International Conference on Challenges Faced by Technical and Scientific Support Organizations (TSOs) in Enhancing Nuclear Safety and Security - IAEA CN-214

Monday, October 27, 2014 - Friday, October 31, 2014

Book of Abstracts

Contents

Session 2: Poster Session / 1

Rise of TSO Role in the Moldovan Nuclear and Radiological Infrastructure

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Actuality of the development of TSO is becoming more acute in the context of the increasing role of nuclear technologies in the development of society. This is not due by diminishing the role of the National Agency for Regulation of Nuclear and Radiological Activity (sole Regulatory Body in Moldova), but due to the complexity and multilateral areas which may influence the radiation protection, nuclear safety and security. Limited human and financial resources of the Regulatory Body consisted the fundamental arguments, which convinced Moldovan legislators to reflect TSO, in the new legislative act on regulation nuclear and radiological activity (Law No. 132 of 8 June 2012, Monitorul Oficial of the Republic of Moldova, no. 229-233 from 02.11.2012). In the Art. 8 of this Law is underline, that the national nuclear infrastructure consists also of radiological experts, other qualified human resources from the sectors of research, training, education, TSO, regardless of its legal form of organization. Thus, for the first time TSO are accepted as intrinsic part of the national infrastructure in the nuclear and radiological field.

As was mentioned above, countries with limited resources have all the reasons to establish such a legal framework, so that the activities of TSO and experts will become benefic and attractive in supporting the Regulatory Body, stakeholders and society as a whole.

Currently TSO development in Moldova is rising, although not with the expected rates. Enabled TSO activate in different sectors as: on evaluation of the regulatory framework and preparation of draft normative acts, consultations concerning technical equipment, training, improving RPO knowledge's, pre-licensing inspection, ensuring quality control, metrological assistance, update of the web page, ensuring information security and providing consultancy on cyber security issues, exchange of information during round tables, workshops as well as conferences or exercises. TSO are both from the private sector, NGO, as well as from the state sector. In particular, it is extremely important the TSO role in new areas, which carries an increasing role, such as cyber security, vulnerability of physical protection involves cyber security requirements. The development of information technology delivers new knowledge to Regulatory Body staff , witch are difficult to implement due to the specific topics. Thus, the areas of cyber security can be supported only by specialised organizations.The regulatory body's partnership with TSO must be a strategic, long-term and their relationship must be in a well-defined regulatory framework, ensuring fair competition, stimulating work, fair recognition of TSO the results of TSO, the possibility of taking into account the recommendations and opinions by TSO.

TSO should confirm to the Regulatory Body, stakeholders and to the society their competences, prove the existence of adequate resources to perform their mission and provide credible technical and scientific expertise. From that point of view TSO are interested in a long term policy, for establishing as baseline of technical expertise and scientific knowledge in the field, for identifying and addressing security and safety research needs, and by fulfilling education and training needs. Moldovan TSO became more attractive, fact confirmed by receiving in the last year more funds from US NRC, Swedish Radiation Safety Authority for sustaining of Moldovan Regulatory Body.

Country or International Organisation:

Republic of Moldova

Session 2: Oral Session / 2

Safety and Security Interfaces in Emergency Situations

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The presentation will focus on table top exercises which create an easy forum to merge safety and security issues and to allow training and open discussions between stakeholders on key points.
The general statements and remarks resulting from the French experience in nuclear secutiry exercises will be shared and detailed in 4 main topoics : 1 the decision making process, 2 the coordination and interfaces, 3 the planning, preparation and training, 4 the time and people managements.

Country or International Organisation:

IRSN FRANCE

Session 2: Poster Session / 4

The Swiss regulator's research strategy and its links to competent and independent expertise

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The research strategy of the Swiss Federal Nuclear Safety Inspectorate ENSI contains several objectives, which refer to the competence and independence of expertise ENSI needs to fulfil its duties:
- Maintaining and expanding ENSI's own expertise and that of ENSI's external specialists;
- Developing independent expertise by preferring research projects carried out by specialists who will also be able to undertake expert work for ENSI without conflicts of interest at a later stage;
- Fostering international integration through research projects like benchmarks in which ENSI and/or its experts participate;
- Making ENSI more attractive to new employees by establishing a key function for ist specialists to follow Research Projects.
The regulator's research programme can have a significant impact on competent and independent expertise. The key to this is anticipating future supervisory needs.

Country or International Organisation:

Switzerland

Session 5: Poster Session / 5

A State University in TSO Role: Fundamental Contribution to Nuclear Safety and Security Regime at National Level through Provision of Commensurate Education, Training and Scientific/Technical Expertize – Experience of Montenegro

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There are, in principle, two major aspects of addressing nuclear safety and security issues in small countries: institutional/legal framework and knowledge/competence/expertize provision. As to Montenegro, the former is relatively well established (and will not be addressed in this paper), while the latter trails somewhat behind [1] and will be dealt with.

Montenegro is, thus, such small, developing and "non-nuclear" country – the use of radiation sources being modest and limited to a few ordinary applications (primarily in health care). Even though, there is (or will be in the foreseeable future) a significant need in nuclear knowledge, competence and expertize – directly or indirectly related to nuclear safety and security issues. It goes about the following, the list being not exhaustive: (i) medical applications (diagnostics, radiotherapy, palliation, sterilization of equipment, consumables, blood products, etc.), (ii) radiation protection, including various dosimetry services and QC/QA of radiation sources; (iii) environmental protection (radioecology, analytical and monitoring services, etc.), (iv) low and medium activity radioactive waste management (including a newly licensed storage), (v) industrial, geological, hydrological, agricultural, biochemical and archaeological applications (non-destructive testing, various gauges, radioisotope labeling, harmful insects sterilization, etc.), (vi) scientific and educational uses, (vii) cultural heritage preservation and investigation, (viii) legislative and regulatory aspects, including complying to international safety/security norms and joining international conventions in the field, (ix) preparedness and response to radiological and nuclear emergency situations, (x) combating illicit trafficking of nuclear and other radioactive materials, (xi) nuclear forensics, (xii) security systems based on X-ray and other nuclear methods, (xiii) introduction of some future topics (e.g. nuclear power for electricity generation and sea water desalination), (xiv) public information and communication with media, etc. [2].

University of Montenegro (UoM) is the only state university in the country and the only one providing higher education, scientific research and expertise in natural and technical sciences, including nuclear/radiation-related ones – it is the statutory duty of UoM to do so, and to do it in a manner commensurate with country needs. By far the most relevant expertise in the country is either concentrated at UoM or is deriving out of it; it therefore goes without saying that UoM has fundamental role in meeting nuclear-related (safety and security included) goals in Montenegro [3].

Small issues in big countries are often big issues in small countries. IAEA offers the unique and equal opportunity for all Member States to come up with their issues and seek for cooperation/assistance in order to cope with the problems; there are numerous modalities in pursuing this aim.

Networking is becoming increasingly important for building/sustaining the national body of knowledge, competence and expertize. This is particularly valid for those countries whose domestic resources are limited and/or where no critical mass of the above three constituents exists, which could sustain the system on its own. IAEA-based international networks for nuclear security education (INSEN) and training&support (NSSC), even relatively recent, proved pivotal/fundamental in this respect [4,5]. At UoM (Department of Physics) we have launched several targeted educational courses at post-graduate level, following INSEN guidelines; the pioneering educational materials developed within the network represent the basic literature for both students' and lecturers' use [6]. We also participate in nuclear knowledge management (NKM) activities and use their information system (INIS) when sourcing relevant data. UoM is also national contact point for INES (International Nuclear and Radiological Event Scale) and has trained staff for properly reporting in case of incident/accident [7]. UoM participates in IAEA-supported Nuclear Instrumentation Laboratory Network (NILNET). We will also be among the first ones to participate in Internet Reactor Laboratory (IRL) – a novel/advanced learning tool in nuclear physics and engineering.

UoM offers a number of laboratory services, primarily for educational/training purposes, but also for routine measurements, monitoring of radioactivity and radiation parameters in the living, working or outdoor environment. Laboratory for nuclear spectrometry has classic NaI and HPGe detector systems, very high sensitivity anti-coincident spectrometer, etc., while environmental laboratory offers atomic absorption spectrometer, medical QC/QA control devices, radon equipment, etc. Most of these are at students' permanent disposal [8].

In concluding [1], UoM is, or should act towards: (i) becoming national center of competence and expertise in nuclear related issues, (ii) assessing, creating, preserving and transferring nuclear knowledge (NK), according to Montenegro needs, (iii) offering consultancies and technical support services to regulatory authorities and relevant stakeholders, (iv) being advisory body to the government for

nuclear related issues and (v) focal point for dissemination and exchange of NK, in particular with the IAEA, (vi) promoting nuclear applications for peaceful purposes, in particular medicine and environmental protection, (vii) being national radiation protection centre, (viii) developing curricula for nuclear related studies at all levels, (ix) supporting young students and scientists in nuclear related field and facilitate their exchange with reputed institutions abroad and (x) giving proper and timely information and comments to the public and media on relevant nuclear related subjects.

REFERENCES

[1] IAEA Knowledge Assist Mission to Montenegro, 2-4 September 2009, End-of-Mission Report, IAEA-605-L2.33.7-MNE, 2010-06-16.
[2] S. Jovanovic, paper presented at International Conference on Challenges Faced by Technical and Scientific Support Organizations (TSO) in Enhancing Nuclear Safety and Security, 25-29 October 2010, Tokyo, Japan
[3] S. Jovanovic, University Centre for Nuclear Competence and Knowledge Management, Establishment Elaborate, July 2008, University of Montenegro, Podgorica.
[4] International Nuclear Security Education Network (INSEN) http://www-ns.iaea.org/security/workshops/insen-wshop.asp
[5] International Network for Nuclear Security Training and Support Centres (NSSC) http://www-ns.iaea.org/security/nssc-network.asp
[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Educational Programme in Nuclear Security, IAEA Nuclear Security Series No. 12, Vienna (2010) http://www-pub.iaea.org/MTCD/publications/PDF/Pub1439_web.p
[7] International Nuclear Event Scale, INES, http://www-ns.iaea.org/tech-areas/emergency/ines.asp
[8] European Online Laboratory, page Montenegro http://www.reak.bme.hu/munkatarsak/dr-doczi-rita/european-online-laboratory-eol/montenegro.html

Country or International Organisation:

Montenegro

Session 1: Poster Session / 8

Challenges To Enhance Nuclear Safety and Security by Internal Technical and Scientific Support Organizations

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All nuclear activities using or relating to nuclear energy in Indonesia are controlled by the Nuclear Energy Regulatory Agency (BAPETEN). In executing the three main activities (regulations, licensing utilization, ans inspection) in controlling of utilization of nuclear energy, BAPETEN requires to execute activity of review and assessment and research and development on nuclear safety and radiation safety as scientific justification in determining the safety requirement. Technical and scientific support organizations (TSOs) dedicated to supporting national regulatory authorities. At present BAPETEN has internal TSOs. At present, BAPETEN has internal TSOs. The mission of internal TSO consist of: technical or engineering consideration to regulation making process, technical verification to licensing (application) review process, technical consideration to the inspection findings verification

Country or International Organisation:

Indonesia Nuclear Energy Regulatory Agency (BAPETEN)

Session 5: Poster Session / **9**

Egyptian Nuclear and Radiological Regulatory Experience and its Relation with Technical Supporting Organizations

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The Egyptian Nuclear law No. 7 was issued in 2010. According to this law the Nuclear and Radiological Regulatory Authority (NRRA) was established as an independent body, reporting directly to the prime minister and having the responsibility of all regulatory functions for nuclear and radiation facilities and activities (with the exception of x-ray for medical applications) as well as safeguards and security. Previously the regulatory functions was conducted since 1984 through the National Center for Nuclear Safety and Radiation Control which was one of the 4 centers of the Atomic Energy Authority. This Center had a more or less a research nature, and the regulatory functions were carried out through specialized committees. The new independent Regulatory Body established an organizational structure including specialized sectors addressing the main regulatory functions in addition to the research institute. This research institute has actually the main expertise which constitute the main competent personnel and can be considered as an internal Technical Supporting Organization, while the other regulatory sectors are now in the phase of building its personnel. The challenge now is first to direct the research more toward regulatory research and second to get the best use of the competency acquired in the research institute to fulfill the regulatory responsibilities of the NRRA. The nuclear safety experience was mainly in the field of research reactors and the radiation sources as well as safeguards. Egypt is now embarking on nuclear power plants for electricity generation. Therefore it is of outmost importance to raise the competence of its regulatory and research personnel in order to be able to conduct its regulatory responsibilities. This is done through self assessment, a Systematic Approach for Training, contacts with several regulator bodies and technical supporting organizations both locally and externally as well as regulatory networking. Many technical cooperation and research projects are implemented with the International Energy Agency, with workshops , training fellowships and scientific visits and many experts have been consulted on several occasions. Egypt is a member of IAEA Steering Committee of the Human Resources for Regulatory Bodies The NRRA is involved in review and assessment work for site permit and environmental impact of the nuclear power plant to be constructed at El-Dabba. For this purpose it may be necessary to get the help of technical support organizations and some external experts. NRRA is following the IAEA guidance in choosing external experts in order to get an independent and reliable advise, taking into consideration that the final decision responsibility lies with the regulatory body.

Country or International Organisation:

Egypt

Session 5: Poster Session / **10**

TSO Activities in Licensing and Supervision Procedure during the Construction, Operation and Dismantling of the Vitrification Facility Karlsruhe

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The Karlsruhe Reprocessing Plant (WAK) was built as a pilot plant for later commercial reprocessing in the 1960s. During the reprocessing phase of the WAK the about 60 m3 of high-level waste solution

remained in the storage building of the WAK plant from 1971 to 1990. To condition the high-level waste solution from reprocessing to a waste product for final repository storage, the Vitrification Facility Karlsruhe (VEK) was build near the high-level waste storage building.
For the construction, commissioning and operation of the VEK the regulatory authority commissioned its technical support organization (TSO) TUEV SÜD Energietechnik in the licensing and supervision procedure to assess the safety design and quality control measures to assure that the precaution measures against the damage are sufficient. The aim is to avoid unallowable enhanced releases of radiological substances to the atmosphere during normal and abnormal operation and under accident conditions caused by internal or external events. Various recommendations on safety requirements were provided by the TSO in the expertise to concept, erection and operation of the VEK from December 1997 to July 2007.
After implementation of all these requirements the complete high-level liquid waste was vitrified. 140 canisters with 56 t of waste glass in total were produced. Five Castor containers were filled with 28 canisters each and transported to the interim storage site North. Negative disruptions can be avoided during the operational period of the VEK from September 2009 to November 2010.
The decommissioning and dismantling of the VEK is now ongoing. The TSO is just as well involved in licensing and supervision procedure for dismantling of the VEK and evaluates the planned decommissioning and dismantling steps for safe implementation.

Country or International Organisation:

Germany

Session 3: Poster Session / 11

Experience on the Assessment of Exercises for Emergency Preparedness and Response at the Center for Accelerator Science and Technology

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Experience on the Assessment of Exercises for Emergency Preparedness and Response at the Center for Accelerator Science and Technology. Center for Accelerator Science and Technology (CAST) is curently operating nuclear facilities such as accelerator neutron generator, electron beam machine, uranium purification laboratory, and Kartini Research Reactor. According to the national rule, CAST should have a program and plan for radiological emergency preparedness and response (EPR) with at least practically exercised annually. The primary goals of preparedness and response for a nuclear or radiation emergency are: to ensure that arrangements are in place for an effective response at the scene and, as appropriate, at the local, regional, national and international levels, to a nuclear or radiation emergency; to ensure that, for reasonably foreseeable incidents, radiation risks would be minor; for any incidents that do occur, to take practical measures to mitigate any consequences for human life, health and the environment [1].
CAST is located at the central Java, surrounded by several active volcanoes, the most active volcano is mount Merapi 30 km away from the CAST. Java is the most dense populated and a relatively small island in Indonesia, it has a highest concentration of active volcanoes (45 active volcanoes). Mount Merapi has erupted more than 80 times [2]. The International Association of Volcanology and Chemistry of the Earth's Interior has named Mount Merapi as a Decade Volcano since 1995 because of its high volcanic activity [3]. Therefore, the external events: earthquqes and volcano eruptions should be considered in the emergency preparadness of CAST nuclear facilities. While in the recent decade the terorist threat is also increasing and should be accomodated in the safety-security analysis, and emergency preparadness and response, therefore, the local design basis threat has been established [4,5].
As a regulation mandatory, CAST through CAST's Radiation Emergency Response Team (RERT or PKDR) has conducted exercises simulating radiological emergencies relating to Kartini research

reactor operation, anually, and the assessment was performed accordingly. CSTA hosted an EPR exercises for emergency conditions (on- and off-site) anually. This exercise was designed to evaluate the initial response to the incident and the management of the consequences associated with external events such as earthquakes and volcano eruptions, terrorism, and work incidents. The exercise scenario for year 2013 was a fire occurred in reactor ventilation system followed by explotion, causing two workers as victim have to be evacuated. The exercise is participated by several government's agency such as: nuclear regulatory body (BAPETEN, local police departement, hospital, fire brigade, local government, emergency response division, university staff, etc. The exercise focused on key emergency responder coordination and critical decision-making processes for integrating local government assets necessary to protect public health following a radiation incident. The whole exercise can be monitored by video system from the central alarm station (CAS).
The assessment of the exercise showed that the victims can be evacuated within 9 minutes and the event can be overcame within 20 minutes. In general the advantages and the objective of exercises of EPR have been met [6]. This result is in accordance with the general objectives i.e. exercises of emergency preparedness and response (EPR): test and validate plans and procedures, test the readiness of response capabilities, and increase the confidence and skill of personnel. In addition, exercises allow emergency response staff to identify weaknesses so they can improve performance during an actual response. Interagency exercises also allow the various agencies' personnel to become familiar with each other and learn to coordinate and operate together [7].
The experience on actual response CAST's RERT have also been proven when big earthquake with acceleration of 0,15g hit the reactor complex on 26 May 2006 as well as a big eruption of mount Merapi in 5 November 2010 which is the worst eruption since 1872. During this two events the CAST's RERT/PKDR have been worked with a good performance [8].
References
[1]. Guidelines of Implementation of Emergency Plan and Preparedness, Decree of Chairmen of BAPETEN No. 5-P / 2003, BAPETEN 2003.
[2]. "Merapi Eruptive History". Global Volcanism Program. Smithsonian Institution. Retrieved 10 March 2014.
[3]. The International Association of Volcanology and Chemistry of the Earth's Interior, http://www.iavcei.org/. Retrieved March 2014.
[4]. Prospects for Nuclear Security Partnership in Southeast Asia, the James Martin Center for Nonproliferation Studies (CNS, Monterey, United States), Monterey/ Moscow/ Vienna, May 2012
[5]. Syarip, Design Basis Threat Analysis and Implementation of the Physical Protection System at Nuclear Facility of BATAN Yogyakarta, Journal for Safeguards Technology, Vol.1. No.1. Oct. 2005, ISSN 1907-0535.
[6]. "Nuclear Installation Safety Review Committee", Doc. No.: LKIN 04/APB, BATAN Yogyakarta, January 2014.
[7]. United States Environmental Protection Agency, http://www.epa.gov/radiation/rert /exercises.html. Retrieved on March 2, 2014.
[8]. Syarip, et al, Experience on the Implementation of INSARR Recommendations on Seismic Analysis and External Events Assessment of Kartini Research Reactor, Proceedings of an International Conference on Research Reactor Safe Management and Effective Utilization, Rabat, Morocco, 14-18 Nov. 2011, IAEA, Vienna, September 2012.

Country or International Organisation:

INDONESIA, NATIONAL NUCLEAR ENERGY AGENCY

Session 2: Poster Session / 12

Technical Support Organizations: Other Bricks of the Defence in Depth Layers

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Following an objective approach, the interests of operators, regulatory authorities, and of the public,

with regard to major hazard industries and practices would coincide in that all of them wish no undesirable outcomes from their applications. This paper conveys the will to share experiences gone through in Cuba that might be helpful to others, especially developing countries, in accommodating the interfaces of the above mentioned stakeholders, mainly in the area of attaining and managing technical support for reliability and availability; covering the lessons from two main stages; an initial one, having a nuclear power plant project under way, in addition to other projects involving the use of ionizing radiations in industry, research, medicine and radiopharmaceutical applications, as well as in education; and a second stage, at present, where there is no nuclear power plant project in construction, or operation, but the rest of the practices from stage one generally remain.
In developing countries, where the availability of resources may be not enough or scarce, to have the capacity of identifying where the needs for technical support are the priorities, for implementation of a graded approach, is of paramount importance, so the efforts dedicated could, nevertheless, yield the greatest results in reliability and availability. Here are accounts mainly aimed at the attainment of safety objectives, which should be seen, and in fact is, in line, with the interests of regulators, licensees and of the public. The paper is prepared, mainly, pursuant to Topical Issues 2 and 4 of the Conference.
Key words: Technical support, major hazard, safety, security, reliability, availability, nuclear power, ionizing radiations, irradiators, radiopharmaceutical, assessments, research, training, interface, regulators, licensees, industry, graded approach, holistic approach, capacity building, accidents, risks, defence in depth.

Country or International Organisation:

Safety Assess Div, National Center for Nuc Safety

Session 2: Poster Session / **13**

Lithuanian activities in the nuclear competence building

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The closure of Ignalina NPP in Lithuania at the end of 2009 brought to an end the previous nuclear energy generation period of Lithuania. After being a net exporter of electricity for more than two decades, from the beginning of 2010 Lithuania changed its status overnight to that of importer. The closure of Ignalina NPP also had significant impact on the balance of energy distribution in remaining Baltic States (Latvia and Estonia). At the same time in the Poland the situation in the energy market (due to constantly rising demand) changed also – the country assumed that nuclear power might be included in the energy mix.

As a consequence in February 2006, the leaders of the three Baltic States announced their support for an initiative to build a new nuclear power plant in Lithuania, to replace the Ignalina NPP and reduce the Baltic States' dependence on imported Russian electricity and natural gas. In response to this, the task of competence building in the nuclear safety field arose for the nuclear safety institutions. The appropriate "nuclear human resources infrastructure" should be organized in all Baltic Region. The Lithuanian State Nuclear Power Inspectorate in 2008 initiated the idea regarding the establishment of a Regional Nuclear Safety Training Centre. The main goal of this centre is to enhance the competence and to transfer knowledge in nuclear safety that would comply with the most advanced international practice. The first successful attempt was organized with the help of IAEA: the Basic professional training course in Lithuania in 2008 and 2009.

In 2010 LEI joined the initiative of Institute for Radiological and Nuclear Safety (IRNS) to establish the European Nuclear Safety Training and Tutoring Institute (ENSTTI). The objective of ENSTTI is to provide educational, consultation and practical services by assessing radiological and nuclear safety. LEI, as one of the founders of ENSTTI, participated in training activities from the establishment of

the ENSTTI. LEI is providing the trainers for the different level training courses in nuclear safety, nuclear security and radiation protection.

Recently, the idea regarding creation of some permanent institution, specific to the Baltic region, whish allows to identify barriers in developing nuclear power, was raised again. The countries around Baltic see (Estonia, Latvia, Lithuania, Poland and Sweden) initiated the BRILLIANT idea (Baltic Region Initiative for Long Lasting InnovAtive Nuclear Technologies). The BRILLIANT idea was officially presented at Euratom conference FISA 2013 in Vilnius under Lithuanian EU presidency.

The main goal of this paper is to show, that each training course is a good school not only for the trainees, but also for the trainers, as well for the course organisers. Thus, providing the trainers LEI has several objectives: to strength and systematize the nuclear knowledge, to preserve competition in nuclear safety, to gain new ideas. The close contacts with specialists from different countries, also has very positive impact and forcing to improve the knowledge in different nuclear areas. Participation in such activities will allow to Lithuanian TSO to be ready for the construction of the new NPP.

Country or International Organisation:

Lithuania

Session 1: Poster Session / **15**

Enhancement of Nuclear Safety in Seismic Analysis for TRR-14-1/M1 After Fukushima Daiichi Accident

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After the Fukushima Daiichi Accident, IAEA recommended for strengthening the reactor safety by conducting the seismic analysis of the reactor. The Thai Research Reactor-1/Modification 1 (TRR-1/M1) is an open pool type TRIGA-Mark III using light water as a coolant, moderator, reflector and shield with concrete biological shield and four neutron beam tubes. The maximum power of TRR-1/M1 is licensed at 1.3 MW. TRR-1/M1 uses two types of low enriched uranium TRIGA fuel elements; 8.5% wt. uranium and 20% wt. uranium. The major achievement for Thailand Institute of Nuclear Technology (TINT) as a Technical and Scientific Support Organization (TSO) for the TRR-1/M1 includes the seismic analysis. The Computer Programs which were used in the study including SAP2000 and PCA Column. The TRR-1/M1 seismic analytical results, under different critical combinations of dead load, live load and seismic load, indicate that the maximum stress that will develop in the beam and column is significantly lower than the membrane strength. This can be explained by the interaction of the reactor pool and its building that effectively shorten the overall structure period and reduces the membrane forces. It can be concluded that both the reactor pool and its building structure can withstand from earthquake loading and consequently no strengthening measure is required for the structures under consideration. The further analysis of the reactor is considered the detailed analysis related to other reactor safety aspects.

Country or International Organisation:

Thailand

Session 2: Poster Session / **17**

The Concept of Licensing Process for Standardised Reactor Technologies and the Role of TSO

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The main reason of crisis in nuclear development in the world is the high level of risk connected with nuclear investment. The main goal for nuclear stakeholders is the decrease of this risk. Without risk decrease the financing of nuclear power is possible only with very strong dependence on national governmental financing or support. There are two main sources of risk for nuclear industry: fear (nuclear accidents, proliferation, terrorism) and costs (adaptation of design to national requirements, risk of closure by political decision, time of licensing and construction). The licensing process needs necessary changes. However these changes are extremely difficult because of well implemented habitudes and rules. The process of changes has to be realized step by step and with a strong support of very well prepared and understanding its necessity international community. The best international community to stimulate the process of implementation of these changes is the community of TSOs on different levels: regional, continental and international. We in Europe have to start this process by the harmonization of regulations and rules of EU Member Countries. But at the same time by the creation of the European Nuclear Safety Authority and the clear division of competences between European and National Safety Authorities. The process of implementation of these changes can by long, but it is necessary to start it as soon as possible.

Country or International Organisation:

Poland

Session 2: Poster Session / **19**

Nuclear Regulatory and Technical Assistance Programs in support of the International Mission of the US Nuclear Regulatory Commission

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Nuclear energy offers long-term economic and environmental benefits providing a reliable energy source with significant environmental advantages in reducing the effect of human activities on global warming. National governments in countries operating or planning to establish nuclear facilities have instituted regulatory regimes on the use of nuclear materials and facilities to insure a high level of operational safety. The national regulatory environments fully recognize the potential risk involved in operating nuclear facilities and the additional risk that could extend beyond national boundaries. This unique feature of the risk in operating nuclear facilities require international cooperation among nation states regardless whether they actually operate any nuclear facility. International cooperation allows addressing safety problems in an international forum going beyond national regulatory regimes and offers the potential for cooperation and promotion of common nuclear standards through international regulatory coordination.

In the US the Atomic Energy Act of 1954 together with the Energy Reorganization Act of 1974 (establishing US Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)) provide for

the development and regulation of the uses of nuclear materials and facilities with the general goals of promoting "world peace, improve general welfare, increase the standard of living, and strengthen free competition in private enterprise." The Acts empower the NRC to establish rules and orders governing the use of nuclear materials "to protect health and safety and minimize danger to life and property." The NRC supports the international safe and secure use of nuclear materials and actively participates in various international organizations. It aims to provide advice and assistance to international organizations and foreign countries to develop effective regulatory organizations and safety standards. Many of these activities are carried out in direct cooperation with the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA), or other international organizations. In addition, a number of programs in foreign countries are conducted directly with the counterpart agencies under bilateral regulatory and research cooperation agreements.

One of the key elements determining the operational safety of nuclear facilities is an appropriate regulatory regime establishing the regulatory requirements and the safety envelope for nuclear operations. In the early 1990s the US NRC established an international regulatory safety assistance program in countries with Soviet-designed nuclear reactors. In many of those countries the nuclear regulatory authorities were not well established, had no clear division of responsibility, and had difficulty in enforcing regulatory requirements due to lack of basic nuclear regulatory laws and legal requirements. The initial safety assistance programs provided critical training and technical knowledge of regulatory personnel using US technical experts based at NRC and DOE laboratories such as Brookhaven National Laboratory (BNL).

This paper will review the challenges, development, and successes in the strengthening the regulatory and technical capabilities of the foreign nuclear regulatory organizations and the technical support organizations (TSO) under the NRC international regulatory support program that has expanded beyond its original scope encompassing many countries with operating or planned nuclear facilities

.

The international assistance, training, and technical support include wide ranging regulatory and technical areas through cooperative training programs, workshops, and joint projects:

- Safety analysis methodologies and code applications, design basis analyses
- Licensing and inspection procedures,
- Risk informed and analytical methods design basis analysis,
- Severe accident methodologies and procedures,
- Emergency response and infrastructure development,
- Development of regulatory guidelines and bases for regulatory actions.

The program also contains a significant infrastructure component providing improvement in analytical hardware, dosimeter equipment, networking capabilities, and communication infrastructure. The paper will further explain the various components, which are used to transfer technologies and establish cooperative projects.

One of the important objectives is to strengthen the oversight capabilities and effectiveness of the foreign nuclear regulatory agencies and improve the TSO's ability to carry out the required technical supports. In each respective countries the program further enhances the regulatory regimes, improve nuclear regulations and standards that is more consistent with international and IAEA practices. The main benefit of the regulatory and technical cooperation is the improvement in regulatory and technical capabilities both at the nuclear regulatory agency and the TSOs. The future challenge is to ensure that the cooperation between NRC and foreign regulatory agencies responds to the country specific regulatory needs and further increase the capabilities with an overall increase in the safety of the nuclear facilities.

Country or International Organisation:

US Nuclear Regulatory Commission/Brookhaven National Laboratory, USA

Session 5: Poster Session / **20**

Russian Support Experience to Strengthen Newcomer Countries

Regulatory Infrastructure

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The Russian Federation implements an ambitious exporting program of Russian nuclear energy technologies including Russian design NPP constructiong all over the world, including the newcomer countries. Accroding to international agreements and the ebst practices this leads to a necessity of providing a consistent nuclear regulatory infrastructure support, transfer of regulatory practice and expereience, technical and scientific consulting, personnell training and wide set of services rendered by Russian TSOs.

Country or International Organisation:

Russian Federation

Session 5: Poster Session / **21**

The International Centre for Environmental and Nuclear Sciences (ICENS) as a TSO in Enhancing Nuclear Safety and Security in Jamaica

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This paper will present the existing and potential capabilities of the International Centre for Environmental and Nuclear Sciences (ICENS), formerly the Centre for Nuclear Sciences (CNS), as a Technical and Scientific Support Organization (TSO) with a view of enhancing nuclear and radiation safety regulations, including capacity building in Jamaica and the Caribbean region.

Country or International Organisation:

International Centre for Environmental and Nuclear Sciences, Jamaica

Session 2: Poster Session / **22**

Differences Between TSOs for Regulators and TSOs for Operators

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TSO is a technical and scientific support organization that provides support concerning nuclear and radiation safety issues to the national regulatory authority (NRA) "regulator" or to the nuclear industry "operator". National regulatory authorities are responsible for licensing nuclear installations, for issuing regulations and for supervising licensed facilities during their operation, with corresponding decision making and enforcement if needed. To perform its tasks, the NRA can do everything itself, with in-house technical and scientific support. However, it is becoming difficult to have specialists in every field of nuclear technology to cover an ever increasing number of topics, including human and organizational aspects. Hence many NRAs opt for outside technical and scientific support. For instance, in the licensing process, a TSO can provide support to an NRA at all stages of the process. At the pre-conceptual phase, the design objectives must be defined for internal and external events and for the various plant operational conditions. In many countries, periodic safety reviews are required. For the initial safety assessment, the TSO can provide the NRA with an evaluation of the actions proposed by the licensee and advise it concerning any additional measures required to maintain or improve the safety of the installation and update the licensing basis. Operational experience of the plant, and of similar plants worldwide, should also be investigated by the TSO, so that the NRA can ask the licensee to identify preventive measures, avoid recurring events, and verify that lessons have been learned and modifications made have met their objectives.
In the case of accidents, the TSO can advise the NRA about the possible accident scenarios and emergency measures that might be necessary. Some TSOs have indeed developed computer codes to predict the radiological consequences of design basis accidents or more severe accidents. When a plant ceases its operations, the TSO can assess the decommissioning plan and monitor its implementation. For all these assessment activities made in support of the NRA, while the TSO should clearly define what the problems are, it should refrain from proposing solutions to the licensees, who bear the complete responsibility for the safety of the licensed installations. In this way, the TSO maintains its freedom to assess the licensee's proposals. A last field of activity for the TSO in support of the NRA is assistance in developing regulations. As TSOs are well aware of the practices on the shop floor, they are in a position to anticipate possible difficulties in the interpretation of regulations and influence the wording so as to avoid future implementation problems.
In all the fields mentioned above, the NRA will be able to outsource the assessments to the TSO and integrate the results into its decision making and enforcement processes.

The TSO activities in support of the nuclear industry cover some of the same areas as those in support of NRAs. However, the emphasis is not only on the problems to be tackled, but also on proposals for solving them. As its contribution to the licensing process, the TSO can carry out the safety assessment of the project, identify the problem areas and indicate the best solutions. It can also help to prepare the commissioning tests, participate in them and evaluate the results. During operation, the TSO can identify/review modifications to facilitate plant operation, increase plant availability through a reduction of the outage time, prepare the periodic safety reviews, examine measures to extend the life of the installation and assess lessons learned from feedback of operational experience, both national and international. The TSO can even make inspections of the installation during operation, if the operator desires some kind of external audit. When the NRA intends to develop new regulations, the TSO can review the draft regulations and provide comments, reflecting the viewpoints of the operator so as to facilitate full compliance with the requirements. In the case of accidents, the TSO can try to develop different evolution scenarios, evaluate their possible radiological consequences and recommend appropriate countermeasures to the licensee.

Country or International Organisation:

Egyptian Nuclear and Radiological Authority

Session 1: Poster Session / **23**

Challenges of Nuclear Power Safety

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CHALLENGES OF NUCLEAR POWER SAFETY
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Abstract. Major accidents at nuclear power plants are counted on fingers and they led to no population life losses (Three Mile Island, Chernobyl). The latest accident at Fukushima went with no victims of radiation, while the Great Eastern Earthquake and the following tsunami in 2011 took about 20,000 lives. The conclusion suggests itself: the nuclear accidents are not related directly to losses of lives, but are perceived by public much more seriously than a mega-tsunami event. The public perception of nuclear accident consequences, by orders exceeding actual damages, goes hand in hand to inadequate perception of the radiation risks by the overwhelming majority of society. The urgent matter of the world nuclear community is to formulate the main purpose of nuclear safety more precisely: ensuring that there is no severe damage to society in case of any accident, which may or may not involve loss of human lives or health. Two complementary tasks are to be solved to achieve the above goal. The first task is to reduce the probability of a severe accident to an acceptable level and ensure the advanced national and international emergency response systems. The second task, however, in our opinion, is far from being recognized well enough, namely: education of public achieving a civilized perception of radiation risk issues that shall be a responsibility of national governments and be conducted in concert with other nations. If a country decides to go towards the nuclear generation, and its government approves this step, the government should take a responsibility to protect and educate people in this matter. International Convention on Nuclear Safety should be extended by the education provision.

Country or International Organisation:

ROSTECHNADZOR, Nuclear Safety Institute of RAS - IBRAE RAN

Session 1: Oral Session / **24**

Study on Severe Accident Progression and Source Terms in Fukushima Dai-ichi NPPs

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It has been past three years since the severe accident of TEPCO's Fukushima Daiichi Nuclear Power Plants. Decommissioning of severe damaged plants is in progress. In parallel, onsite R&D for investigation of the accident is undergoing. However, due to technical difficulties for investigation such as high radiation, leakage of contaminated water, etc., available information, especially for the inside of primary containment vessel, is limited. Therefore, computational simulation is useful method to understand the accident progression. This study focused on estimation of performance of safety systems under beyond design basis conditions. Calculation revealed how degraded safety systems affected accident progression.
After the core was damaged, integrity of PCV and its leak tightness was challenged. Finally, a large amount of radioactive materials were released to the environment. Northwest part of Fukushima prefecture was significantly contaminated. Based on the above calculation, source terms from Units 1 through 3 were estimated.

Country or International Organisation:

NRA, Japan

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Experience of Interaction between National and International Technical and Scientific Support Organizations for Assistance to the Regulatory Authority in Licensing Long Term Operation of South Ukrainian NPP Unit 1

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The Energy Strategy of Ukraine for the period till 2030 foresees that about half of the power generating capacities in Ukraine during the next 10 years will constitute NPP units with extended lifetime (long term operation).
The first "pilot" long term operation units were Rivne NPP units 1 and 2 (VVER-440/213). Based on the periodic safety review results, the Regulatory Authority of Ukraine made a decision to extend their lifetime for 20 years beyond the design-basis period under condition that the next safety review is conducted in 10 years.
South-Ukrainian NPP unit 1 (VVER-1000/V-302) is the next step in gaining long term operation experience in Ukraine. The decision on long term operation of South-Ukrainian NPP unit 1 was taken by the Regulatory Authority of Ukraine (SNRIU) in November 2013 with its subsequent safety review in 10 years.
This decision was preceded by many-year comprehensive activities performed by the Utility, Regulator and also national and international scientific and technical support organizations, which were involved from the Utility and Regulator sides.
The first and the most important step before starting the long term operation activity was creation of respective up-to-date rules and standards. These standards are based on the best international experience, IAEA recommendations and cooperation of the national TSOs with international technical and scientific organizations to develop new regulatory documents.
In accordance with nuclear and radiation safety regulations in force in Ukraine, the main document submitted by the Utility to the Regulatory Authority along with the application for license extension is a periodic safety review report (PSRR). It includes 14 safety factors and describes results of all activities performed in the framework of long term operation arrangements. In particular, these activities include assessment of current technical state of structures, systems and components, implementation of an effective ageing management program, equipment qualification and upgrade package.
One of the most important components that determine the possibility of long term operation as a whole is the reactor pressure vessel (RPV). It is quite natural that special attention has been paid to safety substantiation of this component and that national and international scientific and technical support organizations were involved into assessment of the safety substantiations. Experts from SSTC NRS and the Institute for Problems of Strength under the National Academy Sciences of Ukraine (from the Ukrainian side) as well as IAEA and Swedish Nuclear Regulatory Authority took part in this assessment (from international side). Similar examples of involvement of national and international scientific and technical support organizations to assist the Regulatory Authority concerned assessment areas such as seismic hazard of SUNPP site, implementation of upgrade package etc., where organizations such as NRI Rez (Czech Republic), SEC NRS (Russian Federation), GRS (Germany), IRSN (France), STUK (Finland) and other organizations were involved.
It is necessary to point out that in the framework of SUNPP unit 1 preparation for long term operation, the Fukushima-Daiichi NPP accident lessons were taken into account to the maximum extent by implementing measures such as: feeding of "critical" loads from 0.4 kV mobile diesel generators; feeding of the spent fuel pool by mobile pumping units from alternative water reservoirs; service water supply by mobile pumping units from alternative water reservoirs; organization of the controlled discharge of steam and water medium from containment.
.
Basing on the results of the activities performed in the framework of SUNPP unit 1 preparation for long term operation and review and analysis of respective documentation by the Regulatory Authority and scientific and technical support organizations, it has been ascertained that:
 the defined core damage frequency and large release frequency meet safety criteria;

-power unit resistance to natural hazards and their combinations is confirmed (SAR, PSRR, “stress-test” results);
-“post-Fukushima” measures and defined safety margins are implemented.
Granting a license for long term operation of SUNPP unit 1 has become possible owing to joint and efficient activities of the group of technical support organizations in review of documentation on long term operation substantiation

Country or International Organisation:

Ukraine, SSTC NRS

Session 1: Poster Session / **26**

Application of RASCAL 4.2 to estimate the Fukushima Accident Source Term

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This paper presents some results obtained using the fast-running code RASCAL-4.2 as applied to the Fukushima Daiichi accident. Using similar NPPs already present in the RASCAL database of US NPPs and introducing appropriate accident event sequences for each Units at Fukushima, it is possible to evaluate the amounts of radioactive material released to the atmosphere. The sequences used for the calculations have been reconstructed from TEPCO data (ventings, explosions etc.) and from accurate best-estimate code simulations (core dewatering times) published by other research groups worldwide. However, to properly represent the real Source Terms we had to advance an hypothesis on the real release pathway, which consists in a direct release from drywells instead of from wetwells. There are indeed several indications that wetwell lines couldn’t work properly. Moreover some numerical hypotheses on the release rates for ventings and explosions have been introduced. The obtained results are comparable with other numerical evaluations available in the open literature.

Country or International Organisation:

Italy

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Experiences of Technology Transfer and Support in Argentinean Nuclear Industry

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The Atomic Energy Commission of Argentina (Comisión Nacional de Energía Atómica – CNEA) is a state-owned R&D organization that; among other functions such as designing research reactors,

developing uranium mining and supplying radioisotopes to the medical market; is in charge of providing support and technological update to all Argentinean Nuclear Power Plants (NPPs). Several activities have taken place in the past years carried out by many Departments of the Institution, which regularly provide services, technical support, and assistance to the NPPs. Recently, a new Management Unit has been created, aimed to coordinate all these activities and to enhance the response capability of the Institution by the implementation of its main actions:

• Act as a Single Point of Contact with the Nuclear Power Plants
• Keep an updated knowledge base of the technological support CNEA is able to provide, detecting existing gaps and fostering investments in these areas
• Coordinate the actions carried out by different Departments along the Institution, in order to minimize interferences and provide a sound response to NPPs
• Follow the quality of the technical support provided
• Search for present and future demands within the NPPs

In the present work a brief review of the most important technical support activities carried out by CNEA is presented, along with an assessment of the challenges faced and beneficial outputs obtained from these tasks.

Country or International Organisation:

Argentina

Session 1: Poster Session / **28**

Role of Regulators in Assessment of Preparedness of Nuclear and Radiation facilities against Natural Calamities

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The events of earthquake, tsunami, and subsequent nuclear accident at Fukushima, Japan have provided us a warning about the possible consequences on nuclear safety arising out of natural calamities. The event has raised a lot of emotions worldwide against the whole nuclear community. However it is the responsibility of all the stake holders to keep a rational eye on this event. The whole nuclear community in the world responded to address the specific issues w.r.t preparedness against natural calamities.

The natural calamities considered are earthquake; flooding due to excessive rain fall with high tide, storm surge and wave, tsunami and dam failure. The facilities are therefore being investigated for the beyond design basis scenario arising out of natural calamities similar to the one in Japan and assess the ability to cope up with the possible consequences. The important parameter considered is maximum peak ground acceleration of the civil structures, for which the plant/facility is designed. The possible consequences like sloshing, land slide due to earthquake etc. are taken care. The degradation of the old facilities due to aging process is also considered. The other parameter considered is flooding which may occur due to excessive rain fall during the high tide, storm surge and storm wave, tsunami and dam failure. It is essential to keep the safety critical equipments at safe height to avoid black out conditions during heavy flooding. This aspect has been addressed by redefining the safe flood level based on a heavy rainfall which affected the facilities lying below the safe flood level.

Subsequent to the 2004 Indian Ocean tsunami, a detailed exercise is in progress at nuclear and radiation community of India for estimating the maximum tsunami wave heights that can possibly be generated from the sub-sea faults around the Indian coasts using validated computer codes for

analysis. Work done so far indicates that the maximum postulated flood level (based on a tsunami generated from the strongest possible sub-sea earthquake caused by the Andaman-Nicobar-Sumatra fault) will get revised upwards for eastern coast of India. Many facilities are located at considerable distance from the shoreline and are not vulnerable to flooding due to tsunami.

Detailed investigation on indirect consequences like knocking out of all external and internal power supplies, hook up of power supply and coolant as corrective measures have been carried out. Common emergency services like fire, civil maintenance and their command line have also been reviewed. An action plan on readiness of plant specific emergency preparedness in case of natural calamities has been drawn and placed into effect.

This paper summarizes about the role of regulatory body and the Technical and Scientific support Organisations (TSO) in enhancing safety and security of the nuclear and radiological facilities during natural calamities which are beyond the design basis for the particular plant/facility.

Country or International Organisation:

INDIA

Session 2: Poster Session / **29**

Development of Independent Regulator's Level-1 PSA Model by TSO to Support Regulatory Oversight

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Independent Regulator's Level-1 PSA Model for 300 MWe Pressurized Water Reactor (PWR) has been developed by the Technical Support Organization (TSO) of Pakistan Nuclear Regulatory Authority (PNRA) to support regulatory oversight process. PSA model development project was initiated by the regulatory body as a tool for ensuring safety of the nuclear power plant in relation to potential initiating events caused by random component failure and human errors. The PSA model provided many useful insights into plant systems and components including an independent assessment of the probabilities of occurrence of core damage state caused by various initiating events and adequacy of plant emergency procedures. PSA model development was started with the identification and selection of initiating events followed by initiating event grouping. Success criteria were developed for each front line safety system and all corresponding support systems. Comprehensive dependency analysis was performed to incorporate functional, physical, human interaction and component failure dependencies. Small event tree and large fault tree methodology was adopted for accident sequence modeling. Quality assurance program (QAP) and task specific procedures were developed to maintain high quality and consistency in the project. Standardized Plant Analysis Risk – Human Reliability Analysis (SPAR-H) method was used to calculate human error probabilities. Risk Spectrum Professional computer code was used for event tree and fault tree development and quantification of accident sequences. Resources required for the successful completion of the project, i.e., adequate and dedicated manpower, appropriate training, equipment and tools were provided to the PSA model development team. PSA team was also deputed for some time to NPP site to obtain necessary plant familiarization of important safety systems. Safety Assessment Section and Technical Cooperation departments of IAEA provided assistance for technical guidance and review of the PSA model. This paper describes the technical and administrative measures taken for successful completion of the project, challenges faced during the execution and lessons learnt. Results and insights obtained from PSA model development will be used in future applications for the regulatory oversight of NPPs.

Country or International Organisation:

PNRA

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Drawing Experiences From International Guidelines In Developing Internal Technical And Scientific Competency Of The Regulatory Authority For Nuclear Safety In Malaysia

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The development of internal technical and scientific competency within the regulatory authority is essential for any country embarking on a nuclear power programme, including Malaysia. Although a regulatory authority may decide to obtain technical or other expert professional advice or services as a necessary support of its regulatory functions, this should not relieve the regulatory authority of its assigned responsibilities. The regulatory authority may also decide to establish a dedicated technical support organization (TSO), for which work the regulatory authority provides direction and control. Therefore, in preparation of a nuclear power programme the regulatory authority needs to develop sufficient internal technical and scientific competence to provide basis for regulatory framework development and regulatory decisions, and to be able to procure, guide and control support activities of a TSO or other service providers. In Malaysia, planning for human resources development for nuclear power within the regulatory authority began in the early 2006 with emphasis given to building regulatory authority capacity and competence in nuclear power safety infrastructure. This approach was continuously strengthened following the approval of a national Economic Transformation Programme (ETP) in 2010. A study was conducted in reference to relevant International Guidelines, in particular those provided by International Atomic Energy Agency (IAEA). Subsequently a survey was conducted on the group of nuclear regulatory authority personnel in Malaysia assigned for safety assessment activities for nuclear installations, to identify areas in nuclear safety requiring further development. Advice from international experts applying the methodology of the IAEA Safety Assessment Advisory programme (SAAP) is also summarised. The study shows that internal technical and scientific competency of the Malaysia regulatory authority in nuclear safety has some advantages in areas of radiation and nuclear safety related to non-power applications. However, continuous effort to develop a higher level of competency in nuclear safety is needed to address international requirements and best practices. In order to achieve this, four areas are emphasized for strengthening the technical and scientific competency of the Malaysian regulatory authority: (i) understanding of key technical documents need to be reviewed by the regulatory authority;(ii) decision on the appropriate national approach and development of a regulatory guidance document;(iii) familiarization with safety analysis software tools to assure efficient and informed regulatory review of the safety analysis documents; (iv) access to technical and scientific support from external organizations either locally and or internationally sourced. In conclusion the study indicates areas which require further development in building nuclear safety technical and scientific competency of the regulatory authority. The paper concludes with summary recommendations for best approaches for countries embarking on a nuclear power programme in building internal technical and scientific competence of the regulatory authority for nuclear safety.

Country or International Organisation:

Malaysia

Session 4: Poster Session / 31

Roles and Challenges of University in Supporting Nuclear Education and Training in an Emerging Nuclear Energy Country

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While the existence of nuclear and radiation facilities in Southeast Asia dated back to the 1970s, the usage of nuclear technology has been limited to the non-power applications, and there was never an urgency to develop a large number of human resources in the region. Only a few universities offered formal degrees in nuclear or nuclear-related fields. Most institutions opted to provide courses in nuclear and radiation only as part of other engineering or science programs. Overall, nuclear education was considered as "something to have" but not "something to promote".
However, Southeast Asia in recent years has changed to become an emerging market for nuclear power technology. Human resource planning is now recognized as one of the crucial issues for the implementation of nuclear power. The first nuclear power plant in the region will start operating in Vietnam in the early 2020s. Several other countries, including Indonesia, Malaysia, and Thailand, have also been considering nuclear for power production, and have tentative plan to use nuclear in their energy mix in the late 2020s. University will have an important role to play in providing sufficient and qualified human resources for these growing demands.
On the educational side, many new formal degree programs are now being created at several universities in Southeast Asia. Existing programs are also being updated to be able to support nuclear power education. Nuclear security courses/programs are also being implemented to reflect the global trend.
On the training side, both regulatory body and utilities are now providing professional-development-type training programs for their staff. University is sometimes asked to support these programs by providing background knowledge prior to the practical training.
As a newcomer country, however, the overall number of trainers and training facilities in the country are usually limited. The challenge here is then to create synergy among the university, the regulatory body, and the utilities so that the limited resources can be fully utilized. Sharing of resources will be necessary, while making sure that all three organizations are developing together at the same pace.
This paper will present the challenges faced by the university in this growing process, and suggest the way to cope with the challenges from the university point-of-view.

Country or International Organisation:

Thailand

Session 1: Poster Session / 33

AAEA Contribution and Programme of Action Towards Safety and Security Strengthening in the Arab Countries

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The Arab Atomic Energy Agency (AAEA) is a regional specialized organization working within the auspices of the League of Arab States to coordinate among its member states in the field of peaceful uses of atomic energy. It contributes also to the transfer of the peaceful nuclear knowledge and technologies to these countries assist in manpower development and scientific information concerning nuclear sciences and setting up harmonized Arab regulations for radiation protection, nuclear safety and security and safe handling of radioactive materials.
The uses of atomic energy in Arab countries have significantly increased in the last decades in many aspects of life. All Arab countries demonstrated need for capacity building to initiate and sustain

a safe and secure utilization of nuclear technologies. AAEA plays a major role, as a TSO, for Arab countries to develop the infrastructures and capabilities needed for nuclear and radiological safety and security towards the establishment of independent regulatory authorities.
A legally well established, effectively independent, technically competent and efficient regulatory body is considered essential for nuclear, radiation, radioactive waste and transport safety and nuclear security. The Arab States need to establish and maintain stable and effective regulatory regimes in order to guarantee a high level of safety and security of all nuclear facilities and activities under their national responsibility, and to regulate the introduction and safe and secure conduct of any practice involving radiation sources and nuclear power. In this regard, AAEA has established the Arab Network of Nuclear Regulators ANNuR to foster enhancement, strengthening and harmonization of the radiation protection, nuclear safety and security regulatory infrastructure and framework among the members of ANNuR; and to provide mechanisms for the ANNUR to be an effective and efficient internationally recognized forum for the exchange of regulatory experiences and practices among the radiation and nuclear regulatory bodies in Arab countries. ANNuR has 6 thematic working groups. These working groups include: strengthening infrastructure and capacity building for regulatory bodies; Legislation and Regulation frameworks; Emergency preparedness and response; Radioactive waste management and disposal of spent fuel; Safety, Security and Safeguards and Information technology. Each working group has its own action plan including training programmes and technical meetings. All thematic working groups get assistance and support from IAEA, KINS, US-NRC, US-DoE, EU and CNNC. Approximately 15 training activities and technical meetings have been conducted per year since the establishment of ANNuR five years ago.

Country or International Organisation:

The Arab Atomic Energy Agency

Session 4: Poster Session / **34**

Contribution of European TSOs to research in nuclear safety, radiation protection, waste management and decommissioning

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Following the European study on the benefits and limitations of Nuclear fission for a low-carbon economy (February 2013), the priorities on research are clearly oriented towards nuclear safety, radiation protection, waste management and decommissioning and active engagement of the public. The European Commission supports all these domains of research through its Euratom Framework Programmes. All European stakeholders endorsed these priorities, in particular ETSON, the European network of Technical Safety Organisations (TSO).

Country or International Organisation:

ETSON Research Group

Session 1: Poster Session / **36**

The Impact of Fukushima Nuclear Accident to China's Mainland Environment

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With the radiation monitoring results from the environmental protection agencies, the monitoring results of gamma dose rate, air, water and soil were systematically analyzed and summed up, and the general level of radiation quality during the accident was summarized in this paper.

Country or International Organisation:

China

Session 1: Poster Session / **39**

The Future Directions of Environmental Radiation Monitoring in the post-Fukushima Era

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By summarizing the environmental radiation emergency monitoring methods and results in China and Japan, we analyzed the deficiencies in the emergency monitoring radiation in our country. 1) There are no enough automatic monitoring stations in the Radiation Environmental Monitoring Network so the coverage is narrow. 2) The lack of clear emergency monitoring programs. 3) The incomplete quality assurance system. Etc.

For these problems, we proposed some suggestions of the future development directions for radiation environmental monitoring in the post-Fukushima Era. 1) Strengthening the construction of radiation automatic monitoring stations. 2) Developing the targeted capacity-building of National Radiation Environmental Monitoring. 3) Setting up scientific and standardized emergency preplan. 4) Developing rapid monitoring technology. 5) Strengthening the quality management system of the whole process of radiation monitoring.

Country or International Organisation:

People's Republic of China

Session 4: Poster Session / **40**

Assessment of External Irradiation Dose of China's Mainland Residents Caused by Natural Radiation

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Based on the field, road and building indoor gamma absorbed dose rates in air (hereinafter referred to as gamma dose rates) measured by the national natural radioactive level survey in more than 20 thousand points from 1983 to 1990, the calculation of effective dose rates of cosmic rays, GIS, classification of grid, and also according to the “Sub-counties population statistics of the People’s Republic of China in 2007”, in this paper, the per capital effective doses of China’s mainland residents caused by cosmic rays, natural radiation and natural penetrating radiation were assessed for 0.304mSv,0.544mSv and 0.848mSv, respectively.

Country or International Organisation:

China

Session 3: Poster Session / **42**

Achievement of an international emergency exercise involving a transport of radioactive material

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Transports of radioactive materials are regularly performed in an international context and accidents with cross-border consequences cannot be avoided. Therefore, there is a need to harmonize emergency response or at least to have a clear understanding of other countries emergency plans. To
that end, it was proposed to include a study dedicated to this topic in the European project PREPARE (Innovative integrative tools and Platforms to be prepared for Radiological Emergencies and Post-Accident Response in Europe) including various objectives relative to the off-site nuclear emergency response and preparedness in European countries notably in case of transport accident.
The first step of this project was to clearly describe the national and local emergency organisation and preparedness in the European countries participating to the project (France, United Kingdom and Belgium) especially in case of accident involving a transport of radioactive material. The description of local requirements was obtained using a specific questionnaire in order to have the same level of information in each country.
The second step of this project was to test, in case of an accident scenario involving an international transport of radioactive material, the emergency plans applied and the communications between two neighboring countries (France and Belgium). A table top exercise was organized to evaluate the accident management process including, on the one hand all phases relative to alerts, reflex actions, information exchange and concerted assessment, on the other hand public information and solution to bring back the transport in a safe status. The accident and all the emergency response teams of each organization were located in adjacent meeting rooms in order to provide the necessary information to the participants and to monitor the flow of information. This exercise, the first involving an international transport of radioactive materials, took place in the Emergency Technical Centre of IRSN (Institut de Radioprotection et de Sûreté Nucléaire) located in Fontenay-aux-Roses in
France. More than 30 peoples were involved including representatives of the Belgian competent authority (Federal Agency for Nuclear Control – FANC), the French Nuclear Safety Authority (ASN) as
well as their Technical Safety Operators (TSO), respectively BEL V and IRSN, and the major French operator AREVA TN International. This exercise mainly highlighted communication between competent authorities and the necessary coordination of local intervention teams. Lessons learned

from this experience allowed participants to create a feedback and to improve concerted European emergency management in case of accident involving an international transport of radioactive material.

Country or International Organisation:

IRSN (France)

Session 3: Poster Session / **44**

The Study of the Construction Requirements for CPI Nuclear Emergency Technical Support Center

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China Power Investment Corporation (CPI) is one of the five state-owned electrical corporations in China and Involves of thermal power, nuclear power, hydropower, renewable energies, coal and transportation, coal chemical industry and aluminum production etc. CPI Nuclear Power Institute (CNPI) as the Technical Support Organization of CPI, is working on the construction of CPI Nuclear Emergency Technical Support Center. The paper discusses the construction requirements for CPI Nuclear Emergency Technical Support Center. The content includes the role and responsibilities between utilities and the headquarter of nuclear corporations in nuclear emergency preparedness and response, the organization of emergency technical support center, management process and staff requirements, technical and material support requirements, the hardware and software requirements , e.g. cord damage assessment, source term assessment, accident consequence assessment.

Country or International Organisation:

Nuclear Power Institute, China Power Investment Corporation

Session 4: Poster Session / **45**

Suggestions on the Perfection of Civil Nuclear Safety Equipment Activities License Extension Management

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Based on the concepts of clear requirements, comprehensive assessment, objective evaluation, dynamic management, this paper gives suggestions on the perfection of civil nuclear safety equipment design, manufacture, installation and non-destructive examination activities license extension management from four aspects of establishing a relatively unified license extension review standard, combining multi-views and closing the link of license review & supervision, giving full play to the

role of daily supervision and inspection results, further improving motivation and elimination mechanism.

Country or International Organisation:

CHINA

Session 1: Poster Session / **46**

The discussion of several important safety requirements for the new Nuclear Power Plant

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Post the Fukushima nuclear accident, the Chinese Government raised higher safety goals and safety requirements for the new Nuclear Power Plant for construction. The paper has expounded the important indicators of safety requirements and the aspects of safety modification that had been developed for the new NPPs. Discussed and analyzed the main field that required by the new NPPs safety requirements in design concept, design method, defenses of internal and external events, severe accident prevention and mitigation, optimized the engineer technical measure. That looks forward to the new requirements which conduct to regulate the site selecting and the design of NPP. The paper had supported the industry better to comprehend the primary position and philosophy of safety requirements which developed for the new NPP.

Country or International Organisation:

CHINA

47

The public image and shape of the nuclear and radiation safety supervision organization

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Good image is the basis of trust. It is very urgent to build good public image of government because the negative information of the relevant government departments has become the focus of society and the public which directly or indirectly affect the public image of the government departments in recent years. How to fulfill the social responsibility, how to respond to and handle emergencies properly and how to build and improve public relationship becomes the required course of the officers in the authorities. Combining nuclear and radiation safety supervision work, this paper discussed the necessity of government departments to build up good public image, and how to establish the public image of the nuclear and radiation safety supervision organization.

Country or International Organisation:

China

Session 1: Poster Session / **48**

The Influence on the Design of Chinese Nuclear Power Plants Based on Fukushima Accident Feedback

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The Chinese nuclear safety regulation HAF102-2004 is based on IAEA Safety Standard Series No.NS-R-1"Safety of Nuclear Power Plants：Design"(2000). NS-R-1 was superseded by No.SSR-2/1, with the establishment of the long-term set of Safety Standards in 2012. According to the feedback of Fukushima nuclear accident, SSR-2/1 is revised and some augmented requirements are put forward, which will be published in 2015. The different requirements of SSR-2/1 and NS-R-1 are identified in this article, and the revision of SSR-2/1 and the strengthened requirements are reviewed and interpreted, and also the trend of safety design requirement is discussed. Further, compared with the current Chinese nuclear safety regulation, the influence on the design of Chinese nuclear power plants is analyzed.

Country or International Organisation:

Beijing Review Center of Nuclear Safety,China

Session 4: Poster Session / **49**

Enhancing the role of knowledge management in developing human capacity for nuclear security

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The concept of knowledge management is widely accepted in nuclear industry, particularly in nuclear energy related areas. With the increasing need of human capacity for nuclear security, it is well recognized that nuclear knowledge management will play more and more important role in enhancing human capacity development in the filed of nuclear security.
This article discussed the status and challenges faced by nuclear security related stakeholders which include, inter alia, competent authorities, regulatory body, operators and TSOs. This article also discussed the roles and functions of nuclear knowledge management in enhancing nuclear security capacity, at national and international level.
With the construction and operation of Center of Excellence on Nuclear Security in China, COE will make valuable contribution to the enhancement of nuclear security capacity in China and in the Asia-Pacific Region. In this context, some mechanisms and measures for enhancing the role of nuclear knowledge management in developing human capacity for nuclear security were proposed.

Country or International Organisation:

China

Session 4: Poster Session / 50

Enhancing Nuclear Security Capability by establishing COE in China

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The recent economic development in China demonstrated a strong demand on clean, secure and sustainable energy supply. Nuclear power has been widely recognized as clean energy. By 2020 the total nuclear power capacity in China will be 58GWe in operation, plus 18GWe under construction. With the increasing number of nuclear power units in operation, and the amount of nuclear materials in use, process, storage as well as transportation, the possibility of illicit acquisition and malicious use of nuclear and other radioactive materials had significantly increased.
The Chinese Government has been attaching great importance on Nuclear Security. During the Washington Nuclear Security Summit in April 2010, the former President Hu Jintao announced that China will establish a Center of Excellence (COE) on Nuclear Security. In order to facilitate the construction of COE and further strengthen nuclear security capacity in China, the Government decided to establish State Nuclear Security Technology Center (SNSTC), which is responsible for design, construction, operation and maintenance of COE. The main functions of COE include education and training, advanced technology demonstration and R&D, testing and certification, as well as international cooperation.
By establishing SNSTC and constructing the COE, China has made further steps to strengthen its national nuclear security infrastructure and will make more and more contribution to the enhancement of global nuclear security regime.

Country or International Organisation:

China

Session 4: Poster Session / 51

Training the Staff of Technical Support Organization (TSO) for Pakistan Nuclear Regulatory Authority (PNRA)

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Centre for Nuclear Safety (CNS) was established in June 2005 as the Technical Support Organization (TSO) of Pakistan Nuclear Regulatory Authority (PNRA) to provide technical assistance in the safety review and assessment of nuclear power plant related submissions. Adequate training of staff in the relevant field is a pre-requisite to achieve quality outcome. With the inception of CNS, it was a challenge to recruit qualified engineers and scientists and provide them appropriate training in relevant regulatory disciplines. This paper describes the identification process for training needs for CNS and transformation of training needs into a comprehensive training program. Exemplary model for

development of the training program, its execution with the acquisition of tools and benefits obtained through specialized training are also addressed. Training Needs Assessment (TNA) project was launched by PNRA in 2004 in line with the IAEA four-quadrant competency model given in IAEA TECDOC-1254 to identify the areas where competencies were to be enhanced. Utilizing the recommendations of TNA, salient features of the training program for CNS were chalked out. These included improving the skills and knowledge of the regulatory personnel through enhancing academic qualifications, specialized training at local and foreign institutions, utilization of experiences of other nuclear regulatory bodies, participation in seminars, conferences in the country and elsewhere, participation in research projects and activities within Pakistan and outside, development of competency in Chinese language, etc. Selected officers were also awarded fellowships for on the job training at reputable international organizations like International Atomic Energy Agency (IAEA), Nuclear Safety Centre (NSC) China and various research institutes for nuclear power plants, etc. Analysis tools required for safety review and assessment i.e., regulatory documents, applicable codes and standards, software and computer codes for conducting audit calculations were acquired and staff were trained on these software and codes. Through adequate training to the staff of TSO, PNRA developed the capability to conduct review and assessment of NPP submissions independently.

Country or International Organisation:

Pakistan

Session 4: Poster Session / **52**

TSO Support to Strengthen Newcomer Countries: GRS Model and Experience

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Worldwide, the number of countries embarking or re-embarking on the use of nuclear energy and making more extended use of nuclear technologies is increasing. Handling nuclear materials, ensuring the safe operation of nuclear facilities, and managing radioactive waste requires a strong national regulatory framework, an independent, powerful authority capable of enforcing the national regulations, disposing of sufficient internal technical competence or being supported by external expertise available through a Technical Safety Organisation (TSO).
These newcomers and the returning countries, too, need to build up capacities in rule-setting and enforcement, licensing, oversight and inspection in a variety of interrelated and complex fields ranging from radiation protection and nuclear safety to waste management and nuclear security.
The execution of the above-mentioned tasks, especially of rule-setting and safety assessment as part of licensing and oversight, requires a science- and knowledge-based approach, which is best implemented by the immediate involvement of the Technical Safety Organisation (TSO), supporting the regulatory body, in nuclear safety research and development.

Due to the wide range of independent expertise available within developed TSOs and their science-based approach and international engagement in research and training, TSOs have become a key factor in the building-up and strengthening of regulatory and TSO capacities in newcomer countries.

GRS is the central Technical Safety Organisation in Germany serving the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, which acts as the uppermost regulatory body. At the same time, GRS is also a major research institution in all fields of nuclear safety. As a non-profit organisation, GRS is independent of any political and commercial influences and

is strictly committed to the highest international standards and practices in nuclear safety. GRS is an active force in the exchange of experience and the discussion among experts through intensive international networking, e.g. in the European Technical Safety Organisations Network (ETSON) and the IAEA TSO Forum. These are essential preconditions for successfully communicating within the different safety cultures.

GRS contributes to the further development of the state of the art in science and technology by its own internationally integrated research and development activities. Through bilateral agreements and international assistance programmes, we are collaborating extensively with international regulators and TSOs. We are rigorously committed to our value charter to exclude any conflicts of interest towards third parties. Today, we can refer to successful experiences in supporting foreign regulators and their TSOs in capacity-building and in know-how transfer.
The expertise of GRS comprises all essential fields of nuclear safety and security (including e.g. safety assessment, development of advanced simulation codes, I&C, systems and component behaviour, ageing management, external and internal hazards), safety of radioactive waste (e.g. waste disposal concepts, geo-chemical and geo-mechanical behaviour), and radiation protection (e.g. fuel inventories, activation and consequence analysis and calculations, emergency preparedness, decommissioning).
An effective way of know-how transfer is the transfer of simulation codes for the safety assessment of nuclear facilities, accompanied by training in how to handle these simulation tools correctly. In this way, GRS makes available its thermal hydraulics system code ATHLET and the severe accident simulation tools ATHLET-CD and COCOSYS. Together with our French partner IRSN, we are constantly developing the integrated severe accident code ASTEC, which we provide to other institutions and which has become the European reference tool in this field. In the last years, the number of requests for a code transfer has increased to about 50 per year.
Recipients are among others universities, research institutions and regulatory authorities or TSOs that use these instruments for research, education and safety assessment in charge of their national regulators.

Furthermore, GRS is involved in a variety of European INSC projects co-ordinated by the IRSN-GRS subsidiary RISKAUDIT. These projects mainly aim at building and strengthening regulatory infrastructures, supporting regulators in setting safety requirements or establishing QM, licensing of nuclear facilities and their decommissioning. Classically, the INSC programme was targeted at the countries of the former Soviet Union, like the Ukraine, Belarus, and Armenia. Meanwhile the focus has widened e.g. to Mexico, Brazil, Vietnam and North African countries. Over many years, emphasis was put on the assistance to the Ukrainian regulator and his TSO in coping with the Chernobyl legacy.
Moreover, GRS has entered into bilateral agreements with foreign regulators. Our experts review safety analysis reports, perform PSAs and stress tests, assess internal and external hazards, and prepare advanced safety requirements. For example, GRS drafted the new Dutch safety requirements, which are guided by the latest German safety requirements and consider international safety standards of the IAEA or WENRA.

Through all these activities, we have gathered useful experience in connection with the safety issues related to a large spectrum of existing and advanced reactors as well as regarding different national safety approaches and requirements.

Country or International Organisation:

GRS mbH

Session 2: Poster Session / **53**

Development of Intra- and Inter- TSO network for NRA in Belarus

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Approaches to technical and scientific support for the Nuclear Regulatory Authority in Belarus (Ministry for Emergency Situations/Gosatomnadzor) are described and compared with the recommendations of the IAEA. It is a challenge to establish the needed NRA TSO capacities for the nuclear regulatory body inside existing national institutions (Intra- TSO network). Initially, the technical support structure was focused on capabilities of the National Academy of Sciences as complex institution.
There are described elements of Intra- TSO network. Issues for improvement of Intra- TSO network are presented.
The specific regulation for development of NRA TSO was elaborated. New regulation establishes scope, objectives, functions and policy of activities for organization of technical support for regulatory body (technical support organization of nuclear regulatory body), develops the current requirements of legislation and regulation of Gosatomnadzor and licensing, has be implemented for arrangement, coordination and planning of NRA TSO activities and arrangements. There are determined for NRA TSO:
sphere of competence, responsibilities, basic principles, spectra of requirements (to institutions, activities etc.), obligations, conditions for realized activities, tasks and functions;
requirements for policy in sphere of competence and safety, quality assurance elements, responsibilities to staff, safety culture aspects, assessment of activities, self assessment;
requirements to quality assurance system.
This issue implements and bases on IAEA publications.
There is described the current system of external experts for NRA technical support (safety assessment, expertise, supervision) including foreign possibilities (Inter- TSO network) of bi- and multilateral agreements and projects.

Country or International Organisation:

Belarus

Session 4: Poster Session / **55**

Training and Tutoring for experts of Nuclear Regulatory Authorities and their TSOs for developing or strengthening their regulatory and technical capabilities

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Capacity building for staff of nuclear regulators represents a key achievement to set up an effective nuclear infrastructure in countries operating or developing a nuclear program.
Nuclear Regulatory Authorities (NRA) and their Technical Support Organization (TSO) need to develop a wide range of professional capacities including: legal-regulatory framework; roles & responsibilities; safety objectives and requirements; licensing process; technological aspects of nuclear facilities; analytical tools for independent assessment, regulatory inspection; physical protection; emergency preparedness; public communication.
Training and tutoring (T&T) on these topics need to be specifically planned and implemented by professionals having senior experience as regulators and TSO. The training activity shall be carried out with the view and perspective of the regulatory role. The tutoring needs to be carried out at

NRA or TSO headquarter with progressive involvement in concrete activity to effectively transfer approach and working methods.
These basic elements have been adopted and implemented while carrying out the activities of the ''INSC Project MC.03/10: Training and Tutoring for experts of the NRAs and their TSOs for developing or strengthening their regulatory and technical capabilities - Lot 1'' financed by the European Commission.
Thirteen training courses on nuclear and radiation safety topics have been implemented since 2012, most of them specifically developed as ''dedicated '' courses, with participation of 141 trainees from NRA/TSO of 15 partner countries (PC's) outside the EU.
Eight tutoring courses for a total of 34 man-months duration have been carried out at NRAs/ TSOs headquarters in EU (Italy, Slovenia, Belgium, Finland, Bulgaria) for staff (19) coming from NRA of Ukraine, Brazil, Vietnam, Mexico, Armenia, Belarus, Jordan, Indonesia, Philippines, Malaysia and Iraq. About 94 Consultant's senior experts have contributed as trainers and tutors.
Factors ensuring effectiveness have been the constant relation with the PC's to identify needs, collect requests, propose T&T modules, select trainees and the extensive experience of the project team composed of a significant number of EU NRA-TSO organizations with 4 Nuclear Regulators.
The feedback from performed activity has confirmed the validity of adopted approach regarding both a) organization/content of T&T activity, b) conduct of T&T activity.

Country or International Organisation:

Italy

Session 5: Oral Session / **61**

Lithuania increase networking after joining the EU

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In 1990, after Lithuania declared its independence, the Ignalina NPP came to jurisdiction of the Republic of Lithuania, however, all technical scientific support organizations remained in Russia. Therefore the need to develop the independent institutions of nuclear regulatory and technical support was raised. During the 1991 – 2009 (till the final close of Ignalina NPP) the necessary infrastructure for nuclear regulation and technical-scientific support was created. Lithuanian Energy Institute (LEI) became one of main technical support organizations in Lithuania, capable to perform all necessary safety analyses for Ignalina NPP. The support of Western countries and experience, received participating in different international projects, was very important during the process of experience acquiring. Lithuania's accession to the EU (2004) has opened wide horizons for cooperation. Active participation in European research programmes was very important to Lithuania since it allows Lithuania to further integrate into the European Research Area, benefiting both Lithuanian researchers and country as a whole. Lithuania is actively participating in the European research programmes (FP6, FP7) and this is the basis for successful participation in the biggest EU Research and Innovation programme Horizon 2020. However, evaluating the differences in research infrastructures between the "old" and "new" EU Member States, there is only way for new EU states to participate on equal basis with the EU-15 countries – to join forces and work together.

Country or International Organisation:

Lithuania

Session 3 (cont'd): Oral Session / **62**

Role of the technical experts in the ConvEx 3

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Morocco hosted on 20-21 November 2013 a ConvEx 3 Exercise, co named Bab Al Maghrib. This type of exercise is a large scale joint international exercise covering the early phase of a severe radiation emergency, based on a national exercise conducted in Morocco. The purpose of the ConvEx-3 exercises is to evaluate response to a major radiation emergency and, in particular, to evaluate the exchange of information, provision of the international assistance and coordination of public information.

The 2013 CONVEX 3 exercise was based on a severe radiological emergency triggered by nuclear security events with transnational/transboundary implications. The exercise was conducted for 25 hours on real time, with the participation of 59 Member State and 10 International Organizations.

The exercise scenario was based on evolving threats and multiple nuclear security events (RDDs) in populated places. The following issues were addressed in the exercise scenario: (a) dispersion of radioactive material into the atmosphere, (b) the interface between safety and security, (c) medical and public health, (d) impact on commerce, industry and tourism (food and products contamination, contamination of vehicles, ships), and (e) communication with the public. Additionally, at the international level, the exercise focused on different protective and other response actions in connection with activities such as commerce, industry and tourism.

Protecting the public, the responders and mitigating the consequences require a clear view and understanding of the situation, the risks and the potential consequences. With this regard, beside the national organizations and authorities in charge of lifesaving, security, public protection, control command and coordination, several technical organizations (such as meteorology, aviation, maritime, health, regulatory body and TSO organizations) played an important role in assisting national authorities responsible for decision making and the protection of the public to have a better understanding of the risks and their potential consequences.

Around 15 national organizations participated to the exercise playing in three activated emergency centers: On Scene (managing the situation on the scene), at the National Emergency Center / NEC (ensuring decision making, coordination and allocation of resources), at the Technical Crisis Center.

Throughout the exercise preparation and conduct, the technical experts provide a substantial support: technical injects, exercise documents, meteorological data, plume modeling, on scene radiation safety, radiological search and survey, radiological environmental survey, decontamination, etc. In particular, the Technical Crisis Center (TCC) located at the National Center for Nuclear Energy, Sciences and Techniques (CNESTEN) acting as TSO supported the National Emergency Center (NEC) for decision making regarding the protective actions. The main mission of the TCC was to support the NEC by performing radiological risk assessment and making recommendations on protective actions for the public and the emergency responders.

The presentation will focus on the presentation of the exercise features and the role and involvement of the technical experts to support both the exercise preparation and conduct and the response to such events.

Country or International Organisation:

Morocco

Session 1 (cont'd): Oral Session / **63**

Post Fukushima Research in the View of the European TSO Network ETSON

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ETSON is the network of ten major European Technical Safety Organizations (TSOs) and of three associated TSOs from Japan, Ukraine, and Russia. ETSON aims at the convergence of nuclear safety practices in Europe by exchanging on nuclear safety assessment guidelines and by collaboration in research. As regards the Fukushima Daiichi NPP accident, the ETSON members obtained deep insights into the course of the accident including related human factor and emergency management aspects. With its knowledge about gaps in the understanding of safety relevant phenomena and about the needs for safety improvements, ETSON is an important driver for the definition and conduction of common post Fukushima research activities. Still in 2011, ETSON presented an Research and Development position paper that identifies the main research topics also taking into account the lessons learned from the Fukushima accident. Since then the ETSON Research Group has been spending continuous efforts to further prioritize the identified topics and to define coordinated research projects. In spring 2014, the ETSON Research Group held a workshop to exchange results of ongoing projects and to share views about common future activities. The workshop focused on the improved simulation of the Fukushima accident, including core degradation, vessel failure, and ex-vessel phenomena as well as Hydrogen distribution and explosion. Among others, it also highlighted the efforts to better understand the phenomena governing potential accident progression in spent fuel pools, and e.g. to improve the capability for fast and reliable source term assessment. Common work is also directed towards the support to IRSN in the development of the European severe accident reference code ASTEC. In order to efficiently work on these priorities, the ETSON members also participate in research projects of OECD/NEA like BSAF ("Benchmark Study of the Accident at the Fukushima Daiichi NPP") and they collaborate in the framework of EURATOM projects like CESAM ("Code for European Severe Accident Management"). The paper will provide an overview on the Fukushima related research priorities pursued by ETSON members and will highlight the status by selected technical examples.

Country or International Organisation:

Germany

Session 1 (cont'd): Oral Session / **64**

Off-site post-accident recovery after the Fukushima Daiichi accident: challenges and solutions

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The response to an accidental release is generally divided into two phases. In the emergency phase immediately after the accident has occurred, key off-site sources of radiation dose to humans include

inhalation and radionuclides deposited onto both man-made and natural surfaces. Actions to reduce radiation doses in the emergency phase are termed countermeasures. Thereafter, in the post-accident recovery phase, external doses from surfaces and internal doses from foodchain pathways are both potentially important and actions to reduce these doses are collectively termed remediation. Decisions made on the target dose rates for remediation are critical for planning the remediation strategy, as are the methods used to estimate the external and internal doses to people.

For many countries, the main focus of most emergency preparedness is focused on the emergency phase and little consideration is given to the post-accident recovery phase, especially off site. Accident exercises seldom consider more than the first few days and the development of appropriate policy and plans for the existing situation is rare.

Whilst radioiodine is a potentially important exposure route in emergency situations, radiocaesium and radiostrontium are often the most important dose-forming radionuclides in the long term due to the relatively long physical half lives of some of their radioisotopes and their environmental mobility. Many of the challenges in both the emergency and the post-accident recovery phase are determined by the source term. However, for the post-accident recovery phase there are many other factors which need to be considered, such as the agricultural, economic, social and cultural situation in the affected countries.

Many national and international guidance documents on countermeasures and remediation after nuclear accidents are based on previous experience of serious accidents impacting outside the site boundary, and also of dealing with legacy sites. Such International guidance documents on remediation include the International Atomic Energy Agency's recent Technical Report Series document TRS 475 and the Euranos Handbooks on Emergency Preparedness. For the off-site recovery phase, in particular, much of the guidance is currently based on the experience gained during the response to accidents in the former Soviet Union in the East Urals (Kyshtym accident) and at Chernobyl.

The importance of the external dose pathways is much greater than the internal dose pathway in Japan than it was after the Chernobyl accident, partially due to the enforcement of restrictions and comprehensive monitoring of all food entering the foodchain. The selection of remedial measures, the extent to which they are being applied and the timescale over which they are being implemented also differs. Furthermore, the practicability, feasibility and acceptability of some remedial measures differs considerably in Japan compared with the situation after the Chernobyl accident. Careful analysis of the reasons for differences in the decisions made in Japan and the implementation of remedial measures compared with other accidents will be valuable in extracting lessons for the wider international community.

It is clear that we need to revisit the international guidance documents to take into account of the experience of dealing with the post accident recovery phase in Japan. IAEA activities such as recent report on the Follow–up International Mission on remediation of large contaminated areas off-site the Fukushima Daiichi Nuclear power plant and the Fukushima Report currently being prepared by the IAEA involving more than 100 international experts will provide an important input into this process.

Country or International Organisation:

United Kingdaom

Session 5 (cont'd): Oral Session / **66**

The European Clearinghouse for NPP Operating Experience Feedback operated by EC-JRC: Networking European Nuclear Regulators and TSOs

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Operating Experience Feedback (OEF) is one of the ways of improving nuclear safety of operating nuclear power plants. Several participants at the conference on Improving Nuclear Safety through Operating Experience Feedback that was held in Germany in 2006 discussed the possibility and benefits of joined efforts at European level to enhance the effectiveness of OEF. As a result a regional initiative has been set up in 2008 in support of EU Member States' nuclear safety regulatory authorities, but also EU technical support organizations, international organizations and the broader nuclear community, to enhance nuclear safety through improvement of the use of lessons learned from operational experience of nuclear power plants (NPPs). The experience of US NRC Operating Experience (OE) Clearinghouse showed that the establishment of a centralized OE Clearinghouse for a particular region in the world can yield significant benefits due to optimized use of resources and improved feedback of lessons learnt. Due to differing regulatory regimes in the EU member countries, significant diversity of the NPP designs and different languages used, the establishment of the European Clearinghouse was more complicated and challenging and needed strong support and commitment from the EU nuclear safety regulatory authorities.

The Joint Research Centre (JRC) of the EC has been chosen to play a central role in establishing and running of the European Clearinghouse for OEF. The choice allowed use of well-established JRC working mechanisms, means and technical expertise in the field to promote better cooperation and more effective use of the limited national resources and to strengthen the capabilities for OE analyses and dissemination of the lessons learned.
The European Clearinghouse is organized as a Network operated by a Central Office located at the Institute for Energy and Transport that is part of JRC of the European Commission. It gathers 17 European Safety and 3 major European TSOs.

The main objectives of the European Clearinghouse are:
• Strengthening co-operation between European Safety Authorities, Technical Support Organizations (TSO) and the international OEF community to collect, evaluate and share NPP operational events data and apply lessons learnt in a consistent manner throughout member countries.
• Establishment of European best-practice for assessment of operational events in NPPs.
• Coordination of OEF activities and maintenance of effective communication between experts from European regulatory authorities involved in OEF analyses and their TSO.
• Strengthening European resources in operational experience.
• Support for the long-term EU research and policy needs on NPP Operating Experience Feedback.

The main activities covered by the European Clearinghouse are:
-Topical studies providing in-depth assessment of preselected subjects related to NPP operating experience
-Contribution to improve the quality of event reports sent to the International Reporting System
-Quarterly reports on Operating Experience
-Development, maintenance and population of a database for storage of Operating Experience related information
-Delivery of training in the field of Root Cause Analysis and event investigation.

Six years of operation of the European Clearinghouse have shown the added value of the initiative and further areas are being developed such as statistical tools to identify topics on which the efforts should focus in the future.

Country or International Organisation:

European Commission, JRC-IET

Session 2: Oral Session / **69**

How to meet the Challenges in Public Communication: KINS experiences and practices

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This paper presents the main challenges faced by TSOs in communicating with the public. The Fukushima Daiichi Accident underlined the importance of effective communication during crisis situations and as well drew more attention to the need of improving day-to-day communication approaches. As all nuclear related organizations have been confronted with the same challenges, TSOs have also been requested to promote good communication environments for the public in which clear, consistent, and technically sound messages are continuously provided to ensure that the public is well protected against any possible nuclear related problems.
The first part of the paper will address the same challenges shared by regulators and TSOs in communicating with the public. It shall reflect the general working conditions where both regulator and TSO are situated in interfacing with the public and stakeholders. After identifying the key elements in public communication that can be applied to any communication strategies, understanding the respective roles of regulators and TSOs will be presented. In general, nuclear regulators are the main contacts for any questions and information regarding nuclear safety and regulation while TSOs are more frequently requested to provide some sort of technical explanation and scientific background about the regulator's decisions. From the coherent communication perspective, both of them need to work together effectively as to provide a synergy, and to avoid any possible conflicts.
A global approach is also discussed to be more proactive in communicating with the international public - we are living in a globalized society and are confronting the same challenges to address the public's concern in a more effective and coherent way. Since the TSOs need to be adequately trusted by the public for its technical competence, the need to cooperate among TSOs for effective communication is also highlighted.
As part of the good communication practices, Korea Institute of Nuclear Safety (KINS) activities regarding public communication and awareness will be shared. As a unique TSO, KINS has greatly contributed to enhance the public's understanding about its nuclear regulatory activities by supporting the Nuclear Safety and Security Commission (NSSC, Korean regulatory authority) and also carrying out its own outreach activities to cover various stakeholders and public.

Country or International Organisation:

Korea Institute of Nuclear Safety

Session 3: Oral Session / **70**

Role of KINS for Emergency Preparedness and Response in Korea

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This paper reviews the important role of Korea Institute of Nuclear Safety (KINS) for emergency preparedness and response in Korea. The KINS performs the regulation for the safety performance and radiological emergency preparedness of the nuclear facilities and radiation utilizations. The radiological emergency preparedness in Korea is based on the Act on Physical Protection and Radiological Emergency which stipulate a national preparation against radiological emergency. Also, KINS has set up the "Radiological Emergency Technical Advisory Plan" and the associated procedures such as an emergency response manual in consideration of the IAEA Safety Standards GS-R-2 and GS-G-2.1. The Radiological Emergency Technical Advisory Center (RETAC), which is in charge of providing technical advice on radiological emergency response, dispatching technical advisory

teams to the affected Off-site Emergency Management Center (OEMC), initiating emergency operation of 128 nation-wide environmental radioactivity monitoring stations in accordance with the Nationwide Environmental Radioactivity Monitoring Plan, coordination and control of off-site radiation monitoring, offering radiation monitoring cars, and monitoring the response activities of the operator, will be organized by KINS for the response of emergency situations. Moreover, so as to efficiently implement technical support activities for protection of the public and the environment in a nuclear or radiological emergency of a nuclear power plant, the "Atomic Computerized Technical Advisory System for a Radiological Emergency" (AtomCARE) has been developed and is in operation. Through the system, any nuclear or radiological emergency and its consequences can be quickly verified and assessed, and subsequently, comprehensive management of the information related to public protective actions is also made possible. Recently, The KINS published the report (2013) to adapt the Precautionary Action Zone (PAZ) and Urgent Protective Action Planning Zone (UPZ) applying the IAEA guidelines and reflecting the lessons learned from Fukushima Daiichi NPP accident and was legislated in the Radiological Emergency Act.

Country or International Organisation:

Republic of Korea

Session 3 (cont'd): Oral Session / **71**

Legislative and regulatory framework for protecting emergency workers in Ukraine

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Issues related to protection of emergency workers are regulated in Ukraine by a number of regulatory documents. Among them, there are documents of 1) upper legislative level, such as the Code of Civil Protection of Ukraine, the Law of Ukraine "On Human Protection against Ionising Radiation"; 2) state safety standards, such as Radiation Safety Standards of Ukraine (NRBU-97) and Basic Health and Safety Rules of Ukraine (OSPU-2005); 3) normative documents of the regulatory authority, such as "General Safety Provisions for NPPs", "Requirements for NPP On-Site and Off-Site Emergency Centres"; 4) normative documents of the operating organisation, such as "Standard Emergency Plan for NPPs of Ukraine", Procedure on Planning Doses of Emergency Workers, Procedure on Conducting Individual Dosimetry Control of External and Internal Exposure of Personnel in Conditions of Emergency, etc.

The paper will present information on health and radiation regulations, procedures on issuing permission for higher exposure, definition of emergency personnel, and measures on protecting emergency workers.

The main technical and organisational measures on protecting emergency workers include supervision over non-exceeding health and radiation regulations, restriction of exposure, conducting radiation survey on NPP premises and site, prophylaxis of external and internal exposure of personnel, decontamination, medical protection, arrangements for continuous monitoring and recording of doses received by emergency workers, procedures to ensure that doses received and contamination are monitored in accordance with established guidance and international standards, and arrangements for the provision of appropriate specialized protective equipment, both individual and collective, procedures and training for emergency response in the anticipated hazardous conditions, etc.

Conclusions will be given on conformity of the Ukrainian regulatory framework in force for protecting emergency workers with the IAEA Safety Requirements GS-R-2 "Preparedness and Response for a Nuclear or Radiological Emergency".

Country or International Organisation:

Ukraine

Session 1: Oral Session / **72**

Response to the IAEA Action Plan on Nuclear Safety by TSO

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Based on the IAEA Action Plan on Nuclear Safety, the Russian Federation developed an "Action Programme of Russian Authorities and Organisations Concerned in Implementation of the IAEA Action Plan on Nuclear Safety" up to the year 2015.
The Report represents information on the Programme implementation by the Russian regulatory authority for nuclear and radiation safety in the field of use of atomic energy (Rostechnadzor), and also considers the results of stress tests conducted for the Russian NPPs (either in operation or planned for construction) and the most powerful research reactors.
Moreover, it provides information about R&D and standard-setting activities in the field of regulation of atomic energy use carried out by the Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS – Rostechnadzor's TSO) to support the Rostechnadzor's activity aimed at implementation of the IAEA Action Plan on Nuclear Safety.
The Report also emphasizes the results of the IAEA Integrated Regulatory Review Service (IRRS) follow-up mission that was held in November 2013, in preparation and conduct of which SEC NRS took part.

Country or International Organisation:

The Russian Federation

Session 2 (cont'd): Oral Session / **74**

Interface from Russian Regulator to TSO

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The Russian regulatory body – Rostechnadzor – is the state executive body which performs functions related to elaboration and implementation of the state policy and establishment of legal and regulatory framework within the specified field of activity, including state regulation of safety in the field of use of atomic energy. Aiming to provide scientific and technical support to Rostechnadzor its TSOs are facing challenges in fulfillment of its missions.
The presentation will focus on the following issues:
1. Mission, Functions and structure of Rostechnadzor.
2. Roles and functions of TSOs with regard to provision of scientific and technical support to Rostechnadzor in regulation of nuclear and radiation safety (legal framework for TSO establishment and functioning, categorization criteria for TSO, TSO missions).
3. Regulatory body interaction with TSOs when making regulatory decisions based on results of safety review conducted by TSO, as well as in the process of supervision and licensing.
4. Provision of the regulatory body with scientific support by TSO when enhancing the regulatory framework.
5. Training and professional development of Rostechnadzor personnel with the assistance of TSOs.

6. TSOs involvement in international cooperation of Rostechnadzor.
7. Involvement of TSOs in implementation of Rostechnadzor's interagency agreements with regulatory authorities of newcomers on cooperation in the field of nuclear and radiation safety regulation at atomic energy peaceful use, including training of regulatory authority personnel, review and development of regulatory documents and etc.
8. R&D to support decision making of regulatory body.

Country or International Organisation:

The Russian Federation

Session 3: Oral Session / **75**

Canadian TSO Experience during Major National Exercise (Unified Response)

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The role of the Canadian Nuclear Safety Commission (CNSC) during a nuclear emergency is to provide assurance that appropriate actions are taken by the licensee and response organizations to limit the risk to health, safety, security of the public and the environment. This includes an independent assessment of the onsite conditions and potential offsite consequences as well as assessing and confirming both the licensee's and the responsible government's recommendations concerning protective measures. The Technical Support Branch (TSB) of the CNSC is the integrated TSO of the Canadian nuclear regulator and is responsible for conducting this independent assessment.
In May 2014, Exercise Unified Response (ExUR), a three day national level emergency preparedness exercise, was conducted at Darlington Nuclear Generating Station (DNGS). More than 50 government agencies and regional organizations, including the Government of Canada, the CNSC, the Government of Ontario, Ontario Power Generation, the Regional Municipality of Durham and the Municipality of Clarington worked together to test and validate emergency response plans and processes to demonstrate Canada's collective ability to respond to a nuclear emergency.
ExUR was a full scale severe accident emergency based on a single-unit loss-of-coolant accident followed by a tornado-initiated full station (4 unit) blackout. Day 3 of the exercise included a simulated radiological release in order to include participation from local authorities in carrying out protective measures for the public.
The CNSC fully activated its Emergency Operations Centre (EOC) for the duration of the exercise. Select staff from TSB formed the Technical Assessment Section which provided round the clock assessments of the accident progression, potential source term estimates, and subsequent dispersion and dose evaluations. The team established communication links with international players including the US NRC and the IAEA in order to share technical information and plant status updates.
The exercise highlighted many positive aspects of the CNSC response, but also identified areas for improvement. On a positive note the Technical Assessment Section's response indicated that it has a clear role and is able to carry out this role with well established procedures. However, the section was limited in its capability due to the limited plant data available. As well, with the large number of national and international players, the continuous requests for information showed that the section was undermanned.
The CNSC has noted all lessons learned and is committed to take the necessary steps to improve its technical response capability. An EOC Improvement Team has been established and will be focusing its efforts in five key areas:
1. Re-assessing the EOC venue;
2. Reviewing current manning levels so that all national and international obligations are met;
3. Improving plant data transfer during accidents from the licensee to the regulator;
4. Implementing a program to develop a state-of-th- art accident assessment tool package; and
5. Developing a comprehensive e-library repository of nuclear power plant information.

Implementation of the EOC Improvement Project will ensure that the CNSC Technical Assessment Section's processes and capabilities are in line with best international practices and allow the CNSC to fully meet its mandate during a nuclear emergency.

Country or International Organisation:

Canada

Opening Plenary / **76**

Progress in the implementation of recommendations from the last TSO Conference held in 2010

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As a follow up to the conclusions of the first Conference held in France, the second TSO Conference in Tokyo in 2010 sought to achieve such objectives as: to develop a common understanding of the responsibilities, needs and opportunities of TSOs; to promote International Cooperation and Networking between TSOs; to foster capacity building and the work of TSOs in countries embarking in nuclear program, or in those with limited as well as extensive experience.

To address those issues, the Tokyo Conference recognized the importance for the global safety community to maintain and continuously develop TSO functions, which should be adequately recognized in national regulatory systems. In this context, it was highlighted that TSOs have to rely on the following sources and capabilities: adequate human and financial resources; scientific risk-oriented research; relevant operating experience analysis; capacity building, professional educational and training courses; knowledge management.

Those elements still remain keys in ensuring nuclear safety on sound scientific bases. However, six months after the second Conference, the Fukushima accident in March 2011 brought further challenges and generated a global mobilization to enhance safety and radiation protection worldwide. Many new initiatives have emerged, such as the IAEA Action Plan on Nuclear Safety, worldwide stress tests, enhanced legislation and regulation, notably in Europe. Lessons learned also pointed out to the key importance of emergency preparedness and response and of improved communication to the public. Experience showed that all those aspects rely largely on scientific and technical support and highlighted further the critical importance of TSO functions.

Moreover, further to the recommendations of the Conference in Tokyo, the 'TSO Forum' was established, with a view to cooperating more effectively and on a regular basis, addressing common challenges and sharing experiences with respect to nuclear safety and security. In addition, synergies between nuclear safety and security were developed, following the principles set out by the IAEA.
Four years after the Tokyo Conference, substantial progress has been achieved on many of its recommendations as well as on other challenges.

Nevertheless, the implementation of several recommendations still needs efforts, for instance with respect to the development of IAEA documents to define a framework and provide sufficient guidance on the roles and functions of TSOs in ensuring nuclear safety, including its interface with nuclear security, or regarding the implementation of the necessary capability building process in embarking countries to develop required TSO functions, in particular through knowledge and experience transfer by the international community.

The paper will elaborate on progress achieved and remaining challenges, illustrating the analysis with concrete examples taken from different countries and from Europe as an entity with its specific regional nuclear safety approach.

Country or International Organisation:

France

Session 4 (cont'd): Oral Session / **77**

The objectives and current progress to strengthen TSO capability building in China

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TSOs have been playing very important roles during the development of nuclear energy in China. This paper describes TSO's values, functions capability requirements and general situation, introduces the target of strengthen TSO capability building in China as well as current achievements and progress, including establishment and construction of China's National Research and development Base on Nuclear and Radiation Safety.

Country or International Organisation:

China

Session 1: Oral Session / **78**

Discussion of some new safety concepts and new safety requirements in light of the Fukushima Accident

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After Fukushima Nuclear Accident, some new safety concepts and new safety requirements are suggested and discussed among the nuclear industry and nuclear safety regulatory organizations all over the world. In this paper, new safety concepts and new safety requirements, such as "Design Extension Condition", "enhance the application of Defense in Depth", "independence between different levels of Defense in Depth", "enhance the diversity design of safety features", "safety level should be As High As Reasonable Achievable", and "practically elimination of large release of radioactive materials" are discussed; and also it is stated in this paper that, with the consideration of "safety level should be As High As Reasonable Achievable", deterministic and probabilistic methodologies should be used to identify the safety voluntaries in the design of NPPs, and reasonable practicable measures should be taken to minimize the consequence of residual risk, and to achieve the safety goal of practically elimination of large release of radioactive materials.

Country or International Organisation:

China

Session 3 (cont'd): Oral Session / **79**

Nuclear and Radiation Accident Emergency Response and Radiation Environmental Monitoring in China

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This paper introduced the regulatory framework, legal system and organizational structure of the nuclear and radiation accident emergency preparedness and response as well as radiation environmental monitoring in China. It described the roles and responsibilities of the National Nuclear Safety Administration and its TSOs in this regard and their major activities. In addition, the paper introduced the improvements made by the government in the field of nuclear and radiation accident emergency preparedness and response after the Fukushima nuclear accident, the latest plan and perspectives regarding nuclear and radiation emergency response in China, and the challenges and planned improvements for NNSA/NSC in this field.

Country or International Organisation:

China

Session 4: Oral Session / **80**

Human and Organizational Factors

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The integration of Human and Organizational Factors (HOF) within a regulatory framework will strengthen the actions of a Technical Support Organization (TSO), lead to a more effective regulatory oversight and result in improved nuclear safety regulatory system. The importance of HOF has long been recognized as critical to safe operations. As safety results from the interaction of individuals with technology within the organisation, as indicated in the IAEA in Safety Standard GS-G-3.5, "The Management System for Nuclear Installations", a sound safety oversight should encompass this interaction as well."
This presentation will describe how the Canadian Nuclear Safety Commission (CNSC) has developed a robust regulatory framework which supports our oversight in the area of HOF. CNSC's Safety and Control Area framework explicitly identifies the integration of HOF within its regulatory oversight activities. While there is still work to be done, practical examples are provided which demonstrate how the CNSC has achieved successful integration amongst technical disciplines and the benefits realized from this approach. One of the most significant benefits is in the synergy created when specialists from various disciplines interact, share knowledge and approach safety from a holistic perspective. This integrated approach ensures the continuous development and availability of the scientific expertise necessary to support an effective nuclear safety regulatory system.

Country or International Organisation:

Canada

Session 2: Oral Session / **81**

Meeting the challenge of the safety-security interface: IAEA's role in supporting the enhance-ment of technical competence and support for nuclear security within Technical Support Organizations

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Nuclear security and nuclear safety have in common the aim of protecting persons, property, society and the environment, in the case of safety from the harmful consequences of ionising radiation and in the case of nuclear security from the harmful consequences of a nuclear security event. Establishment of effective nuclear security measures require an understanding of the interface between safety and security measures and an awareness of the need to optimise the effectiveness of each.
Nuclear security requires a State to focus on prevention of, detection of and response to criminal and intentional unauthorised acts directed at or involving nuclear material, radioactive material, associated facilities and associated activities.
Nuclear security is a State responsibility and developing and implementing an effective national nuclear security infrastructure is a key requirement for every country and is built on a foundation of legal, regulatory, technical and administrative competence in nuclear security.
Appropriate management of the interface between safety and security results in both safety and security in a State being strengthened and enhances each State's capacity to protect and secure its nuclear and other radioactive material, associated facilities and associated activities.
Traditionally many Technical Support Organizations have been focused on support for nuclear safety. However in many countries this has changed over time, particularly where a single regulatory body has responsibility for safety and security and has access to the services of a Technical Support Organization. The last international conference on Technical Support Organizations convened in Tokyo recommended that Technical Support Organization functions be extended to providing technical support to competent authorities in the field of nuclear security.
This paper will focus on the role of the IAEA in supporting, upon request, the development of technical competence in nuclear security in all States in order that the safety-security interface is appropriately managed and the capacities of technical support organisations be expanded to include nuclear security. This paper will examine a number of modalities for this support, including national and regional nuclear security support centres, collaborative knowledge networks, guidance and training.

Country or International Organisation:

IAEA

Session 1: Oral Session / **82**

Peer review and implementation process of EU stress tests

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The accident at the Fukushima Daiichi Nuclear Power Plant in March 2011 was a milestone in nuclear industry that has once again emphasized the importance of responsible and conservative decision making processes among all stakeholders involved in assuring nuclear safety. The lessons learned are showing how important is the preparedness to worst scenarios by the NPP operators, how crucial

is critical review and assessment by the regulatory bodies and certainly how inevitable is excellent understanding of natural phenomena based on the best available knowledge base.
The Fukushima accident in March 2011 represented a big challenge to everybody involved in nuclear safety. The first meeting of everybody involved with nuclear safety in EU was held already 4 days after the tsunami in Japan. The decision was made to start immediate campaign for analysis of vulnerability of European NPPs to external events and for implementation of potential improvements. The initiative was soon endorsed by the European Council. WENRA and ENSREG have prepared comprehensive specifications for so called Stress Tests, which were endorsed at the end of May 2011. During the rest of 2011 operators of all NPPs in EU, Switzerland and Ukraine and national regulators have spent hundreds of man years analysing vulnerabilities of their facilities and preparing improvement measures. By the end of 2011 national reports were made public. In spring of 2012 the intensive Peer Review process was going on where a group of about 80 regulators has reviewed all national reports, visited selected facilities and prepared recommendations to national regulators.
The final report of the Stress Test campaign was endorsed by ENSREG on 25 April 2012 and was later delivered to the European Council. The Peer Review Team has determined that a lot has been done in all NPPs in Europe and that there are also plans for further long term improvements. The report is highlighting four major recommendations on European level (need for development of common reference levels about protection against external hazards, importance of containment integrity, importance of Periodic Safety Reviews and importance of severe accident management preparedness). 17 National Peer Review Reports are introducing additional recommendations to each national regulator.
ENSREG has approved a special Action Plan on 1 August 2012 to make sure that the conclusions from the stress tests and their peer review result in improvements in safety across European nuclear power plants. Each country has prepared its own National Action Plan. Their implementation will be cross-checked during another peer-review process planned for the first half of 2013. This will ensure that the recommendations and suggestions from the stress test peer review are addressed by national regulators and ENSREG in a consistent manner.
In parallel with the stress test campaign in 2011 WENRA has started the development of additional Reference Levels addressing issues related to the safety against external events. After almost three years of preparations and discussions with stakeholders new reference levels were approved in July 2014. In next years all European nuclear countries will harmonize their nuclear safety related legislative framework with these Reference Levels.
During the Stress Test campaign it was becoming more and more obvious that improvements are needed also in the area of emergency preparedness off the nuclear sites, i.e. in the wider surroundings and on national levels. Special task force under the umbrella of WENRA and HERCA is currently working on harmonization nuclear emergency preparedness arrangements in different countries.

Country or International Organisation:

Slovenia

Session 5: Oral Session / **83**

The TSO Forum in the Global Nuclear Safety and Security Network (GNSSN)

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The Technical and Scientific Support organization (TSO) Forum also known as TSOF was established following the recommendations of the TSO Conference 2010 in Tokyo. The objectives of the Forum as defined in the Terms-of-Reference are to encourage open dialogue and sharing of scientific and technical information among the technical experts and their TSOs in general worldwide. The Forum

is open to all member States after official nomination.
The IAEA hosts numerous networks to support the international efforts to enhance nuclear safety and security. The Global Nuclear Safety and Security Network (GNSSN) integrates numerous global, regional and thematic networks, is a working platform and document archive and gives access to many information resources of the IAEA. The TSO Forum is fully integrated in GNSSN.
The paper gives an overview of the structure of TSOF in GNSSN. Like many other networks it includes a public and a password protected section. Major activities of the Forum and their reflection in the network are discussed. TSOF has a Steering Committee with chair and vice-chair. Major meetings at IAEA and internationally are used to promote the Forum. Those technical experts who are not yet members of the Forum will be invited to join TSOF and to benefit from enhanced international collaboration.

Country or International Organisation:

IAEA

Session 2: Oral Session / **84**

Challenges for a TSO supporting both the regulator and industry

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A typical TSO supporting both the regulator and industry is a TSO in a relatively small country that has only a few nuclear power plants in operation or in construction. The paper reflects and discusses the challenges met by such a TSO mainly using the VTT Technical Research Centre of Finland (VTT) as the example case. In Finland the TSO role of VTT was born along with the construction of the first four NPP units in the country during the late 1970' and early 1980's. In particular, for the two Loviisa VVER-440 type plant units there was a need of independent analysis tools and expertise both for the regulatory side and for the side of the plant owner. During the past four decades the challenges for VTT as a TSO that has continued to support both the regulator and the industry have also changed due to changes in the domestic and international operational environment. There are also changes in the VTT itself, such as changes in funding structure from a governmentally funded organisation to an organisation with only 25 percent or less in the near future from the governmental budget. The TSO needs from the domestic regulator are fairly predictable with fairly large annual changes of the need of TSO services. Such a situation forces VTT to continue to support also the domestic nuclear operators as well as to continue to enhance operation with foreign regulators and industry. The major challenge for a TSO supporting both the regulator and industry is to avoid conflicts of interest and simultaneously maintain the impartiality and transparency. The paper provides information on the principles applied at VTT and discusses the practical application of these principles. Another challenge for a TSO is to create, maintain and enforce the required competences (experts, tools, facilities). In Finland the national research programmes in reactor safety and waste management have a key role in ensuring that the country possesses the required competences. The particular feature of these programmes is that all key players of the country including both the regulator and the industry are represented in the decision making bodies. These programmes and their role for VTT as the main research partner are described.
Additional challenges for a TSO supporting both the regulator and industry include prioritising the customer needs, making strategic decisions on participation in future tasks in Finland and abroad and making strategic decisions on acquiring new major research facilities, such as the VTT Centre for Nuclear Safety.
The paper concludes with a short discussion on the lessons learned during the existence of VTT as a TSO in the nuclear energy area.

Country or International Organisation:

Finland

Session 4: Oral Session / **85**

Bridging required capabilities and training

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For Bel V, the Belgian TSO, developing and maintaining required competence and expertise is of utmost importance. Essential activities to achieve this goal are embedded within several processes of the Bel V integrated management system (IMS) which is certified according to ISO 9001:2008. The main processes of interest are:
• Deliver expert services in nuclear safety and radiation protection;
• Manage expertise and technical quality;
• Manage Human Resources
The presentation will explain the role of Bel V's Technical Responsibility Centres (TRC) that play a key role in the process on "Deliver expert services in nuclear safety and radiation protection", especially for the identification of required expertise, and for daily managing and periodic evaluation of the expertise.
The process "Manage expertise and technical quality" covers aspects related to knowledge management. Examples of available tools will be presented that are important for evaluating the vulnerability of our expertise (by using the in house developed Knowledge Critical Grid) or for ensuring knowledge transfer where needed.
Further, the process "Manage Human Resources" plays an important role by covering all aspects related to recruitment, by providing role descriptions, and by describing how to manage competence and training. Within that process, an important effort was recently started in view of a more structured identification of the individual existing competence (KSA) gaps using the SARCoN tool, on the basis of a reference list of KSAs and the role descriptions. Our first findings after having performed a pilot-project for implementation will be presented.
Besides the investments on developing and maintaining technical expertise, Bel V also decided recently to launch an important effort on non-technical training through participation of the whole staff in an "Interpersonal Effectiveness Development Path", coordinated by an external consultant company. The main aspects of this effort will be presented.

Country or International Organisation:

Belgium

Session 4: Oral Session / **86**

Meeting challenges of professional development of EU Technical Safety Organisations experts

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[1] *ENSTTI*

The support provided by Technical Safety Organizations (TSOs) to Nuclear Regulatory Authorities (NRAs) in carrying out their designated functions, depends on highly qualified personnel who are competent in many disciplines. The development and maintenance of this workforce needs on-going attention from governments and stakeholders to ensure that adequately skilled and competent personnel are available at any time, taking into consideration retirements and the continuous need for personnel resulting from natural fluctuation, from new developments or national requirements.

In the European Union, this demand for skilled personnel set against a generally ageing workforce makes it very clear that it is high time to put in place a training mechanism that ensures the maintenance of the current skilled and competent personnel at NRAs and TSOs, and the flow of new recruits for long-term sustainability.
In the light of the above identified need, and in the aftermath of the Fukushima Daiichi accident, the European Commission took action and launched a project for "Sharing & Growing Nuclear Safety Competences" (NUSHARE project). This project aims at strengthening nuclear safety and fostering a common nuclear safety culture in the EU-28. One out of three working packages of the NUSHARE project is dedicated to the development of a comprehensive training programme for new entrants, professional staff already working at NRAs or TSOs, or experts who wish to start a career in this field. This important task is coordinated by the European Nuclear Safety Training and Tutoring Institute (ENSTTI), an initiative of the European Technical Safety Organizations Network-ETSON. ENSTTI is a centre specialized in meeting the growing need for highly qualified personnel with adequate knowledge and skills in nuclear safety and security at NRAs and TSOs.
The paper provides a brief overview of the NUSHARE project with a focus on the development of a comprehensive training programme tailored to the requirements of NRAs and TSOs. In addition, the paper highlights one module of the training programme that is dedicated to the systematic development of entry-level skills necessary for employment at NRAs or TSOs. ENSTTI addresses also the above indicated issues by developing a comprehensive training catalogue implementing the European Credit system for Vocational Education and Training (ECVET) which is already used in many other industrial sectors. The objective of the ECVET system is to promote mutual trust, transparency and mutual recognition of acquired learning outcomes in the form of ECVET credits.

Country or International Organisation:

ENSTTI

Session 4 (cont'd): Oral Session / **87**

A Strong and Viable Technical Service Organization to Meet Current and Future Regulatory Challenges – NRC's Vision and Perspectives

Author: Brian Thomas[1]

Co-authors: Raj Mohan Iyengar [1]; Steven West [1]

[1] *USNRC*

The Office of Nuclear Regulatory Research (RES) is, as established under Statute, a US-NRC program office that develops and maintains technical tools, analytical models, analyses, experimental data, and technical guidance needed to support the agency's regulatory decisions. RES is essentially the NRC's statutorily mandated technical support organization (TSO) that provides technical expertise and capabilities to support NRC's program offices, namely the Office of Nuclear reactor regulation (NRR), the Office of New Reactors (NRO), the Office of Nuclear Material Safety and Safeguards (NMSS), and the Office of Nuclear Safety and Incident Response (NSIR) in licensing and regulatory decisions. RES develops the technical bases to confirm that the methods and data generated by the nuclear industry help ensure that adequate safety is established and maintained.

In addition to conducting confirmatory research, as a technical support organization, RES conducts anticipatory research whereby it develops expertise and capabilities to evaluate longer term (approximately five years and beyond) needs of the Agency. To provide the technical bases for future regulatory decisions, RES looks where the regulated industry is moving and conducts exploratory research as needed to prepare the USNRC to respond to industry requests and initiatives. The paper will provide some examples of the technical activities and support provided by RES in support of US-NRC mission. The core capabilities required to continuously provide these technical services are of paramount importance to RES.

In addition to regulating the commercial use of radioactive materials to protect public health and safety and to protect the environment, the USNRC has responsibility for protecting and safeguarding nuclear materials and nuclear power plants in the interest of national security. Hence, RES also provides research and technical support to broad government-wide initiatives associated with national security. Thus, safety and security culture is an integral part of RES and US-NRC. In its broadest sense, "safety culture" refers to how well the NRC's mission, policies, and working environment support nuclear safety and security as the agency's overriding priorities. RES ensures that personnel in the safety and security sectors have an appreciation for the importance of each, emphasizing the need for integration and balance to achieve both safety and security in their activities. It is important that consideration of these activities be integrated so as not to diminish or adversely affect either; thus, mechanisms should be established to identify and resolve these differences. To this end, several important programs, such as Open and Collaborative Work Environment, have been put in place.

RES's principal product is knowledge; thus, knowledge management (KM) is an integral part of the RES mission. RES's objective is to capture, preserve, and transfer key knowledge among employees and stakeholders. The body of knowledge can be used when making regulatory and policy decisions and ensures that issues are viewed and analyzed within a historical context. RES KM activities include participation in an Agency-Level KM Steering Committee to helpm promote and cultivate an awareness of the value of KM, expansion of Expertise Exchange Program, continuation of support to communities of practice (CoPs), and championing KM development and preservation.

Country or International Organisation:

United States of America

Session 5: Oral Session / **88**

Networking activities in ETSON

Author: Miroslav Hrehor[1]

[1] *Nuclear Research Institute Rez*

Nuclear Safety Convention, EU Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations and a number of publications of the IAEA and OECD Nuclear Energy Agency declare the vital role of the state, even in today's market conditions, in the field of peaceful use of nuclear energy, in particular in creating the political, legal and regulatory framework and long-term strategy with a focus on sustainability and public awareness. The key is in particular the regulatory role of the state in the field of nuclear safety and the necessary expertise in this area. In a number of countries operating nuclear power plants there exist independent scientific expert organizations, so called "Technical Safety Organizations - TSO", providing a comprehensive view of the long-term safety of nuclear installations and maintaining a high level of expertise on the basis of research and development activities.

The paper describes the basic mission of TSO organizations - support of state regulatory authority in the form of an independent expert, analytical and research services in the field of nuclear safety and radiation protection - and the ways of its implementing. TSOs are developing and maintaining their expertise and skills by carrying out long-term R & D programs aimed, inter alia, at verification of technical solutions proposed by the nuclear industry and at building a comprehensive knowledge base for assessment of nuclear safety. The paper briefly lists the main research topics which are subjects of the TSOs R&D projects.

Nuclear safety assessment requires a high level of proficiency in safety assessment methodologies and in analysis of operating experience feedback as well as. The need for increased co-operation and reinforced sharing of experience in the field of nuclear safety expertise emboldened the competent organizations with nuclear safety expertise in Europe to establish an ETSON association (European

Technical Safety Organisation Network) - a network aimed in promoting close cooperation on harmonized approaches to safety issues and their assessments. The paper describes the structure of ETSON association, methods of its working and summarizes the main recent activities and achievements.

Country or International Organisation:

Czech Republic

Session 5 (cont'd): Oral Session / **89**

FORO, ENHANCING NUCLEAR SAFETY AND RADIATION PROTECTION IN THE IBERO-AMERICAN REGION

Author: Fernando Castello[1]

Co-authors: Alfredo de los Reyes [2]; Rejane Spiegelberg-Planer [3]; S. Fernández Moreno [4]

[1] *FORO (Ibero-American Forum of Radiological and Nuclear Regulatory Agencies)*

[2] *(CSN)*

[3] *IAEA*

[4] *FORO*

The Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) was established with the purpose of promoting a high level of radiological and nuclear safety in all practices using radioactive materials in the member countries and, consequently, in the countries of the Ibero-American region. The FORO was created in 1997 and is now composed of the nuclear regulatory bodies of nine countries: Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Peru, Spain and Uruguay.
The FORO has the vision of providing a fruitful environment for strengthening the regulatory organizations in its member countries, through the exchange of information, experience and best practices, as well as a robust technical programme in key radiological and nuclear safety areas and regulatory practices identified and supported by the FORO's members. The FORO values cooperation with other organizations while maintaining its independence.
The FORO has launched a number of relevant technical projects in close cooperation with the IAEA (FORO's scientific reference), in key areas of nuclear safety and radiological protection. Seven of these projects have been completed: (1) prevention of accidental exposures in radiation therapy through the application of probabilistic risk assessment and the development of a radiotherapy risk assessment tool (named SEVRRA); (2) cooperation between regulatory and health authorities for the regulatory control of medical exposure; (3) regulatory assessment and inspection of ageing management and long term operation in nuclear power plants (NPPs); (4) control of inadvertent radioactive material in scrap metal and recycling industries; (5) assessment of stress tests performed to NPPs in the FORO member countries and (6) preparedness and response to emergencies and (7) licensing and inspection programme for cyclotrons. The results of many of these projects have been published jointly with the IAEA in Spanish –FORO language- and some of them are also available in English.
In addition, other activities are being conducted on safety culture in regulatory practices for radioactive sources; the implementation of the radiotherapy risk evaluation tool SEVRRA in FORO member countries; the development of a guide for building, developing and maintaining of competences and training programmes on licensing and inspection of safety of nuclear reactors for regulatory staff; and the clearance of small low level waste from small facilities.
The FORO has recently launched new technical projects on implementation of clearance concept and criteria for (small) nuclear installations and on Risk Matrix applied to Industrial Installations.
As the results of the technical program become available, dissemination to all countries in the region and beyond as well as their eventual application is basically being carried out through the IAEA's technical cooperation programme in close collaboration with the FORO. The dissemination of these results is achieved through workshops, conferences, technical meetings and the Global Nuclear Safety and Security Network (GNSSN).
The FORO collaborative web-based IT platform, the RED, was fully updated and released in June 2013. The new RED aims at further sharing and exchanging knowledge on new or existing nuclear and radiological safety and nuclear security issues of regulatory interest and contributes to the development of national systems for the regulation, authorization and control of activities involving

the safe use of ionizing radiation. The RED constitutes a valuable reservoir of technical information on radiation protection, nuclear safety and security from the regulatory perspective.
FORO is strengthening its cooperation with other associations, institutions and networks: (1) The World and the Pan-American Health Organisations in the field of radiation protection to patients; (2) The General Secretariat for Ibero-America to facilitate the spreading of the results of its projects; (3) The International Commission on Radiological Protection as Special Liaison Organisation to exchange scientific and technical information on radiation safety, (4) The International Radiation Protection Association (IRPA) to cooperate in radiation protection through areas of mutual interest like the safety culture.
Around one hundred regulatory specialists in various technical areas related to radiation protection, nuclear safety and security are networking in groups, sharing their experiences, good practices and lessons, addressing problems and regulatory challenges by means of technical projects and other activities. These activities are prioritized by FORO taking into account the members' needs and without duplicating the efforts made by the IAEA in these areas and making the results available to others.
FORO, as an association of 9 regulators, provides technical support to its members, to the other regulators in the region, creating a reference in nuclear safety and radiation protection in close cooperation with the IAEA.

Country or International Organisation:

FORO

Session 5: Oral Session / **90**

A new environment for nuclear safety: Main challenges for the OECD/NEA

Author: Javier Reig[1]

[1] *OECD Nuclear Energy Agency*

The paper presents the new challenges for the NEA after the Fukushima Daiichi accident. All the seven committees of the NEA have initiated specific activities to address the lessons learnt from the accident. The NEA issued a report last year describing the main goals and expectations of these activities as well as an initial response to the accident. (The Fukushima Daiichi Nuclear Power Plant Accident: OECD/NEA Nuclear Safety Response and Lessons Learnt – NEA No. 7161. September 2013). The paper presented at this conference focuses on the activities coordinated by the safety committees, the Committee on Nuclear Regulatory Activities (CNRA) and the Committee on the Safety of Nuclear Installations (CSNI). The CNRA has launched activities related to accident management, defence-in-depth, crisis communication and the safety culture of the regulatory body. The CSNI is looking at different technical issues which played an important role on the evolution of the accident. In addition the CSNI has launched several safety research projects related to the accident scenario and has established a Senior Task Group on Safety Research to achieve a dual objective, to support the Japanese safety institutions and to agree on research activities which will benefit the international community. The paper will conclude describing the current status of the Benchmark Study of the Accident at the Fukushima Daiichi NPP (BSAF), which is completing its phase 1 this November.

Country or International Organisation:

OECD Nuclear Energy Agency

Session 2 (cont'd): Oral Session / **91**

Nuclear Safety and Nuclear Security

Author: Jo Byttebier[1]

[1] *WANO (World Association of Nuclear Operators)*

In the presentation of Jo Byttebier, the operating experience programme director of WANO will discuss the topic of nuclear safety versus nuclear security.
The World Association of Nuclear operators is a membership organisation for operational nuclear power plants and reprocessing plants that was formed in 1989 as a result of Chernobyl accident. The challenges that both nuclear safety and nuclear security are facing will be looked at and the methodology WANO is using to improve and maximise the safety and reliability of the nuclear power plants worldwide will be discussed. From a personal point of view, he will indicate which main directions he would expect nuclear power plants to take to enhance nuclear security in their plants.

Country or International Organisation:

WANO (World Association of Nuclear Operators)

Session 4: Oral Session / **92**

Post Fukushima Activities at AECL

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[1] *Atomic Energy of Canada Limited, Chalk River Laboratories*

Atomic Energy of Canada Limited (AECL) is Canada's premier nuclear Science and Technology (S&T) organization. AECL's capabilities have been utilized extensively to provide technical support to government and industry partners as the events of Fukushima unfolded. They continue to play a role in supporting longer-term S&T for both the industry and the regulator to demonstrate defense in depth for Canadian nuclear facilities.

Country or International Organisation:

Canada

Session 3: Oral Session / **93**

IRSN role, organization, methodology and means as the French TSO for Emergency Preparedness and Response

Author: Olivier Isnard[1]

[1] *IRSN*

After the nuclear accident at Fukushima Daiichi Nuclear Power Plant, Japan in 2011, France decided to enhance its operational capability to respond to any nuclear and radiological emergency, at the governmental level, and to take into account acquired experience during the 2011 response. In this context, the French Government has developed a National Response Plan to a Major Nuclear or Radiological Accident. This plan, addresses the actions to be taken in the areas of protection of the population, but also the aspects of strategic communication or post-accidental management.

The French Institute for Radiological Protection and Nuclear Safety, IRSN, fits easily into this governmental scheme, as the national expert in radiological and nuclear risk to public authorities. IRSN is independent of the French operators and as developed specific operational technical capabilities, supported by its area of expertise. IRSN developed its own response organization to meet governmental needs especially in the expertise area. IRSN provides to the French government on an operational basis an expertise capability in the safety and in the accident progression field, in the assessment of radiological consequences field through the evaluation of doses to the public, the monitoring of the environment and also the public.
The current paper presents the main features of the capabilities of IRSN in the framework of expertise needed during any response to a nuclear or radiological emergency. The organization, methodologies and tools developed by IRSN to fulfill its duty is also presented.

Country or International Organisation:

France

Opening Plenary / 94

Summary on Fukushima Related Activities in Japan

Author: Masashi Hirano[1]

[1] *Nuclear Regulation Authority (NRA)*

This keynote presentation presents an overview and update on the new regulatory framework in Japan including merger of the former TSO, JNES (Japan Nuclear Energy Safety Organization) with the regulatory body, the NRA (Nuclear Regulation Authority), and on the Fukushima Daiichi-related activities with a focus on on-site stabilization such as fuel removal from the spent fuel pools and management of large amount of radioactive water toward safe and prompt decommissioning.
The NRA was established as an independent and integrated commission body in September 2012 and urgently started developing the new regulatory requirements for nuclear power plants which came into force in July 2013. So far, a total of 20 units, 12 PWRs and 8 BWRs, have applied for conformance review to the new requirements for restart.
On March 1, 2014, the former JNES was merged with NRA to enhance the technical competence and expertise of NRA. On that occasion, a new department, Regulatory Standard and Research Department was created in NRA as a so-called "internal TSO" for developing the technical standards and guides and conducting safety research. In parallel, cooperation with the Nuclear Safety Research Center in JAEA (Japan Atomic Energy Agency) and NIRS (National Institute for Radiological Sciences) which are the external TSOs has been strengthened.
Regarding Fukushima Daiichi, Tokyo Electric Power Company (TEPCO) has conducting various activities according to the Mid-and-Long-Term Roadmap towards Decommissioning under the supervision of the Council for Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station of the government.
TEPCO has already started fuel removal from the spent fuel pool (SFP) at unit 4, more than 75% of which has been completed. According to the roadmap, fuel debris removal would start in the first half of the fiscal year 2020 at earliest. It would take 30 to 40 years to complete the whole process.
Large amount of radioactive water being created daily is a difficult issue that needs long-term efforts. Highly radioactive water remaining in the seawater pipe trenches in the seaside area is believed to be the highest risk contributor at the moment. In order to drain the radioactive water in the trenches, TEPCO is attempting to plug the flow paths between the trenches and turbine buildings by applying the ice plugging technique that will also be applied for construction of the so-called "frozen soil wall" surrounding the units 1 to 4.

Country or International Organisation:

Japan

Session 4 (cont'd): Oral Session / **95**

Organization and responsibilities of internal or external TSOs, IAEA perspective

Author: Nesimi Kilic[1]

[1] *IAEA*

It has been recognized that the provision of effective technical support is essential to optimize the safe operation of nuclear power plants and to maximize their reliability, availability and productivity. A competent TSO can greatly support the nuclear programme leaders, the appointed government organizations and other stakeholders to provide all necessary information to support their decisions including during the licensing, construction, commissioning and operation phases. The importance of a Technical Support Organizations (TSO) was enhanced again in the technical reviews and activities that followed the Fukushima accident.
In the light of collected operational experience since the issue of IAEA's Roles and Responsibilities of Technical Support Organizations (TSO) document (TECDOC-1078), IAEA initiated a revision and update to such guidance in mid-2012 for improvement of TSO organizations and their functions. The new guidance is also to serve as a reference for new comer countries, where establishing an effective TSO both in operating organization and the regulatory body becomes essential for successful and safe implementation of the first nuclear power plant. This paper discusses the IAEA activities on the guidance and provides key points, such as organization, roles and functions, which have been elaborated during the consultancy and technical meetings with Member States experts.

Country or International Organisation:

IAEA

Session 1 (cont'd): Oral Session / **96**

The UK and European Response to Fukushima

Author: Andy Hall[1]

[1] *ONR*

Following the accident at the Fukushima Dai-ichi site, ONR's Chief Nuclear Inspector reported on the implications and lessons learnt for the UK nuclear industry. This review extended to all UK nuclear licenced sites and concluded that analysis of the Fukushima Dai-ichi accident revealed no fundamental safety weaknesses in the UK nuclear industry. However, 38 areas were identified where lessons could be learned in the UK from the crisis in Japan.
In developing its response to Fukushima, ONR co-operated extensively with international organisations, notably with the IAEA and the Western European Nuclear Regulators Association (WENRA). ONR's approach was consistent with European response to Fukushima, developed by the European Commission and European Nuclear Safety Regulators Group (ENSREG).
The report highlighted the importance of the principle of "continuous improvement" to achieving high standards of nuclear safety. This principle is embedded in UK law, where there is a requirement for nuclear designers and operators to reduced risks so far as is reasonably practicable. This is underpinned by the requirement for detailed periodic reviews of safety (throughout the life of an installation) to seek further improvements. This means that, no matter how high the standards of nuclear design and subsequent operation are, the quest for improvement should never stop. Seeking to learn from events, new knowledge and experience, both nationally and internationally, is a fundamental feature of the safety culture in the UK nuclear industry.
Whenever a major accident occurs there are, not unreasonably, questions and comments directed to the regulatory body in relation to its role overseeing the safety of facilities. Often questions arise over the independence of the regulator, and the approach taken for individual regulatory decisions. The concept of "intelligent customer" has developed in UK to ensure that organisations account for

their legal duties for any work commissioned externally. Applied to the regulatory context, this concept requires regulators to have sufficient competent resource within the regulatory body to specify, oversee and accept support provided under technical support contracts. Regulatory decisions are made by the warranted inspectors to safeguard regulatory independence.

Country or International Organisation:

UK

Session 1 (cont'd): Oral Session / **97**

Panel discussion (Session 1)

Session 2 (cont'd): Oral Session / **98**

Panel discussion (Session 2)

Opening Plenary / **100**

Progress on the implementation of the IAEA Action Plan on Nuclear Safety and the IAEA Fukushima Report

Author: Gustavo Caruso[1]

[1] *IAEA*

In response to the accident at the Fukushima Daiichi nuclear power plant, IAEA Member States unanimously adopted the Action Plan on Nuclear Safety. The purpose of the Action Plan is to define a programme of work to strengthen the global nuclear safety framework. Strengthening nuclear safety in light of the accident is addressed through a number of measures proposed in this Action Plan including 12 main actions, each with corresponding sub-actions, focusing on: safety assessments IAEA peer reviews; emergency preparedness and response; national regulatory bodies; operating organizations; IAEA Safety Standards; international legal framework; Member States planning to embark on a nuclear power programme; capacity building; protection of people and the environment from ionizing radiation; communication and information dissemination; and research and development. In this context Technical Support Organizations (TSOs) play a very important role in supporting regulatory bodies and operating organizations in strengthening nuclear safety worldwide, including through the effective utilization of the results of research and development. The activities of the IAEA to learn the lessons from the Fukushima Daiichi accident are described, in particular the needs for further research and development and how these needs have been widely disseminated. In addition the activities to promote cooperation and collaboration among the TSO community by the IAEA are summarised. Progress with the preparation of the IAEA Report on the Fukushima Daiichi accident is also described.

Country or International Organisation:

IAEA

Session 3 (cont'd): Oral Session / **101**

Panel discussion (Session 3)

Session 4 (cont'd): Oral Session / **102**

Panel discussion (Session 4)

Session 5 (cont'd): Oral Session / **103**

Panel discussion (Session 5)

Session 3: Oral Session / **104**

Potential Role of TSOs In IAEA's Assessment and Prognosis in Response to an Emergency at a Nuclear Power Plant

Author: Florian Baciu[1]

[1] *IAEA*

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Country or International Organisation:

IAEA

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Nuclear Safety & Security Program at Al-Tuwaitha Site

Author: Haider Kamil Esa Al-Hamadani[1]

[1] *Radiation and Nuclear Safety Directorate (RNSD)*

There are a number of sites in Iraq which had been used for nuclear activities and which contain significant amounts of radioactive material (former Iraqi Atomic Energy Commission). The principal nuclear site is Al- Tuwaitha Nuclear Research Center, it is the main nuclear site in Iraq that was involved with handling nuclear material. It was established in 1967, where three main nuclear facilities and waste location were put in operation. which were the IRT-5 MW research reactor, the radioisotope production building and the dumping station (waste store).
Al-Tuwaitha Nuclear Research Center which contains 18 facilities and radwaste locations, including research reactors, hot cells, waste treatment and storage facilities. Also, there are a further 10 sites identified in the country (outside Al-Tuwaitha site) of which mainly processed and enriched uranium material. These sites suffered substantial physical damage during the Gulf Wars of 1991. All these sites require decommissioning program and/or remediation in order to ensure nuclear safety

and security.
This paper aims to describe the nuclear safety and security program at Al-Tuwaitha site, which is designed to protect workers, public and environment.

Country or International Organisation:

Radiation and Nuclear Safety Directorate (RNSD)