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Technical Translation in Nuclear Energy: New Terms, Context, Equivalence

The paper briefly outlines the theoretical concepts underlying scientific and technical translation such as equivalence and context. It emphasizes the importance of contextual knowledge essential for the translation of new terms that emerge in modern academic and technological society. The significance of extensive and comprehensive contextual knowledge is demonstrated by the example of two new concepts brought to light following the Fukushima Daiichi accident. The concepts and challenges associated with their translation are addressed in detail.

Keywords: scientific and technical translation, Fukushima Daiichi accident, stress tests, post-Fukushima measures, safety upgrades, nuclear power plant.

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Технічний переклад у сфері атомної енергетики: поява нових термінів, контекст, еквівалентність

Стисло викладаються теоретичні концепції, що лежать в основі науково-технічного перекладу, такі як еквівалентність і контекст. Підкреслюється важливість контекстуальних знань для перекладу нових термінів, які виникають у сучасному науково-технічному суспільстві. Значимість вичерпного розуміння контексту продемонстровано на прикладі двох нових концепцій, що виникли після аварії на АЕС «Фукусіма». Детально розглядаються самі концепції та пов'язані з ними питання перекладу.

Ключові слова: науково-технічний переклад, аварія на АЕС «Фукусіма», стрес-тести, постфукусімські заходи, підвищення безпеки, атомна електростанція.

Scientific and technical translation is an essential component of academic and technological society, promoting the dissemination of ideas, notions and concepts. Its role in today's information age has become especially important. It is a vehicle for facilitating significant scientific and technological advances that accompany virtually all aspects of our lives. It should be recognized universally that translation is a necessary driving force in imparting scientific and technical knowledge [1].

Nowadays, the domain of science and technology is a major area of translation. Among other things, there is a fundamental concept of equivalence. The context-based notion of equivalence is generally accepted today as a tool for reaching relevant equivalence-related insights. The text is an integral part of the context. It is essential that the context relates predominantly to the domain underlying the text [2].

Science and technology are expressed through language. Thus, scientific and technical translation is essential for disseminating knowledge on an international scale at various levels. Contextual knowledge refers to the specific domain of science or technology, such as nuclear and radiation safety in our case. International organizations in specific areas (for example, International Atomic Energy Agency, International Electrotechnical Commission, etc.) produce their own terminological equivalents that may semantically differ from the standardized terminology of science and technology in general. In this instance, equivalence is largely dependent on specific context reflecting the conventions of a specialized language community, as will be discussed below.

Unfortunately, the emergence of new terms in the field of nuclear and radiation safety may be associated with accidents or emergencies that occur at nuclear power plants with different reactor designs. The severe accident that occurred in March 2011 at the Fukushima nuclear power plant is no exception. Following the accident at the Fukushima nuclear power plant in Japan, the European Council declared that *"the safety of all EU nuclear plants should be reviewed, on the basis of a comprehensive and transparent risk assessment (stress tests)"* [3]. Based on the WENRA proposals made at the plenary meeting, the European Commission and ENSREG members decided to agree upon "an initial independent regulatory technical definition of a stress test" and its application across Europe. Hence, a stress test is defined as a targeted reassessment of the safety margins of nuclear power plants in the light of the events that occurred at Fukushima: extreme natural events challenging the plant safety functions and leading to a severe accident.

This new term is a striking example of a semantic unit whose definition depends on the specific domain and context. It is limited to the use in nuclear community, unlike universal definitions accepted previously for applied science and medicine. For example, Webster's Unabridged Dictionary [4] defines a stress test as *"1. A test, especially one conducted in a laboratory, to determine how much pressure, tension, wear, etc., a product or material can withstand. 2. A test of cardiovascular health made by recording heart rate, blood pressure, electrocardiograms, and other parameters while a person undergoes physical exertion"*. Wikipedia, in turn, offers a variety of descriptions for "stress tests" or "stress testing" as applied to medicine, finances, human research, mechanics, etc.

Following the stress tests, European Union countries prepared reports and statements regarding the comprehensive and transparent risk assessments. For example, the French Nuclear Safety Authority (ASN) in its "Opinion N°2012-AV-0139 of 3rd January 2012 concerning the complementary safety assessments of the priority nuclear facilities in the light of the accident that occurred on the nuclear power plant at Fukushima Daiichi" [5]

imposed a range of measures on the licensees. In particular, it underlies the importance of the "*creation of a "hard-core" of material and organizational measures designed to ensure control of the basic safety functions in extreme situations; the licensees will propose ASN the content and specifications of this "hard-core" for each facility*" [5].

ASN thus noted the emergence of the "hard-core" concept defined by IRSN and asked the licensees to propose a "hard-core" of material and organizational measures for each facility, specifications and procedures for implementing these measures, such as control of the basic safety functions in exceptional situations.

Appendix II to the ASN Opinion [5] defines composition of the *hard-core*: *"crisis management premises and equipment, means of communication and alert, technical and environmental monitoring instrumentation, operational dosimetry resources for workers, strengthened equipment, including for the nuclear power plants, an electricity generating set and an emergency cooldown water supply for each reactor".*

Therefore, another new term, associated with the lessons learnt from the Fukushima accident, came into use in nuclear community. For instance, Philippe Jamet, Chairman of the Stress Test Peer Review Board, mentioned the "hard core" concept in his presentation at the International Experts' Meeting on Reactor and Spent Fuel Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant held in IAEA Headquarters in Vienna in March 2012. Hence, the "hard core" of material and organizational measures to manage basic safety functions in extreme situations is intended to prevent a severe accident or limit its progression, limit large-scale releases in a severe accident and enable the operator to perform emergency management duties. The "hard core" is designed to withstand much more severe conditions than the plant design basis and a significant proportion of European plants decided to implement this concept.

The ENSREG Peer Review Report on Stress Tests Performed on European Nuclear Power Plants [6] recommended the national regulators to consider, inter alia, the development of a "hardened core" of selected safety systems protected against extreme hazards and stated that numerous plants decided to install a "hardened core" of equipment and organizational measures or bunker-based systems having their own power sources with dedicated fuel reserve, dedicated pumps with independent sources of water, their own instrumentation and controls. According to the report, the "hardened core" concept, besides equipment, encompasses trained staff and procedures designed to cope with a wide variety of extreme events.

Furthermore, the ENSREG Peer Review Country Report (for France) [7] extensively uses the term "hardened safety core" characterized as follows: *"As a substantial safety improvement, the licensee proposes to define a "hardened safety core" of reinforced equipment such as to minimize the potential for severe accidents and avoid significant radioactive releases into the environment, over and above the current safety requirements, for the deterministic situations studied in the complementary safety assessments. The licensee intends to draw up a list of the main hardened safety core items and the robustness requirements to be applied to them."* The concept of "hardened safety core" has been implemented through gradual creation of the Nuclear Rapid Response Force (Force d'Action Rapide du Nucl*й*aire, FARN) proposed by EDF, a national response system comprising specialist crews and equipment, able to take over from the personnel of a site affected by an accident and deploy additional emergency response resources in less than 24 hours.

According to Webster's Unabridged Dictionary [5], *hard core* is defined as *"1. The permanent, dedicated, and completely faithful nucleus of a group or movement, as of a political party. 2. An unyielding or intransigent element in a social or organizational structure, as that part of a group consisting of longtime adherents or those resistant to change. 3. Those whose condition seems to be without hope of remedy or change".*

The hardened safety core (hard-core or hardened core) term as well poses a challenge for the translator since no previously and universally accepted definition can obviously be applied. Given clarity of the concept based upon extensive definitions and already available applications, it still remains to find the relevant, perceptive and concise translation for the term into national language, considering that it is not governed by either national or international terminological systems. In such instances, in view of the collective and comprehensive nature of the new term, the translator should study and analyze all available approaches, concepts, and opinions and consult experts specializing in the field in question to reach the adequacy and equivalence of the translation.

Conclusions

The role of scientific and technical translation has become especially important as a necessary driving force for disseminating new knowledge and exchange of information on an international scale at various levels. Conceptual knowledge is an essential prerequisite for interpreting and translating the new terms that emerge in modern conditions in an adequate and perceptive manner. This has been demonstrated by the example of two new concepts or terms that appeared in the light of the lessons learnt from the Fukushima Daiichi accident. It is emphasized that the correct and adequate translation of the new terms is challenging and requires deep analysis and consultation with experts in the field of question, to be further implemented and standardized in national terminological system.

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Summaries

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Experience of Separating Regulatory and Technical Requirements for Nuclear and Radiation Safety

Within the concept of improving the regulatory and legal framework of Ukraine on nuclear and radiation safety, the paper justifies the need for separation of proven and generally accepted safety principles formulated in the legal and regulatory documents as obligatory ("regulatory") requirements and "technical" requirements established in the standards of the operating organizations and/or codes of standard practices, which explain in details regulatory requirements from the documents of higher level.

The paper considers the results based on the development of first in Ukraine standards, regulations and rules on functional safety of instrumentation and control systems and their components, where the separation of regulatory and technical requirements is implemented.

K e y w o r d s: safety, regulation, regulatory document, rules, regulatory requirements, standards, technical requirements, nuclear and radiation safety.

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Analysis of Severe Accidents in Spent Fuel Pool of Fukushima Daiichi NPP Using MELCOR 1.8.6 Computer Code

The paper presents specific approaches to modeling the spent fuel pool (SFP) of Fukushima Daiichi NPP and results of thermohydraulic calculations of severe accidents in SFP using MELCOR 1.8.6 computer code. The dynamics of main processes accompanying severe accident progression in SFP of such a type was defined based on computer analysis. Obtained results may be used to improve available SFP computer models to receive more reliable data on the progression of emergency processes in NPP SFPs.

K e y w o r d s: spent fuel pool, computer model, MELCOR1.8.6, severe accident.

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ALARA Principle to Minimize Collective Dose in NPP Accident Management within the Containment

The paper focuses on application of the ALARA principle to minimize the collective doses (both for NPP personnel and the public) related to admission of personnel to the containment for accident management activities and depending on operation of ventilation systems.

Results from assessment of radiation consequences are applied to a small-break LOCA with failure of LPIS at VVER-1000 reactors. The public doses are evaluated using up-to-date RODOS, MACCS and HotSpot software for assessment of radiation consequences. The personnel doses are evaluated with MicroShield and InterRAS codes. The time function and optimal value of the collective dose are defined.

The developed approach can be applied for minimization of the collective dose for optimization of accident management strategies at NPPs.

K e y w o r d s: ALARA principle, radiation consequences, minimization of collective dose, small-break LOCA

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Analysis of SG Feeding by Mobile Pump under Total Blackout of NPP with VVER-1000/320

The paper presents the analysis of steam generator feeding by mobile pump under power unit total blackout with loss of heat removal to the ultimate heat sink. Thermohydraulic model of NPP with VVER-1000/320 for RELAP5/MOD3.2 was used in calculations. The assessment of hydraulic loss of mobile pump head was performed based on initial data of Zaporizhzhya NPP Unit 1. Results of thermohydraulic calculations confirmed the effectiveness of SG feeding via mobile pump at an early and late stages of the accident and revealed typical aspects of the transient progression.

K e y w o r d s: accident, Fukushima-Daiichi nuclear power plant, SG feeding, mobile pump, thermohydraulic analysis.

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Risk-Informed Approach to Structure Integrity Prediction and Optimization of In-Service Inspection of Heat Exchange Equipment with High Defect Statistics

A physically and statistically based approach to steam generator heat exchange tube integrity assessment is proposed in the paper. The method is based on stochastic laws of crack dimensions distribution taking into account their growth, limit load model of cracked tube and SG plugging statistics. Based on the history of plugging tubes of specific SG, three statistical parameters have to be found: initial number of defects, initial defect size and defect growth rate. The developed method was used to predict HET failure for all Ukrainian SGs and to justify pressure reduction of hydrostatic test (HT) for primary side of NPPs with VVER. It is shown that pressure reduction does not practically increase the fracture probability during operation.

K e y w o r d s: heat exchange tubes, steam generator, statistical data, defect, risk-informed approach, in-service inspection.

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Analysis of Conditions and Mechanisms for Generation of Explosive Mixtures at an Early Stage of Chornobyl Accident

The paper presents the scenario developed for an early stage of the accident progression to assess impact of highly explosive hydrogen on RBMK-1000 design. It was found out that the ratio between the speed of local generation of gaseous hydrogen and the speed of hydrogen spreading in the vapor-gas medium of the core is the determining factor for the occurrence of conditions of explosive vapor-air mixture in the core.

Obtained data can be used in further studies to model the formation of explosive mixtures in the environment, the amount of air and water vapor in the analysis of explosive vapor-air mixture. Practical calculations make it possible to assess fracture energy and predict the impact on structures.

K e y w o r d s: explosiveness of hydrogen, zirconium-steam reaction, reactor graphite, Chornobyl Nuclear Power Plant.

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What to do with Chornobyl NPP Unit 4? For the 30th Anniversary of the Shelter

Thirty years ago, on 30 November 1986, the State Commission accepted temporary shutdown Unit 4 of Chornobyl NPP for the maintenance. Ukraine together with the world community takes measures on the Shelter transformation into the environmentally safe system. By the end of 2016, it is planned to complete the last stage of the project, when the Shelter will be covered by the New Safe Confinement (NSC). However, the paper shows that NSC movement is only the initial stage of transformation and many research efforts, organizational and technical measures are needed for reaching the final goal, which is the retrieval of fuel containing materials.

Keywords: Chornobyl NPP, accident, the Shelter, New Safe Confinement, Shelter transformation into the environmentally safe system.

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Gamma-Spectrometric Determination of the Content and the Mass of Uranium Isotopes in Samples of Unknown Composition and Products of the Nuclear Fuel Cycle

The results of the uranium isotopes masses and content determination in depleted and low enriched uranium bearing samples using gamma-spectrometric data and iterative method were presented in the paper. Powders of UO_2 and U_3O_8, compact products on their basis, metal uranium and scrap with an enrichment by the isotope ^{235}U from 0,3 to 19,9 % were used as test samples. The sample mass ranged from tens of grams to several kilograms. Gamma-spectrometric data were processed using commercial software packages by Canberra Company: Genie 2000, MGAU, ISOCS and GeometryComposer. The proposed method provides a satisfactory correlation between the experimental and calculated data and allows estimating the quantitative characteristics (enrichment, mass of isotopes, uranium content in the matrix) of uranium bearing samples with different physical shape and chemical composition.

Keywords: uranium bearing material, in situ gamma-spectrometry, mass of uranium isotopes, uranium content in the matrix, absolute detection efficiency

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Development of Inventory of Sites for Construction of New NPP Units in Ukraine

The paper considers issues related to the development of the inventory of sites for construction of new NPP units in Ukraine as one the priority measures to fulfil the Energy Strategy of Ukraine till 2030. There are stages of the document development and the list of possible potential sites. The approval of the document submitted in 2013 for the consideration of the Ministry of Energy and Coal Industry of Ukraine will make it possible to reduce sufficiently costs for the development of feasibility study for the construction of new NPP units and to reserve territories for them.

Keywords: inventory of sites, site for possible NPP construction, NPP site.

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Computer Security of NPP Instrumentation and Control Systems: Categorization

The paper is devoted to studying categorization of NPP instrumentation and control (I&C) systems from the point of view of computer security and to consideration of the computer security levels and zones used by the International Atomic Energy Agency (IAEA). The paper also describes the computer security degrees and zones regulated by the International Electrotechnical Commission (IEC) standard. The computer security categorization of the systems used by the U.S. Nuclear Regulatory Commission (NRC) is presented. The experts analyzed the main differences in I&C systems computer security categorization accepted by the IAEA, IEC and U.S. NRC. The approaches to categorization that should be advisably used in Ukraine during the development of regulation on NPP I&C systems computer security are proposed in the paper.

Keywords: computer security, instrumentation and control system, categorization, level, degree, zone.

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The paper briefly outlines the theoretical concepts underlying scientific and technical translation such as equivalence and context. It emphasizes the importance of contextual knowledge essential for the translation of new terms that emerge in modern academic and technological society. The significance of extensive and comprehensive contextual knowledge is demonstrated by the example of two new concepts brought to light following the Fukushima Daiichi accident. The concepts and challenges associated with their translation are addressed in detail.

Keywords: scientific and technical translation, Fukushima Daiichi accident, stress tests, post-Fukushima measures, safety upgrades, nuclear power plant.