

G. Schnuerer¹, M. Yastrebenetsky²

¹GRS/ISTec — Institute for Safety Technology, Research Campus, Germany

²SSTC NRS — State Scientific Technical Centre on Nuclear and Radiation Safety, Ukraine

15 Years collaboration between SSTC NRS (Ukraine) and ISTec (GRS) in NPP I&C area

Collaboration between the Institute for Safety Technology (ISTec) from Germany and the State Scientific Technical Center on Nuclear and Radiation Safety (SSTC NRS) from Ukraine has been performed for about 15 years. The main topics of cooperation have been assessment and qualification of digital safety I&C systems for NPP, licensing of those systems and elaboration of standards and guidelines for the licensing processes mentioned above. The paper gives a brief overview about the activities and results of the collaboration.

Key words: instrumentation, control, system, licensing, digital.

Г. Шнюерер, М. О. Ястребенецький

15 років співпраці ДНТЦ ЯРБ (Україна) та ISTec (Німеччина) в галузі інформаційних та керуючих систем АЕС

Співпраця Інституту технологій безпеки (Німеччина) та Державного науково-технічного центру з ядерної та радіаційної безпеки (Україна) триває протягом 15 років. Основними напрямками співпраці є оцінка і кваліфікація цифрових інформаційних та керуючих систем АЕС, ліцензування цих систем і розробка стандартів та керівництв для ліцензування. Стаття містить короткий огляд цієї діяльності та її результатів.

Ключові слова: керування, прилади, системи, ліцензування, цифровий.

Г. Шнюерер, М. А. Ястребенецький

15 лет сотрудничества ГНТЦ ЯРБ (Украина) и ISTec (Германия) в области информационных и управляющих систем АЭС

Сотрудничество Института технологий безопасности (Германия) и Государственного научно-технического центра по ядерной и радиационной безопасности (Украина) продолжается в течение 15 лет. Основными направлениями сотрудничества являются оценка и квалификация цифровых информационных и управляющих систем АЭС, лицензирование этих систем и разработка стандартов и руководств для лицензирования. Статья содержит краткий обзор этой деятельности и ее результатов.

Ключевые слова: управление, приборы, системы, лицензирование, цифровой.

The collaboration between ISTec from Germany and the SSTC NRS from Ukraine has been meanwhile performed for about 15 years. While the collaboration from 1995 to 2000 was more or less characterized by an information flow from ISTec to SSTC NRS; in the meantime it has become a real balanced two-way cooperation in the fields:

Assessment and qualification of digital safety I&C systems for nuclear power plants,

Licensing issues of digital as well as programmable safety systems,

Elaboration of standards and guidelines for the licensing, assessment and qualification.

In addition information about the application and the status of digital safety I&C in Ukraine and Germany have been exchanged. This paper gives a brief overview about the activities and results achieved over the really successful period of collaboration.

1. Introduction

Collaboration between the Institute for Safety Technology (ISTec) from Germany and the State Scientific Technical Centre on Nuclear and Radiation Safety (SSTC NRS) from Ukraine has been performed for about 15 years. Some issues of this collaboration have been already reported in [1]. This paper presents key issues and achievements of the recent years of collaboration.

The most spread types of Eastern European NPP's are NPP's with WWER reactors. At present some 30 WWER-1000 and 27 WWER-440 units are in operation in 8 countries. From the vantage point of the present, the origin instrumentation and control (I&C) designs of these units had a lot of safety deficiencies, mainly

- low level of reliability of hardware and I&C functions,
- non-satisfactory diagnostics,
- discrepancy of seismic requirements and I&C system properties,
- low quality of man-machine interface,
- Missing information support systems for operator staff, etc.

Therefore wide upgrading of I&C systems has been done on practically all WWER units. The main direction of upgrading is based on the use of digital computer as well as programmable techniques. Common advantages of such I&C for improvement of NPP safety are better reliability, high processing and data transmission rate, high accuracy, high system variability, extended self-test, maintenance and diagnostic opportunities and modern man-machine-interfaces. But besides all advantages I&C upgrades add new problems to the task of safety assessment, like:

- it is needed to analyze the combination of hardware and software,
- the growth of system complexity,
- no possibility of full testing in many cases,
- it is necessary also to evaluate the process of system creation and tools for creation,
- the rapid change of hardware, software and technology of development.

How to qualify programmable systems in accordance with international standards?

These problems and the ways to solve them are common for Germany and Ukraine and consequently they are topics of the collaboration between the two organizations which are

supporting national regulatory activities — Institute of Safety Technology (ISTec) — Germany and State Scientific Technical Centre on Nuclear and Radiation Safety (SSTC NRS) — Ukraine.

2. Collaboration between ISTec (Germany) and SSTC NRS (Ukraine)

The collaboration between ISTec and SSTC NRS has started in 1995 [1]. The collaboration during 2001–2009 was characterized by a comprehensive information exchange to the application, qualification and licensing of digital and programmable I&C systems. The work was done by regular meetings, trainings, on-site inspections of NPPs and exchange of technical publications, regulative documents etc.

During the regular working meetings between ISTec and SSTC NRS the following topics were discussed:

German and international requirements on safety and safety important I&C systems, explanation of the German and international compilation of information documents for electrical safety I&C system, for main, emergency and local control rooms,

Requirements to modification procedures of safety important software during operation,

Operation experience with digital I&C, incidents and data gathering about faults and failures,

Test procedures during commissioning of digital I&C (factory acceptance test FAT, site acceptance test SAT, self-test, periodical tests),

Improvement and assessment of reliability of digital systems,

Information exchange and analysis of characteristics of different digital I&C system platforms e.g. Teleperm XS, Teleperm ME, Teleperm XP, Common Q, Tricon, etc.,

Information exchange and analysis of characteristics of different programmable I&C systems,

Development and application of standards e.g. standards for safety assessments, qualification issues, environmental testing, like electro-magnetic compatibility applied in Germany, etc.

The training of Ukrainian experts took place in the framework of the TACIS Project U3.02/00 (UK/TS/25) “Improvement of scientific and technical support to the nuclear and radiation safety regulation in Ukraine by developing the infrastructure of SSTC NRS and its subsidiaries, including enhancement of training capabilities”.

One of the tasks in this project — Task 3 “Summary report by results of improvement of SSTC NRS expert evaluation methodology” — related directly to digital I&C. This task was performed during 2004–2005 and consisted in the following two subtasks:

Subtask 3.1: Safety review of software of upgraded I&C systems.

The main characteristic was to demonstrate compliance of software with safety requirements by means of quality properties of the software. Also information about software-tools had been submitted, e.g. PEAK, MALPAS, REVEAL.

Subtask 3.2: Reliability assessment of I&C systems.

The reliability assessment of I&C systems is an important task and is needed for all I&C systems important to safety. The reliability analysis methodology applied was compliant with IAEA recommendations and internationally-accepted methodological principles.

The Ukrainian experts had been trained with the following software packages:

CATS (tool for static analysis of software),

LDRA-Testbed (tool for static and dynamic analysis of software),

Risk Spectrum (tool for probabilistic assessment of systems),

SUSA (tool for detailed probabilistic assessment),

At last but not at least SSTC NRS and ISTec exchanged publications and participated jointly in international meetings, workshops and conferences, etc.

All the examples mentioned above should demonstrate both, the fruitful and effective collaboration between German and Ukrainian expert organizations in the field of I&C safety.

3. Elaboration of standards and regulations for digital I&C

At present the main topic of collaboration is the actual national regulation work in Ukraine and Germany.

The Ukrainian “pyramid” of regulations and standards is given in figure 1.

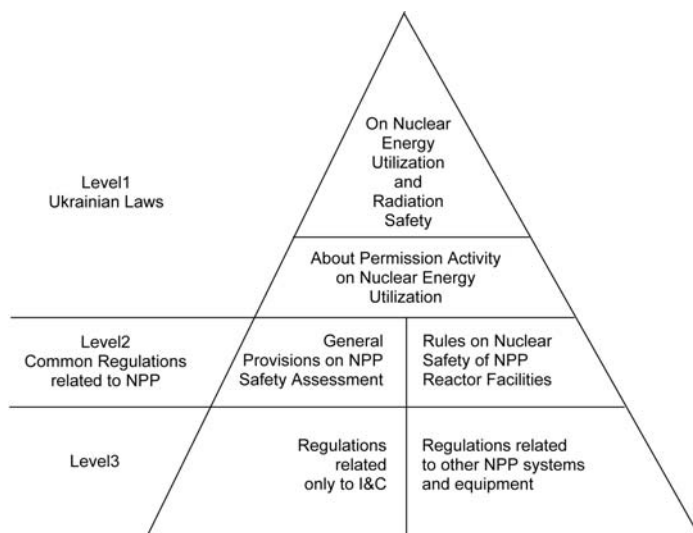


Fig. 1. Ukrainian regulations and standards

The high level is Ukrainian laws. The Law “On Nuclear Energy Utilization and Radiation Safety” contains main principles of licensing, as one of the main direction of regulatory activity.

The level 2 contains two documents: “Rules on Nuclear Safety of NPP Reactor Facilities and “General Provision on NPP Safety Assessment”. Documents of this level contain common requirements to different types of systems important to safety.

Documents of level 3 are related directly to I&C systems. These documents were elaborated by SSTC NRS and approved by Ukrainian Nuclear Regulatory Authority (NRA). The first of them is “Requirements on Nuclear and Radiation Safety to I&C Systems Important to Safety” [5].

Areas of application of this document are:

NPP I&C important to safety,
software-hardware complex (SHC) as a set of hardware and software components intended for use as part of I&C systems,
hardware intended for use in I&C directly or as part of SHC,
software for I&C and SHC.

Document “Methodic of Assessment of Compliance of I&C System to Safety Requirements” [6] contains:

- Identification (certain definition) of regulatory requirements to the system and its components,
- Requirements to documents which substantiate safety
- List of regulatory requirements,
- List of reviews which are to be prepared by experts,
- Expert evaluation approach,
- Software and hardware analysis along with analysis of the systems as a whole,
- Analysis of the process of software development, verification and validation, etc.

Table 1: Typical stages of licensing and expert reviews in the Ukraine

Stage of licensing	Expert review
1. Accordance of NPP Technical Decision about modernization	Expert review of NPP technical decision about modernization
2. Accordance of Terms of Reference (Specification)	Expert review of Terms of Reference
3. Accordance of Permission to Mounting	Expert review of software verification plan
	Expert review of software verification report
	Expert review of report about reliability
	Expert review of preliminary safety analysis report
4. Accordance of Permission to Operation	Expert review of SAT programs and methods
	Expert review of experimental operation program
	Expert review of final safety analysis report

The German “pyramid” of regulations and standards is given in figure 2.

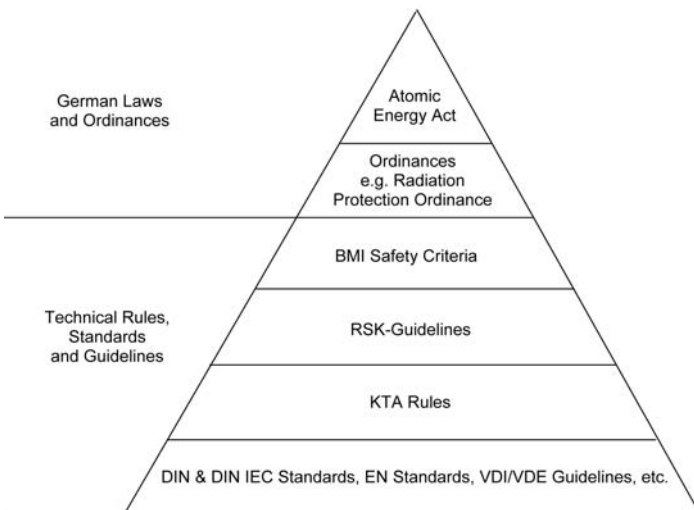


Fig. 2. German regulations and standards (present situation)

At present the level of the Technical KTA Rules on I&C are mostly under revision. The actual draft of the documents had been presented to the SSTC partners. To keep the “state of the art” requirements the international standards and guidelines are incorporated into the German requirement documents.

Nevertheless at present on the level of KTA*-Rules requirements to digital I&C are not completely included. That is why for digital I&C the DIN** IEC standards, EN standards and VDI/VDE*** guidelines have to be applied. Nevertheless, approved requirements that are independent from the I&C technology will be maintained.

ISTec as well as SSTC NRS is involved in several international working groups, projects and committees like subcommittee SC45A of the IEC, the COMPSIS-project**** of the OECD/NEA (ISTec only) and the Technical Working Group on Nuclear Power Plant Control and Instrumentation (TWG-NPPCI) of the IAEA. It became good practice during the collaboration of SSTC NRS and ISTec to exchange information and experiences from those activities. This helps to establish joint activities e.g. in working groups of SC45A.

4. Conclusions and outlook

The information exchange regarding elaboration and application of standards and guidelines provides the basis for a better understanding of the licensing approaches in Ukraine and Germany.

Due to the collaboration between SSTC NRS and ISTec both partners has got an overview about the procedures for backfitting of digital and programmable safety I&C in nuclear power plants. Thus the Ukrainian and German experts could enhance their methodology of safety assessments.

For the Ukrainian and German experts are national as well as international faced with a rapid change of I&C technologies, it is needed to focus and strengthen the expert know. Examples for such a strengthening of capabilities especially in view of the future collaboration activities are:

Since Ukraine is not involved in all international projects (e.g. the COMPSIS project of the OECD/NEA, the collaboration between SSTC NRS and ISTec provides an opportunity to continue the information exchange in the field of evaluation of operational experience of digital and programmable I&C.

The ongoing adoption and harmonisation of international (EN, IEC, IAEA, CENELEC, IEEE...) standards and safety guides in national nuclear standards.

The common development of new assessment, evaluation, qualification as well as licensing requirements of new safety I&C (inclusive its development tools), like programmable systems.

The continuation of the common national (and international) regulation work.

Elaboration of testing requirements (periodical testing, self-testing, SAT, FAT).

The qualification of programmable systems in accordance with international approaches.

The reliability investigations of new I&C technologies.

The evaluation of complexity of new I&C techniques.

* Kerntechnischer Ausschuss

** Deutsches Institut für Normung e.V.

*** Verein Deutscher Ingenieure e.V./Verband der Elektrotechnik Elektronik Informationstechnik e.V.

**** COMPUter based Systems Important to Safety

References

1. *Yastrebenetsky M.* German-Ukrainian collaboration in the assessment of digital I&C systems for safety applications in NPPs / M. Yastrebenetsky, D. Wach, B. Mulka, S. Vinogradskaya // Nuclear and Radiation Safety. — Special Issue for TACIS 10-th Anniversary. — 2002.
2. *Yastrebenetsky M.* Nuclear Power Plants Safety: Instrumentation and Control Systems / M. Yastrebenetsky, V. Vasilchenko, S. Vinogradskaya, V. Goldrin, Y. Rozen, L. Spektor, V Kharchenko. — Kiev, 2004. — 470 p (in Russian)
3. *Schn̈rger G.* Technical Requirements on Maintenance and Modifications of Digital I&C Systems Important to Safety / G. Schn̈rger, M. Kersken, F. Seidel // International Scientific-Technical Conference “New NPP I&C: Safety Aspects”. Abstracts. Kharkov, 2005.
4. *IAEA TECDOC-1328.* Solution for cost effective assessment of software based instrumentation and control systems in nuclear power plants. — IAEA, 2002.
5. *НП 306.5.02/035 2000.* Requirements on Nuclear and Radiation Safety to I&C Systems Important to Safety (Russian).
6. *ГНД 306.7.02/2.041 2000.* Methodic of Assessment of Compliance of I&C System to Safety Requirement. (Russian).
7. *Lindner A.* Experiences gained from Independent Assessment in Licensing of Advanced I&C Systems in Nuclear Power Plants / A. Lindner, D. Wach // Nuclear Technology. — 2003, Aug. — Vol. 143. — Pp. 197–207.

Надійшла до редакції 11.06.2010.