LIFETIME EXTENSION OF RUSSIAN NPPs

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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 assessment 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
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.

- 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 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
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

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

(to be continued)
The following systems have been upgraded:

- accident localization system through installation of jet-vortex condenser
- reactor control, monitoring and protection systems
- essential power supply systems
- process systems and safety systems

(to be continued)
Implementation of life extension concept at Novovoronezh NPP Unit 3

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

(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
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.
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:

- 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.
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.