteria and approaches, and (3) describe how these activities can be done jointly between Regulators and Operators.

Each of these steps will require the preparation and distribution of material by MS participating in a working group and meetings to agree to the breadth and scope of the required documentation.

The following main elements have to be addressed by all Working Groups:

Comprehensive plant safety assessment

If re-establishment of the design basis is found necessary, it should be addressed, and upgrading actions taken, in the context of the "Plant Design" safety factor of [1].

The safety factor "Ageing" needs more attention than indicated in [1] in order to be applied for the purpose of plants' LTO.

The role of a comprehensive safety assessment carried out by a MS, is twofold. First, to identify remaining safety concerns left from the upgrading/modernization activities in MS. Second, to identify design-specific LTO related safety concerns.

Managing of plant specific ageing for LTO

Assistance to MS on effectively identifying and managing ageing effects of SSCs is the central element of the common framework for LTO to be developed for operating plants approaching the end of their original license period.

The guidelines for regulators and operators should consider analyses of systems, structures and components with respect to ageing for a specified period of time. The adequacy of these analyses and the measures taken needs to be evaluated to demonstrate that:

- the analyses remain valid for and until the end of the period of LTO; and
- the effects of ageing on the intended functions will be adequately managed for the period of LTO.

Updated FSAR with respect to LTO

The FSAR, as a substitute for the licensing basis (in the USA, as defined in 10 *Code of Federal Regulations* Part 54), is a key input for decision making concerning LTO of a plant. The updated FSAR (e.g. in a form of a supplement), has to be submitted with the application for LTO.

Other key areas related to LTO, such as radiological impact on environment evaluations, etc are country specific and therefore not foreseen to be directly addressed in this Programme.

PROGRAMME ORGANIZATION

A Steering Committee (SC), composed of senior representatives of main Programme participants, will guide Programme efforts. The Programme activities will be conducted in parallel by Working Groups (WGs) dedicated to specific areas. Initially it is expected that four WGs will be formed. One WG will address a generic approach (safety aspects of LTO) and the another 3 will address mechanical/material, electrical/I&C, and structures. Additional WGs may be formed as determined by the SC. WG leaders will attend and report at SC meetings. Representatives of Member States and International Organizations involved on a substantial scale in nuclear safety assistance will be invited to attend SC meetings to facilitate exchange of information, co-ordination, and avoid duplication of effort. For the same reasons, the SC will be also provided with detailed information on related IAEA activities (regular budget and TC projects).

The EBP final report will be published in both English and Russian.

The estimated total EBP duration is 3.5 years including a 0.5 year phasing out period.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Periodic Safety Review of Nuclear Power Plants, Draft Safety Guide DS 307, IAEA, Vienna, in print.

APPENDIX II.

STEERING COMMITTEE TERMS OF REFERENCE

The Steering Committee will guide the Programme implementation. The Steering Committee will be composed of senior representatives of countries participating in the Programme. Working Groups will implement the Programme technical activities. Working Group leaders will attend Steering Committee meetings as required and report on the activities carried out and planned.

The role of the Steering Committee is in particular:

1. to define priorities and determine number and scope of the Working Groups based on the Programme Workplan;
2. to review and approve work plans, reports, and recommendations of the Programme Working Groups;
3. to monitor the Programme progress achieved, collect, co-ordinate, and assimilate the results of Working Groups;
4. to ensure Working Groups identify gaps and overlaps through the exchange of information on related work underway and planned to avoid duplication of effort;
5. to endorse a Final Report of the Programme and advise how the Final Report recommendations could be integrated into existing programmes.

APPENDIX III.

AGENDA

Monday, 19 May 2003

9:30	Opening	K.Brockman
	Meeting objective	R.Havel
	Chairman's address and EBP proposal	F.Gillespie
	National presentations	
10:00	Bulgaria	Ms.R.Tranteeva
10:30	Czech Republic	Mr.P.Krs
11:00	*Coffee break*	
11:30	Finland	Mr.H.Koponen
12:00	Hungary	Mr.K.Horvath
12:30	*Lunch break*	
14:00	Russia	Mr.N.M.Sorokin
14:30	Slovak Republic	Ms.M.Ziakova
15:00	Spain	Mr.J.Figueras
15:30	*Coffee break*	
16:00	Sweden	Mr.E.Liszka
16:30	Ukraine	Mr.Semenov/Shumkov
17:00	USA	Mr.W.Burton
17:30	Discussion	
18:00	*Adjourn*	
18:15	Reception	

Tuesday, 20 May 2003

	International organizations statements	
9:30	EC activities on nuclear safety in CEE and FSU	Mr.I.Lopez-Arcos
	Neutron Embrittlement of VVER RPV-Recent Results, Open Issues and New Developments	Mr.M.Bieth
	Related IAEA activities	
10:15	NSNI/SAS	Mr.F.Niehaus
10:30	NSNI/OSS	Mr.M.Lipar
10:45	Introduction of Major related activities at NSNI/ESS	Mr.T.Saito
11:00	*Coffee break*	
11:30	NENP/NPES	Mr.K-S.Kang
12:00	EBP implementation proposal	Mr.R.Havel
12:15	Discussion	
12:30	*Lunch break*	
14:00	Discussion cont'd	
17:30	*Adjourn*	

Wednesday, 21 May 2003

9:30	Finalization of the EBP draft Workplan, TOR, and implementation plan
11:00	*Coffee break*
11:30	Conclusions
12:00	Final remarks
12:30	*Adjourn*

APPENDIX IV.

STEERING COMMITTEE MEMBERS

Members	
Mr. Sergei Adamchik	GAN, Russian Federation
Mr. William Burton	NRC, USA
Mr. Yury G. Dragunov	OKB Gidropress, Russian Federation
Mr. Jose M. Figueras	Consejo de Seguridad Nacional, Spain
Mr. Frank P. Gillespie	NRC, USA, SC Chairman
Mr. Hannu Kopponen	STUK, Finland
Mr. Petr Krs	SUJB, Czech Republic
Mr. Lars Gunnar Larsson	SIP, Sweden
Mr. Robert L. Moffit	PNNL, USA
Mr. Daniel Queniart	IRSN, France
Mr. Richard Reister	DOE, USA
Mr. Oleksandr Semenov	State Nuclear Regulatory Committee of Ukraine
Mr. Yevhen Shumkov	NAEK, Ukraine
Mr. Nikolai M. Sorokin	Rosenergoatom, Russian Federation
Ms. Radelina Tranteeva	Kozloduy Nuclear Power Plant, Bulgaria
Mr. Lajos Voross	HAEA, Hungary
Ms. Marta Ziakova	Nuclear Regulatory Authority of Slovak Republic

Observers	
Mr. Isidro Lopez Arcos	European Commission
Mr. Michel Bieth	European Commission

APPENDIX V.

FIRST STEERING COMMITTEE MEETING PARTICIPANTS

BULGARIA

Ms. Radelina Tranteeva
Kozloduy Nuclear Power Plant
Safety Department
3321 Kozloduy
Bulgaria
Tel.: +359 973 73870
Fax: +359 973 80718
E-mail: rtranteeva@npp.cit.bg

CZECH REPUBLIC

Mr. Petr Krs
State Office for Nuclear Safety
SUJB
Senovazne Namesti 9
CZ-11000
Prague 1
Czech Republic
Tel: + 420 221 624 207
Fax: +420 221 624 396
E-mail: petr.krs@sujb.cz

FINLAND

Mr. Hannu Koponen
Radiation and Nuclear Safety Authority
STUK
P.O. Box 14
Helsinki
00881 Finland
Tel.: + 358 9 7598 8202
Fax: + 358 9 7598 8216
E-mail: hannu.koponen@stuk.fi

HUNGARY

Mr. Kristóf Horváth
Hungarian Atomic Energy Authority
HAEA
H-1539 Budapest 114
P.O. Box 676
Hungary
Tel.: +36 1 436 4911
Fax: +36 1 436 4909
E-mail: Horvath@haea.gov.hu

RUSSIA

Mr. Nikolai M. Sorokin
State Concern "Rosenergoatom"
24/26 Bolshaya Ordynka Street
Moscow 109017
Russian Federation
Tel.: +7 095 220 6316
Fax: +7 095 220 4027
E-mail: sorokin@rosenergoatom.ru

Mr. Genadij Nefedov
Ministry of the Russian Federation for Atomic Energy
Staromonetny pereulok 26
RU-109180
Moscow
Russian Federation
Tel.: +7 095 239 4065
Fax: +7 095 230 2420
E-mail: erastov@diec.skc.ru

Mr. Sergei Adamchik
Federal Nuclear and Radiation Safety Authority of Russia
RF GOSATOMNADZOR
Taganskaya ul., 34
Moscow
109147
Russian Federation
Tel.: + 7 095 911 1954 / +7 095 911 6021
Fax: + 7 095 912 4710
E-mail: oos@gan.ru

RUSSIA

Mr. Nikolai Pozniakov
State Concern "Rosenergoatom"
Staromonetny per., 26
Moscow
Russian Federation
Tel.: +7 095 239 2606
Fax: + 7 095 239 2668
E-mail: ndolgova@yahoo.com

Mr. Yury G. Dragunov
MINATOM RF, Federal state enterprise
"Gidropress"
Ordzhonikidze street, 21
142103 Podolsk
Moscow
Russian Federation
Tel.: +7 0967 54 25 16
Fax: + 7 0967 54 27 33
E-mail: dragunov@grpress.podolsk.ru

SLOVAKIA

Ms. Marta Ziakova
Nuclear Regulatory Authority
Bajkalska 27
P.O. Box 24
820 07 Bratislava
Slovak Republic
Tel.: +421 2 5342 1032
Fax: +421 2 5342 1015
E-mail: marta.ziakova@ujd.gov.sk

SPAIN

Mr. José M. Figueras
Deputy Director Engineering
Mechanical & Structural Engineering Branch
Consejo de Seguridad Nuclear
Justo Dorado, 11
28040 Madrid
Spain
Tel.: +34 913 46 0204
Fax: +34 913 46 0216
E-mail: jmfc@csn.es

SWEDEN

Mr. Ervin Liszka
Swedish International Project Nuclear Safety
Klarabergsviadukten 90
P.O. Box 70283
Stockholm
S-10722 Sweden
Tel.: +46 8 698 30 82
Fax: +46 8 209 895
E-mail: elk@sip.se

UKRAINE

Mr. Oleksandr Semenov
State Nuclear Regulatory Committee of Ukraine
Arsenalna str. 9/11
Kiev 01011
Ukraine
Tel.: +380 44 254 35 13
Fax: +380 44 254 33 11
E-mail: semenov@hq.snrc.gov.ua

Mr. Yevhen Shumkov
National Energy Generating Company
NAEK "Energoatom"
Vetrova street 3
Kiev 01032
Ukraine
Tel.: +380 44 201 47 57 / 380 44 294 4865
Fax: +380 44 294 48 83

Ms. Viktoria Starostenko
National Energy Generating Company
NAEK "Energoatom"
Vetrova street 3
Kiev 01032
Ukraine
Tel.: +380 44 201 47 57
Fax: +380 44 294 48 83

USA

Mr. Frank P. Gillespie
U.S. Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Mail Stop 0 – 12E5
Washington, D.C. 20555-0001
USA
Tel.: +1 301 415 1267
Fax: +1 301 415 1032
E-mail: FPG@nrc.gov

Mr. William Burton
U.S. Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Mail Stop 0 – 11F1
Washington, D.C. 20555-0001
USA
Tel.: +1 301 415 2853
Fax: +1 301 415 2002
E-mail: WFB@nrc.gov

Mr. Robert L. Moffitt
Pacific Northwest National Laboratory (PNNL)
902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
USA
Tel.: +1 509 372 4108
Fax: +1 509 372 4411
E-mail: bob.moffitt@pnl.gov

Mr. Richard Reister
Director
Office of International Nuclear Safety
NA-231 Germantown Building
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1290
Tel.: +1 301 903 0234
Fax: +1 301 903 4211
E-mail: richard.reister@nnsa.doe.gov

EC

Mr. Isidro Lopez Arcos
European Commission
Directorate-General for External Relations
200, rue de la Loi
B-1049 Brussels
Belgium
Tel: +32 2 296 3793
Fax: +32 2 296 3379
E-mail: Isidro.Lopez-Arcos@cec.eu.int

Mr. Michel Bieth
European Commission
Directorate General JRC
Westerduinweg 3
P.O. Box 2
1755 ZG Petten
The Netherlands
Tel.: +31 224 565 157
Fax: +31 224 565 637
E-mail: michel.bieth@cec.eu.int

IAEA

Mr. Radim Havel - Scientific Secretary	NSNI-ESS
Mr. Ken Brockman	NSNI
Mr. Aybars Guerpinar	NSNI-ESS
Mr. Takeyuki Inagaki	NSNI-ESS
Mr. Ki Sig Kang	NENP
Mr. Miroslav Lipar	NSNI-OSS
Mr. Friedrich Niehaus	NSNI-SAS
Mr. Takehiko Saito	NSNI-ESS

APPENDIX VI.

PRESENTATION HANDOUTS

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

1st Steering Committee Meeting

IAEA, Vienna, 19-21 May 2003
Radim Havel

EBP OBJECTIVE

- Develop an internationally agreed licensing framework to support safe long term operation including related processes and practices
- Assist WWER 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

1st STEERING COMMITTEE MEETING (SCM) OBJECTIVE

- Initiates the EBP
- To finalize the EBP objective, scope and approach taking into account views of all participating MS
- To advise the Agency on the EBP implementation

1st SCM OUTCOMES AND AGENDA

- Approved (and finalized i.a.) EBP Workplan
- Approved (and finalized i.a.) SC Terms of reference
- Finalized and approved EBP general implementation plan
- Agreed first practical steps of EBP implementation, e.g. 1st WG to collect national practices etc., recommend scope, number and focus of WGs of the EBP, develop the long term operation related licensing framework, etc. (incl. WG mtgs, nominations, and approach)

KOZLODUY NPP

Status. Modernization Programs and Evaluation of Rest Life Time

IAEA EBP on Safety Aspects of Long Term Operation of Pressurized Water Reactors,

SCM, Vienna 19- 21 May 2003.

Radelina Tranteeva, Kozloduy NPP

KNPP Units 3 & 4

KNPP operates four WWER-440 reactors, commissioned 1974 – 1982, and two WWER-1000 reactors commissioned 1987 - 1991. On a decision of the Government of Bulgaria Units 1 and 2 were shutdown on 31.12.2002 and brought into Status "E" in conformity of the Technical Specifications. The power station used to produce up to December 2002 more than 45% of the country's electricity.

Unit	Reactor type	Start of operation	Current fuel cycle	Expected end of 30th fuel cycle
Unit 1	WWER-440/V 230	Oct. 1974	Shut down in 2002 /23	-
Unit 2	WWER-440/V 230	Nov.1975	Shut down in 2002/24	-
Unit 3	WWER-440/V 230*	Dec. 1980	18	2015
Unit 4	WWER-440/V 230*	Jun. 1982	17	2016
Unit 5	WWER-1000/V 320	Nov.1987	10	2024
Unit 6	WWER-1000/V 320	May 1991	8	2025

Although Units 3&4 have been traditionally referred to as WWER-440/B-230 model, in their original design there are number of important differences from a standard B-230 model, which makes them closer to B-213 design. Those include a cladded pressure vessel, a functional capability of the safety systems, (3 X 100%, high pressure-low pressure injection), emergency control room, etc.

UNITS 3 AND 4 - IMPROVED DESIGN
Safety systems equal to V-213

- **Three safety systems channels (HPIP, LPIP, SP, EFWP, two SWP, DG, ESFAS)**
- **Simultaneous start of all pumps in one safety channel in case of ECCS actuation signal**

The safety improvement activities at KNPP started in 1991 with the implementation of the three stage **"Short term program for safety**

upgrading"(STP) realized in close cooperation with IAEA, RISKAUDIT, BNSA, GIDROPRESS and Western reactor organizations. The realization of the **STP** between 1991 and 1997 resulted in implementation of more than **800** upgrading measures, which decreased the number of deviations in both the original design and operational safety from the requirements of current standards. In the process of in-depth safety analysis for defining current level of safety a set of specific measures was defined and unified in the **"Complex modernization program"(CMP) for units 1-4 – PRG'97**.

The version **PRG'97/A** of the CMP was created in 1999 and focused on providing adequate reliability of barriers under accident conditions corresponding to all initiative events, on implementation of additional measures to improve reliability of the plant structures, systems and components, and on providing hardware and software for severe accident management to enhance the overall plant safety level.

Considering the inherent safety features of WWER 440 plants and taking advantage of both the specific original design features of KNPP 3&4 and the considerable improvements implemented in the past, in September 2000 KNPP launched the Project PR-B-209M as the last version of the CMP that was aimed at upgrading the original design basis according to international safety practice. This project has been successfully completed.

KNPP 3&4 modernization programs:

Three Stage Short Term Program 1991-1997 – 800 improvements
Complex Modernization Program (CMP) 1997-2002 – 500 improvements
Final goal of the CMP – Upgraded Design Basis – reached in 2002

Examples of involvement of international programmes and organizations in KNPP 3&4 safety are shown in Table 1.

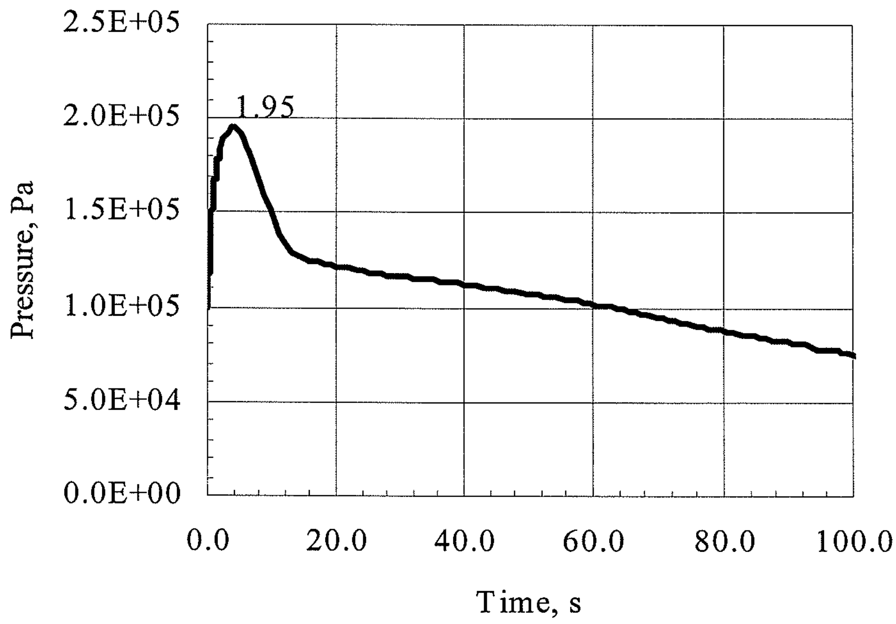
Table 1-1: Safety Areas in KNPP 3&4 Reviewed by Independent Organizations or International Programmes.

Area of safety concern	Independent organizations reviewing the area or international programmes leading the work
RPV embrittlement and integrity	IAEA, Siemens, Framatome, Gidropress
RPV and RCS inspection	PHARE
PTS prevention	PHARE, EBRD B-1, B-2, B-3, Siemens, Framatome
LBB applicability	IAEA ,PHARE, RISKAUDIT
Secondary water chemistry	PHARE
I&C	IAEA, PHARE, RISKAUDIT
MCR habitability	RISKAUDIT

Equipment qualification	PHARE, Empresarios Agrupados, RISKAUDIT
Electrical systems, Batteries	RISKAUDIT
Fire Protection	RISKAUDIT, WENRA
Seismic protection	IAEA, PHARE
Confinement	IAEA, PHARE, Rosenergoexport, British Energy and Empresarios Agrupados
Accident analyses	IAEA, Univ. of Pisa
APS	IAEA, Empresarios Agrupados, PHARE
Overall safety reviews	IAEA, IPSN, GRS, RISKAUDIT, WENRA, WPNS

KNPP let continuously peer review its safety improvement activities by competent experts of national and international organizations to update the proposed measures. This was well reflected in the various stages of both the **STP** and the **CMP**. Owing to this fact, **the spectrum of upgrading measures covers the whole range of safety concerns for pressurized water reactors required by the current safety standards and international safety practice.**

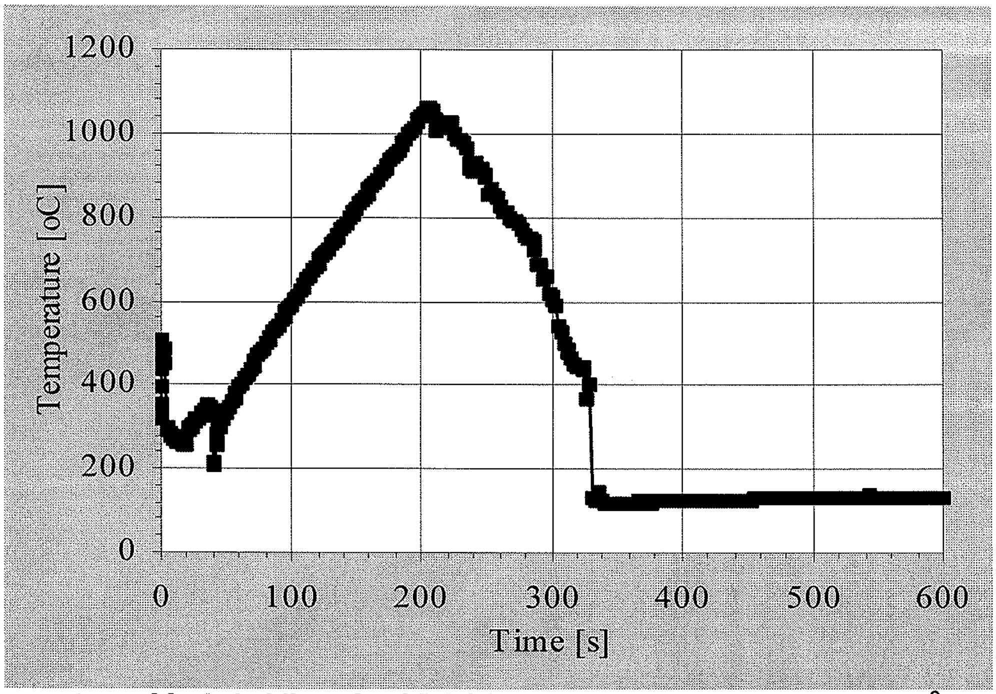
Strengthening the confinement was one of the most important tasks. The installation of the Jet Vortex Condenser assures structural integrity after all RCS breaks including 500 mm break. Confinement leak tightness was significantly improved and radiological requirements are fulfilled for all postulated events.



Pressure in KNPP 3&4 confinement after LB LOCA does not exceed the design limit of 200 kPa

The confinement is under process to be provided with two systems protecting its integrity even in the case of a severe accident – a System of Hydrogen Recombiners, to prevent the explosion hazard and Filter Venting System to prevent uncontrolled leakeges.

Plant safety systems are proved to be able to cope with a 500 mm pipe break. Years of experience has shown that the reactor shutdown does not provoke sequential loss of off-site power. This has been taken into account in safety analyses, which proved that the maximum cladding temperature after accident does not exceed the limit 1200 C .



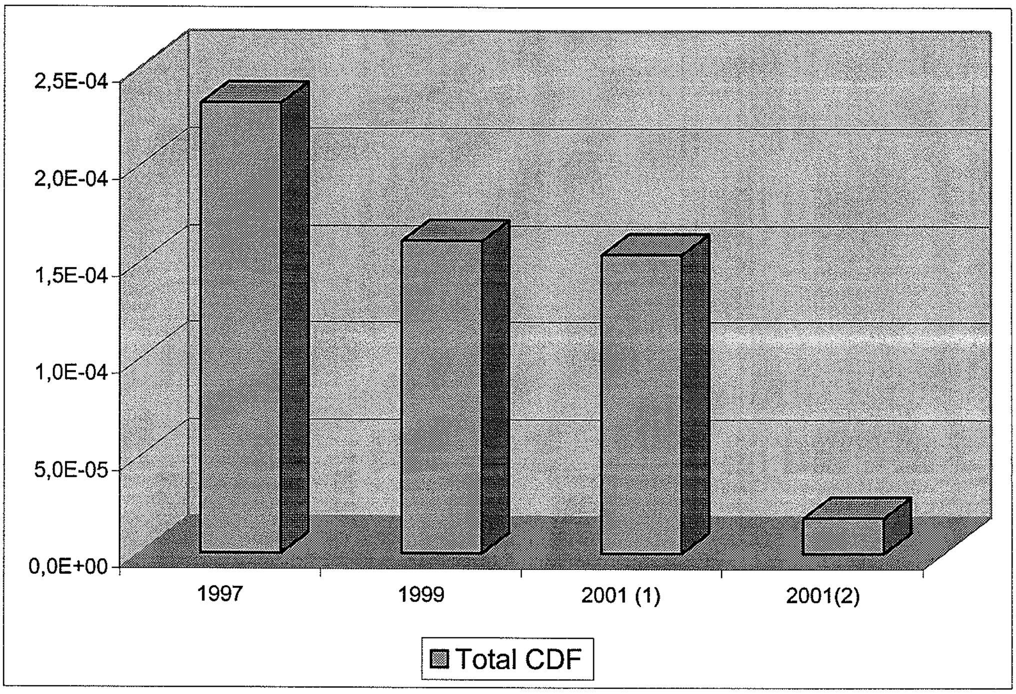
Temperature of fuel cladding after LB LOCA remains below the limit of 1200 °C

The defence in depth concept of fire protection was achieved in all levels. Fire risk analysis was completed, fire fighting systems reconstructed, new fire detection systems installed and qualified for accident conditions. The present status fully reflects current safety international practice.

Core Damage Frequency due to fire:

- Original design: once in 15 000 years
- After upgrading: once **in 250 000 years**

PSA for KNPP 3&4 was periodically performed in parallel to the modernizations implementation. The **Core Damage Frequency** has been reduced to 1.6E-05/year – which includes internal events, seismic and fire hazards. That is nearly an order of magnitude better than the international target for operating plants set by IAEA INSAG at 1E-04/year.



KNNP 3&4 Core damage frequency –1.6E-05

Opinions of IAEA on KNPP 3&4 achievements in safety upgrading

Issue	IAEA opinions, 28 June 2002
Cooling the fuel in normal/transient conditions	"Addressed even ***beyond initial expectations"***
Cooling the core in all conditions	"Defense in depth going ***beyond initial expectations*** in cases"
RPV integrity and RPV rest lifetime	"Assured for ***safe operation*** at least until design lifetime"
3 independent leak detection systems	***"Fulfill standard regulatory requirements"***
Reactor heat removal to the ultimate heat sink	"Improved even ***beyond the initial recommendations "***
Common cause failures	***"High level of reliability in all plant conditions "***
Scope of analysis in Safety Analysis Report	***"Goes beyond the usual scope*** required by US and IAEA"
All areas dealing with operational safety	***"High quality standards*** observed"
Control room staff attitude	"Professionalism and ***open and frank***

	discussion"
Approach to safety and quality	"The ***fundamental tool to maintaining plant safety"***

The modernization has resolved all IAEA safety issues [IAEA-TECDOC-640], the requirements of the Complex Program for Modernization, as well as the IAEA and WENRA missions' requirements.

Major safety improvements implemented at KNPP 3&4 include the following items:

- ***Complementary Emergency Feed Water System (CEFWS)***
- Enhancing redundancy, separation and qualification of equipment
- ***Qualification of equipment***
- ***Reactor Pressure Vessel (RPV) strength.***
- ***Power Operated Relief Valves (PORV)***
- ***Leak-Before-Break (LBB)*** **System.**
- ***Reactor Trip System (RTS)*** **upgrading**
- ***Main Control Room (MCR) and Emergency Control Room (ECR)***
- ***Emergency power supply upgrading***
- ***Elimination of common cause hazards***
- ***Improvement of the confinement*** –Jet Vortex Condenser
- ***Leaktightness of the confinement was improved***
- ***Necessary upgrading of the secondary side systems and electric power***
- ***Intensive accident analyses***
- ***Fire protection has been strengthened***
- ***Seismic upgrading –buildings fully qualified for any of the expected seismic event***
- ***DBAs - LOCA 500 mm***
- ***Operational practice and improved housekeeping***
- ***PSA confirm the core damage frequency has been reduced to 1.6 10E-05/year***

Evaluation of **Rest Life Time(RLT)** of Kozloduy NPP units 3 & 4 was executed by a Consortium between Framatome ANP GmbH (a Framatome and Siemens company) and Atomstroyexport, Russia. It comprises an evaluation of the residual service life of components/systems subject to acceptance by international experts, identifying the need for further investigations/calculations in certain cases, and finding solutions for improvements that achieve a consensus of safety and economy. The final phase of the project consists of generating an **Aging Management Program (AMP)** that permits detection, evaluation and mitigation of the relevant aging degradation mechanisms and identification of the plant locations where they are likely to occur. The project was finalized in June 2002 after duration of almost 2 years extensive work.

AMP was dedicated to all components and equipment relevant to safety and critical for the residual service life. It is part of the maintenance program of specific plant units.

As a conclusion of the RLT project was stated, that there are **no general problems that might effect the plant operation till the expected 30 years of operation** .

The operation of the considered components, systems and structures of Kozloduy NPP units 3&4 **for the expected 30 years of operation is possible**, taking into account certain recommendations, such as:

- Giving continuous special focus to the irradiation behavior of Weld No 4 of Unit 3 Reactor Pressure Vessel;
- Collection of additional information as well as subsequent analysis e.g. for some valves,
- Experimental verification of current condition of cables and
- Performance of repair works e.g. at specific areas of civil structures and facilities

More of that, for the biggest part of the most-important components was found out that they could operate significantly longer – for 35 or 40 years without major interventions.

Fore enhancing the precision of the evaluation of the residual life time in the future, powerful tools like the aging management systems FAMOS, COMSY as well the Aging management data base (AMDB) were implemented for continuous follow–up process of RLT management, where:

- FAMOS – is the System for monitoring and calculation of the fatigue of the key components and pipelines in the confinement.
- COMSY – is the Conditions oriented computerized system for monitoring and prediction of the wall thickness due to erosion-corrosion phenomena of secondary pipelines, based on real working conditions – Loads, Water chemistry, etc.

KOZLODUY 5 & 6 – WWER-1000/V 320 MODERNIZATION PROGRAM

Before the **Modernization Program (MP)** for Units 5&6 was outlined and designed, implementation of some important **improvements** had started. The **most significant** of them are:

- Transition from two to three-year fuel life cycle;
- Development of a new fast method of checking fuel cladding tightness;
- Improvement of the dynamic stability of the units during transients, introduction of digital control in the automatic turbine governor system;
- Implementation of ultrasonic check of reactor internals and steam generator integrity;
- Updating of the Technological Regulations and the Safety Analysis Report (SAR) taking into account the operation experience;
- Full-scale training simulator for the plant staff.

The Units 5&6 Modernization Program was produced in 1995. Its main purpose was to introduce improvements so that the modernized units would be able to meet any new international safety and reliability requirements towards the nuclear power plant and the full scope of improvement steps prescribed by the IAEA document "Assessment of the Safety Problems of WWER-1000 Model 320 Units".

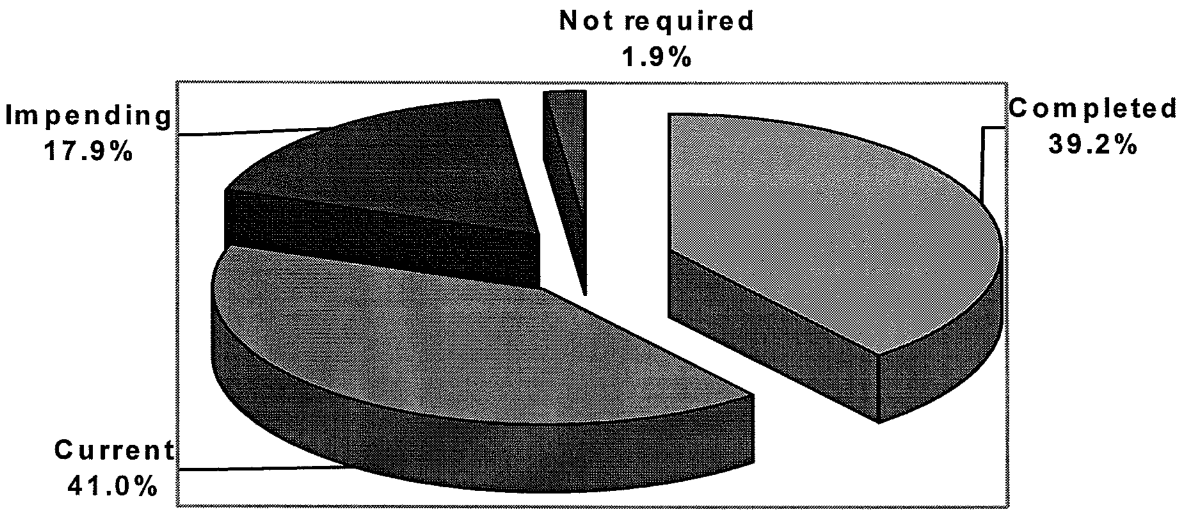
The Modernization Programe was organized as a set of 212 specific measures, distributed in 5 groups:

- Measures to improve the safety of Units 5&6 through implementation of new design solutions;
- Measures aiming at the validation of an adequate safety level by means of various analyses and additional studies in conformity with internationally adopted normative documents;
- Measures for safety upgrading through replacement of the equipment with expiring design life and of critical equipment.
- Measures to improve work efficiency and operating conditions;
- Measures related to preparation for equipment decommissioning.

- and delivery of the equipment, installation and tests, licensing and commissioning.

The scope of envisaged technical measures as well as the investments required for their implementation render the U5&6 Modernization Program the largest-scope current nuclear power project in Europe and in the USA. The funds for performance of the MP total 491M€. Out of that, about 135M€ is planned equity that Kozloduy NPP will invest into the MP, and about 356 M€ was raised through credit agreements with various credit institutions.

The chart illustrate the percentage performance status of the Program at the end of 2002.



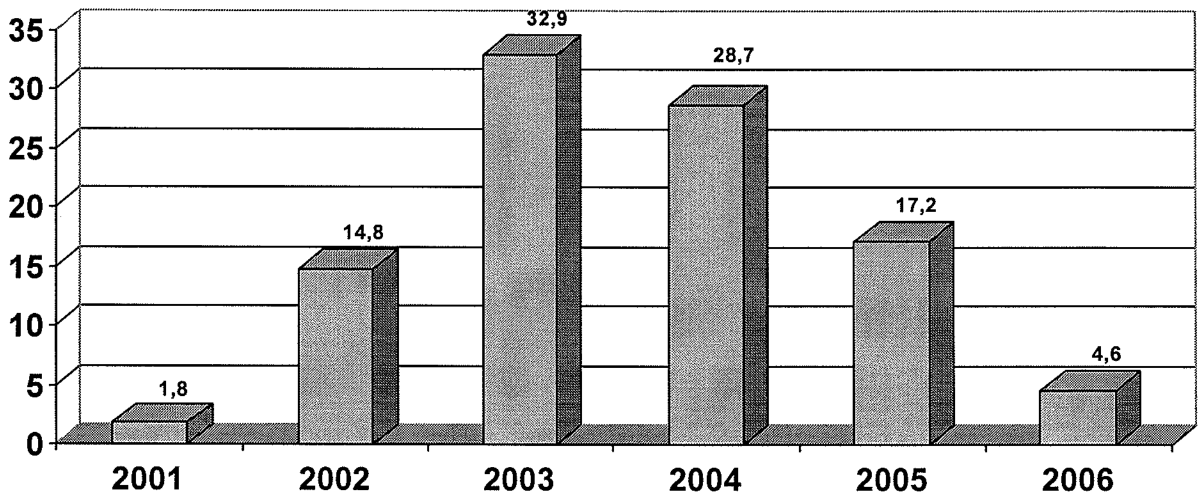
Year 2002

Thirteen technical measures were implemented last year within the time of scheduled refuellings. Some of them are :

- Improvement of the containment test procedure through implementation of a new leakage measurement method allowing performance of four different measurements in a shorter test time and with significantly higher precision;
- Modernization of the component cooling system for the purpose of preserving the efficiency of barriers (the system of leak tight shields) in the way of radioactivity spreading in the environment;
- Installation of up-to-date instrumentation for precise measurement of the activity of gases released through ventilation stacks;
- Implementation of systems for monitoring the radionuclide content of releases through the vent stacks;
- Development and implementation of a radiation monitoring system for severe accident events;

- Installation of a hydrogen detection and burning system designed for continuous and on-line monitoring of hydrogen concentrations in various points within the containment under normal operation mode as well as after loss-of-coolant accidents (LOCA), and for hydrogen recombination for the purpose of reducing its concentration in the containment in order to prevent a possible explosion and to assure confinement of radioactive materials within the containment in the event of a severe accident;
- Replacement of the existing turbine condenser filters by a new type designed to provide protection against cooling water pollution in the condensers with biomass and steadier operation of the unit at rated power.

In 2003 we will have to perform about one third of the scheduled scope of measures the estimated cost of which is 152.1 M€. 127.31 M€ of that is funds to be raised through loans, and 24.8 M€ equity of the power plant.



MP development was performed by experts from Kozloduy NPP, Energoproject plc, Risk Engineering plc and EDF taking into account the IAEA requirements.

The developed Program was reviewed twice by IAEA (in 1995 and 2000), and in 1997 it was subjected to independent expert evaluation by Risk Audit employing a team of specialists from IPSN and GRS International.

Contractors who were to perform the high-priority measures were selected by an international bid in 1996. It was won by two participants – Westinghouse from the USA, and the European Consortium Kozloduy including three leading companies in the nuclear sector of the Old Continent – Framatome, Siemens and Atomenergoexport.

All the time since the startup of the basic engineering phase in 1998, our colleagues from Parsons Energy & Chemicals (PEC) have been working side by side with the Bulgarian team as our corrective and technical consultant providing assistance from their US head office as well as by means of their site team at Kozloduy NPP including specialists from the USA, U.K., Italy, Russia, and Bulgaria. Besides, precious methodological and organizational support was provided to us in the initial phase of the Project by the consortium between Empresarios Agrupados (Spain) and British Energy.

Having committed the best capabilities of European and USA nuclear power communities, proceeding from the most recent requirements in the Chief Design Engineer and IAEA regulatory documents, after completion of the Modernization Program, units 5&6 will definitely rank among the most reliable and safe nuclear facilities and that it will be possible to extend their design life by 15-20 years beyond the design limits.

With the Modernization Programs of Units 3&4 and 5&6 and the Rest Life Time Analysis for units 3&4 KNPP has already undertaken activities towards Long Term Operation .

Bulgaria supports the objectives of the Extrabudgetary Program on Long Term Operation of Pressurized Water Reactors and welcomes the idea for a cooperative EBP and could provide a financial support .

Bulgaria is considering the possibility to host a Steering Committee Meeting.

IAEA EBP on
SAFETY ASPECTS OF PWR'S LONG TERM OPERATION

First Steering Committee Meeting
Vienna
19-21 May, 2003

Presentation by Petr KRS,
State Office for Nuclear Safety
Czech Republic

OBJECTIVES OF THE PRESENTATION

- Status in the Czech Republic
- Objectives of ongoing and planned activities regarding long term operation
- Expectations from the EBP

2

STATUS IN THE CZECH REPUBLIC

- Two sites - Dukovany (4 x VVER 440/213 type); first unit operational since 1984
  - Temelín (2 x VVER 1000/320 type); both units in trial operation

3

STATUS IN THE CZECH REPUBLIC

- Operational License - in addition to nuclear safety and radiation protection issues covers environmental, conventional safety and other aspects - not limited in time
- Individual Permits issued on basis of the Atomic Act - time limited where appropriate - for “activities” such as power operation, bringing unit critical after refueling outage or safety relevant change in design - provides for specific safety assessments through out operational life
- Verification by inspections
- Periodic Safety Review concept serves as a governing philosophy - 10 years cycles - format and content of the review negotiated in particular for each cycle

4

OBJECTIVES OF ONGOING AND PLANNED ACTIVITIES REGARDING LONG TERM OPERATION

- Goal of PSR - allow to address a request for continuous operation a nuclear power plant unit beyond a period established by evaluation
  - confirmation that there continues to be a valid licensing basis
  - comprehensive assessment to what extent the plant meets currently internationally accepted safety standards and practices
  - confirmation that adequate arrangements are in place to maintain safety level until the next PSR
  - determination of safety improvements that should be implemented to resolve safety issues that have been identified

5

OBJECTIVES OF ONGOING AND PLANNED ACTIVITIES REGARDING LONG TERM OPERATION

- Main objective regarding long term operation - ensure that all processes are in place in appropriate scope and format to allow for long term operation considerations in the future - all activities are finally enshrined to PSR
  - Screening of existing legal framework / current standards
  - Regular checks of technical and organizational processes
  - Industry projects, such as support to AMP , EQ
  - Government sponsored R&D program
  - On - going modernization/upgrading at NPP Dukovany

6

FOR WHAT THE NEW EBP SHOULD SERVE ?

- Exchange of information regarding different issues of long term operation of nuclear power plants
  - legal issues / standards
  - organizational aspects
  - technical aspects
- Collection of technical information specific for VVER technology
- “Consultations in users club” - final responsibility with the operator and national regulator
- Final solutions/decisions may differ

FINNISH APPROACH TO NPP LICENSING AND LIFETIME MANAGEMENT

Hannu Koponen
STUK

EBP on Safety Aspects of Long Term Operation of Pressurized Water Reactors,
Vienna 19 – 21 May, 2003

Main Legislation

- Nuclear Energy Act (990/1987, as amended)
- Nuclear Energy Degree (161/1988, as amended)
- Radiation Act (592/1991, as amended)
- Radiation Degree (1512/1991, as amended)
- Act on the Radiation and Nuclear Safety Authority (1069/1983, as amended)
- Decree on the Radiation and Nuclear Safety Authority (618/1997, as amended)

STUK

Main Legislation

Licensing phases according to Nuclear Energy Act:

- Decision in Principle
- Construction License
- Operating License
- Operating License renewal

STUK

Main Legislation

General conditions for granting licenses:

- use of nuclear energy, taking into account its various effects, shall be considered generally beneficial for society
- use of nuclear energy shall be safe and it shall not cause injury to human beings, the environment and property
- nuclear waste generated in connection with or as a result of the use of nuclear energy in Finland shall be handled, stored and permanently disposed of in Finland
- physical security, emergency preparedness and other arrangements shall be sufficient to mitigate nuclear accidents and to safeguard nuclear energy against illegal actions

The licensee is responsible for safety

Main Legislation

Nuclear Energy Act, 24 §:

- The license, excluding the construction license, shall be granted for a fixed term.
- When length of the term is considered, particular attention shall be paid to ensuring safety and to the estimated duration of operations.

Decisions of the State Council

Decisions of the State Council on the General Regulations for the

- Safety of Nuclear Power Plants (395/1991)
- Physical Protection of Nuclear Power Plants (396/1991)
- Emergency Response Arrangements at Nuclear Power Plants (397/1991)
- Safety of a Disposal Facility for Reactor Waste (398/1991)
- Safety of Disposal of Spent Nuclear Fuel (478/1999)

STUK

YVL Guides (regulatory guides)

- rules, which a licensee shall comply with, unless STUK has been presented another acceptable procedure or solution by which the safety level laid down in YVL Guides is achieved
- guides are systematically updated to address the most recent safety concerns and knowledge in safety issues
- are applied as such to new NPPs
- are applied to operating plants as separately decided (implementation decision for each guide)

STUK

National Policy on Lifetime Management

Decision of the Council of State (395/1991) on General Regulations for the Safety of NPPs:

- Operating experience from NPPs as well as results of safety research shall be systematically assessed and followed.
- For further safety enhancement action shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology.

STUK

Lifetime Management in Practice

- maintain the safety and reliability of the operation of the NPP
- meet the upgraded safety requirements
- follow the principle of continuous safety improvements
- replace of unreliable technologies
- take care of competence of personnel
- attention on safety culture, plant documentation, maintenance, strategies, in-service-testing and inspections, operating experiences etc.
- systematic collection of plant information

STUK

Regulatory Control of Operating NPPs

Main regulatory control activities:

- endorsement of new regulations
- day-to-day regulatory oversight
- reviews and inspections to be requested by a utility on the basis of the YVL Guides
- reactive reviews and investigations (due to operational events, poor performance etc.)
- periodical inspection programme
- day-to-day safety enhancement (research, new technology, operating experience elsewhere etc.)
- periodic safety review (PSR)
    - part of a license renewal process, or a separate review if the license is valid more than 10 years, or if regulations are thoroughly renewed (for example in 1991 due to new decisions of the State Council)

STUK

License Renewal in Practice

Activity	Loviisa NPP	Olkiluoto NPP
STUK action plan • requirements to the licensees	29 March 1996	
Application submitted by a utility to the State Council (Ministry of Trade and Industry	20 December 1996	18 December 1996
STUK's statement on safety to the Ministry of Trade and Industry	2 March 1998	30 June 1998
Decision of the State Council (Government)	2 April 1998	20 August 1998

STUK

License Renewal in Practice

STUK requirements to the licensees

- refer to legislative documentation to be supplied
- evaluation of the compliance with regulations and YVL Guides
- review of safety based on safety factors / IAEA-50-SG-012
- main emphasis on power upgradings and related accident and transient analysis
- PSA 1 and 2 levels

STUK

Licensing Situation in Finland

New operating licenses of all four units

- licenses of Loviisa plants valid up to the end of 2007
- after Loviisa 1 license expires, 31 years operation is over
- licenses of Olkiluoto plants valid up to the end of 2018, periodic review by the end of 2008
- after Olkiluoto 1 license expires, 40 years operation is over
- no specific “design lifetime” in licenses

Modernisation and power uprating connected with the license renewal processes

- Olkiluoto 710 -> 840 MWe (net)
- Loviisa 445 -> 488 MWe (net)

Decisions in Principle

- spent fuel disposal facility (2001)
- new nuclear power plant unit (2002)

STUK

Future Challenges in Lifetime Management

- qualification of non-destructive testing systems
- assessment of re-embrittlement of Loviisa reactor pressure vessel
- severe accident management programmes
- modernisation of instrumentation and control systems of NPPs
- maintenance programmes, replacing old technologies
- use of PSA, risk informed regulations and especially directing in-service inspections
- competence of personnel
- research programmes

Conclusions

- new long term licenses were issued in 1998
- the importance of lifetime management is recognised
- the principle on continuous improvement is emphasized
- in addition to continuous regulatory control activities, periodic safety assessments have been implemented

Renewal of the Operation Licence for Paks NPP

presented by

Kristóf Horváth
horvath@haea.gov.hu

Content

Introduction 1/2

- Unit No.1. of Paks NPP was commissioned in 1982
  - "design life" = 30 years
  - licence will expire in 2012
  - design life = limit of the licence for operation
- Commitment of the operator
  - the Board of Directors aims at operation of the units beyond the design life
  - the general assembly accepted *(Jan 2001)* the objectives
    - power upgrade
    - operation beyond the design lifetime
- Legislation
  - does not exclude the licence renewal (LR)
  - no detailed instructions how

Introduction 2/2

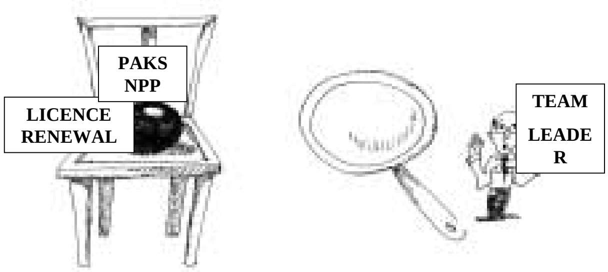
- 2001. January – decision on lifetime extension made by Propriatory Meeting of Paks NPP
- 2001. May – official request of Paks NPP
  - submitted to HAEA-NSD for regulatory requirements
- 2001. June – joint expert team from representatives of NSD, Paks NPP, TSOs established
- 2001. November – agreement between NSD and Paks NPP on timetable of tasks to be accomplished for licence renewal
- 2001-2. – development of regulatory guidelines

Preparatory activities

- Studying IAEA documents related to ageing
- Studying of US NRC documents related to ageing and LR
- Identification of gaps and overlaps between
  - NRC Reg. Guide 1.70 on FSAR
  - IAEA safety guide 50-SG-012 (DS 307) on PSR
- Comparison of international experience to Hungarian opportunities
  - identification of gaps in input information
- Listing of equipment that needs ageing management
- Identification of scope and structure of ageing analysis

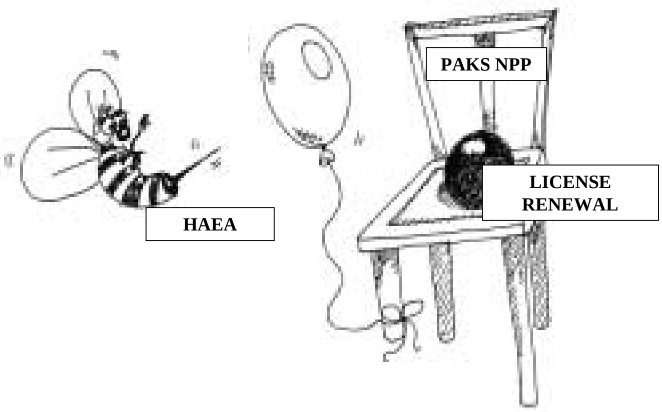
Licensing logic and rules

- Four main areas are determined
- The four areas need to be properly managed both by the utility and the regulatory body
- This is not only a prerequisite for LR, but it has to be managed in the frame of current operating licence



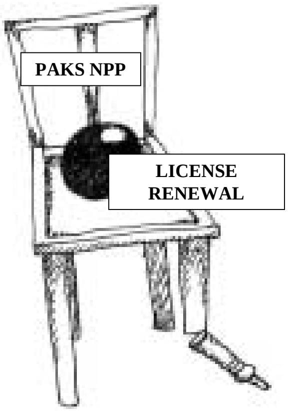
Licensing logic and rules

1. LEG: EQUIPMENT QUALIFICATION



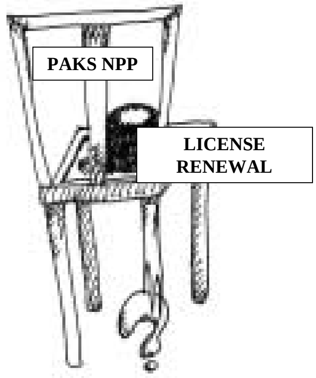
Licensing logic and rules

2. LEG: MAINTENACE OF SAFETY RELATED EQUIPMENT



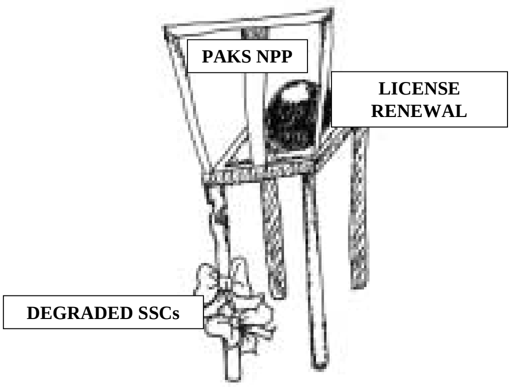
Licensing logic and rules

3. LEG: THE DESIGN BASIS



Licensing logic and rules

4. LEG: THE AGEING MANAGEMENT PROGRAM



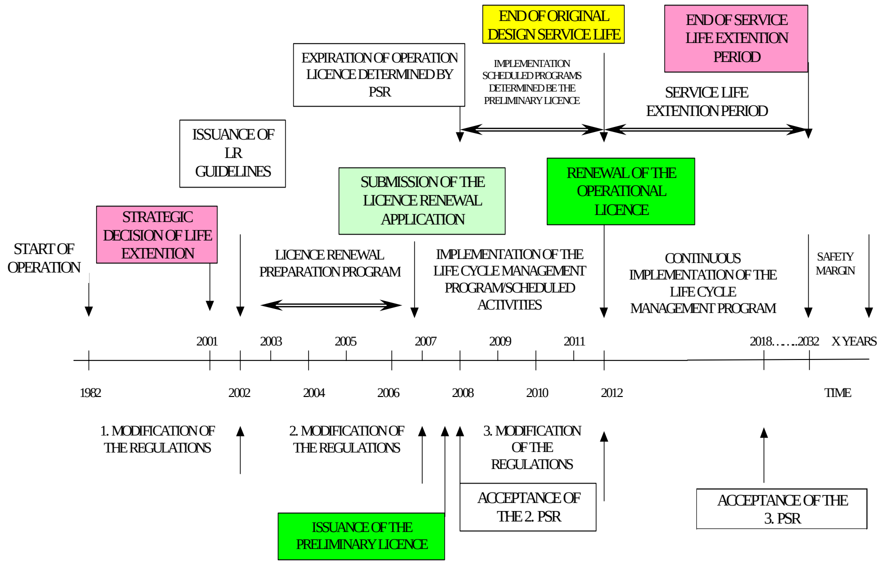
Licensing logic and rules

IF ONE OF THE LEGS FAILS...

Further tasks

- Guides for ageing management have been developed and agreed as well as guides for EQ.
- An agreement on the concept of licence renewal is concluded by HAEA and PNPP.
- Draft guides for Licence Renewal application have been elaborated.
- There is an agreement on starting the implementation of NRC's "Maintenance Rule".
- New role and content of PSR and FSAR has been defined and related regulations have been reviewed.
- The legal basis to all these efforts will be provided by modification of related Governmental Decree and the Nuclear Safety Regulations.

PLANNED SCHEDULE OF THE LICENCE RENEWAL PROCESS ON THE E XAMPLE OF THE UNIT 1



First Steering Committee Meeting of the Extrabudgetary Programme on Safety aspects of long term operation of PWRs
19 to 21 May 2003

13

Russian Federation Ministry for Atomic Energy

"Rosenergoatom" utility

LIFETIME EXTENSION OF RUSSIAN NPPs

Abagyan A.A. – Vice President of "Rosenergoatom" utility, VNIIAES Director General

Sorokin N.M. – Vice President, Technical Director of "Rosenergoatom" utility

Vienna, 2002

Lifetime extension of operating NPPs:

- Essential trend in the modern stage of nuclear power development
- Most efficient area for investments to maintain the existing generating capacities

NPP lifetime extension activities are performed in accordance with:

- "Program of RF nuclear industry development in 1998-2005 and up to the year of 2010",

  approved by RF Government Decree of 21.07.98 № 815

- "Strategy of Russian nuclear industry development in the first half of the 21st century",

  approved by RF Government on 25.05.2000

Factors contributing to lifetime extension work performance

- Conservatism of the adopted calculation basis to justify the 30-year operating life of existing NPPs
- Specific costs of unit life extension work are significantly less than those to commission new units

NPP operating experience allows to justify the revision of the earlier specified unit lifetime

Prior to 2006 a number of activities have to be completed to modify and extend the lifetime of 10 NPP units with the total installed capacity of 4345 MW

Legislation and federal norms in the area of NPP unit life extension

Federal Act "About the Use of Atomic Energy" (Article 9) and other federal documents allow for the possibility of unit life extension

New regulatory and methodological documents have been developed and put into force

- Federal Norms "Basic requirements for NPP unit lifetime extension"
- Guidance document of the Russian Gosatomnadzor "Requirements to the content and composition of the documents justifying the safety for the period of NPP extended life"

(to be continued)

New regulatory and methodological documents have been developed and put into force

(continued)

- Methodological and guiding documents of the Utility which specify the conduct of modernization, comprehensive investigation, justification of component residual lifetime, assuring quality of life extension activities

Sequence of life extension activities

NPP unit comprehensive investigation

Estimation of residual life of unit components

Unit safety assessment

Cost-benefit analysis of life extension of the unit in question

↓

Taking decision on life extension work performing

↓

Development of a program of unit preparation for additional operation period

Program of units preparation for additional operation period

Justification of life extension of non-replaceable components

Implementation of a comprehensive program of NPP unit modernization

Conduct of NPP unit systems (components) testing

Justification of NPP unit safety

↓

The results of the work are reviewed in the Russian Minatom and submitted by the Utility to Gosatomnadzor of Russia for independent review and to obtain NPP unit operation license for additional period

The work under the program is performed on the basis of:

- Deterministic assessment of design compliance with the existing safety regulations
- Probabilistic safety assessment
- Taking account of IAEA recommendations and international experience

Main objectives of unit comprehensive investigation

- Receipt and analysis of information on the actual status and lifetime characteristics of unit components

(to be continued)

Main objectives of unit comprehensive investigation (continued)

- Identification of unit components that need to be replaced due to lifetime expiration
- Identification of unit components with residual lifetime and those planned for continued operation

As a result of unit comprehensive investigation the following actions have been planned:

- Replacement of components with expired lifetime
- Maintenance and repair of components, whose lifetime restoration is foreseen by the regulatory documents
- Justification of residual lifetime of "critical" (non-replaceable) unit components

Implementation of life extension concept at Novovoronezh NPP Unit 3

In 1999-2001
a comprehensive program of
Novovoronezh NPP Unit 3
life extension activities
was fully implemented including:

(to be continued)

Implementation of life extension concept at Novovoronezh NPP Unit 3

(continued)

- Unit comprehensive investigation and justification of component residual lifetime
- Cost-benefit analysis of unit life extension

(to be continued)

Implementation of life extension concept at Novovoronezh NPP Unit 3

(continued)

- The following systems have been upgraded:
  - accident localization system through installation of jet-vortex condenser
  - reactor control, monitoring and protection systems
  - essential power systems
  - process systems and safety systems

(to be continued)

Implementation of life extension concept at Novovoronezh NPP Unit 3

(continued)

- In-depth Safety Assessment Report (IDSAR) has been prepared taking account of all modifications completed at the unit

(to be continued)

Implementation of life extension concept at Novovoronezh NPP Unit 3

(continued)

- Pre-commissioning activities have been completed including the required testing of the modified systems and components
- Novovoronezh NPP Unit 3 personnel retraining has been conducted

Results of activities completed at Novovoronezh NPP Unit 3

- After the upgrading efforts core damage frequency has decreased from $1.8 \cdot 10^{-3}$ to $3.44 \cdot 10^{-5}$ per reactor-year
- Gosatomnadzor of Russia has granted a unit operation license

Life extension activities at RBMK-1000 units of the first generation

To extend the lifetime of Kursk NPP Units 1, 2 and Leningrad NPP Units 1, 2 the following actions are in progress:

- Modification of control rods, installation of fast-acting emergency protection system
- Modification of control and protection system

21

(to be continued)

Life extension activities at RBMK-1000 units of the first generation

(continued)

- Efforts to improve reactor physics
- Restoration of the "fuel channel-graphite" gap
- Modification of accident localization systems and emergency cooling systems
- Modification of the primary circuit

22

In-depth safety assessment of RBMK-1000 units

- The development of Kursk NPP Unit 1 In-depth Safety Assessment Report has been completed in accordance with the "Agreement on the Projects of Nuclear Safety Account in the Russian Federation" signed by the Government of Russia and EBRD

(to be continued)

In-depth safety assessment of RBMK-1000 units

(continued)

- Interim IDSAR for Kursk NPP Unit 1 under the first stage of international review effort has been reviewed by EBRD at the SRG meeting and received positive response
- Preparation of IDSARs for Kursk NPP Unit 2 and Leningrad NPP Units 1, 2 will be completed in the first quarter of 2003

RBMK-1000 units upgrading efforts will result in:

- Compensation of deviations from the requirements of regulatory documents
- Expansion of the spectrum of design basis accidents

(to be continued)

RBMK-1000 units upgrading efforts will result in:

(continued)

- Improvement of unit safety

The expected core damage frequency after the upgrading efforts should not exceed 2.0-6.2 $\cdot 10^{-5}$ per reactor-year

Results of Russian NPP life extension activities

- Technical and economic expediency of NPP unit life extension has been justified
- Measures to justify life extension have been developed and implemented at Novovoronezh NPP Unit 3, and a license for continued operation of the unit has been obtained. Similar activities are under way at 10 NPP units

(to be continued)

Results of Russian NPP life extension activities

(continued)

- Consistent efforts are under way to further improve the legal, regulatory, methodological and guidance documents

All required conditions and prerequisites are available in Russia to implement NPP unit life extension programs

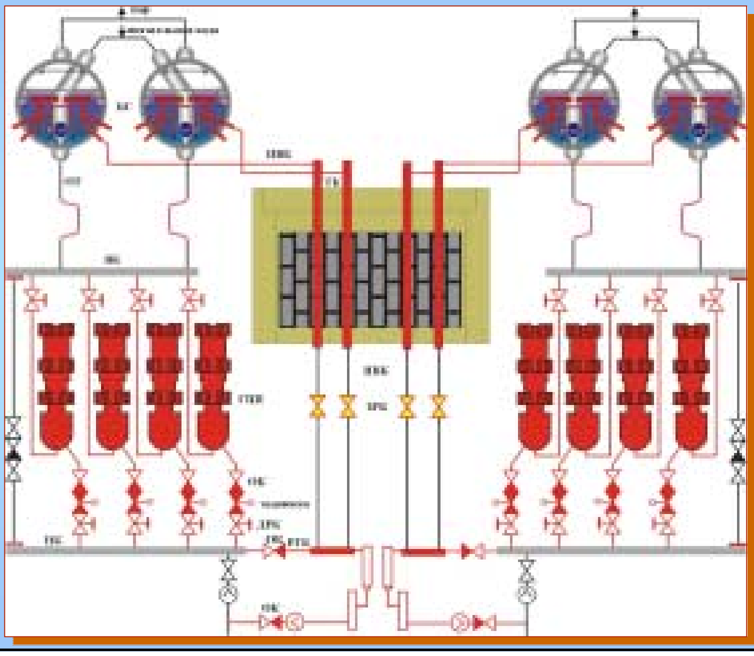
The end of the design life of the first generation NPP Units

NPP Units	Year of commissioning	The end of the design life							
		2002	2003	2004	2005	2006	2007	2008	2009
Novovoronezh Unit 3	1971	prolonged	prolonged						
Unit 4	1972	prolonged	prolonged						
Kola Unit 1	1973		29.06						
Unit 2	1974			09.12					
Bilibino Unit 1	1974			12.01					
Unit 2	1974			30.12					
Unit 3	1975				22.12				
Unit 4	1975					27.12			
Leningrad Unit 1	1973		21.12						
Unit 2	1975				11.07				
Kursk Unit 1	1976					12.12			

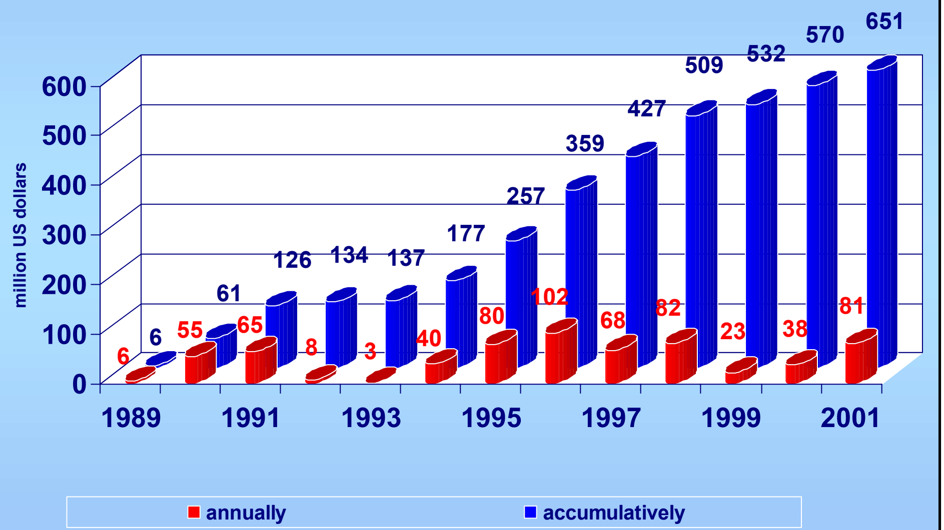
Influence on safety of the performed modernization defined by deterministic analysis

Degree of multilevel in depth safety	Number of deviations							
	Before modernization				After modernization			
	Σ	Safety Category 1	Safety Category 2	Safety Category 3	Σ	Safety Category 1	Safety Category 2	Safety Category 3
Conditions of NPP sitting and prevention of normal operation deviations	250	110	100	40	147	124	23	0
Prevention of design accidents by using normal operational systems	52	33	19	0	43	37	6	0
Prevention of beyond design accidents by safety systems	26	0	13	13	7	1	6	0
Beyond design accidents management	7	0	5	2	3	0	3	0
Anty accident planning	9	0	9	0	3	0	3	0
Total deviations	344	143	146	55	203	162	41	0

RECONSTRUCTION OF MAIN CIRCULATION CIRCUIT



Expenditures for upgrading and safety enhancement of Leningrad NPP



Recommendation of operating organization concern "Rosenergoatom"

- "… exchange of experience and coordination of various national, bilateral and international activities to utilize the knowledge accumulated in Member States concerned, which participate in the activity on safety upgrading during the past decade" (Draft of Extra Budgetary Project, Working Plan, version 4 dated 04.03.03);
- Working out of general methodological approaches to long operation on the basis of IAEA recommendation;
- Working out of approaches for the use of probability methods for optimization of planned modernization of systems and equipment;
- Working out of criteria to select the critical components for NPP equipment life time management

Recommendation of operating organization concern "Rosenergoatom" (continuation)

- Comparison, improving and optimization of methodological approaches used for justification NPPs' safety to solve the following tasks:
  - Analysis of neutron physical processes during design and beyond design accidents ;
  - Analysis of thermo hydraulic processes during the transient regimes and accidents;
  - Analyses of radiation consequences of design and beyond design accidents;
  - Evaluation of probability of destruction (dehermitization) of first cirquit equipment;
  - Probability safety analysis ;
  - Evaluation of the residual resources of first circuit equipment and piping;
  - Evaluation of seismic resistance of constructions.

Recommendation of operating organization concern “Rosenergoatom” (continuation)

- Upgrading the research methods for NPP unit critical components which define the possibility of protracted operation:
  - Radiation embrittlement of reactor pressure vessel
  - Radiation embrittlement of reactor supports during low temperature irradiation
  - Metal properties changing under irradiation for reactor internals
  - Radiation changes of reactor grafite stack
- Broadening of the scope of normative documentation developed in the frame work of IAEA Project RUS/9/003 “Development of the basis for safety management for renewal of license for NPP operation/ Prolongation of operational life time”

ОКБ "ГИДРОПРЕСС"

Modernization of WWER-440 of the first generation and extension of NPP operating life

Yu.Dragunov, S.Ryzhov, M.Nikitenko, F.Plushch, I.Mozul, A.Chetverikov

ОКБ "ГИДРОПРЕСС"

Criteria of a possibility of NPP Unit operation during the additional operation period

- ❑ Operation of NPP Unit is possible if the necessary measures are taken aimed at bringing NPP Unit in compliance with the requirements of the valid regulatory documents;
- ❑Technical state of NPP Unit shall meet the requirements of technical documents;
- ❑ Within the period of additional operating time the activities shall be accomplished on safety improvement;
- ❑ Residual life of nonrecoverable components shall be justified and sufficient;
- ❑ Management of equipment reliability (service life) shall be provided.

ОКБ "ГИДРОПРЕСС"

Design bases of WWER-440 of the first generation

Principle of ensuring the integrity of the primary equipment as the barrier on the way of radioactivity spreading that is provided by the following:

- **using the appropriate materials;**
- **quality assurance in designing;**
- **experimental verification of strength and leak tightness;**
- **quality of manufacture and assembling;**
- **broadened and systematic in-service inspection of equipment state.**

ОКБ "ГИДРОПРЕСС"

Design bases of WWER-440 of the first generation

High stability to the process scenarios with uncontrolled power increase, and namely:

- **high effectiveness of reactor protection systems;**
- **negative coolant temperature coefficients of reactivity under all operating conditions;**
- **negative void effect of reactivity;**
- **negative power coefficient of reactivity;**
- **stability of spatial power distribution.**

ОКБ "ГИДРОПРЕСС"

Design bases of WWER-440 of the first generation

High reliability of the 1st and 2nd barriers on the way of radioactivity spreading under operational occurrences and accidents, owing to:

- **low value of linear heat rate of fuel rods;**
- **low volumetric power peaking (2,08);**
- **low power peaking of some fuel rods (1,55);**
- **high reliability of fuel rod cladding.**

ОКБ "ГИДРОПРЕСС"

Design bases of WWER-440 of the first generation

High heat-engineering reliability owing to:

- **multi-loop system of heat removal from the core that ensures high degree of redundancy;**
- **reactor cooling down by natural coolant circulation under all accident conditions;**
- **passive safety at the expense of internal coolant inventories in the primary and secondary circuits.**

ОКБ "ГИДРОПРЕСС"

Basic trends of safety improvement

Basic technical measures:

- **broadening the spectrum of design basis accidents;**
- **ensuring the primary circuit integrity;**
- **improving reliability of components and systems important to safety;**
- **reducing probability of occurrence of initiating events;**
- **improving structural reliability of safety systems;**
- **improving leak-tightness and integrity of the sealed zone;**
- **management of beyond design basis accidents;**
- **improving operation culture.**

ОКБ "ГИДРОПРЕСС"

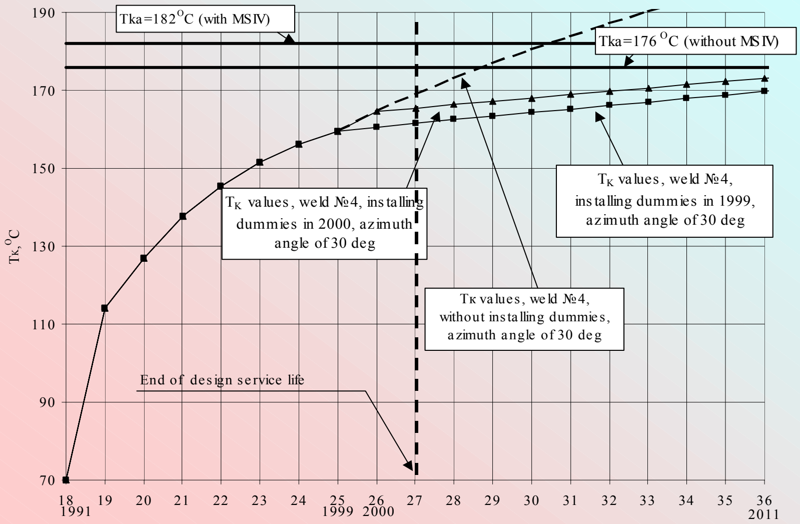
Basic measures on safety improvement

- **implementation of "leak-before-break" concept (up-to-date system of diagnostics and non-destructive testing);**
- **solution of a problem of the RPV brittle strength (annealing, installing dummies, templets);**
- **replacement of safety valves of PRZ PORV and SG PORV;**
- **installing MSIV;**
- **safety systems upgrading (system of reliable power supply to the consumers of the first and second groups, safety boron injection and sprinkling systems, service water system);**
- **upgrading the 4th physical barrier (implementation of jet-eddy condenser; improving leak-tightness of sealed enclosure);**
- **replacement of reactor control, monitoring and protection technical equipment (NFME, PPPE, APC, PG, ICIS);**
- **measures on management of beyond design basis accidents (movable diesel-generator plant, additional emergency SG makeup).**

ОКБ "ГИДРОПРЕСС"

Reactor pressure vessel of NV NPP, Unit 3

Тк values for weld No.4 with and without dummies



ОКБ "ГИДРОПРЕСС"

Results of modernization of NV NPP, Unit 3

Broadening the accident spectrum

- **broadening the spectrum of design basis accidents, up to LOCA Dnom100, is justified.**

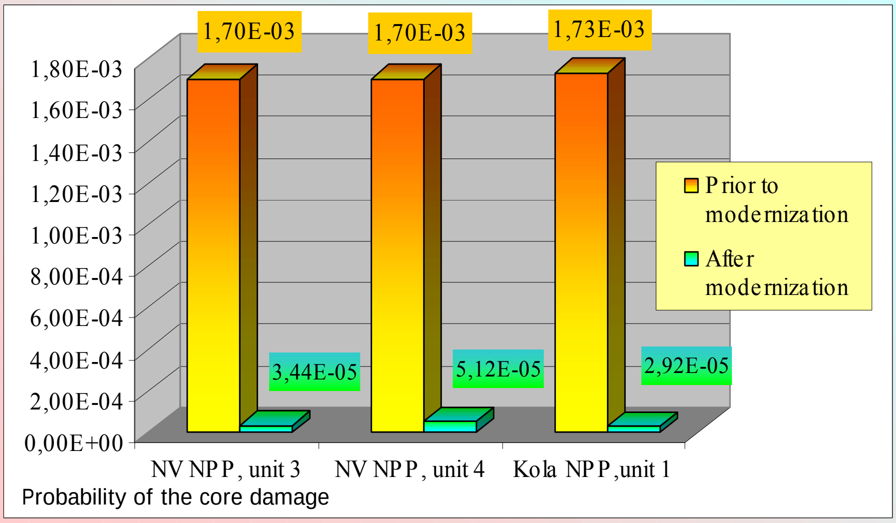
ОКБ “ГИДРОПРЕСС”

Results of modernization of NV NPP, Unit 3

Level of defense-in-depth	Prior to modernization				After modernization			
	Σ	1	2	3	Σ	1	2	3
Conditions of NPP siting and prevention of operational occurrences	250	110	100	40	147	124	23	0
Prevention of design basis accidents by the systems of normal operation	52	33	19	0	43	37	6	0
Prevention of beyond design basis accidents by safety systems	26	0	13	13	7	1	6	0
Management of beyond design basis accidents	7	0	5	2	3	0	3	0
Emergency planning	9	0	9	0	3	0	3	0
Deviations in total	344	143	146	55	203	162	41	0

ОКБ “ГИДРОПРЕСС”

Results of modernization of NV NPP, Units 3 & 4, and Kola NPP, Unit 1



ОКБ "ГИДРОПРЕСС"

Operating life extension

Regulatory basis:

- Principal possibility of NPP Unit operating life extension is defined in OPB-88/97 (item 5.1.14);
- Requirements for extension of operating life of RP equipment and pipelines are defined in i. 2.1. 11 of "Rules…" PNAE G-7-008-89;
- Federal regulations "Basic requirements for NPP Unit operating life extension" NP-017-2000
- "Standard program of comprehensive examination of NPP Unit during operating life extension" RD EO 0283-01
- "Regulations on management of service life characteristics of NPP Unit components" RD EO 0281-01
- Quality assurance program for activities on operating life extension of NPP Units of the first generation (standard), RD EO 0291-01

ОКБ "ГИДРОПРЕСС"

Extension of operating life

Basic measures according to NP-017-2000

- performing the comprehensive examination;
- developing the program of Unit preparing to extension of operating life;
- preparing Unit to operation within the period of additional operating period, including justification of safety and residual life of components, replacement of equipment with the service life exhausted, and modernization or reconstruction of Unit, if required;
- performing the tests required.

ОКБ "ГИДРОПРЕСС"

Extension of operating life

The following shall be determined as a result of comprehensive examination:

- technical state of the equipment important to safety;
- equipment with the exhausted service life;
- equipment which service life can be extended;
- nonrecoverable equipment and preliminary assessment of its residual life.

ОКБ "ГИДРОПРЕСС"

Calculational justification of RP equipment service life for NV NPP, Unit 3

Basic stages of the work:

- analysis of equipment operation history;
- provision of material properties;
- regulatory documents;
- calculational justification of equipment strength.

Calculational justification of RP equipment service life for NV NPP, Unit 3

Analysis of RP equipment operation history:

- specifying the list of operating conditions;
- determination of actual number of cycles of operating conditions;
- forecast of the number of cycles of operating conditions for the service life to be extended;
- determination of equipment technical state:
  - analysis of deviations from the design during manufacture and mounting of equipment;
  - analysis of in-service inspection results;
  - analysis of repair work results.

Calculational justification of RP equipment service life for NV NPP, Unit 3

Provision of material properties

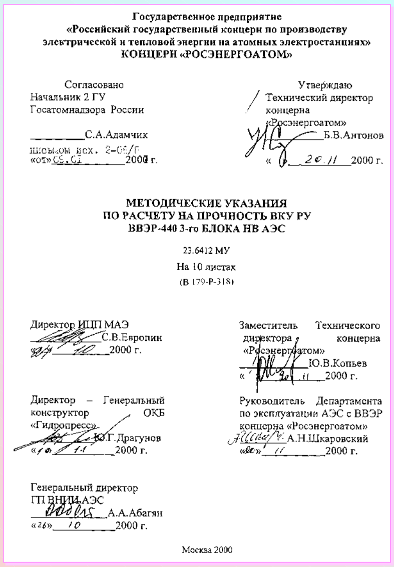
Objective – justification of guaranteed values of physical-mechanical properties of RP equipment materials for the extended service life with regard for their degradation from the effect of operational factors

The work was performed by specialists from:

- CNII KM "Prometei";
- IRTM RRC "Kurchatov Institute";
- VNIIAES;
- OKB "Gidropress".

Calculational justification of RP equipment service life for NV NPP, Unit 3

The regulatory document “Methodical instructions to strength calculation of RP internals for WWER-440 of NV NPP, Unit 3” has been developed



Государственное предприятие
«Российский государственный концерн по производству электрической и тепловой энергии на атомных электростанциях»
КОНЦЕРН «РОСЭНЕРГОАТОМ»

Согласовано
Начальник 2 ГУ
Госатомнадзора России
_________С.А.Адамчик
письмом исх. 2-06/
«от» ________2000 г.

Утверждаю
Технический директор концерна «Росэнергоатом»
_________Б.В.Антонов
« ________2000 г.

МЕТОДИЧЕСКИЕ УКАЗАНИЯ
ПО РАСЧЕТУ НА ПРОЧНОСТЬ ВКУ РУ
ВВЭР-440 3-го БЛОКА НВ АЭС

23.6412 МУ

На 10 листах

(В 179-Р-318)

Директор ИЦП МАЭ
_________С.В.Европин
« » ________2000 г.

Заместитель Технического директора концерна «Росэнергоатом»
_________Ю.В.Копьев
« » ________2000 г.

Директор – Генеральный конструктор ОКБ «Гидропресс»
_________Ю.Г.Драгунов
« » ________2000 г.

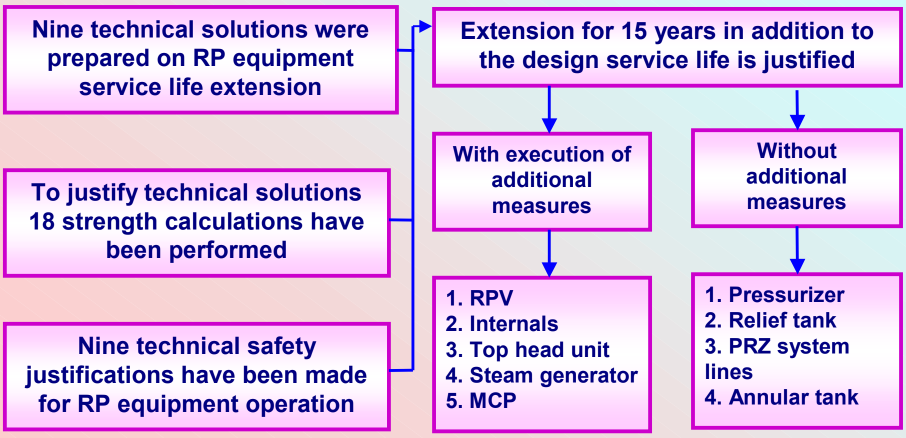
Руководитель Департамента по эксплуатации АЭС с ВВЭР концерна «Росэнергоатом»
_________А.Н.Шкаровский
« » ________2000 г.

Генеральный директор
ГП ВНИИАЭС
_________А.А.Абагян
« » ________2000 г.

Москва 2000

ОКБ “ГИДРОПРЕСС”

Calculational justification of RP equipment service life for NV NPP, Unit 3



Calculational justification of RP equipment service life for NV NPP, Unit 3

Further operation of reactor pressure vessel is allowed for the period of 15 years in addition to the design life providing the following measures:

Templets shall be cut out from RPV in 2005 and in 2011.

Assessment of technical state and specifying the RPV residual life shall be made before 2007 and before 2012 with regard for results of study of templets cut out in 2005 and in 2011, respectively

Methods and technical equipment shall be developed for inspection of weld No. 10 before preventive maintenance of 2003 according to i. 4.3 of “Program of work on justification of a possibility to extend the service life of WWER-440 RPV for NV NPP, Units 3 & 4”

AGEING MANAGEMENT OF NUCLEAR POWER PLANTS

EBP on
Safety Aspects of Long-Term Operation
of Pressurized Water Reactors
IAEA Vienna, 19-21 May 2003

Marta Ziakova, Chairperson UJD SR

OUTLINE

LEGAL BASIS
SAFETY GUIDELINES
CURRENT SITUATION
CONCLUSIONS

LEGAL BASIS (1)

ACT No. 130/1998 Coll. ON PEACEFUL USE OF NUCLEAR ENERGY

§ 16 - Extension of nuclear installation lifetime

(1) Regulatory Authority may extend the validity of the operational licence based on an actual condition of the nuclear installation and the supplementary safety documentation

LEGAL BASIS (2)

ACT No. 130/1998 Coll. ON PEACEFUL USE OF NUCLEAR ENERGY

§ 16 - Extension of nuclear installation lifetime

(2) Supplementary safety documentation supplements the safety documentation (required prior commissioning and operation) at the application of operational licence extension

LEGAL BASIS (3)

REGULATION No. 318/2002 Coll. ON SAFETY DOCUMENTATION OF NUCLEAR INSTALLATIONS

- Defines content and format of safety documentation submitting to NRA for:
  - ✓Construction
  - ✓Commissioning
  - ✓Operation
  - ✓Lifetime extension

LEGAL BASIS (4)

Regulation No. 318/2002 Coll. On Safety Documentation of Nuclear Installations

§ 27 - Supplementary safety documentation

- overall evaluation of equipment condition
- evaluation of operation phase
- evaluation of ageing management programme
- modifications of OP necessary for PLEX
- design modifications required for PLEX
- safety assessment of proposed modifications

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (1)

MAIN AIMS

- to provide the operating and technical support organisation with methodology for elaboration and implementation of AMP
- to elaborate in more detail provisions of generally obligatory legal regulations

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (2)

FEATURES

- elaborated based on IAEA documents (TECDOC, GUIDELINES, …)
- nonmandatory document, however in specific cases the regulatory authority may require the operator to act in accordance with the guide
- the guidelines requirements are considered as minimal ones
- analogue to it can be used for all types of NI

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (3)

MAIN AREAS

- field of application
- criteria for selection of SSCs
- requirements on AMP organisation
- requirements on database of SSCs
- requirements on documentation
- assessment of AMP implementation
- responsibilities

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (4)

FIELD OF APPLICATION

- the goal - safety and reliability of long term operation through
  - ✓ understanding of degradation mechanisms
  - ✓ monitoring and trending of degradation
  - ✓ minimisation of expected degradation
  - ✓ implementation of corrective measures
  - ✓ evaluation of AMP effectiveness
- interface with other programmes
- main attributes and scope of AMP
- operation, maintenance and ISI feedback

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (5)

CRITERIA FOR SELECTION OF SSCs

- importance to nuclear safety
- replacebility of components
- expected failure modes
- impact on NPP reliability
- dose rate of personnel
- operational feedback experience
- availability of monitoring techniques

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (6)

REQUIREMENTS ON AMP ORGANIZATION

- control and co-ordination of AMP by assigned organisational unit
- appropriate staff structure
- co-operation with other relevant NPP units
- co-ordination of R&D activities in AM
- assessment of AMP effectiveness and implementation of recommendations

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (6)

REQUIREMENTS ON DATABASE OF SSCs

- general data set
- SSCs specific data set
- interface with other databases

REQUIREMENTS ON DOCUMENTATION

- listed documents within AMP documentation
- compliance with QA programme

NRA SAFETY GUIDELINE BNS I.9.2/2001 „AGEING MANAGEMENT OF NPPs“ (7)

ASSESSMENT OF AMP IMPLEMENTATION

- appropriate periodicity (1 and 4 years interval and within periodic safety review)
- results submitted to

RESPONSIBILITIES

- operational organisation
- technical support organisation
- regulatory authority

CURRENT SITUATION IN SLOVAKIA (1)

Age profile of NPPs

plant / type	unit	start up	remark
Bohunice V-1/WWER 440/230	1	1978	EOO
	2	1979	EOO
Bohunice V-2/WWER 440/213	3	1984	PLEX
	4	1985	PLEX
Mochovce/WWER 440/213	1	1998	PLEX
	2	1999	PLEX
	3	Under conservation	
	4	Under conservation	

CURRENT SITUATION IN SLOVAKIA (2)

IMPLEMENTATION OF AMP (1)

- Bohunice V-1 and V-2 NPP AMPs are implemented
  - ✓RPVs surveillance programmes
  - ✓fatigue damage evaluation
  - ✓corrosion programme of RCS components
  - ✓corrosion-erosion programme of secondary circuit
  - ✓confinement – tightness, cladding
  - ✓cables

CURRENT SITUATION IN SLOVAKIA (3)

IMPLEMENTATION OF AMP (2)

- at Bohunice V-2 NPP within the modernisation and safety upgrading programme a R&D project aimed at development and implementation of integrated AMP is planned, including plant life extension
- at Mochovce NPP, unit 1 and 2 AMP implemented, unit 3 and 4 are under conservation

CONCLUSIONS

- IMPLEMENTATION OF AGEING MANAGEMENT PROGRAMME IS PRECONDITION FOR NPPs LIFE EXTENSION
- EXISTING GENERALLY OBLIGATORY LEGAL REGULATIONS ASSUME A POTENTIAL PLANT LIFE EXTENSION
- NRA SR SAFETY GUIDELINES ON“NUCLEAR POWER PLANT AGEING MANAGEMENT“ PROVIDE METHODOLOGY FOR IMPLEMENTATION AND UTILIZATION OF AMP

CSN

Consejo de Seguridad Nuclear

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain.

Presentation to the EBP Steering Committee on Safety Aspects of LTO of PWR

IAEA HQ, Vienna, 19-21/May/2003

José M. Figueras (CSN)

CSN

AGEING MANAGEMENT

- Ageing management programmes (AMP) started in Spain on a systematic way in 1992, with two pilots plants:
  - BWR-3/GE/500 -> S. M. GAROÑA
  - PWR/W/1000 -> VANDELLÓS 2
- AMP rulemaking based on:
  - IAEA Safety Standard NS-R1, Safety Guide NS-G-1.2, Safety Report 15 and TECDOCS: 540, 547, 670, ...
  - USA: NRC RULE 10CFR54, NEI 95-10, LRR SRP, ...
- International experience applied (Pilot projects or applications from USA & other countries)

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- National rulemaked by:

  – Royal Decree 2209/95:

    "... PRESENT STATUS OF SPANISH NUCLEAR FLEET AND OBJECTIVES OF ACTUAL NUCLEAR ENERGY PLAN DRIVE TO CONCLUDE THAT IT IS NECESSARY TO BOOST MATERIALS BEHAVIOUR PROGRAMS AS WELL AS PLANT LIFETIME MANAGEMENT PROGRAMS ..." .

  Is a very generic mandate, and is developed through:

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

  – CSN Safety Guide 1.10 (NPP Periodic Safety Revision):

    - **A)** *"... GLOBAL SAFETY REVISIONS SHALL BE PERFORMED PERIODICALLY, IN ORDER TO EVALUATE, IN A INTEGRATED WAY, ... AGEING MANAGEMENT PROGRAMS, ...".*
    - **B)** *" ... ANALYSIS SHALL BE DONE FOLLOWING NATIONAL GUIDES, INTERNATIONAL CODES AND STANDARDS AND THOSE OF COUNTRY-OF-ORIGIN OF PROJECT".*
    - **C)** *"EQUIPMENT ANALYSIS SHALL BE PERFORMED IDENTIFYING ALL AGEING AND DEGRADATION MECHANISMS AND ALL CORRECTIVE MEASURES TAKEN OR FORESEEN".*

CSN

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

– NPP Specific Operation Permit Condition:

- *"A YEARLY REPORT SHALL BE SUBMITTED TO CSN, ON THE PLANT´S LIFE MANAGEMENT PROGRAM, INCLUDING:*
  - *1.- AGEING AND DEGRADATION MECHANISMS ANALYSIS AND SURVEILLANCE ON SSC RELATED WITH SAFETY,*
  - *2.- NEW INSPECTION, SURVEILLANCE, CONDITION MONITORING AND/OR MAINTENANCE ACTIVITIES, INCORPORATED IN ORDER TO DETECT THESE MECHANISMS AND CONTROL THEIR EFFECTS".*

CSN

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- NPPs programmes meet the main elements of the IAEA safety documents, but the scope is not limited to safety objectives, including also economic aspects such as the impact on plant availability and replacement costs.
- The AMP are similar to the EPRI programme for Monticello and Surry NPPs, including four phases:
  - (1) critical component selection,
  - (2) analysis of degradation mechanisms,
  - (3) assessment of maintenance practices against ageing mechanisms,
  - (4) improvement of the maintenance practices.

- (1) Critical component selection criteria:
  - SSC list based on Maintenance Rule scope.
  - Applied criteria:
    - *Operation & Economics* (Availability, Repair and/or Replacement costs, ...)
    - *Safety* (As per 10CFR54.4 scope, at structures & systems level)
    - *Regulatory* (Licenseability, ECCS functions, Tech. Specs, Safe Shutdown, Core Damage Frequency, Qualification, ...)
    - *Historical* (Maintenance, Corrective actions, Industry experience, ...)
    - *Reliability* (Failure rates, Suppliers, Time, ...)

- Determination of critical components:
  - 200-300 SSC included (mean number per plant)
    - Mechanical
    - Electrical
    - I&C
    - Structures & Buildings

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- (2) Analysis of Degradation Mechanisms:
  - 28 different ageing mechanisms studied.
  - Analysed for single components (i.e. RPV, SG or T-G) and for families of components (i.e. Piping, Valves or Motors) -> *"COMPONENT DEGRADATION DATASHEET, **HDC**".*
  - Degradation risks categorised as "significant" / "non significant".
- (3) Assessment of Maintenance Practices:
  - Analysis and file recording of all NPP practices (Maintenance, Inspection, Testing,…) applied in each single component or families of components -> *"MAINTENANCE PRACTICE DATASHEET, **HDM**".*

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- (4) Improvement of Maintenance Practices (Analysis of Surveillance and Monitoring Activities):
  - For each individual component or family, a cross comparison between ***HDC**s* (Degradation Mechanism) and ***HDM**s* (Maintenance Practices) is performed.
  - Maintenance practices are catalogued for all risk significant components or families.
  - Combining ***HDC/HDM*** bins with the risk level, Practices are categorised and priority is established.
  - Practices are enhanced or modified in order to obtain lower risk and higher degree of confidence for the component.

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- Actual status:
  - All spanish NPPs are conducting AMP.
  - José Cabrera (Zorita) NPP has developed AMP only up to end of design life (40 years).
    - actually all 4 AMP phases are implemented in the NPP SSCs.
  - Rest of NPPs (Sta.M.Garoña, Almaraz, Ascó, Cofrentes, Trillo and Vandellós 2) establish AMPs for long term operation (aiming an extension of life > 40 years).
    - Different status of AMP implementations (all NPP have defined their critical components, in AMP phase 1).
    - Sta.M.Garoña NPP is foreseen as the first plant to request an extension of life > 40 years (up to 60?), in 2006 (end of design life in 2008).
    - Next are Almaraz 1 in 2020 and Ascó 1 in 2022.

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

PLANT LIFE EXTENSION (LTO)

- CSN is working on the development of a safety policy (legal, technical and administrative provisions) to cover plant life extension applications: **"Conditions for long term operation of NPP" (April 2002)**
- This approach will require a new revision of CSN regulations and recommendations in the Periodic Safety Review to be carried out every ≈10 years.
- In case of long term operation the licensee will have to prove that operation beyond plant design life (> 40 years) can be performed in accordance with prescribed regulations.

CSN

Nuclear Power Plant Life Management and Long Term Operation Programmes in Spain

- Actually there is a joint Industry/CSN Task Force developing the main concepts (technical and administrative issues) of the safety policy.
- T.F. work is expected to finish this year 2003, proposing a draft report to CSN Counsellors for final decision.
- Spain is also working, on PLIM and PLEX subjects, in other forums as NEA-CSNI and WENRA.
- Inside WENRA Group on Reactor Safety Harmonisation (Pilot Project, phase 2, 2003/04), Spain (CSN) is responsible for developing a proposal related to plant aging management.

CSN

Swedish approach on Long Term Operation

Ervin Liszka
Swedish International Project
Nuclear Safety

SiP

SIP

- Responsible for implementation of bilateral Swedish co-operation with Eastern and Central Europe on nuclear safety
- Governmental organisation - special part (co-operation - not authority) of Swedish Nuclear Power Inspectorate (SKI)
  - Safety
  - Knowledge
  - Integrity

SiP

SKI's Organization

SKi

SiP

3 IAEA, 2003-05-19

SIP

- Project oriented approach
- Small staff (8) with broad competence
  - 6 nuclear engineers
  - 150 reactor years experience
  - mostly industrial experience
  - 3 speaks Russian
  - participation in IAEA activites
    - EBP on the Safety of WWER and RBMK NPPs
    - EBP on mitigation of IGSCC in RBMK reactors
    - OSART, ASSET missions

SiP

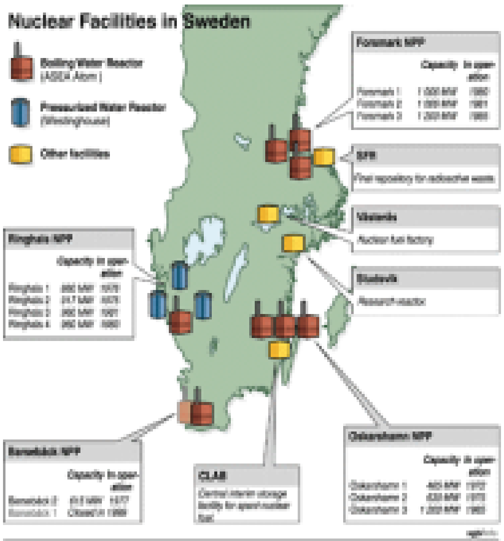
4 IAEA, 2003-05-19

Safety is a Continuous Process of Modernisation

Modifications and replacements have to be made due to

- Operational experience
- Spare parts are difficult to find
- Control equipment becomes obsolete
- Aging of components and materials
- Technical renewal and backfitting
- Regulatory requirements
- Utility policies

Nuclear Power in Sweden



Oskarshamn 1 - Safety Upgrading

History

•The reactor is the first power producing reactor in Sweden

•Construction of the unit started 1966 and the operation 1972

•BWR, 1375 MWt, 465 Mwe

•Design - RPV with four external loops and MCP

•Design life 40 years

SiP

Oskarshamn 1 - Safety Upgrading

Examples of modernisations during 70's and 80's

•1975 - Fire protection CO_2 +watersprinkling in cablespreading room

•1978-79 - Cable separation project, new 2-train auxiliary feedwater system, more reliable emergency power supply

•1988 - Installation of filtered venting of containment

SiP

Oskarshamn 1 - Safety Upgrading

Three-steps modernisation programme during 90's

FENIX, MAX, MOD

Project FENIX (Further ENergy production In eXisting plant)

•Start summer 1993 - shut down for three years

•Consists of 7 various tasks

•The biggest - measures to renovate RPV

•Total decontamination to a level for work inside RPV

•Thorough Inspection of RPV and Main Circulation Loops

•Fracture Mechanics analysis based on inspection results

SiP

Oskarshamn 1 - Safety Upgrading

•Replacement of

- feed-water pipelines inside RPV
- Core-sprinkling lines inside RPV
- MC loop nozzles

•Installation of

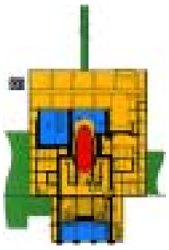
- additional restrains at Main Steam Lines
- additional restrains at MC loops
- leak detection system
- new motor drives for control rods and isolation valves

SiP

Oskarshamn 1 - Safety Upgrading

•Improvement of containment function

- structural reinforcements of the containment and reactor building
- verification of blow path's to protect the reactor building in case of LOCA outside of the containment



11 IAEA, 2003-05-19

SiP

Oskarshamn 1 - Safety Upgrading

•Environmental qualification of el. systems

- replacement and separation of cables in containment
- modification of electrical supply systems and auxiliary systems
- seismically safe electrical battery supply

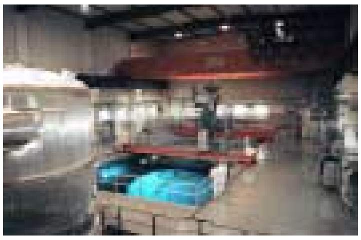
12 IAEA, 2003-05-19

SiP

Oskarshamn 1 - Safety Upgrading

Project MAX(Moderator-tAnk eXchange)

- **During outages 1996-1998**
- **Replacement of RPV internals**
  - core shroud (moderator-tank)
  - steam separators
- **Replacement of Main Steam Isolation Valv**



SiP

13 IAEA, 2003-05-19

Oskarshamn 1 - Safety Upgrading

Project MODernisation (1996-2002)

Why the last part of the upgrading of the plant?

The plant did not fulfil modern requirements regarding

- separation between safety and operation
- redundancy, diversification and physical separation
- defence against fire, flooding, earthquake and blockage of sea water
- old equipment

SiP

14 IAEA, 2003-05-19

Oskarshamn 1 - Safety Upgrading

Reactor Protection System (RPS)

- digital system with four redundant trains
- an additional hardwired part of the system handling initiation of safety systems for the most frequent initiating events

SiP

Oskarshamn 1 - Safety Upgrading

New systems and components in new emergency control building

- New RPS
- Two new diesel generators
- Two secondary cooling water pumps and heat exchangers for safety systems
- Two auxiliary feed water pumps and a pump to auxiliary condenser
- Switchgears and redundant ventilation system
- Emergency control system

SiP

Oskarshamn 1 - Safety Upgrading

Changes in the old plant

- New safety concept with 4 trains separated electrical power supply and I&C, physically separated cable routs
- New main circulation pumps and new valves in auxiliary condenser system
- New HP and LP turbine parts
- New modern control room design with a safety panel, large screen and screen based operator interface

Goal - period of further 20 years of operation

17 IAEA, 2003-05-19

SiP

Conclusions from Swedish perspective

•Safety upgrading - a continuous process with ”quantum jumps”

•The issue is upgrading of older design - not life time per se

•Large experience in Sweden

•co-operation on regulatory side

•industrial co-operation

•IAEA EBP and bilateral co-operation programmes complement each other

18 IAEA, 2003-05-19

SiP

:

Продление срока эксплуатации АЭС.

ГРИЩЕНКО Вадим Васильевич

Председатель Комитета ядерного регулирования Украины

Руководящий комитет внебюджетной программы МАГАТЭ
“Управление ресурсом АЭС”
г.Вена, Австрия, 19-21 мая 2003 г.

ПРОЕКТНЫЕ СРОКИ ЭКСПЛУАТАЦИИ ОБОРУДОВАНИЯ АЕС

- **АЭС сложный промышленный комплекс, в котором испльзуются материалы и оборудование с различными сроками эксплуатации (от нескольких дней до полногосрока выработки ресурса).**
- **В течение эксплуатации ресурс оборудования контролируется, оценивается, прогнозируется и обновляется ремонтами либо заменой на новое оборудование.**
- **Проектний срок эксплуатации АЭС определяется ресурсом критичных элементов, ремонт и замена которых либо технически не возможна либо экономически нецелесообразна, к ним относятся:**
  - ***Корпус реактора*;**
  - ***Трубопроводы первого контура;***
  - ***Основные сооружения и строительные конструкции;***
  - ***другое.***

КРИТЕРИИ УСПЕХА ПРОЕКТА ПРОДЛЕНИЯ СРОКА ЭКСПЛУАТАЦИИ АЭС

- **Наличие стратегии продления срока эксплуатации, утвержденной в установленном порядке.**
- **Наличие нормативно-правовой базы для оценки ресурса и продления срока эксплуатации.**
- **Уровень безопасности АЭС соответствует современным требованиям.**
- **Экономическая целесообразность.**
- **Техническая возможность (наличие остаточного ресурса критичных элементов АЭС или наличие технологий для обновления ресурса). Наличие источников финансирования проекта продления срока эксплуатации.**
- **Оптимальный график реализации проекта.**

Руководящий комитет внебюджетной программы МАГАТЭ
“Управление ресурсом АЭС”
г.Вена, Австрия, 19-21 мая 2003 г.

Варианты стратегии продления эксплуатации.

- **Отложенное принятие решения до истечения проектного срока эксплуатации.**
  - **В течение проектного срока эксплуатации не предпринимаются никакие действия по продлению срока эксплуатации блока АЭС.**
  - **Ресурс оборудования вырабатывается до критического состояния на конец проектного срока эксплуатации.**
  - **В течение эксплуатации накапливается и обрабатывается база данных по критическим элементам АЭС.**
  - **После остановки блока проводится техническое обследование критических элементов и принимается решение о технической возможности продления срока эксплуатации и на основе этого общее решение о реализации проекта продления эксплуатации.**

- **Принятие и реализация решения о продлении срока эксплуатации за 5 - 10 лет до окончания проектного срока эксплуатации.**
  - **Решение о технической осуществимости продления эксплуатации принимается на основе прогноза ресурса критических элементов блока АЭС.**
  - **На основе решения о технической осуществимости продления эксплуатации принимается и реализуется общее решение о продлении срока эксплуатации.**

Отложенное принятие решения до истечения проектного срока эксплуатации.

- **Преимущества:**
  - **минимальный коммерческий риск;**
  - **более низкие эксплуатационные расходы на управление ресурсом на протяжении проектного срока эксплуатации.**

- **Недостатки:**
  - **снижение надежности и уровня безопасности к концу проектного срока эксплуатации;**
  - **неуверенность персонала в завтрашнем дне;**
  - **продолжительный срок простоя блока на восстановление ресурса и повышение безопасности;**
  - **необходимость концентрации значительных финансовых ресурсов в короткий промежуток времени.**

Принятие и реализация решения о продлении срока эксплуатации за 5 - 10 лет до окончания проектного срока эксплуатации.

- **Недостатки:**
  - **высокий коммерческий риск;**
  - **повышенные эксплуатационные расходы на управление ресурсом в течении проектного срока эксплуатации.**

- **Преимущества:**
- **надежность и уровень безопасности блока повышаются в течение проектного срока эксплуатации за счет внедрения проектов повышения безопасности и замены оборудования на более современное;**
- **распределение ресурсов на продление эксплуатации на 5-10 лет;**
- **возможность перенести часть расходов на продление срока эксплуатации на эксплуатационные затраты;**
- **ритмичное участие национальных проектных институтов, научных организаций и промышленности в проектах продления срока эксплуатации;**
- **отсутствие продолжительного простоя блока АЭС.**

ОРГАНИЗАЦИОННОЕ ОБЕСПЕЧЕНИЕ ПРОДОЛЖЕНИЯ СРОКА ЭКСПЛУАТАЦИИ

- **Продолжение срока эксплуатации является инвестиционным проектом, который реализуется в соответствии с законом Украины “Про инвестиционную деятельность”, а также согласно постановлениям КМУ и Государственным строительным нормам.**
- **Эксплуатирующей организации необходимо определится в какое количество этапов будет осуществлятся проектирование, существует минимум два этапа:**
  - **Технико-экономическое обоснование.**
  - **Рабочая документация:**
    - **Программы и методики обследования и оценки остаточного ресурса.**
    - **Чертежи и обоснование мероприятий по повышению безопасности.**
    - **Внесение изменений в эксплуатаціонную документацию по условиям и лимитах эксплуатации**

Выводы

- **Система нормативно-правовых актов, стандартов и других нормативних документов по вопросам оценки и продления ресурса оборудования АЭС Украины для текущей эксплуатации существует как на уровне государственного регулирования, так и на уровне эксплуатирующей организации.**
- **Система документов текущей эксплуатации, база данных по опыту эксплуатации и надежности должна использоватся для продления срока эксплуатации блоков АЭС.**
- **Для критичных элементов (корпус реактора, железобетонные конструкции оболочки реакторного отделения, фундаменты, закладные элементы оборудования) с точки зрения ресурса блока АЭС, необходимо разработать дополнительные рограммы и методики для оценки их ресурса.**
- **Продолжение эксплуатации блоков АЭС в за проектный срок является инвестиционной деятельностью на которую распространяется действие закона Украины “Про инвестиционную деятельность”, а также соотвествующие нормативные акты и Государственные строительные нормы.**

Руководящий комитет внебюджетной программы МАГАТЭ
“Управление ресурсом АЭС”
г.Вена, Австрия, 19-21 мая 2003 г.

Основные действия по продлению ресурса эксплуатации

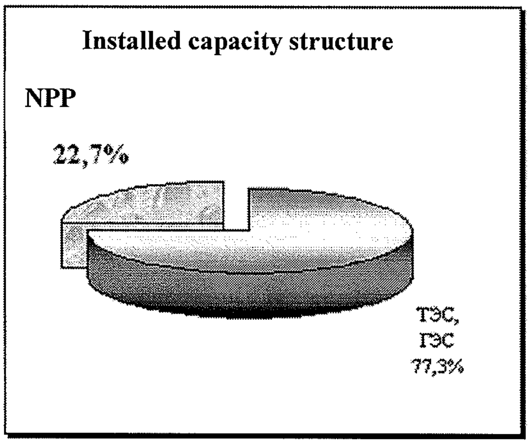
- **Эксплуатационный контроль и техобслуживание оборудования АЭС, в том числе контроль металла корпуса реактора. На этой основе принятие решения о возможном продлении ресурса эксплуатации.**
- **Замена оборудования (контроль достижения пределов эксплуатации оборудования).**

Вопросы для рассмотрения Руководящего комитета

- **Эксплуатационный контроль и техобслуживание оборудования АЭС, в том числе контроль металла корпуса реактора. На этой основе принятие решения о возможном продлении ресурса эксплуатации.**
- **Замена оборудования (контроль достижения пределов эксплуатации оборудования).**

1 Information on current status of activities on the nuclear power units life-extension at NPPs of Ukraine

- **At present, there are 13 WWER –440 and WWER-1000 units in operation at four NPPs in Ukraine. The installed capacity of Ukrainian NPPs accounts for 22.7% of the power sector structure. In 2002 the nuclear power plants have generated 77 990 million kWh of the electric power that accounted for 45.1% of the total electricity production in Ukraine (Diagram 1).**



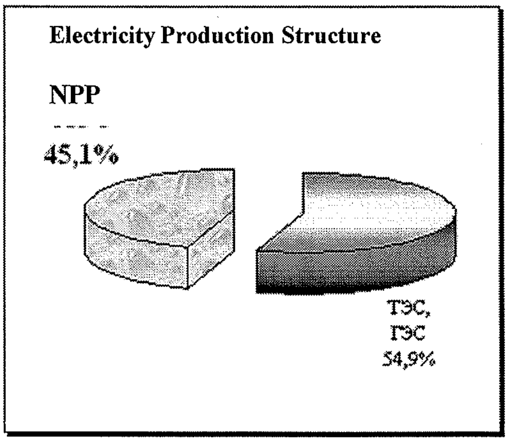


Diagram 1

- **Therefore, the Nuclear Power Sector plays a basic role in the national economy of Ukraine. In 2002 NPP load factor was 75.2 %. In 2003 the load factor is expected to achieve 78 %, that is fully acceptable, taking into account SG replacement activities to conducted at South Ukraine Unit 2. For four months of 2003 the number of events was actually halved compared with a similar period of 2002. Dynamics of event occurrence distributions is shown for the period from 1995 to 2002.**

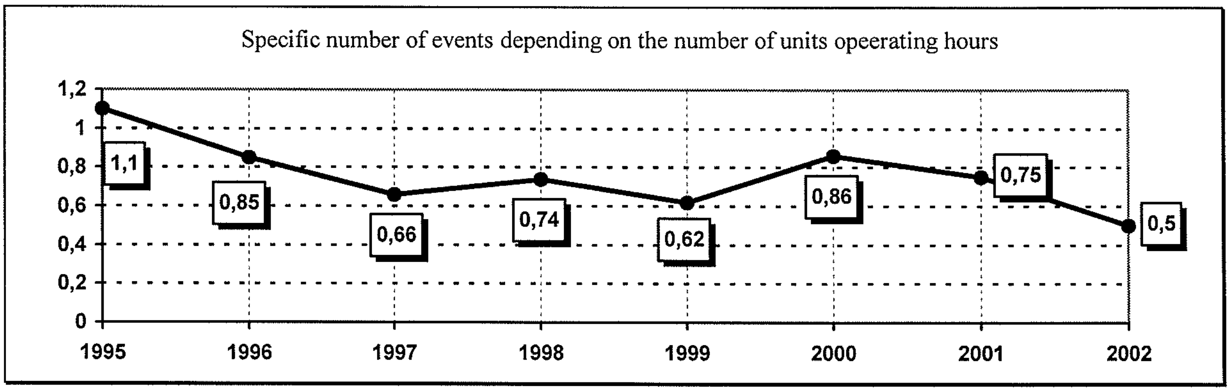


Diagram 2

Design service–life of all NPP unit operation is equal to 30 years.

Table shows the dates of operation start and the units operating license expiry for the NPPs of Ukraine.

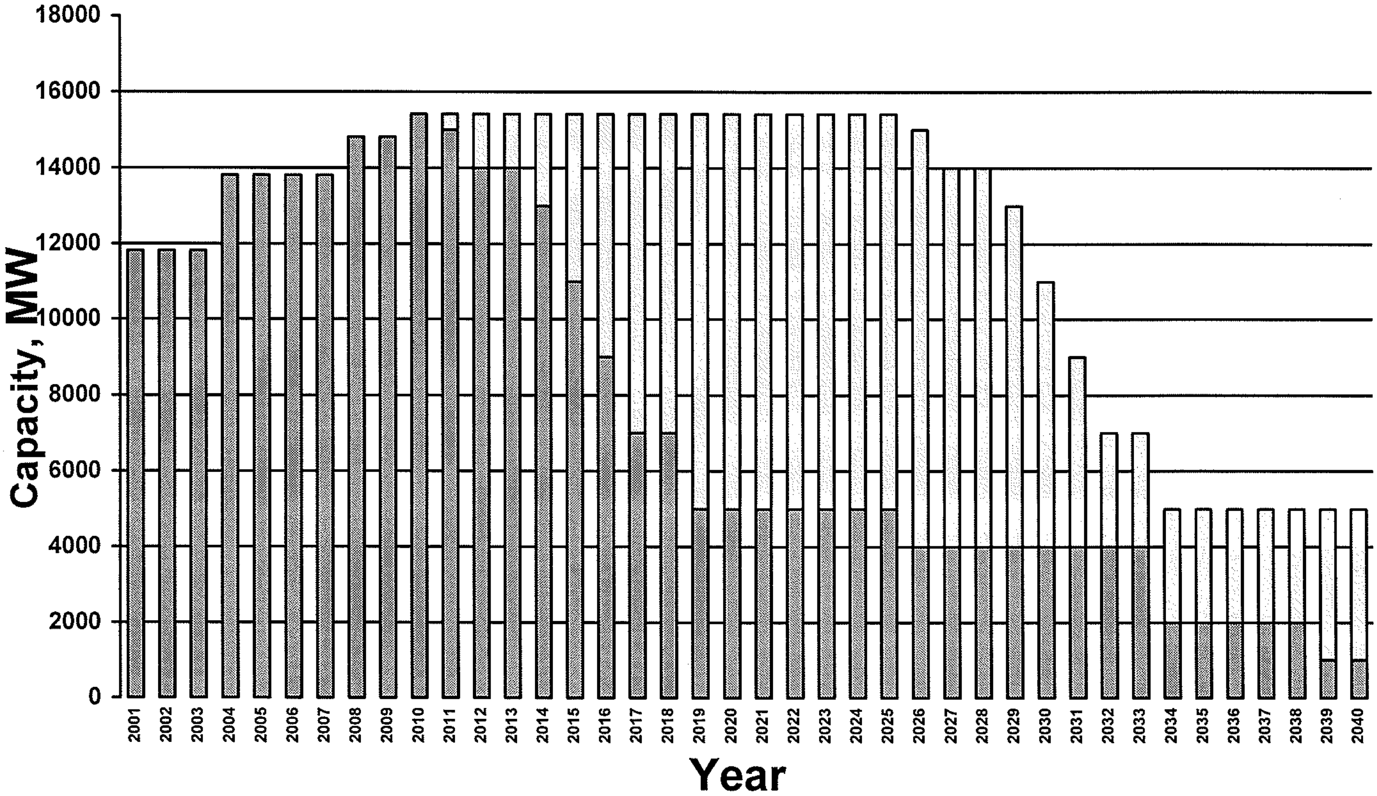
Table 1

NPP, Unit	Type/Model of the reactor Installation	Capacity, MW (e)	Start of operation	Year of the design operation termination
RNPP-1	WWER-440/B-213	416	31.12.80	2010
RNPP-2	WWER-440/B-213	416	30.12.81	2011
SU NPP-1	WWER-1000/B-302	1000	22.12.82	2012
ZNPP-1	WWER-1000/B-320	1000	10.10.84	2014
SU NPP-2	WWER-1000/B-338	1000	06.01.85	2015
ZNPP-2	WWER-1000/B-320	1000	02.07.85	2015
ZNPP-3	WWER-1000/B-320	1000	10.12.86	2016
RNPP-3	WWER-1000/B-320	1000	24.12.86	2016
ZNPP-4	WWER-1000/B-320	1000	24.12.87	2017
KhNPP-1	WWER-1000/B-320	1000	31.12.87	2017
SUNPP-5	WWER-1000/B-320	1000	31.08.89	2019
SU NPP-3	WWER-1000/B-320	1000	20.09.89	2019
ZNPP-6	WWER-1000/B-320	1000	19.10.95	2025

Since 2011, due to the design service life term expiry, the total electricity generation at the Ukrainian NPP will tend to decrease.
Possibly, in 2019, only Zaporizhzhya Unit 6 would continue its operation.

Diagram 3

Diagram 3 shows the installed capacity decrease at the Ukrainian NPPs in case the service-life of power units will not be extended.



For providing and maintaining electricity generation in Ukraine at the current level there is only one - unique effective method. This method is ensuring the NPP power units service-life extension or long-term operation. This will enable us, while constructing and commissioning new generating capacities in our country, to avoid any gaps in the electricity production and accumulate financial resources to be spent NPP decommissioning in future. Diagram 5 shows changes in the installed capacity of Ukrainian NPPs for the period up to 2040 provided that new four power units will be commissioned as well as service-life of 15 units will be extended for 15 years each.

Total installed capacity of NPP units in Ukraine subject to service –life extension for 15 years and commissioning of four units

Expected additional production (at Load factor equaling 0,8) in case of the service life –extension will come to 1,32 trillion kW-hour.
At the tariff of UAH 0.065 per kW-hour, UAH 86 billion will be received.
Extra charges for service-life extension activity will approximately come to – UAH 6.6 billion.

Measures focused on ensuring long-term operation of WWER-440/WWER-1000 power units:

- **the gained operating experience of NPP power units and the safety analysis performed allow to state, that safety principles laying basis for design of operating NPPs, meets mainly the international standards' requirements.**

- **As for now, the comprehensive safety analysis for NPPs in operation have been performed, on the deterministic basis with engaging both the Ukrainian and foreign specialists, including the IAEA's experts. Safety problems revealed have been classified with using the IAEA's methodology based on the degree of their impact importance for in-depth safety, and, respectively, the priority of their implementation.**

- **Results of the probabilistic safety analysis performed for pilot units of Ukrainian NPPs have shown that, the main indicator (factor) of the NPP safe operation assessment - the total core damage frequency (ЧЗ) value correspond to that imposed in standards effective in Ukraine and <u>does not exceed those recommended by the IAEA.</u>**

- **In-depth safety analysis performed for design of power units equipped with WWER-440/B-213 and WWER-1000/B-320 reactors evidence that there is safety deficiency that could hamper the extension of further operation of NPP units.**

- **Probabilistic safety analysis performed enable us to identify the priority and optimize safety improvements to be implemented, with taking into account their numerical contribution to total CDF values (as well as optimize the distribution of funds having regard to the safety maintaining at the appropriate level) and organize the works to apply risk-informed approaches to the operating process optimization.**

- **On-going «Comprehensive Program on NPP units upgrading and safety improvements» has been developed in Ukraine. According to the Program, Category III measures (as per the IAEA classification) will be implemented by 2006. As a result of this Program implementation, in addition to the design safety improvement, a major part of equipment will be replaced that have their service-life expired. It will be replaced with more advanced one;**

- **Developed «Comprehensive program on organizational and technical measures on the NPP service-life extension». The expected results are as follows:**

- **establishing of a structure for administration and scientific and technical support to the NPP service life extension;**

- **development of normative documents ensuring activities to be performed on the service-life assessment and extension of the NPP operation based on the procedures agreed upon with the Regulator.**

- **preparation of technical and economical calculations of Ukrainian NPP life extension costs for the period up to 2025;**

- **development and initiation of unit program implementation on the NPP CSS aging management;**

- **development and realization of the program on the RPV aging management;**

- **In the frameworks of the Program on the NPP unit components aging management that following activities are planned to be realized:**
- **perform the assessment of the technical condition and define residual service-life of the power units equipment;**

- **develop and implement measures required to control the equipment aging in future;**

- **replace equipment with service -life expired.**

- **At the final stage the Unit safety re-assessment should be performed. Based on its results a decision will be drawn either to extend the operating license term or to start decommissioning of the unit.**

- **Time-frame of the major steps on the service-life extension of pilot units, namely: Rivne Unit 1 and SUNPP Unit 1 are as follows:**

- **development of standards and regulations - 2003;**
- **assessment of technical condition and identification of residual equipment service-life - 2004 – 2005;**
- **feasibility study of the service-life extension:**
  RNPP-1 2005;
  SUNPP-1 2006;
- **preparation of units for service-life extension:**

RNPP-1 2005 – 2007
SUNPP-1 2006 –2008

- **unit safety re-assessment and operating license term extension:**
  РАЭС-1 2008 – 2010;
  ЮУ АЭС-1 2009 –2011.

- **Expectations from the Extrabudgetary program:**

- **exchange of experience, activities results, procedural materials on the SSC aging management and unit service- life extension;**

- **support provided on the IAEA' s part;**

- **technical missions to NPPs, which have some experience in extending the NPP service-life**

- **Mode of Support:**

- **participation in the Steering Committee meeting;**

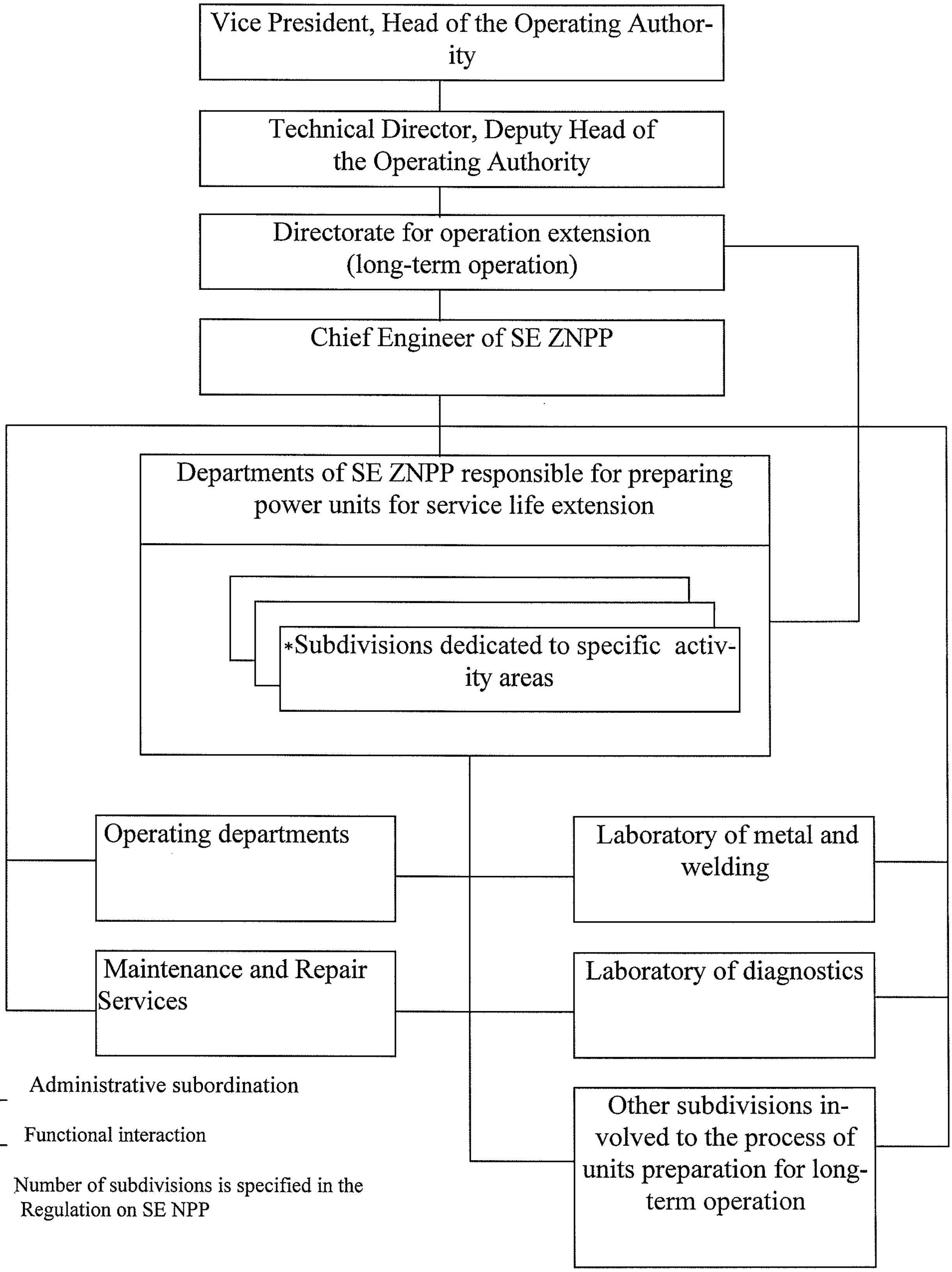
- **arrangement of the technical support missions**

List of standard program (procedures) on assessment of the technical condition and re-setting of the unit SSC service-life

No.	Title
	Standards and codes
1.	Standard program on the unit component aging management
	Mechanical equipment
2.	Program on the assessment of technical condition and re-setting of the WWER -440 RPV service-life.
3.	Program on the assessment of technical condition and re-setting of the WWER -1000 RPV service-life.
4.	Program on the assessment of technical condition and re-setting of the reactor internals service-life.
5.	Program on the assessment of technical condition and re-setting of service-life of the main RI circulating piping (WWER)
6.	Program on the assessment of technical condition and re-setting of the WWER-440, -1000 SG service-life
7.	Program on the assessment of technical condition and re-setting of the RCP service-life.
8.	Program on the assessment of technical condition and service-life re-setting of pipeline with supports and hangers
9.	Program on the assessment of technical condition and re-setting of the heat exchange equipment service-life.
10.	Program on the assessment of technical condition and re-setting of the vessels service-life.
11.	Program on the assessment of technical condition and re-setting of the NPP turbine installation service-life
12.	Program on the assessment of technical condition and service-life re-setting of ventilation equipment intended for NPP safety important systems.
13.	Program on the assessment of technical condition and service-life re-setting of NPP safety diesel installations
14.	Methods for evaluation of NPP valves' technical condition for the service-life extension purpose.
15.	Standard program of pumping equipment inspection for the service-life extension purpose
16.	Standard program of activities to be performed for extending service -life of removable parts of fixed valves

	Fuel handling
1.	Program on the assessment of technical condition and service-life re-setting of NPP Fuel handling part. Overhead crane.
2.	Program on the assessment of technical condition and service-life re-setting of NPP Fuel handling part. Refueling machine.
	Civil works
3.	Program on the assessment of technical condition and service-life re-setting of foundations, embedded parts, and equipment fastening components
4.	Program on the assessment of technical condition and service-life re-setting of the building housing safety important systems
5.	Program on the assessment of technical condition and service-life re-setting of the building of the NPP civil structures. Bed, walls and slabs of the reactor hall._
6.	Program on the assessment of technical condition and service-life re-setting of the spent fuel pool with all components, including racks._
7.	Program on the assessment of technical condition and service-life re-setting of the NPP civil structures. Reactor vault._
8.	Standard procedure for identifying the current status of WWER-1000/B-320 units' in Ukraine and assessing their residual service -life.
	Electrical equipment
9.	Program on the assessment of technical condition and service-life re-setting of the NPP electrical generators
10.	Program and procedure of assessment of technical condition and service life of NPP transformers
11.	Program on the assessment of technical condition and service-life re-setting of the NPP cabling. High voltage cable.
12.	Program on the assessment of technical condition and service-life re-setting of the NPP cabling. Power cables up to 1000V.
13.	Program on the assessment of technical condition and service-life re-setting of the NPP cabling. Control cable up to 1000V.

10 Organizational Chart of the ZNPP Service responsible for preparing units for their life-extension



____ Administrative subordination

____ Functional interaction

* Number of subdivisions is specified in the Regulation on SE NPP

11 STRUCTURE OF THE COMPREHENSIVE PROGRAM on organizational and technical measures on Ukrainian NPP service-life extension (2003 - 2010)

1. Organization of external interactions

1.1 *Establishing of the Company' s service- life extension policy at the State level*
1.2 *Establishing of the SNRCU' s legal frameworks (normative basis) on the long-term operation*

2. Administrative management

2.1 *Organization of the Company' s activities on the NPP service-life extension*

3. Production process control

3.1 *Activities in the frames of effective licenses for power unit operation*
3.2 *Preparation of NPP operating license extension for the period exceeding its design term*

4. Financial and economic control

4.1 *Providing financial resources to activity the Company performed in the area of the NPP long-term operation*

5. International relations

5.1 *Formation of a positive public attitude in Ukraine and abroad towards the NPP long-term operation*
5.2 *Obtaining of international assistance for Ukrainian NPP long-term operation.*

6. Material resources management

6.1 *Providing of the Operating Authority with material & technical products required for ensuring the NPP long-term operation*

7. Human resources management

7.1 *Training of ENERGOATOM' s personnel in performing activities on the NPP service-life extension*

European Commission
DG RELEX

EC activities on Nuclear Safety

1991-2002

European Commission
DG RELEX

Tacis Nuclear Safety Programme

From 1991 to 2002, the nuclear safety Tacis programme allocated some 900 m€ for the whole CIS, including Ukraine, Armenia and Kazakhstan to improve nuclear safety.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

On site assistance

provided on a continuous basis through EU operators at 14 sites in the NIS. The assistance has concentrated on the level of design safety, operating and surveillance conditions, the organisation of operational safety and on the provision of equipment

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Assistance to regulatory authorities.

The overall safety culture is being improved through methodological assistance to the regulators

European Commission
DG RELEX

Tacis Nuclear Safety Programme

In Chernobyl, Tacis has helped towards the decommissioning of units 1, 2 and 3. In special, Tacis is funding the construction of the an Industrial Complex for Solid Radwaste (ICSRM) arising from the decommissioning

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Attention has been focused on the problem of waste management and on problems linked to the treatment, storage and disposal of nuclear waste and spent fuel in Russia.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

- The opening of the Russian Methodological and Training Centre (RMTC) was a major step in support for the establishment of safeguards in Russia.
- The programme has assisted in the preparation of Euratom loans, like in the case of K2R4.
- Off-site Emergency Preparedness: Tacis funded in 1995 a study to determine the needs of the region regarding preparedness in case of nuclear accidents.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Priorities 2004-2006

At Regulator level, continue with the transfer of methodology and with the TSO support, specially in licensing plant modifications through the 2+2.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Priorities 2004-2006

At Operator Level:

In Russia: Finishing the two PIP that will be still left after 2004

In Ukraine, implementing the recommendations of the Tacis 10^{th} years conference, which include to solve all category III items left.

In Armenia continue with the soft assistance until the plant is closed.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Priorities 2004-2006

Design Safety:

Continue with the assistance to license accident computer codes

Possibility to assist in reviewing safety analysis reports in modern plants.

European Commission
DG RELEX

Tacis Nuclear Safety Programme

Priorities 2004-2006

Waste/Spent fuel:

Contributing to tackle radwaste problems in NW Russia, including the Lepse project (and other projects that can arise outside NDEP)

European Commission
DG RELEX

Working Group Russia-EC on First Generation Reactors

Created in January 2001 to explore the possibilities of compensating closure of first generation reactors in Russia by means of Euratom loans to complete reactors under construction.

Two meetings in 2001 and 2002.

TACIS and PHARE Nuclear Safety programmes: Case of Neutron Embrittlement of VVER Reactor Pressure Vessels – Recent Results, Open Issues and New Developments

M. Bièth, C. Rieg, R. Ahlstrand

European Commission, Joint Research Center, Institute for Energy

Petten, The Netherlands

Introduction

- The TACIS and PHARE programs were established since 1991 along with other EU programs as support mechanisms through which projects could be identified and addressed satisfactorily. One priority for TACIS or PHARE funding is nuclear safety
- In Nuclear Safety, the countries mainly concerned are Russia, Ukraine, Armenia, and Kazakhstan for the Tacis programme, and Bulgaria, Czech Republic, Hungary, Slovak Republic, Lithuania, Romania and Slovenia for the PHARE program

Introduction

- The Tacis and PHARE programs concerning the Nuclear Power Plants consist of projects for:

- On Site Assistance and Operational Safety,
- Design Safety,
- Regulatory Assistance,
- Waste Management

and are focused on reactor safety issues, contributing to the improvement in the safety of East European reactors and providing technology and safety culture transfer

Introduction

- As nuclear power plants age, material ageing of key reactor components becomes a crucial consideration for continued safe plant operation. Decisions regarding the verification of design plant lifetime and potential license renewal periods involve a determination of the metal condition
- In VVER Reactor Pressure Vessel material ageing field, Tacis and Phare funded several projects

Background

- EC funds (TACIS, PHARE, EURATOM R & D) and other sources have been used since 1991 for improving the knowledge on neutron embrittlement of VVER RPVs
- There is still a need for further clarification of material issues (embrittlement & re-embrittlement rates, accurate material toughness characterisation and prediction, surveillance programme)
- Two TACIS projects are under preparation (TACIS 2000 annual programme), aiming to generate comprehensive RPV integrity assessments with particular concern on materials embrittlement aspects (up to date predictions)

Background

- VVER 440/230
  - Lack of representative manufacturing data and sensitive welds (high P & Cu contents)
  - No surveillance programmes
  - Thermal annealing and other (operational) measures
  - Safety assessment based on direct characterisation (non-clad)
- VVER 440/213
  - Better neutron resistant materials than in VVER 440/230, but very high End of Life neutron dose
  - Surveillance efficiency (long-term)
- VVER 1000/187 (NVZ5), 302 (SU1), 338 (SU2, KLN 1 & 2) & 320
  - Nickel effect ?
  - Shortcomings in surveillance programmes

Main findings & results of past projects (1/6)

VVER 440/230

- List of relevant TACIS & PHARE projects:
  - R1/91 – TSO/VVER01C(94) – R2.02/95 – R6.01/96
  - PH/91 – PH/92 – PH/93
- Main findings:
  - Direct characterisation by means of mini CVs have been performed for KZD 1&2, NVZ 3&4 (Retrospective T_{k0}, annealing efficiency, anticipated re-embrittlement rate)
  - Acceptable margins could be shown after annealing, but the experimental re-embrittlement results and microstructure investigations were not numerous and consistent enough to underpin a mechanistically based re-embrittlement model

Main findings & results of past projects (2/6)

VVER 440/230 (cont'd)

- State of the art:
  - There is no global synthesis of the available results (TACIS/PHARE – Bilateral, Domestic, ...), which makes the basis of the justification of the long term operation of these plants questionable
  - Further progress in direct characterisation (among other potential sources) is needed to exclude part of the uncertainties of the past generic procedure and compensate for the absence of on-line surveillance programme
  - There is no further TACIS project, but EC is taking part as observer in the advisory committee of the new dedicated IAEA extra-budgetary project, which should help to have the technical bases clarified and evaluated on an international scale

Main findings & results of past projects (3/6)

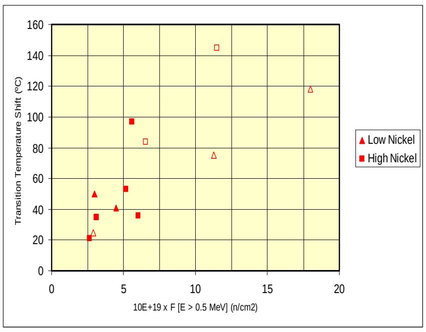
VVER 440/213

- List of relevant TACIS & PHARE projects :
  - R6.01/96 & PH2.01/95
- Main findings:
  - Sampling possibilities at Greifswald’s units
  - Development of a relevant PTS procedure and fracture toughness criteria
- State of the art:
  - Long-term operation shall be supported by more refined assessments on-line with international practice developments (implementation of mitigation measures at sensitive plants)

Main findings & results of past projects (4/6)

VVER 1000/187 (NVZ5), 302 (SU1), 338 (SU2, KLN 1 & 2) & 320

- List of relevant TACIS projects :
  - U1.02/92 – R2.09/94 – SRR2/95 – R2.06/96
- Main findings:
  - Additional irradiation experiments did not provide for clear conclusions (scatter, basis for physical models) on the“nickel effect”



Main findings & results of past projects (5/6)

VVER 1000/187 (NVZ5), 302 (SU1), 338 (SU2, KLN 1 & 2) & 320 (cont'd)

- Main findings (cont'd):
  - Shortcomings in the surveillance programmes were confirmed (temperature, neutron doses evaluation relying on ^{54}Mn activity measurements, severe flux gradients within the specimens and among one set) and upgrading of the surveillance results evaluation procedure was required
  - Benchmarking on activity measurements and neutron transport calculation provided the basis for neutron dose evaluation principles
  - Specific experiment at Balakovo 1 confirmed limited over heating of the surveillance specimens
  - Reconstitution technique was qualified and provides for further impact testing.

IAEA EBP on "Safety aspects of long term operation of PWR", Vienna, May 19-21, 2003

Main findings & results of past projects(6/6)

VVER 1000/187 (NVZ5), 302 (SU1), 338 (SU2, KLN 1 & 2) & 320 (cont'd)

- Main findings (cont'd):
  - Static toughness tests (Master Curve applicability) and advanced techniques (NDT, local approaches) investigated
- State of the art:
  - Overheating of surveillance specimens is limited (<= 10ºC) [no correction proposed]
  - Recommendations have been set-up for upgrading the surveillance results (improved dosimetry [flux gradient, power & burn-up distribution at the surrounding assemblies and ^{93m}Nb dosimetry] / reconstituted specimens / use of impact and static toughness measurements)
  - R&D topics on K_{1c}/T shape for irradiated materials and possible implementation of local approach procedures, flux effect, …

EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute for Energy
Technical and Scientific Support to TACIS/PHARE

Brief description of the planned projects (1/8)

Project purpose and specific objectives (1/2)

- TAREG 2.01/00 & 2.02: twinned (interconnected) / simultaneous implementation in Russia & Ukraine for VVER 440/213 and 1000
- TAREG 2.01/00 (EC/JRC-IE):
  - Global programme validation through a Senior Advisory Group (SAG): experimental programme, surveillance evaluation, spectrum and flux effects, direct measurement of fracture toughness
  - Preparation of the material data for the PTS assessments with upgraded surveillance data
  - Comprehensive PTS assessments with particular concern in material aspects using up to date toughness prediction
  - Conclusions on available safety margins and recommendations on mitigation measures

IAEA EBP on “Safety aspects of long term operation of PWR”, Vienna, May 19-21, 2003

Brief description of the planned projects (2/8)

Project purpose and specific objectives (1/2)

- TAREG 2.02 (Industrial EU Main Contractor):
  - Reconstitution of standard and pre-cracked Charpy V and testing (impact / static toughness) using broken surveillance specimens
  - Implementation and qualification of reconstitution equipment and procedure in Ukraine
  - Benchmarking of methods (Codified K_{1c}/T_k indexation / Master Curve / Local Approach)
  - Assessment of the toughness curve (irradiated material)
  - Characterisation of irradiated cladding

Conclusion

- The planned twinned TACIS projects are concentrating on the VVER 1000 and 440/213 NPPs
- Upgrading the material toughness prediction capabilities by reassessing the surveillance programme results is the main goal (and provides for Ukrainian / Russian co-operation)
- Updating (generic) PTS assessments in order to help the operators to take the adequate decisions (ISI optimisation, R&D topics, mitigation measures) for PLIM
- The implementation of the 2 projects will involve external advice (SAG) and should provide valuable results for long-term operation

Dissemination of Tacis results

- Preparation of Executive Summaries of the 14 Design safety projects as well as workshop papers and press releases
- Preparation of 355 Tacis projects for Project Description Summaries (for Russia) (for Ukraine to be started soon)
- Creation of a web site http://sic-www.jrc.nl/tp/ for the 355 Project Description Summaries for Russian projects and the Executive Summaries

Disseminated Design Safety Tacis projects concerning VVER NPPs

Project reference	Project title
1. 1/91	Reactor Vessel Embrittlement
1. 2/91	Primary Circuit Integrity. Application of Leak Before Break concept
1. 3/91	Accident Analysis
1.13/91	Safety related equipment qualification under accident conditions
3.2/91 & R2.10/93	Quality Assurance Programme Development
3. 5/91 & R2.08/93N	Maintenance on VVER-1000
3. 8/91	Severe accidents and accident management technology
R2.05/93C	Non-Destructive Examination in-service Inspection
R2.09/94	Integrity assessment of VVER-1000 RPV including embrittlement

SAS Activities Related to Long-term Operation of NPPs

Safety Assessment Section

- Safety Development
- Regulatory Activities

Interest in Project

- Regulatory Approaches
- Use of Safety Methodologies

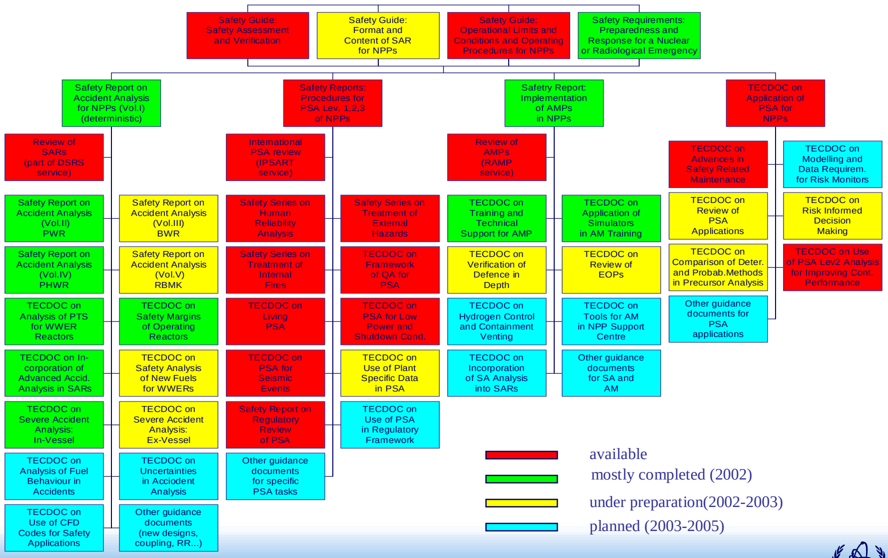
Safety Analysis

- Format and Content of Safety Analysis Report (Safety Guide)

(5) Deterministic Safety Analysis
- DBA
- Severe Accident Analysis
- Accident Management
- RAMP Safety Service

(6) Probabilistic Safety Analysis
- PSA Level 1, 2, 3
- Regulatory Review
- PSA 'Quality Guide'
- Specific Topics (HRA, CCF, etc.)
- IPSART Safety Service

IAEA Documents Related to Safety Analysis and Accident Management



International Atomic Energy Agency

Performance and Feedback of Experience

(8) Safety Performance

- **Safety Performance Indicators (Framework, Quantification Methodologies)**

(9) Use of experience from other NPPs, etc.

- **IRS for NPPs**
  - **Several Periodic Reports on Events and Lessons Learned**
  - **Topical Studies**

International Atomic Energy Agency

International Atomic Energy Agency

EBP on Safety Aspects of Long Term Operation of Pressurized Water Reactors

Miroslav Lipár
Operational safety section head

MISSION of OSS

- To develop Safety Standards and other documents for Nuclear Power Plants Operation (long term)
- To implement the Safety Standards through advisory and review missions in Member States (OSART, PROSPER, SCEP, SCART)
- To conduct training courses, seminars, workshops (regular budget,TC)

Organization

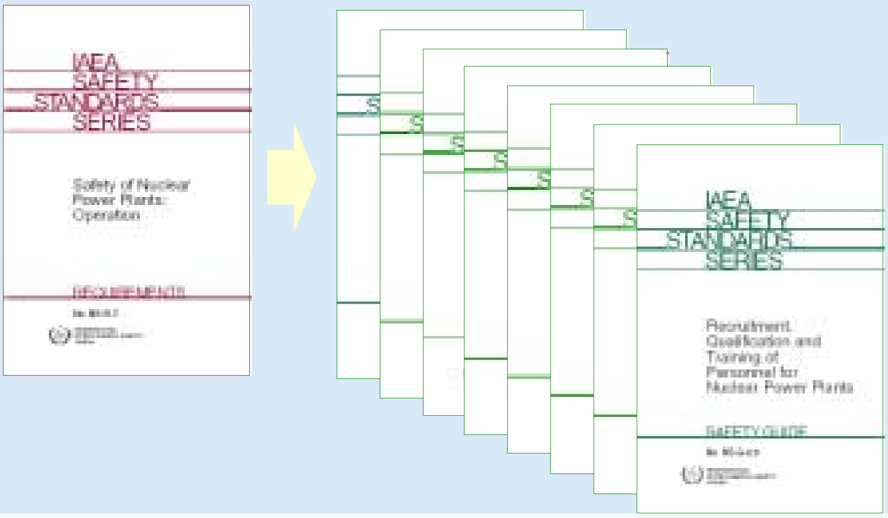
Operational Safety Section

Safety Culture
SCEP
SCART

Operational Safety Unit
OSART

Operating Experience Unit
PROSPER

IAEA Safety Standards : Operational Safety

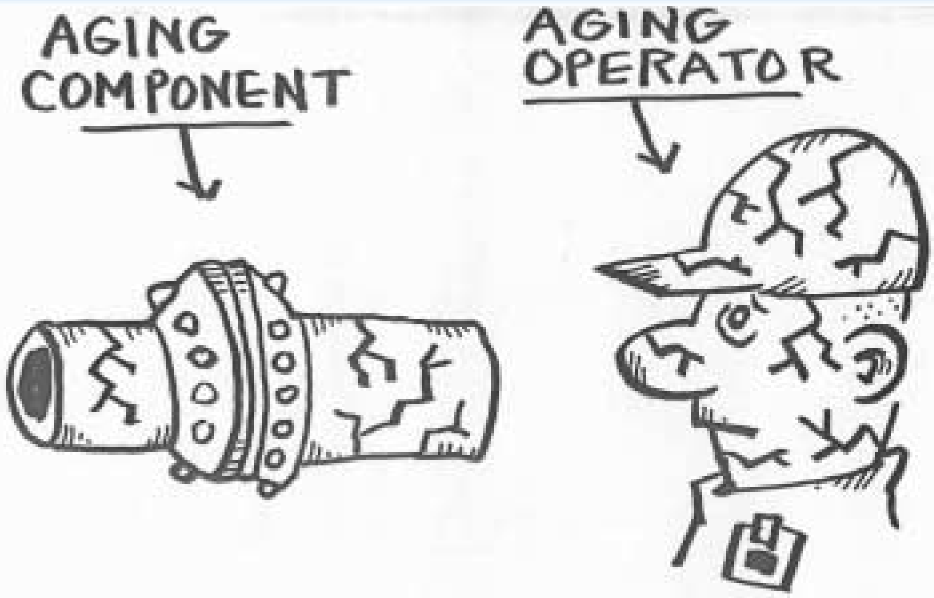


Requirements
Safety of Nuclear Power Plants:Operation

- Qualification and training of personnel
- Operating organization
- Plant operations
- Maintenance, testing, surveillance and in-service inspections
- Plant modifications
- Periodic safety review

Safety Guide
Periodic safety review of NPPs

- Plant design
- Actual condition of SSC
- Equipment qualification
- Ageing
- Safety analysis (deterministic, PSA)
- Safety performance
- Use of experience from others
- Human factor



Other relevant Safety Guides

- Modifications to Nuclear Power Plants
- The operating organization for Nuclear power Plants
- Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants
- Recruitment, Qualification and Training for Nuclear Power Plants

OSART Guideline

Long term operation:

- Staffing, pool of knowledge
- Long term policy, programme
- Process information, records
- Degradation reporting, analysing
- Surveillance, In-service inspection
- Maintenance strategy and programme

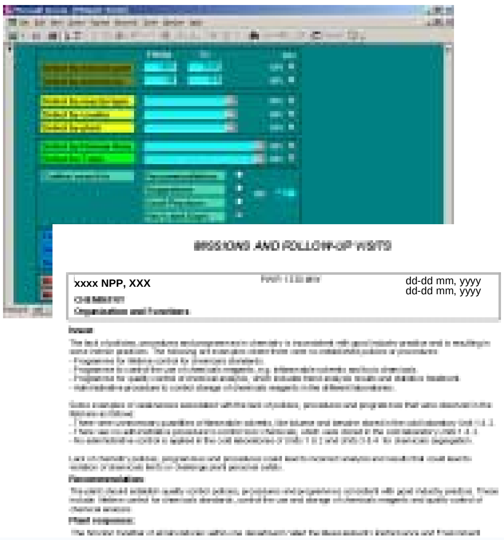
OSART - Effectiveness

Status of Issues at Follow-up Visits

Years [Visits]	Resolved (%)	Satisfactory Progress (%)	Insufficient Progress (%)	Withdrawn (%)
1989/90 [6]	40	43	14	3
1991/92 [10]	43	38	17	1
1993/94 [11]	46	41	13	< 1
1995/96 [5]	59	39	2	0
1997/98 [6]	45	47	7	1
1999/2000 [7]	38	52	10	0
2001/2002 [5*]	59	38	3	0

* Visits with finalized report only

OSMIR Database



- Distributed in CD-ROM
- Contains results from 53 OSART missions and 33 follow-up visits from 1991
- 2200 Recommendations, 1350 Suggestions and 500 Good Practices

Thank you for your attention

Safety Aspects of Long Term Operation: Introduction of Major Related Activities at Eng'g Safety Section

1st Steering Committee Meeting of EBP on Safety Aspects of Long Term Operation of Pressurized Water Reactors, Vienna, 19-21 May 2003

Takehiko Saito

Engineering Safety Section, Department of Nuclear Safety and Security, IAEA

Contents of Presentation

2

1. INTRODUCTION

- Recommendations of 1988 Advisory Group
  - Mission
  - Objective
- Safety Aspects of NPP Ageing, TECDOC-540 (1990)
  - Potential impact of ageing on safety
  - Material ageing mechanisms
  - Approach for managing ageing

  Contributed to general recognition of the need for ageing and life management in NPPs
- Man power in this area at Design Unit of ESS

3

2. ACCOMPLISHED WORK: Initial Knowledge Base

- SAFETY FUNDAMENTALS
- SAFETY REQUIREMENTS
- SAFETY GUIDES
- PROGRAMMATIC GUIDELINES
- COMPONENT SPECIFIC GUIDELINES
- AGEING MANAGEMENT REVIEW GUIDELINES
- OTHERS: See attachment

4

Structure of Knowledge Base for Ageing Management (Phase 1)

0. User's Guide
a) User's Guide

1. Safety Standards related to ageing management

1.1 SAFETY FUNDAMENTALS
a) The Safety of Nuclear Installations (Safety Series No. 110)

1.2 SAFETY REQUIREMENTS
a) Requirements on Safety of Nuclear Power Plants: Design (No. NS-R-1)
b) Requirements on Safety of Nuclear Power Plants: Operation (No. NS-R-2),

2.3 SAFETY GUIDES
a) The Safety Guide on Maintenance, Surveillance and In-Service Inspection (No. NS-G-2.6)
b) The Safety Guide on The Operating Organization for Nuclear Power Plants (No. NS-G-2.4)
c) The Safety Guide on Periodic Safety Review of Nuclear Power Plants (No. 50-SG-O12; updated draft DS307)

2. Ageing Management Guidance Documents for Nuclear Power Plants

2.1 Programmatic Guidelines (Safety Practices, Safety Report Series, Technical Report Series)
a) Data Collection and Record Keeping for the Management of Nuclear Power Plant Ageing (Safety Practice: Safety Series No.50-P-3)
b) Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety (Technical Report Series No.338)
c) Implementation and Review of Nuclear Power Plant Ageing Management Programmes (Safety Report Series No.15)
d) Equipment Qualification in Operational Nuclear Power Plants (Safety Report Series No.3)
e) Proactive Ageing Management (to be issued)

Continue to next Slide

2. ACCOMPLISHED WORK: Initial Knowledge Base

- SAFETY FUNDAMENTALS
- SAFETY REQUIREMENTS
- SAFETY GUIDES
- PROGRAMMATIC GUIDELINES
- COMPONENT SPECIFIC GUIDELINES
- AGEING MANAGEMENT REVIEW GUIDELINES
- OTHERS: See attachment

6

Structure of Knowledge Base for Ageing Management (Phase 1)

0. User's Guide
a) User's Guide

1. Safety Standards related to ageing management

1.1 SAFETY FUNDAMENTALS
a) The Safety of Nuclear Installations (Safety Series No. 110)

1.2 SAFETY REQUIREMENTS
a) Requirements on Safety of Nuclear Power Plants: Design (No. NS-R-1)
b) Requirements on Safety of Nuclear Power Plants: Operation (No. NS-R-2),

2.3 SAFETY GUIDES
a) The Safety Guide on Maintenance, Surveillance and In-Service Inspection (No. NS-G-2.6)
b) The Safety Guide on The Operating Organization for Nuclear Power Plants (No. NS-G-2.4)
c) The Safety Guide on Periodic Safety Review of Nuclear Power Plants (No. 50-SG-O12; updated draft DS307)

2. Ageing Management Guidance Documents for Nuclear Power Plants

2.1 Programmatic Guidelines (Safety Practices, Safety Report Series, Technical Report Series)
a) Data Collection and Record Keeping for the Management of Nuclear Power Plant Ageing (Safety Practice: Safety Series No.50-P-3)
b) Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety (Technical Report Series No.338)
c) Implementation and Review of Nuclear Power Plant Ageing Management Programmes (Safety Report Series No.15)
d) Equipment Qualification in Operational Nuclear Power Plants (Safety Report Series No.3)
e) Proactive Ageing Management (to be issued)

Continue to next Slide

2. ACCOMPLISHED WORK: Initial Knowledge Base

- SAFETY FUNDAMENTALS
- SAFETY REQUIREMENTS
- SAFETY GUIDES

- PROGRAMMATIC GUIDELINES
- COMPONENT SPECIFIC GUIDELINES

- AGEING MANAGEMENT REVIEW GUIDELINES

- OTHERS: See attachment

8

Structure of Knowledge Base for Ageing Management (Phase 1)

0. User's Guide
- a) User's Guide

1. Safety Standards related to ageing management

1.1 SAFETY FUNDAMENTALS
- a) The Safety of Nuclear Installations (Safety Series No. 110)

1.2 SAFETY REQUIREMENTS
- a) Requirements on Safety of Nuclear Power Plants: Design (No. NS-R-1)
- b) Requirements on Safety of Nuclear Power Plants: Operation (No. NS-R-2),

2.3 SAFETY GUIDES
- a) The Safety Guide on Maintenance, Surveillance and In-Service Inspection (No. NS-G-2.6)
- b) The Safety Guide on The Operating Organization for Nuclear Power Plants (No. NS-G-2.4)
- c) The Safety Guide on Periodic Safety Review of Nuclear Power Plants (No. 50-SG-O12; updated draft DS307)

2. Ageing Management Guidance Documents for Nuclear Power Plants

2.1 Programmatic Guidelines (Safety Practices, Safety Report Series, Technical Report Series)
- a) Data Collection and Record Keeping for the Management of Nuclear Power Plant Ageing (Safety Practice: Safety Series No.50-P-3)
- b) Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety (Technical Report Series No.338)
- c) Implementation and Review of Nuclear Power Plant Ageing Management Programmes (Safety Report Series No.15)
- d) Equipment Qualification in Operational Nuclear Power Plants (Safety Report Series No.3)
- e) Proactive Ageing Management (to be issued)

Continue to next Slide

From previous slide

2.2 Component Specific Guidelines (TECDOC Series)

"Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety"
- a) Steam generators (TECDOC 981)
- b) Concrete containment buildings (TECDOC 1025)
- c) CANDU pressure tubes (TECDOC 1037)
- d) PWR pressure vessels (TECDOC 1120)
- e) PWR vessel internals (TECDOC 1119)
- f) Metal components of BWR containment (TECDOC 1181)
- g) In-containment I&C Cables (TECDOC 1188)
- h) CANDU reactor assemblies (TECDOC 1197)
- i) PWR primary piping (TECDOC being printed for publication)
- j) BWR Reactor Pressure Vessel (TECDOC finalizing the draft)
- k) BWR Reactor Pressure Vessel Internals (TECDOC finalizing the draft)

2.3 Ageing Management Review Guidelines (Services Series)
- a) AMAT Guidelines (Services Series No.4)

3. Training course materials on AM and EQ

3.1 Past Materials (to be collected)

3.2 Standard training modules (being produced)

4. Other Reference Documents

4.1 Awareness (Experience in Member States) (TECDOC Series)
- a) TECDOC 540 on Safety Aspects of Nuclear Power Plant Ageing

4.2 Pilot Programme Reports (TECDOC Series)
- a) Pilot studies on management of ageing of nuclear power plant components (TECDOC-670)
- b) Pilot study on the management of ageing of instrumentation and control cables (TECDOC-932).

4.3 Technical documents on Ageing/Plant life Management published by Nuclear Energy Department (TECDOC Series)

4.4. Supportive Documents
- a) List of contributors
- b) Abbreviations and Terminologies
- c) List of key reference documents
- d) List of reference dociuments

5. Relevant Database

5.1 Past Records of Meetings and Missions (to be issued)

5.2 Link to NE Database (Phase II or III)

6. Ageing Management Guidance and Reference Documents for Nuclear Fuel Cycle Facilities (Phase II)

PROGRAMMATIC GUIDELINES

- **Data Collection and Record Keeping for the Management of Nuclear Power Plant Ageing (Safety Practice: Safety Series No.50-P-3)**
- **Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety (Technical Report Series No.338)**
- **Implementation and Review of Nuclear Power Plant Ageing Management Programmes (Safety Report Series No.15)**
- **Equipment Qualification in Operational Nuclear Power Plants (Safety Report Series No.3)**
- **Proactive Ageing Management** (being finalized)

11

COMPONENT SPECIFIC GUIDELINES

Assessment and Management of Ageing of Major Nuclear Power Plant Component Important to Safety

- **Steam generators (TECDOC 981, 1997)**
- **Concrete containment buildings (TECDOC 1025, 1998)**
- **CANDU pressure tubes (TECDOC 1037, 1998)**
- **PWR pressure vessels (TECDOC 1120, 1999)**
- **PWR vessel internals (TECDOC 1119, 1999)**
- **Metal components of BWR containment (TECDOC 1181, 2000**
- **In-containment I&C Cables (TECDOC 1188, 2000)**
- **CANDU reactor assemblies (TECDOC 1197, 2001)**
- **PWR primary piping (TECDOC being printed)**
- **BWR Reactor Pressure Vessel (TECDOC under finalization)**
- **BWR Reactor Pressure Vessel Internals (TECDOC under finalization)**

12

From previous slide

2.2 Component Specific Guidelines (TECDOC Series)

"Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety"

a) Steam generators (TECDOC 981)
b) Concrete containment buildings (TECDOC 1025)
c) CANDU pressure tubes (TECDOC 1037)
d) PWR pressure vessels (TECDOC 1120)
e) PWR vessel internals (TECDOC 1119)
f) Metal components of BWR containment (TECDOC 1181)
g) In-containment I&C Cables (TECDOC 1188)
h) CANDU reactor assemblies (TECDOC 1197)
i) PWR primary piping (TECDOC being printed for publication)
j) BWR Reactor Pressure Vessel (TECDOC finalizing the draft)
k) BWR Reactor Pressure Vessel Internals (TECDOC finalizing the draft)

2.3 Ageing Management Review Guidelines (Services Series)

a) AMAT Guidelines (Services Series No.4)

3. Training course materials on AM and EQ

3.1 Past Materials (to be collected)

3.2 Standard training modules (being produced)

4. Other Reference Documents

4.1 Awareness (Experience in Member States) (TECDOC Series)

a) TECDOC 540 on Safety Aspects of Nuclear Power Plant Ageing

4.2 Pilot Programme Reports (TECDOC Series)

a) Pilot studies on management of ageing of nuclear power plant components (TECDOC-670)
b) Pilot study on the management of ageing of instrumentation and control cables (TECDOC-932).

4.3 Technical documents on Ageing/Plant life Management published by Nuclear Energy Department (TECDOC Series)

4.4. Supportive Documents

a) List of contributors
b) Abbreviations and Terminologies
c) List of key reference documents
d) List of reference dociuments

5. Relevant Database

5.1 Past Records of Meetings and Missions (to be issued)

5.2 Link to NE Database (Phase II or III)

6. Ageing Management Guidance and Reference Documents for Nuclear Fuel Cycle Facilities (Phase II)

3. CURRENT AND FUTURE ACTIVITIES

- **Future project focus on assisting Member States in the implementation of systematic ageing management programmes**
- **Additional efforts to assist Member states in ensuring safety of long term operation/ life extension of NPPs**
- **AMAT Service**
  - AMAT Objective:

    To provide advice and assistance to utilities or individual NPPs on improving the effectiveness of their ageing management programme (AMP)
  - Types of AMAT Services:
    - programmatic review of a utility or NPP AMP
    - review focused on specific age related problem/issues

14

3. CURRENT AND FUTURE ACTIVITIES

- Future project focus on assisting Member States in the implementation of systematic ageing management programmes
- Additional efforts to assist Member states in ensuring safety of long term operation/ life extension of NPPs
- AMAT Service
  - AMAT Objective:

    To provide advice and assistance to utilities or individual NPPs on improving the effectiveness of their ageing management programme (AMP)
  - Types of AMAT Services:
    - programmatic review of a utility or NPP AMP
    - review focused on specific age related problem/issues

15

3.1 Regular Programme Activities (major activities)

- Assistance for implementation of PSR Safety Guide
  - Experience of Member States in implementing PSR
  - Major safety issues identified by PSRs and associated safety improvements
  - Supplementary document will elaborate different Safety Factors relating to life extension
- Additional Guidance Documents
  - Proactive Management of Ageing
  - Component specific guidelines for PWR primary piping, BWR RPV and BWR core internals
- Knowledge Base on Ageing Management
  - IAEA Guidance Documents, Expert list, Abbreviations, Links to other database
  - Past meeting reports, mission reports
  - Past training course materials and workshop materials
  - Standard education and training modules

16

3.2 TC Projects

- **Projects**
  - License renewal of Paks NPP operations, Hungary, 2003-2006
  - NPP lifetime management in Ukraine, 2003-2006 (tentative)
  - Development of a regulatory basis for NPP license / renewal of NPP operation, Russia, 2001-2004 (tentative)
  - WWER Design Basis Documentation Management, 2001-2003 (2-3 years extension foreseen)
- **Sub-activities of projects (Sub-tasks)**
  - Challenges of units operation beyond design lifetime, Russia, 2003
  - Establishment of ageing and lifetime management, Russia, 2004
- **Sub-activities of projects (Workshops)**
  - Regional workshop on safety aspects in life extension for NPPs, Slovakia, May 2003
  - Workshop on configuration management, Hungary, June 2003
  - National workshop on management of ageing, China, October 2003

17

3.3 EBP Projects

- Safety aspects of long-term operation of PWRs (This project), 2003-2007
- EBP Asia
  - Management and assessment of the steam generator lifetime, China, 2003
  - WWER's horizontal SG tubing and primary composite material pipe examination technology, China, 2003

18


Thank you for your
attention !!!

Integrated NPP Life Cycle Management – Nuclear Power Division

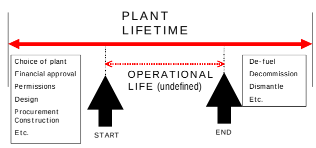
May 19, 2003

Ki-Sig Kang, Scientific Secretary, TWG LM-NPP

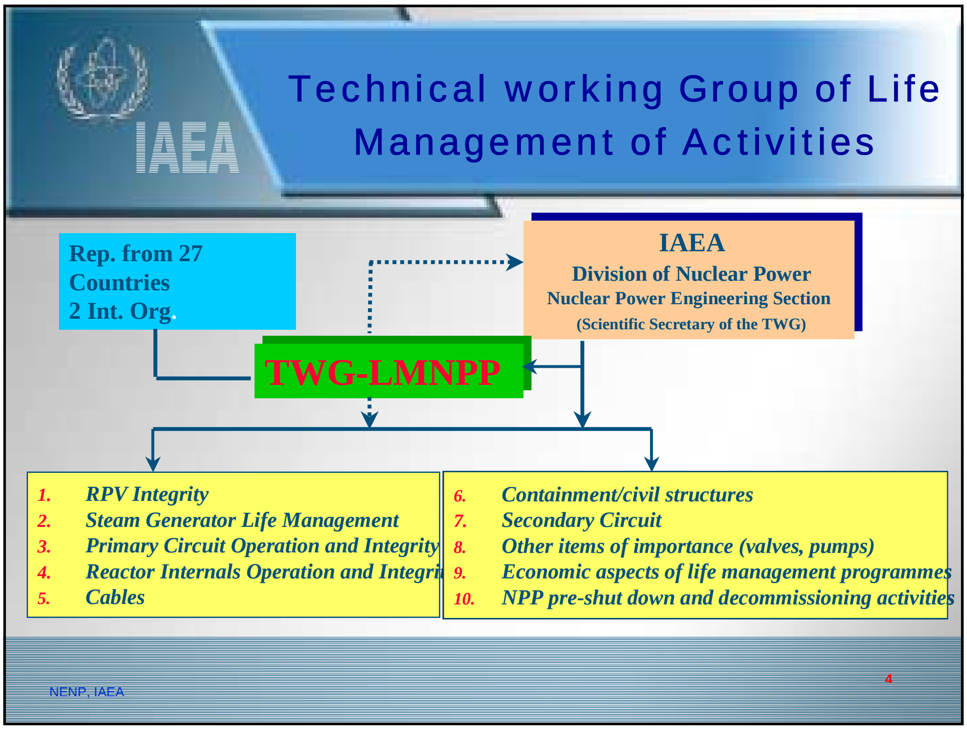
Period of Plant Life Cycle

- **Period of NPP Life Cycle**
  - ***Early conceptual phase through choice, approval, financing, construction, operation,***
  - ***Shutdown and de-commissioning to the eventual restoration of the site to a 'green field'***
  - ***Eventual disposal or re-assignment of responsibility for the fuel and waste.***

- ***In practical terms the full scope of the 'Life Cycle' of a NPP covers the entire period when financial charges are incurred by the project.***




IAEA
Relation with Actives for PLIM
Quality Assurance
Control and Instrumentation
Economics of Plant Life Cycle Optimisation
Plant Life Management Programme
Preservation of Knowledge
Maintenance Programmes and In-Service Inspection
Operational issues and Decommissio ning
NENP, IAEA
3


IAEA
Technical working Group of Life Management of Activities
Rep. from 27 Countries
2 Int. Org.
IAEA
Division of Nuclear Power
Nuclear Power Engineering Section
(Scientific Secretary of the TWG)
TWG-LMNPP
1. RPV Integrity
2. Steam Generator Life Management
3. Primary Circuit Operation and Integrity
4. Reactor Internals Operation and Integri
5. Cables
6. Containment/civil structures
7. Secondary Circuit
8. Other items of importance (valves, pumps)
9. Economic aspects of life management programmes
10. NPP pre-shut down and decommissioning activities
NENP, IAEA
4

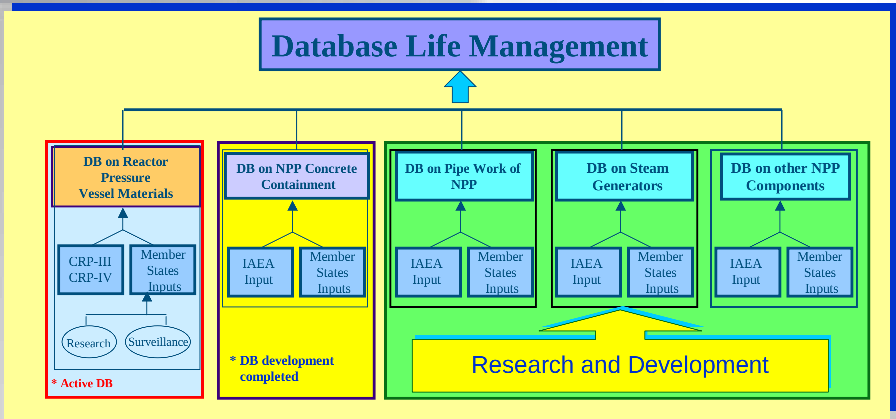
Four Co-ordinated Research Projects (CRP)

- ***Surveillance Programme Results Application to RPV Integrity Assessment***
- ***Mechanism of Nickel Content Effect in Radiation Embrittlement of RPV Materials***
- **Evaluation of Radiation Damage of WWER Reactor Pressure Vessel using the IAEA Database on RPV Materials**
- **Verification of WWER Steam Generator tube integrity**

NENP, IAEA

5

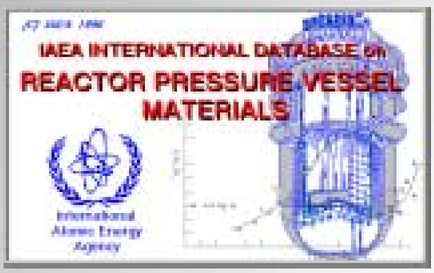
International Database on Life Management



NENP, IAEA

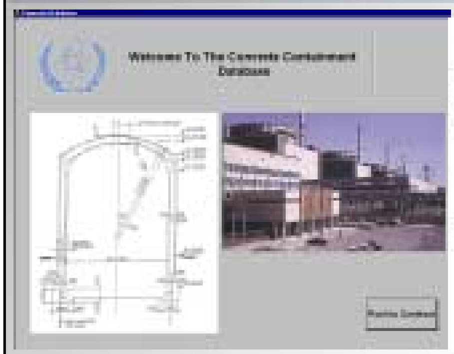
6

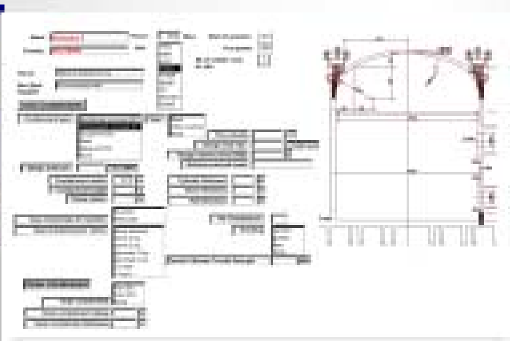
International Database on Reactor Pressure Vessel Material



- Organization information
- Reactor information
- Reactor pressure vessel information
- Material properties
- Irradiation conditions
- Test conditions and results

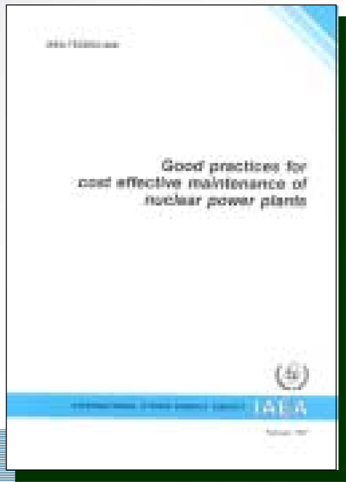
International Database on Concrete Containment





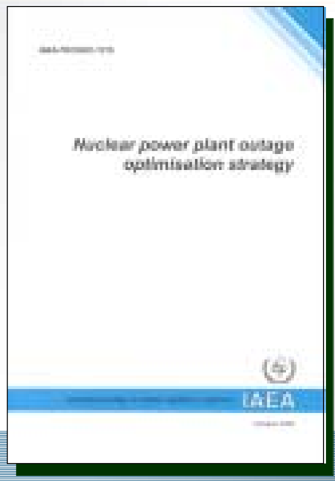
Maintenance Programmes and In-Service Inspection

- Maintenance Programme
  - *Structural integrity and reliability of passive components*
  - *In-service inspection*
  - *On line and/ or periodic condition monitoring*
- Developing guidelines for recommendations
  - *Optimisation of NPP maintenance programmes*
  - *Good practices on ISI effectiveness improvement*

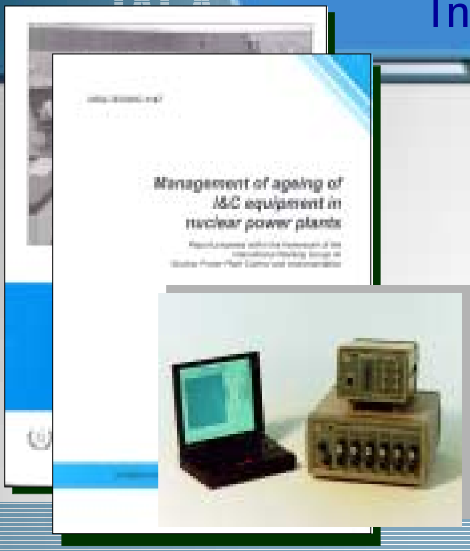


Operational issues

- Developed the optimisation of the outage management
  - *Not to minimize O&M cost or to maximize performance,*
  - *Minimize the total cost by optimising the O&M cost.*
  - *Outage management optimisation*
- Developed DB for Nuclear Economic Performance Information System (NEPIS)

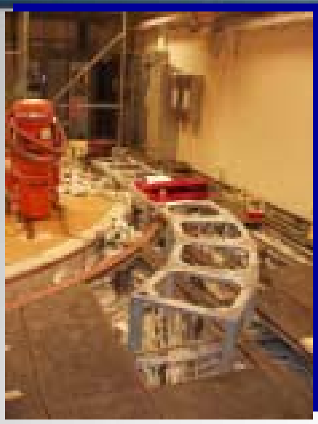


Control and Instrumentation



- ❑ Development of I&C modernization strategies
  - Greater part of original analog and aged digital I&C systems
  - I&C Modernization Project using using Digital I&C system
- ❑ Development of the guidelines
  - Management of Ageing of I&C Equipment
  - Under preparation : Impact of I & C Ageing & Obsolescence on NPP life management and extension

Modernization of Main Control Room

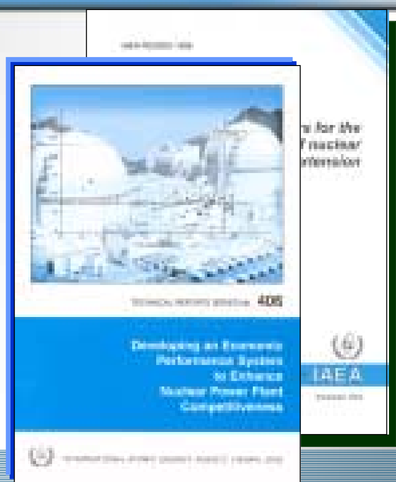


Preservation of Knowledge

- ❑ *Analysis of Systematic Approach to Training (SAT)*
  - ***Provide the SAT-based training programmes, consistent with guidance***
  - ***TRS - 380 : Nuclear Power Plant Personnel Training and its Evaluation***
- ❑ *Integrated Approach*
  - ***Emphasizing not only technical knowledge and skills but also human factor related knowledge, skills and attitudes***

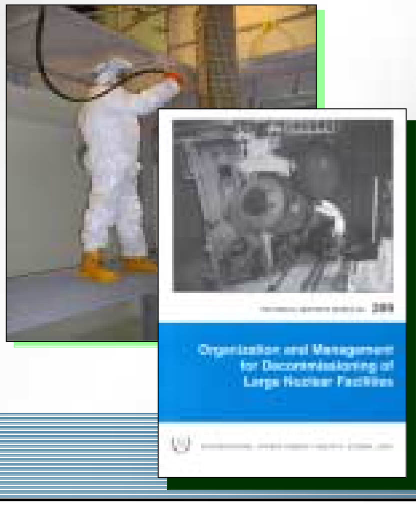
Economics of Plant Life Cycle Optimisation

- ❑ *Cost drivers for the assessment of Life extension*
  - ***Provide an understanding of the various cost elements and drivers in NPP life management using cost data collected from MSs***
  - ***Identify the basis of the available cost estimates of different activities***
- ❑ *Developing Computer Model*
  - ***PC based computer model to assist plant owners with the assessment of economic effectiveness of extension and other generation***



Decommissioning

- ❑ *Decommissioning costs of WWER-440 NPPs*
  - ***Presented and analysed Decommissioning costs with the joint EC/IAEA/OECD-NEA***
- ❑ *Joined study with OECD/ NEA*
  - ***Decommissioning Policies Strategies and Costs for the period 2001 - 2002***
  - ***Provide policy makers with comprehensive information on key issues related to decommissioning***



Under Preparation of Technical Documents

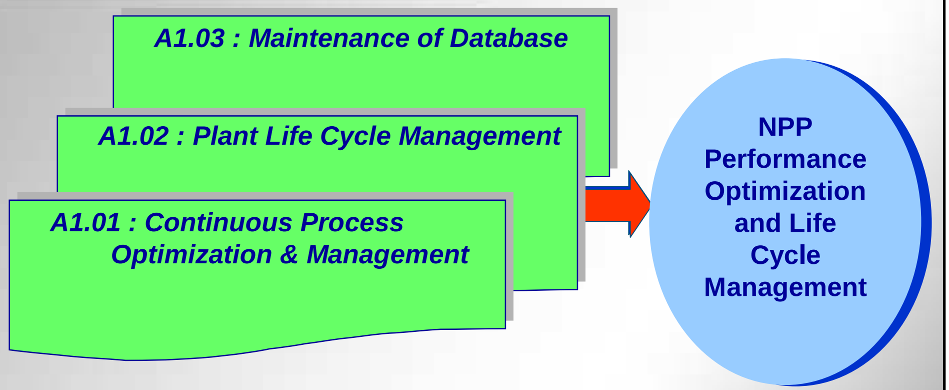
- ❑ ***TECDOC on "Surveillance programmes results applications to RPV integrity assessment"***
- ❑ ***TECDOC on "Guideline of Master curve testing and results application to RPV integrity assessment"***
- ❑ ***TRS on "Irradiation effects in RPV steels and weldments"***
- ❑ ***Best Practices in NPP Life Management – Electronic Database of Ageing Management (EDABAM)***

Technical Cooperation Project (2004 - 05)

- Europe Regional Project
  - *Optimization of NPP performance and Service Life*
- Bulgaria
  - *Upgrading reactor pressure vessel surveillance programme for Kozloduy NPP*
  - *Planning and management of decomissioning Kozloduy NPP units*
  - *Re-training personnel involved in decommissioning Kozloduy NPP*
- Czech
  - *Evaluation of radiation damage Attenuation in WWER Reactor*
- Hungary
  - *License Renewal and Plant Life Extension*
- Armenia
  - *Strengthening ISI activity through Modern NDT method*
- Ukraine
  - *Support for decommissioning of Chernobyl NPP*
  - *Action Plans for nuclear power lifetime management*
  - *In-service inspection and plugging of WWER-1000 steam generators*
- ***Technical collaboration with EC***
  - *Cross check activities between TAREG.01/001 Project and Agency Programme to avoid the duplication and make consistency*

NENP, IAEA 17

Regular programme Operating Performance and Life cycle management in 2004- 2005



NENP, IAEA 18

Improving Quality Assurance, Technical infrastructure and Human Performance in 2004- 2005

IAEA

A2.03 : Strengthening NPP system to Achieve & Maintain High Standard of Personnel Performance

A2.02 : Strengthening National Nuclear Power Infrastructure

A2.01 : Harmonization of NPP Quality Assurance / Quality Management Principle

→ **Human Performance Improvement , Quality Assurance and Strengthening Technical Infrastructure**

NENP, IAEA

19

Main Activities Summary

IAEA

- Continuously Support to MSs
  - ***Information exchange, technology transfer and management programmes***
- TWG on Life Management NPPs and other TWGs
  - ***Support of improvements in the Management of all aspects of the Life Cycle***
- Acts as a catalyst for dissemination of experience in LCM activities for all MSs.
  - ***Produce standard and Proven practice***
  - ***Support of improvements in all aspects of the Life Cycle Management***

NENP, IAEA

Coordinated Research Projects

Surveillance Programmes Results Application to RPV Integrity Assessment

- Better quantification of fracture toughness results from surveillance programmes relative to reactor pressure vessel integrity assessment,
- Evaluation of present procedures and surveillance programmes for irradiated small size fracture toughness specimen testing
- Development of guidelines for integrity evaluation using results from unirradiated and irradiated surveillance fracture toughness specimen testing.

Coordinated Research Projects

Mechanism of Ni Effect in Radiation Embrittlement of RPV Materials

- Started in 2001
- High Ni content alone could not provide fully descriptive influence on the irradiated material properties.
- Some other alloying elements like Mn and Si should be taken into account due to their possible synergy in the process of irradiation damage of RPV Materials.

Coordinated Research Projects

Evaluation of Radiation Damage of WWER Reactor Pressure Vessel using International DB for Reactor pressure Vessel material

- Started in 2002
- Critical evaluation and analysis of all existing data from irradiation of WWER materials
- Analysis to all surveillance test data, from WWER-440 type reactors,
- Analysis of procedures for neutron dosimetry used within surveillance programmes
- Guidelines for evaluation of test data and trend curves in all existing cases of WWER RPVs.

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

EBP Implementation proposal

IAEA, Vienna, 19-21 May 2003
Radim Havel

EBP APPROACH

- Systematic, structured and comprehensive
- Addressing areas of interest of participating MS
- International consensus integrating regulators' and operators' views
- Utilizing best practices and experience of participating MS and Agency documents (Safety Standards, …)
- Transparent-IAEA/NS www pages

EBP IMPLEMENTATION

- Activities carried out in several Working Groups (WG)
- WG membership-a “good mixture” of both operators and regulators (and TSOs?)
- WG members nominated by SC members
- WG objectives and workplans approved by the SC
- WG leaders report to the SC as required

Working Group 1

- Collect information on national practices, criteria, etc., and develop a list of relevant standards, approaches, criteria, and programmes
- Develop licensing framework on long term operation based on PSR Guide, see handouts
- Recommend the number and focus of WGs within the EBP (possible examples “mechanical/materials”, “electrical/I&C”, “structures”, etc.)
- Develop a “matrix tool” to assist guiding the EBP (e.g. function/system, or safety factor/…, etc.)
- Finalize licensing framework taking into account results obtained in the frame of the EBP and other info made available (end of the EBP)

APPENDIX VII.

WORKING GROUP 1

SCOPE

- Regulatory approaches to long term operation
- Safety criteria applicable
- Re-licensing processes
- Deterministic and probabilistic safety analyses
- Upgrading Programmes as a basis to re-licensing
- Future challenges

FINAL REPORT

- Review national procedures, common features, differences
- Advice to regulators on good practices
- Future co-operation issues

APPENDIX VIII.

WORKING GROUP FORMAT AND STRUCTURE

WG 1 GENERAL LTO FRAMEWORK	WG 2 MECHANICAL AND MATERIALS	WG 3 ELECTRICAL AND I&C	WG 4 STRUCTURES
Definition of scope, systems included	**SAMPLE COMMON BREAKDOWN** system: primary circuit component: main circulating pump safety functions: passive -pressure boundary -supports & anchors active -coolant circulation\ -electric motor -snubbers -control circuits		
Analysis of scope and level of detail			
Equipment qualification			
QA Plan			
ISI Plan			
Design basis requirements			
Maintenance prgm.			

Material	Environment	Degradation	Acceptable Programme Reference