

Challenges of NPP I&C Systems Digitalization and their Solutions by International Nuclear Society



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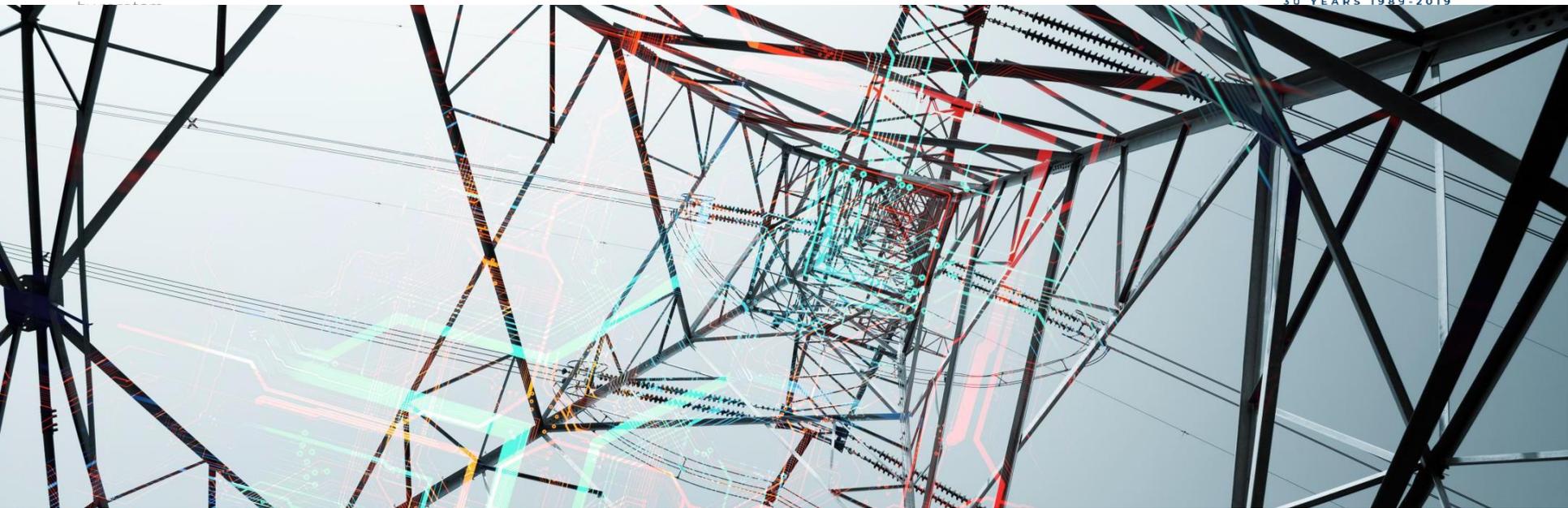
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“RASU” JSC

WANO MC New Build Conference

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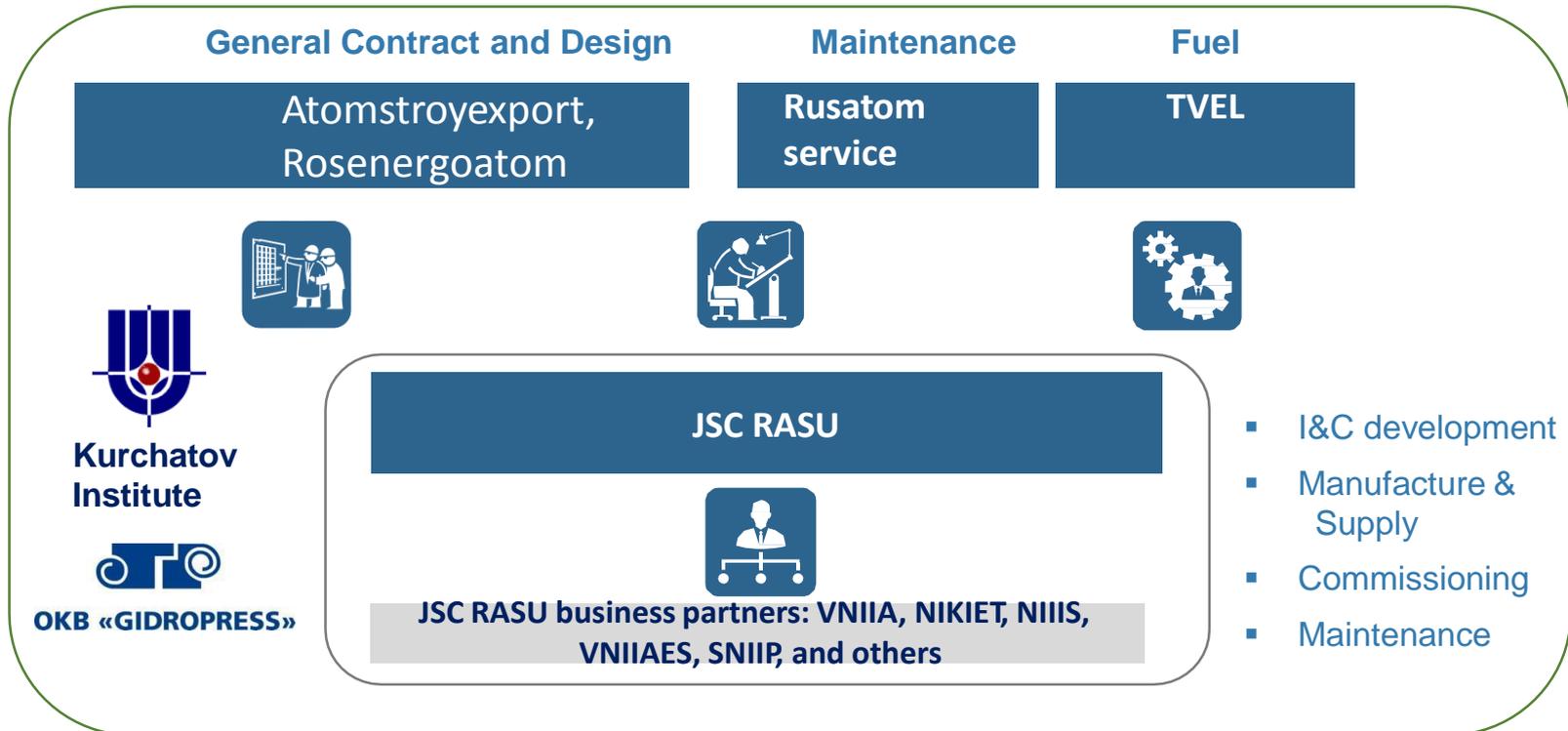
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- **Introduction of JSC “RASU” as new Rosatom’s company**
- **Challenges of NPP I&C digitalization**
- **IAEA experience on the solutions of the digital I&C challenges: IERICS missions**
- **WANO involvement to the digital I&C challenges solutions: the tasks announced at BGM-2017**
- **JSC “RASU” initiative to intergrade the efforts of WANO and IAEA for the challenges better solutions**
- **IAEA, WANO-MC and JSC “RASU” agreements achieved at the beginning of efforts integration**
- **Conclusion**

Introduction of JSC “RASU : RASU role and place in Rosatom’s structure



CUSTOMERS and
PARTNERS



RASU is a new Rosatom’s company centralizing efforts in I&C design, supply and system integration

Fast developing digital technologies are being introduced in all industries including nuclear one.

They provide obvious and valuable advantages such as:

- Self-diagnostics and availability
- Accuracy
- Noise tolerance
- Easiness of modifications
- Maintainability
- Others



For nuclear applications is very important that they also provide calculation of safety significant parameters which can not be measured directly, for example DNB.

However, the introduction of the digital technology, especially in safety systems, adds new risks of dangerous events or even accidents because :

- **V&V** of programmable control and protection systems are difficult and even hardly possible in full scope (100%)
- **Calculation of reliability** of such systems is a problem especially for very low levels of probabilities (no common methods accepted by nuclear regulators, ref. Report on Common positions)
- **Problems of cybersecurity**, possibility of introduction of viruses and errors during the design and maintenance

The recent planes crashes in world aviation confirm that **challenges of digital technologies** are very important and must be seriously considered in all dangerous industries !



Some national and international organizations (for example IAEA, WENRA) are already taking serious care about digital I&C challenges. Among the proposed solutions are following:

- Minimization of common cause failures of digital I&C by implementation of **principle of diversity** (in design, technologies, people and vendors involved)
- Complementation of the digital safety systems by **additional diverse actuation system** based on not-programmable technology (IAEA TECDOC-1848, Vienna 2018, WENRA reports)
- **Additional V&V** of the safety critical software **by independent company**
- **Conduction of special missions, such as IAEA IERICS** to assess NPP I&C systems (details are in IAEA section of this presentation)



IERICS: Independent Engineering Review of Instrumentation and Control Systems

- To review the design, prototype, testing, operation, maintenance, and modernization of I&C systems **mainly digital**
- Conducted by a **team of international experts** from complementary technical areas
- Based on appropriate IAEA documents, such as **Safety Guides and Nuclear Energy Series Reports**
- Findings include a list of **recommendations, suggestions** and identified **good practices**

IERICS mission website:

<https://www.iaea.org/services/review-missions/independent-engineering-review-of-ic-systems-ierics>

Key objectives of the IERICS mission

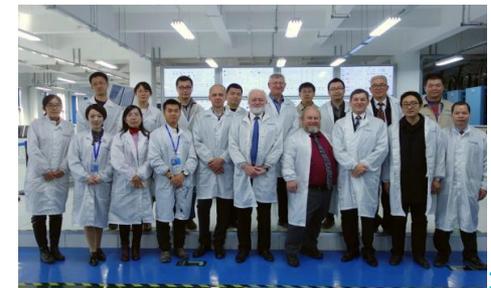
- **Assess** the design approach, principles, and procedures of the system under review
- **Identify** existing or potential design, operational, and licensing related issues or concerns of the system under review
- **Propose measures** to address issues identified
- **Identify** any outstanding **good practice** that could be a benefit to other NPPs or solutions
- **Provide** the counterpart with **an opportunity to discuss** their practices with experts who have experience of other practices in the same field

Specific review subjects

See Appendix I of IAEA TECDOC 1662 (Rev. 1.) for specific subjects of the review The proposed **subjects are organized into 9 main themes:**

- System identification
- Critical attributes
- Functional review
- System review
- Development processes review
- **Operation & maintenance processes review**
- **Operating history review**
- Focused reviews
- Technical visits

- Doosan Heavy Industries & Construction Co., RoK, 2010
- Research and Production Corporation Radiy, Ukraine, 2010
- **Joint Stock Company VNIIAES, Russia, 2012**
- Joint Stock Company SRPA “Impulse”, Ukraine, 2013
- China Techenergy Co. Ltd., China, 2016
- China Nuclear Control System Engineering Co. Ltd., China, 2016



- Importance of digital I&C challenges was highlighted several times at BGM-2017 in Republic of Korea
- All new NPP Units and Units under modernization are mainly based on digital I&C
- This enhancement of the level of NPP automation brings new challenges for NPP operational safety performance
- Reliability of digital I&C has direct influence on reliability, effectiveness and safety of the NPP operation
- Assessment of digital I&C from the point of view of their influence on reliable and safe operation of NPP could be a new and very significant task of WANO performance (in possible cooperation with IAEA)

RASU initiative to intergrade the efforts of WANO and IAEA for better solutions of the digital I&C challenges

WANO BGM's message on digital I&C challenges was clearly understood by the BGM participants from JSC "RASU".

Right after the BGM (in October 2017) they informed WANO-MC about the initiative on cooperation with the IAEA to support each other's' activities in the identification and review of the design, operation and modification of digital I&C systems at NPPs.

It was mentioned that the involved parties together have all needed tools and qualifications for performing in the future special missions to assess and assist for solving the digital I&C challenges in cooperation:

- The IAEA has the methodical tools, procedures and valuable experience for such assessments (IERICS missions)
- WANO has infrastructure for NPPs involvement and vast experience of technical support missions and peer-reviews at NPPs
- JSC "RASU" has well qualified specialists in digital I&C system design and operation

WANO-MC and JSC “RASU” have managed to organize 2 meetings at the IAEA headquarters in Vienna to discuss the proposed cooperation on digital I&C assessment.

The main meeting was conducted on 1 February 2018, its participants were the following:

No	Name of participant	Organisation	Position
1	Mr. Chudakov, Mikhail	IAEA	Deputy Director General, NE
2	Mr. Vincze, Pal	IAEA	Section Head, NPES
3	Mr. Eiler, Janos	IAEA	Nuclear Power Engineer, NPES
4	Mr. Alexander Duchac	IAEA	Nuclear Safety Officer, NSNI
5	Mr. Ponomarev, Anton	IAEA	DDG Referent, NE
6	Mr. Sandor Nagy	WANO-London Office	Projects Director
7	Mr. Frolov, Sergey	WANO-Moscow Center	Deputy Director
8	Mr. Chichikin, Dmitrii	WANO-Moscow Center	New Build Support Manager
9	Mr. Sivokon, Vladimir	JSC „RASU”	DG Advisor
10	Mr. Igor Mischenko	JSC „RASU”	Deputy of Chief Designer- Head of the sub-division on standardization

- The common agreement was reached that the proposed new direction of cooperation is very actual and important for NPPs, especially for the new build and Units under modernization.
- As one of the possible ways of further development it was suggested to sign the Practical Arrangements between IAEA and WANO at the high level (still pending). In fact, as it was discussed later, the works can be started even earlier.
- Nowadays it is proper time to undertake the first practical steps to make this cooperation real. Let us start in 2019, why not ?

Conclusions

All the meeting participants concluded that the meeting was successful and its main objectives were met. Further actions will be taken in accordance with the agreed clearance process.

SIGNATURES:

Mr. Eiler, Janos
Vladimir

Mr. Sandor Nagy

Mr. Frolov, Sergey

Mr. Sivokon,

Conclusion

Digital I&C are effective for NPP safety and productivity only when they are correctly and carefully designed, installed, operated, maintained and modernized.

International organizations such as IAEA and WANO (with the help of the experts from the companies like JSC “RASU” from different countries) may **regularly assess and assist to control digital I&C challenges** and by combing their efforts and introducing good practices !

There is no other way for us as to provide safety of NPPs at all stages of their life-cycle !



Photo from Brazilian presentation at IAEA TWG on NPP IC, 2017

Thank you for attention !
(and also Janos Eiler for IAEA IERICS missions information)