

“АЕЦ КОЗЛОДУЙ” ЕАД
KOZLODUY NPP PLC

Experience with Periodic Safety Review (PSR) of units 5 of Kozloduy NPP



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Vladimir Popov
Kozloduy NPP, www.kznpp.bg



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Role of PSR

Systematic safety reassessment, termed Periodic Safety Review (PSR) – to assess the cumulative effects of plant ageing and modifications, operating experience, technical developments and siting aspects

- **Assessment of the plant design and operation against applicable current safety standards and operating practices**
- **To ensure a high level of safety throughout the plant's operating lifetime**
- **Complementary to the routine and special safety reviews and does not replaced them**





Role of PSR

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Provides a means for:

- Regulation of safety of NPP operation in the long term
- Addressing requests by licensees for authorization to continue NPP operation beyond an established licensed term or for a further period established by a safety evaluation
- Provide reassurance that there continues to be a valid licensing basis (taking account of e.g. ageing, current safety requirements and operating practices)
- Provides an effective way to obtain an overall view of actual NPP safety and the quality of the safety documents
- Determine reasonable and practical modifications to ensure safety or improve safety to an appropriate high level (identification of any NPP lifetime limiting features)





Requirements for PSR

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BNRA: Regulation for nuclear safety (2004)

Art. 22. (1):

“Existing plant design and operations shall be periodically reviewed in the light of the operating experience and the new safety significant information to identify deviations from current requirements and international recognized operational experience”





Requirements for PSR

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IAEA: Safety of NPPs: Commission and Operation, SSR-25 (2011)

Requirement 12:

“Systematic safety assessment of the plant, in accordance with the regulatory requirements, shall be performed by the operating organization throughout the plant’s operational lifetime, with due account taken of operating experience and significant new safety related information from all relevant sources.”





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Objectives of PSR

To define:

- The level of compliance with current safety requirements
- The level of validity of licensing basis
- The appropriate measures to ensure safety throughout the next PSR or to the end of the NPP lifetime
- Measures to resolve the defined deviations from the safety requirements





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Scope of PSR

Includes all aspects of NPP safety

- The whole equipment (Structures, Systems and Components - SSCs) on NPP site, included in the operating license and their operation together with operating organization and staff
- Declared operating term considered in the PSR
- PSR final report – a key document for requesting additional ten-years license, after expiration of the current license (for unit 5 – until 2017)





Scope of PSR

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License basis at the time of initiating the PSR

- A set of documents with requirements of BNRA and approved by BNRA
- Standards issued until 01 July 2014

Priority of the documents for PSR

- In accordance with requirements of the BNRA and recommendation in the IAEA guidance SSG-25 towards higher conservatism

Three levels of importance for the documents in PSR:

- Bulgarian documents
- IAEA documents
- Documents of manufactures and suppliers of the equipment (SSCs)

Areas and safety factors for PSR

- Important aspects of safety in NPP operation which are in the scope of PSR – safety factors (SF)





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Scope of PSR

Areas and Safety Factors (SF)

- Important aspects of the safety of NPP operation, considered in PSR – termed “areas” and “Safety factors (SF)”

Requirements

- BNRA, para (2), art. 22 of Regulation for nuclear safety – 9 areas / safety factors
- IAEA guidance SSG-25 (2013) – 14 safety factors





Scope of PSR

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Areas and Safety Factors (SF)

Area	Factor	Factor
	BNRA requirements	IAEA requirements (SSG-25)
Plant	(1) Site characteristics considered in the design	<u>SF01</u> : Plant design
	(2) Plant design as built and actual condition of SSCs taking into account implemented modifications, ageing and other aspects that impact safety and plant lifetime	<u>SF02</u> : Actual condition of SSCs important to safety
		<u>SF03</u> : Equipment qualification
		<u>SF04</u> : Ageing





Scope of PSR

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Areas and Safety Factors (SF)

Area	Factor	Factor
	BNRA requirements	IAEA requirements (SSG-25)
Safety analysis	(3) Current safety analysis methods and applicable new safety requirements	<u>SF05</u> : Deterministic safety analysis
		<u>SF06</u> : Probabilistic safety assessment
		<u>SF07</u> : Hazard analysis
Performance and feedback of experience	(6) Safety performance indicators and effectiveness of safety and quality management	<u>SF08</u> : Safety performance
	(4) Operating experience during the review period and effectiveness of the systems used for experience feedback	<u>SF09</u> : Use of experience from other plants and research findings





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Scope of PSR

Areas and Safety Factors (SF)

Area	Factor	Factor
	BNRA requirements	IAEA requirements (SSG-25)
Management	(5) Organizational arrangements for operation	<u>SF10</u> : Organization, the management system and safety culture
		<u>SF11</u> : Procedures
	(7) Staff number, levels of training and qualification	<u>SF12</u> : Human factors
	(8) Emergency preparedness	<u>SF13</u> : Emergency planning
Environment	(9) Radiological impact on the environment	<u>SF14</u> : Radiological impact on the environment





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Stages and activities of PSR

Features of PSR for unit 5 and 6 of Kozloduy NPP:

- Last PSR: June 2007 – March 2008
- It covers the last ten-years period of operation of unit 5 and 6 in their designed lifetime of 30 years
- The PSR report is part of the set of documents which will be submitted to the BNRA licence renewal of unit 5
- Joined together with the updated Safety Analysis Report (USAR)





Resources for PSR

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- KNPP specialists used mainly
- Cooperation with external companies and organizations were used in areas where they have proved experience

Experience in:

- Project of last PSR – in 2008
- Projects of the stress tests
- Project of assessment of the current condition of equipment (SSCs)

Training (covers all features and complexity of the PSR, e.g.)

- Non routing activities
- Participation of many specialists in deferent areas
- Participation and coordination between many specialists (from KNPP and external companies and organization
- Insurance of team work and cooperation with representatives on the Bulgarian NRA
- Simultaneous work and coordination of several teams





Stages and activities of PSR

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Features of PSR for unit 5 of Kozloduy NPP:

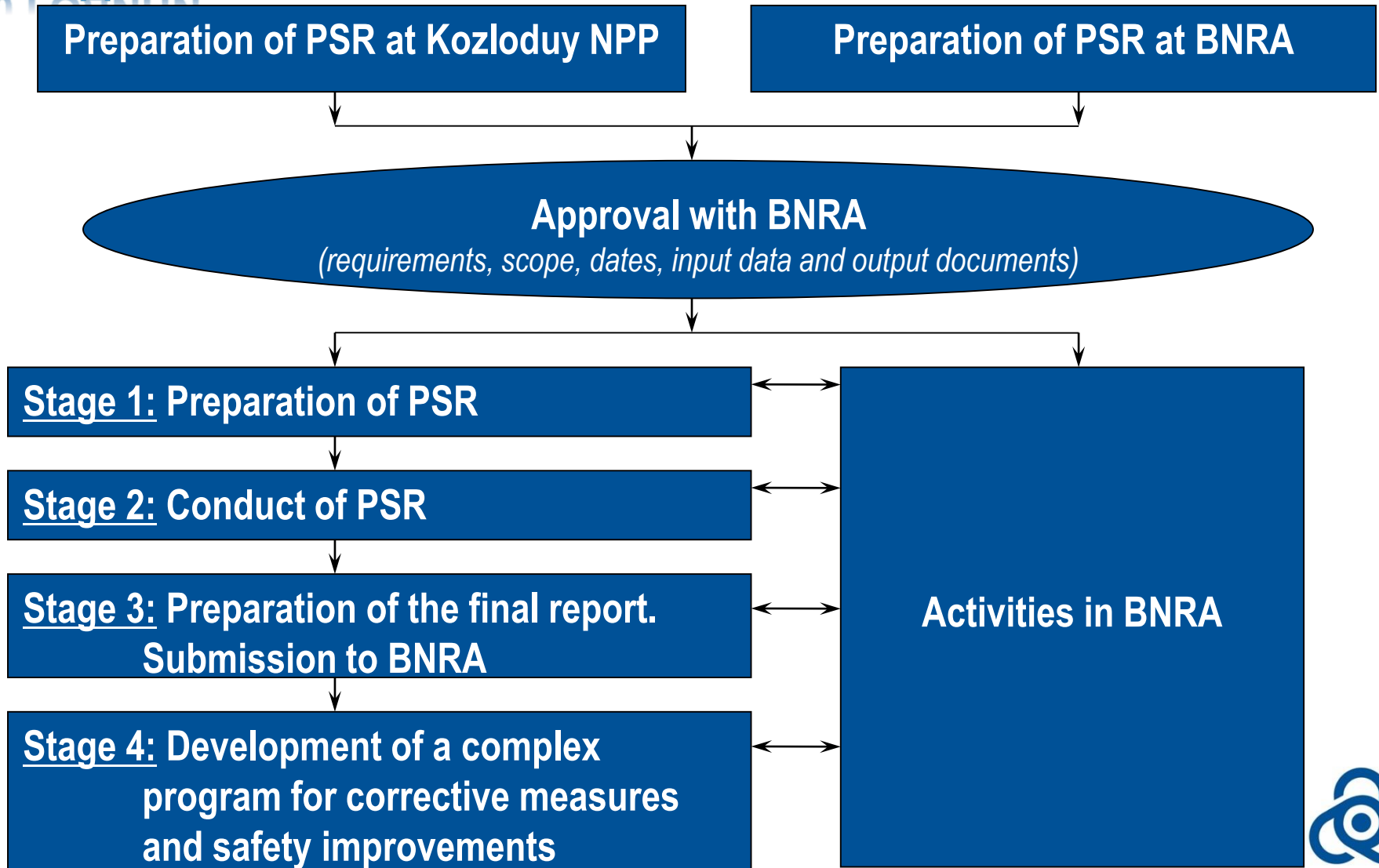
- Accomplishment and results of the stress-test for Kozloduy NPP
- Accomplishment and results from Complex Assessment of actual conditions of equipment SSCs (e.g. Aging Management Review - AMR) of unit 5 and 6, 2012-2014 г. It covers SF2 – actual condition of SSCs , SF3 – Equipment qualification and SF4 - Ageing
- Applicability of the results of existing analyses (e.g. results from last PSR - 2008)





Stages and activities of PSR

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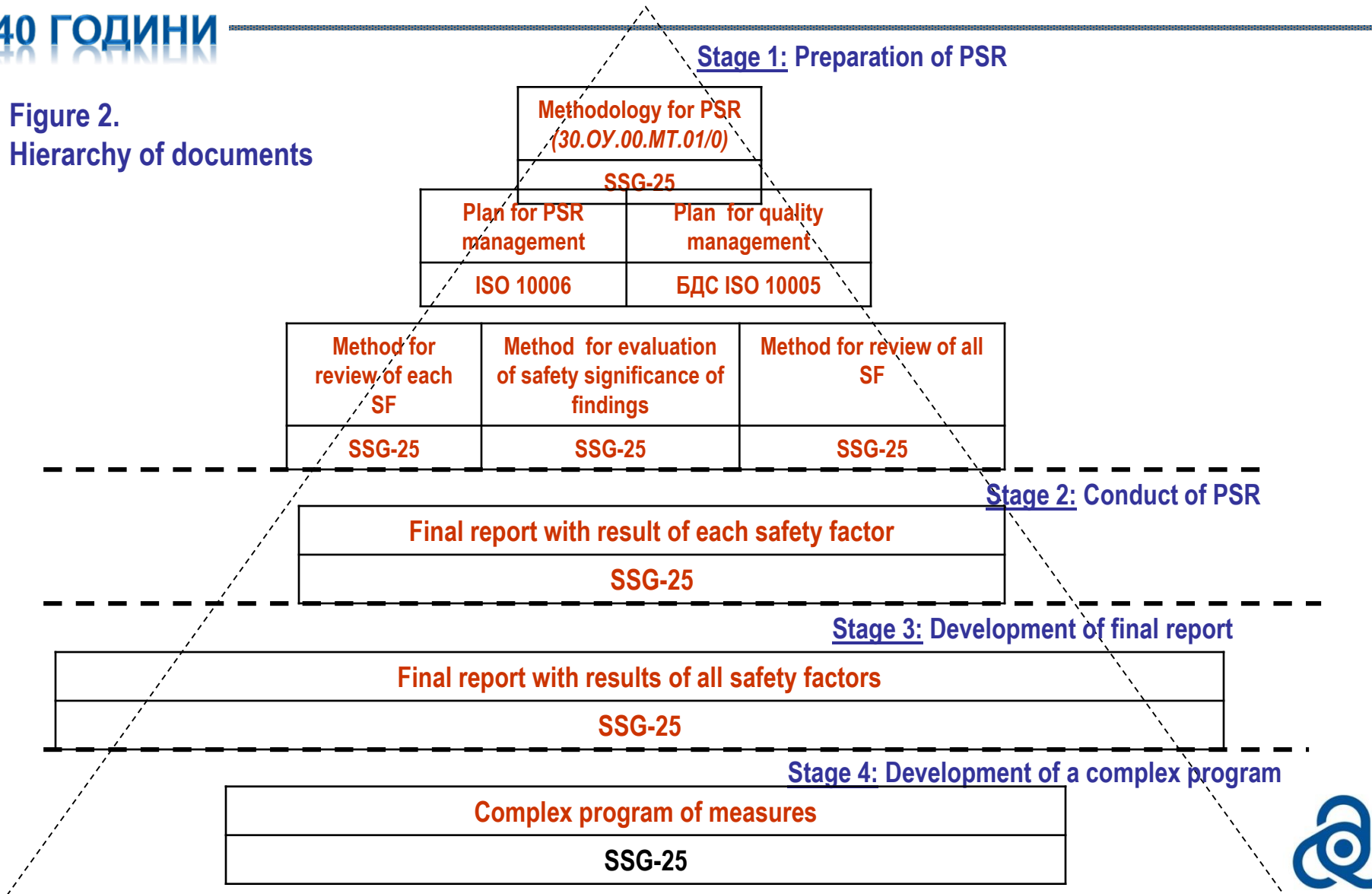




Stages and activities of PSR

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Figure 2.
Hierarchy of documents





Stages and activities of PSR

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Terms:

(in accordance with plan for plant lifetime extension PLEX-DQA-KNPP-000-01):

Carrying out the PSR

- for unit 5: 05 December 2014 – 04 November 2016
- for unit 6: 30 November 2015 – 02 October 2017

Submission of the final report and complex program to BNRA

- for unit 5: 05 November 2016
- for unit 6: 03 October 2017





Stages and activities of PSR

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- A Working team has been nominated at the NPP level to prepare and carry out the PSR
- The working team consists of more than 150 NPP experts: operational, maintenance and engineering staff with high experience and proficiency in PSR areas.
- The real process of NPP Kozloduy PSR was launched at the beginning of year 2014, when NPP Kozloduy and RB expert groups prepared a “Plan for NPP Kozloduy PSR implementation”- 30.ОУ.00.ПЛ.08/0
- The Review methodology № 30.ОБ.00.МТ.24 was then developed in NPP Kozloduy as operator’s controlling document.





Stages and activities of PSR

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- Following principles have been agreed on the criteria compilation:
- The review criteria were compiled in an working document called Metodology for each safety factor, list of review criteria. Before its use, the document were submitted to the RB for their opinion.
 - For each PSR safety element and criterion, two groups of requirements were defined (national, international).
 - The national requirements were derived from the valid legislation. If in case normative engineering documents were used for the criteria definition, their actual condition were considered.





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Stages and activities of PSR

- Review methodology gives advise how to perform the review process for each safety factor, specifies which of related aspect should be considered, gives classification of shortcomings (safety unimportant deviations), based on related INSAG and IAEA guides.
- Final classification of shortcomings was carried out by group of experts from NS department
- Findings (shortcoming or strong-points) and corrective action were found and preliminary classified by evaluators, verified by group of NSD expert (importance of deviation), verified by heads of responsible department (correctness of findings, applicability of corrective action and implementation term).





Stages and activities of PSR

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- Safety factors, and Review criterion was the basic element of the PSR.
- Each review criterion has its ID code (e.g. F4_E05_K20). For each review criterion a review paper was prepared.
- On the base of review papers documentary outputs were prepared – all findings and corrective actions are traceable back to the review paper for the particular criterion
- Total amount of Safety elements of RSR was **134** (109₂₀₀₈), review criterion was **645** (434₂₀₀₈), total amount of review paper was more than **4500**





Stages and activities of PSR

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Total amount of shortcomings were **183**. Shortcomings were classified into 4 group according to *30.ОБ.00.МТ.13* :

- Category NSS1 to 4 - NSS1 to 4 (important, medium importance, low importance, very low importance).
- For all shortcomings from NSS1 to 3 were suggested corrective actions.
- Corrective actions for shortcomings classified as important and medium importance are considered as obligatory and were submitted to RB in Safety review report.
- Based on Safety review report an Integrated Program with corrective measures for enhancement of safety of unit 5 were elaborated.





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The results

- Most of the review criteria have been fulfilled with none or minor shortcomings.
- As important shortcomings were classified mainly longer known deviations for which corrective actions have already been under realization but delayed.
- Most of deviations classified as medium importance are connected with:
 - missing or incomleted hazard analysys
 - missing PSA level 2,
 - shortcomings in procedures, technical specification, specific design potential hazards that weren't analysed in adequate detail,
 - shortcomings in equipment qualification program,
 - shortcomings in safety culture levels in some organizational structures.





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The results

- **Acquirement of fundamentals for a preparation for the NPP Kozloduy reactor unit operation license renewal after year 2017.**
- **PSR results make one of the most important inputs for preparation LTO concept.**
- **Assessment of NPP Kozloduy real safety preparedness for its operation after the year 2027 will be subject of a following NPP Kozloduy extended PSR (2025-2027).**
- **PSR doesn't cover safety irrelevant systems and equipment which are, nevertheless, necessary for the operation and may be extremely important from the economic point of view.**





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The results

- PSR doesn't address economic aspects of the NPP service life optimization.
- SAR remains and will remain the licensing document which will be used as a certificate for a further operation licence even after the end of the original design expected service life but will be accompanied by PSR.
- Within EU generally, PSR and related SAR revisions are accepted as a sufficient procedure for the NPP operation safety capability assessment in the initially expected period, or the period of the operational licence.





Summary

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- KNPP Unit 5 in technical and technological aspects complies with applicable standards for nuclear safety and radiation protection. Currently, the unit is in regular operation in accordance with the “License to operate a fifth energy block”, Series E, Reg. № 03000 / 02.10.2009 in a period of up to 05.11.2017.
- Periodic safety review (PSR) of the unit 5 demonstrates a high level of nuclear, radiation and technical safety commensurate with the best similar plants. Design and operational practices meet the requirements of national and international safety standards recommended by the IAEA.
- Discrepancies found no significant negative impact on SSCs working practices and the status of the safety of the unit 5.





Summary

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- Suggestions term license of the unit 5 in accordance with CLB is up to 10 years. The residual lifetime of major systems and components of the unit 5 exceed the proposed new license term what were justified by the results of implemented activities under Phase 2 of the PLEX project for unit 5.
- KNPP has fulfilled and implement transitional arrangements in the current license within the allowed by the NRA timeline. Under the proposed new license term KNPP will implement the remaining measures in already launched unit 5 program "PLEX-DQA-KNPP-0003.
- Relicensing unit 5 will allow long-term planning of the resources of the company and optimization of safe operation of existing and planned nuclear facilities at the KNPP.





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Summary

- PSR is complementary to the routine and special safety reviews and does not replace them
- All safety aspects of NPP operation and all equipment (SSCs) on site were reviewed and compared with the level of compliance with current safety requirements
- Measures in the Program for preparation of unit 5 for plant lifetime extension PLEX-DQA-KNPP-003, addressed on the units' operation licence renewal are under way
- IAEA SALTO mission is planned



Thank you for your attention!



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