Adaptability of technologies for regulation and analysis of nuclear and radiation safety in Belarus ID#24

1. Planning the directions of regulatory areas

- There is planning to define in order to realize the key elements for analysis, oversee, testing for NPP' equipment and systems during NPP operation stages and control of ageing and obsolescence to operate safely and reliably, and radioactive waste management activities.
- Separate directions are the development of aging and obsolescence control programs, the specification and development of measures and procedures for the safe management of radioactive waste and spent nuclear fuel.

2. Flexibility of regulation, supervision and licensing of activities. Systematization of the safety analysis of complex systems

- The main stream for NPP life management will realized and started from *basic regulation requirements*. The real and fact conditions will issued according to the practice related to referent equipment and systems and NPP units, recommendations of NPP producer.
- The period of license issuing is based on comprehensive safety reviewing and *NPP configuration* analysis.

Adaptability of technologies for regulation and analysis of nuclear and radiation safety in Belarus ID#24

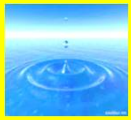
3. Aspects of nuclear and radiation safety regulation, impact on management systems and man-to-man, man-to-machine systems

- It is necessary to proceed from the concept of the human factor in the interpretation used in *engineering psychology*.
- **The main focus** should be on improving the emergency resilience of the operator or its services. Insufficient qualification and low discipline of management and staff, deficiencies in logistics, moral and technical deterioration of equipment and errors in the design of nuclear installations are the cause of accidents.
- When predicting the influence of the human factor, the adequacy of the degree of responsibility of decision-making by specialists of new (beginner) operator to possible consequences should be taken into account.

5. Development of a comprehensive training system for *expert* personnel

- **The main role** for successful promotion of NPP longtime management program depends on training, ageing of NPP and regulatory staff, knowledge lacks.
- **Strategically**, as target and key direction of the NPP life management program, the conservation of knowledge and experience management should be provided and accumulated in training centers under supervision of high skilled tutors which have large experience in regulation and (or) NPP operation.

Adaptability of technologies for regulation and analysis of nuclear and radiation safety in Belarus ID#24



4. Analysis of safety indicators of nuclear installations. Approaches and models of robust data analysis

- Science about Safety → **Safeology**

- Quantitative assessment of Safety level or Safety index → **Safeometrics**
- *Safeometrics* combines adequate quantitative possibilities such as in *Chemometrics*

- *Safeometrics* uses convenient methods of *Probability theory* and *Mathematical statistics* etc.
- *Safeometrics* issues can be used for *safety in industry and nuclear power engineering*, in *cybernetics, information theory, management theory, economics*
- **REF:** Journal "Promyshlennaya bezopasnost'" #10, 2022, p.46-47; #1, 2023, p.34-36

Research input: to determine the priority and frequency of supervisory activities, to make emphasis on paying attention to various systems and equipment, to determine the critical condition of equipment or systems, as well as to be able to determine the precursors of incidents and accidents.

- **There are three categories of robust mathematical analysis** : ***quantitative analysis, graph theory, BIG DATA theory***.
- **Method:** Regulatory and operational documents contain lists of established **safety indicators** of nuclear installations (physical quantities, probabilities, risks). **Indicators are the initial parameters for differentiated safety analysis** : belonging to systems and equipment, safety classes, groups of equipment systems, frequency of monitoring indicators, consequences of changes in the level of safety, classification of the severity of violations, etc.
- **The parameters of graphs** are determined (the number of vertices and connections, the valence of vertices, etc.), the change in graph parameters, the presence of extremes are analyzed, critical systems and their complexity are determined, and a conclusion is made about priority regulatory actions.
- The concepts of **the Reasonable safety level** and **the Maximum achievable safety level:** $Q(N) = a + \alpha \times \ln N$, $Q(N)$ - Safety level or Safety index; N - number of safety systems; a, α- factors. $\{\underline{Q} 0 \overline{Q}\}$
- **Issues** can be used when making *regulatory decisions, visualization of regulation*.

Adaptability of technologies for regulation and analysis of nuclear and radiation safety in Belarus ID#24

Planning

Flexibility

Aspects

Training

Analysis

Adaptability of technologies for regulation and analysis of nuclear and radiation safety in Belarus ID#24