Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security

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25–29 October 2010

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PROCEEDINGS SERIES

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FOREWORD

To sustain the Global Nuclear Safety and Security Framework, Member States, the IAEA, other international organizations and interested stakeholders have continued to work to strengthen each element of that framework, all of which are critical to its success. To accomplish this task, the IAEA has convened a number of major conferences to address topical issues and key strategies for consideration by the international nuclear community. Technical and scientific support organizations (TSOs) are key stakeholders that play an integral and substantive role in assisting regulatory authorities in establishing and maintaining nuclear and radiological programmes based on a firm, science based foundation for safety and security.

In 2007, the first International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety was held in Aix-en-Provence, France, with the objective of providing TSOs from different countries, international organizations and experts with an opportunity to develop a common understanding of the responsibilities, needs and opportunities of TSOs. At the Aix-en-Provence conference, senior regulators, heads of TSOs and other stakeholders concluded that a platform for networking between TSOs for the enhancement of nuclear safety and security was needed. To help realize this vision, an International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security was held in Tokyo from 25 to 29 October 2010. This second conference focused on international cooperation and networking among TSOs to enhance nuclear safety and security, especially in terms of their common values and their role in the regulatory process and capacity building in those Member States considering embarking on nuclear power programmes.

Thirty-two panel members from across the spectrum of international nuclear activities made presentations addressing topical issues that expanded on the themes of the 2007 conference held in Aix-en-Provence. These topical issues were: the roles, functions and values that guide TSOs in enhancing nuclear and radiation safety; technical and scientific support for nuclear safety infrastructure development and capacity building; the emerging need for nuclear security technical and scientific support; and nuclear safety and nuclear security networking and centres of excellence.

The President's report on the conference, as well as the conclusions and recommendations of the meeting, is included in these proceedings and provides an overview of all the issues addressed.

In the presentations and subsequent discussions, the conference highlighted positive outcomes, confronted areas of continuing concern and explored avenues to address those concerns. Among the more salient findings was the determination that a means for continuous dialogue among TSOs was necessary. The need to support the review process for a future IAEA safety publication on external expert support on safety issues was also identified. Finally, consideration of a TSO forum along the lines of the Regulatory Cooperation Forum to develop best practices and promote common values was recommended.

This publication constitutes a record of the conference and includes: a foreword, a summary, the opening addresses and invited papers, and the conclusions, recommendations and a conference summary by the President. The attached CD-ROM contains the unedited contributed papers, the list of participants and the presentations that were submitted with the invited papers.

The IAEA gratefully acknowledges the work of the Programme Committee and the support and generous hospitality of the Government of Japan and, in particular, the Japan Nuclear Energy Safety Organization (JNES) in organizing this conference.

EDITORIAL NOTE

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SUMMARY

In 2007, the first International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety was held in Aix-en-Provence, France. An objective of that conference was to provide technical and scientific support organizations (TSOs) from different countries, and international organizations and experts, with an opportunity to discuss relevant issues and develop a common understanding of the responsibilities, needs and opportunities of TSOs. At the Aix-en-Provence conference, senior regulators, heads of TSOs and other stakeholders concluded that a platform for networking between TSOs for the enhancement of nuclear safety and security was needed. To realize this vision, an International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security was held in Tokyo from 25 to 29 October 2010. This second conference focused on international cooperation and networking among TSOs to enhance nuclear safety and security, especially in terms of their role in the regulatory framework, including capacity building in those countries considering embarking on nuclear power programmes.

The objectives of this conference were to develop a common understanding of the responsibilities, needs and opportunities of TSOs and to further promote international cooperation and networking among TSOs to enhance nuclear and radiation safety and nuclear security, including capacity building in countries with experience — extensive or limited — in nuclear power and in countries considering embarking on nuclear power programmes.

The Conference President was J. Repussard, Director General of the Institute for Radiological Protection and Nuclear Safety (IRSN). A total of 229 participants and observers from 46 Member States and 5 organizations attended the conference. There were six opening addresses, a keynote panel discussion, four topical issue sessions and a closing session, with 32 presentations from invited speakers and a large number of contributed papers, all of which are available on the attached CD-ROM.

The opening session of the conference included addresses by dignitaries from the Government of Japan, the Japanese Nuclear and Industrial Safety Agency (NISA), the Japan Nuclear Energy Safety Organization (JNES), IRSN, the French Nuclear Safety Authority (ASN) and the IAEA. The opening addresses stressed the importance of the contribution that TSOs make to nuclear safety and security and identified competence, expertise and research as key areas in which TSOs have a role. The Conference President concluded the session by emphasizing that nuclear safety, radiation protection and nuclear security are not static, and that their constant evolution is dependent on science and technology, progressing or regressing on the basis of economic and societal influences and fluctuations.

A keynote panel composed of six representatives of Member States and international organizations addressed the conference on the subject of "Challenges in Enhancing the Global Nuclear Safety and Nuclear Security Regime: How Can Technical and Scientific Support Contribute?" The panel discussion emphasized the need to strengthen the role of TSOs and their global cooperation, particularly for those countries in the process of expanding, or considering embarking on, a nuclear power programme.

The keynote panel was followed by four sessions, moderated by two chairpersons each, devoted to topics of interest. The sessions included 21 presentations by key participants from Member States, the IAEA and other international organizations.

The first topical issue session, on "Roles, Functions and Values that Guide TSOs", was a follow-up of the discussions initiated at the first TSO conference in 2007 in Aix-en-Provence. The progress achieved since that time in developing a common understanding of the roles, responsibilities and key values and principles that guide TSOs was addressed.

The second topical issue session, on "Technical and Scientific Support for Nuclear Safety Infrastructure Development and Capacity Building", presented the status and challenges of capacity building and infrastructure development, particularly as encountered by countries considering nuclear power programmes for the first time. A number of examples were raised, such as support for medical and industrial dosimetry, and support during extended shutdown of research reactors. The challenges of both extending an existing nuclear programme and of establishing a new nuclear safety infrastructure were discussed.

Presentations in the third topical issue session, on "The Emerging Need for Nuclear Security Technical and Scientific Support", pointed out that a strong security culture in synergy with the safety culture is essential to further develop nuclear power security programmes. There is a strong need for technical support in the field of nuclear security. New areas of work in this field must be covered by a high degree of competence. Questions on how to develop human and other resources were discussed, and the need for cooperative and integrated approaches was pointed out. There was a strong consensus on the need to fully take into account security issues, including the provision of scientific and technical expert advice to the regulatory body, so as to adequately balance security and safety requirements.

The discussion in the fourth topical issue session, on "Nuclear Safety and Nuclear Security Networking and Centres of Excellence", focused on the value of TSO networks in sharing safety and security knowledge and culture, experience and lessons learned. It was emphasized that all such networks have to be oriented towards improving nuclear safety and security, following the principles set out in the IAEA safety standards and nuclear security guidance. The example of the Asian Nuclear Safety Network and others were explored to illustrate this point.

The closing panel discussion, on “Actions Needed to Move Forward”, focused on the development of concrete proposals to promote the role of TSOs as an essential part of the Global Nuclear Safety and Security Framework and to organize and foster information exchange and cooperation between TSOs.

Following the presentations and panel discussions, the President developed six specific conclusions and five recommendations, which were presented to the conference and are detailed in the President’s report included in these proceedings and summarized here. The conclusions are as follows:

- *Much progress has taken place in the field of TSO issues since the first TSO conference was held in France in 2007, but there are also many ongoing challenges, particularly in Member States embarking on nuclear power programmes.* The conference recognized that the sustainable performance of a national nuclear safety regulatory system requires that major functions be adequately resourced and organized. The conference recognized that it is up to each Member State to decide which type of organization is most suitable for carrying out these technical support functions, taking into consideration relevant national parameters, in particular with respect to the existing mechanisms to recruit staff and manage funding systems in governmental bodies. There was a strong consensus on the need to fully take into account security issues at the scientific and technical expertise level of the regulatory system employed. There was general agreement that it is virtually impossible to include in the regulatory system (the regulatory body and its technical support) all the scientific resources and competencies needed for regulatory purposes. This is particularly true for those Member States that are at the beginning of their nuclear strategy implementation. The explicit identification of TSO functions may facilitate the appropriation, at the national level, of the human, technical, organizational, institutional and financial resources needed to perform key support functions. In this context, the conference encouraged Member States to participate in the IAEA safety standards development process by providing comments on the draft Safety Guide on External Expert Support on Safety Issues (DS429). Substantive comments provided now will ensure that this important guide takes full advantage of the outcome of the discussions that took place in Tokyo, and in the future will serve as an appropriate basis for peer review mechanisms dedicated to TSO functions. Reinforcing TSO networking capacity worldwide by providing a forum for TSO interaction, with close working relations with the Regulatory Cooperation Forum

(RCF), where international and regional technical cooperation opportunities could be explored, was also encouraged. The Tokyo TSO conference recognized the outstanding contribution of TSOs to the enhancement of nuclear safety and security worldwide.

- *It is essential that ongoing efforts to improve and optimize the technical capabilities needed worldwide be continued, in order to adequately support nuclear safety and security supervision.* The conference recognized that effective nuclear safety and security requires access to excellent, state-of-the-art risk assessment capabilities, which should be continuously developed. There was a widely shared concern that, from a quantitative point of view, the currently available TSO resources are insufficient to address all needs. The conference noted that such needs can be generated by existing or new nuclear power programmes. The conference pointed out that access to existing expert resources could be improved and optimized in several ways. The resources can be utilized to support the oversight of safety and security programmes.
- *There is an emerging need for nuclear security scientific and technical support.* The conference illustrated the strong international consensus on the need to address nuclear security challenges using a holistic and synergetic approach, taking into consideration technical, organizational and cultural aspects. Optimization of security at nuclear installations requires that it be taken into account from the very point at which it is decided to pursue nuclear power and, operationally, in the design stage. The broader range of stakeholders that have responsibility for nuclear security may require specific coordination arrangements, such as a federation of organizations. Several positive examples were presented of the need to introduce and implement a nuclear security culture. Safety and security training and applied tutoring programmes, including tabletop or in situ exercises, should be organized. There was consensus that there is, in all Member States, a growing need for a broad range of TSO capabilities in the field of security.
- *Governments have a unique responsibility in the definition and implementation of TSO capability policies.* The conference underlined the essential role of competent governmental institutions, in the current context of development of nuclear energy applications, to ensure that adequate and timely measures are adopted in order to strengthen and maintain TSO capabilities in the light of national needs. Qualified and appropriately trained personnel are needed by both the nuclear industry and the regulatory system within each Member State. Adequate levels of financial resources dedicated to nuclear safety and nuclear security — in particular, funding plans for new build programmes — should from the start include the

coverage of costs associated with technical support needs in the context of licensing and regulatory oversight processes. Finally, there was consensus on the need for TSOs, whatever their mode of organization at the national level, to maintain close scientific connection with the research and academic communities, as well as with industry and other stakeholders.

- *TSO needs are particularly crucial for countries engaged in nuclear energy programmes.* The conference pointed out that one of the main challenges for a country embarking on a nuclear power programme is to develop its own capacity building strategy, plans and practical organization. It reaffirmed the crucial importance of the availability of adequate technical and scientific support. The conference considered that the goal of achieving high levels of nuclear safety and security worldwide, especially given the large number of countries anticipating or currently using nuclear energy, calls for a more concerted effort by all stakeholders to develop and maintain a substantive knowledge base and to make it readily available.
- *There is a continued need for a strong driving force for the development of TSO capability.* The conference agreed on the need for a central organization to facilitate the emergence of consensus on safety, security, public health and environmental issues by developing comprehensive standards and guidance documents within the Global Nuclear Safety and Security Framework. Further development of networking between and among TSOs worldwide should also be encouraged, as a key element to facilitate effective and sustainable capacity building and infrastructure development for new and expanding nuclear power programmes. Regarding knowledge transfer, the conference noted the initiatives of TSO networks to organize and increase training and tutoring possibilities, and to respond to today’s pressing demand in this field. It was emphasized that the quality of training in safety and security assessment depends upon the practical expertise of the trainers. Access of safety and security authorities in all Member States to state-of-the-art expert services provided by TSOs should be facilitated, by supporting the establishment of designated TSO centres of excellence.

The five recommendations can be read in full length at the end of these proceedings. They include the following:

(1) Relating to the IAEA draft Safety Guide on External Expert Support on Safety Issues (DS429), the IAEA may wish to consider including in the final version the relevant conclusions from this conference together with future comments from Member States.

(2) Plans for a third international TSO conference, to be held in 2013–2014, should be initiated. In this respect, the conference welcomed the proposal of China to host this next conference.

(3) Efforts should be made to foster the establishment of a forum dedicated to nuclear safety infrastructure development issues related to scientific and technical support. Such a ‘TSO Forum’ would meet regularly in the intervals between the international TSO conferences, establish close working relations with the RCF, and operate in conjunction with established regional TSO cooperation structures as well as with the OECD Nuclear Energy Agency’s Committee on the Safety of Nuclear Installations (CSNI) on science related issues.

(4) All parties concerned should promote the principal findings and outcomes of this conference on the occasion of major international nuclear safety meetings and other relevant venues.

(5) Considering the increasing importance of the interdependence of nuclear safety and security in the light of emerging threats, including cybersecurity, the conference recommended that, as appropriate, TSO functions should be expanded to include providing technical support to competent authorities in the field of nuclear security, in order to achieve greater safety and security synergy.

The President and the conference participants encouraged international organizations and Member States to implement these recommendations and commit to continuing the cooperation realized at the conference. The participants agreed that conferences such as this were essential to continuous improvement in pursuit of a harmonized, well organized and highly effective nuclear safety and security framework.

OPENING SESSION

OPENING ADDRESS

T. Matsushita
Senior Vice Minister of Economy, Trade and Industry,
Tokyo, Japan

As kindly introduced, I am Tadahiro Matsushita, Senior Vice Minister of Economy, Trade and Industry. I was born and brought up in Kagoshima, a prefecture in the south of Japan. In my hometown, Satsumasendai, two 890 MW nuclear reactors were built about 30 years ago, and a new 1590 MW reactor, Japan's largest, is about to be built. All the procedures have been almost finished, and in three years construction will start. So such is my hometown, and I have the responsibility of Senior Vice Minister of Economy, Trade and Industry, which is the Ministry in charge of nuclear energy policy in Japan.

I am very pleased that Japan is hosting such an important international conference. To address current environmental and other issues, an increasing number of countries are willing to enhance their use of nuclear energy or to introduce it; thus it is very important for ensuring safety that adequate infrastructure be developed and expert training programmes be supported. At the Nuclear Security Summit held in April this year, Japan issued a national statement to stress the importance of ensuring nuclear security.

Under such circumstances, there is no doubt that the IAEA's activities in the safety and security field will gain even more importance. And it is pertinent that the parties concerned fully discuss the issues to be confronted by TSOs, including those concerning nuclear security, at this conference.

TSOs play a very important role in supporting the regulatory bodies of the participating countries with their scientific and technical knowledge. The Ministry of Economy, Trade and Industry gives first priority to ensuring safety in promoting the nuclear energy policy. Through international organizations such as the IAEA, Japan will continue to contribute to the international community in making full use of the excellence of Japanese technology and in sharing its knowledge and experience at the international level.

Finally, I sincerely hope that lively discussion will allow the TSOs of the participating countries to develop an even better international network and to deepen mutual understanding, which in turn contributes to global nuclear safety.

As the Diet is in session, I am sorry that I must leave the conference hall very soon. I hope that you will have a productive discussion and that the conference will result in a fruitful outcome.

Thank you for your kind attention.

OPENING ADDRESS

D. Flory
Deputy Director General,
Department of Nuclear Safety and Security,
International Atomic Energy Agency,
Vienna

WELCOME AND INTRODUCTION

Good morning, Senior Vice Minister Matsushita, Mr. Repussard, Conference President and Director General of the Institute for Radiological Protection and Nuclear Safety (IRSN), Mr. Sogabe, President of the Japan Nuclear Energy Safety Organization (JNES), Mr. Terasaka, Director-General of the Nuclear and Industrial Safety Agency (NISA), Mr. Lacoste, President of the French Nuclear Safety Authority (ASN), distinguished guests and colleagues. On behalf of Director General Yukiya Amano and the Secretariat of the IAEA, I am very pleased to welcome you to the 2010 International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security.

I do not think there is a coined definition of TSOs; it is also true that the meaning of the letter ‘s’ varies indeed, from ‘support’ to ‘scientific’, going through ‘safety’… and why not ‘security’?

It may be easier to say what they do: TSOs provide the necessary scientific approaches and support to the authorities, the regulators and even sometimes to the public, in the development of nuclear safety and security. They are present in the international Convention on Nuclear Safety, even if somewhat subliminally, through the objective “to achieve and maintain a high level of nuclear safety worldwide through the enhancement of national measures and international co-operation including, where appropriate, safety-related technical co-operation”.

The Global Nuclear Safety and Security Framework (GNSSF), now operational, is the international framework for achieving and maintaining this high level of safety and security at nuclear facilities and activities around the world. This framework is meant to answer some of the needs relevant to the challenges faced by TSOs.

TOKYO CONFERENCE OBJECTIVES

Let us refer back to the first TSO conference in France. In 2007, many of you attended the first International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety, held in Aix-en-Provence — a city close to my heart, where I started my career some years ago. That conference provided an opportunity for TSOs from different countries and other organizations and experts to discuss and develop a common understanding of the responsibilities, needs and opportunities of TSOs. Further, senior regulators, TSO leaders and other stakeholders at that conference concluded that better visibility and a clearer understanding of the role of TSOs in the enhancement of nuclear safety was needed. In this respect and as a follow-up to that conclusion, this second conference in Tokyo seeks to achieve the following objectives:

- 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 through the use of TSOs in those countries embarking on, or those with limited as well as extensive experience in, nuclear power programmes.

WHAT HAS BEEN ACHIEVED?

Among the main achievements realized so far, I would like to stress the following:

- The first TSO conference recommended that the IAEA facilitate the establishment or enhancement of networks on a regional and an international level. A big step forward has recently been made by establishing and making available to professionals and the public the Global Nuclear Safety and Security Network (GNSSN). We must keep in mind that we still have to establish a global network for TSOs. More details on this global network will be covered on Thursday in the fourth topical issue session. All interested Member States and international organizations are invited to use this platform for active cooperation and dissemination of knowledge, experience and lessons learned.

— Since 2007, the IAEA has taken the initiative to address Member State concerns with respect to the roles and activities of TSOs as detailed in the draft Safety Guide on “External Expert Support on Safety Issues” (DS429), which will soon be sent to Member States for 120 days to comment.

WHAT ARE THE ACTUAL CHALLENGES FACING A TSO?

The global energy world is experiencing a period of dynamic changes. The introduction of new nuclear power plants in newcomer countries, the expansion of existing nuclear power programmes, and the wider use of radioactive sources and ionizing radiation in general highlight the need for continued and improved international cooperation, strengthened capacity building and infrastructure development and knowledge networking to address the associated challenges.

Among these challenges are the following:

— As new regulatory authorities are being established, their need for support appears to be growing, and the IAEA draft Safety Guide on “External Expert Support on Safety Issues” (DS429) will help them in this purview. However, without a good scientific basis, safety cannot find its roots. The reality is that it takes longer to develop the education, research and training system in physics, chemistry and mechanics, and in safety, than to draft a nuclear law. Existing TSOs and their networks will need to organize themselves to answer this crucial need. The good news is that they have already started, and that we, at the IAEA, shall continue to lend all our support to their efforts.

— The IAEA draft Safety Guide on “Establishing the Safety Infrastructure for a Nuclear Power Programme” (DS424) provides guidance on how to apply the IAEA safety standards in the development of a nuclear power programme. This guide was successfully approved this month by the Commission on Safety Standards and will soon be published.

— In addition to new nuclear power plants, long term operation (LTO) and ageing management are growing issues in many nuclear power plants. The number of nuclear power plants eligible for an extension of their operating life is increasing, and hence the LTO issue is becoming very significant and deserves to be systematically addressed and integrated into all aspects relevant to safety and security. Here also, science and research are needed in support of the licence extension process.

— The coexistence of different nuclear power plant designs with different levels of safety and security features will raise the question of how to reduce the safety and security gap between nuclear power plants designed in the past century and still operating and those that are being built or foreseen today and that may well operate into the 22nd century.
— Improving the long term management of radioactive and nuclear materials: The Code of Conduct on the Safety and Security of Radioactive Sources — supported by many countries — helps Member States to achieve and maintain a high level of safety and security of radioactive sources. It also helps to prevent unauthorized access and helps to mitigate, or minimize, the radiological consequences of any accident or malicious acts.
— To meet the issues I have mentioned, it is important that the global TSO community work towards helping regulatory bodies establish and maintain adequate safety and security infrastructures and build technical capacity so they do not fall behind in the rapid development of nuclear technology. Further, TSOs will need to work with so-called newcomers and with those expanding their nuclear energy programme, to bring them their scientific, safety and security experience. They will be instrumental in helping to ensure the establishment of the necessary scientific and technical safety and security knowledge and capacity, which is an integral part of the regulatory processes.

THE CHALLENGES THIS WEEK

At this conference, we need to seize this opportunity to share ideas, advance the current TSO body of knowledge, and network with each other on a national, regional and global scale.

It is vitally important that we make the most of the time we invest in this week’s programme. There are urgent needs for us to identify and take concrete international actions to meet today’s emerging challenges to further enable the safe, secure, peaceful use of nuclear and radiation technologies throughout the world.

Also, let me take this opportunity to sincerely thank the Government of Japan for hosting this very important event through the Japan Nuclear Energy Safety Organization (JNES) and for making excellent arrangements for its success. My sincere thanks and appreciation go to J. Repussard, the Conference President, together with the Scientific Secretaries, Conference Secretariat and the Programme Committee, for their hard work in putting this excellent programme together.

The success of this international conference will in no small way depend on your active participation this week, and also on your continued support and involvement in the implementation of the conclusion and recommendations that will result from it.

I enthusiastically look forward to the presentations and discussions we will have during the coming days. I wish you all a successful conference.

OPENING ADDRESS

N. Terasaka
Director-General,
Nuclear and Industrial Safety Agency (NISA),
Tokyo, Japan

I am Nobuaki Terasaka, Director-General of NISA, the Nuclear and Industrial Safety Agency of Japan. I am grateful that we are all together today at the second technical and scientific support organization (TSO) conference, organized by the IAEA and hosted by the Japan Nuclear Energy Safety Organization (JNES) here in Tokyo. I am very proud that, with the support of JNES, Japan is the host country for this important international conference. We also know that this is the result of great cooperation and efforts made by the staff at the IAEA and many stakeholders from related countries. Therefore, I would like to take this opportunity to express my deep appreciation to Mr. Denis Flory from the IAEA, and to everyone else who made this conference possible.

WORLD SITUATION, NUCLEAR RENAISSANCE AND THE JAPANESE CONTRIBUTION

As Senior Vice Minister Tadahiro Matsushita told us, in order to address global warming and energy security issues, nuclear energy is now being re-evaluated internationally — as we call it, the ‘nuclear renaissance’. Under these circumstances, the role of the IAEA is becoming more and more important in securing global nuclear safety and security. In Japan, we have been making human resource and financial contributions to the IAEA’s activities, including education. For example, Japan has been a leading country in establishing a nuclear safety network and in improving the level of nuclear security in Asia for the last ten years.

Also, Japan has a tremendous amount of experience and knowledge concerning seismic safety, and when the IAEA started the International Seismic Safety Centre, we were deeply involved and have been making special human resource and financial contributions to the activity. And we will continuously support the IAEA’s safety related activities.

LACK OF HUMAN RESOURCES IN NUCLEAR POWER

A challenge we face is that the lack of human resources in the nuclear field is a serious issue that is growing and becoming more global. This lack of human resources can directly influence nuclear safety, and we must take immediate measures to address this issue.

At the same time, those countries that have a lot of experience with the peaceful use of atomic energy, including Japan, are working with the IAEA and other organizations to support newcomer countries with assistance in nuclear safety and security. However, resources for such support are limited.

SIGNIFICANCE OF TSOs

Because of this, the role of TSOs is expected to become increasingly important in the future. There is often a gap between the desired safety level and the resources to secure that required level in the regulatory bodies. The TSO is the organization that is expected to fill that gap with its technical and professional skills.

It is also an important TSO role to conduct safety research on technical infrastructure development, in order to handle new regulatory challenges. In many ways, TSOs have become absolutely imperative to securing nuclear safety.

The resolution made at the IAEA's General Conference in September promotes better understanding of the significance of TSOs, and we are hoping such an understanding of TSOs in each country will be enhanced through this conference.

USE OF TSOs BY NEWCOMER COUNTRIES IN BUILDING SAFETY INFRASTRUCTURE

To support nuclear safety infrastructure development in newcomer countries, there are high expectations on the TSOs of the nuclear developed countries that can provide effective support tools, including human resources development capabilities. TSO support tools should be effectively and efficiently shared around the world, and these tools should facilitate the development of the infrastructure for nuclear safety and security, such as capacity building in newcomer countries. TSOs around the world should enhance the Global Nuclear Safety and Security Network and address the challenges together.

If each emerging nuclear power country can introduce technical and regulatory systems appropriately, the outcome, which is safety, will be enjoyed internationally. We share the same nuclear power destiny on a global level. If there is a weakness in a safety and security programme somewhere on our planet, and if there is an accident or incident, wherever it is, it will stop nuclear power development worldwide.

Nuclear developed countries, which have long and rich experience in nuclear power, such as Japan, are expected to support emerging nuclear power countries with nuclear safety and security, and we believe that utilizing TSO resources effectively in each country is a realistic approach.

ROLE OF TSOs FROM THE POINT OF VIEW OF THE REGULATORY BODIES

Let me take a few minutes to explain the regulatory body in Japan. NISA is a regulatory body, and we have a very good relationship with JNES, which is a TSO that supports our regulatory activities directly.

NISA has about 450 staff, engaged not only with nuclear power but also with other regulations, and JNES has about 420 experts, supporting mainly safety related regulations in nuclear power. JNES is capable of taking a partial role in safety evaluation and investigation, and NISA and JNES share roles to ensure safety.

For example, in safety evaluations, when the operators submit their safety analyses, JNES conducts cross-check studies on them; based on those results, NISA evaluates the validity of the safety analyses of the operators. With regard to safety investigations, JNES is the main body to conduct periodic safety management reviews, checking how the licensees manage their system. And NISA makes evaluations based on the results given by JNES.

Also, JNES works on severe accident response and risk information sharing, so they have well established technical infrastructure with which to respond to new regulatory challenges. As my few examples show, JNES contributes to improving the nuclear safety levels in Japan by technically supporting regulatory activities and by establishing technical infrastructure.

We believe that regulatory bodies and TSOs working closely together to improve domestic safety and security standards is one effective model to maximize the competency of TSOs.

CONCLUSION

Last but not least, I hope this second international TSO conference will be a significant one through active discussions. Also, I sincerely hope that the participants will share and implement the outcome of this conference in their future activities.

October is a very good time to be in Tokyo. While you are here, I hope everyone will create a cooperative human network, deepen international communication and enjoy the Japanese culture.

OPENING ADDRESS

A.-C. Lacoste
President,
French Nuclear Safety Authority (ASN),
Paris, France

Pursuant to the Law of 13 June 2006 on Transparency and Security in the Nuclear Field (the TSN Law), the French nuclear regulatory body, called the French Nuclear Safety Authority (Autorité de sûreté nucléaire (ASN)), was constituted as an independent administrative authority. The new status ensures ASN's independence from the Government, while maintaining its integration within the French State. It also provides for ASN to regulate nuclear safety and radiation protection, with a view to protecting workers, patients, the public and the environment against the risks relating to nuclear activities, and to contributing to informing the public.

The TSN Law, which sets a comprehensive and clear framework for the regulation of nuclear safety and radiation protection in France, details the various duties and responsibilities of the French regulatory body, especially with regard to the drafting of regulatory texts, the issue of commissioning and discharge authorizations, the oversight of licensed installations and the information of citizens.

In France, since the early development of nuclear energy, there has been a clear political determination to separate the safety assessment from the regulation of nuclear safety. Already in the early 1970s, the choice was made to set up two bodies, one with an authoritative and decision making role and the other as a technical support team with expert skills.

Forty years later, a strong link has been established between ASN and its technical support organization, the French Institute for Radiological Protection and Nuclear Safety (Institut de radioprotection et de sûreté nucléaire (IRSN)). As a unique technical support organization (TSO) in France, the IRSN has been involved throughout the development of the French nuclear fleet. The IRSN is a key actor in nuclear safety and radiation protection in France and shares the memory of the entire system with ASN.

In order to carry out its duties, ASN relies on high level expert skills for the safety assessment and analysis of technical cases. The competence and expertise of both ASN and the IRSN are mutual and complementary. The good relationships and the close interface that exist between ASN and the IRSN were highlighted by the peer team coordinated by the International Atomic Energy

Agency (IAEA) for the Integrated Regulatory Review Service (IRRS) mission that was held in France in November 2006.

ASN is truly supporting the development of IRRS missions worldwide and also favours the creation of a similar expert review service dedicated to TSOs. That issue was pointed out at the first conference on TSOs, held in Aix-en-Provence, France, in 2007.

One of the recommendations issued by the IRRS expert team in France deals with ASN's involvement in the research programme performed by the IRSN and other research bodies. Since high quality safety assessments are nurtured by the best currently available knowledge, relevant research programmes need to be implemented with anticipation. It is actually essential for regulatory bodies to ensure that knowledge is available when needed.

ASN's interest in applied research programmes is increasing, likely in order to provide results for improving safety assessments within five or ten years. ASN is not a research body by nature and does not intend to be involved in putting together programmes or running them. However, ASN wishes to ensure that all research orientations regarding nuclear safety and radiation protection are duly taken into account in the programmes adopted by the IRSN, operators and other French research bodies (universities, industry), as well as in European and international projects.

A scientific committee was set up within ASN in July 2010. With six members, including a foreign expert, that committee reports to the ASN Commission and is in charge of identifying essential topics to be included in national and international research programmes.

By addressing key challenges for TSOs, irrespective of the organizational set-up in various countries — with the TSO integrated into the regulatory body or independent of it — I am confident that this conference will be fruitful and will show the way forward to harmonization and international cooperation.

OPENING ADDRESS

K. Sogabe
President,
Japan Nuclear Energy Safety Organization (JNES),
Tokyo, Japan

Good morning, ladies and gentlemen. I am Katsuhiro Sogabe, President of JNES, the Japan Nuclear Energy Safety Organization.

First, it is a great honour and privilege for us to host this very important conference of the IAEA in Japan. I also would like to extend a warm welcome to all of you, especially to those who have come a long way to attend this conference. JNES is a technical and scientific support organization (TSO) for the Nuclear and Industrial Safety Agency, which is the nuclear safety regulatory authority in Japan. As an expert organization, JNES conducts a wide range of activities, including inspection of nuclear facilities, safety analysis and evaluation, emergency preparedness, and investigation, testing and research on nuclear safety, to support the foundations of nuclear safety regulation.

In the pursuit of the essential mission of ensuring nuclear safety, we are striving to continuously improve our technical knowledge and expertise and to optimize our organization for accomplishing this mission. At the same time, JNES considers international cooperation to be essential to ensuring global nuclear safety, including the development of nuclear safety infrastructure in those countries that are launching nuclear power generation programmes. In this context, we are proactively working for international cooperative activities, including the Asian Nuclear Safety Network.

Movements in the world nuclear community have changed drastically during these past 10 years. The speed of change has also increased considerably. The significant global changes include, among others, the resurgence of expectations for nuclear power generation, emergence of new nuclear countries, globalization of the nuclear industry and increased importance of nuclear security. In this changing world, the challenges faced by TSOs have changed significantly. For example, the resurgence of nuclear power generation requires an even higher level of safety than before, the emergence of newcomer countries has brought up a capacity building issue, and the globalization of the nuclear industry has brought up the issue of global harmonization of codes and standards. All of these challenges highlight the importance of TSOs that provide technical support for nuclear safety and security, and indicate the importance of international cooperation to resolve these issues.

In today's rapidly changing world, TSOs in those countries already operating nuclear power plants are facing a number of other challenges that have to be addressed with further foresight into the future and a broader perspective than ever. These are, for example, the issues of technological development and diversification, human and organizational factors, resolution of potential problems, risk reduction by regulatory actions, human resources development, improvement of inspection effectiveness and future directions of safety regulation as a whole.

On the other hand, for those countries embarking on a nuclear power generation programme, establishment of safety infrastructure is the critical issue to be tackled. Introduction of international safety standards, technology transfer, networking — the countries attending this conference should address these matters through multilayered cooperation schemes, including those provided by TSOs.

JNES continues to cooperate with newcomer countries in establishing nuclear safety capacity building in these countries by making the best use of our experience in the startup and operation of the Asian Nuclear Safety Network and other bilateral and multilateral international cooperation activities.

I think that every nuclear safety related TSO in the world is facing more or less similar challenges today. I also think that those countries newly introducing nuclear power generation have a lot of challenges in common. This conference, I think, is a very meaningful and timely one for sharing such challenges and discussing measures to address them.

Finally, we, as the host organization, will do our best to make the conference a productive one for all of you here today.

Thank you for your kind attention.

OPENING ADDRESS BY THE CONFERENCE PRESIDENT

J. Repussard
Director General,
Institute for Radiological Protection and Nuclear Safety (IRSN),
Fontenay-aux-Roses, France

It is an honour, a pleasure and also a responsibility to chair this conference organized by the Japan Nuclear Energy Safety Organization (JNES) and the IAEA, and I will be at your service during these three days so when you return home you will feel that it has been a useful time spent together.

The previous speakers have mentioned that this is an important conference. I would just like to say a few words about why I, too, think this is true.

Nuclear safety, and by that term, which is generic, we should also not forget radiation protection and nuclear security: it is the whole scope we are talking about in this conference. Nuclear safety is not static. It has been progressing in the past decades, but it is not written anywhere that it will not regress in the future.

Nuclear safety depends on science and technology, and we usually think that it is always moving forward. But it also depends on economic factors, because it costs money; and it depends on societal movements, politics and other environmental requirements. So, it is not written in the stars that it will always progress.

Because it is a science based activity, we should look for the knowledge base: Where does it come from? Well, looking at history, atomic energy commissions were organized in a very similar way in all nuclear countries, which started to develop civil nuclear energy in the second half of the 20th century. These organizations were not only in charge of the design of the technology but were also in charge of integrating safety and radiation protection.

In the last quarter of the 20th century, there was a societal demand to separate regulation from technology development and the operation of nuclear plants. It was certainly a very powerful societal demand which led to significant progress in safety in most countries, particularly through research.

However, there is a need for the regulatory system, which is now usually separated from the industry background and research background, to continue to have access to the scientific knowledge, without which there can be no lasting safety achievements.

I would like here to pay a tribute to Mr. Taniguchi, who was, I believe, the first top level executive of the IAEA to have understood the fact that the IAEA could call on experts worldwide to write standards and to discuss their implementation. Of course, these experts have to come from somewhere. The way they are trained, the way they accumulate knowledge and the way they become available nationally, but also internationally, is maybe something that should be considered as the role of the IAEA, to make sure that these resources of expertise will continue in the future as well. Remember that in the discussion we had together when you came to Cadarache in 2006, we decided that it would be worthwhile to hold this kind of conference. And I am glad you did that because without you, we would not be here today.

Hence, this is the subject of this conference: How does research, how do training activities, how do scientific analyses of plant operators, how does all this create an international expertise capability for the purpose of safety, in particular from a regulatory perspective?

So, ladies and gentlemen, this is what this TSO conference is about. We will discuss the following issues:

— The role, values and functions of TSOs, remembering that TSOs are just one example of the organization of the infrastructure; there are other models, but you have to take ‘TSO’ as a generic term for that kind of activity, which has to exist in every country.
— Capacity building within an international perspective.
— The particular emphasis on security issues, which have been a growing concern over the past decades.
— How to further coordinate and try to look at the future is the challenge of the last part of this conference.

So, I look very much forward to this conference, and I hope it is likewise for all participants. I hope there will be debates, because this conference is open to everybody and to all views, and certainly I will do my best to make sure that the floor is not monopolized by the panellists and invited speakers. So, you will have your chance to speak up, but please prepare your comments and questions carefully. Thank you very much.

ROLES, FUNCTIONS AND VALUES THAT GUIDE TSOs

(Topical Issue 1)

Chairpersons

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Armenia

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ROLES, FUNCTIONS AND VALUES THAT GUIDE TSOs

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Abstract

While legal responsibility lies with the regulatory body, technical evaluations that underlie regulatory decisions can be performed outside the administration. This is an important area where technical and scientific support organizations (TSOs) can support the regulatory body. Further areas of support include training of staff, legal advice and even project management. No matter what type of support is provided, it should be clear that a TSO has to maintain high levels of performance and follow special standards. Considering each country's own history and experience in the nuclear field, it is understandable that the role of a TSO is not the same in every country. This is well known and not surprising. What is new, however, is the increasing importance of TSOs across national borders. New countries that do not share the same historical and technological experiences are entering the scene and are looking for support. TSOs have therefore increasingly gained importance in providing assistance to regulatory bodies with limited resources. To fulfil their role nationally and internationally, TSOs need to maintain comprehensive competence in all aspects of nuclear safety and security. As technology and science are ever evolving and progressing, the emphasis lies on the maintenance of competence. This involves the consideration of both past experience and ongoing change through a well established programme for knowledge management. Another aspect is the synergies arising from doing research and applying the results in safety assessments. Growing demand for competence, along with the need for independence and clear rules of conduct, are important topics that are laid out in more detail in the paper.

1. COMPETENCE AND NUCLEAR SAFETY RESEARCH

Competence is not static and cannot be taken for granted. Technological challenges and national demands change, and a technical and scientific support organization (TSO) has to anticipate and reflect on these changes. One element is that a TSO has to look beyond the daily regulatory business and take part in the advancement of nuclear safety. This includes, for example, involvement in operating experience feedback procedures, as well as the development of advanced methods and simulation tools. The application of uncertainty studies to safety analyses is a good example. This was first undertaken by TSOs and has in the meantime been adopted by others.

In order to meet regulators' expectations, TSOs have to rely on their own expertise. In this context, participation in safety research strengthens their capability to perform independent analyses. To this end, TSOs cooperate with universities and research centres. However, the unique position of TSOs calls for them to take the lead in identifying new research needs.

2. INDEPENDENCE AND TRANSPARENCY

Competence is a necessary requirement of the work of TSOs, but it is not the only one. There are two basic principles that should be followed by all organizations involved in the safety assessment of nuclear installations.

Perhaps the most important of these principles is independence. A TSO must be able to develop and express its technical assessment independently of any external interests, be they political or economic. There can be no doubt that a TSO must resist any undue influence from the licensor or licensee. On the other hand, it should also be clear that the sole responsibility for making decisions on legal actions lies with the regulator. A TSO can only assist the regulator by providing the necessary facts and technical assessments that reflect the state of the art in nuclear safety.

The second indispensable principle is transparency. This applies in particular to a TSO's cooperation with licensees. If a TSO provides services to a licensee, it has to do so in full transparency, and it has to demonstrate that conflicts of interest are excluded. In this context, it should not be forgotten that a critical but trustful relationship is in general valuable to licensees, TSOs and regulators alike. An example of this is the involvement in the exchange and assessment of operating experience from nuclear installations. As is known, operating experience feedback helps to prevent similar events or failures in the future. Its analysis is also extremely useful in identifying gaps in evaluation methods and simulation capabilities. In Europe, TSOs therefore support the expansion of the European Clearinghouse for Operating Experience Feedback.

The members of the European TSO Network (ETSON) have defined the principles of independence and transparency as an elementary basis of their work. These principles express their shared values and foster a common understanding that underlies the members' cooperative actions. New candidates for ETSON membership must verify that they are willing and able to respect these principles. Self-assessments ensure stringent compliance. Any organization that is looking for support by ETSON partners should use the ETSON fundamental documents to assess their codes of conduct.

Acknowledging the importance of independence and transparency, there was general consensus at the last TSO conference, in 2007, that the IAEA should assume a special role in establishing such principles. The IAEA draft Safety Guide dealing with technical and scientific support for the regulatory body will play an important role in guiding authorities as well as TSOs.

3. COLLABORATION AND NETWORKS

The aforementioned European Clearinghouse initiative exemplifies what can be achieved through active collaboration. At the same time, it highlights the important role of the IAEA and the OECD Nuclear Energy Agency (OECD/NEA). A conference on operating experience, jointly organized by these two organizations in 2006, triggered the interactions that led to the creation of the European Clearinghouse. The unique position of the IAEA to convene conferences of such influence and impact is well known. Today, in an environment of growing global demand for expertise, these efforts have to be mirrored by an increasing level of cooperation between TSOs. Sharing knowledge and experience as well as providing it to others is increasingly called for. The formation of ETSON is in line with these developments, and it is an effective and efficient answer to some of today's challenges.

As mentioned, the crucial role of the IAEA and the OECD/NEA in fostering global consensus and in working towards the harmonization of nuclear safety is highly appreciated. Currently, the IAEA is pushing forward international collaboration by building up the Global Nuclear Safety and Security Network. TSOs or groups of TSOs, such as ETSON, should take an active role in this network. I am confident that sharing our know-how can be beneficial to countries new to nuclear power.

4. KNOWLEDGE MANAGEMENT

The transfer of know-how to international partners and the next generation of experts is demanding. Legal acts, regulations and rules tell us what to assess. Guidelines provide methods that should be used. However, in most cases these rules and guidelines do not include information on their background and origin. A significant part of this background information, the so called know-why, is concentrated in the minds of senior experts. This know-why can be of significant importance when the rules have to be applied to new situations or advanced reactor technologies. It also applies to the transfer of knowledge to assist new TSOs. In the context of a global increase of nuclear power and the need for qualified staff, innovative efforts regarding knowledge management are needed.

Again, TSOs have to take on a special responsibility that goes far beyond the concern for the competence of junior staff. Universities, for example, belong to those institutions that need TSO support in educating young academics in the field of nuclear safety. Task oriented training and tutoring is one way TSOs systematically prepare new professionals for future jobs. By setting up academies and training institutes, TSOs can make such training available to other institutions and make it more economical and effective. Some European TSOs, for example, have established such an institution by creating the European Nuclear Safety Training and Tutoring Institute (ENSTTI).

5. SAFETY RESEARCH AND DEVELOPMENT

TSOs have a special role in gaining knowledge from R&D and translating these results into safety practices. In their practical safety assessments, TSOs are the first to become aware of gaps in the knowledge base and to identify new research needs. It is their obligation to communicate these needs to those who make decisions on suitable research programmes and to support their implementation. A concrete example of this is the sump clogging event at Barsebaeck. TSOs analysed the event and issued a series of recommendations. Subsequently, they also played an essential role in coordinating appropriate research programmes which are still ongoing today.

However, individual TSOs are unable to cover the entire field of nuclear safety research on their own. Therefore, it is highly important to join R&D networks that coordinate research activities and provide access to research results and data. Outside the TSO community, cooperation should also extend to research centres, universities and specialized expert organizations. This applies in particular to those areas that are not covered by in-house competencies. In many cases, these areas do not belong to the core of nuclear technology itself but may nevertheless have an essential influence on safety.

Through these efforts, TSOs enhance and broaden their own level of competence. At the same time, they should look in another direction and enhance the competence base of other initiatives whose focus is not exclusively on safety. For example, ETSON has set up a working group to identify safety research needs. These are then communicated to programmes such as the Sustainable Nuclear Energy Technology Platform of the European Commission.

Another aspect that should not be excluded concerns the funding of research. Nuclear safety research conducted at universities, research centres or national laboratories can be funded in a variety of ways. The different models range from funding by a TSO, national authorities, research organizations or nuclear regulators up to funding by licensees. The available options make it clear that it is necessary to be aware of the independence of safety research.

6. PUBLIC DEBATE

Last but not least, TSOs can play a role when it comes to informing the general public. One element of this is a contribution to making more objective the public debate on the benefits and risks of nuclear energy. However, it has to be underlined that the formulation of safety goals — in other words, the definition of what a society regards as ‘safe enough’ — can only take place in a political discourse. In this regard, a TSO’s possible contribution is clearly limited to the provision of scientific and technical facts. Another reservation concerns subjects currently being dealt with by TSOs on behalf of the regulator. In these cases, TSOs should not enter into a public debate without prior consent.

Nevertheless, standing at the interface of the technical dialogue, TSOs should have the staff and the scientific facts available to present themselves as the competent experts that they are.

7. CONCLUSION

The history of nuclear safety has indicated the importance of human factors and the organization of those dealing with nuclear power. Today, in the face of increasing global demand for scarce resources, this lesson may again claim its relevance at a new level.

The challenges of a changing world can only be addressed if technological advancements are accompanied by effective organization of available resources. In this context, the importance of knowledge management, cooperation and networking is greater than ever. TSOs are an increasingly important source of support to address these issues. But at the same time, they must maintain their high standards of ethics and professional performance.

In this context, the TSO conference hosted by the Japanese Government and co-organized by the IAEA in October 2010 is a very important and great contribution for TSOs to master the present and future challenges of nuclear safety.

KNOWLEDGE CREATION, MANAGEMENT AND TRANSFER: THE EXPERIENCE OF THE KOREA INSTITUTE OF NUCLEAR SAFETY

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Presented by Yuon Won Park

Abstract

Regulatory activities are composed of four major functions: authorization, review and assessment, inspection and enforcement, and development of regulations and guidelines. To discharge these regulatory functions, the regulatory body needs to have an appropriate level of competencies rooted in sound knowledge and skills. These competencies can only be established by continuous efforts to absorb and digest the information available and to convert it into useful knowledge. As safety challenges arise from new reactor designs as well as from the ageing of nuclear power plants, the regulatory support organization (RSO)/technical support organization (TSO) should endeavour to develop the technical capacity to address such challenges. Knowledge should be managed to help individuals and groups to share valuable organizational insights and to transfer these insights from senior to junior staff in a systematic way. As an RSO/TSO in the Republic of Korea, the Korea Institute of Nuclear Safety (KINS) has been building up its competencies by creating, managing and transferring the knowledge necessary to perform regulatory functions. The paper describes how an RSO/TSO develops capacity building, taking the experience of KINS as an example.

1. INTERNATIONAL APPROACH FOR REGULATORY COMPETENCY

The regulatory body has four important functions: authorization, review and assessment, inspection and enforcement, and development of safety standards and guidelines [1]. Since a very wide spectrum of expertise is required to fulfil these regulatory functions, it is not easy for the regulatory body to secure all the competencies necessary. In this regard, according to IAEA safety requirements, the regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions (Requirement 20 of Ref. [1]). Paragraph 4.22 of Ref. [1] states that obtaining advice and assistance does not relieve the regulatory body of its assigned responsibilities and that the regulatory body shall have an adequate core competence to make informed decisions. This means that the regulatory body can consult with technical support organizations (TSOs) but it must have its own competence to make an appropriate decision.

The definition of regulatory competence is well described in IAEA-TECDOC-1254 [2] as a group of related knowledge, skills and attitudes needed to perform regulatory functions. The knowledge is the depth and breadth of information absorbed and retained by a person that would enable that person to deal with different situations, changes and the unexpected. The skills are the demonstrated abilities and expertise of a person to perform a task to prescribed standards as judged by an evaluator, and the attitudes are the appropriation and the practiced behaviour of a person to perform a job or a task with due diligence.

The major responsibility of a TSO is to provide the scientific basis and rationale for regulatory decision making. Hereinafter, how the appropriate knowledge for regulatory competence has been built up in the Republic of Korea will be discussed.

2. CAPACITY BUILDING IN THE REPUBLIC OF KOREA

After the nuclear power programme was started in the Republic of Korea in the 1970s, the technical safety review for the first three reactors was undertaken by government officials and researchers. However, recognizing the depth and breadth of the technical expertise required in conducting the licensing process for the three reactors, the Government decided to set up a technical expert organization dedicated to nuclear safety. The Nuclear Safety Center (NSC) was created in 1981 as part of the Korea Atomic Energy Research Institute (KAERI). The national nuclear technology localization programme, launched in the 1980s to minimize technical dependence on other countries, was an important motivation for setting up a more established regulatory expert organization, the Korea Institute of Nuclear Safety (KINS), in 1990. During this period, KAERI became one of the most important engineering resources for this programme, and as a result the issue of regulatory independence gained increased focus. It is noteworthy that when KINS was established, the Government decided that all technical matters should be delegated, by law, to KINS, including safety review for licensing, inspection, rule making for safety regulation, regulatory competence training, relevant R&D, and international cooperation therewith. This is the reason why KINS is often called a regulatory support organization (RSO) rather than a TSO. Since government officials in the Republic of Korea have to move from one post to another relatively frequently, technical expertise is difficult to build up and maintain, even if the licensing authority rests with the government official. In this sense, the government official has the final responsibility for the decision, and the technical authority is given to the regulatory expert organization. This system has proved to be an excellent approach to achieving a very high level of regulatory capacity in a short period of time in the Republic of Korea.

The needed regulatory competence can be provided by the recruitment of personnel, a staff qualification system, training and education programmes, and continuous knowledge buildup through the execution of regulatory activities such as safety reviews and inspections.

KINS has been building up its technical capacity by conducting safety reviews, assessments, and pre-operational inspections for nuclear power plants under construction, and safety inspections for operating ones, for more than 20 reactors during the past two decades. In the early 2000s, KINS was selected as a regulatory consulting provider for nuclear power construction in the Democratic People's Republic of Korea (DPRK). This was a very good opportunity to establish a systematic training programme not only for regulators from the DPRK but also for KINS staff. Thanks to the nuclear power plant standardization programme, resulting from the nuclear technology localization programme, KINS was able to accumulate the once-through technical competence necessary for regulatory decisions in design, manufacturing, installation, commissioning, operation and maintenance of nuclear power plants.

As the number of new staff members increased in the 1990s, the inspector qualification programme was put in place to ensure the safety of nuclear power plants. Once a staff member is recruited, he or she participates in a two year apprentice inspector training programme including classroom lectures and field experience. After this apprentice period, the inspector should maintain and develop his or her capability by receiving a refresher course every three years.

The training programmes are composed of three pillars: an in-house programme, international cooperation programmes and community partnership programmes. The in-house programme provides diverse training covering development of leadership at the managerial level, a common competency programme for interpersonal relationships and communication, and professional training programmes for different disciplines.

The R&D activities are also essential to knowledge buildup. The objectives of regulatory safety R&D programmes are to develop safety standards, address current and future safety challenges, find solutions for safety issues and improve the technical capability of the regulatory staff. Since the establishment of KINS in 1990, R&D activities have been integrated into the functions of KINS, and thus the technical competence of KINS can be attributed, to a large extent, to this R&D effort.

During the past three decades, the demand for regulatory activities has been increasing very rapidly in the Republic of Korea due to the continuous deployment of the nuclear fleet. However, the supply of regulatory personnel could not fill the gap in proportion to this regulatory demand. This gap could be managed through the use of an effective and efficient knowledge management system supported by information technology. A comprehensive web based work management system, called MIDAS, was put place in 2008 to optimize the internal work process, including project management, job assignment, administrative control, etc. One of the most IT-elaborate systems is Atom-CARE, developed more than 15 years ago to manage emergency response and online monitoring of reactor status. Atom-CARE is indispensible to KINS and plays a key role in technical decision making in the case of an emergency, from safety parameter displays, mobile alarm systems and inventory estimation to evacuation strategy and communication with other stakeholders involved in the response to an emergency.

All knowledge should be shared with other organizations and disseminated to other stakeholders to maximize its value. Knowledge sharing activities are in place as an integrated part of regulatory activities. One example is the Nuclear Safety Information Conference, an annual event with more than a thousand participants from industry, universities and regulators. Extensive discussions take place during this conference on diverse safety issues and future safety challenges. Knowledge sharing takes place not only at the national level but also with the international community. KINS concluded an arrangement with the IAEA in January 2008 to share its experience and knowledge with Member States in the early stages of constructing nuclear power plants. Since 2009, ten international training programmes, such as the Basic Professional Training Course, Regulatory Control and On the Job Training, have been available at the International Nuclear Safety School on a yearly basis. With the objective of educating safety leaders in new entrant countries, a new long term training programme, the KINS-KAIST International Nuclear Safety Master's Degree Program, was launched in September 2009. Recently, to provide more effective support for new entrants in capacity building, an Integrated Regulatory Infrastructure Support Service (IRISS) was developed based on Ref. [3].

3. CONCLUSION

In order for the regulatory body to discharge its regulatory responsibilities, its decisions should be based on appropriate regulatory competence that is defined by the knowledge, skills and attitudes needed to perform regulatory functions. The regulatory body should be entirely self-sufficient in all technical and functional areas. However, it is almost impossible for the regulatory body to have such self-sufficient regulatory competence, because a wide spectrum of technical disciplines are involved in regulatory decision making. Accordingly, the regulatory body should seek technical support from TSOs. In some cases, the major part of technical authority and the associated responsibilities are delegated to an independent organization by law. In this case, it would be better to refer to the organization as an RSO. Whether it is a TSO or an RSO, the most important element for regulatory competence is to build the knowledge that enables the regulators to deal with safety issues in all circumstances.

As a model RSO, KINS was introduced to build the appropriate knowledge, and to manage and to share that knowledge. KINS was established as a regulatory expert organization in 1990 and was able to accumulate the technical competence necessary for regulatory decisions in design, manufacturing, installation, commissioning, operation and maintenance by carrying out regulatory activities for more than 20 nuclear power plants during the past two decades. The inspector qualification programme and training programmes are in place for newly recruited personnel and for in-house capacity building. R&D activities are also essential to knowledge buildup. An effective and efficient knowledge management system, enhanced with information technology, was developed and is in use. Knowledge sharing takes place not only at the national level but also with the international community.

In short, the RSO/TSO should address safety challenges through international cooperation between new entrants and countries with existing nuclear power programmes in the flattening world. Harmonized safety approaches for the different reactor generations help to ensure transparency in nuclear activities, which are therefore more open to the public.

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THERE IS NO CHALLENGE TSOs CANNOT TAKE UP IF THEY UNITE

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Abstract

To achieve an acceptable level of nuclear safety and radiation protection requires a high level of regulatory control supported by expert assessments based on state-of-the-art scientific and technical competence. For technical safety organizations (TSOs), this translates into three major roles in enhancing safety knowledge: identifying and addressing safety research needs to gain the scientific and technical knowledge necessary to support the regulatory body with expert assessment; serving as a repository of the knowledge gained through research and operating experience feedback; and identifying and addressing education and training needs. The paper discusses the ways TSOs are fulfilling these roles in increasingly efficient ways, such as by joining regional TSO networks (for example, the European TSO Network (ETSON)), coordinating efforts devoted to safety oriented R&D (for example simulation code development and benchmarking, experimental infrastructures), and developing networking and technology platforms (for example, the Sustainable Nuclear Energy Technology Platform (SNETP), the Generation IV International Forum (GIF)). The paper concludes by setting out the ways TSOs help disseminate knowledge and information about good practice worldwide.

1. INTRODUCTION

Back in the 16th century, François Rabelais, a Renaissance writer, doctor and humanist, wrote, “Knowledge without conscience is but the ruin of the soul”. This statement is probably more up-to-date than ever. At a time where technical safety organizations (TSOs) are faced with multiple challenges worldwide, a global awareness as well as a clear view of the safety and security issues must drive science and research in the nuclear sector (Fig. 1). Most TSOs are, indeed, tasked simultaneously with providing expert assessment of:

— The safety and radiation protection associated with the dismantling of Gen I nuclear power plants (NPPs) as well as the handling of subsequent waste;
— The safe operation of ageing Gen II NPPs, as many utilities voice their intention to extend the operating life of such facilities beyond 40 years;

FIG. 1. Safety oriented R&D as a strategic, multidisciplinary challenge.

— The safety cases relating to Gen III NPPs as a support to the regulatory authorities in charge of the licensing procedure.

Concurrently, TSOs are expected to gain the scientific and technical knowledge possibly required for the eventual assessment of Gen IV reactors and future nuclear fuel cycle facilities.

For each generation of facilities, industrial players promote innovative approaches whose safety assessment requires scientific and technical research. Thus, anticipating industrial innovation is a major stake — and challenge — for TSOs. More obviously than ever, today's research paves the way to tomorrow's assessment, just as today's assessment draws upon yesterday's research and operating experience feedback (OEF).

2. KEEPING PACE WITH THE UPSURGE OF NUCLEAR POWER

The development of nuclear power spans three historical periods:

— *Until the Three Mile Island and Chernobyl accidents*, nuclear power developed at a fast pace, driven by technology, with relatively low regulatory control.

— *Following these two accidents*, the construction of new NPPs was practically brought to a standstill for 20 years in the European Union and the United States of America, whereas increased public investment was devoted to safety oriented R&D with large international programmes.

— *Since 2000*, new build projects have come forward both in countries already equipped with NPPs and in 'newcomer' countries, involving in particular Gen III reactors. At the same time, the 'independent safety authority' has emerged as a concept aimed at improving control and fostering public acceptance.

Compounded by technological shifts (e.g. from analogue to digital command and control) and changes in human and organizational factors in ageing facilities, the upsurge of new build programmes poses unprecedented safety and radiation protection challenges that TSOs must take up.

3. THE AIM OF TSOs REGARDING A SCIENCE BASED ACTIVITY

History shows that a high level of regulatory control supported by expert assessments based on state-of-the-art scientific and technical competence is mandatory to achieve an acceptable level of nuclear safety and radiation protection. From the TSO’s perspective, this statement translates into three major roles to enhance safety knowledge:

— Identify and address safety research needs to gain the scientific and technical knowledge necessary to support the regulatory authority with expert assessment.
— Serve as the repository of the knowledge gained through research and OEF.
— Identify and address education and training needs.

To fulfil these simultaneous commitments with greater efficiency, an increasing number of European TSOs are joining the European TSO Network (ETSON). ETSON is involved in complementary activities aimed chiefly at allowing the exchange of views on safety *research* needs (through the EUROSAFE initiative); providing nuclear safety *training* (through the European Nuclear Safety Training and Tutoring Institute (ENSTTI)); and carrying out expert *assessment* (through joint ventures such as Riskaudit).

From a broader perspective, TSOs are part of a safety oriented R&D scheme involving primarily three parties:

— *The industrial players*, who carry out industrial development derived from last-mile research with one priority: to acquire technological advances conducive to overcoming competitive barriers and to provide a high return on investment;
— *The academic research and main research organizations*, who carry out fundamental research to address innovation needs with one priority: to achieve scientific and technical quality in each discipline;
— *The TSOs themselves*, who perform finalized, cross-disciplinary research with one priority: to gain up-to-date knowledge and tools in order to adequately assess and prioritize potential safety risks and consequences associated with nuclear operations.

4. A FAR-REACHING APPROACH TO R&D

Among the parties involved in safety oriented R&D, the TSOs play a pivotal part on all continents, as they are tasked with — and committed to — achieving three major goals. The first one is to foster research both in their own facilities and in cooperation with third parties such as universities or operators. Analysing the OEF from current facilities is part of this approach aimed at gaining knowledge for the enhancement of safety in the future. The second function of TSOs is to provide scientific and technical support to regulatory authorities in the setting and implementation of safety and security standards as well as in the prevention and management of incidents/accidents. Last but not least, TSOs are expected to make safety knowledge widely available through their contribution to engineer training (e.g. ENSTTI), specialized publications (e.g. OECD/NEA collections) and expert assessments carried out by pluralist expert groups.

In a context of R&D cost effectiveness required by governments worldwide, TSOs are striving for an increasingly efficient use of four types of resource — time, means, structures and guidance — to organize safety oriented R&D:

- *Time*: Careful management of the time frame is a key factor in the successful planning of research, along clearly defined priorities, topics and tasks.
- *Means*: A second key factor is the pooling and systematic coordination of the efforts devoted to safety oriented R&D, for example, simulation code development and benchmarking, and experimental infrastructure.
- *Structures*: The development of networking and technology platforms such as DoReMi[1], SNETP[2], SARnet[3] or GIF[4] allows maximum efficiency of the means contributed by each partner for the benefit of all.
- *Guidance*: As recommended at the IAEA conference on TSOs held in April 2007, safety oriented R&D activities should be promoted and carried out

[1] DoReMi is a Network of Excellence set up by the Multidisciplinary European Low Dose Initiative (MELODI), a European platform dedicated to low dose risk research.

[2] The Sustainable Nuclear Energy Technology Platform (SNETP) promotes research, development and demonstration of the nuclear fission technologies.

[3] The Severe Accident Research Network (SARnet) is a Network of Excellence federating European research on core meltdown reactor accidents.

[4] The Generation IV International Forum (GIF) is a cooperative international endeavour organized to carry out the R&D needed to establish the feasibility and performance capabilities of the next generation nuclear energy systems.

under the aegis of existing international organizations such as the OECD Nuclear Energy Agency (OECD/NEA). For instance, TSOs largely participate in the projects developed by the OECD/NEA's Committee on the Safety of Nuclear Installations (CSNI).

5. A VISION WITH NO ACTION REMAINS A DREAM, AN ACTION WITH NO VISION IS A NIGHTMARE

In performing research and expert assessments alike, TSOs follow a code of conduct based on values that give them a vision beyond the immediate task to be carried out:

— *Humanism*: beyond knowledge, priority to safety, to the protection of people and the environment. This value guides the TSOs' research strategy in nuclear technology and radiation protection.
— *Openness*: beyond transparency, the sharing of knowledge. This value guides the TSOs' relations with stakeholders and the public at large.
— *Honesty*: beyond conformity assessment, a comprehensive safety approach. The TSOs' aim is not to just to guarantee compliance of the safety reports submitted by the industry with regulatory requirements. It is to relentlessly contribute to enhancing safety and radiation protection.
— *Independence*: beyond particular interests, unbiased judgement to support independent regulators. The TSOs believe empowerment, self-government and self-reliance, based on independent R&D, are sine qua non conditions to provide trustworthy expert judgement.

The commitment of TSOs is to support safety authorities in setting up and enforcing independent and competent regulatory policies. This mandate gives them a central role in enhancing safety in their own country and, since a nuclear issue anywhere is an issue everywhere, in helping disseminate knowledge and good practices worldwide. Such endeavour relies upon three major achievements:

— The development of safety oriented R&D combined with efficient operating experience data mining[5]. A continuously updated combination of

[5] The European Clearinghouse is a new mechanism aimed at jointly exploiting safety related data on nuclear power reactor operations among a dozen European countries. Its purpose is to give countries with only a few nuclear facilities access to the analytical capabilities of countries with larger reactor fleets and more operating experience.

science based and experience based knowledge is essential to acquire a vision of long term safety beyond conformity to current standards and to be capable of interfacing technically with operators and regulators.

— The promotion of international cooperation with a view to enhancing the cost effectiveness of R&D, fostering convergence of safety and radiation protection practices to achieve the highest standards, and streamlining, for example, the licensing processes.
— Involvement in education and training, and in knowledge dissemination and transfer to countries entering the nuclear field.

Twenty years ago, TSOs used to strive disjointedly to improve safety and radiation protection. Today, they are performing research and, increasingly, expert assessments in partnership. This major shift gives them the critical mass and visibility to continue to promote safety and radiation protection in a globalizing world.

A REGULATOR’S PERSPECTIVE ON RULES OF CONDUCT FOR TSOs

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Abstract

Unlike with most nuclear regulators, the technical and scientific support functions for the Canadian Nuclear Safety Commission (CNSC) are provided by an in-house technical support organization (TSO). The TSO for the CNSC comprises some 300 engineers, scientists and technicians. The Canadian TSO provides support in the areas of: environmental sciences, radiation and health protection, security, safeguards, human factors and the full range of nuclear engineering disciplines. This support function is provided across the full range of facilities regulated by the CNSC, including uranium mines and mills, research reactors, power reactors and radiation sources. In addition to its purely technical role, TSO staff also provides support in the review of licensee submissions, and participates in inspections and in the development of regulatory policy. Collaboration frequently includes contributions from several disciplines within the TSO, thus requiring an integrated approach to issue resolution. The paper describes the role and structure of this organization and presents the challenges and benefits associated with using an internal TSO. Management of the interface between the internal TSO and the licensing/compliance organization is discussed, including suggestions on this topic resulting from the recent IAEA Integrated Regulatory Review Service (IRRS) conducted in Canada.

1. STRUCTURE OF THE CNSC AND THE CNSC INTERNAL TSO

The Canadian Nuclear Safety Commission (CNSC) is the sole regulator of nuclear facilities and activities in Canada and has four major branches: Regulatory Operations, Technical Support, Regulatory Affairs and Corporate Services. The Regulatory Operations Branch is responsible for managing regulatory activities as well as licensing and compliance decision making under designated offices and designated authorities. The Technical Support Branch provides the internal technical support organization (TSO) function. The staff of the Technical Support Branch (the TSO) provides technical support to the Regulatory Operations Branch (the regulator), for example, by providing specialist advice for regulatory programmes, reviewing nuclear power plant licensee submissions, participating in inspections and helping to develop relevant regulatory framework documents. Collaboration frequently includes contributions involving several disciplines from across the Technical Support Branch and the Regulatory Operations Branch, requiring an integrated approach to resolving issues. The staff of the Technical Support Branch also shares scientific and technical information and experience with stakeholders in Canada and in other countries, and undertakes special projects within its expertise and mandate.

2. MANAGEMENT OF THE INTERFACE BETWEEN THE TSO AND REGULATORY FUNCTIONS

Within the CNSC, the effective management of the interface between the TSO and regulatory functions is based upon a clear understanding of the relative roles and responsibilities and specific rules of conduct, as discussed below.

2.1. Roles and responsibilities

The CNSC regulatory staff is responsible and accountable for:

— Requesting the appropriate technical assessments and recommendations from the TSO;
— Establishing the scope and depth of the assessments in collaboration with the TSO;
— Understanding the risk significance of the results and findings in consultation with the TSO;
— Consulting in advance with the TSO if choosing not to follow recommendations from the TSO;
— Documenting how and why the results and recommendations were integrated, or not, into the regulatory decisions or recommendations made, and communicating any changes to the TSO.

The CNSC TSO staff is responsible and accountable for:

— Conducting technical assessments that are based on the best available science, technical knowledge and analytical methods;
— Consulting with the regulatory staff on findings prior to finalizing assessments;
— Providing recommendations for regulatory actions as appropriate;
— Regulatory framework development.

With this understanding, the foundation for an effective and efficient interface is established.

2.2. Specific rules of conduct

Beyond the roles and responsibilities, the CNSC has implemented specific rules of conduct to address the usual challenges faced at the interface between regulatory organizations and TSOs. These include:

— *Direct communications between regulatory and technical specialists:* The staff is encouraged to communicate directly, in order to resolve any issues at the working level. Strict rules for respectful communication are enforced. Furthermore, periodic rotation of staff members between regulatory and TSO positions is encouraged.

— *Director led teams:* These teams have been established to create and maintain a 3–5 year strategic regulator plan; facilitate regular and open communications between regulatory and TSO units; develop defensible regulatory decisions; and serve as the initial management level forum for dispute resolution.

— *Formal process for dispute resolution:* If issues cannot be resolved at the staff and director led team levels, a formal escalation procedure exists. Issues then proceed to either the directorate manager level or to the TSO and regulatory top level managers, where final rulings are made. The results of decisions reached are formally documented and communicated at all staff levels.

— *Regulatory/TSO management meetings:* The senior managers from the regulatory and TSO branches meet every two weeks to discuss planning, strategy and priorities.

— *The TSO staff writes the first drafts of regulatory recommendations:* Regarding the integration of the findings of the TSO specialists and their translation into regulatory decisions, the TSO staff is required to write the first draft of the regulatory recommendations. In addition, for those analyses which are highly complex or require input across many technical areas, a specialist ‘Assessment Integration Division’ has been established within the TSO.

— *Shared responsibilities:* TSO and regulatory management and staff are responsible for identifying and resolving differences in professional opinion as early as possible in the regulatory decision making process, and in accordance with the established review processes.

— *Respectful communication:* TSO and regulatory management and staff are responsible and accountable at all times for treating their colleagues in an open, honest, forthright and respectful manner.

3. IAEA IRRS REVIEW FINDINGS CONCERNING THE TSO–REGULATOR INTERFACE ON SAFETY AND SECURITY

Establishing a proper balance between nuclear safety and nuclear security is a challenge faced by all nuclear regulators. This topic was explored during an IAEA Integrated Regulatory Review Service (IRRS) mission to Canada in 2009. There were no overall recommendations regarding the TSO–regulator interface, thus affirming the basic soundness of the Canadian TSO approach. However, there was one IRRS suggestion concerning the TSO–regulator interface on safety and security:

Suggestion S3 from the IRRS mission:

> "Staff from the Regulatory Operations Branch and Technical Support Branch branches of CNSC may wish to review how they could work together in a more harmonized manner to ensure that security measures do not compromise safety and vice versa and to ensure continued compliance with security requirements as reviewed."

The CNSC management response was as follows:

> "Regulatory Operations Branch and Technical Support Branch will conduct a review of how they can work together in a more harmonized manner. This will examine how they work together for assessments and compliance inspections that impact both safety and security, and overall communication processes to ensure that security staff and licensing/compliance staff do not work in isolation of each other. The conclusion of the review will be the formalization of the respective roles and responsibilities within the CNSC (first phase: NPPs) and the development of a generic CNSC communications protocol with licensees that addresses both safety and security…."

In terms of concrete measures, in order to ensure the better integration of safety and security, the following steps have been taken:

- *The TSO has the required in-house expertise:* All required expertise has been established within the TSO, thus ensuring that no integration barriers are introduced by the presence of third parties.
- *Assessments/inspections are examined for both safety and security:* A holistic approach is taken during assessments and inspections, allowing possible integration issues to be identified and resolved as soon as is practical, and on a mutually informed basis.
- *Communications protocol:* A communications protocol has been implemented which requires that regulatory staff directors sign off on security related inspections and reviews. This ensures that they will be aware of any security items that may have an impact on site safety. This protocol also addresses how security inspections are conducted at nuclear power plants.
- *Participation of TSO and regulatory staff:* Staff members from both organizations take part in assessments and inspections. This aids greatly in reducing internal barriers (‘silos’ in safety and security), fostering both better communication and increased awareness of the complementary aspects of safety and security.
- *Licensee role and responsibilities:* Just as licensees have the ultimate responsibility for safety, they also have the ultimate responsibility for security and for integration of the two. These licensee responsibilities have been clearly communicated, and licensees are required to identify any safety–security integration issues which may occur and to bring them to the attention of the regulator.
- *Regulatory requirement documents reflect the need to balance:* In particular, all regulatory documents on the topic of security contain a preamble with respect to the need for licensees to identify any safety–security integration issues.
- *Culture shift:* Through their behaviour, managers, engineers and workers are encouraged to demonstrate their commitment to nuclear security in the same way they are committed to nuclear safety. This major shift in the culture is founded on the understanding that security is not a matter for security specialists alone. It should be part of the overall organizational culture, and all employees who work at a facility should be included.

4. CONCLUSION

Support to the regulator can work with a number of TSO models. Regardless of the model, some common challenges arise regarding the interface. These challenges are manageable, provided that there is a clear understanding of roles and responsibilities, and that there are processes and procedures to resolve disagreements and to put risk into context. Above all, clear and respectful communication is required.

RECENT EXPERIENCE IN AND POSSIBLE DEVELOPMENT OF TSO CONTRIBUTIONS TO PUBLIC OUTREACH: AN AUSTRALIAN PERSPECTIVE

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Abstract

The paper explains the arrangements in place in Australia and in particular the experience with technical and scientific support organization (TSO) support through the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). ARPANSA was established as an independent regulator in 1998 after the amalgamation of the Australian Radiation Laboratory and the Nuclear Safety Bureau. It does not have the support of a formally constituted TSO, but in effect the functions provided by what was originally the Australian Radiation Laboratory are equivalent to the services provided by a TSO and are now available within ARPANSA. These functions provide support for the regulatory function of the organization, but in general contribute to ARPANSA's legislated role "to protect the health and safety of people, and to protect the environment, from the harmful effects of radiation". The paper includes further information on areas of TSO support towards public outreach in ARPANSA.

1. ARPANSA

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a statutory body. It was established and operates under the Australian Radiation Protection and Nuclear Safety Act 1998.

Its legislated objective is "to protect the health and safety of people, and to protect the environment, from the harmful effects of radiation". Its functions are to:

- Advise the Government and community about radiation protection and nuclear safety;
- Represent Australia in international forums;
- Undertake research and services for radiation protection;
- Promote national uniformity in radiation protection;
- Be an independent regulator of the use of radiation and nuclear technology.

ARPANSA was established as an independent regulator in 1998 after the amalgamation of the Australian Radiation Laboratory and the Nuclear Safety Bureau. It does not have the support of a formally constituted technical and scientific support organization (TSO), but in effect the functions provided by what was originally the Australian Radiation Laboratory are equivalent to the services provided by a TSO and are now available within ARPANSA. These functions provide support for the regulatory function of the organization but in general contribute to ARPANSA's legislated role as stated above.

ARPANSA is organized into five branches. The regulatory branch, derived from the former Nuclear Safety Bureau, remains in Sydney, and the three scientific branches, derived from the Australian Radiation Laboratory, remain in Melbourne.

Figure 1 shows the organization of the agency in terms of the various functional sections within the branches. There is a legal and corporate branch that provides support for the whole organization, located in both Sydney and Melbourne, and there is a small office that assists with Government liaison, located in Canberra.

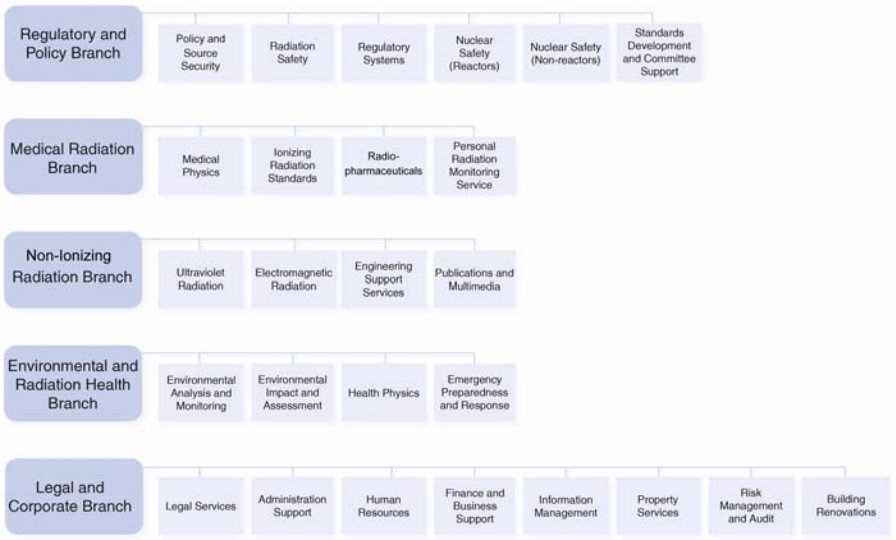

FIG. 1. ARPANSA functional organization structure.

2. REGULATORY BRANCH

The regulatory branch incorporates six functional areas as follows:

- Nuclear safety (reactors);
- Nuclear safety (non-reactors);
- Radiation safety;
- Policy and source security;
- Regulatory systems;
- Standards development and committee support.

The committee support function provides secretarial support for the three legislated advisory committees:

- Radiation Health and Safety Advisory Council (RHSAC);
- Radiation Health Committee (RHC);
- Nuclear Safety Committee (NSC).

These committees advise the CEO on matters of radiation and nuclear safety.

The RHSAC is appointed by the Minister, and the RHC and NSC are appointed by the CEO. The committees collectively represent consumer, environmental, community, and State and Territory radiation safety regulatory interests. They include experts in the relevant areas.

3. PUBLIC OUTREACH

3.1. General areas of public outreach

ARPANSA's scientific branches provide TSO information, expertise, services and regulatory support in a number of areas of public outreach:

- Advice to the Minister and Government;
- Media response and releases;
- Legislated advisory committees;
- Public: media, web site, guidelines, codes, standards, conferences, forums;
- Industry/professional: guidelines, codes, standards, conferences, forums;
- Coordination, support of State and Territory jurisdictions and stakeholders.

3.2. Legislated areas of public outreach

As part of its legislated regulatory process, ARPANSA undertakes public outreach in a number of areas as follows:

— Quarterly, annual and other reports to Parliament;
— Exemption notices for requirement for a facility licence;
— Notice of application for a facility licence;
— Notice of application for a nuclear installation licence and call for public submissions.

3.3. Examples of TSO services for public outreach

The following examples indicate the nature of TSO services provided by ARPANSA:

— Daily regional UV index posted on the web site;
— UV swing tags provided for compliant clothing;
— An Australian National Radiation Dose Register for uranium mining workers;
— A personal radiation monitoring service;
— Australian diagnostic reference levels for computer tomography;
— Calibration of hospital therapy reference dosimeters;
— Monitoring of electromagnetic fields from power lines;
— Monitoring of radiofrequency electromagnetic radiation.

3.4. Examples of TSO information for public outreach

In addition to the TSO services listed above, the following examples indicate the nature of TSO information provided by ARPANSA:

— A comprehensive web site;
— Multiple fact sheets on ionizing and non-ionizing radiation;
— A wide range of medical and industrial radiation safety and security codes;
— Advice and information to Ministers and in response to political inquiries;
— Public advice and information for press releases or responses to inquiries.

3.5. TSO support for regulatory public outreach

The scientific branches of ARPANSA provide important support to the regulatory branch in public outreach. In particular, they provide:

— Stakeholder confidence in the scientific expertise of the regulator;
— Monitoring for radioactive contamination in the atmosphere, water, food and the human body;
— Monitoring for radioactive contamination from nuclear activities including decommissioning of facilities;
— Radiation emergency preparedness and response;
— Scientific support for special inspections;
— Active contribution to the Asian Nuclear Safety Network (ANSN) and other regional support initiatives for radiation safety and security.

3.6. Recent issues involving TSO public outreach

This presentation concludes with summaries of some recent significant issues where ARPANSA has provided TSO public outreach.

— After a high profile case of a young woman who died as a result of cancer attributed to her use of solaria, ARPANSA provided public advice and a code as the basis for new State and Territory regulation on the use of solaria in Australia.
— Advice was provided to the Government and the public to give guidance in relation to interpretation of, and appropriate precautions resulting from, the INTERPHONE study.
— Regular testing and guidance is provided to the public in relation to the appropriate location of mobile phone transmitter towers.
— Radiation emission measurements and public advice have been provided in relation to cancer clusters suspected to be of radiation origin. An example was electromagnetic radiation exposure of staff working in a radio studio building with an antenna on the roof.
— Measurements and public advice have been provided in relation to possible contamination resulting from radiation transport incidents.
— Measurements and public advice have been provided in relation to sites contaminated by radioactive waste.
— Government and public advice has been provided in relation to the proposed use of body scanners for airport security.

ESTABLISHMENT OF A TSO AND ITS POSSIBLE CONTRIBUTION TO PUBLIC OUTREACH IN INDONESIA

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Abstract

One of the key issues in the nuclear power programme is obtaining public acceptance, and the most challenging problem in this regard is how to properly educate, and disseminate information on nuclear safety to, the public. Another important issue is strengthening national safety infrastructure by establishing an independent technical support organization (TSO). The expected roles of the TSO are mainly to provide technical and scientific support to the regulatory body in carrying out the regulatory functions (setting up regulation, licensing and inspection). Depending on the country's need, the TSO can also function as technical support for the executing body or operating organization in strengthening research and development in nuclear safety. Recognizing its competence and independence, the TSO is considered able to take on the role of a public communicator for the nuclear power programme in obtaining the public's confidence. The paper provides some considerations regarding the establishment of the TSO in Indonesia and its possible contribution to public outreach.

1. INTRODUCTION

The plan to introduce nuclear power plants (NPPs) in Indonesia was initiated several decades ago. To support the plan, three research reactors were established and operated to conduct research and development in nuclear science and technology. Through establishing and operating the three research reactors, Indonesia has learned many aspects of nuclear science and achieved several milestones in nuclear development. From the regulatory point of view, the establishment and operation of the reactors has allowed the regulatory body to learn and to gain a huge amount of experience and regulatory knowledge in nuclear safety. This experience and knowledge will be important bases for managing the nuclear power programme in the future.

To make the nuclear programme effective, the regulatory body has been separated from the executing body on the basis of Act No. 10 Year 1997 on Nuclear Energy [1]. Based on this law, the National Nuclear Energy Agency (BATAN) was established as an executing body with the responsibility to conduct research and to develop and promote the use of nuclear technology. On the other hand, based on the same law, the Indonesian Nuclear Energy Regulatory Agency (BAPETEN) was founded as a regulatory body with the responsibility to control any utilization of nuclear energy in Indonesia.

Both the executing body and the regulatory body are equipped with technical working units that support their functions. BATAN has the Centre for Reactor Technology and Nuclear Safety (PTRKN), which carries out research in reactor technology and nuclear safety, and the Centre for Technology of Radiation Safety and Metrology (PTKMR), which conducts research and development of technology for health physics, radiation safety and radiation metrology. Both units are considered as internal technical support organizations (TSOs) for the executing body. BAPETEN as a regulatory body is also supported by the two centres of review and assessment: the Centre for Safety Assessment of Nuclear Installations and Materials (P2STPIBN) and the Centre for Safety Assessment of Radiation Facilities and Radioactive Materials (P2STPFRZR). These centres conduct reviews and assessments of nuclear safety and radiation protection to support a licensing and inspection process and to oversee the harmonization of the regulations to be established, as well as the effectiveness of regulatory functions.

In order to make the TSO function more effectively, the internal TSOs of BATAN and BAPETEN should be merged and strengthened as a national independent TSO. The function of the TSO should be developed as scientific and technical support for both the executing body and the regulatory body. In addition, the role of the TSO can also be extended to include public outreach, providing a bridge between the Government and the public. In this role, the TSO can share its competence with the public through education and the dissemination of information on nuclear safety. Through this, the public will be sufficiently informed about nuclear safety issues, and in turn could support the nuclear power programme in the future.

2. NUCLEAR POWER PROGRAMME

Regarding the plans for establishing a nuclear power programme, BATAN as a promoting body has been making a continuous effort to convince the public and decision makers of the importance of nuclear power as a future energy source. In parallel to this effort, several national universities have established new study programmes relevant to nuclear science and technology in order to prepare the human resources for supporting the nuclear programme [2]. Nevertheless, the programme has not yet been successfully realized.

Due to the global as well as the national situation, the Indonesian nuclear power programme has shown a dynamic rhythm. The programme that was launched in the 1970s encountered a serious setback with the occurrence of the Chernobyl accident in 1986. However, just one year later, in 1987, the Government officially launched the operation of a new research reactor, the Multi-Purpose Reactor ‘G.A. Siwabessy’, with nominal power of 30 MW [2, 3]. In the early 1990s a feasibility study for an NPP site on the Muria peninsula was conducted. In 1997, a new law on nuclear energy, Act No. 10 on Nuclear Energy [1], was enacted.

The nuclear programme suffered an apparent death due to the economic crisis in 1998. However, owing to the recent global energy crisis, dwindling oil reserves and global warming, the nuclear power programme has been revitalized. The most challenging problem currently is how to educate and inform the public so that they might have a more positive perception of nuclear power and finally support the nuclear power programme.

3. SAFETY ISSUE AND PUBLIC ACCEPTANCE

The success of the nuclear programme should come from the effort and support of many parties, including the public through their confidence. To gain the public’s confidence, several nuclear issues must be addressed. The main issue which is closely related to public acceptance is nuclear safety.

Although many nuclear experts have proved and shown the reliability of nuclear safety technology for several decades, most people in Indonesia remain doubtful. Even though the probability of the occurrence of a nuclear accident has been calculated as being extremely low, people are still anxious. This is because of the common misperception that nuclear power is identical to an atomic bomb, and the assumption that misoperation of a nuclear facility is the same as exploding a bomb. Therefore, public education and transparent information regarding nuclear safety knowledge are of the utmost importance.

In this case, the public needs to receive comprehensive and clear information, so that it can understand the issues correctly and gain a positive perception of nuclear power. For this purpose, information dissemination and public education about nuclear technology should be carried out by credible parties with accurate and persuasive methods as an important first step in gaining the public’s trust. Without trust, good cooperation with the public in running the programme is difficult. The next step is to take advantage of the trust to deliver comprehensive and clear information on nuclear knowledge, so that the public can absorb and correctly understand the nuclear information provided from the aspects of safety, economics, benefit and risk.

For a long time period, promotion of the nuclear power programme has been carried out by the executing body, which is a government institution. However, it is no exaggeration to say that it has not yet gained the public support that was expected, and that the anti-nuclear movement which is provoked by some non-governmental organizations (NGOs) tends to increase. This is because of the lack of public confidence in the Government in promoting the nuclear power programme. This might be different if the promotion of the nuclear programme were performed by independent organizations, such as high schools and universities. It might be more agreeable to the public, since such organizations are considered to be more transparent and free of conflicts of interest. However, the question is whether high schools and universities have enough commitment to carry out the promotion of the nuclear power programme. In fact, since universities and other educational institutions have no obligation to perform information dissemination and public education on nuclear knowledge, their commitment cannot be ensured. Therefore, another type of organization specifically dedicated and having nuclear competence and capability must undertake the promtion of the nuclear programme; that is, a national TSO.

4. EXPECTED ROLES OF THE TSO

As an independent technical organization, the TSO should be able to provide technical and scientific support for the regulatory functions of the regulatory body, especially to provide technical competence in conducting review and assessment of licensing documents submitted by applicants. Its competence and independence are needed in this matter in order to maintain the credibility of the regulatory body in policy making for reviewing the safety of nuclear facilities and issuing licences.

At other times, the TSO should also be able to provide technical support to the executing body, especially in conducting research and development of nuclear safety technology, managing nuclear knowledge, and providing human resources with expertise in nuclear safety. In this case, the TSO should be able to maintain its professionalism as well as its independence in order to avoid any conflict of interest.

On the other hand, TSOs are also expected to assume a public outreach role, providing a bridge between the Government and the public, particularly in education and information dissemination. With the independence of the TSO, the public is expected to gain trust in the organization and cooperate with it to achieve nuclear knowledge from the aspects of safety, economy, benefit and risk.

For technical support, a TSO can be formed based on two options:

(1) *Hybrid TSO* [4]: A multifunctional organization that provides technical support to the regulatory body on one side, and to the executing body on the other side. It can also serve a public information function for the nuclear programme. From the budgeting point of view, this approach would be more efficient, but from the functional point of view it would be quite difficult to maintain its independence. In this case, the conditions under which the TSO could take a role as a supporting organization for both promotion and regulatory functions should be determined.

(2) *Single function TSO*: A single task organization that is dedicated to supporting only the regulatory body or the executing body. Depending on the country's needs, establishment of a single function TSO could be more effective. However, to form two or more organizations with a single function might be more costly.

5. THE TSO AND PUBLIC ACCEPTANCE

As mentioned, besides technical and scientific support to the operating organization and the regulatory body, the TSO can also be given a public outreach role for the nuclear power programme. To do so, the TSO requires not only deep technical competence in nuclear technology, particularly in nuclear safety, but also capability in public communication. As part of a public education and information dissemination programme, it is important that the TSO perform the following activities:

— Provide on-line nuclear information transparently and continously to provide the public easy access to the information it needs. To enable the public to achieve a balanced and comprehensive understanding, the information provided should be clear and comprehensive, including nuclear benefit and risk.
— Consult and collaborate with the Ministry of Education to enrich the content of national curricula, especially at the basic and intermediate levels, with nuclear knowledge and competence.
— Perform education and training systematically and periodically for young people, who are expected to become public agents in public education and information dissemination.
— Conduct seminars and discussions on nuclear safety by involving public figures, who are expected to become supporters in making the public education and information dissemination programme successful.

— Develop networks among TSOs and maximize utilization of available networks, such as the Asian Nuclear Safety Network (ANSN), to:
  - Build the capacity of the organization, update and maintain its competence so that the TSO can adjust to the global dynamic and recent developments of technology, and always put its position forward;
  - Exchange experience and expertise in nuclear safety technology and information technology;
  - Exchange experts in the framework of national and regional capacity building;
  - Share facilities and resources in conducting capacity building.

Having realized the above mentioned activities consistently, it is expected that the public will have comprehensive nuclear knowledge, and in turn, public confidence could be gained.

6. OPTIONS FOR TSO ESTABLISHMENT

In the case of Indonesia, a TSO can be built by combining several working units from BAPETEN and BATAN, which are currently functioning as internal TSOs, into a stronger and more independent TSO. This TSO can be further strengthened by hiring personnel from universities who have competence and expertise in nuclear science and technology. The legal status of the TSO should be strong enough to enable it to keep its independence.

The legal status of the TSO's organization can be chosen from the following options based upon the national need and legal infrastructure [2]:

(1) *Government:* If the TSO is established as a government organization, it shall be put in a higher position in the government hierarchy, so that its independence can be maintained. As a part of the government, the TSO should be funded from the national budget, and be separated from the budget of the executing body and the regulatory body.

(2) *Semi-government:* A TSO of this form is partly funded by the government (from the national budget) and partly supported by clients. The clients can be the government (BAPETEN/BATAN) or private users. The budget scheme can be 25/75, 50/50 or 75/25. For instance, 25/75 means that 25% is funded by the national budget and the remaining 75% is obtained from service fees, based on work contracts.

(3) *Private:* If the TSO is a private entity, it should be able to finance itself from service fees. In this case, the TSO is a private consultant and is profit oriented. Although it is funded from service fees, the professionalism and independence should be maintained.

7. CONCLUSION

The nuclear power programme in Indonesia has been promoted to the public for several decades. However, it is no exaggeration to say that it has not yet gained the public support that was expected, and that the anti-nuclear movement which is provoked by some NGOs tends to increase. This is because of the Government’s lack of success in creating public confidence in the nuclear power programme. Therefore, how to educate, and disseminate information on nuclear safety to, the public with an appropriate method becomes an important issue.

Establishment of an independent TSO and involving it in public education and dissemination of information on the nuclear power programme is considered to be a good practice. Establishment of the TSO itself will improve the national nuclear safety infrastructure, which in turn could increase public confidence.

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TECHNICAL AND SCIENTIFIC SUPPORT FOR NUCLEAR SAFETY INFRASTRUCTURE DEVELOPMENT AND CAPACITY BULDING

(Topical Issue 2)

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CHALLENGES FACED BY REGULATORS AND TECHNICAL, SCIENTIFIC AND SUPPORT ORGANIZATIONS (TSOs) IN ENHANCING NUCLEAR SAFETY AND SECURITY

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Abstract

Renewed interest in new reactor build programmes, not only in countries with already established nuclear programmes but also in many other countries with limited or no workforce experienced in the design, licensing, construction and operation of nuclear power plants, has resulted in a need for technical, scientific and support organizations (TSOs) to support regulatory bodies in carrying out their mandated responsibilities. The primary function of a regulatory body, such as the Federal Authority for Nuclear Regulation (FANR) in the United Arab Emirates (UAE), is to regulate the safe use of nuclear facilities and radioactive material for peaceful civilian purposes. In so doing, the regulatory body needs to provide a clear and focused approach to: safety, security and safeguards for licensing; inspection and enforcement of reactor design; construction; commissioning; operation; decommissioning; nuclear waste management activities; and the use, possession or transfer of special nuclear materials and activities within the country. Accomplishing this goal requires a highly educated, multidisciplinary, diverse workforce with significant work experience. Recognizing that it takes several decades and a lot of resources to achieve self-sufficiency, many countries, particularly emergent nuclear countries, would have to rely on TSOs to start their programmes and to carry out their oversight responsibilities. Towards that end, FANR is working closely with international counterparts, the International Atomic Energy Agency and TSOs to exchange information, expertise, industry experience and ongoing research to ensure that high levels of safety, security and safeguards are established and maintained in reactor design and operation throughout the life of the facility, and that special nuclear material within the UAE is properly documented and controlled, is not stolen, lost or diverted to any illicit or non-peaceful activities, and does not pose unreasonable radiological risk due to sabotage. The paper briefly discusses a theme of the conference, related to the roles of the government, regulator and regulatory body of the country of origin (defined as the country to whom the reactor design and contract bid have been awarded) and TSOs in the licensing process, capacity building and knowledge management and transfer.

1. INTRODUCTION

The so-called nuclear renaissance is resulting in renewed interest in new reactor build programmes not only in countries with established nuclear programmes but also in many other countries with workforces that have limited or no experience in the design, licensing, construction, operation and regulation of nuclear power plants.

Technical, scientific and support organizations (TSOs) and contractors have been an essential factor for many years in plant construction, maintenance and operation. It is anticipated that TSOs will become even more important, particularly in support of national regulation, in the coming years.

The stated goal of the Government of the United Arab Emirates (UAE) is to exceed international standards in its evaluation of nuclear power and in any deployment of nuclear facilities within the UAE. In that regard, the UAE has indicated its commitment to complete operational transparency; the highest standards of non-proliferation, safety and security; close cooperation with the International Atomic Energy Agency (IAEA); partnership with the Governments and companies of responsible nations; and long term sustainability[1].

In the UAE, the licensee is responsible for taking all steps necessary to achieve and maintain a high level of nuclear safety and security, and is ultimately responsible for the performance of all subcontractors involved in support to their programme. The national regulatory authority, the Federal Authority for Nuclear Regulation (FANR), established in September 2009, is providing regulatory oversight for all matters of nuclear safety, security and safeguards. FANR is developing its own competence but is also utilizing TSO support in many of its areas of responsibility.

The independence of the regulator in performing its regulatory activities to ensure compliance by licensees is a guiding principle for most countries, including the UAE's FANR. In a similar fashion, the regulator is ultimately responsible for utilizing the work performed by its TSOs within the established regulatory framework. The FANR regulatory programme is not 'copying' any particular national regulatory scheme but is being developed in alignment with best international practice, and is drawing heavily upon the standards established by the IAEA.

This short paper will discuss a theme of the conference, which relates to the contribution of the government, the regulator, the regulatory body of the country of origin and TSOs in the licensing process.

[1] See the Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy, 2008 (www.fanr.gov.ae).

2. ROLES OF GOVERNMENT, REGULATOR, REGULATORY BODY OF COUNTRY OF ORIGIN AND TSOs

Role of the Government

The Government plays a key role in establishing the legal foundation of its nuclear programme to ensure that it is anchored in its laws and conforms to the international instruments into which the country has entered.

The development of a comprehensive, national legal framework covering all aspects of nuclear law including safety, security, non-proliferation, nuclear liability and other legislative, regulatory and commercial aspects, was undertaken by the UAE Government.

The major areas within the scope of the UAE legal framework include:

- Establishment of FANR for regulatory oversight of the nuclear sector;
- Assignment of the responsibilities of licensees and operators to take all steps necessary to reduce the risk of an accident to a level that is as low as reasonably achievable;
- Management of radioactive waste and spent fuel;
- Prohibition of the unlawful use of radiation sources within the territory of the UAE and penalizing offenders in the event of unlawful use;
- Nuclear liability (under development).

Role of the regulator

Federal Law, by Decree No. 6 of 2009, Regarding the Peaceful Uses of Nuclear Energy, requires that FANR undertake a thorough review and assessment of technical submissions made by the applicant for a licence for a nuclear power plant in order to assure FANR that:

- The available information demonstrates the safety of the nuclear power plant.
- The information on the applicant’s submissions is accurate and sufficient to confirm compliance with regulatory requirements.
- The technical solutions proposed can be demonstrated to achieve the required level of safety.

FANR is responsible for reviewing, inspecting and conducting enforcement activities to ensure that licensees comply with their safety obligations. Commitment to safety regulations that define licensee obligations is aimed at creating and maintaining safety using international guidance. FANR also regulates the decommissioning of nuclear facilities; physical protection of nuclear materials; and non-proliferation obligations, controls and enforcement.

Role of the regulatory body of the country of origin

While FANR cannot delegate its responsibility for review and assessment to another regulatory body, it is to FANR's advantage to review the safety evaluation performed by another regulatory body in the country of origin and to use this information to supplement its own review and assessment of the licence application submitted by the UAE operator, the Emirates Nuclear Energy Corporation (ENEC).

Drawing upon the work of other regulatory bodies should enable FANR to focus on the most significant licensing issues associated with the facility. ENEC selected the Korean APR 1400 nuclear power plant for operation in the UAE, which had already undergone an extensive safety review (or reviews) by the nuclear regulatory body, the Korea Institute of Nuclear Safety (KINS). The use of the work of KINS should contribute to the efficiency of FANR's review by reducing, where appropriate, the extent of FANR's review.

It is FANR's policy to establish a licensing framework in conformance with the safety standards of the IAEA. The licensing framework will include FANR regulations that stipulate requirements to be met for any application for a nuclear power plant. In turn, the process of review and assessment will be conducted in conformance with IAEA safety standards. The basic approach will be to use information available, where applicable, from KINS and potentially from other regulatory body approvals to support the assessment of whether the proposed facility complies with all FANR requirements.

This is done through:

- FANR collaboration with other regulatory bodies to determine the equivalency between FANR's requirements and those of the other regulatory bodies.
- Implementation of a graded approach for FANR to review the applicant's submissions of assessments by other regulatory bodies to demonstrate that FANR regulations are met.
- Provision of a more in-depth, independent FANR review of:
  - Areas where it cannot be demonstrated that FANR requirements have been met based on other regulatory bodies' assessments;
  - Changes made to the proposed UAE design relative to the design approved by other regulatory bodies;
  - Site characteristics that are unique to the UAE;
  - New technology;

- Operating experience gained since other regulatory bodies' approval;
- Areas of particular policy interest.

Role of the TSO

The nuclear industry is currently facing a range of challenges due to renewed interest in new reactor build programmes, and this has resulted in an increased use of TSOs. The use of TSOs is becoming an increasingly critical part of the organizational resources used by the regulator and licensee. However, their use varies significantly from country to country, which would require both the regulator and licensee to clarify their expectations of the TSOs' roles and responsibilities, and to have the in-house competencies to manage, review and verify their TSOs' activities. While it is important that the regulator's TSOs remain independent of the licensee's TSOs, the TSO is not an independent entity; it works at the request of the regulator.

The TSO:

- Must follow the regulatory framework of the country requesting the service;
- Must address internally any conflict with positions adopted by the national regulator;
- Cannot disseminate information to the public or publish it without permission;
- Cannot interact independently with licensees or their TSOs, if the TSO is that of the regulator.

3. SAFETY–SECURITY INTERFACE

'Safety–security interface' refers to the actual or potential interactions that may adversely affect security activities due to the design or operation (including maintenance) activities, or vice versa. As an overriding consideration, the protective security measures or protective design shall not significantly impede access to nuclear facility equipment that is necessary for operation, emergency response, maintenance, testing or inspection. To this end, security features should be incorporated into the design and assessed together with the safe operation of the nuclear facility, safety of nuclear facility workers and protection of target sets such that one does not compromise the other. Potentially conflicting requirements resulting from safety and physical protection considerations should be carefully analysed to ensure that they do not jeopardize nuclear safety. Probabilistic risk assessments that are used to identify failure scenarios involving equipment malfunctions and operator errors can be used to identify the target set whose destruction by adversaries can result in unacceptable consequences. Procedures or design changes can then be established to identify and resolve any conflicts between safety and physical protection.

4. TSOs AND CAPACITY BUILDING AND KNOWLEDGE MANAGEMENT

Nuclear power development in the UAE is in its initial stage, and the Government of the UAE is actively developing and implementing capacity building and knowledge management/transfer programmes. There is a worldwide shortage of skilled workers to meet the increased demand for nuclear energy, so in order to achieve our mission we:

- Employ experienced expatriates to support the licensing activities of the Braka nuclear power plant;
- Use innovative recruitment, development and retention strategies;
- Develop Emirati leaders;
- Use TSOs to increase staff numbers and mentor young engineers;
- Set individual and organizational performance goals to increase effectiveness, create safety culture and provide opportunities for all employees.

We are implementing a programme to capture valuable undocumented knowledge prior to the departure of experienced expatriates. We are also working cooperatively with the IAEA, and with the Governments and companies of responsible nations that adhere to the highest standards of safety, security and non-proliferation to ensure that we capture and store valuable knowledge and present this knowledge when needed. The goal is to provide the UAE nuclear energy programme staff with a solid foundation of knowledge of the basic physics, chemistry and engineering of nuclear energy, as well as the tools, capabilities and services to optimize their efficiency, productivity and reliability to perform their duties.

5. PROCESS TO CONTRACT TSOs

There are several processes that can be used by the regulator or licensee to establish contracts with TSOs. The important factors that need to be considered include:

- — Ensuring that the process conforms with State policy.
- — Ensuring necessary competencies within the organization:
  - Demonstrated depth in areas being sought;
  - Experience related to design, construction, operation, maintenance, inspection and environmental reviews of nuclear power plants.
- — TSO corporate experience in performing a wide variety of multidisciplinary tasks without a learning or educational period.
- — Successful completion by TSO of tasks similar to the ones being sought.
- — Creativity and problem solving skills.
- — Cost and timeliness.
- — Balanced proposal.
- — Project management and quality control.

In general, technical factors are more important than cost — that is, cost will not be scored — but cost should be a substantial factor in evaluating equally technical offers.

Bidders may form business alliances and/or use selective subcontracting to improve their delivery capabilities in specialist areas. FANR identified potential TSOs and advertised its interest. A three stage tender process was employed:

(1) *First stage:* Written request for proposal (RFP), whereby the bidders provide their technical and commercial responses. FANR shortlisted bidders to participate in the second stage.

(2) *Second stage:* Technical presentation. FANR further reduced the number of bidders in the RFP process.

(3) *Third stage:* The final shortlisted bidders submitted their final tenders in response to an invitation to submit a final tender.

6. CONCLUDING REMARKS

TSOs play a key role in supporting regulators, as they provide needed expertise. Some issues and challenges that are faced by regulators as they utilize TSOs are the following:

- — Certain information will be sensitive from both the security and the proprietary intellectual property point of view (systems must be established to appropriately identify and protect such information).
- — Quality control and consistency in the presentation of documents: interdependences between various TSOs (a TSO may be required to share documents or communicate with another TSO).

— TSO questions should be focused, and not open ended, and should include the appropriate basis.
— The TSO is not an entirely independent entity; it works at the request of the regulator.

CHALLENGES IN CAPACITY BUILDING FOR VARANS’ TSO FOR NUCLEAR POWER PLANT DEVELOPMENT IN VIETNAM

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Abstract

Vietnam is currently planning to build its first nuclear power plant to address its increasing energy needs. Recognizing the importance of the 19 issues laid out in the IAEA publication Milestones in the Development of a National Infrastructure for Nuclear Power, Vietnam is considering how to address these issues and how to mould its current legal and regulatory structure to accommodate a nuclear power programme. This structure has undergone major changes in the past several years and continues to do so. The Vietnam Agency for Radiation and Nuclear Safety (VARANS), which regulates all nuclear and radiological activities in Vietnam, was established as a regulatory agency in 2003. The Law on Atomic Energy passed by the National Assembly in June 2008 specifies the requirements for Vietnam’s future nuclear power programme, and VARANS is an important player in developing Vietnam’s plans for regulating the programme. As the nuclear power programme is moving ahead quickly, VARANS is facing many challenges, including staffing, expertise and especially technical support for its regulatory activities in order to ensure a safe, secure and peaceful nuclear power programme.

1. INTRODUCTION

Vietnam has experienced significant growth in the past decade. Demand for electricity is expected to continue rising, with a prediction of as much as a 17% increase per year over the next decade, and the country is seeking long term solutions to resolve this issue. Although Vietnam has gas and oil reserves, significant infrastructure must be created to tap these resources. Furthermore, Vietnam also recognizes the need for energy diversification as well as the impact of its choices on the environment. As a result of these considerations, Vietnam has decided that it will utilize nuclear power to meet part of its energy needs. In anticipating the development of the nuclear power programme as well as strengthening its regulatory activities, VARANS has been looking for and making every effort to develop its own technical support.

2. CURRENT SITUATION OF NUCLEAR DEVELOPMENT IN VIETNAM

The application of nuclear technology in Vietnam has increased remarkably since early 1930, when Vietnam received its first radioactive source from the famous scientist Marie Curie for diagnosis and treatment. We now have 220 radiation facilities with 4275 radioactive sources distributed in all 63 provinces. This creates a big task for VARANS as the regulatory agency.

In addition, VARANS has the responsibility for safety oversight of the Dalat research reactor. VARANS has been performing safety analysis report (SAR) assessment for renewal of the licence for the reactor, and safety assessment for the replacement of the instrumentation and control (I&C) of the reactor and conversion of the reactor core from high enriched uranium (HEU) to low enriched uranium (LEU) fuel.

As the country is preparing for its nuclear power programme, a pre-feasibility study for the first nuclear power plant (NPP) has been approved by the Government, indicating that the planned nuclear power capacity will reach 4000 MW in 2025. The southern province Ninh Thuan is the proposed site.

On 3 January 2006, the Government of Vietnam approved the Strategy for Peaceful Uses of Atomic Energy up to 2020, which aims to introduce the first NPP by 2020. Vietnam has begun to implement this long term strategy by establishing a comprehensive master plan, with the enactment of the Law on Atomic Energy in 2008 and approval by the National Assembly on 25 November 2009 of the construction of the first NPP. The agreed timescales are that the first reactor will start construction in 2014 and operation in 2020, and that four reactors (4000 MW) will be in operation by 2025 under a basic demand scenario. With this decision, Vietnam considers itself to be in Phase 2 of development as defined in the IAEA publication Milestones in the Development of a National Infrastructure for Nuclear Power [1].

This is another responsibility that VARANS has to take on as the regulatory body responsible for safety oversight of the NPP project at all stages, from site selection, construction and commissioning to operation and decommissioning. As such, VARANS needs to have its own TSO to support its regulatory activities and to be able to perform independent verification.

3. CURRENT EXPERTISE IN NUCLEAR SAFETY IN VIETNAM

Currently, there are some organizations involved in the nuclear sector that may be able to provide technical expertise to the regulatory body. These technical experts are mainly working either at the Vietnam Atomic Energy Institute (VAEI) and its subordinate institutes (the Institute for Nuclear Science and Techniques in Hanoi and the Dalat Nuclear Research Institute) or at VARANS. In total, there are approximately 60 technical experts. However, it should be noted that these people have no experience in NPPs or nuclear power technology.

The VAEI and its subordinate institutes have a number of personnel who have long been working in the nuclear energy field. However, it is only responsible for R&D in this area. It also has a research reactor that is regulated by VARANS. Although, when necessary, VAEI is mobilized to assist VARANS in technical services such as calibration or individual monitoring, it will mainly provide support to the NPP owner. As such, it cannot be a TSO for VARANS, the regulatory body, since this would violate the ‘independence’ principle. Hence, it is essential that VARANS develop its own technical expertise.

4. VARANS’ EFFORT IN DEVELOPING ITS TSO

Figure 1 shows the organizational structure for State management in the nuclear energy field in Vietnam. The National Assembly is the highest authority, and then the Government. The Government has two advisory bodies, the State Assessment Council and the National Nuclear Safety Council. Involved in the nuclear sector are the Ministry of Science and Technology (MOST), Ministry of Industry and Trade (MOIT), Ministry of Foreign Affairs (MOFA), Ministry of Health (MOH) and Ministry of Natural Resources and Environment (MONRE). VARANS is under MOST. Established in 2003, VARANS has the responsibility to assist the Minister of Science and Technology in the State management of radiation and nuclear safety. This responsibility is specified in the Law on Atomic Energy.

At its establishment and during the period from 2003 to 2005, VARANS had only eight staff, of which half were technical staff. Understanding the importance of sufficient staffing and resources in order to discharge its responsibilities, VARANS has created a favourable working environment to attract people to work for VARANS. As a result, a number of experienced professionals who had long been working in the nuclear energy sector have come to work for VARANS. VARANS has also recruited many other recent graduates. Over five years, the number of staff has increased from 8 to 75 at present, of which 11 hold PhD degrees. These staff are divided into seven divisions and a Technical Support Centre for Radiation Protection and Emergency Response. The seven divisions are: Administration and Personnel, Licensing, International Cooperation, Legislation and Information, Nuclear Safety, Nuclear Safeguards and the VARANS Inspectorate.

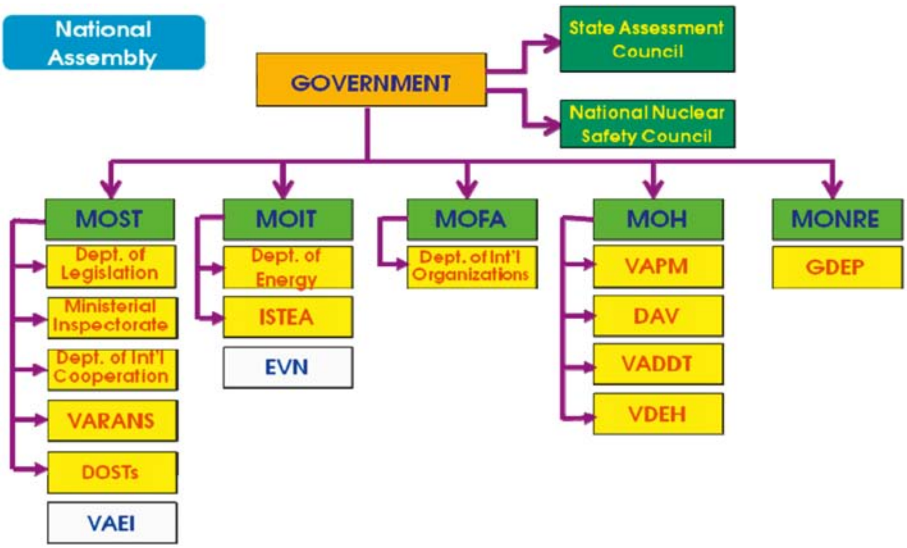

FIG. 1. The organizational structure for State management in the field of nuclear energy in Vietnam.

To discharge its regulatory responsibilities in radiation protection, VARANS has established a Technical Support Centre for Radiation Protection and Emergency Response (TSC-VARANS). Currently, the Centre has 13 staff, who have been provided with training in radiation safety and orphan source recovery. Up to now, the Centre has been provided with approximately US$1 million of funding (mostly from the Government) to establish its laboratory. As the supporting organization, the Centre has been providing technical support to VARANS in licensing and inspection activities. The Centre has also been mobilized in various emergency response operations, including incidents involving lost sources and orphan sources, and for evaluating levels of abnormal radioactivity in Lai Chau province. Recommendations from this operation were then provided to the local authority for action. The Centre has also provided technical expertise in helping the police to locate and recover radioactive material trafficked across the border of Vietnam and China to be used in gambling.

In order to have technical support in nuclear safety, VARANS has established the Division of Nuclear Safety in anticipation of the NPP programme. The division now has 16 staff from different disciplines. The staff have been provided with training on reactor technology and nuclear safety. Experts from the United States Nuclear Regulatory Commission have also been invited to provide instruction in the various codes and standards that are used for nuclear reactors.

Regional training organized by the Asian Nuclear Safety Network is also a source of instruction. Currently we have funding from the IAEA to buy PCTRAN. The Division will also be provided with WSs for calculation for safety verification. The Division has provided VARANS with support in reviewing the Dalat reactor SAR for licence renewal, conversion of the reactor core from HEU to LEU fuel and replacement of its I&C. Recently, the Division has been helping VARANS in reviewing the pre-feasibility study of the first NPP.

However, although VARANS has had its own TSO, for both radiation protection and nuclear safety, VARANS understands that it is facing many challenges as the regulatory agency responsible for safety oversight of the NPP.

5. CHALLENGES FACED BY VARANS’ TSO

In anticipating the introduction of NPPs, one of the challenges is to maintain the effective independence. MOST handles both VAEI (the operator) and VARANS (the regulator). MOIT will be issuing the licence for the NPP and at the same time EVN, the future owner/operator of the NPP, is under MOIT. The same issue arises with MONRE.

Another challenge that VARANS is facing is that it has new responsibilities. These responsibilities include drafting regulatory documents for the NPP, nuclear safety oversight such as nuclear safety assessment, inspection and enforcement, response to radiation and nuclear incidents, and implementation of Vietnamese obligations in international treaties to which Vietnam has acceded. As such, VARANS needs qualified staff who are professionally trained in various disciplines.

As it is taking on new responsibilities, VARANS also needs to be reorganized. It is expected that VARANS will become a larger organization with various departments and technical units providing technical support for its regulatory activities.

Developing regulatory documents is another challenge where support from its TSO is needed. It is expected that from now to 2014, there should be about 60 regulations for the NPP. And in total for the operation of the NPP, 110 regulations shall be issued.

It is also expected that a number of staff will be needed in different areas — for example, in nuclear safety assessment and regulatory document development for the NPP — and regular responsibilities must also be fulfilled. In total, by 2014, about 280 staff will be needed. And as in any nuclear entrant country, it is difficult to recruit new staff with the required qualifications.

Recognizing the importance of an effective regulatory body, in 2009 VARANS invited the IAEA to conduct an Integrated Regulatory Review Service mission. Among others, the most important recommendations from the mission were:

- — VARANS should strengthen without delay its human and financial resources, and technical capability, to meet its immediate needs for regulating both existing activities and, in particular, for the introduction of nuclear power.
- — VARANS should be provided with adequate technical expertise to conduct independent review and assessment, both now and in the future.

As such, VARANS should have a strong TSO to support its regulatory activities, especially for the nuclear power programme. For this, the support of the Government will be needed in providing VARANS with sufficient resources, especially financial resources in order for VARANS:

- — To have sufficient staff;
- — To provide training for recruited staff;
- — To have a sufficient workplace and sufficient equipment.

International cooperation is also important in sharing experience and knowledge in regulations and expertise for oversight of the NPP in all phases.

6. CONCLUSION

Vietnam has made an informed decision to utilize nuclear power to help meet its energy needs. In the coming months and years, it will face many challenges in developing the infrastructure for a safe, secure and peaceful nuclear power programme. The priority is to establish an independent regulatory body in order to be in line with international standards. It is equally important that the regulatory body should have its own TSO to support its regulatory activities. Great effort has been made, but much work remains to be done. As the regulatory body, VARANS still has a long way to go, especially in developing a TSO that has sufficient capability to provide it with the required technical expertise.

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IDENTIFYING AND ADDRESSING SUPPORT NEEDS IN MEMBER STATES INTENDING TO EXPAND EXISTING NUCLEAR POWER PROGRAMMES AND LESSONS LEARNED

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Abstract

The paper focuses on identifying safety challenges, technological issues and technical support needs for regulatory decision making activities from the viewpoint of the practice and knowledge of the nuclear regulatory authorities and technical and scientific support organizations (TSOs) in the Russian Federation and in other countries intending to expand existing nuclear power programmes. With a focus on basic safety criteria and elements for regulatory decisions, the significant aspects of establishing an effective regulatory framework for integrated safety assessment are outlined. Some relevant items with reference to applying different safety analysis techniques and safety assessments for regulatory decision making in the face of uncertainties (e.g. safety culture issues, differing opinions among experts, ageing of data and information on site location, change of the safety level of a facility in operation) are noted. Decommissioning issues that should be taken into account at the early design stage of new nuclear power plants are discussed. Practices of the Russian nuclear regulatory authority and its TSO in pre-licensing activities associated with new designs are presented.

1. INTRODUCTION

The coherent and consistent set of fundamental safety principles [1] to achieve the fundamental safety objective, “To protect people and the environment from harmful effects of ionizing radiation”, includes the prime responsibility of a licensee for safety throughout the lifetime of its facilities and activities, and this responsibility cannot be delegated. In addition, the fundamental safety principles foresee governmental responsibility related to the authorization (or *not*) of licensees’ activities. Traditionally, the components of nuclear safety, which must be realized by a licensee and under constant regulatory focus, are divided into three general areas [2]:

— Human factors (sufficient properly qualified and trained personnel to operate the facility, to maintain the equipment, etc.);

— Technical components (facility is designed, constructed, tested, operated and maintained in accordance with the design and safety requirements);
— Organizational components (set of procedures on operation, testing and maintenance, systematic analysis of operating experience, safety assessments of all changes and corrective actions made, fuel and waste management, ageing management, accident management, security measures, etc.).

For assessment of nuclear safety components, each regulator uses its own national approach. The regulator must have competent and experienced staff to be able to obtain, integrate and judge these safety components and data related to them. In addition, the regulator has to have sufficient resources for independent analysis, investigations and research in order to have an adequate background for assessments to develop the safety regulations, to keep technical competence up to date, to obtain safety assessments independent of those of a licensee, etc.

The activities of the nuclear regulatory authority in the Russian Federation as well as in any country with an existing nuclear power programme are based on the following main elements:

— Authorization of the activities of applicants/licensees (safety review of assessments of applicants/licensees, issuing of new licences, renewals, amendments, permissions on equipment manufacture, transportation of nuclear materials, decommissioning activity, etc.);
— Oversight of licensees' activities (monitoring of performance of nuclear facilities, inspections of licensees' activities, investigations of events, issuing of sanctions to licensees in the case of any violations);
— Analysis of operating experience (assessment of incidents, identification of generic safety issues that affect more than one facility);
— Analytical and research activities (analysis of regulatory process effectiveness, technical studies of safety significant issues, evaluation of potential safety issues involving new technical solutions, etc.);
— Development and updating of safety regulations (safety codes) and regulatory guidance (such as regulatory guides, inspection manuals, standard review plans).

2. CHALLENGES AND TECHNOLOGICAL SAFETY ISSUES AS WELL AS TECHNICAL SUPPORT NEEDS ASSOCIATED WITH EXPANDING NUCLEAR POWER PROGRAMMES

The conclusions of previous international conferences on nuclear regulators and their TSOs [3–5] and the latest analyses by international experts (e.g. Ref. [6]) underline the following safety challenges, which shall now be taken into account:

— Construction of new nuclear power plant (NPP) units after a long time interval;
— Increasing work volume for regulators due to construction of new NPP units;
— Shift to multinational subcontractors while constructing new NPP units;
— Countries embarking on new nuclear programmes;
— Keeping effective regulatory tools and personnel competence (with a shift from ‘know-how’ to ‘know-why’);
— Regulatory requirements and harmonized approaches as well as knowledge exchange based on international cooperation (on safety policy for NPPs in operation, periodic safety review, ageing management, severe accidents policy, etc.);
— Maintaining an effective integrated regulatory framework and transparency in regulatory activities (including support by Integrated Regulatory Review Service (IRRS) missions of the IAEA).

Moreover, it is necessary to underline technological safety issues requiring regulatory attention and TSO assistance in countries with existing nuclear power programmes concerning NPP units in operation [6, 7]:

— Ageing of equipment;
— Life extension of NPP units;
— Power uprates of NPP units;
— Increasing the time interval between outages;
— Failures of electro-transformers at NPP units;
— Safety issues in relation to non-conformance of spare parts at NPP units (due to manufacturer closing down, lack of ability to obtain the original part, change in materials, industrial standards, etc.).

Related to construction of new NPP units, there are additional safety challenges (identifying safety issues specific to new designs, defining a validation basis for these issues, etc.). It is important to note that the

Multinational Design Evaluation Programme is a good forum for such collaboration among regulators and their TSOs.

3. FRAMEWORK FOR A REGULATORY INTEGRATED SAFETY ASSESSMENT

The basic principles for regulatory decision making are well known:

— An adequate set of safety regulations that the licensee must follow;
— Competence in the review and assessment of safety significant issues;
— No time limitation and no pressure from any interests that may conflict with safety;
— Consideration of how a regulatory decision will appear in retrospect (how stakeholders might view a regulatory decision).

From the viewpoint of these basic principles, a set of main elements of the regulatory decision making process could be formulated as follows [8]:

— Clearly define the issues for decisions and determine the criteria to be applied.
— Collect the relevant information and data.
— Determine the analysis to be performed and judge the resources needed for analysis.
— Review and assess the significance for safety.
— Make and write a well informed decision (and publish it, if needed).

Often, there are volumes of safety information and data available to a regulator from inspection reports, licensees' reports, operating experience analysis, event assessment reports, regulatory review results, personnel training records, emergency exercises, etc. While making decisions, sometimes a regulator has questions on the completeness or differing interpretations of safety information and data. The regulator must be sure that any design changes during the construction, commissioning and operation of a given facility do not reduce the safety level of the facility. It has become a common practice to interact with licensees to gain clarification of 'open questions' on design, safety analysis, performance assessment, etc.

One challenge is finding a way to correctly integrate all safety information and data available. It is essential for a regulator to have an adequate framework bringing the different safety issues together in order to get an integrated safety assessment. Some regulators have recently started to develop their own integrated safety assessment system with the following main attributes: systematic, comprehensive, consistent, transparent, with well defined guidelines and ‘user friendly’ layout.

But to set up and operate such an integrated regulatory safety assessment system, it is necessary [8] to:

- Achieve a consensus among staff on criteria for applying such an integrated system;
- Obtain adequate human resources and time for performing analysis of the whole scope of safety information and data;
- Have sufficient resources in order to ensure that the system is functioning effectively.

Another challenge is deciding how to estimate the safety information and data and their significance for safety. There are no direct means of measuring the current level of safety at a given facility, and there are no reliable indicators to predict future safety performance. Sometimes safety criteria cannot cover all safety aspects. Beyond quantitative safety criteria (core damage frequency, large early radioactive release frequency, etc.) a regulator may adopt a qualitative criterion like ‘level of safety’. But there are various statements on this criterion among regulators (‘no unreasonable risk’, ‘risk as low as reasonably practicable’, ‘adequate protection of public health and safety’, etc.). Nevertheless, in countries with existing nuclear power programmes, the fundamental practice is generally to make conservative regulatory decisions [2].

For each safety issue, regulators use a combination of assessment results of past operating experience, current engineering judgement and risk based insights (including relevant information on foreign operating experience as well as non-nuclear experience). Now most regulators require a periodic safety review (a cross-assessment of the safety level of a given facility in operation, including assessment of equipment degradation due to ageing).

4. APPLYING DIFFERENT SAFETY ANALYSIS TECHNIQUES WHILE PERFORMING SAFETY ASSESSMENTS AND REGULATORY DECISION MAKING IN THE FACE OF UNCERTAINTIES

It is clear that not all safety issues or events, or accidents are alike. Always there is the question of what analysis technique is better to use for a regulatory safety assessment of licensees’ activities and the corresponding safety level of nuclear facilities? In the case of an event analysis, it is necessary to note that:

- — Deterministic safety analysis concentrates on a design basis accident and has a focus on ‘high frequency–low consequence’ areas of the risk curve.
- — Probabilistic safety analysis emphasizes a beyond design basis accident and has a focus on ‘low frequency–high consequence’ areas of the risk curve.
- — Deterministic transient analysis is the best technique for events with rapid occurrence development.
- — Probabilistic precursor analysis is the best technique for determination of the safety significance of events.
- — Root cause analysis is the best technique for evaluation of event causal factors and their impact.

All these analysis techniques have their limitations but they complement each other. For example, a probabilistic safety assessment (PSA) can show what external and internal hazards (e.g. seismic, airplane crash, water intake, fire) can be dominating contributors to operational risk. On the other hand, a PSA cannot present the total risk at a plant, nor can it model the safety culture, etc. However, regulators of some countries use PSA results in their decision making process as a complement to deterministic analysis results. But regulators of other countries rely mostly on the deterministic analysis technique, with only a limited use of PSA results.

There are some cases when regulatory decision making comes in the face of uncertainties. A special challenge for a regulator is uncertainty related to evaluation of the actual safety level of a facility. Practically, the actual safety level of a given facility is constantly changing [2] for a number of reasons. Physically, organizationally and environmentally, any given facility is not constant over time:

- — *Physically*: Systems and equipment differ in operation; improvements can be realized from an economic viewpoint (longer fuel cycles, new fuel designs, higher fuel burnups, power uprates, etc.).
- — *Organizationally*: There may be new personnel and managers, operating procedures may be improved, etc.
- — *Environmentally*: Site location and conditions around a facility may change due to industrial developments, new sources of external hazards, etc.

Another challenge is uncertainty related to a situation with differing opinions among safety experts providing a regulator with technical information and analysis results. For such situations, it is necessary to establish an internal regulatory procedure that includes respectful consideration of all differing expert opinions and produces a clear record of a regulatory decision and its basis.

The next challenge is uncertainty related to the evaluation of the safety level if any weakness in the safety culture of a facility is detected. It is not really possible to measure quantitatively the safety culture of a licensee. Such problems may not be covered by a specific safety regulation. Nevertheless, in several countries there are experts working to understand the influence of safety culture on a facility's safe performance.

It is also necessary to note that safety information and data can 'age', and that this is a source of uncertainty for regulatory decision making, too. A big question is, how far can the use of such data (sometimes many years or even decades old) be taken as the basis of the current safety case? The safety experts have difficulties with the verification of old data. They are not able to determine which data were used for the former safety calculations or which old data could be used for new safety assessments.

Additionally, it is necessary to point to ageing of safety assessment results due to new scientific knowledge and background, new safety analysis tools (models, methodologies, accident analysis codes, etc.) and new safety requirements (regulations, standards, even legislation). Of course, the new actual safety information can lead to a change of assessment results and regulatory decisions.

5. DECOMMISSIONING ISSUES IN THE EARLY STAGE OF NEW NUCLEAR POWER PLANT DESIGN

It is well known that safety issues play an important role in relation to decommissioning. Decommissioning aspects must be given special attention during the entire life cycle of a nuclear facility. Safety regulations in many countries with existing nuclear power programmes require that consideration be given to decommissioning issues before an operation licence is granted.

The new generation of NPP designs incorporate many improvements that will be beneficial to plant dismantling. The new designs will provide for optimal operation and maintenance of a facility with early consideration of decommissioning aspects. Such an approach allows special attention to be paid to developing systems for maintaining the records of physical plant configuration changes and the original composition of construction materials used in the facility for future estimation of the inventory of contaminated materials. Many design features will be helpful for assisting in later decommissioning activities, especially relating to radiation protection and waste management, and will also be useful during normal facility management.

For new NPP designs, it has become common practice [9] to develop decommissioning plans at an early design stage with specific reference to the management of waste arising from later decommissioning activities, the end state of a facility and environmental issues. These plans should be used as the basis for estimating adequate financial provisions to address decommissioning issues. This marks a clear change of approach for new NPP designs from that for earlier NPP generations.

6. RUSSIAN PRACTICE CONCERNING PRE-LICENSING ACTIVITIES ASSOCIATED WITH NEW DESIGNS

In the Russian nuclear regulator and its TSO, pre-licensing activities associated with new designs incorporate:

— Reviewing preliminary safety information and data relating to licence applications in the future;
— Interacting with a licensee to gain clarification of ‘open questions’ on design or safety justifications in order to avoid additional questions in the future.

Of course, there are different types of preliminary safety information prepared by a potential applicant — from safety justifications for some innovative technical aspects to safety analysis reports for a ‘standard design’ for new NPP units. However, a pre-licensing regulatory review may be initiated only if:

— A pre-licensing regulatory review provides a basis for increasing the efficiency of this review in the future;
— Preliminary safety information deals with safety issues (not industrial, economic or other issues) and contains enough detailed data on specific issues presented by a potential applicant.

It is clear that the pre-licensing activities of regulators and their TSOs lead to improving the experts’ understanding in preparing for a future regulatory review and to avoiding possible uncertainties.

7. CONCLUSIONS

Since the 2006 International Conference on Effective Nuclear Regulatory Systems held in Moscow [3], the nuclear regulators and their TSOs have continued to face challenges. This TSO conference allows us to review the achievements, and to address current and future challenges through international dialogue in order to strengthen the Global Nuclear Safety and Security Framework.

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IDENTIFYING AND ADDRESSING SUPPORT NEEDS IN RELATION TO MEDICAL AND INDUSTRIAL APPLICATIONS OF IONIZING RADIATION AND LESSONS LEARNED

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Abstract

The first International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety, held in Aix-en-Provence in 2007, focused on the support of the nuclear industry and nuclear regulators, although the possible contribution of technical and scientific support organizations (TSOs) to radiation safety in other areas was also mentioned during the conference. The use of ionizing radiation in medical and industrial applications is continuously increasing throughout the world, requiring a comprehensive system for the verification of compliance with national regulations and international requirements and recommendations, such as those established by the Basic Safety Standards and related IAEA publications. For the implementation of many components of this system, the support of TSOs may be required, as, for example, in the elaboration of regulatory documents, safety assessment of new technologies, emergency preparedness and response, education and training, provision of assays and, in some cases, inspection activities. An important aspect to be considered is the large number of installations existing in many countries that makes necessary the development of appropriate strategies to provide, as much as possible, support to all of them. Taking all those aspects into consideration, the paper discusses the needs of technical and scientific support in relation to medical and industrial applications of ionizing radiation and strategies that could be adopted by TSOs for enhancing radiation safety in those areas.

1. INTRODUCTION

The International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety [1], organized by the IAEA and held in 2007 in Aix-en-Provence, France, provided for the first time a forum for addressing the role of technical and scientific support organizations (TSOs) in enhancing nuclear and radiation safety and, as a consequence, contributed to the strengthening of the Global Nuclear Safety and Security Framework (GNSSF). Although nuclear and radiation safety was mentioned during the conference, almost all specific presentations and discussions focused only on nuclear power plants. However, the general aspects and principles regarding the role of and challenges faced by TSOs could be easily extended to other areas covered by radiation safety, such as the medical and industrial applications of ionizing radiation.

According to the current analysis, based on the UNSCEAR 2008 report [2], approximately 3.6 billion diagnostic radiology X ray examinations (considering both diagnostic medical and dental examinations) are undertaken annually in the world. The annual per capita dose varies from 0.03 mSv in less developed countries up to 1.91 mSv in the more developed ones. For diagnostic nuclear medicine, approximately 32.7 million examinations are performed annually. With regard to radiation therapy, an estimated 5.1 million courses of radiotherapy treatment are administrated annually (4.7 million involving teletherapy and 0.4 million brachytherapy). Medical exposure remains by far the largest artificial source of exposure to ionizing radiation and continues to grow at a remarkable rate. The number of workers involved in medical uses of ionizing radiation was estimated to be about 7.4 million in 2002, with an average annual effective dose of about 0.5 mSv for monitored workers.

Regarding industrial applications of ionizing radiation, the facilities that use radiation sources, including sealed sources, X ray machines and particle accelerators, are classified into the following main practices: industrial radiography, industrial irradiators, industrial accelerators, well logging and nuclear gauges (thickness, moisture, density, level, etc.). In addition to the number of fixed industrial radiography installations, on-site industrial radiography works are carried out in the world, and these activities are responsible for the movement of a high number of industrial gamma radiography apparatuses and workers. The same applies to well logging, with offshore and onshore installations. For industrial applications, the number of workers was estimated to be about 0.9 million, with an average annual effective dose of 0.3 mSv.

In the same report [2], it is mentioned that a small number of accidents have occurred in association with the nuclear fuel cycle and that these are reported widely. However, more than 100 accidents have been reported involving industrial and medical sources that have harmed workers and the public, including accidents that occurred during radiotherapy treatment, overexposing patients. This last figure is likely to be underestimated because of underreporting.

This scenario clearly demonstrates the importance of the support provided by TSOs, to regulators and licensees, in enhancing radiation safety for medical and industrial ionizing radiation applications. This paper intends to identify and discuss possible specific areas for which this support would be of great value. The identification of the areas of support will be based on two key aspects, the first one being the large number of installations and workers involved in those areas and the second one being the fact that IAEA documents are normally used as a basis for the development of national regulations. Most of the discussion on each topic is based on the experience of the Institute of Radiation Protection and Dosimetry (IRD), of the Brazilian National Nuclear Energy Commission (CNEN), which has been acting as a TSO for many years.

2. DEVELOPMENT OF DOCUMENTS

> "In developing regulations and guides, the regulatory body shall take into consideration comments from interested parties and the feedback of experience. Due account shall also be taken of internationally recognized standards and recommendations, such as IAEA safety standards." (Ref. [3], para. 5.28)

TSOs can contribute to the development of basically three types of document. In the first group are the national regulatory documents. Regarding these, it is usual for most regulatory bodies to seek the participation of all the stakeholders, at least in the final phase of revising the final draft before issuing the regulation or guide. Taking into account the knowledge and experience residing in TSOs, it might be useful if they were to participate not only in the final stage, but from the beginning of the drafting phase.

The second category of documents is international documents, such as IAEA safety standards. TSOs should be more involved in this process and make a greater contribution to developing these standards and their updates, which are needed to reflect new developments. Currently, only a few TSOs are involved in the development of IAEA safety standards [1].

The third group consists of more specific technical documents, covering subjects like quality control, operating procedures, technical guides and others. This type of document would be of primary importance for new technologies and equipment, for which a complete analysis of their implications in terms of radiation safety is made by a TSO.

3. INSPECTIONS

> "If the regulatory body is not entirely self-sufficient in all the technical or functional areas necessary to discharge its responsibilities for review and assessment or inspection, it shall seek advice or assistance, as appropriate, from consultants. Whoever may provide such advice or assistance (such as a dedicated support organization, universities or private consultants),

arrangements shall be made to ensure that the consultants are effectively independent of the operator.” (Ref. [4], para. 6.13)

Use of a TSO in some steps of the licensing process, including inspections, is a way of strengthening the effectiveness and efficiency of the radiation safety regulatory programme and affects in a positive way the optimization of resources and the management of programme implementation as a whole. The large number of installations to be inspected, when talking about the medical and industrial uses of ionizing radiation, makes it even more relevant.

One important point that is often questioned is related to enforcement actions in the event of deviations from, or non-compliance with, conditions and requirements that are observed during the inspection. If this is an issue for the specific situation, the terms of reference for support provision should specify clear limits for the external inspectors’ action and templates for their reports, leaving the enforcement actions to the regulatory body after the appropriate decision making process.

A good practice would be the implementation of a quality system based on appropriate guides such as “ISO/IEC 17020:1998: General criteria for the operation of various types of bodies performing inspections” for the inspection act itself and “ISO/IEC 17025:2001: General requirements for the competence of calibration and testing” for the measurements carried out during, and sometimes after, the inspection.

An intensive training programme for the inspectors should be in place. The main outcome of these programmes, especially if a common programme is implemented at both the TSO and the regulatory body, is to make the results of the inspections more uniform between different inspection teams and to considerably increase the efficiency and effectiveness of those inspections. Education and training will be discussed later in this paper.

Another possible question is related to the fact that, to fulfil their tasks, TSOs have to maintain laboratories and installations that may be subject to the licensing process by the regulatory body, and this might be considered a conflict of interest when a TSO is providing support to this body in its licensing process. Therefore, it is clear that the TSO’s staff cannot participate in its own licensing process, including the inspections at its own installation, and in this way there would be no conflict. But this subject has to be clarified, including within the IAEA, since it can affect many TSOs. IRD stopped the conduct of the radiation protection inspection programme of medical and industrial facilities, by a decision of the regulatory authority in 2008, after an IAEA Radiation Safety Infrastructure Appraisal (RaSIA) indicated a potential conflict of interest due to that fact that IRD is also running laboratories that are subject to regulatory control and that the distribution of the regulatory functions among different entities might affect the optimization of resources and the management of the regulatory programme as a whole. Of course there were other facts associated with this decision, but the report was the starting point for the discussion.

4. EMERGENCY AND OVEREXPOSURE EVENT PREPAREDNESS AND RESPONSE

Despite all the improvements in radiation safety over the past few decades, radiation accidents involving radioactive sources continue to occur in many countries, involving the exposure of members of the public as a result of lost or stolen sources from industrial radiography or medical therapy, the exposure of workers at high dose rates, and medical patients overexposed due to calibration error, equipment failure or administrated dose miscalculation.

The response to those events may require expertise in many areas, such as:

— Biokinectic modelling;
— Bioassay methods for ‘in vivo’ and ‘in vitro’ determination of internal contamination;
— Personal dosimetry;
— Biodosimetry (cytogenetics);
— Dose reconstruction;
— Environmental modelling;
— Environmental sample analysis;
— Environmental radiological survey.

The necessary infrastructure and expertise for conducting those activities are normally not available at medical and industrial installations. However, they can be found in many TSOs and are very important contributors not only to the mitigation of accident consequences but also to the investigation of possible accident causes. Besides that, TSOs can contribute to emergency preparedness through education and training of the staff of other organizations involved and through the planning and conduct of exercises and drills.

Especially important for the areas of medical and industrial applications is the response to overexposure events. In the Brazilian system for authorization of external individual monitoring services, there is the provision of a compulsory notification, by the service providers to IRD, of doses greater than 100 mSv, and such notifications trigger an investigation process that includes dose confirmation by cytogenetic analysis if necessary. From 1985 to 2010, more than 500 cases were investigated.

Another important contribution that can be provided by TSOs is to assist the IAEA in fulfilling its obligations under the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [5] by making its staff and resources available for assistance to other countries upon the IAEA's request.

5. ASSAYS, TESTING AND CALIBRATION

In some States, the regulatory body provides services such as assays, testing and calibration:

> "When such functions are undertaken, care shall be taken by the regulatory body to ensure that any conflict with its main regulatory functions is avoided and that the prime responsibility of the operator for safety is not diminished." (Ref. [3], para. 3.5)

Also, "The managements of the regulatory functions and of the technical support services should be in separate organizational entities." (Ref. [4], para. 8.4)

IAEA Safety Standards Series No. GS-G-1.5 [4] gives detailed guidance on the key elements for the organization and operation of a national regulatory infrastructure for radiation safety. It states that, for the regulatory body to function effectively, the regulatory body itself and the operators should have available certain services, when necessary, through arrangements made within the State or from abroad. Some specific services listed in that publication that require a more sophisticated laboratory infrastructure and qualified staff are:

- — Dosimetry services for the assessment and recording of individual external and internal doses for the types of practice authorized;
- — Laboratory services with the capability to provide qualitative and quantitative analyses of radiation measurements;
- — Calibration services with traceability to a standard dosimetry laboratory.

Additionally, the regulatory body should ensure high quality results from those support services, in order that they can be used in the verification of compliance with the national regulations. This quality can be ensured by adequate qualification procedures, specified in regulations or regulatory guides, such as accreditation, certification or authorization processes conducted by specialized institutions at the national or international level [4, 6].

TSOs can provide services, such as those already mentioned, directly or can act as a national or international qualification body for particular service providers within a country. In Brazil, for example, the regulatory body has established in its regulations that all service providers for external individual monitoring and radiological protection survey detector calibration must be authorized by IRD. Actually, there are 11 authorized service providers for individual monitoring, covering 126 000 workers, and 7 authorized calibration services. The authorization process includes periodic audits of the services and the follow-up of their results in proficiency test exercises that are conducted by IRD.

Proficiency test exercises are indispensible tools for the quality assurance of experimental results, and their conduct requires expertise and laboratory infrastructure. Besides the two already mentioned, IRD also conducts proficiency test exercises for environmental sample analysis and for the determination of activity in radiopharmaceutical products measured by nuclear medicine services.

6. RESEARCH AND DEVELOPMENT

It is not the intention of this paper to identify individual areas for research at TSOs, since this would result in a very long list of subjects. It is important to point out that TSOs may conduct research activities in basic science but can also conduct more focused research on the needs of the regulatory process. The rapid development of new concepts for medical diagnosis and treatment with increasing complexity clearly demonstrates the need for the involvement of TSOs in conducting research activities to evaluate the implications to safety and radiological protection and to propose the necessary actions, both to the licensees and to the regulatory body, in order to protect workers, the public and patients.

7. EDUCATION AND TRAINING

> “While implementation of a national strategy for building competence in protection and safety should normally be outside the responsibilities of the regulatory body, circumstances may warrant the direct participation of the regulatory body in the training and qualification of the licensees’ personnel in protection and safety.” (Ref. [7], para. 4.3)

> “In this case, the participation of the regulatory body in the training and qualification of the licensees’ personnel in protection and safety should be considered a transitional arrangement. The regulatory body should not participate to an extent that could compromise its function as an

independent national authority for the control of the use of radiation sources." (Ref. [7], para. 4.4)

Education and training, associated with the experience gained through professional life, are some of the most important factors for achieving competence in any area of work. Requirements for appropriate education and training of all individuals occupationally exposed or with specific responsibilities in relation to the safety of radiation sources — for example, the staff of regulatory bodies — are discussed in many IAEA publications, including the Safety Fundamentals publications and the Basic Safety Standards [8].

The general concept proposed by the IAEA [7] for the development of a national strategy for building competence in protection and safety states that it is the competence of regulatory bodies to establish, through enforcement of relevant regulation, the minimum qualification required for each job category, the procedures for assessment of qualification, authorization of individuals and accreditation of training centres. It also states that implementation of the national strategy should normally not be included in the responsibilities of the regulatory body. If, for any reason, the participation of the regulatory body's staff in training and qualification is necessary, this participation should be a transitional arrangement and should not compromise its function as an independent national authority for the control of the use of radiation sources.

TSOs may also provide education and training to inspectors, reviewers and staff members engaged in regulatory activities. An intensive training programme for inspectors must be in place, including technical aspects, quality system training and behavioural aspects. The main outcome of these programmes is to make the inspection results obtained by different inspection teams more uniform and to ensure the quality of the results of assays performed both during the inspections and afterwards, in those cases where laboratory work has to be done after the inspection.

Through the knowledge existing in them and by providing laboratories and installations for the conduct of education and training activities, TSOs contribute to the development of programmes at different training levels, such as short duration extension courses, formal education and the post-graduate educational course proposed by the IAEA [9]. IRD has been conducting education and training activities for many years; in 12 extension courses, around 800 professionals are trained every year, with half of them being trained in emergency response courses. A Master of Science programme in radiation protection, formally recognized by the Ministry of Education, has been running since 2001, with around 40 students per year. And now, after IRD's recognition as a Regional Training Centre by the IAEA in 2010, a post-graduate educational course is planned to start in 2011.

8. CONCLUSION

It is clear that the support of TSOs is indispensible in the area of medical and industrial applications of ionizing radiation, taking into account the large number of installations and the rapid development of new technologies, especially in the medical area. TSO support to regulatory bodies, even if only in some of the areas described here, would strengthen the effectiveness and efficiency of the radiation safety regulatory programme. In the same light, TSO support to all other stakeholders, as for example in education and training, contributes directly to the enhancement of radiation safety.

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SUPPORT REQUIRED FOR SAFETY MANAGEMENT OF RESEARCH REACTORS, ESPECIALLY THOSE IN EXTENDED SHUTDOWN

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Abstract

The Japan Materials Testing Reactor (JMTR) was operated for 38 years, with 165 cycles for various users, from its first criticality in 1968. The JMTR has been in an extended shutdown period since August 2006 for refurbishment and will restart in 2011. The JMTR is the only testing reactor dedicated to irradiation testing of materials and fuels in Japan. In response to the strong requests of the various users, the Japan Atomic Energy Agency (JAEA) decided to refurbish the JMTR for long term operation, and the work started in 2007. In order to improve the reliability and safety of the reactor, a number of reviews and inspections were conducted in parallel with the refurbishment. The experience of the JMTR during the period could be shared with other organizations which currently or potentially have a similar situation. A periodic safety review was carried out to confirm the integrity of the JMTR facilities, and a 10 year maintenance plan was developed in 2004. Before the restart of the JMTR, equipment to be renewed was selected based on an evaluation of its damage and wear in terms of ageing, significance to safety functions and past safety related maintenance, in order to enhance the operational capability. Renewal work on the power supply system, boiler, radioactive waste facility, etc., was finished as scheduled. Work on the reactor control system, the nuclear instrumentation system and the primary cooling system is being carried out. As for safety management during reactor operation, the owner’s periodic and daily inspections are supposed to be carried out in order to maintain the integrity and reliability of the facility. The performance of the facilities and equipment is confirmed through inspections. During the extended shutdown period, a special classification of the facilities was made based on whether their functions are required continuously during the refurbishment period. Maintenance work and periodic inspections, including those by the regulatory authority, are carried out based on the special classification. As for radiation management, measures have been taken to reduce worker exposure to a dose level well below the limit determined by law, based on the concept of radiation protection of the International Commission on Radiological Protection.

1. INTRODUCTION

The JMTR achieved its first criticality in 1968 and was operated for 38 years to the 165th cycle operation. A periodic safety review (PSR) was carried out to confirm the integrity of the JMTR facilities. Moreover, a 10 year maintenance plan was developed in 2004. As the JMTR is the only irradiation testing reactor in Japan, its long term operation was strongly requested by various users. The Japan Atomic Energy Agency (JAEA) decided to refurbish the JMTR for long term operation, and the refurbishment work was started in FY 2007. The JMTR is now in long term shutdown for refurbishment. Before the start of refurbishment, facilities to be renewed were selected based on the results of the PSR and an evaluation in which damage and wear were considered in terms of ageing, significance to safety functions, past safety related maintenance and the enhancement of facility operation. Restart of the JMTR is planned for 2011 following the refurbishment. This report summarizes the PSR, refurbishment and safety management during reactor shutdown of the JMTR, including the periodic inspections by the regulatory authority.

2. OUTLINE OF JMTR

The JMTR is a materials testing reactor with a thermal power of 50 MW. The JMTR was built to develop domestic power reactors for irradiation testing of materials and fuels, and for radioisotope production. It achieved its first criticality in 1968 and began operation in 1970. The JMTR has various irradiation facilities for various irradiation tests. Moreover, a hot laboratory for post-irradiation examination is connected to the reactor building. A bird's-eye view of the JMTR is shown in Fig. 1. As for the characteristics of the JMTR, the maximum fast and thermal neutron fluxes are both 4×10^{18} $m^{-2} \cdot s^{-1}$, which is the highest neutron flux level available in Japan. Irradiation in the JMTR can be carried out for a wide variety of needs, such as acceleration irradiation of fuels and materials, irradiation of large specimens, capsule irradiation under controlled temperature and load, irradiation using the large loop and so on. Since the reactor is connected to the hot laboratory via a canal, it is easy and safe to transfer samples to the hot laboratory to carry out post-irradiation examination. Furthermore, it is easy to re-fabricate the irradiated specimen into the capsule, and re-irradiation can be carried out in the reactor. Major specifications of the JMTR are shown in Table 1.

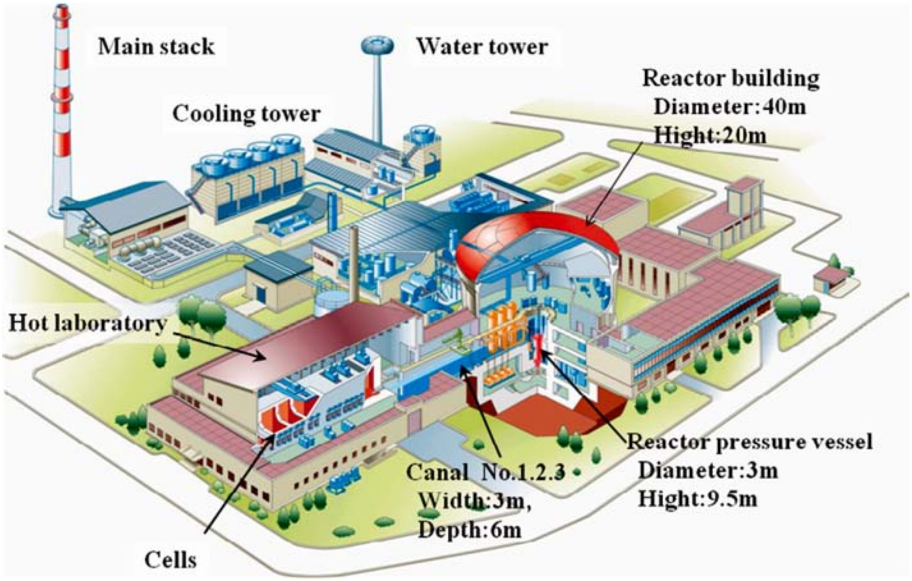


FIG. 1. Bird's-eye view of the JMTR.

TABLE 1. MAJOR SPECIFICATIONS OF THE JMTR

Reactor type	Light water moderated and cooled tank type	
Thermal power	50 000 kW (50 MW)	
Fuel element	U-235 enrichment	20 wt%
	Fuel meat	U_3Si_2–Al dispersion alloy
	Uranium density	4.8 g/cm^3
Neutron flux	Thermal neutron flux	4×10^{18} 1/m^{2}s (Max.)
	Fast neutron flux	4×10^{18} 1/m^{2}s (Max.)

3. PERIODIC SAFETY REVIEW (PSR)

The "Regulations Concerning the Installment, Operation, etc., of Research Reactors" in Japan were revised in February 2004. In compliance with the regulations, the results of the PSR, including the technical evaluation of ageing and the maintenance plan of the JMTR facility, were reported to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in March 2005. For the technical evaluation of ageing, the monitoring of ageing and the evaluation method were investigated and evaluated based on past maintenance records. Moreover, those facilities that were difficult to replace and important to safety were investigated and evaluated to determine whether they could maintain long term safe operation or not. As for the improvement and maintenance plans, improvement of maintenance activities and the 10 year maintenance plan based on the results of the evaluation of operating experience, investigation of the maintenance record and technical evaluation of equipment on ageing was mentioned. According to the maintenance plan based on the PSR, it was confirmed that the long term integrity of the reactor facilities can be maintained by carrying out maintenance activities.

4. REFURBISHMENT OF THE JMTR FACILITY

The JMTR was once categorized as one of the facilities to be shut down in the medium term plan of the JAEA, decided in October 2005. However, long term operation was strongly requested by various users, as the JMTR is the only irradiation testing reactor in Japan. Moreover, it was judged by the Council for Science and Technology Policy that refurbishment of the JMTR for long term operation should be carried out (October 2006). Finally, the JAEA decided to refurbish and restart the JMTR in December 2006, and the refurbishment work began in FY 2007. The 40 year operation from first criticality led to the ageing of facilities. From the results of the PSR, it was confirmed that the integrity of almost all components had been maintained, and the refurbishment schedule for maintaining stable operation of the facility was planned. Once it is restarted, the JMTR is expected to operate until 2030.

4.1. Selection of facilities for renewal

Facilities were selected for renewal based on an evaluation of their damage and wear in terms of ageing, significance to safety functions, past safety related maintenance and enhancement of facility operation.

The selection concepts are as follows:

— Replacement priority is given to aged and worn out facilities, because the JMTR is expected to operate for about 20 years after it is restarted. Priority is decided with special attention to safety concerns. The availability of appropriate monitoring is an important factor in selecting facilities which will be used continuously after the restart.

— Appropriate maintenance of the facility will be important in considering the long term operation of the JMTR after it is restarted. Facilities whose replacement parts are no longer manufactured or are not likely to be manufactured continuously in the near future are selected for renewal.
— Facilities that can be used without renewal (e.g. a reactor building, a reactor pressure vessel, a reactor pool lining, a grid plate and primary cooling pipes) will have their integrity assessed by continuing maintenance based on the PSR of February 2005. The JMTR will be maintained after the restart according to maintenance plans based on the results of the PSR. The integrity of the JMTR will be also confirmed through the voluntary periodic inspection of facilities and other checkups. A special task force for the JMTR renewal plan established in the JAEA's Oarai Research and Development Center to discuss the fundamental idea of renewal confirmed the validity of the renewal plan.

4.2. Equipment renewal

Equipment renewal was designed to improve reliability and maintenance capabilities. Major equipment renewal is as follows:

— Equipment and parts to be renewed in the primary cooling system include the primary circulating pump motors and drive members of the main electric and electromagnetic valves. They are to be replaced with products having equivalent function.
— Equipment and parts to be renewed in the secondary cooling system include the circulating pumps (with their motors), auxiliary water pumps (with their motors), main electric valves and cooling tower fan motors. They are to be replaced with products having equivalent function.
— Equipment and parts to be renewed in the utility cooling line (UCL) system include the circulation pumps (with their motors), water pumps (with their motors), main electric valves and cooling tower fan motors. They are also to be replaced with products having equivalent function.
— Equipment to be renewed in the instrumentation and control system includes the reactor control panel (complete renewal), the process instruments (complete renewal), the nuclear instruments (complete renewal) and part of the control rod drive mechanism. They are to be upgraded to improve operational efficiency and visibility in creating a better human–machine interface.

4.3. Renewal procedure of reactor facilities

An outline of the refurbishment of reactor facilities is shown in Fig. 2. Various facilities are to be renewed sequentially during the four year refurbishment period, and the JMTR is to be restarted in 2011. The renewal procedure must be planned considering the state of the facilities. For example, as the process instruments must be in a usable state when the pre-operational inspection of the primary cooling system is carried out, renewal of the process instruments must be scheduled before the primary cooling system is used. As the renewal work in the reactor building cannot be carried out when the feed and exhaust air system is undergoing renewal, the feed and exhaust air system should be renewed before the other systems. Renewal work outside the reactor building is scheduled for when the feed and exhaust air system is under renewal. Thus, as a first step, renewal work of the boiler component, the power supply system, the feed and exhaust air system and so on was carried out. Then the reactor control system, the control rod drive and the reactor cooling system were renewed. The refurbishment schedule is shown in Table 2.

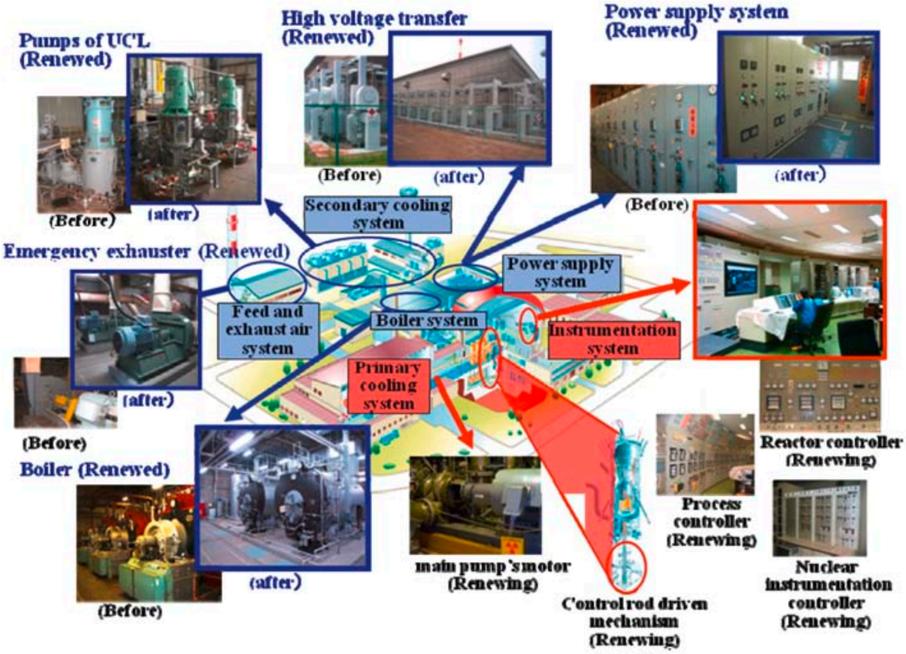
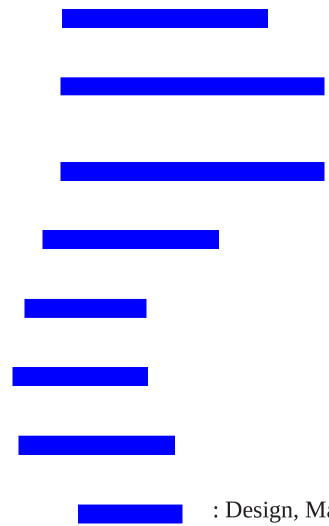


FIG. 2. Outline of the refurbishment of the reactor facilities.

TABLE 2. SCHEDULE FOR RENEWAL OF JMTR EQUIPMENT

Equipment	Items	2007	2008	2009	2010	2011	Status
Reactor	Beryllium frame, gamma ray						Renewed
Instrumentation and control system	Nuclear instruments, process instruments, safety guard circuit						Manufacturing
Reactor cooling system	Primary cooling facility, secondary cooling facility						Manufacturing Renewed
Radioactive waste disposal facility	Feed and exhaust air system, drainage facility						Renewed
Power supply system	High voltage power supply control board, transformer, cables						Renewed
Boiler	Boiler, refrigerator						Renewed
Pure water production equipment	Degassed pure water production equipment, pure water production equipment						Renewed



4.4. Equipment renewed by March 2010

For the power supply system, its design was started in FY 2007 and renewal work for a control board of the high voltage power supply, the transformer, cables and so on was carried out from April 2008 to January 2009. For the control board of the high voltage power supply, the following were improved from the reliability and maintenance performance standpoint: compaction of the control board, digitization of the relay and insertion of the dehumidifier in the control box for prevention of condensation. Incombustible cable was selected as a countermeasure to fire.

The refrigerator for cooling the reactor building, the boiler for warming and the pure water production equipment were renewed. They had been used for 40 years. For the refrigerator, the absorption system of the refrigerator using boiler heat was replaced with a turbo refrigerator not requiring boiler heat. The heavy oil cost of the operation of the boiler in summer is greatly reduced, and the operating costs of the refrigerator can be reduced by about 40%. For the boiler, by reviewing the necessary heat capacity, and by increasing the heat transfer area per boiler, four boilers were replaced with two boilers.

For the feed and exhaust air system of the radioactive waste disposal facility, the exhauster, the blower and their control circuit were renewed. For the liquid waste disposal facility, the washroom, the drainage pump and their pipes, and the drainage pump of the drainage tank were also renewed. The liquid waste disposal facility, washroom, drainage pump and their pipes are normally not contaminated with radioactivity; however, they may become contaminated during an accident. The drainage pump of the drainage tank treats the radioactive wastewater in the tank yard. For the exhauster and blower, the fan and motor of the emergency exhauster were renewed. The drive mechanism of the butterfly valve of the feed air system, a part of the butterfly valve of the exhaust air system and a part of the exhaust duct of the normal exhaust facility were renewed. The motor of the blower for supplying air into the reactor building was changed from a winding type to a squirrel cage type in order to improve maintenance performance. For renewal of the exhauster, the procedure for approval by the regulatory authority was carried out in May 2008, and approval was obtained in June 2008. Renewal work was then started, and the pre-operational inspection was carried out by the regulatory authority in March 2009 and passed. For the control circuit, the power relay unit in the control circuit was changed to a sequencer control device. With this change, the number of components was reduced compared with the previous device. Therefore, maintenance and operation management were simplified, and trouble free operation is expected. For the drainage facility, the drainage tank and pipes to send the wastewater to the drainage tank in the reactor building were renewed. Renewal of the drainage pump of the drainage tank treating the radioactive wastewater in the tank yard was also carried out. Regarding renewal of the drainage facility, the approval procedure was carried out in March 2009 and the pre-operational inspection was passed in February 2010.

For the UCL system, renewal of the circulation pump (including motor), lift pump (including motor), the main valves, the motor of the cooling tower fan and so on was carried out. Regarding renewal of the circulation pump and the lift pump, the approval procedure was carried out in May 2008 and the pre-operational inspection was passed in March 2009. These components have been used for over 40 years since the JMTR was constructed. From the viewpoint of safe operation and component procurement after the restart of the JMTR, the existing equipment was replaced with equipment capable of equivalent performance. For renewal of the transfer pump, including the motor, in the primary cooling system, the approval procedure was carried out in March 2009 and the pre-operational inspection was passed in February 2010. For the secondary cooling system, renewal of the circulating pump (including the motor), auxiliary pump (including the motor), main electric valves, motor of the cooling tower fan and so on was carried out. The existing equipment was also replaced with equipment capable of equivalent performance. Regarding renewal of the circulating pump and auxiliary pump, the approval procedure was carried out in November 2008 and the pre-operational inspection was passed in March 2010.

4.5. Equipment being renewed

The equipment being renewed is the instrumentation and control system including the nuclear instruments, the process instruments, the safety guard circuit and part of the control rod drive mechanism. Their reliability was improved by reinforcing them with a provision for noise mixture and a break in the circuit. The instrumentation equipment was classified by type (display, operation switch, etc.). Equipment will be upgraded to improve operational efficiency and visibility in creating a better human–machine interface. For renewal of the instrumentation equipment, the approval procedure was carried out in March 2008 and approval was obtained in June 2009. The renewal work is ongoing.

For the equipment of the primary cooling system, the main circulating pump motors, the filler pump (including the motor), the drive mechanisms of the main electric valves and so on were renewed. They will be replaced with equivalent products for improvement of reliability. For renewal of the filler pump, the approval procedure was carried out in February 2009 and approval was obtained in March 2009. The renewal work is ongoing.

5. SAFETY MANAGEMENT DURING REACTOR OPERATING PERIOD

As for safety management during the reactor operating period, the operational management of the reactor facility, radiation control and so on are important.

The purpose of the operational management of the reactor facility is to maintain the integrity and reliability of facilities and equipment for safe and steady operation of the reactor. In order to achieve this, the owner's voluntary periodic inspection and daily inspection of facilities were carried out, and it was confirmed that the performance of facilities and equipment has been maintained. An annual maintenance plan for the JMTR was developed in 1979. The annual plan includes the inspection contents and frequencies of inspection required to maintain the performance of the equipment in consideration of its importance, the service conditions, the operating time, the structures and the past operating records of the equipment. The voluntary periodic inspection of facilities has been performed consistent with the annual plan, which has been reviewed and revised on a timely basis in accordance and consistent with actual conditions.

The radiation dose to personnel engaged in radiation work is restricted by laws and regulations. Efforts are made to reduce the exposure, based on the ALARA (as low as reasonably achievable) principle of the International Commission on Radiological Protection, with the exposure limit observed in radiation management as well. As for management of the working environment, the radiation control division measures the dose equivalent rate, the surface density, etc., once a week based on the operational safety programme. Moreover, the division continuously monitors the radiation, the radioactivity level, etc., in the working environment within the radiation control area, using the monitoring device for radiation control. In addition, the radiation monitors and the survey monitors used for measurement of the working environment have been calibrated by the chief of the radiation control division based on the operational safety programme in every period of the facility's periodic inspection to ensure the reliability of the measurement values.

6. SAFETY MANAGEMENT DURING REACTOR RENEWAL PERIOD

Safety management of the reactor during the renewal period is carried out differently from that during reactor operation. Classification of the facilities and inspections is reviewed, and special measures are taken for the renewal work.

6.1. Facility maintenance during reactor renewal period

In facility maintenance during the reactor renewal period, facilities are classified into two groups: (1) facilities that need to function continuously during the renewal period, and (2) facilities that do not need to function continuously during the renewal period. The voluntary periodic inspection is carried out on facilities needed for management in particular in group (1). It is confirmed that the function of the facility is maintained through the inspection.

6.2. Periodic inspection

According to the law, any reactor licensee shall, pursuant to the provision of the ordinance of the competent ministry, undergo an annual inspection by the competent minister concerning the performance of the reactor facilities specified by Cabinet Order. The periodic inspection was carried out on the JMTR from August to November 2006, while the JMTR was in the extended shutdown period for refurbishment. Therefore, the inspection was carried out on the equipment that must function continuously during the long term shutdown period.

The following facilities were classified as those that must function even during the long term shutdown period. These facilities have undergone an annual inspection by the regulatory authority, and it is confirmed that their functions can be performed:

- The reactor pressure vessel and the main circulation system needed to keep the core covered with cooling water;
- The storage facility for nuclear fuel materials, which has storage ability and maintains non-criticality of fresh and spent fuel;
- The disposal facilities for gaseous waste needed to maintain the operational environment even during the reactor shutdown period;
- The reactor containment facility and ventilating installation needed to maintain confinement of the radioactive materials;
- The diesel generator for power supply equipment needed in an emergency when the commercial power supply goes out;
- Warning equipment related to the functions.

Concerning the facilities classified into the group whose function is not needed continuously during the renewal period, regular inspection or maintenance is carried out to maintain the function of the reactor facility from the viewpoint of safety.

As for the facilities that need to function continuously during the long term shutdown period, it was confirmed that the functions satisfied the standards of inspection by the regulatory authority in FY 2006. Periodic inspection of the facilities during the long term shutdown period is carried out at least once a year.

Major inspection items for the JMTR during the long term shutdown period are as follows: visual inspection of the new fuel storage facility; non-criticality inspection and storage ability verification inspection of the spent fuel storage facility; leakage inspection of the reactor building and the pressure vessel; leak check of the main circulation system, and so on. The MEXT carries out the periodic inspection of research reactors in Japan directly based on the law.

6.3. Voluntary periodic inspection

Examinations of the facilities in a wider range are conducted voluntarily during the periodic inspection. Inspections of emergency shutdown of the instrumentation and control system are carried out. Furthermore, a performance examination of emergency interventions is carried out at least once every month. Moreover, the following inspections are carried out to confirm the performance of facilities needed for management, including security, in particular: leakage inspection of the pressure vessel and visual inspection of the nuclear fuel storage equipment. Calibration inspection of the measuring gauges for the nuclear instrumentation, the process instrumentation and the radiation monitors of the cooling system is carried out. However, calibration of the temperature difference indicator between reactor inlet and outlet, the thermal output meter, the primary cooling water monitor and so on is omitted when there is no plan to operate the JMTR and if it is clear that fuels are taken out of the reactor core during the reactor shutdown period. The inspections of the main pipe’s relief valve and the safety valve of the pressure surge tank are also omitted. Thus, the content of the inspection is rationalized. Calibration and inspection of the necessary instruments and equipment in the voluntary periodic inspection are carried out even during the renewal period of the reactor facility.

6.4. Special measures

In accordance with occupational safety and health laws, it is required to adopt special measures for particular work, such as radiation exposure work, work in high places, work in hypoxic conditions and/or closed places, work involving heavy component handling and asbestos removal work. The laws, regulations and rules are observed when such work is carried out. The work on renewal of the main equipment and instrument is shown in Table 3.

TABLE 3. WORK ON RENEWAL OF MAIN EQUIPMENT AND INSTRUMENTS

Details of work	Attention point	Measures
Exchange of the beryllium frame and the gamma ray shielding plate	Radiation exposure and chemical pollution	Reduction in the amount of radiation exposure of the worker with reference to past results is planned.
Exchange of the motor of the main circulating pump and the emergency pump	Heavy load handling	The safety sides such as crane work and binding with rope are noted.
Lining repair of the secondary cooling system pipes inside	Work in tight places Work in high places	The oxygen density is measured with an oxygen meter. A safety belt is worn to prevent falling.
Exchange of high voltage control board, transformer and high voltage cables	Electric shock	Preventive measures against electric shock are taken.
Removal of the thermal insulator of the refrigerator pipe and of the thermal insulator of the boiler steam pipe	Asbestos absorption	Dust masks are worn and dust prevention measures are taken.

7. SUMMARY

The JAEA decided to refurbish the JMTR for long term stable operation, in order to meet the need of various users for the only irradiation testing reactor in Japan. The JMTR operated for 38 years from its first criticality until August 2006 over 165 cycles. The refurbishment work started in 2007. A PSR was carried out to confirm the integrity of the JMTR facilities. For the refurbishment of the JMTR, equipment to be renewed was selected based on an evaluation of its damage and wear in terms of ageing, significance to safety functions, and safety related maintenance experience, in order to enhance the operational capability. Renewal work of the power supply system, boiler, radioactive waste facility, etc., was finished on schedule. Renewal work of the reactor control system, the nuclear instrumentation system and the primary cooling system is being carried out. During the refurbishment period of the extended shutdown, facilities were classified according to whether their functions were required even during the refurbishment period. Maintenance work and periodic inspections by the regulatory authority are carried out based on this special classification in the extended shutdown period. Long term safe operation of the JMTR will be realized by the refurbishment of the appropriate components with adequate inspection and renewal work.

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OECD/NEA ACTIVITIES TO PROMOTE COOPERATION ON NUCLEAR SAFETY ASSESSMENT AND RESEARCH

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Abstract

The first priority for the member countries of the OECD Nuclear Energy Agency (NEA) is nuclear safety and regulation. This fact is clearly recognized in the NEA Strategic Plan for 2011–2016, and it directs the activities of the NEA programme of work, in particular those carried out by the safety committees, the Committee on the Safety of Nuclear Installations (CSNI) and the Committee on Nuclear Regulatory Activities (CNRA). The CSNI has been supporting the safety institutions of NEA member countries for more than 40 years, particularly in two areas: safety assessment and safety research. The CSNI consists of high level experts from regulatory organizations and technical institutions, responsible in their countries for providing technical support to the licensing authority. In some NEA countries, both licensing and technical assessment reside with the regulator, while in others a different institution provides the technical support. The CSNI was the first international concerted response to share and address common safety concerns, using the expertise and resources provided by both of these safety institutions. The main objectives of CSNI are to: keep all member countries involved in and abreast of developments in safety technology; review the state of knowledge on selected topics of nuclear safety technology and safety assessment; promote research as needed to reach consensus on nuclear safety issues of common interest and to maintain competence in nuclear safety matters; and consider the safety implications of scientific and technical developments. To accomplish these objectives, CSNI is organized into six permanent working groups, each covering a different set of technical disciplines. The CSNI has performed numerous state of the art reports (SOARs) or international standard problems (ISPs), which have been key contributors to national safety assessment practices. Also under CSNI is the responsibility for organizing and monitoring cooperative research projects. Cooperative research projects are generally organized to share costs and information on research programmes of common interest to many member countries and/or to ensure that key facilities/programmes related to the nuclear safety infrastructure are maintained. Currently there are 18 ongoing safety research projects. OECD projects like LOFT and Halden are recognized worldwide. The paper underlines the main findings from past NEA experience, focusing on specific safety activities, such as the Task Group on Advanced Reactor Experimental Facilities (TAREF), the long term operation (LTO) and the Multinational Design Evaluation Programme (MDEP), and showing the added value provided to member countries.

From the NEA's perspective, any concerted action among technical institutions addressing safety should build upon the successful cooperation existing today.

1. INTRODUCTION

Mr. Chairman, members of the panel, ladies and gentlemen, first of all I would like to thank the Government of Japan and the IAEA for providing the OECD Nuclear Energy Agency (NEA) the opportunity to present its views on the challenges of nuclear safety and on the activities of the NEA committees to promote cooperation on nuclear safety assessment and research.

Since some of the participants may not be familiar with the Organisation for Economic Co-operation and Development (OECD) and the NEA, let me briefly explain their roles. The OECD brings together the governments of 31 industrialized countries working together to support sustainable social and economic development and to raise living standards in all countries. The OECD provides a forum in which governments compare policy experiences, seek answers to common problems, identify good practice, and coordinate domestic and international policies.

The NEA, as a member of the OECD family, has as its mission to assist member countries in maintaining and further developing, through international cooperation, the scientific, technological and legal bases for a safe, environmentally friendly and economic use of nuclear energy for peaceful purposes. Our members include very advanced nuclear countries and represent a major share of the world's nuclear capacity. In addition, we have a well established and formal relationship with the Russian Federation and the IAEA. Two years ago, the NEA celebrated its 50th anniversary of providing assistance to its member countries in supporting the safe use of nuclear power. Nuclear power will remain a key part of the energy mix for many decades to come and, as such, the NEA looks forward to continuing its value added work in the field of nuclear power.

While the NEA is satisfied that it has an effective process of work in place, we are always looking for ways to improve. This is the reason why, since 1999, we have had a series of strategic plans in order to better focus on the objectives that member countries assign to the Agency for meeting the economic, environmental and societal challenges of the coming years. The important changes that have occurred in the energy and nuclear landscapes, as well as in the OECD framework, are the basis for these revisions insofar as they influence the NEA's role and activities. We have now completed the process for the new Strategic Plan for 2011–2016.

Let me tell you that nuclear safety and regulation is and will continue to be the first priority of the Agency. The NEA will assist member countries to continue sharing information, best practice and lessons learned to enhance nuclear safety worldwide.

The NEA safety committees, the Committee on Nuclear Regulatory Activities (CNRA) and the Committee on the Safety of Nuclear Installations (CSNI), recognize the evolving status of the nuclear industry worldwide and have identified the challenges that regulators and technical safety organizations will need to address over the next five years.

These challenges are:

(1) Adequate nuclear skills and infrastructure;
(2) Effectiveness and efficiency of activities related to safety;
(3) Safe operation of current nuclear facilities;
(4) Safety in new nuclear facilities;
(5) Safety in advanced reactor designs.

I would like to provide a few examples, in what follows, of how the NEA is contributing to cope with these challenges.

2. ADVANCED REACTOR EXPERIMENTAL FACILITIES

For many years, the NEA has been examining advanced reactor issues and disseminating information of use to regulators, designers and researchers on safety issues and research needed. Following the recommendation of participants at an NEA workshop, a Task Group on Advanced Reactor Experimental Facilities (TAREF) was initiated with the aim of providing an overview of facilities suitable for carrying out the safety research considered necessary for gas cooled reactors (GCRs) and sodium cooled fast reactors (SFRs), with other reactor systems possibly being considered in a subsequent phase. The TAREF was thus created in 2008 with the following participating countries: Canada, the Czech Republic, Finland, France, Germany, Hungary, Italy, Japan, the Republic of Korea and the United States of America. In a second stage, India provided valuable information on its experimental facilities related to SFR safety research.

The TAREF members decided to build on the experience of a similar NEA activity described in Nuclear Safety Research in OECD Countries: Support Facilities for Existing and Advanced Reactors (SFEAR) [1]. The study method adopted entailed first identifying high priority safety issues that require research and then categorizing the available facilities in terms of their ability to address the safety issues.

The Task Group also agreed that the GCR related task could be completed at an earlier stage than the SFR task, given that a significant part of the safety issues to be addressed had already been compiled in an earlier United States Nuclear Regulatory Commission (NRC) exercise (called the Phenomenon Identification and Ranking Tables (PIRT)). Hence, two separate reports were produced for the GCR and SFR tasks. These reports are summarized below.

2.1. Approach for GCRs

The Task Group followed an approach similar to that performed by the NRC for the PIRT, and identified the following technical areas for consideration: accidents and thermo-fluids (including neutronics), fission product transport, high temperature metallic materials, graphite and ceramics, and fuel (tristructural isotropic (TRISO) and other fuel types). In the case of structural materials, graphite and ceramics experience can be broader than nuclear and was considered to the degree possible. Other technical areas such as seismic assessment (except for potential consequences on core compaction), fire safety, instrumentation and control, and human and organizational factors were not treated in the report, since the issues are not specific to GCRs.

For each of the above technical areas, the TAREF members identified the safety issues still requiring research. Only those issues identified as being of high importance to safety and for which the state of knowledge is ‘low’ or ‘medium’ were included in the discussions.

2.2. Approach for SFRs

Based on discussions and the results of a questionnaire, the TAREF members identified the following technical areas to be addressed for SFRs: thermo-fluids, fuel safety, reactor physics, severe accidents, sodium risks, structural integrity and other issues. The first four technical areas address phenomena and issues specific to the nuclear industry. The other areas address phenomena that are relevant for the nuclear industry, but for which experience may be broader than nuclear.

In a similar way, seismic assessment (except for potential consequences on core compaction), instrumentation and control, and human and organizational factors were not treated since they are not specific to the nuclear industry, and within the nuclear area they are not specific to SFRs. Other technical areas such as fuel fabrication, fuel handling and irradiated material investigation techniques (as used in hot cell facilities) were not considered, as they are related more to operational concerns or are not specific to SFRs.

For each of the above technical areas, the TAREF members agreed on a set of safety issues requiring research and established a ranking with regard to safety relevance (high, medium, low) and the status of knowledge based on the following scale relative to full knowledge: high (100–75%), medium (75–25%) and low (25–0%). As for GCRs, only the issues identified as being of high safety relevance and for which the state of knowledge is low or medium were included in the discussion, as these issues would likely warrant further study.

As a result of the TAREF activity, an OECD/NEA joint project was proposed by the Japan Atomic Energy Agency (JAEA) and is being set up at the JAEA High Temperature Engineering Test Reactor (HTTR). The objectives of the proposed project are to conduct integrated, large scale tests of loss of forced cooling in the JAEA HTTR, to examine high temperature gas cooled reactor (HTGR) safety characteristics in support of regulatory activities, and to provide data useful for code validation and improvement of simulation accuracy. The reactor performance under accident conditions considered in the PIRT set up by the NRC will be assessed in this project. It is expected that other OECD/NEA joint projects may be initiated based on the recommendations stemming from the TAREF activity. In particular, joint projects addressing first priority SFR safety issues might be initiated within two or three years.

3. SAFETY RESEARCH

In many OECD member countries, nuclear power plays an important role in the overall production of electricity. As in the past, operational requirements, plant utilization and fuel designs are expected to continue evolving, even for current generation reactors, posing new challenges and new questions. Operating experience and plant ageing are also raising new questions. Research will be needed to support a high level of safety, in a context in which economic pressures on plant operators are increasing. Research will also be needed to support developments for new reactor systems, including both evolutionary designs and more advanced reactor concepts such as those under consideration by the Generation IV International Forum (GIF).

Over the past several years, a number of experimental facilities have been shut down and others are in danger of being closed in the future. Consequently, concerns have been raised as to the ability of individual NEA member countries to maintain critical competence and to focus on important safety areas unless practical countermeasures are put in place. International cooperation can help provide a solution and makes economic sense.

The responsibility of the CSNI entails, among others, the conduct of research in support of the resolution of outstanding safety issues, the maintenance of a sufficiently valid technical infrastructure and expertise, and the promotion of cooperation on safety research in OECD member countries. The establishment and operation of OECD/NEA joint projects constitutes one means of carrying out these CSNI tasks.

There are currently 18 OECD/NEA joint projects being carried out in the nuclear safety area, which can broadly be divided into the following categories:

— Fuel projects, which deal with matters related to assessments of fuel behaviour, fuel limits and fuel margins in a variety of operating or anticipated accident conditions. These investigations normally require large and expensive experimental infrastructure, and in some cases unique capabilities, such as test reactors and specialized hot cells. It is common that regulators and industry participate jointly in these projects, partly because cost sharing among several parties is a practical way to carry out the programmes, but more importantly because industry cooperation is essential for obtaining the fuel or material specimens required for the experiments.
— Thermohydraulic projects, mainly dealing with postulated accidents like the loss of coolant accident and other thermohydraulic transients that are identified as the dominant safety concern for water reactors. As full scale experimentation is not feasible in most situations, significant computational capability is needed to simulate such transients properly, as required for the safety case of these reactors. The CSNI has always considered with great attention the issue of thermohydraulic code validation as well as the experimental database needed for such validation.
— Accident assessment projects, currently including two experimental projects on severe accident scenarios following core damage and melting, and one experimental project dedicated to simulations of a variety of fire propagation scenarios relevant for nuclear power plants. Prevention and control of fire propagation are considered to be major contributors to reducing accident risk in nuclear installations, while prevention and mitigation of severe accidents are the largest contributors to reducing the potential risk to the public arising from plant operation.
— Database projects, which have the main function of gathering important data and information on operating experience regarding equipment malfunction or failure. These databases are intended to form the basis for lessons learned and for measures dealing with replacements or preventive maintenance. International cooperation is essential in order to incorporate experience that is as broad as possible on events that are by nature relatively rare.

Experience has shown that all OECD/NEA joint safety projects entail substantial analytical activity, which accompanies the execution of the experimental programme. This activity is centred on code assessments and validation and, where suitable, on model development. Code benchmarking or analytical exercises consisting of both pre-test and post-test calculations are organized among project participants, always bearing in mind the data utilization for the reactor case. This extensive analytical effort has proved to be a very efficient manner to maintain or develop relevant technical expertise. For database projects, workshops are organized when appropriate in order to assess the main outcomes of the data collected and the main lessons learned from the events contained in the databases.

4. LONG TERM OPERATION

The CNRA is an international body made up of senior representatives from nuclear regulatory authorities. The CNRA guides the NEA programme concerning the regulation, licensing and inspection of nuclear installations with respect to safety. It acts as a forum for the exchange of information and experience, and for the review of developments which could affect regulatory requirements.

Following the discussion at the last CNRA meeting, a senior task group was established to prepare a document on regulatory challenges for long term operation of nuclear power plants. The report discusses some of the basic principles and criteria that a regulatory body should consider in making a regulatory decision to approve an operator’s application for long term operation of a nuclear power plant beyond the originally designed operation period. It is intended to present basic principles and actions to be taken by regulators, operators and stakeholders related to the regulation of long term operation.

Currently, 441 nuclear power plants are in operation around the world, of which 155 have been in service for more than 30 years. The past record of operation has shown that nuclear power plants are capable of delivering safe, reliable and economic performance as long as the operators adopt adequate measures to meet the regulatory requirements for safe operation, and maintain and improve the level of safety through the entire period of operation. Furthermore, the operators’ activities are subjected to the regulators’ oversight to confirm that the operators meet the regulatory requirements for safe operation of nuclear power plants for the entire period of operation.

Based on the operating experience, many nuclear power plant operators seek approval for long term operation beyond the operation period that was originally anticipated and have already received the licences for long term operation with conditions that the regulatory requirements for long term operation are fulfilled. It is anticipated that the number of nuclear power plants seeking authorization of long term operation will increase around the world in the following several decades.

Acceptance of a nuclear power plant for long term operation must be based on evidence that the plant will comply with the original licensing basis over the intended period of service. This requires an assessment of the current and projected condition of the plant and, in particular, of the systems that perform fundamental safety functions. How this is achieved will depend on the regulatory strategies in individual countries. For instance, the approach in a prescriptive regulatory regime will likely differ from the approach where regulation is based primarily on specification of safety performance goals allied with establishment of safety guides and standards. Another variation could arise from whether emphasis is placed on maintaining the level of safety in long term operation or whether a goal is set to improve safety to the extent practicable based on requirements in current standards. Given these considerations, the strategy could range from one with measures that mainly address the impact of ageing and changes in the plant to one that seeks changes in the safety level based on expectations for newer plants.

Based on these principles, there are cases of nuclear power plant operators having completed safety assessments and requested authorizations for long term operation of a number of older nuclear power plants. Following reviews by regulatory authorities, many of these plants have received approval for long term operation. While different strategies have been applied as the basis for these authorizations, the experience gained enables compilation of consensus guidance for approval of long term operation of nuclear power plants.

Although the regulator’s approach to granting permission for long term operation may differ among member states, the basic principles of ensuring safety for long term operation are taken into consideration by regulators regardless of differences in regulatory strategies. Therefore the intention of current guidelines for long term operation is to identify fundamental principles, main challenges for regulatory decisions, and roles of regulatory oversight, regulatory assessment and improvements for long term operation beyond the originally planned duration.

5. MULTINATIONAL DESIGN EVALUATION PROGRAMME

It is also in the spirit of addressing new challenges that the NEA welcomes its role as Technical Secretariat of the Multinational Design Evaluation Programme (MDEP). We were involved in the initial discussions of this unique multinational initiative with the NRC and the French Nuclear Safety Authority in

2005, and we are happy to see that the MDEP has been converted into a long term project committed to providing interim results so that we can facilitate cooperation on new reactor design reviews, exploring opportunities to converge on regulatory requirements and practices, and coordinating vendor inspections.

This is a unique multinational initiative that seeks to leverage the expertise of the regulators involved to cooperate on new reactor design reviews as well as to work towards harmonization and standardization of regulatory requirements and practices. Work to date already includes input from industry standards development organizations, and from vendors and licensees worldwide. In summary, progress is being made to increase the efficiency, effectiveness and predictability of the licensing of new reactors while maintaining the appropriate focus on safety.

The NEA sees the work with the MDEP as having a significant goal: how regulators, in dialogue with the industry, are ensuring through harmonization efforts the safe, secure and environmentally friendly use of nuclear energy to produce electricity.

In September 2009, the NEA hosted a conference, chaired by the head of the MDEP Policy Group, Mr. André Lacoste, who is with us in this meeting, to solicit input from industry and to more fully communicate the work of the MDEP to the full spectrum of stakeholders. The industry representatives shared with regulators the efforts that they too are undertaking to encourage standardization.

The benefits of standardization and harmonization of both reactor designs and regulatory requirements and practices will allow all stakeholders (whether they be vendors, licensees or regulators) to focus their limited resources on those issues that are the most significant to safety.

We, at the NEA, consider this work to be a very high priority and have established communication lines with the other committees and programmes we are serving, such as the CNRA, the CSNI and the GIF. Coordination of MDEP efforts with these groups as well as with the IAEA, other international groups and industry representatives is one of the most important features of the MDEP.

6. CONCLUDING REMARKS

- The first priority for NEA countries is safety and regulation.
- The CSNI has been supporting NEA safety institutions in safety assessment and safety research.
- The CSNI is the first international concerted response for enhancing technical exchange, cooperation and consensus building.
- The CSNI products (e.g. SOARs, ISPs) have been key contributors to national safety assessment practices.

- The OECD/NEA joint research projects have contributed to addressing common safety concerns and to retaining countries' technical expertise and infrastructure in strategic fields of nuclear safety.
- From the NEA's perspective, concerted actions among technical safety institutions should build upon the successful framework existing today.

REFERENCE

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THE EMERGING NEED FOR NUCLEAR SECURITY TECHNICAL AND SCIENTIFIC SUPPORT

(Topical Issue 3)

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EMERGING NEED FOR NUCLEAR SECURITY TECHNICAL AND SCIENTIFIC SUPPORT

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Abstract

The paper discusses the types of support provided by technical and scientific support organizations (TSOs) to the United States Nuclear Regulatory Commission (NRC), the independent regulatory agency that regulates commercial nuclear power plants and other commercial uses of nuclear and radioactive materials in the United States of America. It lists significant factors that have contributed to the emerging need for support from TSOs, including the re-examination and re-evaluation of all of the NRC's physical protection and security programmes undertaken in the light of the changing threat environment, and the submission of new reactor designs for technical review to verify that key components of the security plan and design meet the NRC's regulations. The paper also highlights TSO contributions to two important areas — cybersecurity and the safety–security interface — and describes the technical challenges that regulatory bodies face in their use of TSOs. The paper concludes with a discussion of the responsibilities of the regulatory body in its use of TSOs.

The United States Nuclear Regulatory Commission (NRC) is an independent regulatory agency. It regulates commercial nuclear power plants and other commercial uses of nuclear and radioactive materials in the United States of America. In keeping with the theme of this conference, I would like to offer some examples of our experiences to date and hopefully promote discussion among the participants at this conference, not only here, but also when you return to your organizations. Although my examples are focused on nuclear power plants, these challenges are also applicable to all other programmes implemented by the regulatory authorities who use technical and scientific support organizations (TSOs).

Our mission is to protect the public health and safety and to promote America's common defence and security. We have two primary goals:

— *Safety goal:* Ensure adequate protection of public health and safety and of the environment;
— *Security goal (including safeguards):* Ensure adequate protection in the secure use and management of nuclear and radioactive materials.

The Office of Nuclear Security and Incident Response (NSIR) within the NRC is responsible for developing the policy for evaluation and assessment of technical issues involving security at nuclear facilities. Our office also provides an interface with other federal and state agencies, such as the Department of Homeland Security (DHS), the intelligence and law enforcement communities, the Department of Energy (DOE) and other agencies, on safeguards and security issues. We also develop emergency preparedness policies, regulations, programmes and guidelines for both currently licensed nuclear reactors and potential new nuclear reactors.

Two significant factors have contributed to the emerging need for support from TSOs by the NRC. First, the terrorist events of 11 September 2001 precipitated a re-examination and re-evaluation of all of the NRC's physical protection and security programmes. For example, analyses were performed to evaluate the potential impacts of a large aircraft crash at a nuclear power plant. Also, as a result of our evaluations of the increased threat, the NRC first issued orders to enhance the security of all licensed activities at nuclear power plants, and later we revised our physical protection regulations to make these requirements generically applicable. This revision required additional technical and scientific support to form the basis for the associated rulemaking. Second, the nuclear renaissance resulted in new reactor designs being submitted for NRC review. The NRC has received applications for over 25 new reactor units at 18 sites. From a security perspective, these new designs consider security in the initial design phases, and the technical reviews are required to verify that key components of the security plan and design would meet the NRC's regulations. I will discuss some of the unique challenges associated with the security reviews of facilities that are not yet constructed.

Regulatory authorities, whether regulating safety and/or security, share a common purpose of protecting public health and safety. To achieve this, a framework of regulations, licensing, inspection and enforcement is critical. The regulatory framework is not static and should be adapted to events and issues that have generic implications.

As I mentioned, the NRC revised its regulations to enhance security at nuclear power plants and updated its security regulatory framework. The NRC amended the existing security regulations to make the security requirements issued through orders generally applicable in the regulations. There is a list of the citations and topical areas included in the new requirements.

These new requirements were developed from:

- — Insights gained from implementation of the security orders;
- — Reviews of site security plans;
- — Implementation of the enhanced baseline inspection programme;
- — The NRC's evaluation of performance testing through our force-on-force exercises.

I would like to highlight two important areas: cybersecurity and the safety–security interface. Cybersecurity has been an area of growing concern for some time. Our revised regulations require licensees to provide high assurance that digital computer and communication systems and networks are adequately protected against cyberattacks. This includes systems that perform: (1) safety related and important-to-safety functions; (2) security functions; (3) emergency preparedness functions, including off-site communications; and (4) support systems and equipment which, if compromised, would adversely impact safety, security or emergency preparedness functions.

Licensees must establish, implement and maintain a cybersecurity plan that satisfies the cybersecurity programme requirements. The cybersecurity plan describes how the licensee will implement the requirements of the regulation, including site specific conditions that affect implementation. The cybersecurity plan includes: (1) defence in depth protective strategies to protect, detect, respond to and recover from cyberattacks; (2) measures designed to mitigate the adverse effects of cyberattacks; (3) measures to ensure that the functions of protected assets are not adversely impacted by cyberattacks; and (4) cybersecurity awareness and training programmes.

Another key new feature is a specific regulatory requirement for a safety–security interface. This regulation requires licensees to establish programmes to identify potential adverse interfaces between safety and security and to take appropriate compensatory or mitigation actions to maintain both safety and security. We have been aware of examples of various actions taken by operations, maintenance or security personnel at our licensed facilities that were not promptly or effectively communicated to other potentially affected departments. This potentially could have resulted in adverse impacts on plant safety or security.

Some examples include:

- — Placing security barriers that diminished access to fire suppression equipment;

— Placing scaffolding during maintenance activities that affected security lines of fire;
— Staging temporary equipment within security isolation zones.

Licensees already had controls and processes to evaluate safety issues, but security issues were not always included. Therefore, the rule requires licensees to:

— Assess and manage the potential for adverse effects on safety and security, including the site emergency plan, before implementing changes to the plant configurations, facility conditions or security;
— Where potential adverse interactions are identified, communicate them to appropriate licensee personnel and take compensatory and/or mitigation actions to maintain safety and security under applicable Commission regulations, requirements and licence conditions.

In using TSOs, there are several technical challenges that face us as a regulator. An essential characteristic of TSOs should be their independence, which refers to not only the quality of the products but also the structure of the organization. A TSO's role with a regulatory authority is somewhat more complex than the TSO's role in supporting the industry, because of potential questions concerning independent judgement and public confidence in the licensing process, in addition to the TSO's technical credibility. TSOs can provide highly specialized technical expertise to aid the regulator over the long term or provide short term assistance with large casework loads that must be accomplished in a timely manner.

We rely on TSOs not only for many of our research needs, but also to augment our own staff in completing regulatory licensing reviews and inspections. We also use TSOs to assist us with regulatory reviews of new reactor applications. These TSOs include not only the national laboratories, but also universities, private commercial contractors, consensus standards committees and national research centres.

The mechanism by which the NRC engages TSOs is commercial contracting. In awarding contracts, the NRC is required by law to avoid contracting with sources that have conflicts of interest owing to their work with the nuclear industry or with specific licensees. Avoiding such conflicts of interest is extremely important in maintaining the public's confidence. Our contracting procedures require that contractor proposals affirm, in writing, the absence of any conflict of interest, and NRC contracting specialists and technical monitoring are required to carefully examine and check the basis of this assertion.

As with the industry, the technical credibility of the regulator's TSO is essential. Through the contracting process, the expertise and experience of the TSO's staff and the facilities, equipment and resources are evaluated, along with the TSO's past performance, to ensure that their capabilities will support the technical credibility and public confidence of the regulator. The proper security clearances for TSO staff and facilities are also important considerations.

As mentioned, one of the factors that have contributed to the emerging need for TSO support for the NRC is the nuclear renaissance. New reactor designs have been submitted for NRC review, and additional regulatory infrastructure is required to support the NRC's licensing decisions. The revisions to our regulations have required additional regulatory infrastructure improvements.

Infrastructure improvement includes development of standard review plans, safety evaluation report templates, inspection procedures, regulatory guides and technical guidance. Key drivers in obtaining TSO assistance in improving this regulatory infrastructure are short term staffing needs, budgets and the timing required to complete the infrastructure development to support timely licensing decisions. For new reactor reviews, TSOs were used to develop portions of standard review plans and safety evaluation report templates for design certifications, early site permit applications, combined operating licence applications, and inspections, test, analyses, acceptance criteria (ITTAC) reviews.

In the cybersecurity arena, TSOs were used to develop a regulatory guide and technical guidance. During the development of the new reactor security rule, TSOs were used to supplement NRC staff technical capabilities in the area of target set analysis and blast analysis, and in assisting with regulatory guidance development. While the NRC has technical capabilities in these areas, specialized technical expertise was required. In addition, the NRC is in the very early stages of exploring ways of potentially risk-informing security requirements and is reaching out to TSOs.

From a security perspective, these new reactor designs considered security in the initial design phases, and technical reviews must verify that key components of the security plan and design would meet the NRC's regulations. For existing reactors, changes to their security plans were required to meet the new regulations. TSO support has been used to supplement NRC staff technical reviews and in documenting those reviews in safety evaluation reports. Because the requirement for a cybersecurity plan was new, licensees were required to submit cybersecurity plans for the first time. TSO support supplements the technical reviews and tracking of status of the reviews. TSOs, as the technical experts, will also be used to support mandatory public hearings for new reactor combined operating licences.

Regulatory bodies will continue to be challenged with increased workloads and the need for specialized technical capabilities, as a result of the nuclear renaissance and, in security, from the changing threat environment. With the increased use of TSOs, it is important to recognize that the regulatory body retains the responsibility for making the decision and must not be unduly influenced by the TSO.

The regulatory body needs to supervise the work, not just blindly accept the TSO's outcomes. TSO work should be technically reviewed before, during and after implementation. The regulatory body's staff must have sufficient technical knowledge to enable them to identify problems, to determine whether it would be appropriate to seek assistance from an external expert, and to evaluate the external expert's advice.

Transparency is a means to promote independence and confidence in regulatory decision making and to demonstrate such independence to elected officials, licensees and other stakeholders, as well as to the general public. External experts should be chosen with the understanding that they should provide impartial advice. It should be confirmed that the external expert's other activities, as a specialist, do not give rise to a bias in the advice given; the potential for any such conflict of interest should be minimized and when recognized, dealt with immediately.

IDENTIFYING AND ADDRESSING SUPPORT NEEDS FOR ENSURING NUCLEAR SECURITY IN LICENSED FACILITIES AND ACTIVITIES

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Abstract

The paper discusses the use of technical support organizations (TSOs) in support of sustainable nuclear and radiation activities and for ensuring nuclear security in licensed facilities and activities. TSO support plays an important role in areas such as: the creation of regulatory documents and the regulatory framework; the safety–security interface; design basis threat assessment; international instruments for nuclear security; vital area identification; prevention, detection and response aspects of nuclear security; and international cooperation on security matters. In addressing these issues, lessons learned and experience gained in implementing and sustaining nuclear security for the past three decades are highlighted. The paper concludes with recommendations on sustaining TSO activities to ensure nuclear security in the nuclear fuel cycle and radiation facilities.

1. INTRODUCTION

In an era when nuclear energy is gaining acceptance and has technologically matured for power generation, it is also a preferred option for energy security. This has been possible due to a globally mature safety culture and the willingness of the interested countries to mutually benefit from the peaceful uses of atomic energy in all spheres of life — such as power generation, medicine, industry and agriculture.

All these applications require the use of fissile and radioactive materials in various forms, and well established and safe work processes. These are facilitated by the regulatory frameworks in countries and the licences issued to the operators. However, over the past few decades, some intentional unauthorized operations have caused great concern. The pioneering role of the International Atomic Energy Agency in all spheres of atomic energy is significant and is an enabling factor for consistency in safety–security competence creation globally.

2. REGULATORY FRAMEWORK

The creation of the enabling regulatory documents and the regulatory framework is the first requirement of the regulatory bodies in Member States. The linkages with the relevant legal framework, competent authority and sustained activities form the backbone. The requirements include policies on the type of nuclear activity/installation, siting, technologies, design, construction, commissioning, operation and maintenance, and decommissioning; in fact, the activities of the entire fuel cycle are encompassed in the relevant acts identifying the responsibilities of the regulatory body. Technical support organizations (TSOs) have been playing an important role in the above to ensure safe work and are maintaining an excellent record.

3. NUCLEAR SAFETY AND NUCLEAR SECURITY: SYNERGIES AND CONFLICTS

Among the biggest challenges which need to be addressed for unhindered growth and utilization of nuclear energy is ensuring nuclear safety and nuclear security. Complex and ever increasing terrorism scenarios across the world demand that all nuclear and radiation activities be protected against possible malicious acts involving these activities. For a sustainable nuclear programme, it is imperative that a robust nuclear security regime be established which protects civil society from possible acts of terrorism involving nuclear and radiation activities.

One of the main issues being faced is the harmonious relationship between safety and security, involving requirements, synergies, conflicts and interfaces. This is vital, as the agencies responsible for the two pillars — safety and security — may not be the same, and therefore the plant operators and security staffs have to be united in their respective synergetic efforts. Therefore modules for training and the development of more experts in the field of nuclear security are needed on a priority basis. TSOs help in the generation of various modules and tools, and at times even with operating guides for the facilities — accordingly approved by the regulatory bodies.

4. DESIGN BASIS THREAT

Nuclear security concerns have been under consideration globally for a decade, and a few conventions and guidance have been made available to Member States. The theft or diversion of nuclear or radioactive materials for unwanted, dangerous goals is one concern. The sabotage of a nuclear installation to stop its operation as well as the potential release of unacceptable levels of radioactivity off-site have posed major concerns as well. A procedure has to be set up for use, storage and transport of nuclear materials. Plant processes must be protected against intentional unwanted events and any kind of sabotage. Nuclear security concerns need not originate within the country, and so the global acceptance of conventions is important. Also, there are geographical and societal factors that need to be addressed in the determination of a design basis threat.

5. INTERNATIONAL INSTRUMENTS FOR NUCLEAR SECURITY

The Convention on the Physical Protection of Nuclear Material and the Code of Conduct on the Safety and Security of Radioactive Sources have provided the requirements. The technical guides are made in the country to adopt these. Implementation is a major task, and the support of TSOs may be necessary to achieve compliance. This calls for the creation of faculties dealing with security vulnerabilities and possible acceptable solutions through design, evaluations, installations and upgrade support in the future. Training and the development of a large pool of nuclear security professionals is a key factor.

6. VITAL AREA IDENTIFICATION

Every installation has some common infrastructure and specific facilities prone to malicious acts that could endanger the public — locally or elsewhere. This calls for vital area identification and for setting up security measures to protect these areas. This is best done at the facility design stage, as in the as-built stage it poses difficulties for full compliance with the requirements for nuclear security.

7. PREVENTION, DETECTION AND RESPONSE: THREE PILLARS OF NUCLEAR SECURITY

Three pillars of nuclear security — prevention, detection and response — are well recognized and needed by the Member States. In the present scenario, all place heavy dependence on intelligent instruments.

FIG. 1. Integrated security system.

7.1. Prevention

Prevention is primarily focused on the boundaries of nuclear facilities and on the transportation of nuclear and radioactive materials. The security related systems can be readily configured using proven systems (Fig. 1). The fruits of research and development are derived in the design and upgrade of security systems. The design of subsystems related to perimeter protection, access control, surveillance, secure communication, the central monitoring station, data storage, and linkages with State authorities and suitable inputs from intelligence agencies together present a formidable challenge to designers — particularly when there is restricted information.

7.2. Detection

Detection of materials out of regulatory control poses a real problem in any State, and efforts are to be made to ensure that borders, ports and airports are well equipped with radioactive material detectors, adequate means of communication, and event reporting to a network (Fig. 2). These detectors preferably should be developed within the country to support a large country like India. TSOs carry out this work.

Fig. 2. Border checking for radioactive and other materials (left); mobile monitoring laboratory (centre); and inside the mobile laboratory (right).

7.3. Response

Security response per se is normally the work assigned to trained personnel — called a response force — who carry out plans as per established procedures.

8. GLOBAL CENTRE FOR NUCLEAR ENERGY PARTNERSHIP (GCNEP)

TSOs also assist in the development of security courses. In India, regional courses on physical protection systems have been developed with IAEA assistance, and there is now a well established programme. This programme is also utilized effectively for national courses on the subject. This benefits from international benchmarks with a large pool of trainers within the country. In order to enhance and sustain global interactions, the Government of India has begun setting up an independent Global Centre for Nuclear Energy Partnership (GCNEP) near New Delhi (Fig. 3), which will have the following major schools:

— School of Advanced Nuclear Energy System Studies;
— School of Nuclear Security Studies;
— School of Radiological Safety Studies;
— School for Studies on Applications of Radioisotopes and Radiation Technologies.

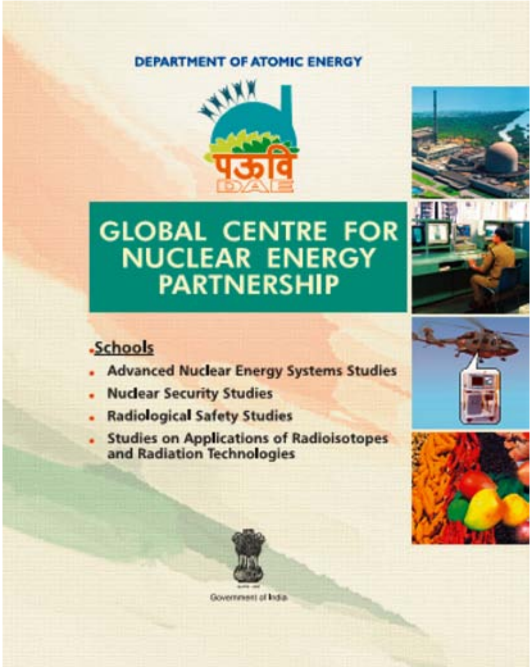

FIG. 3. Global Centre for Nuclear Energy Partnership.

The presentation includes the requirement to use TSOs for sustainable nuclear and radiation activities. While addressing these issues, lessons learned and experience gained in implementing and sustaining nuclear security for the past three decades have been highlighted. In the end, a few recommendations have been made for sustaining TSO activities for ensuring nuclear security in the nuclear fuel cycle and radiation facilities.

THE ROLE OF A NUCLEAR RESEARCH CENTRE AS A TSO IN SETTING UP A NATIONAL NUCLEAR SECURITY REGIME: THE CASE OF MOROCCO

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Abstract

Morocco set up the National Centre for Nuclear Energy, Science and Technology (CNESTEN) in 1986. The centre's missions are: to promote nuclear applications (research and services); to provide technical assistance to the authorities in regard to safety, radiation protection and radioactive waste; and to prepare the technological platform for the nuclear power option. To ensure a safe and secure environment for nuclear activities, and in view of the nuclear option, Morocco depends on CNESTEN, as a technical and scientific support organization (TSO), to contribute to developing a national nuclear security regime, in compliance with Morocco's international commitments. The paper aims to show that the implementation of a nuclear research centre in Morocco drives public authorities to develop a national nuclear security regime.

1. NATIONAL CONTEXT

Radioactive sources have been used in Morocco in many sectors since the 1950s, including medicine, agriculture, education and research, and the environment. Moreover, as the country imports almost all the energy it uses, since the 1980s Morocco has considered nuclear power as an alternative option for the future. In view of preparing for this option, Morocco set up the National Centre for Nuclear Energy, Science and Technology (CNESTEN), a nuclear research centre (NRC) with a 2 MW research reactor, which became operational in 2009. Thus nuclear materials were introduced in 2006.

The physical protection aspect has been taken into account since the beginning of the NRC project at the regulatory level in the design and licensing process. It is in this perspective that CNESTEN plays the role of a technical and scientific support organization (TSO) for the authorities in setting up a national nuclear security regime.

2. REGULATORY FRAMEWORK

2.1. National level

The field of nuclear activities is one of the areas that have been regulated by the Moroccan Government since the 1970s. The national legal and regulatory framework for protection against the harmful effects of ionizing radiation and for safety of radioactive sources, initially based on the law on protection against ionizing radiation [1], has been reviewed and complies with international standards [2–4].

Morocco has two regulatory bodies:

- — The Ministry of Energy, Mines, Water and Environment acts as the safety regulator in charge of the control and licensing of nuclear facilities. The process of licensing follows all phases of the NRC project: construction, fuel loading, commissioning and reactor operation [5].
- — The Ministry of Health, through the National Center of Radioprotection (CBRP), is in charge of the control of the use of all radiation sources.

To update its regulatory framework, Morocco will soon adopt a nuclear and radiological safety and security law. This new law foresees the creation of a new unique and independent regulatory body and includes the main provisions which relate to physical protection and are in compliance with IAEA security guidelines.

2.2. International level

To confirm its willingness to use nuclear technology solely for peaceful purposes, Morocco ratified the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) as well as its comprehensive safeguards agreements with the IAEA. The Convention on the Physical Protection of Nuclear Material (CPPNM) [6], related to physical protection, was also ratified.

In addition to these laws, Morocco has signed all international agreements related to nuclear security and applies all relevant United Nations resolutions; namely, resolution 1540 and the International Convention for the Suppression of Acts of Nuclear Terrorism. Morocco also has notified the IAEA of its acceptance of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources.

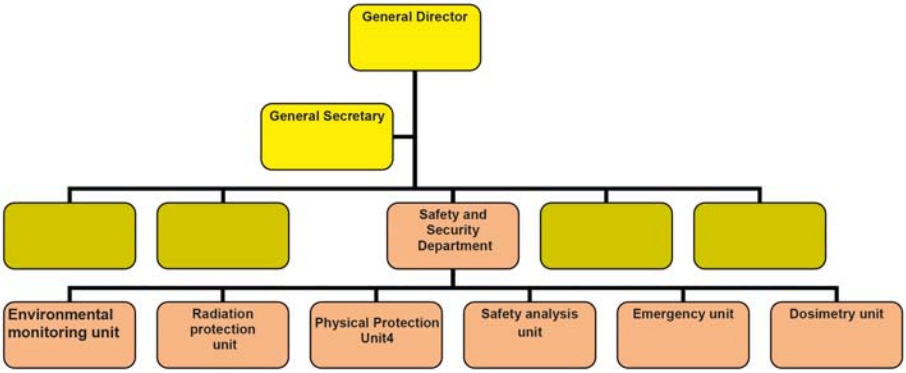

FIG. 1. Security structure within CNESTEN.

3. PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN NRC FACILITIES

The physical protection of the NRC facilities was undertaken during the licensing process. Nowadays, CNESTEN has an integrated vision of safety and security. The centre established a security structure (Fig. 1) which addresses all aspects related to the security and safety of nuclear material and radioactive sources.

The staff in the Safety and Security Department represents more than one quarter of the scientific and technical staff of the NRC. It is trained thanks to IAEA support and bilateral cooperation with France and the United States of America.

At the organizational level, internal regulations include procedures to access all controlled areas, determination of trustworthiness, continuous surveillance and sanction measures.

Technical measures implemented at the centre are elaborated by the physical protection unit team for approval by CNESTEN’s top management. These technical measures should serve three major functions — detection, delay and response — in compliance with international guidance [7, 8]; they include a double fence, an intrusion detection system (cameras, barriers, hardened doors, locks), access control and an armed response force. These measures, which are discussed with the national security authorities, are meant to prevent any malicious act against the NRC facilities.

4. ROLE OF CNESTEN AS A TSO IN ESTABLISHING AND SUSTAINING A NUCLEAR SECURITY REGIME

During the NRC licensing process, institutional partners requested that CNESTEN help in the implementation of a national security regime in line with the country's international commitments. CNESTEN then developed its various TSO functions.

The first approach relates to human resources. CNESTEN invited all partners to the various training events hosted at its facilities. The importance of both IAEA and US bilateral cooperation in the success of this training should be noted here. So far, the centre has trained around 500 Moroccan participants in various fields of nuclear security (prevention, detection and response). Participants from other African countries have also benefited from the training in the framework of African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) projects.

The second approach concerns the personnel in charge of external physical protection of the NRC site, who belong to national security services. The themes addressed included radiation protection, radiation detection equipment for front-line officers, physical protection of nuclear material and physical protection of radioactive sources. The NRC provides all necessary logistical support to the security staff on-site.

The third approach targets the main national users of high level radioactive sources to strengthen their security measures on medical and industrial sites. The objective of these actions was to replace and/or consolidate their protection systems. These actions were carried out with the help of a US Department of Energy project related to the Global Threat Reduction Initiative.

The fourth approach is to provide technical assistance to the public authorities in Morocco's adherence to the Global Initiative to Combat Nuclear Terrorism. The centre offers its expertise in all technical seminars in collaboration with other countries. It also cooperates actively with other national agencies to enhance national capabilities in the field of preparedness for and response to a radiological emergency.

The fifth approach aims to build and sustain TSO capacity in security areas. To achieve this objective, CNESTEN requested IAEA assistance to accompany the centre in establishing a national security support centre with the objectives of:

- — Improving infrastructure for training in nuclear security;
- — Elaborating and implementing a training programme tailored to national needs;
- — Developing a network of expertise in nuclear safety and security;

— Strengthening coordination and cooperation;
— Promoting a nuclear security culture within organizations involved in Morocco;
— Developing regional cooperation.

5. CONCLUSION

All institutional partners (police, fire fighters, customs and regulatory bodies) are now aware of the importance of a safety and security culture. It is expected that CNESTEN will remain a centre of resources and expertise for public authorities. To meet such a challenge, CNESTEN should sustain its capabilities and stay attentive to the concerns and needs of the public authorities. Looking forward to the nuclear option that Morocco is considering under the IAEA milestone approach [9], CNESTEN is expected to play its full role as a TSO.

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POSSIBLE MODES OF ESTABLISHING NUCLEAR SECURITY TECHNICAL AND SCIENTIFIC SUPPORT IN MEMBER STATES INTENDING TO LAUNCH OR EXPAND NUCLEAR POWER PROGRAMMES

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Abstract

Nuclear power generation as an economical energy source and a potential solution to global warming has taken the lead over other alternative sources of energy. Many countries with operating nuclear power plants are trying to expand their nuclear programmes, while many new States are endeavouring to enter into this arena. These developments bring with them new opportunities and challenges in designing and incorporating concepts of nuclear safety, nuclear security and nuclear safeguards at the earliest stage of development. In this context, technical support services are considered one of the main pillars of the safe, secure and peaceful use of nuclear energy. Technical and scientific support is one of the important prerequisites for establishing and maintaining nuclear security systems in a State. For this purpose, it is necessary to build expertise in physical protection and in nuclear material accounting and control. Furthermore, experience is required in the maintenance of systems, equipment and associated software used for effective border monitoring and radiological threat assessment. Technical and scientific support organizations (TSOs), having a neutral outlook, may be part of a regulatory body or may serve as a separate entity. They are gaining increased importance by providing the technical and scientific basis for decisions and activities regarding nuclear and radiation safety. Therefore, the role and quality of the technical and scientific expertise provided by TSOs in the nuclear industry and regulatory systems are of fundamental importance. The paper aims to provide an overview of how technical and scientific support services for nuclear security can be established and maintained at the national level. It also focuses on the ways TSOs could organize to deal with this issue, and on how to develop and enhance cooperation among Member States to support the establishment and maintenance of such services.

1. INTRODUCTION

Nuclear energy has become a catchphrase in the contemporary world, and there is rapidly mounting interest among States in using nuclear energy for peaceful purposes. A large number of States that previously had a modest nuclear energy outlook are intending to expand their nuclear energy plans. There is also a growing list of aspirant States working to embark upon new nuclear energy plans, hence paving the way for a ‘nuclear renaissance’.

The idea of a nuclear renaissance derives its strength from growing concerns about the depletion of traditional sources of energy and the fear of global warming. These concerns are compelling nations to pursue nuclear energy that is both economical and environmentally friendly. However, despite many opportunities, doing so entails great challenges related to nuclear safety, nuclear security and nuclear safeguards. In order to meet these challenges, the international community has agreed on general standards and on undertaking concrete steps to ensure the safe, secure and peaceful application of nuclear energy.

Technical support services in this context are considered one of the main pillars of, and an important prerequisite for, establishing and maintaining a nuclear safety and security regime in a State. In the field of nuclear safety, technical and scientific support organizations (TSOs) have been working for a long time to help the industry to reach better solutions to ensure the safe use of nuclear energy. However, the role of TSOs specialized in nuclear security has not been as strong, lacking in internationally accepted standards and practices. This fact is widely realized and acknowledged. Considering that nuclear security is as essential as nuclear safety, there are ample reasons for establishing nuclear security TSOs.

This paper aims to provide an overview of how a TSO for nuclear security could be established and maintained at the national level. It also provides some ideas on how to develop and enhance cooperation among Member States to support the establishment and maintenance of such organizations at a regional as well as an international level.

2. ENHANCED NUCLEAR SECURITY REGIME

The nuclear renaissance has increased the importance of nuclear security, because the consequences of a major nuclear security incident would likely be catastrophic and global. The threat of terrorism and other malevolent acts involving the use of nuclear and other radioactive materials has led the international community to think about the enhancement of a strengthened nuclear security regime.

A comprehensive nuclear security regime comprises an effective ability to *prevent* and *detect* and *respond to* theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.

Prevention requires the assignment of nuclear security responsibilities at all levels; a strong legislative and regulatory framework; the identification and assessment of threats; licensing and authorization; inspections and verifications; stringent export control measures; and correctly designed and sustainable physical protection systems and measures.

Detection measures are required to be implemented for the discovery and assessment of an attempted or actual intrusion that could have the objective of unauthorized removal or sabotage of nuclear and other radioactive material. Detection can be achieved by visual observation, video surveillance, electronic sensors, material accountability records, seals and other tamper indicating devices. Installing effective monitoring systems at facility entry/exit points and international borders is advantageous.

Response requires the capability to assess the validity and potential consequences of the nuclear security event, to locate, identify and categorize the material, to recover and secure/neutralize the event and device, and to prosecute or extradite those involved.

There are a number of multifaceted legally binding and non-binding instruments that call for the establishment of an international framework for an effective nuclear security regime. These instruments include United Nations Security Council resolutions 1373 (28 September 2001) and 1540 (28 April 2004), the Convention on the Physical Protection of Nuclear Material (and facilities), the International Convention for the Suppression of Acts of Nuclear Terrorism (2005) and non-binding IAEA documents such as INFCIRC/225, the Code of Conduct on the Safety and Security of Radioactive Sources and the supplementary Guidance on the Import and Export of Radioactive Sources.

It is necessary for States to adhere to and implement these instruments/standards in harmony to ensure effective nuclear security in a sustainable manner worldwide.

3. TSOs IN NUCLEAR SECURITY

TSOs are one of the important prerequisites for establishing and maintaining a sustainable nuclear security regime in a State. A comprehensive nuclear security regime requires specific expertise and trained human resources to provide guidance and solutions. For this purpose, it is necessary to know the available resources having expertise in areas such as the physical protection of nuclear material and nuclear facilities, nuclear material accounting and control, detection and response, etc. Furthermore, expertise and experience are required in the maintenance of systems, equipment and associated software. Research and development is needed to improve the systems and their effectiveness. TSOs are developed to support the national organizations for specific guidance, training and expert opinions, etc., for their related functions.

A TSO may have a neutral outlook or an official umbrella; it may be a separate body or part of a regulatory body. In either of these capacities, TSOs are gaining increased importance for providing the technical and scientific basis for decisions and activities regarding nuclear safety and security. Therefore, the role and quality of the technical and scientific expertise provided by TSOs in the nuclear industry and regulatory systems are of fundamental importance. A TSO may be national, regional or international.

3.1. National TSO

At the national level, a TSO may be established either as part of a governmental body or in partnership with the public or private sector. The governmental body may be a research institute, a regulatory body or a totally separate organization.

TSO as a part of the regulatory body or an existing governmental body

Within the regulatory body, there may be a dedicated team of experts to analyse problems and render an opinion on issues related to nuclear security, physical protection, accounting and control, etc. A national TSO should have the capability, capacity and tools to assess and analyse problems and to suggest solutions based on technical logic. The TSO staff should include very experienced persons from the industry, the regulatory body, and implementing and operating organizations (maybe working as consultants), etc.; mid-career workers at the managerial level; and people in the early stages of their careers. The experienced persons can suggest different solutions based on their multidisciplinary experience, while the mid-career workers can discuss the different options to select the best one, and the beginners can help in the collection of data and literature while growing into their jobs. All this requires interdependence, harmonization and mutual cooperation among the team members. Considering this, managers have to choose the right people to make up these teams.

TSO as a separate organization

A team of experts/consultants from various technical organizations such as the regulatory body, operating organizations, policy makers, manufacturers, etc., having experience in specific fields and readily available to provide assistance, guidance and training can join together to set up a TSO. Such TSOs can work simultaneously for the regulators, operators, manufacturers and policy makers, etc. These groups of people may be organized and sponsored by governments or NGOs, or may be volunteers.

National TSOs can work as a focal point for different national organizations to support their efforts, for example, by: suggesting methods that customs and other law enforcement agencies can use to combat illicit trafficking of nuclear and other radioactive materials; providing analysis and evaluation of physical protection proposals to regulators; assessing and detecting radiation doses for relevant stakeholders; and preparing first responders for response actions.

3.2. Regional TSOs

Those countries having modest nuclear or radiation activities may share resources and expertise, and establish regional TSOs. Small national TSOs of those States with specific capacities/capabilities can be integrated to create a complete network encompassing all areas of nuclear security. Such arrangements will help Member States to share resources and expenses and to benefit from each other in most of the desired areas for the provision of necessary guidance/assistance. International organizations such as the IAEA can help Member States to establish regional TSOs.

3.3. Virtual TSOs

Virtual TSOs with a dedicated team of experts may be formed without a central location and may provide assistance, guidance and training on issues related to nuclear security through the Internet or through other electronic means of communication. They may analyse a problem without meeting face to face and suggest a solution virtually.

Virtual TSOs/teams can help organizations/countries to reach the best talent/systems without geographical restrictions.

4. TSOs FOR ‘NEW BUILD’ AND EXPANDING COUNTRIES

The establishment of nuclear security TSOs is important for ‘new build’ countries as well as for countries expanding exiting programmes.

Prerequisites for ’new build’ countries

It is a prerequisite for ‘new build’ countries to establish a regulatory body to regulate and supervise the activities related to nuclear safety, nuclear security and safeguards. In the current scenario, a country without a regulatory infrastructure would not be able to acquire even a radiation source for medical purposes. The regulatory body should be provided with adequate authority, competence, and the financial and human resources to fulfil its national responsibilities. The functions and decisions of the regulatory body should be supported by a national TSO.

The inspection, enforcement and analysis activities of the regulatory body should be supported by the TSO for the provision of expert opinion in related matters such as legislation and provision of regulatory advice on nuclear security issues, evaluation of physical protection plans for nuclear materials and facilities, material accounting and control reports/submissions, radiation detection techniques and dose rates, radiation spectrum analysis, import/export and non-proliferation issues, incident response and recovery methods, etc. (Fig. 1).

It is important to note that security considerations and physical protection requirements must be considered from the site evaluation stage to decommissioning of the facility.

TSOs for countries expanding their programmes

Those States expanding their nuclear power programmes also have to consider further actions. For example, by virtue of already possessing a

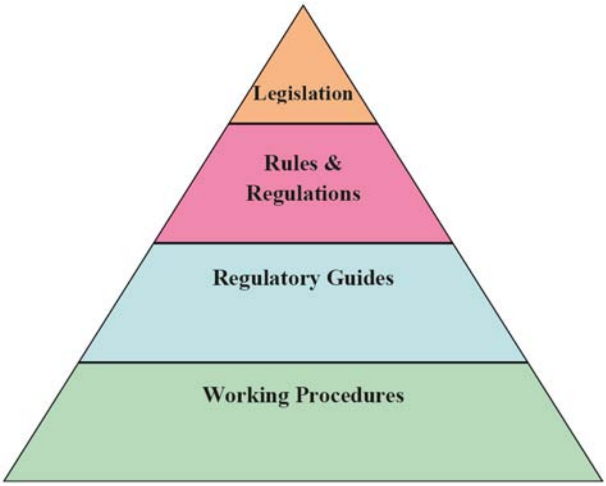

FIG. 1. Regulatory pyramid.

regulatory authority, these States need to conduct gap analysis to find any weaknesses in nuclear safety, nuclear security and nuclear safeguards. This gap analysis will help them to suggest solutions to address these gaps. The regulatory body of the country should have the capabilities: to oversee nuclear security issues; to develop coordination with the relevant organizations in the country for threat analysis, and for information gathering and dissemination; to help recovery and response efforts in the case of theft, loss or sabotage of nuclear material or sabotage to nuclear facilities, etc.; and to develop a nuclear security culture for sustainability and maintenance of the nuclear security regime.

Guidance is available in the form of IAEA nuclear security documents and international legally binding and non-binding instruments.

5. ESTABLISHMENT OF A NUCLEAR SECURITY TSO IN PAKISTAN: AN EXAMPLE

Pakistan’s nuclear programme dates back to the 1960s, and its experience in nuclear safety extends over a period of four decades. Therefore, Pakistan has long had a well established and robust nuclear safety mechanism to ensure the safe application of nuclear energy in the country. The nuclear security regime is also as old as the nuclear industry in Pakistan. For example, the PARR-1 and KANUPP nuclear power plants were built in the early 1970s with security features such as fences and watchtowers, security management by military personnel, background checks of the employees, access cards and access control systems. These systems were quite effective and sufficient according to the environment of that time. The systems have been continuously evaluated and improved according to INFCIRC/225 Revisions.

In order to institutionalize the nuclear security regime, in 2006 Pakistan carried out a gap analysis that resulted in the establishment of the Nuclear Security Action Plan Project (NSAP). The NSAP has a wide scope and works in the following areas:

- Management of radioactive sources;
- Locating and securing of orphan radioactive sources;
- Provision of radiation detection equipment at strategic points;
- Establishment of the Nuclear Security Emergency Coordination Centre (NuSECC);
- Physical protection of nuclear material and nuclear facilities;
- Establishment of the Nuclear Security Training Centre (NSTC).

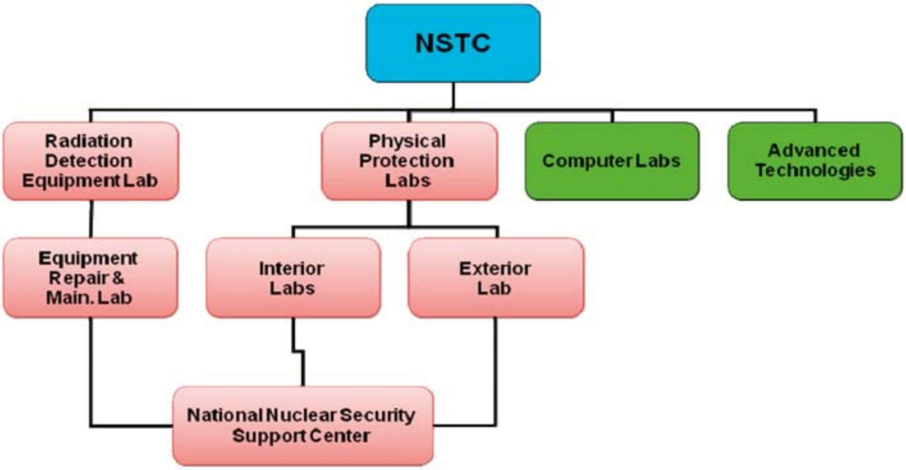

FIG. 2. The National Nuclear Security Support Center (NNSSC).

The goal of the NSTC is to provide training for optimum utilization of human resources by developing a skilled workforce and to nurture a nuclear security culture in the country. For this purpose, under the NSTC, a National Nuclear Security Support Centre (NNSSC) has been established with the help of the IAEA (Fig. 2).

The NNSSC was developed with the objective of bringing sustainable competencies in the nuclear security area in order to:

- — Render expert opinion on detection analysis, radiation doses, protection techniques, etc.;
- — Provide guidance on the preventive maintenance of equipment and on troubleshooting techniques for the best use of radiation detection equipment;
- — Assist stakeholders in procuring, testing and deploying the best radiation detection equipment and physical protection systems available;
- — Provide assistance for the repair, maintenance and calibration of equipment;
- — Provide expert support on the detection of nuclear and other radioactive materials, identification of radioisotopes, response to nuclear security incidents, etc.;
- — Provide training to stakeholders in specific nuclear security areas;
- — Serve as a focal point for sustainable and continued access to the knowledge, skills and abilities of individuals to contribute productively to the comprehensive nuclear security regime.

6. CONCLUSION

With the increasing use of nuclear technology for the benefit of humankind, there is a growing need to establish nuclear security TSOs. These TSOs may be within the organization itself or at the corporate level, or may be a virtual TSO; however, the provision of technical support services is important for solving the specific problems of individuals or organizations. These individuals or organizations may use this technical assistance to develop the technical basis for regulations, decisions, submissions and guidelines and to review the applications of licensees.

IRSN EXPERIENCE IN PROVIDING NUCLEAR SECURITY TECHNICAL AND SCIENTIFIC SUPPORT

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Abstract

The Institute for Radiological Protection and Nuclear Safety (IRSN) provides technical support to the French Ministry of Energy, which is responsible for ensuring that regulations are observed at nuclear facilities and during the transport of nuclear materials. The paper discusses the technical support activities carried out by IRSN, including assessment and operational activities, and describes IRSN's responsibilities in areas such as: inspections, emergency response, preparation of regulatory texts, international activities and training. It concludes with an overview of the areas covered by its current research and development activities, which are aimed at ensuring that IRSN's technical assessment activities are relevant and that the inspections it carries out are of the highest quality.

1. NUCLEAR SECURITY IN FRANCE

In France, the legislative and regulatory aspects of the general approach to protect against malicious acts are laid down in the so-called Defence Code. This code brings together all the laws and decrees passed to protect nuclear materials and facilities against malicious acts. The term 'malicious acts' covers the theft or diversion of nuclear materials as well as acts of sabotage targeting nuclear materials, facilities or transports liable to result in radioactive release to the environment. These two aspects were formerly governed by separate regulations but have now been brought together in an effort to promote synergy in the implementation of a system of protection that is consistent and properly adapted to these types of threat.

Under French regulations, prime responsibility lies with the operators, who must guarantee the security of the nuclear materials in their possession. They must consequently define a system to follow up and account for these materials, and provide effective protection against theft or sabotage. In France, the Ministry of Energy, as the Security Authority, has to ensure that regulations are observed at nuclear facilities and during the transport of nuclear materials, with the Institute for Radiological Protection and Nuclear Safety (IRSN) acting as its technical support.

2. IRSN'S TECHNICAL SUPPORT ACTIVITIES FOR THE AUTHORITIES

2.1. Assessment activities

The Security Authority entrusts IRSN with the task of carrying out technical assessments of documents submitted by licence applicants and operators in the nuclear field. These documents include:

- Documentation submitted to obtain or modify licences required by the Defence Code for the import, export, production, possession, transfer, use and transport of nuclear materials;
- Security studies carried out by operators and used to assess the effectiveness and reliability of measures taken to prevent theft or diversion of the most sensitive nuclear materials;
- Reports concerning physical inventories of nuclear materials taken by each licensee;
- Technical documentation concerning protective measures for transport, with particular regard to routes taken and vehicle protection.

IRSN examines these documents and issues advice to the authority, with written observations and, more especially, its recommendations for any action required. Points considered include:

- Compliance of measures or provisions described by the licence applicants or operators with regulations and requests from the authorities and, more generally, their suitability in view of the risks involved;
- Points calling for supplementary information and those for which the demonstrations provided are inadequate, in particular those for which documentary evidence and explanations are required before an opinion can be reached on the measures taken.

This advice includes a brief summary highlighting key points or points calling for immediate action.

As part of its assessment work, IRSN contacts the licensees or licence applicants to obtain all the technical data required and organizes the necessary technical inspections of the facilities concerned.

IRSN also provides the authorities with technical support in connection with the activities of the advisory groups of experts set up to appraise the design and construction provisions of nuclear facilities to protect against acts of sabotage. Within this context, IRSN:

— Acts as secretary for these groups.
— Prepares the technical data required by group members to reach a decision on any matter put before them by the authorities. In particular, it examines documentation submitted by operators to assess the sensitivity and vulnerability of facilities and transport, and reports its findings to the relevant group of experts.

2.2. Operational activities

IRSN is responsible for centralizing national nuclear material accountability data on behalf of the authorities. This involves:

— Developing and maintaining computer tools for centralizing accountability data; these tools must be compatible with the sensitivity of the data concerned.
— Defining practical procedures for implementing this accountability (account coding rules, data transmission rules, etc.). Coding rules take into consideration requirements applicable to the declarations submitted by France under international agreements.
— Managing annual declarations from organizations in possession of small quantities of nuclear materials and checking these declarations against available data.
— Preparing statements of nuclear material inventories and flows for the various authorities concerned, using the accounting database, at the frequency determined by the public authorities.
— Drawing up individual statements, especially in preparation for inspections.

Centralization is carried out almost in real time, based on the accounting data provided by each licensee or organization in possession of nuclear materials that are subject to declaration.

IRSN also has operational responsibilities for managing the transport of nuclear materials. On behalf of the authorities, it gives transport companies clearance for national shipments of nuclear materials. In addition, it keeps track of nuclear transport at the operational level. Shipments of sensitive nuclear materials are continuously monitored by a special IRSN unit. This involves making phone calls at regular intervals and whenever an event with a real or potential impact on the shipment occurs. In addition, a satellite positioning system gives the exact location of the vehicle at all times. Thus any abnormal movement of the shipment can be detected in real time, allowing a fast alert and response if those responsible for transporting the materials fail to respond.

2.3. Inspections

Inspections are part of an annual programme submitted to the Security Authority by IRSN. The programme is prepared and approved according to certain criteria, such as the sensitivity of facilities or the results of previous inspections. That does not mean, of course, that unscheduled inspections cannot be organized in response to any event considered a matter of concern.

The general purpose of inspections is to ensure that licensees comply with regulations and meet their commitments. They can also be more targeted, in which case they may focus on points such as nuclear material inventories, possibly with measurements of the materials concerned, performance and reliability checks on the different physical protection equipment used, examination of procedures governing alarms, response or access to nuclear material storage areas, and operator accountability checks. Other inspections may focus on a particular operating phase of a facility.

Nuclear material transport inspections are carried out to check compliance with regulations. Unlike inspections of materials stored at facilities, transport inspections are always unannounced. After the inspection, IRSN issues an inspection report and, where necessary, makes proposals for corrective action to remedy any deviations observed.

2.4. Emergency response

At the request of the public authorities, IRSN regularly organizes emergency response exercises that involve taking a nuclear material inventory at a facility. The purpose of these exercises is to test decision making chains and the coordination of the various participants (operators, public authorities). The exercises consist of taking a nuclear material inventory at one or more facilities within the space of a few hours to confirm or rule out the existence of any malicious acts (theft or diversion of nuclear materials, or acts of sabotage).

IRSN also takes part in national security exercises organized to test the coordination and action of the various organizations called upon in the event of a malicious act targeting a nuclear facility. Within this context, IRSN is involved in defining the scenario, coordinating the exercise and leading the working group set up to draw lessons from these exercises.

2.5. Preparation of regulatory texts

IRSN provides the Security Authority with support in preparing regulatory texts applicable to the security of nuclear materials, facilities and transport, and of radioactive sources. Within this context, it participates in the drafting and review of decrees and orders concerning this field of activity. Among the texts concerned are those relating to:

- — Procedures and forms of licences to use or store nuclear materials;
- — Procedures concerning studies on the protection of nuclear materials, facilities and transport;
- — Physical follow-up and accountability of nuclear materials;
- — Physical protection of nuclear materials at facilities;
- — Protection and control of nuclear materials during transport;
- — Protection of nuclear materials subject to declaration;
- — Protection of ionizing radiation sources.

IRSN also drafts policy documents and guides to ensure the continuity of its expertise and consolidate its teams' professional skills. The texts concerned include those relating to:

- — Security culture;
- — A comparative approach to nuclear safety and nuclear security;
- — Internal threats;
- — Security of nuclear materials during transport.

2.6. International activities

IRSN is involved in a range of international activities, acting for the authorities or on its own behalf. The following list gives some examples of these activities:

- — Regarding the IAEA:
  - Helping to draft and review documents that are part of the IAEA Nuclear Security Series (drafting recommendations, guides or methodology documents relating to nuclear security);
  - Giving lectures at courses or seminars on physical protection and follow-up and accountability of nuclear materials;
  - Taking part in assignments organized at the request of IAEA Member States and concerning the physical protection of nuclear and radioactive materials.
- — Regarding the European Commission:
  - Participating in working groups set up to examine ways to prevent chemical, biological, radiological and nuclear threats;
  - Taking part in discussions with other European countries on the security of radioactive sources;
  - Working to build a nuclear security demonstrator (tabletop exercise).

— Regarding bilateral relations, IRSN exchanges information on a regular basis with its counterparts in a number of countries, such as Japan, Spain and Sweden, and cooperates in its specialized technical fields with other countries, including Germany, the United Kingdom and the United States of America.

IRSN is also involved in the activities of the European Safeguards Research and Development Association (ESARDA), where it is a member of the Executive Committee and the Editorial Committee, as well as taking part in several working groups. It is also a member of ENSRA, an association of European security regulators and their technical support organizations. This association provides a forum for discussing the latest developments concerning the security of nuclear materials and facilities in Europe, sharing best practices and seeking joint approaches to security matters.

2.7. Training

The Security Authority has entrusted IRSN with the task of initiating or taking part in national or international training courses and awareness campaigns concerning nuclear security. These can provide an introduction to basic notions and concepts concerning the protection and control of nuclear materials and facilities, the regulatory framework in France and at the international level, and the organizations involved in this field of activity and the role they play. Specialized training courses, for example, on accounting techniques for nuclear materials, are also organized. These can be aimed at:

— Institutions, plant operators or IRSN personnel in France;
— International partner institutions concerned with nuclear security, operators and experts.

2.8. Research and development activities

IRSN keeps close track of progress in protection and control methods and resources. It conducts research and experiments in this area to ensure that its technical assessment activities are relevant and that the inspections it carries out for the authorities are of the highest quality. The areas covered by its current research and development activities in this field include:

— Assessing and developing remote tracking systems for the transport of sensitive material.

— Conducting performance tests and developing new measuring instruments for use on nuclear materials. The aim here is to develop measuring instruments that are both portable and as accurate as possible.
— Carrying out generic or specific studies to assess the impact of sabotage on facilities (e.g. determining how civil structures or equipment respond to explosives) or transport equipment (e.g. resistance of shipping containers to attack by weapons or explosives).

NUCLEAR SAFETY AND
NUCLEAR SECURITY NETWORKING
AND CENTRES OF EXCELLENCE

(Topical Issue 4)

Chairpersons

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NUCLEAR SAFETY AND NUCLEAR SECURITY NETWORKING: CURRENT AND FUTURE ACTIVITIES[1]

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[1] Although a presentation was given, no abstract or paper was made available. The author's PowerPoint presentation appears on the CD-ROM accompanying this book.

DEVELOPING VIRTUAL TSO NETWORKS BASED ON THE EXPERIENCE OF THE ASIAN NUCLEAR SAFETY NETWORK (ANSN)

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Abstract

The Asian Nuclear Safety Network (ANSN) operates within the framework of the IAEA's Extrabudgetary Programme on the Safety of Nuclear Installations in the South East Asia, Pacific and Far East Countries. The ANSN has focused on cybernetworking, along with human networking, to share knowledge and experience concerning nuclear safety among its member countries since 2002. It is now moving forward with capacity building activities based on 'Vision 2020', the aim of which is to successfully establish the necessary safety infrastructure for the introduction and operation of first nuclear power plants in those countries launching nuclear power programmes by 2020. The most urgent issue for countries launching nuclear power programmes is capacity building for nuclear safety. One solution is to have a technical and scientific support organization (TSO) such as those in countries with established nuclear power programmes. However, as it will not be so easy for newcomer countries to establish TSOs in a short time, the ANSN is preparing for a new network function called a 'Virtual TSO' that will be operated on the basis of cooperation among existing TSOs, regulatory bodies and research institutes in member countries. This Virtual TSO is expected to have technical support functions, for example, to provide such services as problem solving and to contribute to the efficient development of the safety infrastructure in new entrant countries. The paper presents a history of the ANSN's activities, reviews factors essential to capacity building and introduces the development of the Virtual TSO to facilitate capacity building for countries launching nuclear power programmes. The ANSN is expected to cooperate with other regional networks involved in similar activities in different regions of the world, under the Global Nuclear Safety and Security Framework.

1. INTRODUCTION

The Asian Nuclear Safety Network (ANSN) is a regional cooperative project operated within the framework of the IAEA's Extrabudgetary Programme on the Safety of Nuclear Installations in the South East Asia, Pacific and Far East Countries. The ANSN's membership consists of Australia, China, Indonesia, Japan, the Republic of Korea, Malaysia, the Philippines, Singapore, Thailand and Vietnam as participating countries; France, Germany, and the United States of

America as supporting countries, and the European Commission as a supporting organization; Bangladesh and Kazakhstan as observers; and Pakistan as an associated country.

2. HISTORY OF THE ANSN

In 2002, the ANSN launched a pilot project focusing on cybernetworking in the area of education and training among members and the IAEA in pursuit of nuclear knowledge management. After the success of the pilot project, the ANSN started full operation in 2004. The ANSN operational hierarchy is composed of the Strategy Dialogue, which provides overall strategies; the Steering Committee, which develops the action plans to realize the strategies; the Topical Groups (TGs), which carry out activities in specific areas; the Capacity Building Coordination Group (CBCG), in charge of coordination among the TGs and the overall arrangement; and the IT Support Group, which provides technical support for cybernetworking.

In 2009, in response to the increasing interest in nuclear power in newcomer countries, the Strategy Dialogue, composed of high ranking government officials and senior regulators of the membership, proposed its ‘Vision 2020’, an approach to capacity building aimed at establishing and enhancing the nuclear safety infrastructure and human resources necessary to construct a nuclear power plant in new entrant countries and to start operation by 2020. The ANSN’s current activities are in accordance with the goals set in Vision 2020.

Currently, there are eight TGs: Education and Training, Safety Analysis, Operational Safety of Nuclear Power Plants, Radioactive Waste Management, Emergency Preparedness and Response, Governmental and Regulatory Infrastructure, Siting, and Safety Management of Research Reactors. In the future, with the progress of nuclear power generation programmes, three additional TGs — on Construction, Commissioning, and Inspection and Enforcement — will be established.

The CBCG identified the necessary action items for capacity building. TGs have just begun to review the activities in their respective specialized areas. Capacity building items were analysed based on the IAEA ‘Milestones’ approach [1], and on the guidance in IAEA Safety Standards Series No. SSG-16 [2] and INSAG-22 [3]; they were then classified into 15 categories. Ten of the categories were selected for the scope of the ANSN’s activities. Others are left for review by governments, licensees or vendors. The details are shown in Table 1.

TABLE 1. CAPACITY BUILDING ITEMS

No.	Item	Responsible entity	Responsible TG
1	National policy	Government	—
2	Legislative framework	ANSN	GRITG
3	Regulatory framework	ANSN	GRITG
4	Electric grid connection	Licensee	—
5	Siting	ANSN	STG
6	Funding	Licensee	—
7	Human resource development	ANSN, licensee, vendor	ETTG
8	Nuclear safety technology	ANSN, vendor	SATG, OSTG
9	Stakeholder involvement	ANSN	All TGs
10	Environmental protection	ANSN	STG
11	Emergency planning	ANSN	EPRTG
12	Radioactive waste management and spent fuel	ANSN	RWMTG
13	Nuclear material management	Government	—
14	Radiation protection	ANSN (collaboration with the Forum for Nuclear Cooperation in Asia)	—
15	Procurement	Licensee	—

3. VIRTUAL TSO

3.1. Features of the Virtual TSO

The IAEA Fundamental Safety Principles [4] state that the government is “responsible for the adoption within its national legal system of such legislation, regulations, and other standards and measures as may be necessary to fulfil all its national responsibilities and international obligations effectively, and for the establishment of an independent regulatory body” (para. 3.8), and that the regulatory body must have “adequate legal authority, technical and managerial competence, and human and financial resources to fulfil its responsibilities" (para. 3.10).

In accordance with these provisions, regulatory bodies in many nuclear power countries have in-house capability or outside organizations that provide necessary technical and scientific support. In this paper, an outside technical support organization is referred to as a TSO.

One approach for a regulatory body in a newcomer country to successfully build capacity is to establish a 'real TSO'; however, doing so might be difficult. In this respect, the ANSN is actively promoting Vision 2020 by introducing a service to provide TSO functions in the network. This 'Virtual TSO' is in principle for newcomer countries but is not limited to them.

The Virtual TSO is a kind of cybercommunity with unique features making it different from a real TSO. Table 2 shows major differences between a real TSO and the Virtual TSO. It should be noted that the idea shown in Table 2 is the

TABLE 2. COMPARISON OF THE REAL TSO AND THE VIRTUAL TSO

	Real TSO	Virtual TSO
Form	— Real entity existing in some nuclear power countries	— Cybercommunity in the network
Operation	— Operated by the TSO itself	— Cooperatively operated by a group of organizations
Main customer	— Fixed customer; typically a domestic regulatory body — Bilateral relationship between the TSO and its customer	— Not-fixed; regulatory bodies in newcomer countries — Multilateral relationship between the TSOs and its customers
Services provided	— Direct services through actual work[a] — Services provided under the fixed relation between the TSO and the regulatory body	— Services via the Internet — Services provided under the flexible relation between a receiver and provider(s)
Responsibility for service	— Sole responsibility of the TSO providing service	— Shared responsibility of providers, or — Receivers
Resources	— Concentrated	— Distributed

[a] The services described in this paper are those for nuclear safety regulation; additional services may also be provided.

author's proposal and requires discussion among the concerned membership to reach a consensus. The most outstanding feature of the Virtual TSO is cooperative operation by both providers and receivers of services from the planning to the post-service evaluation stage.

3.2. TSO functions under development

Table 3 lists the functions that are currently under development.

Advanced IT infrastructure and tools will be introduced to support the Virtual TSO's functions, including an Internet video conference system for closer communication and discussion among the persons concerned and an on-line planning system for planning activities by the members of TGs, the CBCG and the IAEA Secretariat. In addition, as part of the development of a human network, a database of technical experts who can support problem solving services will be introduced.

3.3. Challenges in developing the Virtual TSO

The Virtual TSO constructed based on the network is convenient and will be very useful if it works successfully. But at the same time, there are some issues to be considered regarding security problems, response speed and quality of services. The cybersystem and information in it should be protected from cyberattack by robust security measures. It has to respond to users' requests in a timely manner, and the responses have to be of sufficiently high quality. These aspects should be carefully considered in developing the Virtual TSO. By

TABLE 3. TSO FUNCTIONS UNDER DEVELOPMENT

	Function	Status
e-library	— Wiki-based digital library containing documents including TG activities — Lectures/training videos (planning)	— Trial operation completed — Step-by-step service starting in 2011
Solution Support Service	— Questions and answers among experts within the network for problem solving	— Trial operation started — Full scale service starting in 2012
e-learning	— Remote learning on the network — Quizzes for evaluating the performance of trainees	— Operation started

reflecting operating experience and feedback from users, these issues should be properly resolved.

In the course of developing this project, some other issues have been identified as well, including the following:

- — Are some services to be provided for a fee? If so, what types of service are paid for?
- — Enhanced cybersecurity may have an impact on users' convenience. How can the two be reconciled to construct the optimum system?
- — Does the responsibility for utilizing services rest with the provider or the receiver? If the service is voluntary, does that responsibility still rest with the provider? If services are provided by several providers for a fee, how is the compensation shared between the providers?

4. CAPACITY BUILDING AND THE VIRTUAL TSO

Capacity building refers to development and enhancement of both safety infrastructure and human resources. Safety infrastructure relates to laws and regulations, the regulatory system and organization, technical expertise, etc., while human resources concerns the number and capability of personnel involved in nuclear safety. In the framework of safety infrastructure, the ANSN is seeking to establish the Virtual TSO. To develop human resources, a regional education training centre could be organized in cooperation with national education and training centres in member countries.

The ANSN considers that integration of the Virtual TSO and the education training centres will form the regional capacity building centre.

5. CONCLUSION

The ANSN has been working for almost 10 years to ensure the safety of nuclear facilities in Asia. Now it has matured to support newcomer countries launching nuclear power programmes in developing and enhancing safety infrastructure and human resources. The Virtual TSO is the first attempt in the world to help build the capacity in newcomer countries by providing necessary competence and capability through a cybercommunity. This could be a model for similar activities worldwide. However, issues to be addressed have arisen as the project has progressed to practical implementation. The members of the project believe that these issues will be properly resolved through the effort of the people concerned.

The ANSN is always ready to share experience and to extend cooperation to pioneer other regional activities, and at the same time to ask for views and comments from them. The ANSN is now moving towards realizing the Virtual TSO by overcoming the challenges and expects to grow in collaboration with other networks.

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EXPERIENCE WITH THE EUROPEAN TSO NETWORK (ETSON) AS AN EXAMPLE OF A REGIONAL TSO NETWORK

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Abstract

Technical safety organizations (TSOs) have an important role in supporting the nuclear safety authorities in their safety review activities. It is important that TSOs have broad experience and capabilities in the field and that they have an important role in coordinating and performing research studies related to the development of capabilities needed in the evaluation of the safety performance of nuclear power plants or waste management facilities. In cases where a TSO provides services both to safety authorities and to a domestic or foreign licensee (utility or vendor), it has to do so in full transparency so that it is able to demonstrate that conflicts of interest are excluded. One important practical area of joint activities of the members of the European TSO Network (ETSON) is the preparation of joint safety assessment guidance documentation with the general aim of harmonizing and documenting the applied practices related to safety assessment within a number of specific fields. An important planned objective of ETSON is the provision of joint expert services by ETSON members to European and international organizations in the areas of nuclear safety, radiation protection, waste management, decommissioning and security. The members of ETSON and European safety authorities have experience in such types of activity, as they have actively cooperated in the nuclear safety assistance programmes of the European Union.

1. ROLES AND GENERAL OBJECTIVES OF A TECHNICAL AND SCIENTIFIC SAFETY ORGANIZATION

The provision of the necessary competence to the regulatory body differs from country to country. In some countries, it is organized such that the regulatory body itself disposes of the core competence, while further technical support is provided by other independent organizations. A different approach is the ‘external’ technical and scientific safety organization (TSO) model, in which the TSO is assigned to assist the regulatory body as an independent organization. In this model, both the TSO and the regulatory body must have in-depth knowledge and high level competence in the relevant areas of nuclear safety and related research activities in order to be able to respond adequately to the various regulatory requests and to define topics for research. Within this category of external TSOs there are two further options: the TSO can either serve only the safety authority or alternatively provide services to both the safety authority and the nuclear industry. In both these variants, the TSO in most cases has a central role in coordinating and carrying out extensive research related to nuclear safety. In the latter case, it is imperative to avoid conflicts of interest and to carefully consider that a specific activity on a particular subtopic cannot be performed for both parties. Especially in this approach, TSOs should follow two basic principles:

(1) The expert opinions of the TSO must be independent.
(2) If a TSO also provides services to a domestic or foreign licensee (utility or vendor), it has to do so in full transparency so that when providing services to a regulatory body it is able to demonstrate that conflicts of interest are excluded.

The first principle means that a TSO must be able to elaborate and express its technical assessment independently of any external interests, be they political or economic. They have to be absolutely resistant to any influences from the licensor or licensee. There should be a clear borderline between the technical assessment by the TSO and the legal evaluation by the regulator and the nuclear authority.

The members of the European TSO Network (ETSON), for instance, have defined such principles as an elementary basis of their work[1]. New candidates for ETSON membership will have to verify that they are willing and able to respect these principles. On the one hand, it is the purpose of such principles to enable the nuclear authorities and other organizations contracting a TSO or a consortium of TSOs to measure the performance of their contractors with these principles at hand. On the other hand, the TSOs offering their expertise can, in turn, base these ethical principles on a kind of self-assessment to ensure stringent compliance with them, and they can clearly demonstrate to the outside observer to which value charters they feel obligated.

2. BACKGROUND OF THE EUROPEAN TSO NETWORK

Two general background issues have been important for establishing ETSON:

[1] See STEINHAUER, H., “Roles, functions and values that guide TSOs”, in this volume.

(1) Closely related to the organization of the EUROSAFE conferences, the French, German and Belgian TSOs invited representatives from other European organizations (TSOs and safety authorities) to participate in the planning of these conferences and to perform joint tasks that provided benefits both to TSOs and to regulatory bodies.
(2) The three founding TSOs, together with other European TSOs and safety authorities, have actively cooperated in the nuclear safety assistance programmes of the European Union directed to the countries of eastern Europe and the former Soviet Union.

These two activities have created active collaborative links between the various parties.

3. ESTABLISHMENT OF THE EUROPEAN TSO NETWORK

Initially, the TSOs of France, Germany and Belgium started the preparations for establishing ETSON. During the preparations, three additional TSOs joined the network. The six founding members of the ETSON Association, officially established in August 2010, were:

— Institute for Radiological Protection and Nuclear Safety (IRSN);
— Gesellschaft für Anlagen- und Reaktorsicherheit mbH (GRS);
— Bel V, a subsidiary of Belgium’s Federal Agency for Nuclear Control;
— VTT Technical Research Centre of Finland;
— ÚJV Nuclear Research Institute;
— Lithuanian Energy Institute (LEI).

In Autumn 2010, the VUJE, a Slovakian engineering company that performs design, supply, implementation, research and training activities in the field of nuclear and conventional power generation, became a new ETSON member, and the State Scientific and Technical Centre for Nuclear and Radiation Safety (SSTC NRS) of Ukraine joined as an associated member of ETSON. There are a few additional candidates being considered for membership or associated membership of the Association.

4. OBJECTIVES AND CURRENT ACTIVITIES OF THE ETSON ASSOCIATION

The ETSON Association is a network of TSOs. A country's TSO supports the national licensing and supervisory authorities in all scientific and technical issues relating to the safety of nuclear power.

The ETSON Association has the following general objectives in its current and planned future activities:

- To form a suitable forum for voluntary exchange of analyses and R&D in the field of nuclear safety by sharing experience and exchanging technical and scientific opinions;
- To contribute to fostering the convergence of technical nuclear safety practices within the European Union and beyond;
- To further the planning of nuclear safety research programmes and facilitate their implementation;
- To facilitate the application of the European directive on nuclear safety;
- To work together on safety assessment and research projects funded separately and organized by the respective members in dedicated consortia.

The ongoing and planned future activities of the ETSON Association include the following joint activities:

- To promote the formation of a European scientific and technical network in the nuclear safety field;
- To foster dialogue between ETSON and European nuclear safety authorities as well as other European Union institutions, the IAEA and other international organizations;
- To support members with respect to safety expertise;
- To develop a strategy for European research programmes and to promote it to the member countries of the European Union, and to plan and implement practical joint activities within these programmes;
- To support the EUROSAFE junior staff programme and other similar programmes furthering management and transfer of knowledge.

In addition, ETSON proposes, decides on and launches new activities, especially activities related to the support of European and other nuclear regulators, to be realized under the members' responsibility with separate funding.

ETSON has set up a working group to identify the R&D activities needed and to feed these needs into national and international programmes[1], for example, by participating in the Sustainable Nuclear Energy Technology Platform of the European Commission. Certainly, TSOs contribute considerably to filling such knowledge gaps through their in-house research and by participating in domestic and international research programmes. Obviously, individual TSOs cannot cover the entire field of reactor safety and nuclear waste management research solely based on their own R&D activities. Therefore, it is highly important to join R&D alliances and networks that coordinate the research activities among their members and give reciprocal access to research results and data.

The partners of EUROSAFE and ETSON have launched two further education and training programmes: (1) the European Nuclear Safety Training and Tutoring Institute (ENSTTI), and (2) the ETSON Summer School. The aim of ENSTTI is to impart knowledge and competences from R&D, offering participants the possibility of on-the-job training (tutoring). The focus of the ETSON Summer School is mainly on giving young experts the opportunity to make the acquaintance of other junior scientists on a scientific as well as a social level.

5. EXAMPLES OF CURRENT ACTIVITIES OF ETSON AND EUROSAFE

EUROSAFE has organized annual forums since 1999. The general aim of these annual conferences is to contribute to fostering the convergence of technical nuclear safety practices in a broad European context. The conferences provide technical safety and research organizations, safety authorities, power utilities, the rest of the industry, international organizations and non-governmental organizations with a platform for the presentation of recent analyses and R&D in the field of nuclear safety. Furthermore, the conferences provide an opportunity to share experiences, exchange technical and scientific opinions, and debate key issues in the fields of nuclear safety and radiation protection. The theme of the Eurosafe Conference 2010 was “Innovation in Nuclear Safety and Security” from the point of view of different international organizations, utilities, authorities and European TSOs.

In addition to the annual international EUROSAFE forum, the EUROSAFE initiative publishes the technical journal EUROSAFE Tribune, which presents the contents of the EUROSAFE forum as well as topical articles by international contributors on specific focal issues. Furthermore, EUROSAFE has three

[1] See STEINHAUER, H., “Roles, functions and values that guide TSOs”, in this volume.

working groups for technical cooperation on Safety Assessment Guidelines, Research Needs and Knowledge Management. Technically and as regards content, the EUROSAFE Initiative is guided by the Programme Committee (EPC).

5.1. ETSON Expert Groups

In order to intensify the interaction between ETSON partners and to organize joint projects, expert groups in the main fields of competence of the ETSON partners have been established with the aim of:

- Exchanging information on safety analyses and R&D;
- Exchanging information on their technical nuclear safety practices and making proposals to harmonize them as far as practicable;
- Contributing to the definition of nuclear safety research programmes in defining research needs in their fields of expertise;
- Organizing cooperation teams for joint projects to respond quickly to specific requests on behalf of the project management of the network;
- Keeping each other informed about new developments in their fields of expertise and within their respective organization;
- Continuing work related to a Safety Assessment Guide with the aim of producing a comprehensive set of documents related to specific topics of the guide.

5.2. Safety Assessment Guide subgroup: Activity areas

One important practical area of joint activities between the ETSON partners is the preparation of joint safety assessment guidance documentation with the general aim of harmonizing and documenting the applied practices related to safety assessment within a number of specific fields. The ETSON partners have initiated activities to prepare this type of guidance in the following areas:

- Operating experience feedback, including incident and precursor analysis;
- Mechanical systems;
- Electrical systems;
- Severe accidents;
- Environmental qualification;
- Safety of fluid systems, including auxiliary systems;
- Human and organizational factors;
- Probabilistic safety assessment;
- Lifetime management;

— Thermohydraulic analyses (transients, accidents);
— Safety concepts, defence in depth;
— Core behaviour (operational and accident conditions).

6. ETSON SUPPORT SERVICES TO NATIONAL AND INTERNATIONAL ORGANIZATIONS

ETSON has established the Project Initiation Group (PING) to support the provision of joint expert services by ETSON members to European and international organizations in the areas of nuclear safety, radiation protection, waste management, decommissioning and security. The main objectives of ETSON PING are to:

— Establish a common project consortium agreement;
— Coordinate the acquisition and initiation of projects;
— Offer the ETSON resources to the market;
— Organize joint project teams;
— Support members with additional resources and coordination services;
— Initiate contract and project planning;
— Establish standard documents, procedures and processes (including lessons learned, best practices).

It is recommended to establish links between ETSON activities and other international networks, such as the Global Nuclear Safety and Security Network (GNSSN) of the IAEA.

7. CONCLUSION

European TSOs have comprehensive long term experience in cooperation on topics related to exchange of information and participation in joint projects. ETSON will reinforce the common activities between the partners of the network and will continue general cooperation regarding exchange of information and the harmonization of nuclear safety practices, for example, by preparing common safety assessment guidance. In addition, ETSON aims to provide joint expert services to European and international nuclear safety authorities and other organizations.

CONDUCTING EDUCATION, TRAINING AND RESEARCH IN A GLOBALIZED ENVIRONMENT[1]

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Presented by E. Kapralov

[1] Although a presentation was given, no abstract or paper was made available. The author’s PowerPoint presentation appears on the CD-ROM accompanying this book.

CLOSING SESSION

SUMMARY AND CONCLUSIONS OF THE CONFERENCE[1]

J. REPUSSARD
President of the Conference

BACKGROUND TO THE CONFERENCE

In 2007, the first International Conference on the Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety was held in Aix-en-Provence, France, with the objective of providing technical and scientific support organizations (TSOs) from different countries, and other organizations and experts, with an opportunity to discuss and develop a common understanding of the responsibilities, needs and opportunities of TSOs. At the Aix-en-Provence conference, senior regulators, heads of TSOs and other stakeholders concluded that a platform for networking between TSOs for the enhancement of nuclear safety and security was needed. Accordingly, a second International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security was held in Tokyo from 25 to 29 October 2010, with a focus on international cooperation and networking among TSOs to enhance nuclear safety and security, especially in terms of their role in the regulatory framework, including capacity building in those countries embarking on nuclear power programmes.

OBJECTIVES OF THE CONFERENCE

The objectives of this conference were to develop a common understanding of the responsibilities, needs and opportunities of TSOs, and to further promote international cooperation and networking among TSOs to enhance nuclear and radiation safety and nuclear security, including capacity building in countries with experience — extensive or limited — in nuclear power and in countries embarking on nuclear power programmes.

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[1] The views and recommendations expressed herein are those of the President of the Conference and the participants, and do not necessarily represent those of the IAEA.

In this context, the conference:

- Discussed the roles, functions and values of TSOs in enhancing nuclear and radiation safety, including capacity building in those countries launching or expanding their nuclear power programmes;
- Shared experience and good practices in planning and implementing cooperative activities for capacity building and in identifying needs for assistance from the standpoint of recipient countries;
- Discussed approaches to enhancing cooperation and effective networking among TSOs, including the establishment of a ‘virtual TSO’ and centres of excellence;
- Provided an overview of the technical and scientific support needed for maintaining a sustainable nuclear security system;
- Discussed mechanisms for provision of technical and scientific support for nuclear security and the development of human resources for carrying out related functions;
- Fostered dialogue, at the international level, on technical, scientific, organizational and legal aspects of technical and scientific support.

OPENING SESSION

Tadahiro Matsushita (Japan), Senior Vice Minister of Economy, Trade and Industry (METI), emphasized that current environmental and other issues have led to an increase in the number of countries considering enhancing their use of nuclear energy and in the number considering entering the nuclear energy arena for the first time. He stressed the importance of TSOs in helping to develop adequate infrastructure and in supporting regulatory bodies with scientific and technical advice. He encouraged the attendees to develop an even better international network to deepen their mutual understanding and further contribute to global nuclear safety and security. Finally, he pledged Japan’s continuing support to national and international nuclear safety and security efforts through development of knowledge, experience and technology.

Denis Flory (IAEA), Deputy Director General of the IAEA, detailed the conference objectives: to develop a common understanding of the TSOs’ responsibilities, needs and opportunities; to promote international cooperation and networking between TSOs; and to foster capacity building through the use of TSOs in countries embarking on nuclear power programmes, and in those with limited or extensive experience in nuclear power programmes. He also described the roles of TSOs and the challenges of carrying out these roles — for example, the need for existing TSOs and their networks to organize themselves to answer the crucial development needs of education, research and training systems in physics, chemistry and engineering; the significance of long term operation and the process for extension of operating licences, as well as the need for long term operation to be systematically addressed and integrated into all aspects of safety and security through science and research; the question of how to reduce the safety and security ‘gap’ of different nuclear power plant designs that coexist with different levels of safety and security features; and the need for improvement in the long term management of radioactive waste.

Nobuaki Terasaka (Japan), Director-General of the Nuclear and Industrial Safety Agency (NISA), underscored the human resource deficiency in nuclear power programmes and its direct influence on nuclear safety. Because of this, TSOs are increasingly expected to fill the gap. He encouraged the global network of TSOs to address these challenges together, to maximize competencies, reach common global goals, share knowledge and implement solutions.

André-Claude Lacoste (France), President of the French Nuclear Safety Authority (ASN), listed three ‘magic words’ relevant for TSOs — competence, expertise and research — and highlighted several key related questions: How does each country organize competence, expertise and research in its regulatory control system (at the national and international levels)? What is the best method of sharing information with the regulatory body? Should there be a merged TSO, or separate TSOs, or should the TSO be integrated into the regulatory body itself? How does the sharing of research and information work at the international level? Has international peer review of TSOs been considered as a possible way forward to enhance safety worldwide?

Katsuhiro Sogabe (Japan), President of the Japan Nuclear Energy Safety Organization (JNES), spoke of the speed of change and its effects on the international challenges facing TSOs: nuclear energy resurgence, nuclear energy emergence, globalization of the nuclear industry and the increased importance of nuclear security. All of these challenges require foresight by TSOs in applying a broader perspective to technology, to ascending to a higher level of safety and security, to improving capacity building and to globally harmonizing processes and standards. He further stressed that TSOs must support international technical cooperation with respect to risk reduction, human and organizational factors, and improvements in safety inspections, infrastructure building and safety regulation.

Jacques Repussard (France), President of the Conference and Director General of the Institute for Radiological Protection and Nuclear Safety (IRSN), emphasized that nuclear safety, radiation protection and nuclear security are not static, and that their constant evolution is dependent upon science and technology, progressing or regressing on the basis of economic and societal influences and fluctuations. The question arises of how research, training activities and scientific analysis of operating plants contribute to creating expertise that can be put at the service of the regulatory body. For this purpose, some countries have created a specific organization, the TSO, but there are other models. Each country must determine its own model. However, there is a common problem: safety is based on science, and every country should follow a ‘harmonized’ way to develop this knowledge and maintain it over time. This second TSO conference is an important endeavour to discuss these challenges internationally and to determine the way forward.

KEYNOTE PANEL

Panel discussion: Challenges in enhancing the Global Nuclear Safety and Security Framework. How can technical and scientific support contribute?

The panel discussion was preceded by the addresses of panel members from the Philippines, Japan, the United States of America and Belgium, and the international organizations WANO (World Association of Nuclear Operators) and ENSRA (European Nuclear Security Regulators Association). In the short presentations, the different perspectives of the speakers on the role of TSOs, the status of the various nuclear safety infrastructures and existing issues were outlined. The discussion emphasized the need to strengthen the role of TSOs and their global cooperation, particularly for countries in the process of expanding or embarking on a nuclear programme. Technical support in capacity building was offered by the main players worldwide. It was further emphasized that TSOs and regulatory authorities must maintain independent but complementary roles.

OVERVIEW OF TOPICAL ISSUE SESSIONS

Topical Issue 1: Roles, Functions and Values that Guide TSOs

This session was a follow-up of the discussions initiated at the first TSO conference in 2007 in Aix-en-Provence. The progress achieved since that time in developing a common understanding of the roles, responsibilities and key values and principles that guide TSOs was summarized. Six presentations were made, by speakers from Germany, the Republic of Korea, France, Canada, Australia and Indonesia. The session indicated the substantial progress made in providing adequate scientific and technical support to regulatory bodies.

Topical Issue 2: Technical and Scientific Support for Nuclear Safety Infrastructure Development and Capacity Building

The session presented the status and the challenges of capacity building and infrastructure development. A number of examples were provided, such as support to medical and industrial dosimetry and support during extended shutdown of research reactors. The challenges of both expanding an existing nuclear programme and establishing new nuclear safety infrastructure were discussed. Six presentations were made, by speakers from the United Arab Emirates, Vietnam, the Russian Federation, Brazil, Japan and the OECD Nuclear Energy Agency.

Topical Issue 3: The Emerging Need for Nuclear Security Technical and Scientific Support

This session included five presentations, by speakers from the United States of America, India, Morocco, Pakistan and France. In the presentations it was pointed out that security culture is essential to further develop nuclear security. There is a strong need for technical support in the field of nuclear security. New areas of work in this field must be covered with a high degree of competence. Questions on how to develop human and other resources were discussed, and the need for cooperative and integrated approaches was pointed out. There was a strong consensus on the need to fully take into account security issues, including the provision of scientific and technical expert advice to the regulatory body, so as to adequately balance security and safety requirements.

Topical Issue 4: Nuclear Safety and Nuclear Security Networking and Centres of Excellence

In this session, four presentations were made, by speakers from the IAEA, Japan, the European TSO Network (ETSON) association and the Russian Federation. The session started with a comprehensive review of the elements that constitute the Global Nuclear Safety and Security Framework. This was followed by the presentation of several examples of networks: regulatory networks such as the Asian Nuclear Safety Network (ANSN), networks of TSOs such as the ETSON association and educational networks. The discussion focused on the value of these networks in the sharing of safety and security knowledge, experience, lessons learned and culture, and it was emphasized that all such networks have to be oriented towards improving nuclear safety and security, following the principles set out in the IAEA safety standards and nuclear security guidance.

CLOSING SESSION

Panel discussion: Actions needed to move forward

As an introduction to the final panel discussion, five statements were provided, by panel members from China, Malaysia, the United States of America, Germany and the IAEA. The panel discussion focused on the development of concrete proposals to promote the role of TSOs as an essential part of the Global Nuclear Safety and Security Framework and to organize and foster information exchange and cooperation between TSOs.

CONCLUSIONS

1. Much progress has taken place in the field of TSO issues since the first TSO conference in France (2007), but there are also many ongoing challenges, particularly in Member States embarking on nuclear power development programmes.

In 2007, the first International Conference on the Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety was held in Aix-en-Provence, France, with a focus on providing TSOs from different countries, and other organizations and experts, with an opportunity to discuss and develop a common understanding of the responsibilities, needs and opportunities of TSOs. At the Aix-en-Provence conference, senior regulators, TSO leaders and other stakeholders concluded that a second conference dedicated to these issues was needed. Accordingly, a second International Conference on Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security was held in Tokyo from 25 to 29 October 2010, with a focus on international cooperative activities and networking among TSOs to enhance nuclear safety and security, especially in terms of the regulatory framework, including capacity building in those countries embarking on nuclear power programmes. The conference thanked the IAEA for organizing this important global event and the Government of Japan, in particular the Japanese Nuclear Energy Safety Organization (JNES), for hosting this important conference.

The conference recognized that the sustainable performance of a national nuclear safety regulatory system requires that three major functions be adequately resourced and organized:

— The first is the *regulatory body's authoritative function*, whose roles are mainly to propose nuclear safety policies, to elaborate regulations and to perform licensing operations, inspections, incident management and emergency preparedness.
— Because nuclear safety and security is largely science based, the regulatory body's authoritative function, in relation to nuclear facilities and other licensed activities involving radioactive substances, needs to have permanent access to a suitable *technical and scientific advisory expert function*.
— The continuous generation of this expertise, able to provide a competent and timely response to regulatory needs, requires in turn a *function dedicated to the development and maintenance of an appropriate knowledge base and associated tools* (e.g. calculation codes, databases, operating experience technical analysis, laboratories, simulators) *and services* (e.g. dosimetry, radiation monitoring, laboratory tests, competence certification). This development also implies the availability of *education and training services*, and a *close association with*, and whenever possible active participation in, *national and international R&D* efforts in the field of nuclear safety, including radiation protection, and in the field of nuclear security.

The two last functions (safety and security expertise analysis and knowledge base development) represent what is often referred to as '*technical support functions*'.

The conference recognized that it is up to each Member State to decide which type of organization is most suitable for carrying out these technical support functions, taking into consideration relevant national parameters, in particular with respect to the existing mechanisms to recruit staff and manage funding systems in governmental bodies. It was noted in this respect that:

— Some Member States have preferred a high level of integration, with all three key regulatory functions included into a single organization, while others have made the choice of creating a separate TSO, or procuring the required support services from existing TSOs, in other Member States if necessary.
— Integration has the advantage of resulting in a simpler organization model, while separation has the advantage of giving high visibility to science issues associated with nuclear safety and radiation protection, and to the values that must be observed throughout the expert analysis function: independence of judgement, competence and honesty, and a holistic approach. Several conference participants noted that this model may

facilitate communication with the public, particularly in those Member States in the process of developing a nuclear power programme, as well as properly taking into account public expectations in terms of protecting people, the environment and society as a whole. Similar considerations apply for scientific and technical issues related to nuclear security.

— The procurement of services from established TSOs may provide an appropriate intermediate approach in Member States where the ‘road map’ to the development of national competencies requires a rapid startup of technical assessment activities. However, in the longer term it is essential that appropriate national core competencies and capabilities be developed, including education and training.

There was a strong consensus on the need to *fully take into account security issues*, including at the scientific and technical expertise level of the regulatory system. This important issue was further developed in a specific topical session (see item 3 below).

There was general agreement that it is virtually impossible to include in the regulatory system (the regulatory authority and its technical support) all scientific resources and competencies needed for regulatory purposes. This is particularly true for those Member States that are at the beginning of their nuclear strategy implementation. Consequently, it is advisable to organize appropriate liaisons with universities and research bodies, and, as appropriate, with technology development centres, in order to benefit from available specialized expert knowledge. Instituting a TSO may, however, facilitate the necessary emergence of a general safety culture and the setting up of core nuclear safety and security scientific competencies within the national community, thus providing the regulatory body with indispensable information while ensuring its full independence: *the regulatory system must be independent, but not isolated.*

The explicit identification of TSO functions may facilitate the appropriation, at the national level, of the human, technical, organizational, institutional and financial resources needed to perform these key support functions, according to a development ‘road map’ that should ensure that the regulatory system evolves in accordance with the national nuclear development strategy, including safety and security infrastructure and capacity building.

In this context, the conference invited Member States to provide the IAEA with their further comments on the draft Safety Guide on External Expert Support on Safety Issues (DS429), in order to ensure that this important document takes full advantage of the outcome of the discussions that took place in Tokyo and is able to serve in the future as an appropriate basis for peer review mechanisms dedicated to TSO functions.

The explicit identification of TSO functions may also facilitate international and regional cooperation on scientific and technical matters by giving higher visibility to such matters. The conference took note of the progress made in the development of regional TSO networks and associations and of the availability of advanced professional training and tutoring capabilities open to all Member States. The IAEA was encouraged to reinforce the TSO networking capacity worldwide by providing, alongside the Regulatory Cooperation Forum, a forum for TSO issues where international and regional technical cooperation issues could be addressed.

The Tokyo TSO conference recognized the outstanding contribution of TSOs to the enhancement of nuclear safety and security worldwide, in particular, under the auspices the IAEA. In this respect, the conference reaffirmed the importance of TSOs and shared the following understandings concerning the *key values that should govern TSO activities*:

- In an effort to achieve a high level of global nuclear safety and security, TSOs, as key actors supporting regulatory bodies, should continue to play important roles in contributing to ensuring the safe and secure implementation of nuclear energy programmes and of related technologies.
- However, regulators must be fully responsible for their own judgements and decisions, even when these are based on work by TSOs. They should be able to analyse and make use of the work done by TSOs in support of their regulatory activities.[2]
- Taking into account that nuclear safety and security is science based and that science issues should be addressed in a streamlined way, TSOs provide a unique capability to maintain state of the art knowledge and facilities for safety and security assessment and to provide a comprehensive and holistic view of the safety and security issues at hand, through the aggregation of specialized expert findings.
- TSOs must maintain independence of judgement while also achieving the highest level of technical competence and transparency. Ensuring effective independence requires the implementation of adequate instruments that avoid potential conflicts of interest, and the availability of adequate financial and human resources.
- International cooperation among TSOs for sharing information, experience, lessons learned and good practices is essential not only to improve their

[2] See JACZKO, G.B., "Summary and conclusions of the conference", Effective Regulatory Systems for Further Enhancing Global Nuclear Safety and Security Regime (Proc. Int. Conf. Cape Town, 2009), IAEA, Vienna (2010).

ability to provide the services (e.g. assessment, training, expertise, peer reviews, advisory services) but also to strengthen regional and global forums and knowledge networks in support of harmonization of nuclear safety and security practices at the highest level of performance. In this respect, TSOs have an important role in supporting the IAEA in its mission, especially in promoting the use of its safety standards and security guidance, and its services in support of newcomer States for capacity building and infrastructure development.

— TSOs contribute to public outreach by providing information to the stakeholders concerned, to the media and to the public in general.

2. *It is essential to continue the ongoing efforts to improve and optimize the technical capabilities needed worldwide in order to adequately support nuclear safety and security supervision.*

The conference recognized that effective nuclear safety and security supervision in *a global perspective* requires access to excellent and state of the art risk assessment capabilities, which should be continuously developed by relying on the following sources, in a cooperative multinational manner wherever possible:

— *Scientific risk oriented research,* an essential prerequisite for the success of defence in depth in terms of safety and operational expertise capacity, which is derived from it. For nuclear security, the equivalent prerequisite is an updated design basis threat.
— Relevant *operating experience analysis.*
— *Professional educational and training courses* and e-learning at a national, regional or international level.
— *Knowledge management*, dissemination and transfer to new generations of experts.

There was a widely shared concern that, from a quantitative point of view, the currently available TSO resources are insufficient to address all needs. The conference noted that such needs are not only generated by launched or planned new build programmes; TSO capability is also required for the effective *management of long term operation of existing nuclear power plants (NPPs)* and research reactors, and of decomissioning and waste management programmes. The *rapid expansion of the use of ionizing radiation technologies for medical purposes,* as well as in non-nuclear industries, also requires a strengthening of technical capabilities and associated services (e.g. dosimetry, reference analytical laboratories, radioactive source traceability systems) to correctly assess radiological risks and ensure their appropriate management.

The conference pointed out that access to existing expert resources could be improved and optimized in several ways:

- Improvement of mechanisms for *international coordination and collaboration*, as well as information and knowledge sharing among TSOs, for example, by further developing *cooperative e-services* between TSOs.
- Better identification of the breadth of existing TSO capabilities, including in the field of *capacity building*.
- Development of cooperation with those *Member States embarking on nuclear power programmes* and/or expanding their nuclear power programmes.
- *Enhanced support from government and industry to research in relation to nuclear safety and security at nuclear facilities*. Such initiatives would promote innovative and competitive research in the nuclear energy field, with a focus on safety and security related issues.

3. There is an emerging need for nuclear security scientific and technical support.

The conference illustrated the strong international consensus on the need to address nuclear security challenges with a holistic and synergetic approach, taking into consideration technical, organizational and cultural aspects. It was recognized that nuclear security is a broad field of interest to stakeholders outside of established nuclear facilities (and locations) and the competent nuclear regulator.

Advanced expertise and analysis capability is indispensable for establishing nuclear security guidelines, for nuclear and other radioactive materials, for nuclear facilities and for the expanded reach to security of radioactive materials outside of regulatory control. New and advanced expertise would be required in a broad perspective and for effectively assessing operators' technological and organizational response to current threats, some of them involving new challenges, as for example cybercrime.

Security optimization of nuclear installations requires that it be taken into account from the *design stage*. It was recognized that engineering measures have the potential to eliminate or reduce vulnerabilities. It was also recognized that processes for assessing the need for physical protection of materials or equipment should take into account the assessment processes used to oversee safety, to ensure that nuclear safety and security are mutually enforcing and without contradictions.

The broader range of stakeholders that have responsibilities for nuclear security may require specific coordination arrangements, such as a federation of organizations.

Several positive examples were presented of the necessity to introduce and implement a nuclear security culture. It was also recognized that benefits are achieved through close *interaction between the competent law enforcement and national security agencies with the specialized nuclear safety and security expertise required for regulatory assessment* of nuclear installation projects.

Safety and security training, and applied tutoring programmes, including tabletop or in situ exercises, should be organized with the support of the IAEA where necessary. The possibilities of joint training events were identified as a way to bring together the safety and security technical communities.

There was consensus on the idea that *there is in all Member States a growing need for a broad range of TSO capabilities in the field of security*, and that the *development of such capabilities should be a key security policy objective at the national level*. It was noted that the *development of research activities* in this field was an effective way to develop such broad expertise. It was further reaffirmed that *confidentiality issues were not an obstacle to technical cooperation in this field, provided that this cooperation was centred on generic and theoretical security assessment methods and analysis techniques.* Thereby, sensitive, system specific information would be kept separate, outside the scope of the research project.

The usefulness of extending such cooperation to non-nuclear security fields was also pointed out as a good way to enrich and optimize nuclear security response assessment capability.

4. Governments have a unique responsibility in the definition and implementation of TSO capability policies.

The conference underlined the essential role of competent governmental institutions, in the current context of development of nuclear energy applications, to ensure that adequate and timely measures are adopted in order to strengthen and maintain TSO capabilities in the light of national needs. The conference recalled that in addition to their many beneficial uses, nuclear and radiation technologies may constitute a source of significant risk to people, the environment and society as a whole, which must be minimized worldwide to levels as low as technically achievable. The conference pointed out that this challenge requires the implementation of public policies aimed at ensuring the adequate availability of:

— *State of the art science based knowledge and tools* to analyse nuclear safety and security issues, which are prerequisite elements for assessing in depth nuclear safety and security at nuclear installations.
— *Qualified and appropriately trained personnel*, which are needed by both the nuclear industry and the regulatory system. However, it should be noted that the industry's focus is on technology development, including safety, and on economic performance, while the regulatory system's focus is on optimal and independent risk assessment capability.
— *Adequate levels of financial resources dedicated to nuclear safety and nuclear security — in particular, funding plans for new build programmes — should include from the start the coverage of costs associated with technical support needs in the context of licensing and regulatory supervision processes.*

The choice of the most suitable organization for technical support functions is a national responsibility, to be exercised in line with the prescriptions and recommendations of the IAEA Fundamental Safety Principles, the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and other relevant international instruments.

The conference noted in this respect that beyond the requirement to ensure a clear separation between the regulatory body, on the one hand, and the organizations in charge of the promotion and operation of nuclear activities, on the other, there is a need to ensure that safety, security and radiation protection knowledge and best practice are made available to operators, who are primarily responsible for ensuring safety and security in their installations: *the regulator and the operator both require adequate scientific and technical support. It was noted that the institution of a separate TSO serving both needs, under the condition that it is appropriately resourced and operates in full transparency to the regulatory body, and with an internal organizational structure ensuring effective avoidance of conflicts of interest, was an acceptable solution where national resources are limited.*

Finally, there was a consensus on the *need for TSOs*, whatever their mode of organization at the national level, to *maintain close scientific connections with the research and academic world, as well as with industry and other stakeholders, so as to be able to provide at all times state of the art technical support*, not only in terms of personal competence of experts, but also with respect to assessment tools, such as advanced computational codes.

5. *TSO needs are particularly crucial for countries engaged in nuclear energy programmes.*

In particular, the conference pointed out that one of the main challenges for countries embarking on nuclear power programmes is to develop their own capacity building strategy, plans and practical organization, especially for safety and security regulation, as part of their national responsibility and in compliance with IAEA Fundamental Safety Principles 1 (responsibility for safety) and 2 (the role of government). In this respect, the conference reaffirmed the crucial importance of the availability of adequate technical and scientific support. To this end and to allow those countries to benefit from existing capabilities worldwide, it is important that the relevant capability requirements be identified from the outset of the nuclear energy strategy development, including the associated costs and funding mechanisms.

The conference considered that the goal of achieving high levels of nuclear safety and security worldwide, especially given the perspective of a larger number of countries using nuclear energy, calls for more concerted efforts from all stakeholders to develop and maintain the knowledge base and to make it readily available. This further calls for a significant worldwide increase in the capacity of high level experts to be able to implement this knowledge in effective regulatory activities. *The conference noted in this context that it is essential that the international community facilitate the necessary capability building process in those countries, in particular through knowledge and experience transfer.* This concept includes not only human resources development, education and training, but also organizational, technical (e.g. laboratories, calculation codes, probabilistic studies), institutional and legal frameworks for the development of TSO functions.

6. *The IAEA should continue to be a strong driving force for the development of TSO capabilities.*

The conference agreed that the IAEA should continue to play a central role in facilitating the emergence of consensus on safety, security, public health and environmental issues by developing *comprehensive standards and guidance documents within the Global Nuclear Safety and Security Framework. It was noted in this respect that such developments require sustained input by high level experts from the Member States.*

The IAEA should also encourage the further development of *networking between TSOs worldwide,* as a key element to facilitate effective and sustainable capacity building and infrastructure development for new and expanding nuclear power programmes. It was agreed that the form that a ‘TSO network’ can take depends on the context within which it is created. For instance, ETSON reflects the high degree of maturity of the European nuclear power programmes, while ANSN strives to meet the needs of all the new entrants in the Asian region. It was also recognized that the value of these networks is in the sharing of safety and security knowledge, experience and culture, and they are oriented towards improving nuclear safety and security following principles set out by the IAEA safety standards and security guidance.

Regarding knowledge transfer, the conference noted the initiatives that were taken by TSO networks to organize and increase the training and tutoring possibilities and to respond to today’s pressing demand in this field. It was emphasized that the quality of training in safety and security assessment depends upon the practical expertise of the trainers. In this respect, TSOs are well positioned. The conference recommended to the IAEA that a systematic mapping of the current training and tutoring services be initiated in order to better guide Member States in following their specific needs.

The IAEA should facilitate the access of safety and security authorities in all Member States to the state of the art expertise services provided by TSOs, particularly for the benefit of countries that are currently embarking on nuclear power development, by *supporting the establishment of IAEA designated TSO centres of excellence*, which could contribute to supporting the efforts of countries that intend to create and develop their own TSO activities.

7. The Tokyo TSO conference proposes five main recommendations.

Recommendation No. 1: The draft IAEA Safety Guide on External Expert Support on Safety Issues (DS 429) should be completed, approved and published as soon as possible, taking into account comments by Member States on the available draft, particularly in the light of the conclusions of the Tokyo TSO conference. This guide will provide a framework for the roles of TSOs in ensuring nuclear safety and its interface with nuclear security. It will also provide the basis for peer review and other IAEA generated review services, to be developed subsequently, and allow for an objective evaluation of the performance of TSO functions and the formulation of recommendations for their further improvement.

Recommendation No. 2: The IAEA should initiate plans for a third international TSO conference, to be held in 2013–2014. In this respect, the conference welcomed the proposal of China to host this next conference.

Recommendation No. 3: The IAEA should foster the establishment of a forum dedicated to nuclear safety infrastructure development issues related to scientific and technical support. Such a ‘TSO Forum’ would meet regularly in between the international TSO conferences, establish close working relations with the Regulatory Cooperation Forum, and operate in conjunction with established regional TSO cooperation structures as well as with the OECD Nuclear Energy Agency’s Committee on the Safety of Nuclear Installations on science related issues. This TSO Forum would, inter alia, address the following:

— *Achieving scientific excellence,* particularly through cooperative research projects, shared experimental facilities and knowledge, jointly developed key analysis tools (e.g. computer codes) and cooperative training programmes.
— *Addressing from a science based point of view the technical expertise requirements associated with important issues related to nuclear safety and security at nuclear facilities, such as the assessment of safety in Generation III NPPs,* ageing of existing NPPs, decommissioning of facilities, low dose exposure effects and increases in medical exposures of patients.
— *Facilitating the open international availability of state of the art expertise* in the fields of nuclear safety and security, and radiation protection and radiological emergency response. Similar rosters of experts should be established in the nuclear security field.
— *Contributing to the worldwide harmonization of nuclear safety practices* (in particular for the safety management of research reactors and for carrying out nuclear safety assessments) on the basis of the highest standards. Similarly, practices should be established to ensure that measures for nuclear safety are implemented in harmony with those for nuclear security and that these measures do not contradict each other.
— *Fostering the reciprocal provision of some services by TSOs, in particular in the fields of professional training, assessment, research and peer review.*

Recommendation No. 4: The IAEA, as well as other parties concerned, should promote the principal findings and outcomes of this conference on the occasion of major international nuclear safety meetings, such as the IAEA General Conference in 2011, the next International Conference on Effective Nuclear Regulatory Effectiveness Systems, meetings of senior regulators, and key national or regional nuclear safety and security events such as the forthcoming US Nuclear Regulatory Commission Regulatory Information Conference (RIC), EUROSAFE and EU European Nuclear Regulators Group (ENSREG) nuclear safety conferences.

Recommendation No. 5: Considering the increasing importance of the interdependence of nuclear safety and security in the light of emerging threats, including cybersecurity issues, the conference recommended that, as appropriate, TSO functions be extended to providing technical support to competent authorities in the field of nuclear security, in order to achieve greater safety and security synergy.

PRESIDENT OF THE CONFERENCE

J. REPUSSARD	France

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