Effective Nuclear Regulatory Systems

Facing Safety and Security Challenges

Proceedings of an International Conference, Moscow, 27 February – 3 March 2006

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EFFECTIVE NUCLEAR REGULATORY SYSTEMS: FACING SAFETY AND SECURITY CHALLENGES

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PROCEEDINGS SERIES

EFFECTIVE NUCLEAR REGULATORY SYSTEMS: FACING SAFETY AND SECURITY CHALLENGES

PROCEEDINGS OF AN INTERNATIONAL CONFERENCE ON
EFFECTIVE NUCLEAR REGULATORY SYSTEMS:
FACING SAFETY AND SECURITY CHALLENGES
ORGANIZED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY,
HOSTED BY THE GOVERNMENT OF THE
RUSSIAN FEDERATION
AND HELD IN MOSCOW, 27 FEBRUARY–3 MARCH 2006

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2006

Sales and Promotion Unit, Publishing Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
A-1400 Vienna
Austria
fax: +43 1 2600 29302
tel.: +43 1 2600 22417
http://www.iaea.org/books

Printed by the IAEA in Austria
September 2006
STI/PUB/1272

IAEA Library Cataloguing in Publication Data

International Conference on Effective Nuclear Regulatory Systems : Facing Safety and Security Challenges (2006 : Moscow, Russian Federation)

Effective nuclear regulatory systems : facing safety and security challenges : proceedings of an International Conference on Effective Nuclear Regulatory Systems : Facing Safety and Security Challenges / organized by the International Atomic Energy Agency, hosted by the Government of the Russian Federation and held in Moscow, 27 February – 3 March 2006. — Vienna : The Agency, 2006.

p. ; 24 cm. + 1 CD-ROM. — (Proceedings series, ISSN 0074–1884)
STI/PUB/1272
ISBN 92–0–110606–8
Includes bibliographical references.

1. Nuclear facilities — Safety regulations — Congresses. 2. Nuclear facilities — Security measures — Congresses. I. International Atomic Energy Agency. II. Title. III. Series. Proceedings series (International Atomic Energy Agency).

IAEAL 06–00455

FOREWORD

Over the past 16 years, the IAEA has conducted a series of major conferences that have addressed topical issues and strategies critical to nuclear safety, for consideration by the world's nuclear regulators. This series was initiated in 1991 with the International Conference on the Safety of Nuclear Power: Strategy for the Future. The conference marked the beginning of a global safety regime based on international conventions and legal instruments that was supported by a set of nuclear and radiation safety standards and related review services. The very successful Convention on Nuclear Safety (CNS) resulted from this effort and now has 56 Contracting Parties.

Currently, regulatory authorities and the nuclear industry are facing significant new challenges, which require new strategies and oversight. The key challenges are the result of the following factors:

- Renewed global interest in the use of nuclear energy for electricity generation and, consequently, its likely expansion;
- Increased threats to the security of nuclear installations and the need to link closely security and safety issues and response capabilities;
- Increased global use of radioactive materials and the need to ensure their safety and security, similar to the issues faced with the use of nuclear energy;
- New safety and security challenges from existing nuclear facilities associated with ageing and extensions of their operating lifetimes.

To address these challenges, the International Conference on Effective Nuclear Regulatory Systems: Facing Safety and Security Challenges, was held in Moscow, Russian Federation, from 27 February to 3 March 2006.

The IAEA invited global leaders to this conference, including both government regulators and industry representatives, to share their perspectives and experience in addressing these challenges that transcend national boundaries. Participants were asked to make their contributions in the context of global safety and security standards and methods by which a common vision can be achieved. The aim of this conference was to enhance the global vision and commitments among the senior regulators to promote experience sharing and international cooperation, thereby continuously improving nuclear safety and security worldwide.

On the basis of the presentations and subsequent discussions, the President of the Conference developed issues for consideration by governments and regulatory bodies, issues for future international cooperation and conference conclusions.

This publication constitutes a record of the conference and includes: a summary; the opening and closing speeches; the invited papers and the President's summary. A CD-ROM, which is attached to the back of this publication, contains the unedited contributed papers to the conference and the slides that were submitted with some of the invited papers.

The IAEA gratefully acknowledges the support and generous hospitality of the Government of the Russian Federation.

EDITORIAL NOTE

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SUMMARY

The conference resulted from a meeting between IAEA Director General M. ElBaradei, Nuclear Regulatory Commission Chairperson N. Diaz, and Deputy Head and then acting Chairperson of Rostechnadzor A. Malyshev. This meeting recognized that other forums in which regulators collaborated were often constrained by time, membership or subject matter and there was a need for regulators to have their own conference to focus on regulatory matters.

The objective of the conference was to give senior regulators the opportunity to discuss ways of improving the effectiveness of nuclear safety, radiation safety and security regulation as a whole for the benefit of the global community.

This conference was the first of a kind because it brought together senior regulators of nuclear safety, radiation safety and security, from around the world to discuss how to improve regulatory effectiveness and hence the protection of the public and the users of nuclear and radioactive materials. The President of the Conference was L. Williams, the Director for Safety and Security at the Nuclear Decommissioning Authority in the United Kingdom. A total of 216 participants from 57 countries, 6 organizations and 7 observers participated in the conference. There were also 75 press representatives to cover the conference.

The conference programme consisted of an opening session, four topical sessions which were devoted to Independence and Regulatory Effectiveness, Regulatory Safety Challenges, Regulatory Security Challenges and Enhanced International Regulatory Cooperation, and a concluding panel on Safety and Security Outlook: Global Visions and Commitments for the Future. There were also keynote presentations representing the view from the perspective of both the regulators and the operators.

In the opening session, there were two keynote presentations from the regulatory perspective to set the scene for the conference. In the first keynote presentation, N. Diaz noted that regulation is done for the well-being of people for the common good with full consideration of national interests and international law. In the second keynote presentation, A. Malyshev noted that safety and security were mandatory for the use of nuclear energy for peaceful purposes. He reported that major achievements had been accomplished in nuclear safety regulation in the Russian Federation, including the implementation of effective control and supervision in the field of nuclear energy. He concluded that the world community should prepare global answers to the global challenges.

The first topical session, Independence and Regulatory Effectiveness, focused on the key elements needed to deliver effective regulation of nuclear safety and security so that government can be assured that nuclear energy and associated technologies can be used safely, that society can have confidence and trust in the regulator and that the nuclear industry can be assured that it is being regulated competently and fairly. The second topical session, Regulatory Safety Challenges, identified some of the key challenges in nuclear safety and radiation protection and then discussed how effective nuclear regulatory systems will meet these challenges. The third topical session, Regulatory Security Challenges, looked at how the regulation of nuclear security could be made more effective in the light of the challenges from the changed international security situation. The fourth topical session, Enhanced International Regulatory Cooperation, addressed the need for international cooperation to enhance the effectiveness of safety and security regulation.

The closing session provided an opportunity for two eminent representatives of the nuclear industry, in their keynote presentations, to comment on regulatory effectiveness from the operators' perspective. From these presentations, the conference noted the following industry viewpoints:

- Nuclear safety is a prerequisite for sustainable development and the industry needs effective nuclear safety and security regulation.
- The regulatory body needs to be independent from both operators and politics. The regulatory body needs to have effective communication with all its stakeholders and command the confidence and respect of the public.
- Regulatory credibility is essential and the regulatory body needs to have a broad range of skills and experience so that it can understand the technology it is regulating.
- International regulatory consistency, especially in relation to the global use of nuclear reactors for electricity generation, is desirable.
- Regulatory effectiveness should be given the same rigorous review and attention as that required of the industry.

The concluding panel on Safety and Security Outlook: Global Visions and Commitments for the Future addressed a question posed by the conference president, namely, "What would you do to improve the regulation of nuclear safety and security?" The following are some of the significant points emerging from the discussion:

- Although costly in terms of time and effort, international relationships in the regulatory field are an essential means of moving forward. Regulatory bodies should actively encourage the exchange of staff to share knowledge and experience.

- This conference represents the kind of dedicated forum in contrast to marginal meetings at other events that can have a major impact on nuclear regulation and should be regularized.
- The interrelated elements of accountability and communications are key elements of successful regulation. They should be identified at all interfaces and levels of interaction between regulators, operators and other stakeholders.
- Nuclear safety regulation has both technical and political aspects. State regulation of nuclear activities and practices requires that nuclear safety and security issues receive attention at the highest political level in countries using nuclear technology.
- Attention is needed by regulators in all Member States to the essential functions of standard-setting, licensing, inspection and enforcement.
- IAEA standards documents are extremely valuable to guide national regulatory activities. However, they need to be continually updated to reflect new developments.
- Cooperation at the regional level is of great value and regulators should meet to discuss regional cooperation every 2–3 years,
- At the national level, nuclear regulators need to address continual improvement and quality management and measures to avoid complacency. Sharing of experience and training of a new generation of regulators is needed in view of the retirement of many experienced personnel. On the international level, partnerships of nuclear regulators and harmonization of legal and regulatory regimes need to be pursued.

The conference identified several issues for consideration by governments, issues for consideration by the regulatory bodies, and issues for future international cooperation and made some recommendations. The conference also drew several conclusions.

The conference concluded that the delivery of effective nuclear safety and security regulation is vital to the safe and secure use of nuclear energy and associated technologies both now and in the future and is an essential prerequisite for the achievement of global energy security and global sustainable development.

Regulators work for the benefit of the society and therefore they play a vital role. To be effective they must be independent and free to make regulatory decisions solely in relation to the need to maintain safety and security, without pressure from those who are responsible for the promotion of the use of nuclear energy and associated technologies, or those who are opposed to its use.

Regulators must be competent and have adequate resources to accomplish their mission, which is to ensure the protection of the public and the environment, and to assure the government and the public that their nuclear industry is safe. The safety and security of nuclear facilities and nuclear and radioactive materials requires effective coordination of safety and security regulation.

The conference reiterated the importance of continued and improved international cooperation to develop comprehensive international standards for safety and guidance for security. The conference also stressed the importance of wider participation and fuller implementation of the international instruments such as conventions and codes of conduct. Continued international cooperation to promote good practices in nuclear safety and security was seen as being essential for the delivery of effective regulation and continuous improvement of the regulatory bodies.

The conference noted the value that would be obtained from conveying IAEA standards to the regulatory design review and safety goals of new reactors.

The conference valued this forum and agreed that the head regulators should meet again within three years to review the progress made based on the findings of this conference and identify new emerging regulatory challenges.

OPENING SESSION

OPENING ADDRESS

M. Fradkov
Prime Minister,
Government of the Russian Federation,
Moscow, Russian Federation

Presented by K. Pulikovsky

On behalf of the Government of the Russian Federation let me welcome the participants to the International Atomic Energy Agency Conference on Effective Nuclear Regulatory Systems — Safety and Security Challenges.

Recent global developments resulted in the fact that the issue of ensuring the safety and security of energy supplies would become one of the main issues to be addressed by the G8 within its framework during the presidency of the Russian Federation. Atomic energy can, and should play an important role in the provision of energy for sustainable development of mankind and global environmental enhancement. For its successful deployment, it is necessary to assure a high level of nuclear and environmental safety.

The anticipated high tempo of atomic energy development in a number of countries and a global expansion in the construction of nuclear power plants define the need for stringent requirements related to nuclear and radiation safety regulation and dictate the necessity of strengthening international cooperation in this field.

Atomic energy should be used for the benefit of the global population with the assurance of the required level of nuclear and radiation safety and hence, Russia is supporting the enhancement of the effectiveness of national and international nuclear regulatory systems. In this regard, it is noteworthy that this IAEA conference dedicated to the challenges of nuclear and radiation safety regulation is being held in Moscow.

Russia is a country that has extensively been using atomic energy for peaceful purposes for more than 50 years. We are grateful to the IAEA and our foreign colleagues for the assistance rendered in the improvement of nuclear safety regulation and ensuring physical security of nuclear facilities, as well as in developing the normative basis for the regulation of nuclear facilities, taking into account international experience.

I wish you success in the work of the Conference.

OPENING ADDRESS

INDEPENDENT OVERSIGHT: THE CHALLENGES OF EFFECTIVE NUCLEAR REGULATION

M. ElBaradei
Director General,
International Atomic Energy Agency,
Vienna

Presented by T. Taniguchi

On behalf of the International Atomic Energy Agency I would like to welcome you to Moscow to the International Conference on Effective Nuclear Regulatory Systems. I would like to thank the Russian Federation, and in particular Rostechnadzor, for hosting the conference.

This conference is the result of a meeting I had at the IAEA General Conference in 2004 with Chairman Diaz of the United States Nuclear Regulatory Commission and then Acting Chairman Malyshev of Rostechnadzor. The discussion revolved around the fact that other forums in which regulators collaborated were often constrained by time, membership or subject matter. Nuclear regulators needed a conference of their own, where they set the agenda and the work focused on regulatory matters. And so here we are.

Last October, when the Norwegian Nobel Committee surprised and honoured all of us at the IAEA with its 2005 Peace Prize announcement, I took careful note that the Committee's citation included a recognition of the IAEA's efforts "to ensure that nuclear energy for peaceful purposes is used in the safest possible way". The Committee also emphasized that the achievement of world peace would not hinge purely on effective safeguards, but would also be the result of a global sharing of common visions and objectives. It is in that context that I would like to couch my remarks today.

THE GLOBAL NUCLEAR SAFETY AND SECURITY REGIME

The origins of the global safety regime can be traced back to the aftermath of the 1986 Chernobyl accident, when worldwide consensus emerged on two points related to nuclear safety: first, the need for effective international cooperation; and second, the need to effectively separate nuclear power development from nuclear safety oversight functions.

At the IAEA, this led to a sweeping re-evaluation of its role in international nuclear safety cooperation, and a sustained effort to assist Member States in upgrading their safety programmes on all fronts. Ultimately, this reform led to the creation of the Department of Nuclear Safety in 1996, and the recognition of safety — encompassing nuclear facility safety, radiation safety, transport safety and waste safety — as one of the three pillars of the IAEA.

During the following year, legally binding safety instruments were developed including the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel and Radioactive Waste, and the Early Notification and Assistance Conventions. In the years since, the implementation of these instruments has been notable. Most recently, two non-binding Codes of Conduct have been developed, one on the Safety and Security of Radioactive Sources, and the other on the Safety of Research Reactors.

In a similar way, the development of a global security regime was triggered by the tragic events of 11 September 2001, and successive terrorist events in Europe and Asia. These events gave rise to sweeping reviews of security measures in many fields, including the nuclear industry. The results were seen in a commendable worldwide effort to upgrade national and international nuclear security measures. They were also seen in United Nations Security Council resolutions, the Convention on Nuclear Terrorism and, more recently, the strengthening of the Convention on the Physical Protection of Nuclear Materials.

Today, many of the principal elements of a global nuclear safety and security regime are in place: namely, the international instruments, the body of international safety standards and security guidelines, strong governmental and legal infrastructures, and the strong interest in knowledge management and sharing through growing nuclear safety networks.

THE CHALLENGES FACING NUCLEAR REGULATORS

Most of our international conferences cover one particular industry or a given aspect of nuclear technology. This conference is different. The topic of "Effective Nuclear Regulatory Systems" cuts across all technical areas.

Being a regulator has always been tough. You are given the considerable responsibility of deciding whether someone else is competent and responsible enough to use radioactivity safely. You must oversee an industry that often has much greater resources than you have. Your power is defined by the laws that created your organization, and you must operate within the bounds of these laws. You need enough technical expertise, comparable to that of your licensees, in order to effectively exercise your authority. And as a regulatory body, you must be an exemplary corporate citizen, complying not only with nuclear laws and regulations, but also with the many other legalities that apply to government entities. Even the most independent of regulators must answer to its government in at least some respects.

And although nuclear safety is clearly the responsibility of the operator of the facility and the user of the technology, in the case of a serious accident, there will always be questions about what the regulatory body was doing, or not doing. During any subsequent inquiry, the regulatory body will surely be asked some tough questions.

Standard designs exist for nuclear power plants, research reactors, radiotherapy units and security fences, but every regulatory body has a unique design, based on national laws and the industry it must regulate. Some only regulate nuclear installations. Some must regulate all uses of ionizing radiation, or even non-ionizing radiation. Some share regulatory responsibilities with other organizations. And no two regulatory bodies have the same enforcement tools at their disposal.

But regulatory bodies also share many commonalities — and it is these common challenges and objectives that bring us together here for the next three days. Around the world, civil society and the public at large are increasingly recognized as important stakeholders in the work of the regulatory body. They demand openness, transparency and input in how the regulatory body makes its decisions.

Nuclear regulators have, to a certain extent, had to consider the security implications of the activities they regulate. But today, the security of nuclear installations and radioactive sources is very much in the forefront. Many regulatory bodies are now taking on the difficult challenge of reconciling safety and security requirements. For the first time at an international conference, the regulation of nuclear safety, radiation safety, and nuclear and radiological security are being discussed as a whole.

The next few years will be particularly challenging for regulatory bodies. High-level waste storage and disposal, life extension of existing nuclear facilities, the increasing interest in new nuclear construction, and the ever expanding medical uses of radiation will keep you fully occupied.

And it will be difficult for you to operate in isolation. Your performance and modes of operation may be compared with those of regulatory bodies in neighbouring countries. Increasingly, you will be held to account for your decisions, not just by your parliament or elected officials, but by citizens and other stakeholders. You must always be on guard to defend against complacency. And you will have to do this even though key staff are retiring and moving on; succession planning is a concern not only for the nuclear workforce, but also for nuclear regulators.

GOALS FOR THIS NUCLEAR REGULATORS' CONFERENCE

Much discussion has already taken place concerning the challenges facing regulators and the activities you regulate. It is my hope that this conference will take things to the next level.

I would hope this conference could identify key success factors that apply to all regulatory bodies. What tangible steps can regulatory bodies take towards achieving these key success factors? What can we in the IAEA do to help? Are we learning everything we can from our colleagues that regulate other industries that demand high reliability — such as the aviation and space industries?

What else should we look to achieve at this conference? First, I would hope that the participants would work to articulate the clear link between effective nuclear regulation and safe, secure and efficient use of nuclear energy. Second, I would hope that practical recommendations could be made to national governments, regarding: the nature of legislation needed to create and empower their nuclear regulatory bodies, the resources these regulatory bodies need to be effective, and the key components of an effective nuclear regulatory system. Third, I would hope that participants at this conference would reiterate the international commitment to the global nuclear safety and security regime — by, inter alia, supporting the implementation of the Conventions and Codes of Conduct, and the application of IAEA safety standards and security guidelines as the international reference point for the high level of safety and security required in the nuclear field.

CONCLUSION

It is a truism that every operator and user of nuclear and radiological facilities and materials has the responsibility to conduct these activities in a safe and secure manner. It is equally true that national governments bear the responsibility for overseeing these activities in a manner that reinforces those safety and security measures.

The concept of a global nuclear safety and security regime goes further. It recognizes that, just as the safety and security risks inherent in these activities extend beyond facility fences and national borders, so too our nuclear safety and security strategies must incorporate international cooperation, assistance, standard setting, and information networking. We must learn from each other, and we must continually stimulate each other towards greater effectiveness. In short, we must build a global nuclear safety and security culture. Ultimately, our success will only be as strong as our weakest link.

Your programme committee has worked hard to come up with a useful agenda, and I would like to thank them for this. I also thank Laurence Williams, Director of Nuclear Safety and Security for the United Kingdom Nuclear Decommissioning Authority, for agreeing to be the President of the Conference. His former experience as Her Majesty's Chief Inspector at the UK Nuclear Installation Inspectorate and as chair of the IAEA's Commission on Safety Standards will be of immense help during your deliberations.

I wish you all a successful conference.

OPENING ADDRESS

I. Kamenskih
Rosatom,
Moscow, Russian Federation

Achieving a sustainable and vigorous economic development and energy security in any country or region of the world can be possible only with an adequate supply of safe and clean source of electricity. It is becoming increasingly clear that the threat of a deficit of hydrocarbon energy resources and eventual interruption of its supply cannot be dismissed lightly. The process of reconsideration of existing energy policy and structure has started around the world and an active search for alternative sources of energy is underway.

The resolution of the problem apparently lies with the expansion of energy sources that are capable of satisfying energy needs without political conflicts and on a sustainable basis while meeting contemporary requirements of industrial and environmental safety. Not the least important is the factor of economic competitiveness of alternative sources of energy.

On the basis of the above mentioned considerations nuclear energy appears to be one of the most promising and well established sources in comparison with wind, ocean or biomass, though their contribution as alternative sources should not be diminished. It is also worth noting that without nuclear energy the prospect of large scale use of hydrogen fuelled technology will not be feasible.

There can be no doubt that global energy security directly depends on an increased role of nuclear energy in the future world energy balance.

Fast industrial growth of several developing countries and regions already requires the introduction of new energy facilities as well as appropriate infrastructure development related to the energy sector. According to an IAEA assessment, for instance, 30–80% of the increased energy demands in Asia can be provided by the construction of new nuclear power plants.

In this context one cannot exclude the possibility that a unilateral search for ways and means to maintain national energy security and an assured access to energy resources could lead to political instability, military confrontation, or even a proliferation of the weapons of mass destruction.

The G8 countries, as the leading industrialized nations of the world, should therefore assume the responsibility to create mechanisms that can cope with new challenges to attain optimal shares of nuclear energy in the global energy market taking into consideration its role in maintaining global energy security.

We strongly advocate unconditional implementation of the 2004 G8 Non-Proliferation Action Plan in particular the part devoted to providing an assured access to nuclear material, equipment and technology including nuclear fuel and relevant services in accordance with the market conditions, to all nations that meet their norms and commitments in the field of non-proliferation.

Further expanding this plan, President Vladimir Putin launched an initiative in January 2006, for future development of atomic energy and improvement of its infrastructure. The focal point of the initiative was the proposal to create an international nuclear fuel cycle centre in the Russian Federation under the auspices of the IAEA.

Implementation of this initiative would substantially strengthen global energy security in the long run and provide equal access to all nations interested in the use of nuclear power and increasing nuclear safety and security as well as environmental protection. The most important consequence would be a drastic reduction in the potential for proliferation of nuclear weapons; at the same time promoting sustainable development of the world.

We are now in the process of preparing detailed proposals for the creation of such a center on the Russian territory taking into consideration global trends in the use of nuclear energy and potential demands for nuclear fuel cycle services including enrichment. It is believed that these proposals would facilitate international discussion.

The Russian Federation is a country, which is interested in developing its national nuclear energy programme. Energy strategy approved by the Russian government envisages increasing the nuclear share of total electric power generation in the country to 23% by 2020. A simple calculation shows that to achieve this goal we need to put into operation additional capacity of 2 GW(e) annually.

Such ambitious developments are not feasible without strengthening our national nuclear regulatory system and improving its effectiveness and efficiency.

A strong, independent and competent nuclear regulator in the Russian Federation will create the necessary conditions for public support of nuclear energy and provide confidence to the public on its safe use. The principle of exclusive responsibility of the nuclear operator for the safety and security of nuclear facilities is incorporated into the Russian laws and reflected in several safety standards. This is the general organizational principle for nuclear safety and security in the Russian Federation.

Over the years, we created the national system of licensing which was used to develop internationally recognized basis for nuclear safety of existing

NPPs and to perform activities on the first generation units further extending their operational life.

Having said that, one cannot affirm that the existing system of licensing would be adequate to meet the needs of such a large scale plan for nuclear energy development in the Russian Federation. That is why I believe it would be useful for the community of nuclear regulators to devote a part of your discussions on how to align the licensing system with the nuclear energy development objectives of a nation.

Our national experience and the international experience show that the safety regulations as well as actual improvements of nuclear safety and security should be ahead of any large scale increase in the utilization of nuclear power.

In conclusion I would like to mention the following. The use of nuclear energy for civil purposes for over 50 years gives us clear evidence that it is a safe, economic and effective source of energy. Its safety and security, which are prerequisites for social acceptability, fully depends on us — personnel in the nuclear sector. We know our problems, are ready to solve them and are solving them. In Rosatom we have created the ‘Public Council’ to discuss nuclear safety and environmental protection issues as well as social problems in the framework of nuclear energy development plan. Russian NGOs will not only participate in providing expertise to prepare the laws and decisions related to nuclear power development but will also be involved in its implementation.

OPENING ADDRESS

L. Williams
Nuclear Decommissioning Authority,
Moor Row, Cumbria, United Kingdom

It is indeed an honour for me to be the President of this important conference and to share the stage with so many eminent people. The title of our conference is Effective Nuclear Regulatory Systems, and I believe, therefore, that the key theme is the delivery of effective nuclear regulation. What do we mean by ‘effective’ in the context of nuclear safety and security regulation? I believe effective regulation means the delivery of independent and efficient oversight so that government and society can be assured that their nuclear industry is operating at high levels of nuclear safety and security that are consistent with international norms.

I believe nuclear regulators play a vital role in the delivery of nuclear safety and security. The operators, quite rightly, have the legal responsibility for safety and security but experience has shown us that this is not enough. We need effective regulators to set the appropriate standards, monitor the performance of the industry and take action if industry does not meet the required performance standards. Nuclear regulators, by their very nature, are law enforcement officers and hence effectiveness is not only related to technical competence but also legal powers.

International standards require that nuclear regulators must be independent of the promotion of the nuclear industry so that their views can be accepted as being authoritative and unbiased. However, nuclear regulators exist because there are nuclear industries to regulate. Governments and society decide whether nuclear energy is to be used and hence the nuclear regulators can influence such decisions. If the regulators are effective, then nuclear activities will be seen as safe and secure; the nuclear industry will be committed to sustained excellence in safety and security performance; and the public will not be concerned about nuclear matters.

If nuclear regulators are ineffective, the safety and security of the nuclear industry is likely to be poor and government and society will loose faith in the value of nuclear energy. Nuclear regulators can, therefore, make a difference to the public perception of nuclear energy. However, I believe a positive difference can only be achieved by nuclear regulators recognizing that they can only achieve their goals through the work of others in government, industry and society.

THE ROLE OF GOVERNMENT

Governments have a considerable role to play in the delivery of effective nuclear regulation. I believe, for effective regulation, governments need to define what assurance they need, to be satisfied that the nuclear industry is safe and secure.

Governments also need to set the regulatory framework that gives the regulators the necessary powers to control design, construction, commissioning, operation and decommissioning. In addition to these powers, governments also need to ensure the independence of the nuclear regulators from those with the responsibility for the promotion of the nuclear industry.

Finally, nuclear regulation can only be effective if the nuclear regulator is adequately resourced. Governments clearly have a responsibility to ensure that the regulators have the resources they need to effectively regulate the industry and deliver the necessary assurance on safety and security.

THE ROLE OF AN EFFECTIVE REGULATOR

To be effective, the regulator needs to be independent, but how should regulators judge independence? I believe independence is not simply a separation of reporting lines within government but the guarantee of freedom from influence in decision making through the law. Effective independence also means acceptance of regulatory decisions.

It is not easy to determine what resources a regulator needs to be effective. There is little guidance on how resources should be matched to regulatory workload but effective regulators have robust processes to determine their staffing levels and the competence, qualifications and experience of their staff.

Effective regulators need to be able to measure the impact of their regulatory activities on the performance of the industry they regulate. Again, there is little international experience on how regulatory performance can be measured. Regulators must, therefore, develop effective methods to measure safety and security performance.

For regulators to be effective, they must deliver sustained regulatory excellence. Some regulators have effective quality management systems and continuous improvement programmes but more needs to be done to develop international guidance in this area.

THE ROLE OF INDUSTRY

The nuclear industry has a role to play in the delivery of effective nuclear regulation. The industry needs to explain what it requires of the regulator. This should include an understanding of the regulatory standards, what the regulatory goals are and how routine regulatory activities affect their operations. Synchronizing regulatory authorizations with the industry's operational needs is an important part of effective regulation.

Industry can also contribute to effective regulation by embracing regulatory requirements positively and constructively. By working with the regulator the industry can minimize the likelihood of unexpected regulatory intervention and hence minimize unnecessary operational interruptions. Industry, by delivering sustained excellence in safety and security performance can help deliver effective nuclear regulation.

THE VIEWS OF SOCIETY

Society has an input in the effectiveness of nuclear regulation. Regulation is effective if the public are engaged in the regulatory process and have confidence in the quality and independence of regulatory decision making. Effective regulators engage with society to determine how nuclear safety and security issues are understood, what society requires of the regulator, and how society should engage in the regulatory process.

STAKEHOLDERS

In judging the effectiveness of nuclear regulation there are three key stakeholders: government, industry and society. For nuclear regulation to be effective, government must have confidence in the competence and judgement of the regulator to make trusted decisions. Industry must also have confidence in the competence and fairness of the regulator. Society must also have confidence in the impartiality and judgement of the regulator.

THE ROLE OF THIS CONFERENCE

As I stated earlier, this conference is about the delivery of effective nuclear safety and security regulation to improve safety and security now and in the future. I believe our conference should be meaningful and make a difference to nuclear safety and security worldwide. To do this we must discuss the issues and hopefully go away with the message that nuclear safety and security regulation must be effective.

CONCLUSIONS

For regulation to be effective the regulator must be seen to influence and contribute to a safety and security conscious industry; government accepts that the nuclear industry is safe and secure; and finally society accepts that the use of nuclear energy is safe and secure. There is also another dimension to regulatory effectiveness and this relates to international recognition of a global approach to the harmonization of nuclear safety and security regulation.

THE PROGRAMME

I believe our conference will address all these issues; Session 1 will address the topic of independence and regulatory effectiveness. Session 2 will look at regulatory safety challenges. Session 3 will address security regulatory challenges. Session 4 will look at the international dimension by addressing international regulatory cooperation and the Closing Session will provide an industry view and the opportunity for a panel discussion on safety and security: global visions and commitments for the future.

At the end of the conference I will attempt to summarize the key findings relating to:

- The importance of effective nuclear regulation to the safe, secure and efficient use of nuclear energy;
- The key components of an effective nuclear regulatory system;
- The role of international organizations in supporting the importance of regulatory effectiveness;
- Recommendations to governments; and
- Topics for future regulatory conferences.

I will need your help and I will welcome contributions from you in any of these areas. Let us use the next three days to explore the issues and really make a difference to the way nuclear safety and security is regulated.

OPENING ADDRESS

FACING SAFETY AND SECURITY CHALLENGES: A NATIONAL AND INTERNATIONAL PERSPECTIVE

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It is indeed a pleasure and distinct honour to be here among fellow regulators and distinguished guests, to share my views on effective nuclear regulatory systems, with a few examples specific to the United States of America, and a global perspective. We are all, one way or another, preparing to discharge new responsibilities in a changed and changing world; preparation appears to be turning quickly to implementation.

First, I want to thank the IAEA for organizing this important conference. I especially want to thank IAEA Director General Dr. Mohamed ElBaradei for his direct role in making this meeting of senior nuclear regulators a reality, and Deputy Director General Tomihiro Taniguchi and the IAEA staff for their hard work and commitment to the effort. I would also like to express my sincere appreciation to our Russian colleagues, particularly, First Deputy Chairman Andre Malyshev, for their extraordinary efforts in hosting this meeting, which is dedicated to the key role that national regulatory authorities should continue to play in society, supported by effective international bodies.

I am confident that the resulting deliberations and recommendations will contribute to the effectiveness and sustainability of national regulatory systems, to new regulatory approaches for the use of advanced technologies and innovative designs, and to the development of additional instruments and mechanisms for cooperation among regulators in international forums.

Before I enter into the main topics that I want to share with you, I would like to make a comment on the issue of nuclear proliferation, or better, on the issue of assuring nuclear non-proliferation. It is now unmistakably true that the overriding necessity to achieve nuclear non-proliferation — as a fait accompli — has become a dominant issue in international politics, and of course, at the IAEA. Its importance to world peace, trade and geopolitical activities cannot be overstated. Yet, I will dare to say, that in a grand scheme of world prosperity, commerce, and international law, proliferation should not be more important than nuclear safety and security. In fact, in a world where abundant, economic, and well distributed energy becomes a global cornerstone, safety, security, and non-proliferation are interdependent components of a better and reliable framework for peace and prosperity. Nuclear proliferation should not be a deterrent for safe and secure civilian utilization of nuclear power.

This international conference on Effective Nuclear Regulatory Systems is more than a gathering of senior regulators and of nuclear technologists; it is truly an international assembly of those who implement nuclear safety, security and emergency preparedness. The sessions should have a definitive underlying theme and purpose that support the objectives of the conference. A common understanding of the purpose of regulation in general and nuclear regulation in particular, should provide the connectivity between every one of us, independent of country or organization. A good starting point for the common understanding of regulation would be to note that *regulation is done for the well-being of our people, for the common good, with full consideration of the national interests, and of international law and agreements.*

Nuclear regulation is a disciplined national tool for establishing predictable safety and security frameworks. It works by establishing and improving technical and legal structures to define the acceptable safety case that serves the public interest.

Senior nuclear regulators, you and I, are coming together, in Moscow, in winter, in 2006, to make a statement regarding our responsibilities and to deliver a series of products, sustained by a common understanding of nuclear regulation. Moreover, we are here because we care about our nations and because we can and want to work together, better. In this regard, I present for your thoughtful consideration here, as a purpose, the objective stated by the Nuclear Regulatory Commission (NRC) in its current strategic plan: *to enable the use and management of radioactive materials and nuclear fuels for beneficial civilian purposes in a manner that protects public health and safety and the environment, promotes the security of our nation, and provides for regulatory actions that are open, effective, efficient, realistic and timely.*

With that purpose in mind, it becomes clear why our presence here today is important. In fact, as inevitable as day and night, there is supply and there is demand. Unfortunately, there are also imbalances that may occur in supply and demand. The world is again experiencing that almost forgotten enemy: expensive and/or unreliable energy supply. Many times we have seen that society is disrupted and people suffer when energy is costly, scarce, or not available. The solutions to economic and reliable energy supply are surely important worldwide. In the case of the USA, dependence on energy is somewhat unique; solutions are needed for the short term and solutions are needed that will endure the test of time and crises. Therefore, the USA, like many other countries, is reviewing the strategic, economic, and environmental considerations of the nation's overall energy supply and openly considering the contributions of nuclear power to meet its present and future energy needs. In fact, in the USA, President Bush and the Congress have taken positive steps to ensure that nation's energy mix includes the reliability of supply, the environmental benefits, and the steady costs that are now ascribed to operating nuclear power plants. Maintaining the requisite focus on safety and security, the NRC has the obligation and responsibility to respond to the needs of the country. Although our particular needs may differ, you are surely being asked to be ready to implement a set of effective regulatory tools that are responsive to the energy, economic, and security demands of the present and the near future. I believe that we can agree that every nation of the world would be better served by reducing imbalances in the energy supply and demand, and by supporting safe, economical and environmentally friendly electrical energy supply that meets the global demand.

Furthermore, our presence here is important because nuclear regulatory authorities have a key role to play in resolving the effectiveness and sustainability, indeed the predictability and reliability of regulatory decision making, and therefore, the role that nuclear power could play. Of course we, as regulators, have important duties regarding security and radiological materials safety in addition to reactors. We all need the instruments; mechanisms; resources; and the international, multinational, and bilateral cooperation that will strengthen our capability to serve our people better with regulatory resolution of issues, with openness, and credibility.

I want to summarize for you where the USA is in two areas that are important to the viability of nuclear power generation: safety and economics. These two interdependent factors have seen major improvements in the last 15 years with respect to the consideration of nuclear power in the energy mix for many countries. I believe that safe, reliable, and secure nuclear energy has been and can continue to be part of the solution to energy security and environmental stewardship, and thus contribute to the well-being of all our people. We have played and should continue to play a key role in ensuring the safety of nuclear installations, with the technical know how and regulatory practices of today for today's needs.

For over twenty years, specifically during the decades of the 1970's and 1980's, the economics of nuclear power did not fulfil the early expectations of the USA or the world. The reality is that commercial nuclear power did not have much of a chance to meet expectations during those years. In the USA, and most other places, nuclear power deployment took place during the worst possible time for large capital-intensive projects. Financial, technical, or regulatory predictability was lacking.

The economic situation for nuclear power plants has changed significantly and the prospects for new plants have become more promising. Low inflation and low interest rates have been the norm for the last few years, and low production costs of nuclear generated electricity, including fuel, are now frequently highlighted in the press and in the halls of government. Today, there is stability in regulatory requirements. The USA's plant capacity factor and total electrical generation are sustained at, or near, all time highs; nuclear production costs, at \$0.0168/kW·h, are now lower than coal.

I discussed economics as a necessary part of the global nuclear scenario, but assurance of safety is an essential component. The sociopolitical reality is that nuclear power needs to be safer than other forms of generation. In fact, it needs to be 'safe' in both actual and perceived terms. To achieve safe status, the US nuclear power industry needs to over achieve both in actual safety performance and in how safety is regarded. According to the performance safety indicators used by the NRC, the US nuclear industry has achieved overall better-than-ever performance. Beyond individual safety indicators, I can tell you with confidence that the US nuclear power industry is performing with adequate safety margins, and that NRC oversight is resulting in reasonable assurance of the protection of the public health and safety, the environment, and national security. One of the key responsibilities of nuclear regulators is to define the term 'safe enough'. We all realize that there is no such thing as zero risk; therefore, we need to establish adequate safety margins while enabling the safe use of nuclear technology.

The improved industry performance has enabled the NRC to initiate and implement reforms that are progressively more safety focused. A look at licence renewal is indicative of the profound changes made by the Commission to regulatory effectiveness and efficiency. The US nuclear plants were initially licensed for 40 years, and licence renewal authorizes an additional 20 years of operation after safety requirements for passive components and aging are met. The picture for the survival of nuclear power in the USA was not pretty in 1997; predictions of the accelerated demise of half of the licensed plants were abundant. The Commission undertook the task of reviewing the requirements for protecting public health and safety in deciding the renewal of licences, and thus, served the national interest as articulated in the Commission's authorizing legislation. The resulting improvements in the license renewal process that the Commission put in place, along with changes to the hearing process, assured the Nation that a fair, equitable, and safety driven process would be used for those applying for extension of their licences. Today, 39 licences have been renewed and 12 are being processed. Twenty-seven other licensees have announced their intention to apply for renewal of their licences. The NRC is completing these licence renewal approvals in approximately 22 months after receiving the applications. This process is focused on verifying the adequacy of licensee ageing management programmes. Moreover, the programme has resulted in significant investments by industry that directly contribute to enhancing operational safety. In today's energy environment, the 20-year licence renewal of 39 nuclear power plants provides a great value to the USA in terms of energy, national and economic security, as would be the probable renewal of another 39 nuclear power plant licences in the near future.

In today's world, to ensure protection of public health and safety, the assurance of security is essential. I believe that the NRC has established, using a risk informed approach, the key regulatory requirements needed to provide added assurance of the security of civilian nuclear facilities and materials in the USA. We started early, progressed methodically, and are currently incorporating requirements into our regulations. These include three important security rule makings, planned or under way, to codify security requirements for power reactors. The first is the rule making on the design basis threat for radiological sabotage and a final rule will be issued later this year. The second rule making will amend the power reactor security regulations to align them with the series of orders the Commission issued following 11 September 2001, and to ensure that safety–security interface issues are properly considered in plant operations. Finally, the Commission's expectations on security design for new reactor licensing activities are to be codified in a third rule making by September, 2007. The expectation of the Commission is that the lessons learned by the agency and reactor licensees pre- and post-9/11 should be considered by the vendors at the design stage. We have learned much and I believe improvements can be realized without major design or construction changes.

With this backdrop, I would like to discuss what the NRC is facing and doing to address the renewed commitment of the US administration and Congress to civilian nuclear energy as a means to address the demand for economic and environmentally benign electric power, and the expressed intentions of the US nuclear power industry. To date, 11 potential combined licence (COL) applications for a total of 17 new nuclear power plant units, distributed among the three major reactor vendors now competing for the US marketplace, have been publicly announced. They appear to be 'bunched up' for submittal and review in a short period of time. There are, of course, significant infrastructure and logistic issues to be resolved by the industry and by the NRC, and the time to do it is short.

In order to review effectively multiple COL applications in parallel, the NRC staff is now preparing to implement a design centered approach for reviews of COL applications, to the extent possible, for as many issues as possible. This approach involves the use, for each issue, of one review and one position for multiple applications. It could also be called the 'one-for-all' approach. It is ready for use now; however, it needs the nuclear industry's commitment. One-for-all is once-thorough, comprehensive, NRC safety evaluation to be used repeatedly, as appropriate. Using the design centered approach, the NRC staff would use a single technical evaluation to support multiple combined licence applications for the same technical area of review, as long as the applications standardize the licensing basis to a level that would make this approach viable. For technical review areas amenable to this approach, the staff can complete the evaluation for a 'reference' case, can determine if the design proposed by other applicants is the same as the design reviewed, and proceed to issue the evaluation without further review. Let me emphasize, that for each certified design, standardization is the key to making this approach work. Standardization is everybody's business in reactor licensing.

The design centered approach could also be applied to parallel reviews of a design certification application and COL applications referencing the design. For example, NRC reviews for the ESBWR and the EPR designs are likely to be conducted in parallel with reviews of the first few COL applications referencing these designs. The NRC could proceed with its review of each design and issue a safety evaluation report with open items, just as was done in the case of the AP1000 and earlier designs. Using the design centered approach, the resolution of generic open items in the NRC safety evaluation report could be coordinated between the vendor and the applicants for COLs referencing the vendor's design. The resolution of these generic issues could then be incorporated into the design and included in the rule making certifying the design. In this manner, they would be available to future applicants referencing the design.

I am confident that applying the design centered approach to parallel design certification and COL reviews, and relying on disciplined standardization, will result in a better, more detailed, and more thorough safety evaluation for each design. When an applicant references a standard design certified by rule making, all design matters within the scope of the design certification rule have been resolved using a fair and equitable process and need not be readdressed in the COL processing. The design centered approach could also lead to a significantly higher level of efficiency in the licensing process, thereby reducing the amount of staff resources necessary to conduct each review.

Could it be done differently? Of course it could, and the law clearly says so. In another world, in another time, it might be different. But, here and now, the path forward for nuclear power safety, security, predictability, and growth seems clear: standardization.

The worldwide expectation for large scale deployment of nuclear power is approaching decision making time in many places. However, uncertainties remain. The solution to new reactor deployment includes thorough, timely, and safety focused decisions by nuclear regulatory authorities. I believe that we would agree that this time around nuclear power plant deployment should be carefully planned, and key issues and interfaces, including regulatory issues must be resolved at the front end, on budget and on schedule, with all the safety and engineering know-how developed and learned over the last 25 years. Obviously, there are many ways and various scenarios on how we make decisions in the regulatory process. Yet, it is essential that we ensure regulatory predictability by handling applications in a manner that is expeditious, in a manner that assures that decisions on safety and security are clear, and in a manner that is fair to all parties.

We should be ready to utilize fully international and multinational resources, including technical capabilities and research efforts, to deal with the realities of the increasing 'internationalization' of nuclear technology. We must recognize that changes in the marketplace, technology, and regulation have taken place; international partnerships of industry and international partnerships of independent regulators are needed to make a difference.

At the same time, we should recognize that the world's regulatory authorities and nuclear operators need to maintain a steadfast focus on the safety and security of existing nuclear power reactors. In order to meet this challenge and the added burden of new reactor licensing and construction, innovative approaches will need to be considered to make the best use of regulatory and industrial resources. It is frequently stated by the IAEA that the safety and security of nuclear reactors, in many respects, should have no borders. We need to increase effectiveness by adding international solutions to issues, as appropriate.

As a key example of an international solution to a global issue, the US Department of Energy recently announced the Global Nuclear Energy Partnership (GNEP) as a comprehensive strategy to increase US and global energy security, encourage clean development around the world, reduce the risk of nuclear proliferation, and improve the environment. GNEP is intended to develop and demonstrate new and improved proliferation resistant technologies to recycle nuclear fuel and reduce waste. The USA will work with other nuclear nations to develop a fuel supply and services programme for developing nations. In return, this would necessitate their commitment to refrain from developing enrichment and recycling technologies. In the 1980's, "do it once, do it right, do it internationally", became a mantra of the industrial sector in the European community. This sounds like a usable path for developing meaningful, effective and efficient approaches for new technologies, including their regulatory treatment.

We will share four days in the beautiful city of Moscow; the cold weather only highlights the warmth of our relationships and the strength of our purpose. Some worry that our differences would impede lasting and effective solutions and that turf battles would diminish the benefits we could accrue from converging on safety and security practices, and predictable decision making. I disagree. It matters not whether your entry point or outcome is through the IAEA, or the OECD Nuclear Energy Agency, or you used tripartite or bilateral agreements, or multiple combinations thereof. We need them all, and I believe we use them all, and will need them even more in the future. What matters is the resolve of nuclear regulatory authorities to ensure fair, predicable, safety driven outcomes for the well-being of our people, for the common good, enabling the safe and secure use of nuclear energy and radioactive material for beneficial civilian purposes. Furthermore, it matters that international and multinational agencies provide strong and sustained support to the efforts of nuclear regulatory authorities.

I am confident that our expectations of this conference will become a reality, with increased regulatory effectiveness and responsibility, by addressing key challenges and strengthening nuclear safety and security through lasting partnerships.

OPENING ADDRESS

FACING SAFETY AND SECURITY CHALLENGES: SPECIFIC REGULATORY PERSPECTIVES

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Let me welcome you to the conference of nuclear and radiation safety regulators held by the IAEA on the threshold of the 2006 Summit of the G8. This is not our first assembly for the discussion of nuclear and radiation safety regulation issues. Considerable progress has been made in recent years in this direction owing to the efforts made by the whole world community, the G8 countries, and international organizations, especially the IAEA.

The subject matter of our conference is closely connected with one of the major directions of the G8 Summit to be held later this year — the concept of ensuring the safety and security of global energy supplies, i.e. ensuring the availability of reliable and sustainable energy resources to all the countries that need those for their further development. Atomic energy has been playing a substantial role in the implementation of this concept and in the long term, when the supplies of fossil fuels start depleting, its role and scope of use will be getting more significant. The main and indispensable prerequisite for such large scale use of atomic energy is the assurance of nuclear and environmental safety at all stages of the nuclear fuel cycle. Moreover, physical protection of nuclear facilities, fissile materials and radioactive substances has recently assumed special or one could say paramount importance, which is connected with the problem of proliferation and the terrorist threat.

Ensuring nuclear and radiation safety has always been addressed in parallel with the development of nuclear technologies right from inception and is reflected in the level of scientific knowledge in this field that existed at each point in time. The lessons learnt from the accidents and incidents that occurred, have stimulated corresponding scientific and technological developments, improvement of regulatory standards and the establishment of continuously improving regulatory systems for nuclear safety and radiation safety.

Unfortunately, the end of World War II, had given rise to a confrontation between States that resulted in the race to develop nuclear armaments and the ‘cold war’, notwithstanding the success in the joint defeat of fascism and the foundation of the United Nations organization. This led to the formation of the

United Nations Atomic Energy Commission, which could become the first international regulator.

Meanwhile, the regulation of nuclear and radiation safety, both in the military and civil spheres, was exercised in each country and this regulation had its own specific history and peculiarities. The scientific and technical progress made, in the long run, resulted in the large-scale use of atomic energy for peaceful purposes, which in turn had an immediate effect on the establishment of nuclear safety regulation systems and the creation and development of regulatory authorities.

The cooperation of the specialists of different countries in the field of peaceful uses of atomic energy started with the "Atoms for Peace" speech delivered by Mr. Eisenhower, the US President, at the United Nations General Assembly in 1953. As a result of this, the IAEA was founded. For the time being, the aim of "faster and wider use of atomic energy to sustain peace, well-being and common good all over the world", declared by the IAEA, was playing a significant role in joining the efforts of the specialists from different countries in various directions of peaceful uses of atomic energy, ensuring nuclear and radiation safety and non-proliferation.

Nuclear and radiation safety regulation in the former USSR originated from the establishment of radiation safety control service at Laboratory 2 in 1946 (the present Russian Scientific Center Kurchatov Institute). Twelve years later, in 1958, the first divisions of nuclear safety control within the Physical and Power Engineering Institute of Obninsk and Atomic Energy Institute of Moscow were founded. An independent regulatory authority was established in 1983 after the USSR State Committee for supervision over safe performance of work on atomic energy had been created. Severe accidents at the Three Mile Island and Chernobyl nuclear power plants had a considerable effect, both in the former USSR and all over the world, on enhancement of the safety of nuclear facilities, carried out by the nuclear industry and regulatory authorities.

Subsequently, the international community developed the safety standards for the use of atomic energy, and facilitated the implementation of the basic procedures for the regulation of nuclear and radiation safety. One of the fundamental documents defining the legal bases of ensuring nuclear and radiation safety in countries using atomic energy, is the Convention on Nuclear Safety, which was developed and adopted with the active assistance of the Russian Federation.

The Federal Law on the Use of Atomic Energy that fully meets the basic requirements of the Convention on Nuclear Safety determines the legal basis and principles of regulating the use of atomic energy in the Russian Federation, including the terms of reference of the State nuclear and radiation safety regulation authorities and the authorities that manage the use of atomic energy.

Thus, the State system of nuclear safety regulation was established in accordance with the international obligations of the Russian Federation. The regulation of nuclear and radiation safety in the Russian Federation is the constitutional responsibility of the federal executive authority. Enhancement of nuclear and radiation safety and improvement of physical protection, control and accounting of nuclear materials, is taking on special significance due to the current challenges to global security, including threats of nuclear and radiation terrorism and nuclear proliferation.

The Russian Federation is taking an active part in the implementation of the Convention on Nuclear Safety. In 2004, the Russian Federation, jointly with the United States of America, initiated the Global Threat Reduction Initiative, and was one of the organizers of the International Conference of the Partners in the Global Threat Reduction Initiative in conjunction with the 48th General Conference of the IAEA. In 2005, the Russian Federation participated in the third meeting of contracting parties on the review of the implementation of the Convention on Nuclear Safety. Last year the Russian Federation ratified the Vienna Convention on Civil Liability for Nuclear Damage and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

The President of the Russian Federation approved the Basics of the State policy in ensuring nuclear and radiation safety in the country for the period up to 2010 and beyond. A number of enactments and orders of the Russian Government were adopted, which aimed at the implementation of the measures to ensure nuclear and radiation safety, physical protection of nuclear facilities, and state control and accounting of nuclear materials. The Energy Strategy of the Russian Federation for the Future was approved, wherein a significant role is taken by the development of atomic energy subject to the condition that ensuring nuclear and radiation safety shall not be compromised under any circumstances. A series of federal programs to meet targets in this sphere was formulated and is being implemented.

On the whole, one may note the considerable progress achieved in recent years in safety regulation in the Russian Federation. Major results include the following:

- Creation of regulations, standards and the regulatory system for nuclear facilities;
- Development of licensing and authorizing procedures;
- Implementation of effective control and supervision over nuclear activities with the aim of ensuring safety of the public and the protection of social infrastructure facilities that are critically important for national

safety against natural and man-induced threats with radiological consequences.

Progress has also been achieved in the preparation of new legal and regulatory infrastructure including the development of technical standards for the regulation of nuclear and radiation safety. When developing the technical standards for nuclear and radiation safety, the basic international conventions and the standards of the IAEA are taken into account.

The issues of enhancing the overall safety culture to achieve high standards of nuclear safety and security; new initiatives on improving the level of professional skills of nuclear personnel; and effectiveness of actions to preserve nuclear knowledge are still remaining as important tasks to be carried out. The work on preparation of regulatory documents related to nuclear liability insurance has commenced.

The major approaches to nuclear safety regulation in the Russian Federation aimed at ensuring the preparedness for emerging threats are as follows:

- Preparation of an appropriate organizational structure of state regulatory authority for regulating nuclear safety and security;
- Transparency of regulatory activities and willingness for consultations with relevant stakeholders;
- Harmonization of national and international approaches to safety assurance;
- Harmonization of approaches to ensuring safety of nuclear facilities of different types;
- Tapping the synergies of nuclear safety and security;
- Assurance of nuclear materials integrity;
- Improvement of the level of professional skills of personnel of all categories in the field of atomic energy use;
- Assurance of emergency preparedness.

Nuclear safety and security directly or indirectly depend on the settlement of the current global problems. The main features characterizing the status of the present-day world economy and rising challenges include the following:

- Steady growth of demand for electricity and development of large scale programmes to meet the needs, including programs of atomic energy development;

- Deregulation of electricity and energy markets and associated problems of safety regulation;
- Globalization of world economy and the concurrent activation of nationalist movements and terrorism;
- Global warming, natural disasters, large-scale development of human activities and associated growth of risks caused by human activities;
- Growth of environmental pollution and industrial waste accumulation.

This status defines the basic factors ‘pro’ and ‘contra’ that can have an influence on the development of atomic energy in the world and the occurrence of corresponding challenges and new problems to be solved by the nuclear and radiation safety regulators.

The problems faced by Russian regulators include the following:

- Plans for further significant development of atomic energy and other nuclear technologies in the Russian Federation specify the requirements for the relevant development of licensing and supervisory activity of the regulator;
- Qualitative improvement of nuclear technologies, development of innovative projects of NPPs and construction thereof, use of new types of nuclear fuel and necessary closing of the fuel cycle will require new actions on the part of the regulator;
- The Russian Federation is proceeding with the deregulation of the economy, including that of energy markets, which gives rise to new challenges for the regulators, mainly nuclear and radiation safety regulators;
- Many NPPs and other fuel cycle facilities are nearing the end of their planned lifetime; therefore, the measures for life extension, which in turn define the necessity of relevant regulatory decisions, are implemented from the standpoint of the global tendencies;
- Unresolved problems of threats from past accumulation of radioactive waste and spent nuclear fuel are becoming acute. The situation of radioactive waste and spent nuclear fuel storage facilities at NPPs is becoming more complicated. The hazard posed by fuel cycle radioactive waste causes a concern;
- The tasks of improving physical protection systems of nuclear facilities and nuclear materials, in view of the growth of nuclear terrorism threat, are becoming more urgent.

The ‘political climate’ in the world and the possibility of implementing mutually agreed decisions considering national interests play a significant role in the responses to the challenges of nuclear and radiation safety. The IAEA exerts profound influence on the safety policy of its Member States. The tendency of harmonization of national regulatory approaches and the IAEA safety norms and requirements is growing; and international cooperation on a wide range of problems related to nuclear safety and security is broadening. A broad cooperation of nuclear safety regulators of the IAEA Member States is necessary to provide appropriate responses to new challenges. The joint activity on improving the regulating principles of nuclear safety and security should be based on the general principles of nuclear safety regulation, established earlier. The formation of the West European Nuclear Regulators Association and the efforts to harmonize regulatory principles, provide positive examples in this regard.

The decisions of the G8 are of great importance to ensuring nuclear and radiation safety. In the course of the G8 Summit in Evian in 2003, constitution of the Nuclear Safety Group that immediately started its work, was adopted. Among the prospective tasks of the group is rendering assistance to the countries developing the use of atomic energy for peaceful purposes in creating adequate regulatory systems to ensure nuclear safety.

The global directions of future actions for nuclear safety regulatory authorities were considered and the statement of the regulating principles of nuclear safety regulation in the G8 countries was adopted during the meeting held in Moscow on 24–25 June 2004 among the heads of the regulatory authorities of the G8 countries. It is obvious that the recommendations worked out on the basis of the best experience and practice in the field of safety regulation and their extensive use are vital for the population of all the countries both for the present time and future.

We are on the threshold of taking decisions on moving forward from international cooperation in research and development to global partnership in the management of peaceful use of atomic energy and nuclear and radiation safety regulation. At the very beginning of the atomic era, the United Nations in its first resolution called for the use of atomic energy exclusively for peaceful purposes and liquidate weapons of mass destruction. However, the Baruch plan and other proposals on establishing mechanisms for international management of atomic energy use only for peaceful purposes were not destined to be implemented.

As long ago as the end of the cold war, a group of leading scientists including Chaunsey Starr from the USA, Steven Peck from the United Kingdom and Wolf Haefele from Germany repeatedly proposed consideration be given to the issue joint international solution to the problem of spent fuel and radioactive waste management by creating the so-called Internationally Monitored Retrievable Storage System. However, the actual conditions for facilitating global partnership in the field of atomic energy have appeared only recently. The cold war is over and the leading nuclear powers are actively turning from confrontation to cooperation. Also, many developing countries are waiting for the possibility of obtaining the benefits of atomic energy and, in the course of time, atomic energy may become the sole alternative to ensure the safety and security of global energy supply. Therefore, the global task that faces the world nuclear community and, of course, the IAEA is to contribute to the spread of the benefits of atomic energy and at the same time prevent of its use for military purposes.

Various consortia of operating companies for different stages of nuclear fuel cycle have already been existing and joint research and development of innovative technologies is being carried out under GIF (Generation IV International Forum) and INPRO. Being the community of the specialists in safety regulation, we are taking a great responsibility for the wide commercial implementation, in the future, of nuclear energy technologies in the developing countries. What technologies will be given to these countries, how the supervision over safety assurance of these technologies will be arranged, how the nuclear technologies markets will be developed and regulated — all this will depend on us. Therefore, we support the proposal of the US Nuclear Regulatory Commission on the Multinational Program of Safety Assessment of New NPP Projects.

As you know, a proposal on creating a global infrastructure, which would allow providing equal access to atomic energy to all interested parties on the condition that the requirements of non-proliferation regime are securely observed, is expressed in the opening statement to the conference by Vladimir Putin, the Russian Federation’s President. International centres under the control of the IAEA are proposed to be created within the framework of this infrastructure for: rendering nuclear fuel cycle (enrichment) services; storage of spent fuel; and training of personnel for atomic energy facilities. The initiative of George W. Bush, the US President, on the Global Nuclear Energy Partnership is equally important. We should formulate our vision of further development of nuclear and radiation safety regulation taking into account new global challenges and global responses to these challenges recently set forth in the initiatives of the Presidents of the USA and the Russian Federation.

In conclusion, I would like to stress again that with a view to preventing the possibility of severe accidents in future, the nuclear and radiation safety regulators should come up with appropriate responses to the emerging threats. The world community should prepare the global responses to the global challenges.

INDEPENDENCE AND REGULATORY EFFECTIVENESS

(Topical Session 1)

Chairpersons

S. MATSUURA
Japan

D. DRÁBOVÁ
Czech Republic

INDEPENDENCE AND EFFECTIVENESS IN LICENSING, INSPECTION AND ENFORCEMENT

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Abstract

Nuclear regulators should not actively take part in issues concerning nuclear energy policy. Their essential function is to contribute as effectively as possible to nuclear safety. The author deals with the impact of the following factors on the regulator's independence: directives of the government, the organizational form of the regulatory body, the procedure for selection of the regulators and the independence of the technical service organizations. The paper concludes by describing some measures for improving regulatory independence and effectiveness.

1. INTRODUCTION

Last summer, when I heard for the first time about this conference, I asked myself, what should be the goal of a conference whose issues have been discussed in so many forums before? There are so many frames of international cooperation; do we need another new G8 frame for regulators' cooperation besides the OECD Nuclear Energy Agency, the IAEA, the Convention on Nuclear Safety (CNS), the other frames such as the Western European Nuclear Regulators Association and the International Nuclear Regulators Association (INRA) and a multitude of bilateral and multilateral agreements? And when I looked through the agenda, I noticed a very critical statement and I asked myself whether my participation would contribute to the effectiveness of the German regulatory body. But in the end, I am here. There was also some guidance to the speakers that told us what the goal of the conference should be. Let us look at the guidance for speakers and support staff; it says that *"If nuclear safety and security regulation is made more effective, Governments and Society will have confidence in the contribution nuclear energy can make to the world's energy supply."*

I asked myself whether it is the goal of the regulator to enhance the contribution of nuclear energy world wide. With such an explicit vision for the regulator on energy policy, what happens to the independence of the regulator?

What happens to the independence of a conference of regulators under such a headline?

Further, the guidance to speakers goes on to state that “*If the regulators are effective, then nuclear activities will be seen as safe and secure and this could influence society’s view on the use of nuclear power.*” Is it a leading goal of regulators to promote the use of nuclear power by convincing people that it is safe?

I can tell you what my goal is. My goal as a regulator is contributing as effectively as possible to nuclear safety — not more — not less. As my paper deals with independence and effectiveness of regulatory functions, I thought it would be most effective to make myself independent of that part of the guidance to the speakers that we received.

Independence — that is something very difficult. The very heart of society is human beings living and working together, communicating and exchanging views and convictions. And society means dependence on each other. Can anybody say in this room “I am independent?” So the question is, at first, what does it mean for regulators to be independent? There are some comprehensive answers given, for example, in the CNS and the IAEA standards and there have been good results from discussions within the INRA.

But, at first, let me say what independence does not mean. There are some environmental NGO’s that are questioning the independence of regulators for they are mostly supposed to belong to the nuclear community and regarded as pronuclear. On the other hand, there are examples where a nuclear regulator is supposed to be not in favour of nuclear energy and therefore is not regarded as independent. If anyone of us judges the independence of a regulator by criteria such as presumed personal convictions or personal attitudes, we would have to answer the question whether we really want to investigate presumed convictions; and if yes, which tools could be used to verify them. Finally, we would have to be aware that this process would be touching the roots of human rights and of freedom and democracy.

The same applies to the nations, their freedom and sovereignty. If a society has decided to prefer other forms of providing energy supply than by nuclear plants and wants to phase out nuclear energy then this is not a reason in itself to deny the independence of its regulator.

This is apparently not the opinion of the guidance that gave us the goal for this conference. The guidance reads: *“To meet the goal of the conference ….. participants must go away with the message that nuclear safety and security regulation* ***can only be judged to be effective*** *……when their (the regulator’s) Government accepts that the nuclear industry is safe and secure; and finally when Society in their country accepts that the use of nuclear energy is safe and secure”.*

So let me come to my first point. No matter which conviction the regulator has towards nuclear energy, no matter which energy policy a nation pursues — this has no implications whatsoever for the question of effectiveness or independence.

I will come back to what the IAEA documents say, which in my view provides a very comprehensive understanding of independence of a regulator. Let me quote the Safety Guide No. GS-G-1.1, Organization and Staffing of the Regulatory Body for Nuclear Facilities, *"The primary reason for this independence is that regulatory judgements can be made and regulatory enforcement actions taken without pressure from interests that may conflict with safety."* This statement may serve as the definition of undue influence. Undue influence may come from different sources; from the operator (Art 8, CNS), from the government, from other lobbying organizations, from political parties, and so on.

It is common understanding as documented in the IAEA Safety Guide GS-G-1.1, that there are close relations between:

- Independence and competence;
- Independence and financial resources;
- Independence and transparency;
- Independence and legal basis.

Less discussed is what organizational methods and structures are required to ensure that the above mentioned fundamental goals and prerequisites of independence can be realized to the extent possible. Which are the 'golden rules' that are indispensable for the independence of the regulatory body? Just let me remark that organizational structures and methods or golden rules alone can never guarantee independence. But they can give boundary conditions that may enable and protect independence significantly.

To learn about the advantages and disadvantages of regulatory structures and procedures, I commissioned an internal study on selected regulatory systems. This internal study has drawn my attention to some aspects which I would share with you.

2. INDEPENDENCE AND DIRECTIVES OF THE GOVERNMENT

In some countries, the political responsibility for regulatory decisions lies with a minister. Though in all known cases his regulatory power is delegated to a director general this could give rise to some problems. Following the requirement of Art. 8 of the CNS it should be prohibited that such a minister is also responsible for the economic, scientific or technical development of the nuclear industry. You will notice that this rule is not implemented everywhere.

Also, in those cases where the minister is not related to the promotion or development of nuclear energy there are other politically determined interests within the portfolio of a minister that may get into a conflict with safety considerations of a regulator, especially if there are no specified limits on those directives. Such interference may not occur or succeed in practice, but the structural problem remains.

Our comparison of some selected regulatory systems shows, however, that some countries protect the regulator by restricting the directives of the minister to general ones. Other countries allow directives or decisions of a minister or the government only when licenses are issued. On the basis of our study I would propose some general rules:

- Directives by anybody concerned with economic interests in the field of nuclear energy must be excluded;
- The competence to issue directives should, at least de facto, be limited to general ones. Directives of the government regarding case-by-case decisions should be avoided;
- Any superior authority should regularly provide to the parliament or even to the public the reasons for a directive in a transparent way.

3. INDEPENDENCE AND ORGANIZATIONAL FORM OF THE REGULATORY BODY

Some countries avoid the difficulties discussed above by establishing an independent organizational form of the regulatory body. France and Switzerland, which until now have a ministerial responsibility for nuclear safety, are moving in this direction.

The challenge for those more independent solutions is how to guarantee democratic accountability to the parliament. In a democratic state, the nuclear regulator must, in some way, be part of the system of ‘checks and balances’, where independence is — and must be — limited by democratic accountability. Wherever a minister is responsible for nuclear safety decisions, the accountability of regulatory decisions to the parliament is effected through the accountability of the minister or the government to the parliament.

Existing independent regulatory bodies respond to this requirement through reporting obligations to the parliament. In some countries they are built as commissions with commissioners of different political origin. These commissions provide more democratic legitimacy for the decisions of the regulator and thus compensate for not being part of the hierarchy that leads to democratic parliamentary accountability. In practice, the board members can exert mutual control over each other, thus minimizing external influence. The parliament can keep control by issuing laws to fix fundamental safety objectives and procedures when needed.

If you take a deeper look into organizational structures of existing regulatory bodies, you will find a lot of variety and differences leading to the conclusion that there is no uniquely ideal model. In my view, the basic structure of this model seems to be the strictest approach to optimize the conditions for independent regulatory decisions.

4. INDEPENDENCE AND THE SELECTION PROCEDURE OF THE REGULATOR

Whatever the organizational structure, the regulator will be open to undue influences if the staff and the top regulator do not have:

- The necessary qualification;
- A questioning attitude;
- A personal standing.

Therefore, the rules for recruiting staff should be verified to meet these requirements. And especially, there should be a qualified procedure to select the top regulators. There is little information regarding how top regulators are chosen in practice. So let me initiate the discussion with some ideas that I got out of our study.

First of all, the top regulator should have certain personality characteristics because, if the top regulator is not independent himself, the independence of the nuclear regulatory body will suffer regardless of the quality of its organizational structure. Requirements related to personality characteristics should include:

- A questioning attitude.
- Assertiveness.
- Leadership.
- An effective personal independence from political goals outside nuclear safety. That does not touch the right — the fundamental right of every human being — to have their own convictions. In practice this means that the regulator should not interfere in energy policies. For if he does, he himself loses his neutrality and would likely become an object of political

influence or even pressure. This would be considered undue influence no matter whether it is supporting or criticising. So the risk grows that the regulator's decisions are discussed in the public always in connection with his position on energy policy. On one side this increases the risk that his decisions may be influenced and on the other hand — that is even as important — people may lose trust in his independence. What consequences this may have on the acceptance of nuclear power need not be further explained.

This principle that is valid for the regulator is also valid in the same way for its national or international associations.

Other best practice criteria for the selection process could include the following:

- There should be no links between persons and/or organizations responsible for the selection of the top regulator and economic interests in energy. To ensure this, there should be disclosure rules to make public any links or direct financial interests (e.g. ownership of shares) between the regulator and the nuclear establishment;
- The responsibility for the selection could be assigned to a democratically elected multi-member group, e.g. the parliament or its subgroups or any other chosen committee;
- To ensure professional competence, the candidate could be proposed by the competent minister;
- The appointment of the top regulator should be limited to a certain time period;
- There should be post employment restrictions.

Regarding our study one crucial point of independence seems to be the procedure for dismissal of the top regulator. Best practice seems to me that dismissal of the top regulator should only be allowed for specified reasons and by the same institution responsible for his or her appointment.

5. INDEPENDENCE OF TECHNICAL SERVICE ORGANIZATIONS (TSOs)

It is common knowledge that there is no independence, where staff members of the regulator are contractually bound to the operator. But the same applies to the TSOs that sometimes work for the operator and sometimes — or even worse — at the same time for the regulator. So there should be a rule: TSOs should only work for one side whether that will be the regulator or the operator.

6. INDEPENDENCE AND TRUST

In the past I have had some discussions with colleagues on how trustful the relation between the regulator and the operator should or should not be. The more the operator feels that you trust him the better you may communicate with him and the easier you may get information and hence the regulator's work could be more effective. On the other hand, the more you get acquainted with the operator, the more you are solving his problems and the more you may lose your independence. So what is the right measure between trust and control under the aspect of independence and under the aspect of effectiveness of the regulator? Are independence and effectiveness contradictory goals? In my view we should follow the basic three step procedure:

- The regulator should restrict himself to define clear requirements that are precise and detailed enough to determine the level of needed safety;
- The operator should develop his solutions on his own without the help of the regulator or his TSO;
- The regulator should check and approve the solutions developed by the operator.

This procedure may seem to be obvious. But I know that it is not a common practice.

Let me give you another example of the relation between independence, trust and effectiveness. Often I had the experience that the operator had not been proactive enough to be open to the public whenever there was an identified safety problem. So it was the task of the regulator to inform the public in order not to loose the public trust. As a consequence, the operator was blamed and reacted with mistrust against the regulator. Such behaviour could lead to growing communication problems between the operator and the regulator and in the end could weaken the regulatory effectiveness.

My advice would be that the regulator should encourage the operator not to hide safety problems or safety related events from the public so that the regulator could restrict themself to informing the public what his actions will be without blaming the operator. Following this process, the regulator could retain the trust of the public as well as the trust of the operator. These examples could be generalized under the issue of regulatory safety communication as a part of a safety culture that comprises both the regulator and the operator.

7. PROCEDURES TO IMPROVE INDEPENDENCE AND EFFECTIVENESS

Let me come back to the beginning of my contribution to this conference. All those examples and golden rules should give a hint that we could do something more. We should talk about how we could apply the IAEA standards practically and evaluate our broad experience in realizing independence. For me it was a great experience to try to look behind the curtains of some other regulatory systems and to understand their approach to be effective and independent. We should make our problems and individual solutions regarding this issue more accessible to others. I know that for some of us this is a sensitive issue. But nevertheless we could try to set up a pool of information that could:

- Provide us with reports of generic problems that are drawn from IRRS Missions;
- Provide us with literature about good practice related to structure and procedures;
- Abstract examples of problematic practices; and
- Contribute to the development of some more concrete rules as a basis for a future guide.

This should and could be done within the IRRS of the IAEA. Germany did apply for a mission of the IRRS, the former IRRT; so did other countries with a well developed regulatory structure. The IRRS is no more an instrument only to help countries who are or were on the way to build up independent regulatory authorities. It is an instrument that should play the central role in improving our independence and our effectiveness. It should be strengthened as an instrument to serve all of us including those who sometimes might have thought that they had no need to learn any more. The time of learning in a global partnership has just begun. But we will only learn if we don’t hide our problems, if we are self confident enough to openly communicate with each other even when it, sometimes, may be uncomfortable.

REGULATORY MANAGEMENT SYSTEM FOR LICENSING, INSPECTION AND ENFORCEMENT
Regulatory approach, planning, quality manual, feedback, and measurement and improvement of effectiveness

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Abstract

Licensing of nuclear facilities in Finland is based on a detailed review and assessment of the design against deterministic safety requirements and on additional verification of the design solutions and operating procedures with comprehensive probabilistic risk analysis. Design documents of important structures and components are reviewed before the start of manufacturing and the structures and components are inspected at various stages of implementation. The regulatory management system of STUK is documented in a QA manual that provides guidance on all work processes. It involves systematic planning and evaluation of activities, multiple means of getting feedback on the work processes, and continuous efforts to improve its effectiveness. Necessary factors for success are adequate human resources with professional competence in all the relevant areas for radiation and nuclear safety, a comprehensive and integrated assessment of safety issues, and an attention to detail. Personal responsibility and initiative of the staff is encouraged and emphasized in all decision making and everyone is advised to respond promptly to new safety concerns and to indications of deteriorating performance. Work schedule is responsive to licensee needs and a service oriented attitude is expected from the staff, also outside the office hours. Communication with the licensees and industry is open and functions at two levels: whenever different views or confusion exists, issues can easily be discussed among the experts and at the management level.

1. INTRODUCTION

The operating environment of nuclear regulators is undergoing a major transition in most countries. Owing to the global changes in the conditions for electrical power generation, driven mainly by the fast increases in oil and gas prices and the Kyoto process on climate change, it is possible that a major increase in the use of nuclear energy might appear in the next few years. New concepts for nuclear power plants (NPPs) as well as other nuclear fuel cycle facilities are under development and their safety review and licensing will need additional human resources and increased competences.

At the same time, in many countries like Finland the demography is changing to an unfavourable direction. Advances in modern technologies, the transition to an information society, and the employment opportunities available in a free market economy are appealing to the highly educated and talented younger generation. The public sector must compete more and more in order to get competent and knowledgeable staff from the decreasing population of the younger generation.

The key to sustainable success of a regulatory organization in carrying out its tasks is to achieve a commonly shared understanding that it must develop its human and social capital strategically with the required technical competence. For instance, the regulatory body could gain a competitive edge based on its ability to offer challenging tasks, stable employment and good working conditions and it could use these to attract new staff with the required qualifications. These developments are needed also to improve staff recruitment in the regulatory organization. It is therefore of utmost importance to pay serious attention to developing the management practices, work processes, staff competences, and working environment.

For succeeding and being effective, the regulatory organizations are required to have good businesslike management systems. This includes also advanced financial management that provides accurate information on actual costs of every task. In the following, a case example will be given how the Radiation and Nuclear Safety Authority (STUK), the Finnish nuclear regulator, has addressed these challenges at the strategic level.

In order to give an idea of the boundary conditions of the management of STUK, the scope of the regulatory work on nuclear power plants and the resources available at STUK for this purpose are briefly described in this paper. The rest of the presentation addresses the management system of STUK in general and the management of nuclear power plant regulation in particular.

2. ROLE OF STUK AS THE NATIONAL NUCLEAR REGULATORY BODY

Construction permits and operating licenses for nuclear facilities in Finland are issued by the Government, and the Ministry for Trade and Industry provides administrative support for processing applications. This involves collecting and summarizing the statements and views on the application, preparing the license text with appropriate conditions, and presenting the case to the Government for decision. A prerequisite for any license is the safety evaluation received from STUK and a concluding statement by STUK that from the safety point of view there are no obstacles for issuing the license.

Safety evaluation and all inspections related to the licensing process, as well as the inspections needed to verify the safety status of the facility and the compliance with license conditions over the plant lifetime are conducted by STUK. STUK is also authorized to give binding orders to the licensees as needed to ensure nuclear safety. This means that STUK is functioning as the nuclear regulatory body in Finland.

The number of persons working at STUK is 330. Among them, 80 professionals work in regulation of nuclear power plants, and 20 professionals regulate nuclear materials safeguards and nuclear waste management, including final disposal. Other duties of STUK are regulation of the medical and industrial use of radiation, conducting research in radiation protection, and providing expert services related to radiation and nuclear safety.

A specific feature of the Finnish nuclear regulation is the comprehensive set of national nuclear safety regulations that STUK has developed since 1970. It covers both technical and organizational requirements for nuclear power plants, and also explains in detail what STUK expects from the licensees when conducting safety evaluations and inspections. Regulations are updated as necessary to keep them at the level of state-of-the-art technology. Binding requirements are of the type of general safety principles and are issued as government decisions. Other safety criteria are given in a comprehensive set of non-binding regulatory guides issued by STUK. Any of the criteria can be made binding with a STUK decision if considered necessary for safety.

Finnish nuclear safety requirements and guides aim for a systematic and strictly implemented defence-in-depth approach and they include rules for redundancy, diversity and physical separation as well as for qualification of equipment. They also specify the deterministic safety systems design basis, scope of safety analysis and acceptance criteria. Meeting the deterministic requirements is a necessary but not adequate condition for design approval. In addition, there are numerical risk limits and the design has to be verified with a comprehensive level 2 probabilistic risk analysis (PRA).

Safety evaluations and inspections conducted by STUK penetrate into the details of systems, structures, and components and also into the operation and management practices of the licensees and their contractors. Technical issues are evaluated on the basis of their soundness from engineering point of view and not just by assessing them against given formal regulations and standards. All safety documentation submitted by the licensees is reviewed by STUK's staff members, but STUK also makes contracts with expert organizations in order to get independent advice and reference information as needed to support regulatory decision making. Contracted work includes independent safety analyses, testing, and focused expert judgements on topics specified by STUK.

All regulatory costs are recovered from the licensees, based on the hours actually worked. Therefore, accurate information is available on effective person-years spent annually for regulation of each NPP. Total regulatory effort of 20 person-years has been allocated annually for operating NPPs in the recent years and it is divided quite evenly to all operating NPPs in Finland (Loviisa 1 and 2, Olkiluoto 1 and 2). Safety evaluations and inspections before issuing the construction permit to Olkiluoto 3 required 31 person-years of work at STUK, and about the same amount of contracted work. During the first year after Olkiluoto 3 had received its construction permit, STUK conducted 24 person-years of regulatory work on that plant.

3. FRAMEWORK FOR THE REGULATORY MANAGEMENT SYSTEM APPLIED AT STUK

The framework established at STUK for managing its regulatory work follows a closed feedback loop, ‘plan-do-check-act’, as shown in Fig. 1. The main management tools used in each of the four blocks of Fig. 1 are described in Section 3. Examples of some management practices are given in Section 4.

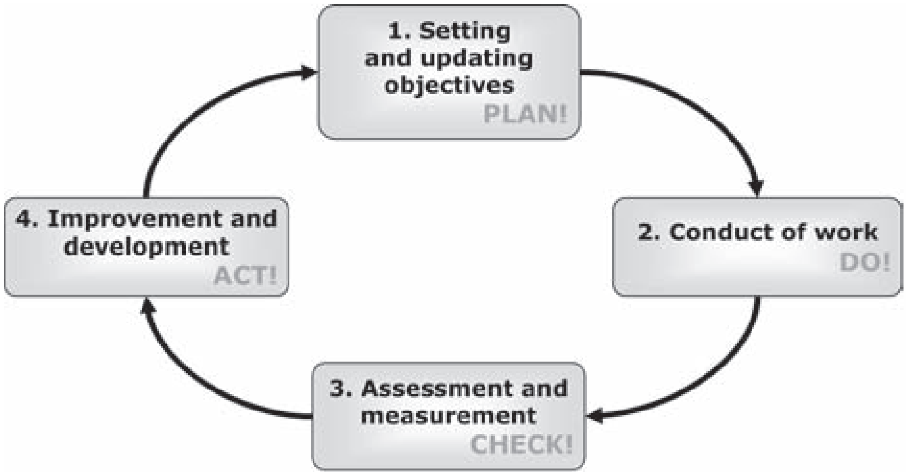

FIG. 1. Feedback loop of the regulatory management system applied at STUK.

3.1. Setting and updating objectives

Management objectives are set in two timescales: four year strategic planning cycles and annual plans. Currently the strategic plan for 2003–2006 is being implemented and input for the next four year cycle is being collected. The strategy for 2007–2010 will be drafted by STUK's management group in its traditional summer retreat and finalized with comments from the staff during the fall. More detailed action plans that are written for each of the 12 result areas of STUK, by the persons responsible for the respective areas, are used as tools to support the implementation of the strategic plan. Regulation of nuclear power plants is the largest of these result areas.

The input for the strategic plan comes from three main sources:

(1) Information on future plans and programmes of the main stakeholders (NPP licensees, users of radiation, national government, European Union)
(2) A SWOT (strengths, weaknesses, opportunities, threats) analysis of other known and potential changes in the operating environment
(3) Improvement and development needs indicated by the systematic assessment and measurement (see Section 2.3).

Annual planning cycle for each year is started at the end of preceding summer with guidance given by the management. The guidance is based on the strategic plan and the need for development identified from the feedback loop. Also the plans and expectations of stakeholders are taken into account. Planning process goes top down in the first step involving meetings of organizational units and then bottom up in the second step through systematic face-to-face discussions at all levels between the supervisors and their subordinates. The output of the process is a work plan that provides performance and development goals for each person, for each organizational unit, and for the entire STUK. Among the goals are output of the work, development of the work processes, and development of the staff knowledge and skills. Performance goals and annual targets of STUK are written in an agreement that the management signs with the Ministry of Social Affairs and Health.

3.2. Conduct of work

Conduct of work at STUK is guided by the quality manual. The manual is a comprehensive set of standing orders, guides, and procedures that give instructions on all operations of STUK, including both administrative and professional work. It starts from a quality policy that explains what the management means by high quality in each of the main work areas. It also describes the tasks and responsibilities of all organizational units and persons, as well as practices of management and internal communications at all levels.

The main part of the quality manual consists of descriptions of STUK's work processes and guidance for managing those processes. The main and sub-processes in NPP regulation are shown in Fig. 2.

The process guidance is written by those persons who have main responsibility for the respective processes and it is intended to ensure that regulatory tasks and other duties at STUK are carried out in a consistent and predictable manner. Process guidance related to review and inspection duties does not address the substance of the work but the professional staff is expected to work on the basis of their own knowledge and skills, within the limits set by the applicable rules, standards and previous decisions of STUK on similar issues. Guidance for administrative tasks is more detailed in order to ensure smooth, correct and efficient conduct of routine work.

An important element in managing the conduct of daily work is the practice of holding regular meetings (every two weeks) of STUK's management group, of each Department's management group, and of the staff of each basic organizational unit.

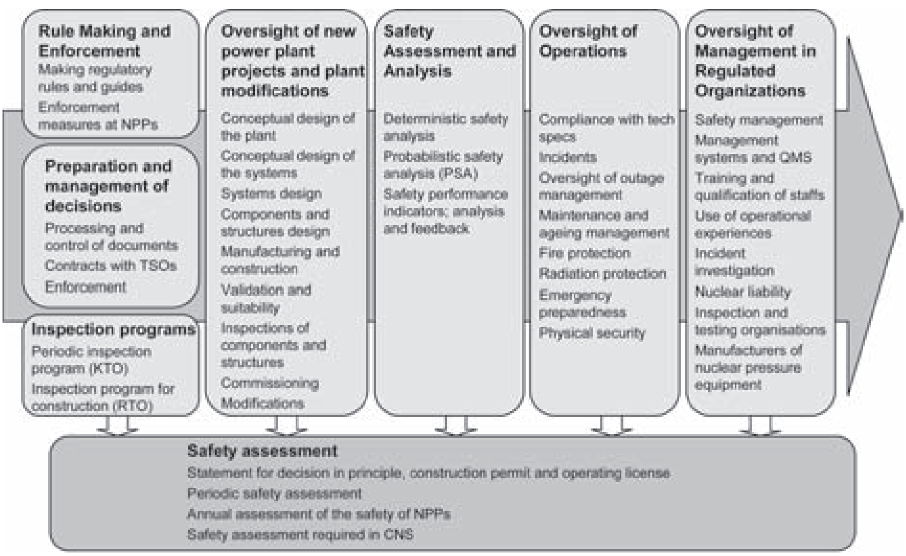

FIG. 2. Main and sub-processes of nuclear power plant regulation at STUK.

3.3. Assessment and measurement

Operations and performance of STUK are assessed both internally and externally. Internal assessment involves the following activities:

(a) Systematic follow-up of achievements against the agreed annual targets;
(b) Cross-audits conducted by staff members according to annual audit programme;
(c) Self-assessment carried out in internal workshops of organizational units;
(d) Staff surveys repeated every two years (on staff engagement, motivation, satisfaction, etc.);
(e) Annual report submitted to the Ministry on work results and developments, including assessment against agreed targets and other performance indicators.

External assessments are conducted by international and national peers, including the following:

(a) Regulatory activities were evaluated by an IAEA IRRT mission in 2000 and a follow-up in 2003.
(b) Research activities (only radiation protection research is conducted at STUK) have been evaluated twice (2000 and 2005) by a team of leading foreign scientists and will be done again in 2010.
(c) One or two topical audits every year by external experts who are working on similar issues.

In addition, financial management of STUK and performance in some substantive area is assessed annually by the Government auditors.

Important feedback for assessing regulatory effectiveness and success in other activities of STUK is also received from surveys and interviews that are made among the stakeholder representatives.

3.4. Improvement and development

A general policy at STUK is to strive for continuous improvement of work processes and regulatory effectiveness. Recommendations for improvements are provided in audits, assessments and evaluations, but development can be started also based on other initiatives. An important source of development ideas is the information received from operating and regulatory experience as part of the international cooperation.

Recommendations and other ideas that the management finds reasonable and easy to implement can be addressed without delay. Recommendations that would require a specific development project are considered when making annual plans. Needs for major modifications in the organization or operating practices are considered in connection with strategic planning.

Once a year the management makes a review to find out to what extent the plans and development targets have actually been met, and decides on actions that may be needed to complete the agreed tasks.

4. EXAMPLES OF MANAGEMENT PRACTICES AT STUK

4.1. Strategic plan

A sound basis for the strategy is given in STUK's mission, vision, and values that are presented below. They are not expected to change in the foreseeable future.

Mission:

Protecting people, society, environment, and future generations from harmful effects of radiation.

Vision:

Level of radiation and nuclear safety is high in Finland and provides an outstanding standard for international benchmarking.

STUK is well known and respected as an expert organization, as an independent regulator dedicated to safety, and as an influential international actor.

Values:

Competence — decisions, positions and other measures are based on professional knowledge and competence.

Openness — acting is open and honest, both towards stakeholders as well as in internal communication.

Courage — problems identified, as well as own views, are brought up rigorously. Responsibility for own decisions and acts is acknowledged and possible errors are corrected.

Strategic planning is done using the ‘balanced score card’ approach which is also the basis for making annual plans and for reporting the results to the Ministry. In this approach the main idea is that achieving sustainable results requires a balanced management attention to four target areas. In addition to effectiveness, equal weight needs to be given to other areas that provide necessary conditions for effectiveness in the long term. The target areas and the success factors derived from the mission and vision are presented in Fig. 3. Main chapters of the strategic plan provide the management policies for promoting the success in all target areas, and set priorities and expected outcomes. Separate action plans written for the result areas provide means to implement the strategy.

4.2. Staff engagement

In the discussions among the staff on STUK’s values, the value that is always mentioned as number one is professional competence. Staff is motivated to give best possible quality in their work and a high work ethic has

FIG. 3. Success factors identified in STUK’s strategy.

grown within the organization since it was established almost half a century ago. This basic attitude is the main driver that needs to be used and further strengthened for ensuring and promoting staff engagement in regulatory tasks.

The best way to motivate the personnel and to achieve good work satisfaction is to give people tasks they find meaningful and challenging with respect to their personal capabilities. Unambiguous description of tasks and responsibilities, and setting of specific goals are thus necessary. In order to ensure efficient work but avoid stressing and overloading of individuals, it is most important that everyone has a feeling of being able to accomplish the committed tasks and a confidence on his or her ability to meet the management expectations.

Personal responsibility is emphasized in all work and especially in decision making. Preparation of regulatory decisions is delegated to the expert level with the best information and knowledge on the relevant issue. A memorandum explaining the decision basis is annexed to the decision letters and kept for records. Decisions are usually made as proposed by the experts unless there are some contradictory factors and thus good reasons to deviate from the expert position. In such cases the issues are thoroughly discussed between the experts and the decision makers and the reasons for deviating from the proposal are explained.

Consensus among regulatory experts is pursued in preparing a decision. If differences of opinion remain, they are recorded in the decision basis documents and the experts can bring them to the attention of the highest management level at any time during the process.

Staff initiative is encouraged. Every expert is advised to respond promptly to new safety concerns and to indications of deteriorating performance. Everyone is also expected to develop his or her own work process, and to participate actively in the internal self-assessment workshops, where ideas for improving work processes can be brought up for discussion.

The staff expects fair and equal treatment from the management. This includes trust, appreciation, encouragement, and positive feedback. Internal communication is also an important issue that gives everyone a feeling of getting correct and timely information on all topics that are relevant for his or her own work. The management stresses that they are willing to listen to personnel whenever the personnel consider it necessary. Moreover, there is a well functioning formal cooperation between the management and staff representatives. Regular cooperation meetings are held to discuss all issues of personnel management.

Last but not least, in order to promote staff involvement with STUK's mission the management is committed to provide everyone with a safe working environment and the necessary support of the work community both in work related and in personal problems. All available means are used to maintain the security of employment. Discrimination or improper behaviour is not tolerated in any form.

4.3. Some highlights of the conduct of work

The main administrative tool for ensuring the cost effectiveness and consistency of work is the quality manual. The predictability of the regulatory positions and regulatory measures is further strengthened by the organizational memory, by the documented basis for the earlier decisions, and by communicating the management views and information on important decisions in staff briefings.

Being effective requires that the right things are done in the right way. It is, therefore, necessary that all professional staff members have a good understanding of the importance of different elements of the defence-in-depth concept in nuclear safety and they use this knowledge when planning review and inspection programmes. Plant specific PRAs are an important tool in ensuring that the regulatory measures are focused and prioritized in a risk informed manner. Insights from PRAs can be directly used because many inspectors have participated in the initial PRA reviews and refreshed their knowledge in periodic safety reviews. The integrated annual safety assessment that is based on the inspection results and on the safety performance indicators is also used as an input for choosing the inspection targets for the subsequent year.

In all regulatory work the management emphasizes a service oriented attitude and it has become an integral part of STUK's work culture. It is a basic assumption among the entire staff that STUK is available any time of the day and year if the licensees request mandatory inspections or fast regulatory decisions. The priorities in work schedule can be changed in a flexible manner to respond to the licensee needs.

During inspections and other contacts with the stakeholders STUK representatives are instructed to behave in a manner that promotes good safety culture.

Communication with the licensees and industry is open and easy. Informal direct contacts can be made anytime by either side if different views or confusion exist and need to be quickly resolved. If a regulatory decision is intended to be different from the one proposed by the licensee, the licensee is always contacted and given a possibility to present comments or further arguments before making a formal decision. Working level or management level meetings can be arranged with short notice for ensuring that all aspects have received due attention. Regular meetings with the licensees are arranged after outages to get feedback both ways and the regulatory management exchanges information on current issues and plans with the licensee counterparts several times a year. In these meetings even small concerns can be raised and discussed in an informal manner.

4.4. Development of human capital

Necessary factors for the success of STUK are adequate human resources and professional competence in all areas relevant to radiation and nuclear safety. Maintaining and developing human capital is supported by mapping of competence needs and actual available competencies within each organizational unit. The original versions of maps were developed by the respective units with support of a consultant and they contain information on skills and knowledge of each person. The competence maps are kept current and are used for:

(a) Making personal development plans for each person;
(b) Succession planning and recruitment of new staff;
(c) Planning development of human capital in the long term (i.e. number of staff and type of competences to respond to future needs).

A systematic orientation to regulator's duties, based on written guidance and a check list, must be provided to new staff members by their supervisors and a standard initial training course is arranged several times a year. Subsequently, the staff is expected to attend training courses on various topics for about two weeks every year. More important, however, is on-the-job training in teams and with senior staff members. A special feature in regulatory work at STUK is the balanced combination of review and inspections tasks that give the staff both theoretical understanding of the issues and practical hands-on experience. There are no separate reviewers and inspectors but all professionals work both in the office and in the field.

Another feature to be noted in staff development at STUK is the lack of formal qualification as a regulatory inspector. Each individual gets gradually more demanding tasks and more responsibility. At the beginning a close supervision is provided by the senior colleagues or the unit head but with the increasing trust on the work skills the amount of supervision is reduced. Duty position and the respective salary are graded along with demonstrated increasing performance and knowledge. Each individual can become, in the same basic organizational position, a world class expert if he or she is not interested in moving to a management career.

In case STUK has inadequate corporate knowledge on a specific topic relevant to safety, it can use consultants who provide advice and at the same time support the development of in-house knowledge.

A continuous programme is run for leadership training, and all supervisory staff is expected to attend. The topics are agreed as part of annual plan, and the programme consists of lectures followed by discussions in small groups among supervisors. Conclusions of those discussions are used for developing STUK's management processes. New people entering supervisory positions are sent to appropriate management courses provided by external training organizations.

In order to ensure recruitment of high quality staff, STUK keeps active contacts with universities and provides summer job and graduation job opportunities for students. STUK experts also serve as lecturers in universities. This approach has ensured good visibility and good reputation that attracts students as well as an opportunity to recruit from students found to possess qualifications needed for performing STUK tasks. More experienced staff is attracted by STUK's good reputation as employer, competitive salary, good working conditions, and a possibility to work in an organization that enjoys high appreciation and trust of the society.

4.5. Financial resources and tools

A good financing position and adequate flexibility to take into account even major changes in workload were achieved when STUK agreed some years ago with the Ministry that it can charge regulatory costs directly to the licensees. At the same time the management committed to ensure that any unfounded escalation of the regulatory costs is avoided. The costs can be increased only at the same rate as the inflation, unless there are new projects that evidently require more resources. The system has functioned well, and the licensees are generally satisfied. To day they get regulatory response to their applications and proposals without harmful delays that might be caused by lack of regulatory resources.

The financing system requires accurate recording of work hours and an advanced accounting system. To have these systems in place is very helpful also for planning and managing STUK operations and investments. The management is now able to provide modern tools and good physical working environment to the staff and it does not need to spend much time and effort in trying to find financial means for necessary operations. This is important also for increasing staff motivation and engagement

4.6. Public communication

Public communication has in the recent years become an important element of STUK's management. It is now considered inevitable for earning and maintaining trust among the public and stakeholders. Public trust is one of the main prerequisites for success in STUK's mission.

STUK management has declared a policy to communicate openly, promptly and proactively about radiation and nuclear safety related issues. STUK also maintains a duty system for ensuring that the relevant experts can be contacted around the clock. Communication on own work area is the privilege and duty of all employees.

All experts providing information to the news media are reminded that the communication must be based on the best available information. Also, sensitive matters need to be openly communicated unless they are related to the physical security of NPPs.

Good cooperation with the media is emphasized as a means to reach all citizens and to provide them with correct information. A prerequisite for a successful communication is that STUK is well known among the news media and the general public and the information given by STUK is regarded as truthful.

MEETING CHALLENGES THROUGH GOOD PRACTICE
Using the highlights from the third review meeting of the Convention on Nuclear Safety to improve national regulatory systems

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Abstract

The third review meeting of the Convention on Nuclear Safety (CNS), held in April 2005, demonstrated collective progress on ensuring worldwide nuclear safety. The Contracting Parties highlighted areas of focus to be brought back to the fourth review meeting and also committed to a continuity process to revitalize the review processes under the CNS. Specific progress has been achieved in the first year since the conclusion of the third review meeting, but further commitment to progress is required, by the Contracting Parties and the Secretariat of the IAEA, over the next year, especially if changes to the review processes are to be achieved for the fourth review meeting in 2008.

1. INTRODUCTION

Highlights from the third review meeting of the Convention on Nuclear Safety (CNS) offer some perspectives on how to use this international peer review process to make national nuclear regulatory systems more effective. This paper proceeds through three parts.

First, it briefly summarizes the highlights from the third review meeting that was held last year. Second, it focuses on improving national nuclear regulatory systems through a closer examination of the Convention's obligations respecting national regulatory bodies by reviewing the specific observations on regulatory bodies that were contained in the final summary

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report from the third review meeting. The paper underscores the next steps by the Contracting Parties and the IAEA. Third, and finally, the paper reviews the commitment that the Contracting Parties made at the conclusion of the third review meeting to support an ongoing continuity process that would examine various improvements to the peer review processes under the Convention.

2. HIGHLIGHTS OF THE THIRD REVIEW MEETING OF THE CNS

The third review meeting of the Convention on Nuclear Safety was held in Vienna from 11–22 April 2005. Fifty-one of the fifty-six Contracting Parties participated and India was unanimously granted special observer status at the meeting. In essence, with the exception of six nuclear power plants in Taiwan, China, the Convention on Nuclear Safety now covers all operating nuclear power plants in the world. An outstanding issue that does remain, however, is the coverage of nuclear power plants under construction, especially in non-Contracting Parties.

The third review meeting also featured a special panel discussion on the "role of leadership" in nuclear safety which concluded that there is a need for strong leadership in both regulators and industry chief executive officers to ensure safety in these complex times.

The peer review process continued as per the previous review meetings. However, guidance was issued in advance to assist the Contracting Parties to focus their presentations and templates were used to collect the information from these peer review processes. While both these tools need further refinement, they were important steps toward improving the peer review process. In addition, commitments were also made to adhere to the rules throughout the meeting. An open ended working group was afforded every opportunity to make the necessary rule changes. To this end, the Contracting Parties agreed to important changes to the rules governing the format of future meetings, particularly those pertaining to transparency of documentation, participation in country group sessions and knowledge management from one meeting to the next.

The final summary reports and the President's report of the review meeting delineated the outcomes of the meeting for the use of Contracting Parties in follow-up and public communications. Finally, several media interactions were held throughout the process to raise the profile of the Convention and its objectives. While respecting the confidentiality provisions of the CNS and its peer review process, these fora were used to state the progress in nuclear safety that had been achieved since the last meeting as well as the challenges requiring further work prior to 2008.

The final summary report also highlighted several issues that were to be brought back to the fourth review meeting, including inter alia, experience with International Regulatory Review Team (IRRT) missions, implementation of quality management systems in regulatory bodies, development of assessment tools for safety management systems, methodologies for analysing human factor events, reduction of collective doses resulting from long periodic inspections, risk informed regulatory decision making and experience with periodic safety assessments.

3. OBSERVATIONS ON REGULATORY BODIES

Article 8 of the Convention on Nuclear Safety outlines the obligations placed on the Contracting Parties with respect to their regulatory bodies. Specifically:

(1) Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

(2) Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

In their national reports and then in their presentations at the review meetings, the Contracting Parties are supposed to demonstrate how they are meeting these obligations.

It is through reviewing the specific observations on regulatory bodies from the summary report of the last review meeting that the major challenges facing many regulatory bodies and Contracting Parties in their efforts to build effective national nuclear regulatory systems and good practices can be identified.

3.1. Human and financial resources

As with previous review meetings, the structure and functioning of regulatory bodies featured prominently in the third review meeting. Many

Contracting Parties reported on restructuring of their regulatory bodies and bestowing increased authority through legislative changes.

Many Contracting Parties reported on the human resource challenges in the context of their responsibilities for assuring the maintenance of a competent workforce and for the provision of adequate financial and human resources for the regulatory body. Some regulatory bodies have been negatively impacted by government-wide spending reductions.

Some Contracting Parties have taken active steps to improve the human and financial situations of their regulatory bodies. Recruitment and retention challenges include competitive salaries, succession planning programs, written guidance to successors, mentoring (or shadowing) of newcomers with experienced staff, and the development of systematic training programs.

Recognizing the importance of maintaining competence in nuclear safety, several Contracting Parties indicated that regulatory bodies, with the support of their governments, would be developing and undertaking systematic programs to compensate for expected retirements and loss of knowledge and to include support for higher education and training programs as well as enhanced national, regional and/or international research capacity.

3.2. Effective regulatory frameworks

In general, the Contracting Parties are striving to develop new regulatory frameworks and approaches to improve effectiveness and efficiency. There were reports on four developments in this regard.

First, in terms of frameworks, steps had been taken in several Contracting Parties to merge regulatory responsibilities, which had previously been separated amongst different agencies, into one regulatory body. Second, within the regulatory bodies of some Contracting Parties, there was a convergence towards risk informed regulatory approaches. Third, several Contracting Parties reported on modern management systems being developed within regulatory organizations. Fourth, integrated safety oversight programmes including the use of performance indicators are being developed.

3.3. Quality management systems

While many Contracting Parties reported that they had begun the process of implementing quality management systems within their regulatory bodies, many also noted the challenges in these tasks. Accordingly, the implementation of quality management systems within regulatory bodies is expected to be highlighted in national reports and presentations at the fourth review meeting.

3.4. Communication and dialogue

Many Contracting Parties stressed the importance of appropriate communications and dialogue between the regulator and the operator. This dialogue and communication, at both senior management and working levels, is important in addressing urgent as well as mid- and long-term safety issues.

3.5. Effective independence: An essential element in nuclear safety

As was reported at the second review meeting, questions remain as to the effective independence of regulatory bodies in some Contracting Parties. The effective independence of regulatory bodies is considered an essential element in nuclear safety.

All Contracting Parties need robust means to ensure that there is no undue pressure or interference on their regulatory bodies. The regulatory bodies of many Contracting Parties appeared to act in a clearly independent way in a de facto sense, relying on well established management policies. Nevertheless it was noted that in several cases, it remains desirable to further improve the de jure independence of the regulatory body. However, independence given to the regulatory body must be matched by the ability of the senior regulators to be courageous in demonstrating this independence.

4. NEXT STEPS BY CONTRACTING PARTIES AND THE IAEA

The next steps that are necessary between now and the next review meeting of the CNS fall under two broad groups, namely next steps by Contracting Parties and by the IAEA. The Contracting Parties, and in most cases their national nuclear regulators, signing the Convention should be living the principles of it on a daily basis. It means commitment to continuous improvement through revisiting the results of the specific peer review process for their country and by developing the necessary action plans for measures to improve safety to address the challenges that were raised. For the IAEA secretariat, specific milestones identified in the final reports and continued integration of routine activities with objectives of the CNS should be pursued.

5. PROGRESS THROUGH CONTINUITY

At the conclusion of the review meeting in April, the Contracting Parties committed to reform of the review processes through continuity between the third and fourth review meetings of the CNS. The continuity process was the subject of a keynote address to the senior regulators meeting in the margins of the IAEA General Conference in September 2005. Some specific measures have already been taken.

Work has been pursued with the IAEA secretariat to ensure knowledge management and capture of key information associated with the processes and conduct of the third review meeting. This information will help the executive and organizers of the fourth review meeting.

In December 2005, a major step was taken toward resolving the unnecessary overlap that was created between the safety of power reactors and research reactors under the CNS by clearly demarcating this separate process for moving forward on the implementation of the code of conduct for the safety of research reactors.

5.1. Friends of the President of the CNS

Under the current President of the CNS, a group of 'Friends of the President' is being identified who will be assisting the continuity process.

The Contracting Parties agreed to report, on a voluntary basis, the use of IAEA safety standards within the review meeting. To this end, the IAEA was specifically tasked to develop a synopsis of the safety objectives of international standards and those of the Articles of the Convention. This synopsis will be an important input to developing new guidance on the structure of national reports.

It was decided that improvements were needed in the process of peer review. One of the principal drivers in the peer review process is the national report format. Over the next six months, a new national report format will be proposed. Other related issues include selection and training of officers, revisions to the templates and a consideration of the role of the IAEA.

The role of the Contracting Parties without nuclear power plants requires study and recommendations. Their reporting could be different while permitting more time for peer review questioning and participation in the sessions of the Contracting Parties with nuclear power plants.

Issues of transparency and independence were also raised in the concluding sessions of the review meeting. There is interest in developing these areas so as to identify suitable measures to enhance these processes and reporting within the context of the next review meeting.

The most important and immediate objective is enhanced communications. Without enhancing the means of communications amongst all Contracting Parties in all areas of continuity, it is not possible to achieve the full

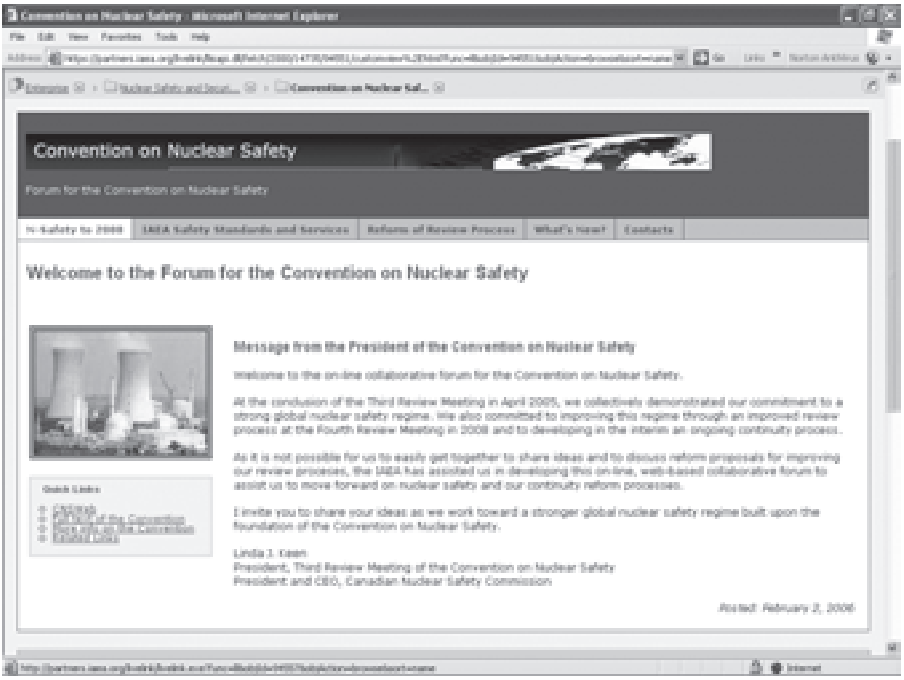

FIG. 1. 'Webshot' from the new on-line Forum for the Convention on Nuclear Safety.

potential of the ongoing continuity objectives flowing from the third review meeting of the CNS.

5.2. Forum for the CNS

The new Forum for the CNS (see Fig.1), developed with the assistance of the IAEA secretariat, is a new on-line collaborative forum that complements the existing public websites and protected members' websites by offering the Contracting Parties a vehicle for exchanging ideas and discussing reform proposals for the review processes. It is not very easy for the Contracting Parties to get together. Therefore, a new website has been built using existing IAEA platforms and based on the objectives that have already been set. The Forum for the CNS assists the Contracting Parties in fulfilling the objectives only if it is used and used to its full potential.

6. CONCLUSIONS

Time is short. The first anniversary of last year's review meeting is approaching and many countries will be starting their drafting of the fourth report this fall. Action is needed now to improve the review process, if change is to be realized for the next review meeting in 2008.

The CNS is important to the global nuclear safety regime. Its peer review processes reinforce ongoing responsibilities but lessons offered and learned must be put into action by each Contracting Party within their own country. This commitment is necessary to ensure strengthened nuclear safety by the time of the fourth review meeting in 2008.

ROLE OF INTERNATIONAL STANDARDS AND INTERNATIONAL COOPERATION FOR EFFECTIVENESS OF NATIONAL REGULATORS

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Abstract

The design, construction and operation of nuclear power plants, though a national activity, have transboundary and international repercussions. Therefore, activities related to nuclear safety of nuclear power plants attract international interest. In this regard, agencies such as the IAEA have played a very constructive role. The paper examines the role international standards play along with international cooperation to enhance effectiveness of national regulators. Such national regulators usually belong to countries that import nuclear power plants and may lack an advanced industrial infrastructure at par with other exporting countries. International cooperation is, therefore, needed to assure an acceptably high level of safety keeping in view the economy, public acceptance of risks, vendor ease, utility benefit and regulatory effectiveness. Furthermore, international standards — which may be design or fabrication or installation standards — are prepared by large national and/or multinational groups of knowledgeable experts. However, these standards based on knowledge and experiences appear to be information for the regulators of a nuclear power plant importing country. International cooperation is needed to re-transform this information into knowledge at the user end. The paper includes a brief description of such cooperation under an IAEA technical cooperation project entitled Applicability of IAEA Nuclear Safety Standards for NPP in Pakistan-(PAK/9/29), which is an example of international cooperation in the use of international standards to enhance the regulatory effectiveness of the national regulator in Pakistan. The role international organizations play in helping regulators become more effective is also highlighted which is necessary in an expanding international market for nuclear power plants and achieving the common global goal of providing affordable, secure, sustainable and safe electricity without undue hazards to man and his environment.

1. INTRODUCTION

Operation of nuclear power plants may have trans-boundary effects and should be sited, built and operated in a manner that other States are not adversely affected, which is a general international obligation. Use and implementation of international safety standards provide necessary assurances in this regard. Moreover, the international safety standards promote international trade and cooperation and ensure that a consistent approach to safety is followed in all States. States establish nuclear regulatory bodies to verify that nuclear power plants in the State are sited, built and operated according to acceptable standards of safety. The effectiveness and efficiency of these regulatory bodies depend on the degree of maturity of nuclear power programmes and level of knowledge and competency in the stake holders, which include the operating organization, suppliers, universities and regulatory body. Any shortcoming can be compensated by international collaboration as it is essential that the effectiveness of national regulators is ensured by other States through international cooperation so that the nuclear and radiation related technologies are continuously used safely for the benefit of humankind.

The Pakistan Nuclear Regulatory Authority (PNRA) is the national statutory nuclear regulatory authority in Pakistan entrusted with the task to regulate all aspects of application of ionizing radiations and nuclear energy in Pakistan. The national nuclear safety regulations in Pakistan are based on the IAEA safety standards and are complemented by safety standards of the United States of America and the exporting country. For achieving regulatory effectiveness in implementing the national regulations, the PNRA seeks and avails itself of international cooperation and feedback.

In the following sections, an attempt has been made to describe the implementation of national nuclear safety regulations — based on international standards — through international cooperation conducted under an IAEA technical cooperation project entitled Applicability of IAEA Nuclear Safety Standards for NPPs in Pakistan-(PAK/9/29).

2. INTERNATIONAL SAFETY STANDARDS

Nuclear safety standards are required to establish a link between the requirements of the society specified in terms of safety goals, permissible doses, permissible radioactive releases, etc., and the capabilities and practices of the industry specified in the industrial standards such as ASME, RCC, IEC, ISO, IEEE, ACI, etc. As shown in Fig. 1, the safety goals etc. occupy the top tiers of the regulatory pyramid and may vary from one society to another but given the trans-boundary consequences of nuclear power plant operation and the fact that the world is shrinking in to a global village, most countries have set similar goals.

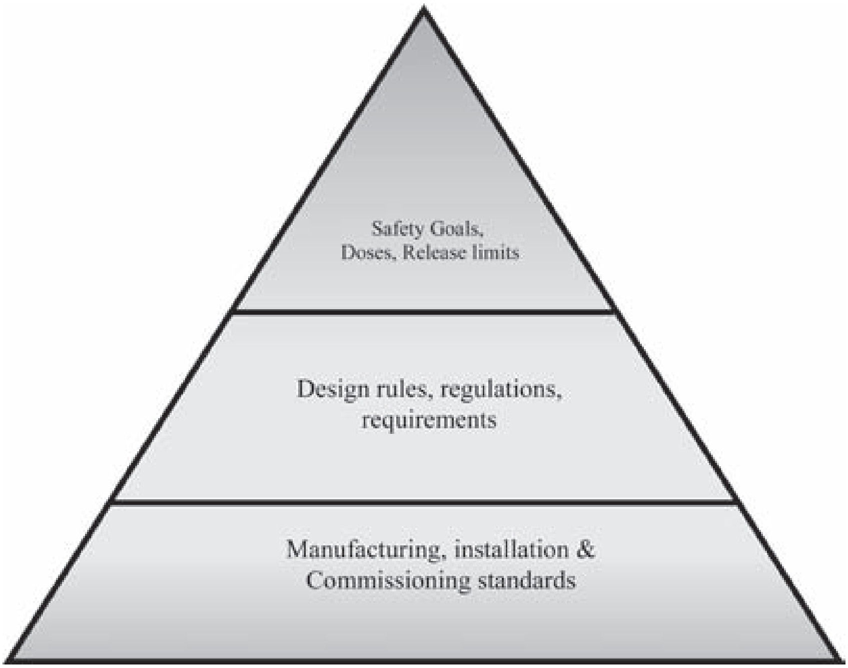

FIG. 1. Regulatory pyramid.

The IAEA safety standards occupy the middle tier of the pyramid. The IAEA launched its safety standards programme in 1974 to address the question of the basis of safety of exported plants and how that safety was ensured. It was observed that there were significant differences in safety standards of exporting countries such as France, Germany, United Kingdom, USA, etc. The aim was to establish a set of international nuclear safety rules by consensus. After TMI, export and installation of new nuclear power plants declined significantly worldwide. Consequently, few new safety standards related to design were issued. However, the IAEA continued its work on safety standards. Therefore, the IAEA standards are most up-to-date and accordingly, these are a good option for countries desirous of importing nuclear power plants expected to operate for the next sixty years or more. The IAEA standards are truly international in character as these are drafted by an international group of experts, reviewed by the Member States and approved by the IAEA Board of Governors and these are kept current through periodic and regular reviews.

The Convention on Nuclear Safety (CNS) is based on the IAEA publication Safety Fundamentals: The Safety of Nuclear Installations (Safety

Series No. 110). All countries operating nuclear power plants are party to this Convention and the internationally agreed standards provide an excellent reference for the contracting parties to demonstrate that they are meeting the obligations under the Convention. The standards are also being used by countries as a global benchmark. A few countries have used these as a basis or reference for their national regulations whereas some have adopted these as national regulations. However, these standards have never been applied to the whole licensing process of a nuclear power plant. Such problems are described later in the section describing the case study.

The bottom of the pyramid is occupied by the industrial standards. These are issued by industrial societies such as IEEE, ASME, DIN, API, etc. or by international organizations for instance ISO, IEC, etc. These are the standards which are actually used in the design of the nuclear power plant systems and components and determine the hardware and software configuration of the plant. The design of pressurized water reactors varies in countries such as China, France, Germany, UK and the USA, amongst others, and one reason for this is the set of safety standards applied. The regulatory pyramid of the IAEA does not have this tier but it is likely that in future this gap would be filled to make the IAEA standards truly global and complete. This would make designing and licensing easier for future nuclear power plants and create an international market where design and equipment can be supplied by different countries at competitive prices thus helping in achieving economic viability for nuclear option in a deregulated electric power industry.

Another problem faced is that the IAEA safety standards and industrial standards are drafted by experts of international repute and these standards reflect the collective national and/or international experience. However, for a regulatory body of a country with a nascent or small nuclear power programme – lacking an industrial base and infrastructure – it is merely information. To effectively apply these standards such regulatory bodies need assistance to re-convert this information into knowledge. The PNRA has been participating in an IAEA technical assistance project to achieve this end. This has been described in the case study.

3. INTERNATIONAL COOPERATION

PNRA Ordinance 2001 authorizes the PNRA to take measures for international cooperation and liaison in the area of nuclear safety and radiation protection. Accordingly, the PNRA is working closely with the IAEA and regulatory bodies of other countries. The PNRA has strong links with the regulatory body of China and has been working together in the review of safety submissions leading to licensing of the nuclear power plants imported from China. The PNRA is a member of NERS – a group of regulatory bodies of countries with small nuclear power programmes. Arrangements are in place for sharing of personnel and safety related information with Finnish Nuclear Safety Authority (STUK) and Nuclear Regulatory Commission of United States of America (USNRC). An agreement has been signed with VUJE — a consulting organization of Slovak Republic — to avail consultancy services in the areas of nuclear safety review, assessment and inspection. The PNRA is also a member of the Centre for Nuclear Safety in Central and Eastern Europe (CENS) and Asian Nuclear Safety Network (ANSN). In addition, such links facilitate cooperation on a number of fronts, including the exchange of information and the training of PNRA staff.

The IAEA and the PNRA are extensively collaborating with each other for mutual benefit. In addition to the several technical assistance projects, the PNRA is participating in a number of Regional Asia (RAS) technical cooperation projects and peer reviews. It had invited IRRT and RASSIA missions. PNRA staff has participated in similar missions in other countries as IAEA experts.

The PNRA believes that a robust and safe plant is one which is designed, constructed, manufactured, installed, commissioned and operated during its life according to applicable international (IAEA) standards. In order to achieve this goal, the PNRA is using exchange of reviewers as well as inspectors to gain knowledge and to further enhance its effectiveness. Such visits have been used to conduct quality assurance inspections to verify that the applicable standards are being followed. In addition, the PNRA encourages missions such as OSART to its licensed nuclear powers plants. This helps to enhance safety during pre-operational and operational stages. Both OSART and IRRT peer review missions base their review and recommendations on IAEA safety standards. This is another mechanism by which countries use IAEA safety standards as a global benchmarking and safety enhancement tool.

Most regulatory bodies are regulating both safety and security aspects. International cooperation should, therefore, not merely be limited to application of IAEA safety standards but also extended to IAEA security guidance documents and assistance. The peace triangle shown in Fig. 2 requires all three elements safety, security and science for development. Regulatory bodies can and are cooperating through the IAEA to offer regional and international training courses to provide a common global approach to the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.

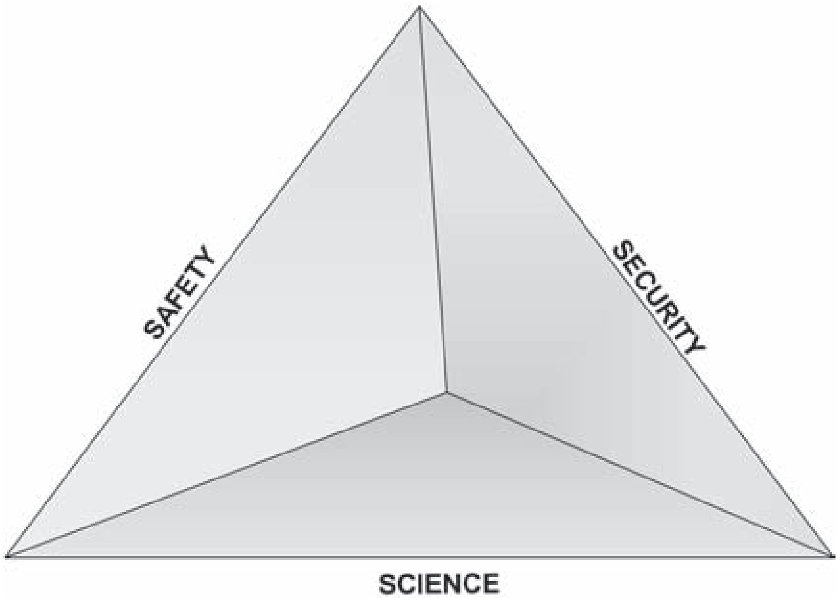

FIG. 2. Peace triangle.

The PNRA has utilized international cooperation to increase its regulatory effectiveness by broadening the knowledge and skills and enhancing the experience of its staff. In the context of international safety standards, the PNRA has been participating in the IAEA meetings of Commission on Safety Standards, Transport Safety Standards Committee, Nuclear Safety Standards Committee, Radiation Safety Standards Committee, etc. The PNRA and the IAEA are working together under an IAEA technical cooperation project to fulfill the vision of the IAEA standards as *global reference* for protecting people and environment through creation and maintenance of a set of harmonized safety standards of high technical quality that takes into account recent trends and developments. Therefore the objective of this project is similar to that of the international action plan (GOV/2004/6). It aims at strengthening application of the IAEA standards by Member States and helps in extending outreach of the IAEA safety standards, as these would be referred in safety reviews and regulatory inspections. As a spin off, the PNRA is expecting to enhance its regulatory effectiveness through the IAEA technical cooperation project entitled Applicability of IAEA Nuclear Safety Standards for NPPs in Pakistan-(PAK/9/29).

4. REGULATORY EFFECTIVENESS

Regulatory effectiveness per se means "to do the right work" whereas regulatory efficiency means "to do the work right". This has been stated in PDRP-4[1], Assessment of Regulatory Effectiveness. PDRP-4 also elaborates that given the necessary authority and resources as prerequisites, the regulatory body is effective when it:

- Ensures that an acceptable level of safety is being maintained by the regulated operating organizations;
- Takes appropriate actions to prevent degradation of safety and to promote safety improvements;
- Performs its regulatory functions in a timely and cost effective manner as well as in a manner that ensures the confidence of the operating organizations, the general public and the government;
- Strives for continuous improvements to its performance.

The monitoring and evaluation system (M&E) within the PNRA is based on twelve strategic performance indicators similar to the one described in PDRP-4. Overall performance of the PNRA is judged against each of these twelve strategic indicators given in Fig. 3.

The PNRA has been striving to achieve the above goals ever since its establishment. However, it should be kept in mind that regulatory effectiveness cannot be enhanced beyond a certain point without international cooperation. It is observed that the IRRT, OSART, RASSIA and peer review missions which use the IAEA standards as the basis for their review help in enhancing regulatory effectiveness. These review teams and/or missions comprise of experts drawn from various countries and reflect international experience and practices. The PNRA has used this experience and the IAEA standards to increase its regulatory performance (effectiveness and efficiency).

The case study in the following section gives a detailed insight of the importance of having a set of global safety standards and the need for having international cooperation for enhancing regulatory effectiveness. The study also describes the need for transformation of these standards into discrete knowledge which can be used for regulatory decision making.

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[1] Assessment of Regulatory Effectiveness (PDRP-4), Peer Discussions on Regulatory Practices, IAEA, Vienna (1999).

Ensures acceptable level of safety being maintained by licensees	Appropriate actions taken to prevent degradation of safety and to promote safety improvements	Performs its functions in a timely and cost-effective manner	Performs its functions in a manner that ensures the confidence of operating organization
Ensures regulations and procedures are in position and are understood by licensees	Takes appropriate steps for human resource development and has competent and certified regulatory staff	Ensures that a well-established quality management system exists	Performs its functions in a manner that ensures the confidence of the general public
Strives for continuous improvement of its performance	Ensures that adequate legal provisions exist, i.e., dealing with non-compliance or licence violations	Ensures that adequate resources available for performing its functions and Technical Support Centre(s) available for specialist assistance when required	Performs its functions in a manner that ensures the confidence of the government

Rating Key

GREEN	**Satisfactory**
WHITE	**Minimally Acceptable**
YELLOW	**Needs Improvement**
RED	**Unsatisfactory**
PINK	**Not Assessed**

FIG. 3. PNRA performance assessment indicators.

5. CASE STUDY: IAEA TECHNICAL COOPERATION PROJECT — LESSONS LEARNED

The PNRA and the IAEA are participating in an IAEA technical cooperation project entitled Applicability of IAEA Nuclear Safety Standards for NPPs in Pakistan — PAK/9/29. The main objective of the project is to verify the applicability of newly developed national nuclear safety regulations — based on the IAEA standards — to the nuclear power plants in Pakistan; to enhance a common understanding between regulatory authority and plant owner on how to use the newly developed national regulations for licensing review; and to provide guidance to meet regulatory requirements for Chashma Nuclear Power Plant Unit 2 (C2). In accordance with the project objectives, the major task of the project will be to assist the PNRA and the Pakistan Atomic Energy Commission (PAEC) in the review and approval of preliminary safety analysis report (PSAR) of C2.

The project was designed to include several expert missions to review the chapters of the PSAR of C2. The format of the PSAR is in accordance with the USNRC RG 1.70 (Rev. 3). It also includes chapters 18 and 19. In addition to the PSAR, a probabilistic safety analysis (PSA) report is also required. Figure 4 shows the process for an IAEA review of a PSAR for a NPP. After hard and soft copies of the PSAR (and PSA) are provided to the IAEA, preparatory meetings have been held, and a programme is 'chalked out', expert missions for each chapter are arranged. The international experts review their respective chapters and raise issues which are then responded to by applicant's personnel (supported by the NSSS vendor and designer staff). A review meeting takes place to discuss the responses and finalize the recommendations. A mission report is issued containing the issues, reference to IAEA standards, views of the applicant/designer, assessment of the IAEA review team and the recommendations made. These recommendations are not part of the formal licensing process but are used indirectly in the licensing decisions. Table 1 show the action plan for the project and gives the current status of the number of expert missions concluded and the chapters reviewed.

On the basis of the experience gained from the project, the following can be concluded:

(a) The IAEA standards, if used in conjunction with the lower tier guides, can be used for a safety review of a nuclear power plant design. However, in certain cases the reviewer had to refer to 10 CFR 50, USNRC RG, USNRC NUREG reports, ANSI/IEC standards, etc. This indicates the need for more specific guides in some areas. Guidance on issues such as application of single failure criterion is also needed.

(b) However, all the requirements of standards cannot be applied to a particular type of nuclear power plant design. This is understandable as these standards cover all types of land based nuclear reactors.

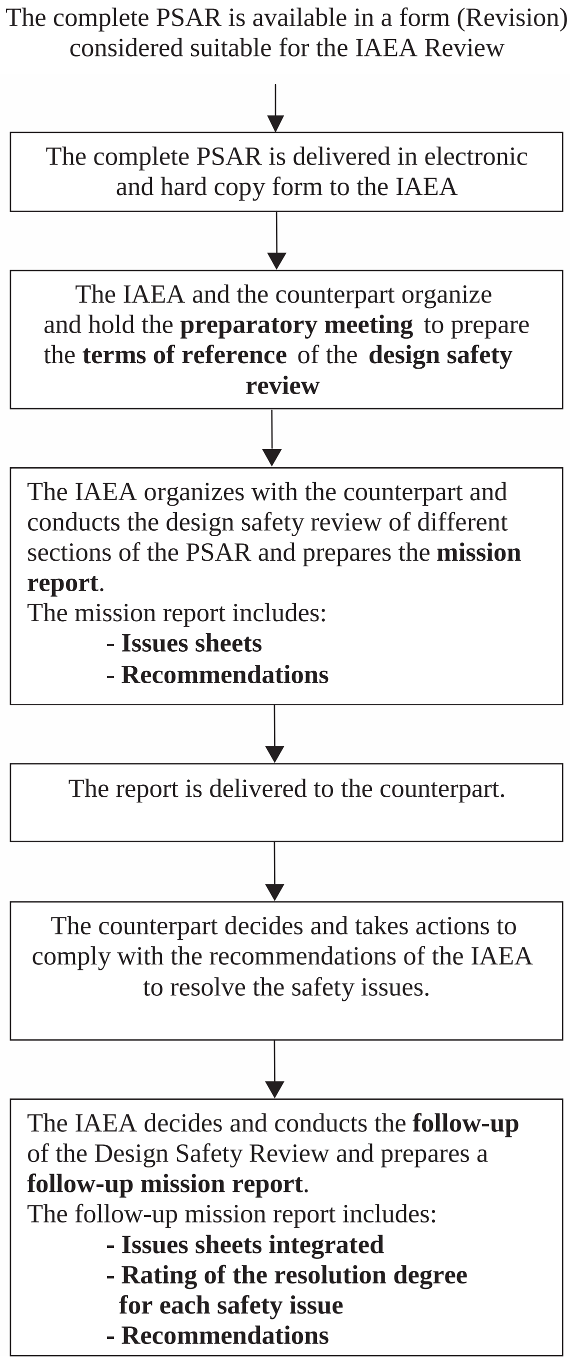

FIG. 4. Typical process for an IAEA review of a PSAR for a nuclear power plant.

TABLE 1. STATUS OF EXPERT MISSIONS — PAK/9/29: APPLICABILITY OF IAEA NUCLEAR SAFETY STANDARDS FOR NPPs IN PAKISTAN

EM No.	Type of Activity	Objectives	Duration/ Duty Station/Date	Estimation of Resources	Implementing Officer	Status/Comments
2	EM	Early identification of Safety Issues of two-loop PWR vis a vis IAEA SSS NS-R-1	1 W, Islamabad, Feb. 2005	1 Staff, 1 exp China, 3 exp Europe	M. Gasparini	Done 21-24 Feb. 2005 Mission Report sent electronically to PNRA on 23 May 2005
1	EM	Review of Ch 2 of PSAR	1 W, Chashma site, March 2005	1 Staff	A. Gürpinar	Done 14-18 March 2005 Mission Report: Delivered
4	EM	Preparatory meeting for Review of Chapters 3, 6,7 15, 18,19	3 days, Vienna 8-10 June 2005	1 staff, 1 expert	M. Gasparini	Done 8-10 June 2005 Terms of Reference for Tasks 5 &6 prepared and delivered
5 & 6	EM	Review of Chapters 3, 4, 6, 7, 15, 18, 19	2 Ws, Shanghai, 4-15 September 2005	3 staff, 7 experts	M. Gasparini	Done 4-15 Sept . 2005 Mission report sent electronically to PNRA and PAEC on 16 Nov. 2005
9	EM	Preparatory meeting for review Chapters 5, 8, 9, 10	1 W, Vienna 16-20 Jan. 2006		M. Gasparini	**Done:** Shanghai during EM 5&6 Vienna during GC

TABLE 1. STATUS OF EXPERT MISSIONS — PAK/9/29: APPLICABILITY OF IAEA NUCLEAR SAFETY STANDARDS FOR NPPs IN PAKISTAN (cont.)

EM No.	Type of Activity	Objectives	Duration/ Duty Station/Date	Estimation of Resources	Implementing Officer	Status/Comments
3	EM	Review of Chapter 17	1 W, Islamabad 23-27 Jan. 2006	1 staff, 1 expert	Pal Vincze (NE)	Meeting between PNRA and IAEA review team on 22 Jan. afternoon
10 & 11	EM	Review of Chapters 5, 8, 9, 10	1 W, Islamabad, 23-27 Jan. 2006	1 staff, 4 experts	Csilla Toth	Expert briefing meeting in Vienna 17-20 Jan. 2006
8	EM	Review of Chapters 11, 12	4 days, Islamabad 30 Jan.-2 Feb. 2006	1 staff, 1 expert	M. Gasparini	Expert briefing meeting in Vienna 9-11 Jan. 2006
12	EM	Preparatory meeting for review Chapter 13, 14, 16	2 days, Vienna 27-28 April 2006	1 staff, 1 expert	Staff from NSNI/OSS	Participants from IAEA, PNRA, PAEC
13	EM	Review of Chapters 13 14, 16	2 Ws, Islamabad May 2006	1 staff, 3 experts	Staff from NSNI/OSS	Date to be defined
14	EM	Follow up mission	September 2006	TBD	M. Gasparini	EM 14 and EM15 will be conducted jointly
15	EM	Feedback of the PSAR review on IAEA safety Standards	September 2006	TBD	M. Gasparini	EM 14 and EM15 will be conducted jointly
7	EM	—	—	—	—	Deleted

(c) The safety review can be further facilitated if an associated review plan is also prepared by the IAEA laying out the acceptance criteria for each requirement. The PNRA has prepared in collaboration with IAEA, such review plans for a few areas.
(d) It would also be helpful if the lower tier documents (industrial standards) are also referred to some extent in the acceptance criteria in the review plan or in the standards or guides.

Regarding the enhancement of regulatory effectiveness, the PNRA reaped the following benefits:

(a) PNRA staff gained insight into the rationale of requirements laid down in the IAEA standards and in determining the corresponding acceptance criteria with the help of the international experts that participated in the expert missions. The prime example of this is the applicability of IAEA SSS NS-R-1 Safety of Nuclear Power Plants: Design § 5.31 (3) which states “Potential design changes or procedural changes that could either reduce the likelihood of these selected events, or mitigate their consequences should these selected events occur, shall be evaluated and shall be implemented if reasonably practicable”. During earlier meetings between the PNRA and the applicant, the PNRA was of the opinion that the most plausible manner in which this clause 5.31 can be met is through the installation of some dedicated hardware like “core catcher” to cope with severe accident conditions. However, as a consequence of insight gained through this project, it was understood that other provisions available in C-2 e.g. primary depressurization system to prevent direct containment heating as a result of high pressure melt injection; in-vessel corium retention by employing external cavity cooling of the RPV bottom head through cavity cooling system; and installation of passive hydrogen re-combiners to control combustible hydrogen concentration; in conjunction with emergency procedures and guidelines to prevent/ mitigate severe accidents, are the measures, which could help in fulfilling the intent of clause 5.31.
(b) The safety review was accelerated as the regulatory issues between the regulator and designer were discussed and resolved quickly with the assistance and advice from the international experts.
(c) The issues identified by the international experts were later taken up by the regulator as a part of the licensing process, which enhanced the thoroughness and completeness of the safety review.

The applicant also benefited from the exercise as its staff also gained new knowledge from the experts and based on the initial findings of the safety review, the PNRA allowed pouring of concrete in the nuclear island base mat sixty two days earlier than the scheduled date. This would have economic benefits for the licensee.

The benefits of this technical cooperation project also extend to the future nuclear power programme. It is believed that the experience so gained could be utilized by the PNRA in the licensing of the next series of nuclear power plants that are expected to be installed in the country as per plans of the Government of Pakistan to enhance nuclear generation capacity in the country from the current 400 MW(e) to 8800 MW(e) by 2030. The licensing of these plants would be easier as a better understanding of the IAEA standards now exists within the PNRA, the owner/operator and the NSSS vendor.

6. CONNECTION BETWEEN INTERNATIONAL STANDARDS–INTERNATIONAL COOPERATION AND REGULATORY EFFECTIVENESS

It is evident from the above section that a clear connection between the use of IAEA safety standards and cooperation of regulatory bodies in their use exists as it provides a common platform for communication within the various regulatory bodies. Although existence of such a platform in the form of IAEA safety standards is useful in enhancing regulatory effectiveness, the absence of lower tier industrial standards in the IAEA publication is hampering the fulfilment of its actual potential. Therefore it is imperative that efforts should be made in the IAEA to fill the bottom of the pyramid by referring to and/or associating with industrial societies such as IEEE, ASME, DIN, API etc.

7. CONCLUSION AND FURTHER SUGGESTED ACTIONS

Encouraged by the experience of Pakistan, it is expected that other Member States of the IAEA may also base their national regulations on the IAEA standards. This should impel the IAEA to further improve and complete the safety standards so as to make these truly international safety standards. The IAEA may initiate programmes to complete its standards-pyramid by adopting the safety goals and/or allowable risks (consequences and frequencies), which form the top of the pyramid and to ensure that they are also similar in the Member States. So far, the IAEA standards are silent on this aspect and it has been left to each country to define these safety goals and/or allowable risks. Moreover, the lower tier levels of the pyramid which comprise of the industrial standards and practices should also be completed.

In addition, the IAEA may consider institutionalizing the international cooperation and assistance provided under the PAK/9/29 project on the pattern of OSART, IRRT, IPSART, etc. Furthermore, in view of the expanding international market for nuclear power plants and achieving the common global goal of providing affordable, secure, sustainable and safe electricity without undue hazards to man and his environment, international organizations have to play a bigger role in helping regulators to become more effective. This is necessary because of the trans-boundary effects of nuclear power plant operation and perceived concerns of public within and outside a country. The international organizations may have to be assigned a role in harmonizing of designs of nuclear power plants, which presently vary from one country to another. Ideally speaking the hardware configuration of a nuclear power plant may vary from one site to another but should not be affected by political boundaries. This means that the IAEA may, if approached by participating or consenting Member States, review nuclear power plant designs for installation in such Member States. After the review of the design, the IAEA should facilitate the free flow of software and hardware needed for the nuclear power plant as per the design. The IAEA may act as the custodian of the design and major design changes may be made with the approval of the national regulator in consultation with the IAEA. The regulatory body of such a Member State importing a NPP may issue site permits and operating licence based on the internationally agreed design of the NPP. In addition, it would be responsible for overseeing of operational safety during the plant life time. Care may be exercised to the extent that IAEA does not assume the role of an international regulator and that the role of national regulator is not compromised. This would not only simplify the licensing process but allay the current concerns of safety of nuclear power plants in neighbouring countries or in some areas of the world but facilitate free flow of hardware across the borders resulting in more economical plants.

INTERACTING WITH STAKEHOLDERS: GENERATING TRUST, CONFIDENCE AND INFLUENCE THROUGH CREDIBILITY, RESPONSIVENESS AND VALUES

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Abstract

Gaining public trust and confidence by regulatory bodies can only come about by demonstrating in an open and engaging way a high level of integrity and professionalism. The challenge is to operate in a fast changing environment where the regulators are increasingly under scrutiny. The thirst of the public for information has increased due to the availability of vastly improved media and communication channels and society has acquired a heightened concern for its own safety and security. The factors that pose challenges to the regulatory functions and some potential ways forward are discussed in this paper.

1. INTRODUCTION

We live in a post-trust society. The perception of the public is that being a government official or technical expert no longer means that you can be trusted to do the right things at the right time and serve in the public interest with integrity. One of the major challenges we face is to earn the confidence of those that we serve; that we will secure their safety from the activities of the nuclear industry but at the same time serve wider needs of society including industry's ability to undertake legitimate activities confident of a fair, effective and efficient regulatory system, preserving due confidentiality and security.

2. THE ENVIRONMENT

2.1. The information age and a post-trust society

Our challenge is to operate in a fast changing environment where we are increasingly under scrutiny and challenged for the decisions we make, what we do and don't do, how we operate, and where the consequences if we and the industry get it wrong are significant; not only possibly in terms of worker and public health and safety, but greater in the social, political and economic arena.

You may say that this is nothing new for us, we have been regulating for a long time in a 'fish bowl'. The public and media have always been sensitive to anything that can be termed 'nuclear' or involved radioactive waste. However, two things have changed. These are: (i) the thirst of the public for information through vastly improved media and communication channels; and (ii) their loss of trust for those in authority or who are deemed to be experts.

We have seen in recent times how quickly news about worldwide events is reported in our homes. We watch the events of war unfold in real time. The public expects to be well informed and is impatient for information. It provides a far better basis for questioning policy makers and expert opinion. The Freedom of Information Act in the United Kingdom provides an additional dimension, especially as it acts retrospectively.

The mismanagement of a number of high profile national crises[1]has meant that government officials can no longer expect to have the confidence of the public as a given, it needs to be earned. Elsewhere, expert witnesses' opinions in some legal cases have led to miscarriages of justice, evoking further mistrust of scientific experts. Surveys confirm such trends.

In order to increase our credibility we need to interact and communicate better with our stakeholders to provide society with the confidence it demands of its regulators and the regulatory processes we operate.

2.2. Other environmental factors

We live in a society with a heightened concern for its own safety and security. Recent terrorist events have made our task more difficult and increased our need to secure the protection of nuclear activities from those that may put them at threat. To address this issue effectively places limits on openness, which can affect the public's perception of the regulator.

In addition, industry is changing with privatization and contracting out work packages gathering pace. Increasing economic pressures and efficiency drives bring sharper attention to concerns about the perceived burdens of regulation.

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[1] Examples include: BSE in UK cattle, tainted blood in France, dioxin entering the food chain in Belgium. (See Risk Management in Post-Trust Societies, Ragnar E. Lofstedt.)

In the UK, there has been a resurgence of interest in the possibility of new nuclear build and with that, dealing with our legacy of radioactive waste. Associated with this interest is increased attention on regulatory processes and effectiveness. So once again we are in the spotlight and it provides us with both a challenge and an opportunity. The challenge is to meet the public and Government's expectations of us as we regulate the significant changes occurring in the nuclear industry. However, in a very visible way it also provides us with an opportunity to demonstrate that we are effective and efficient in securing sensible control of health, safety and radioactive waste management at nuclear sites, protecting the public and the workers.

In the UK, the Government has put in place a new public body to own nuclear sites and finance their decommissioning —the Nuclear Decommissioning Authority. We are working in partnership with this body to accelerate the decommissioning of the UK's legacy facilities. In addition, the Government is considering how to better manage nuclear waste in the long term.

All these changes in the environment demand greater effectiveness and efficiency in the nuclear regulatory bodies. We are looking at how we can enhance our effectiveness through targeted increased leverage, working in partnership to maximise influence and engaging stakeholders better.

Of course, the approach you adopt to address the challenges of controlling risks and stakeholder engagement in a changing environment depends upon the particular philosophy of government, legal system, etc., of the society in which you operate. It will also depend upon the regulatory decision making processes that Parliament has put in place to safeguard society and its people. It has to take account of the perception of stakeholders and the effectiveness of any engagement strategy will be heavily influenced by how the regulatory body and individuals within it behave.

3. BUILDING STAKEHOLDER TRUST AND CONFIDENCE

We have noted above the reduction in trust that has occurred as society has changed over the past few years and failures in policy or control that have led to crises. The issue of falling trust is important for the nuclear regulator when called upon to make judgements about risk in a changing environment. Research[2] indicates that it is much easier to destroy trust than to build it, and that public trust is one of the most important factors influencing the public's

[2] SLOVIC, P., Perceived risk, trust and democracy, Risk Analysis **13** (1993) 675–682.

perception of risk. If the public or others do not trust you as a nuclear regulator then they are much more likely to be concerned about the residual risk and perceive it as high even though from a technical point of view it is very low.

So with trust comes confidence in your judgements and with that, influence on others' perceptions of risk. This applies to all stakeholders — the public, workers, the licensees, the government, NGOs, media, etc.

To earn trust takes time, effort and a managed approach. But it has to be built on a firm basis of:

- Reputation;
- Credibility;
- Responsiveness;
- Regulatory excellence; and most importantly
- Regulatory values.

Of these, perhaps the most influential is regulatory values. We put forward the following as the main ones we aspire to exhibit in all we do:

- Integrity;
- Independence;
- Impartiality;
- Openness;
- Honesty;
- Fairness;
- Humility.

These are the bases for effective engagement with stakeholders but it has to be targeted and managed within a clear framework. We provide an example of one approach.

4. SETTING THE FRAMEWORK

If we are to be successful in meeting the challenges of a changing environment we need to be consistent in our approach across the whole of our business and to achieve these, we need to work within a framework. Establishing a mission and then communicating it, is a central plank to our operating framework. The mission should give a clear sense of direction and purpose to all stakeholders, both external and, crucially, internal to the staff of the regulatory body. The mission for us is:

To secure effective control of health, safety and radioactive waste management at nuclear sites for the protection of the public and workers and to further public confidence in the nuclear regulatory system by being open about what we do.

This mission makes three statements. It states the scope of our responsibilities. It says who we aim to protect and it states how we can be expected to behave; most importantly though, it connects all three in one clear statement of intent. By communicating it to our stakeholders, we help set their expectations of us. By communicating it to our staff, we make it clear what is expected of them and the values and behaviours that we need to adopt. This statement underpins the aims, objectives and goals we set for ourselves but we also need to do this in a framework that is meaningful in our day-to-day work.

In our striving for regulatory excellence, we have adopted the European Foundation for Quality Management (EFQM) model, now termed Investors in Excellence as our framework. It helps us set a basis for targeting how we should continuously improve. One important plank in this model for us is our relationship with stakeholders. It establishes the following goal regarding how we should engage:

To further public confidence in the UK nuclear regulatory system by providing information to our stakeholders, seeking their views and responding to them as appropriate.

We have developed our framework from a number of surveys of a wide range of stakeholders and of our own staff, which had the main objective of clarifying our stakeholders' expectations of us as a regulatory body. We established some key outputs from this work. These have helped us to decide our improvement programme:

- Identifying and prioritising our stakeholders;
- Mapping and analysing current stakeholder activities;
- Identifying motivations and expectations of each stakeholder;
- Establishing benchmarks for stakeholder engagement activities; and from each of these
- Developing and implementing a stakeholder engagement strategy.

We have developed this framework into a tool, which we use to identify what each stakeholder expects of us, and then translate it for use in different parts of our business. From this we have identified what is desirable to do as well as what is achievable and on this basis we have selected priority areas for improvement with a properly resourced change process. Finally, this tool provides us with an evidence based approach, which we can use to identify the most effective way to intervene and to give us the greatest leverage for our interventions. We have communicated this to staff through workshops where managers set personal commitments in the context of their own business area. In essence, we have provided managers and staff with an effective stakeholder engagement tool, which will go right to the heart of our operational strategy.

5. BENCHMARKING AND MEASURING IMPROVEMENT

As nuclear regulators striving for excellence we seek to learn from others. Moreover, we do not operate in isolation and the international community must be confident that we are operating to the highest possible standards. This is where the exchanges through the Conventions, as took place last year for nuclear safety and as will take place in the Joint Convention later this year, are invaluable. The process of international regulatory review aids in providing another outside view and ideas for improvement as well as providing additional confidence about the effectiveness of the regulator. Similarly, through multilateral work, such as that of WENRA, we are able to share what is considered to be good practice and establish benchmarks. Clearly, the IAEA has an important role in setting international best practice and here we should give credit to its report No. 24 entitled Communication Planning by the Nuclear Regulatory Body. The OECD NEA Committee on Nuclear Regulatory Authorities also has been working through its working group on public communications in order to be an exchange on regulatory good practice. At another level, we have regular exchanges with other regulators both inside and outside the UK. Additionally, we have found outside review by non-nuclear, non-regulatory bodies (through the wider EFQM community) very beneficial.

Through benchmarking with others we can set the levels which we aim to attain but it is important that once we have done this that we also set our own benchmarks and communicate them to our stakeholders. On the one hand it makes it clear what they can expect from us and on the other it provides measures for demonstrating how we will be improving in the future. When we have established our benchmarks we then need to generate operational performance data against specific criteria to learn and improve, and target our resources better.

6. CASE STUDIES

Here we provide current examples of what we are doing to engage stakeholders, which helps to illustrate our approach, showing where we believe we have been effective but also where we have learnt some lessons. The aim of our approach to stakeholders is to work towards enhancing their trust, maximising their confidence and our leverage to better achieve our mission.

6.1. Energy review

The Health and Safety Executive (HSE) has been asked by the Government, as part of its energy review consultation[3], to provide an independent expert report on the risks associated with some specific energy developments. This includes consideration of a new generation of nuclear power stations and the potential role of pre-licensing assessments of candidate designs.

It is over twenty years since an electricity utility last applied for a nuclear site licence to build and operate a nuclear power station in the UK and the industry has changed significantly over that period. The HSE is, therefore, reviewing its regulatory strategy for licensing new nuclear facilities to ensure it would remain effective and in doing so intends to engage widely with stakeholders.

The crux of the submission of our contribution to the HSE report will be based on the Nuclear Installation Inspectorate's (NII) expert knowledge and experience. Information will be collated through a compilation of facts on the risks posed by new designs of a nuclear power station, and an explanation of how those risks are controlled by the industry and regulated by the HSE. Also, we will be setting out issues relating to our approach to regulating any proposed new design of nuclear reactors, if that is what the Government determines to be appropriate.

However, engaging effectively with key stakeholders will be a key aspect of earning their trust and confidence. As one step in this process, we are holding a stakeholder workshop to outline the NII strategy for regulating a new reactor, including the role of 'pre-licensing' assessments. The objective of the workshop will be to provide information, gather views on the relevant issues, discuss them and gather further information around the potential role of pre-licensing assessments of new reactor designs.

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[3] Our Energy Challenge: Securing clean, affordable energy for the long term, launched on 23 January 2006.

Following the workshop a discussion document will be published on the HSE intranet to share more widely our draft input and stakeholders will be invited to submit views on the perceived robustness, clarity, consistency, etc. Stakeholders will be notified directly when the strategy is published on the Internet as well as by accompanying publicity such as articles in trade journals, etc.

Parallel to this approach consideration will be given to targeted communication with communities or groups with special interests, such as those in the vicinity of nuclear sites or with active anti-nuclear views.

Comments received from stakeholders will be taken into account in preparing a final position statement. The issues/views/concerns expressed by stakeholders on the legislative regime will be addressed in the HSE 'expert' report as part of developing a considered view on our approach to any pre-licensing.

6.2. Safety assessment principles (SAPs)

The 'permissioning' process of the HSE's NII includes assessment of safety submissions made by licensees of nuclear installations, to determine if the safety measures for any proposed activity meet legal requirements. The NII has developed regulatory assessment guidance for its inspectors, including its published SAPs[4]. Since these were last revised in 1992 there have been several developments leading to the conclusion that a review and revision of the SAPs was timely.

Thus, a project was started in January 2004 to benchmark our 1992 SAPs and supporting technical assessment guides against the IAEA Requirements and Safety Guides, taking account of recently published WENRA reference levels, and developments in our views based on experience. As part of this work, we have sought early engagement with principal stakeholders to achieve a draft for public comment before finalising.

Openness and engagement with principal stakeholders (primarily the licensees and other regulators) has been a key aspect to this project. In December 2004, a discussion document on the architecture of the revised SAPs was issued to stakeholders and placed on the HSE website. In June 2005, the

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[4] SAPs provide NII's inspectors with guidance as to what they should have a reasonable expectation of finding in a safety case and in the associated management arrangements for its preparation and implementation. The law in the UK requires that the risks arising from work activities, to both workers and the public, must be reduced so far as is reasonably practicable. Thus the SAPs are not lists of requirement to be complied with, but expectations to be met so far as reasonably practical.

project obtained its own web page (www.hse.gov.uk/nuclear/saps) and between June and November 2005, early drafts were placed on the site and comments welcomed. In addition, facilitated workshops were also held with principal stakeholders on subjects that they have requested; these being, management for safety, radioactive waste management and decommissioning, numerical targets and the application to any future new build in the UK.

There was a risk in making the early drafts available as they had been generated by various authors with little cross-reference to each other owing to the constraints of time and resources. Despite this, numerous useful comments were received and are being taken into account in developing the draft for public comment.

The end of this phase of the project was marked by a major one-day public workshop in November 2005, organized by the Institute of Mechanical Engineers. It marked the completion of the first drafting stage and early stakeholder engagement and was the start of a wider engagement leading up to the published public draft version at the end of March.

A communications plan has been prepared for the public stage of the process. The revised SAPs will be published on the HSE web site in a downloadable format. Copies will be printed and sent to those that do not have Internet access. In addition to a press release, we are identifying all interest groups in order to contact them and we are planning a series of regional half-day seminars through the British Nuclear Energy Society at the beginning of April. A paper, setting out the basis for the work and the responses invited, will be published with the draft SAPs. This will also contain a view on the impact of the SAPs upon those we regulate. The final version will be published together with information on how we have addressed the views submitted.

6.3. The THORP incident

It is difficult to speak in detail about the incident at THORP, back in 2005, because, although the investigation is complete, the outcome might result in a prosecution of the licensee. However, we would like to comment on lessons learnt from how we handled the communications of the event.

Activities at Sellafield and the site itself are sensitive both locally in Cumbria, nationally and internationally. Any incident on site is likely to attract media coverage and a lot of interest from the public and Parliament. The circumstances of this incident resulted in a leak of a large quantity of radioactive liquor but it would appear the secondary containment operated effectively and there was no apparent release outside the secondary containment or into the environment.

In the early stages of the incident it was less clear as to what would be the scale of the event and its likely consequences. The proximity of the Sellafield site to the Irish Sea means that Ireland is very sensitive to any occurrences on the site that may lead to the contamination of the sea or release into the air. Similarly, because of the tidal flow of water out of the Irish Sea and towards the Norwegian coastline, the Norwegian Government is concerned about releases from the site. As the UK nuclear regulatory body we are keen to cooperate with the appropriate agencies from both countries including alerting them to significant events on the site. In the case of the event at THORP we alerted the Irish Nuclear Radiation Protection agency but failed to do so proactively with the Norwegian equivalent. Additionally, we underestimated the worldwide interest in this event and the need for early and contemporaneous information. This potentially could have led to a loss of trust in the regulator as well as the licensee.

The way this event was handled highlighted areas where we can improve our stakeholder engagement activities. It has caused us to ask ourselves how we can be more proactive in our communications. We are aiming to work more closely with other UK agencies that have regulatory responsibility for nuclear sites and with other government departments to ensure information about such events is communicated in a more timely fashion.

7. ADDRESSING FUTURE CHALLENGES

In conclusion, we would like to leave you with what we see are the key challenges for us to face in the future. Gaining public trust and confidence can only come about by demonstrating in an open and engaging way a high level of integrity and professionalism. We must be able to show that we operate with absolute independence and integrity, be seen to be open and honest, but also demonstrate a profound understanding of the technology and issues and how these contribute to our society. We need to bring about change in the way we operate in order to earn the trust of our key stakeholders but we need to manage this change through a well thought out framework which lays down expectations both to our stakeholders and to our staff. In deciding how we are to change, we need to learn from the past and we need to recognize where issues could have been handled better. We need to engage our stakeholders wherever we can and do so consistently across the full extent of our business. We recognize that we still have some way to go to achieve this aim but it will only become possible if we engage our own staff and instil in them a culture where we care deeply about the views of those we serve.

ESTABLISHMENT AND APPLICATION OF SAFETY STANDARDS AND SECURITY GUIDANCE

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Abstract

The paper describes the IAEA programmes and capabilities contributing to the peaceful uses of nuclear technology on a global scale. The IAEA has developed and continues to support a global nuclear safety regime that is comprised of several facets. The prinicipal elements are binding and non-binding international legal instruments such as the various conventions and codes of conduct; a comprehensive suite of nuclear safety standards; a suite of international safety reviews and services, based on the safety standards; and the need to ensure strong national infrastructures and a global community of experts. These elements are described in some detail and the future challenges are outlined.

1. INTRODUCTION

In this paper I will be describing the IAEA programmes and capabilities contributing to the peaceful uses of nuclear technology on a global scale. The IAEA mission is founded on three well-established pillars: verification; nuclear technology; and safety and security. This paper is dedicated to the third of these pillars — safety and security. This pillar represents a fundamental component of nuclear regulation and is, therefore, of critical importance to nuclear regulators globally.

2. ELEMENTS OF THE GLOBAL NUCLEAR SAFETY AND SECURITY REGIME

In fulfilling its safety and security role, the IAEA has developed a global nuclear safety regime that is comprised of several facets. Global regimes are based on considering the interest of a wide range of national and international actors to achieve shared goals while preserving and complimenting the sovereignty, authority and ultimate responsibilities of States. The relevant actors include industry, governmental, non-governmental and intergovernmental organizations, experts' communities and civil society. The IAEA continues to support a global nuclear safety regime based on four principal elements: first, the widespread subscription to binding and non-binding international legal instruments such as the Convention on Early Notification of a Nuclear Accident, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the Convention on Nuclear Safety (CNS), the Joint Convention on the Safety of Spent Fuel and the Safety of Radioactive Waste Management (Joint Convention), the Code of Conduct on the Safety and Security of Radioactive Sources, and the Code of Conduct on the Safety of Research Reactors; second, a comprehensive suite of nuclear safety standards that embodies good practices as a reference point to the high level of safety required for all nuclear activities; third, a suite of international safety reviews and services, based on the safety standards; and fourth, the need to ensure strong national infrastructures and a global experts' community.

National infrastructures include appropriate legal and institutional aspects, particularly the nuclear regulatory body, the research and educational institutions, and the industrial capability. Self-sustaining safety networks of expert knowledge and experience are essential to continuous safety improvement and mutual learning. The IAEA serves as the principal actor for the second and third elements. In recent years, significant progress has been made in all four elements of the global safety regime. Consequently, the global safety regime is maturing and becoming a practical basis for promoting global cooperation.

A similar vision is being developed for a global security framework that is fully integrated with that for safety in the longer term. Currently, there are several major components in place that form the basis of this framework. There are two principal conventions, the Convention on the Physical Protection of Nuclear Materials, as amended, and the Convention on the Suppression of Acts of Nuclear Terrorism. There are also several safeguards agreements and additional protocols in place. In addition, there is the Code of Conduct on the Safety and Security of Radioactive Sources. The IAEA also has produced guidance documents under the nuclear safety series and offers a host of nuclear security services.

Safety and security overlap in several areas; however, current practical needs require a separate but synergistic approach. Of course, security measures are in place to assist in ensuring nuclear safety and vice versa. There are obvious areas where measures such as access control contribute to both safety and security. Such common measures can and do lead to synergies, where the measures taken together provide protection that exceeds the simple arithmetic sum. However, it is necessary to take into careful consideration the inherent differences in the manner in which regulation of safety is typically conducted (open, transparent and science based) in contrast to the policies of maintaining security (confidential, sensitive, and malicious). An appropriate balance will eventually be determined but more experience and dialog is necessary before final guidance can be developed in a consistent and complementary manner. The IAEA and its member states are coordinating efforts in this important area.

We are in a position now to state clearly what is essential for an effective global nuclear safety regime. All of us, regulators, operators, governments, must have a global sharing of the same visions and objectives. Of utmost importance, all of the following attributes must be endorsed and practiced on a global scale: continuous exchange of insights and experiences; the development and use of objective scientific knowledge and assessments; cooperation and mutual support; continuous striving for improvement; and the guarding against complacency. It is critical to remember always that any serious nuclear accident anywhere in the world affects the globe in at least two major ways. First, as demonstrated by the Chernobyl accident, radioactive releases do not respect political boundaries. Virtually all countries were recipients of the radioactive debris resulting from that event, affecting in a very negative way peoples' perspectives on the use of nuclear energy. Second, as demonstrated by the Three Mile Island accident, even without a significant release of radioactive material, the world's perception of nuclear energy was also affected very negatively. The result of both of these events was the cessation of the expansion or phase out of nuclear energy for many years. The cliché, "We are all in the same boat now", clearly applies to our situation.

There are several processes in place to assist in the promulgation of safety and security in the peaceful uses of nuclear energy. The highest and strongest of the processes are international legal instruments. There are two components in this process — legally binding instruments within the bounds of international law and non-binding instruments. Conventions are developed to address specific issues. When enacted, the convention is offered to members; parties of the convention are required to follow its directives. Codes of Conduct are non-binding legal instruments and are used to encourage the learning and use of good practices. Codes of Conduct provide opportunities for improvement in many nuclear sub-disciplines both now and represent a tool for use in the future. The strength of this process is that it reflects a global substantive consensus among technical experts and governments.

The IAEA and its Director General received the Nobel Peace Prize last year and the following quote from the Norwegian Nobel Committee citation is particularly noteworthy:

> "The… Committee has decided that the Nobel Peace Prize for 2005 is to be shared… between the IAEA and its Director General … for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way."
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> "At a time… when there is a danger that nuclear arms will spread both to states and to terrorists groups, and when nuclear power again appears to be playing an increasingly significant role, IAEA's work is of incalculable importance."

3. THE ROLE OF THE IAEA IN SUSTAINABLE DEVELOPMENT OF NUCLEAR ENERGY

I will now discuss the role of the IAEA and the sustainable development of nuclear energy. There are three distinct concepts that are mutually inclusive; sustainable development, worldwide use of nuclear technology, and nuclear security. 'Nuclear security', as used here, includes the three sub-categories of safety, security, and safeguards. It is essential that the three concepts listed above be addressed in an integrated way so as to ensure the peaceful, safe, and secure use of nuclear technology.

First, the key attributes of the regulator need to be specified. Effectiveness is imperative with a continuing emphasis on clarity and improvements. An appropriate balance of transparency and openness needs to be established while protecting sensitive information. Independence is critical but requires competence and objectivity to be effectively independent. Only when these attributes are successfully implemented can stakeholder confidence be maintained. Also, it is important to be constantly reminded that stakeholders include the sponsoring government, the regulated industry, and the public. As part of the efforts to ensure continuous improvements, it is recommended that regulators benchmark their processes against IAEA safety standards and security guidance. Feedback from the benchmarking process can be used to share insights across political boundaries with all stakeholders.

For operators, similar recommendations apply. The requirement for transparency and openness are equally important for operators. The safety of any facility is dependent upon the management ensuring that the goal is communicated to all levels within the organization. Continuous dialogue and effective communication are essential between the operators and the regulators, recognizing and respecting their respective roles. As part of a global practice, feedback from their experience and lessons learned to regulators and to the IAEA for inclusion in safety standards is important as well.

The benefits (and needs) of harmonizing safety standards are many in today's globalizing international community. The experience of the Western European Nuclear Regulators Association (WENRA) will be described later in this conference. In addition, the IAEA has a benchmarking programme under way that has involved Canada, China, Japan, Pakistan, the United Kingdom and others. The experience has been positive and other countries have expressed an interest in participating as well.

An important aspect in establishing and continuing an effective global safety regime is the sharing of knowledge and experience across national boundaries. The sharing can be accomplished through networking whereby the results of, for example, self-assessments and peer reviews can be discussed and critiqued. The information can also be shared with the IAEA so that its many programmes, such as IRS, NEWS, INES, ITDB, can be enhanced.

The IAEA safety standards are high quality international technical references defining practices that lead to high levels of safety for both regulators and operators within the world nuclear community. The standards were developed by experts from many Member States through a transparent and systematic process and reflect a global consensus for good practices that enhance safety.

The safety fundamentals comprise three safety series publications that address the following: the safety of nuclear installations; principles of radioactive waste management; and, radiation protection and the safety of radiation sources. These publications, which are at the top of the IAEA safety hierarchy, are in the final process of being unified. The safety standards publication is also under revision to move all of the Legal and Governmental Infrastructure (LGI) requirements to GS-R-1. GS-R-1 will be the sole reference for all of the legal requirements. Currently under preparation is another guidance document, Management Systems for Regulatory Bodies, which will address critical management issues for regulators.

The IAEA has a very active programme addressing nuclear security. There is an emerging series of publications addressing security. The top level defines the foundations of nuclear security, the second level provides recommendations on nuclear security and the third level is the development of implementing guides on prevention, detection, and response to security challenges.

4. IAEA ADVISORY AND EVALUATION SERVICES IN THE AREA OF NUCLEAR SAFETY AND SECURITY

Consistent with the IAEA's role in safety issues, there are advisory and evaluation services available as well. Of particular note are the following capabilities: International Nuclear Security Advisory Service (INSServ); International Physical Protection Advisory Service (IPPAS); Regulatory Safety/ Security Infrastructure Advisory Service (RaSSIA); and the State system of accounting for and control of nuclear material (SSAC) and the IAEA SSAC Advisory Service (ISSAS). Training courses and workshops are offered at all levels ranging from international, regional, or national.

The IAEA safety and appraisal services available currently on the legal and governmental infrastructure standards consist principally of the following:

(a) International Regulatory Review Team (IRRT);
(b) Radiation Safety and Security Infrastructure Appraisal (RaSSIA);
(c) Transport Safety Appraisal (TranSAS);
(d) International Nuclear Security Advisory Service (INSServ);
(e) Emergency Preparedness Review (EPREV).

Under the proposed new system, the Integrated Regulatory Review Service (IRRS), we will provide a coherent review package with the following attributes:

(a) Customized, module based reviews of all aspects of legal and governmental infrastructure will be conducted, as requested;
(b) IAEA safety standards and security guidance will form the basis for the review;
(c) The review will promote self-assessment and continuous self-improvement;
(d) The review will also provide feedback to the IAEA on the use and application of its safety standards and security guidance.

The IRRS is constructed modularly, allowing the services to be selected to meet the schedule and needs of the individual candidates. Currently, Canada, France, Germany, Spain, and the UK have asked for the IRRS. Japan, the Russian Federation and the the United States of America have expressed interest in extending an invitation for the service. To date, there have been 32 IRRT missions, 27 INSServ missions, and 45 RaSSIA missions. Feedback on the success of the missions has been very positive.

5. CONCLUSION

In conclusion, it is important to reiterate the challenges faced by national regulators:

> How are the regulators going to address the effects of globalization on their respective country's nuclear programmes, particularly in light of the impending nuclear renaissance? Are they equipped to deal competently with the advances in technology while facing the ageing and its effects on the current generation of facilities and personnel? How can we guard against the risk of complacency? How do the regulators address the threat of terrorism? At the same time, regulators must identify and resolve any safety issues associated with potential weak links in the nuclear industry.
>
> As pointed out by the IAEA Director General in his statement:
>
> "Much discussion has already taken place concerning the challenges facing regulators and the activities you regulate. It is my hope that this conference will take things to the next level.
>
> "I would hope this conference could identify key success factors that apply to all regulatory bodies. What tangible steps can regulatory bodies take towards achieving these key success factors? What can we in the IAEA do to help? Are we learning everything we can from our colleagues that regulate other industries that demand high reliability — such as the aviation and space industries?
>
> "What else should we look to achieve at this conference? First, I would hope that the participants would work to articulate the clear link between effective nuclear regulation and safe, secure and efficient use of nuclear energy. Second, I would hope that practical recommendations could be made to national governments, regarding: the nature of legislation needed to create and empower their nuclear regulatory bodies, the resources these regulatory bodies need to be effective, and the key components of an effective nuclear regulatory system. Third, I would hope that participants at this conference would reiterate the international commitment to the global nuclear safety and security regime — by, inter alia, supporting the implementation of the Conventions and Codes of Conduct, and the application of IAEA safety standards and security guidelines as the international reference point for the high level of safety and security required in the nuclear field."

LEGAL IMPLICATION OF THE GLOBAL NUCLEAR SAFETY AND SECURITY REGIME

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Presented by G. Philip

Abstract

Currently, a dynamic international legal framework exists comprising a complex mix of internationally binding and voluntary norms and principles. Also, the interrelationship between safety and security and the positive effect that a well-developed regulatory safety system in a given State has on ensuring the security of radioactive material, is acknowledged. Further consideration has to be given to the impact of safety and security measures on each other. The IAEA is now pursuing a comprehensive approach, which recognizes the interface between the different areas namely, nuclear safety, security and safeguards — the '3S' concept — as well as encompassing nuclear liability. The challenge is to make the normative framework more effective and applicable in an effort to enlarge widespread observance with the basic norms governing the safe and peaceful uses of nuclear energy.

1. INTRODUCTION

Internationalization of nuclear law has been a long process. Its roots can be found in the Baruch Plan of 1946 and the 1953 'Atoms for Peace' speech which lead to the creation of the IAEA four years later. Since that time, the world and nuclear energy have undergone many changes. The past years alone have witnessed a significant change in attitudes towards nuclear power. There is increasing attention to its benefits as an environmentally clean source of electricity and meeting energy needs in the 21st Century. At the same time, concerns still remain related to nuclear safety, waste disposal and nuclear security. There are also fears, driven by new realities; the rise in terrorism, the discovery of clandestine nuclear programmes and the emergence of a nuclear black market, to name but a few.

These factors have necessitated the international nuclear community to strive for a harmonized, effective and transparent global framework based on strong national safety and security infrastructures, reinforced by widespread subscription to international legally binding and non-binding instruments. At the same time, however, both nuclear safety and security have traditionally been considered as falling within the sovereign control of States.

As a consequence, binding international commitments, while they do exist, are fewer in number than one might have hoped for. In fact, as much, if not more, has been done by the international community through other mechanisms to develop international cooperation and harmonization, in particular, under the auspices of the IAEA and other international organizations, NGOs, associations and other bodies such as the OECD/NEA, WENRA and WANO.

2. LEGAL FRAMEWORK

To date the approach has been defined by a complex network of national and international standards and measures, including, binding and non-binding bilateral and multilateral international instruments. The fundamental principle has been international harmonization and cooperation with the primary goal to ensure that nuclear activities are conducted in a safe and secure manner.

The international legal framework on the safe and peaceful uses of nuclear energy is also not complete without appropriate mechanisms to safeguard that nuclear material and nuclear facilities are being used exclusively for peaceful purposes. In fact, the peaceful applications of nuclear energy have paradoxically been perceived in conjunction with the prospect of nuclear weapons proliferation and nuclear war. The founders of the IAEA were equally mindful of the dual nature of nuclear energy and created the organization with the twin and inseparable statutory objectives of promotion and control. Nearly 50 years later this dual nature was recognized in the award of the 2005 Nobel Peace Prize.

The legal framework is often discussed at the national level — as regulators, many of you implement rules or regulations, based on your national legal framework, which reflect the various obligations and recommendations of the international legal instruments. Of course, these rules or restrictions are varied due to historical, legal, constitutional, political, institutional, social and cultural differences. There is diversity in approach — national authorities have different organizational and infrastructural themes; different scope of regulatory functions; a different degree of political and legal control; different types and extent of licensable activities — to name but a few. Such diversity in approach to regulation is acceptable but only if it is supported by a strong regulatory programme and within the context of general international principles and standards of regulation.

3. NUCLEAR SAFETY REGIME

Nuclear safety — or what has been referred to as the international nuclear safety regime — is a central component of the international legal framework. In the aftermath of Chernobyl, there was an overdue call for the creation of such a regime as there was a need for harmonization and a need for more general binding-norms in the form of multilateral treaties, than the purely technical recommendations of the safety standards.

Consequently, in the two decades since the accident, the international community has, through the treaty process, created varying degrees of obligations in a wide range of new and improved binding international instruments. Most notable examples are the Convention on Nuclear Safety (CNS) and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, which can be considered as effective instruments for enhancing nuclear safety worldwide. Also, the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency should be mentioned.

The two codes of conduct that have been adopted these past years: one on research reactor safety and the other on the safety and security of radioactive sources could at a first glance, appear to be a step backwards. Again like the safety standards they are not obligatory, leaving States free to choose whether to apply at will the norms contained therein. The codes on the one hand, reflect the reluctance of the international community to establish binding commitments in the field under consideration but at the same time illustrate the acknowledgement that the existing normative documents are insufficient.

It is interesting to note in this context that whatever the legal form of an instrument — whether it is binding such as a treaty, or not — is to a certain extent unimportant. In fact, a binding instrument may itself contain non-obligatory language and it may do very little to alter the behaviour of its addressees - even more so if it is not in force or is deficient from a lack of adherence. At the same time, a non-binding instrument such as a Code of Conduct can be supported by many more States committing themselves to apply the guidance contained therein, than might become party to a legally binding convention.

In addition, as with any international legal instrument, more so with a code of conduct, proper application is the key to its success. Application can be encouraged through the incorporation of peer review mechanisms such as in the CNS and Joint Convention. While at the outset, States did not wish the inclusion of such mechanisms during the preparatory work on these codes, now the international community is considering the effectiveness of the application of the codes. To give examples, at an international conference held last year in Bordeaux, States discussed 24 national reports voluntarily submitted, covering national implementation of the Code of Conduct on the Safety and Security of Radioactive Sources. The call at the conference for consultations on a possible formal review mechanism was echoed some months later in the resolution of the IAEA General Conference. Similarly, with regard to the Code of Conduct on the Safety of Research Reactors consensus was reached some months ago for periodic meetings to discuss the effective application of the code. Also, with regard to the supplementary guidance to the code of conduct, on the import and export of radioactive sources, States have already met to share national experiences in its application with a view to applying it in a cooperative and harmonized manner.

It will be interesting to see over time, whether States wish to take the necessary steps leading to the adoption of a formalized process for discussing the application of the Code of Conduct on the Safety and Security of Radioactive Sources. Should States choose to do so, it will illustrate a new and interesting development of nuclear normative rule making at the IAEA: a mechanism for hardening what is in fact ‘soft law’.

4. NUCLEAR LIABILITY REGIME

The corollary of safety, an adequate nuclear third party liability regime, is also an essential component of the international legal framework. This regime has been improved by the adoption in 1988 of an important link, in the form of a Joint Protocol, between the liability conventions of the 1960s, the revision of these instruments in 1997 and the adoption of a new convention that seeks to create a global liability regime and provides for compensation supplementary to that available under the other conventions. However, concerns still remain and need to be addressed, particularly the concerns from States that are close to the routes of ships transporting radioactive or nuclear material - the so called “coastal states”. Indeed there is some uncertainty and debate related to the implementation of the regime to deal with the legal liability resulting from an accident during the transport of radioactive material.

In this respect, the International Expert Group On Nuclear Liability (INLEX) was established in 2003 by the Director General with the purpose of discussing and advising on nuclear issues. Among the tasks INLEX has accomplished so far, is the finalization of explanatory texts on the nuclear liability instruments adopted under the IAEA auspices. These texts constitute a comprehensive study of the IAEA nuclear liability regime in order to aid the understanding and authoritative interpretation of that regime. In addition, INLEX has also discussed possible gaps and ambiguities in the scope and coverage of the existing nuclear liability regime, and the disadvantages of not adhering to a global nuclear liability regime, in particular, with regard to the possible difficulties of obtaining compensation outside the regime.

5. NUCLEAR SECURITY

The challenge of increasing the nuclear security of States has taken place at an exceptionally fast pace on multiple fronts. The events of September 2001 have propelled a rapid and dramatic re-evaluation of the risks of terrorism in all its forms, including the threat of nuclear and radiological terrorism. This re-evaluation is also taking into account, illicit trafficking and terrorist activities and bombings around the world and the threat that one day such activities may involve the sabotage of a facility or mode of transport, the use of a "dirty bomb" or the use of an improvised nuclear explosive device.

The 'lesson' of Chernobyl in the safety sphere has been applied to nuclear security, in the sense that nuclear security should be urgently strengthened without waiting for a watershed event to provide the impetus for security upgrades and expanded international cooperation.

Reflecting the sensitivity of nuclear security, achieving consensus through the treaty process, has sometimes been an arduous and lengthy process. The final agreement and adoption after a number of years work of an Amendment to the Convention on Physical Protection of Nuclear Material and, the International Convention for the Suppression of Acts of Nuclear Terrorism under the UN auspices, are cases in point. These instruments can be considered as milestones in international efforts to improve nuclear security and reduce the vulnerability of nuclear material and nuclear facilities to crime and terrorism.

Unlike the safety of power plants and radioactive waste and spent fuel management, however, there is no single international legal instrument to address nuclear security. Instead, there are a wide range of instruments that address the subject in one way or another. In addition, these instruments touch upon an area which is traditionally outside the nuclear regulatory domain, namely criminal law. The challenge for the international nuclear community therefore is clearly to analyse all the relevant international instruments that have been adopted in various fora, to explore their interrelation and synergies and also to assist States in their implementation, both at the technical and legal level.

6. CONCLUSIONS

It is clear that a dynamic international legal framework exists comprising of a complex mix of internationally binding and voluntary norms and principles. Also, the interrelationship between safety and security and the positive effect that a well-developed regulatory safety system in a given State has on ensuring the security of radioactive material, is acknowledged. Similarly, a number of IAEA documents already point to the central contribution of IAEA safeguards agreements and additional protocols and also of State systems of accounting for and control of nuclear material (SSACs) to preventing illicit trafficking and to deterring and detecting diversion of nuclear material. But more needs to be done than simple recognition.

Further consideration has to be given to the impact of safety and security measures on each other. Bringing balance and harmony of these two principles will require the development of appropriate international guidance as well as the implementation of effectively coordinated national coping strategies. This is a big challenge as the interrelationship as well as the areas of overlap and of diversity must be identified, rationalized and given effect in the national legislation. Past experience shows that this is not often achieved.

However, to explore this further, the IAEA is now pursuing a comprehensive approach, which recognizes the interface between the different areas namely, nuclear safety, security and safeguards — the ‘3S’ concept — as well as encompassing nuclear liability. While these areas have traditionally been considered as unrelated, the synergies are now becoming clearer and you are all invited, as regulators, to join in this effort.

The challenge is how best to make a normative framework more effective and applicable in an effort to enlarge widespread observance with the basic norms governing the safe and peaceful uses of nuclear energy. The IAEA stands ready not only through its legislative assistance programme but also through continuous legal support in the various safety and security bodies, to assist in this regard.

REGULATORY SAFETY CHALLENGES

(Topical Session 2)

Chairpersons

R. RACANA
Argentina

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Syrian Arab Republic

ADAPTATION OF THE SOUTH AFRICAN REGULATORY FRAMEWORK TO THE LICENSING OF THE PEBBLE BED MODULAR REACTOR
Regulatory challenges

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Abstract

Internationally, it has been recognized that there is a need to adapt the regulatory systems and regulations in the countries being faced with the introduction of new nuclear technologies and applications, thus posing some challenges to the regulatory framework of such countries. With the development of the pebble bed modular reactor, being pursued by South Africa as one of its alternative energy sources, the South African regulatory framework and licensing philosophy had to be adapted in terms of ensuring that a credible and effective licensing process be developed and implemented for this 'new' technology. This paper will present the major challenges which the South African National Nuclear Regulator faced in developing and implementing such a licensing process and how these are being addressed. The paper will also discuss the stakeholders' involvement and interaction in this project as required by the relevant South African legislation.

1. INTRODUCTION

The South African electricity utility (Eskom) is committed to investigating alternative energy sources. One of the many technologies being investigated is the pebble bed modular reactor (PBMR).

In terms of the South African legislation, the National Nuclear Regulator Act (NNRA) (Act No. 47 of 1999), no person may site, construct, operate, decontaminate or decommission a nuclear installation, except under the authority of a nuclear installation licence, granted by the National Nuclear Regulator (NNR).

Any person wishing to site, construct, operate, decontaminate or decommission a nuclear installation may apply in the prescribed format to the NNR Chief Executive Officer for a nuclear installation licence and must furnish such information as the NNR board requires.

In response to the earlier investigation by Eskom, the NNR has been proactively reviewing aspects of high temperature gas cooled reactor (HTGR) technology since 1999, in anticipation of the PBMR licence application.

In July 2000, the NNR received a nuclear installation licence application from Eskom for the prospective siting, construction, operation, decontamination and decommissioning of a 110 MW(e) class demonstration unit of a PBMR electricity generating power station.

In order to determine whether such a reactor is licensable in South Africa, the NNR was faced with the challenges to:

- Develop licensing requirements for such a power reactor and to elaborate the processes that will need to be undertaken to demonstrate compliance with these requirements by the designer and the applicant;
- Develop/adjust its internal regulatory processes to ensure a credible and effective licensing process of this 'new' reactor technology.

2. CHALLENGES FACED BY THE NNR

The major challenges faced by the NNR are mainly related to its internal human resources capacity to undertake the licensing review of the PBMR and the adjustment of the regulatory philosophy and processes to the licensing of a 'first of a kind' reactor project.

2.1. Human resources capacity

At the onset of the PBMR project (1998–1999) in terms of the capacity of the NNR, it became evident that in order to undertake the necessary licensing work associated with PBMR reactor technology it will clearly be necessary to bolster the NNR staff, who were more experienced in the licensing of pressurized water reactors, and to develop in-house expertise in gas/graphite reactor technology.

A campaign to identify potential local and international technical support organizations in this reactor technology was started. It was concluded that at that time there were no local institutions that could provide such specialized services.

Thus, contact was established with various international organizations that could possibly provide the NNR with the necessary consultancy services and the necessary expertise and experience with this type of reactor technology. The organizations were selected on the basis of advice solicited from international contacts and the involvement the NNR has had with the IAEA with regard to high temperature gas cooled reactors.

Two international companies have been providing technical services to the NNR for the review of the PBMR safety submissions and internal capacity building of the organization.

To date, the support of these two international companies to the NNR has proved very successful and beneficial to the progress of the licensing review and also to the capacity building of the regulator. It is envisaged that their services will be retained for future technical support and capacity building of the regulator, during the various stages of PBMR licensing.

2.2. Adjustment of the regulatory philosophy and processes to the licensing of a first of a kind reactor project

Before presenting the adjustment that the NNR made to its regulatory processes and philosophy it is important to first understand the licensing philosophy and process which the regulator applied to the licensing of the first nuclear power plant in South Africa.

2.2.1. Philosophy/process applied to the licensing of the Koeberg Nuclear Power Station (KNPS)

Eskom operates the KPNS, comprising two 900 MW(e) pressurized water reactors, on the Atlantic coast 40 kilometres north of Cape Town. The station was built by a French consortium as a turnkey project, with Framatome having responsibility for the nuclear island, Alsthom Atlantique for the conventional island, Spie Batignolles for the civil works and Framateg for the overall project coordination. Following the regulator's satisfactory review of the nuclear licence application, the first nuclear licence (NL-1) was issued to Eskom for the construction of the power station, which commenced in 1976. The two units were brought into commercial operation in July 1984 and November 1985 respectively.

The legislation which was in place at that time was broad enabling legislation that empowered the regulatory body to apply whatever conditions it deemed necessary to provide for the protection of persons, property and the environment against nuclear damage. In addition, the legislation enabled the regulatory body to call for whatever information was necessary in order to evaluate the licensee's application. These broad principles are still applicable to the current legislation which was updated in 1999.

On the basis of these statutory requirements, the licensing process adopted for the licensing of the KPNS was that the design of any nuclear installation to be constructed should be based on one that was licensed in the country of origin and that utilized design codes and criteria that were broadly recognized internationally. In addition, the design was required to be subject to a quantitative safety assessment making use of probabilistic risk assessment techniques which demonstrate compliance with the quantitative risk criteria laid down by the regulatory body.

The design was required, in the safety assessment process, to be demonstrated to be compliant with the design codes and criteria specified, the equipment to be ‘fit for purpose’ and the risk criteria met. This was achieved through a process whereby the licence holder provided safety submissions with supporting evidence and that these submissions were subject to a technical review and approval process by the regulatory body.

The construction process was required by the regulatory body to be carried out in terms of assessed specifications and processes, including testing and inspection requirements. The overall process was subject to a quality assurance regime assessed and approved by the regulatory body. During the construction process, ongoing review and inspection of compliance with these requirements were maintained and staged approvals were provided throughout the construction phase.

In terms of meeting international norms and standards, the design and general operating rules of the nuclear installation conformed to the applicable laws, regulations, codes and standards that were used in the design and construction of the nuclear installation used as the reference station, i.e. Tricastin in France. French laws, regulations, codes and standards, including Electricité de France rules used for design, procurement, manufacturing, construction and testing, were those used in the reference station on 18 June 1976.

2.2.2. Regulatory philosophy/process adopted for the licensing of the PBMR

As indicated above, the broad principles of the legislation in place during the licensing process of the KNPS are still applicable today even though some significant changes have been made to the legislation since the 1970s.

Broadly speaking, the NNR licensing process requires the applicant to present a safety case to the NNR, which comprises a structured presentation of documented information, analyses and intellectual arguments to demonstrate that the proposed design can and will comply with NNR licensing requirements. The licensing philosophy is not prescriptive as far as the adoption of codes and standards to the design and operation of the nuclear installation, as long as the applicant or the holder of an authorization adopt and apply internationally acceptable, proven standards and practices.

The regulatory philosophy applied to the licensing of the KNPS and summarized in Section 2.2.1, presented some challenges to the NNR in terms of its applicability to the PBMR. One of the major aspects of the PBMR licensing process, which must be thoroughly considered as an integral part of the development (by the applicant) and review (by the regulator) of the safety case, is the credibility of the PBMR design basis. Unlike LWRs such as KPNS, for which well-researched and documented design criteria and rules are readily available, broad international consensus has not been developed on general design criteria and design rules for the PBMR. Although high temperature gas cooled reactors have been licensed and operated elsewhere in the world, no international 'off the shelf' package is available for defining the design basis and the safety case of the PBMR. As part of the safety case, the establishment, documentation and assessment of the PBMR design basis is thus an important step in the licensing process and is receiving major attention by the designers, the applicant and the NNR.

Although the KNPS reactors were subject to licensing requirements developed in the 1970s (as indicated in Section 2.2.1), the first challenge faced by the NNR was to develop licensing requirements for this new type of reactor, taking cognizance of reactor operating experience, developments in international safety standards and application of these in the design of new generation of reactors such as, for example, the European pressurized reactor. Taking cognizance of these factors, the NNR, with the support of its international technical support organizations, developed and published the first revision of the Basic Licensing Requirements for the PBMR in 2000. This was followed by the progressive development of many specific regulatory requirements and guidance documents in support of these Basic Licensing Requirements, which will form the basis of the NNR review of the safety case as presented by the applicant.

The next challenge faced by the NNR was to provide guidance to the applicant and the designer on the processes that will need to be undertaken to demonstrate compliance with these requirements. In order to demonstrate that the PBMR design will meet the above licensing requirements Eskom has, in consultation with the NNR, developed and implemented a structured process to develop the PBMR safety case for which, as opposed to LWRs, well-researched and documented design criteria and rules are not readily available. This process also provides a logical link between the various steps of the design process, the safety assessment and the development of operational support programmes. The main components for the development and review of the PBMR safety case are:

(a) The PBMR safety case philosophy provides the intellectual and philosophical arguments of how PBMR safety will be demonstrated to meet the safety requirements set by the NNR in respect of the PBMR. These refer to the broad safety objectives of the PBMR. The process for developing the safety case philosophy also involved the systematic identification of key licensing issues applicable to this type of reactor technology which will need to be addressed as part of the demonstration of the PBMR safety objectives in the safety analysis report.

(b) The safety analysis report for the PBMR and other supporting documents are to provide a detailed justification of how the safety arguments/ objectives presented in the safety case philosophy are or will be demonstrated.

(c) The general operating rules and additional development/support documents, e.g. on project and licensing management, and test and commissioning. The general operating rules refer collectively to safety related practices or programmes that are applicable during the operational phase of the plant and that may also be applicable during interim licensing stages.

The NNR acknowledges that the production of a safety case, particularly for the demonstration plant of a novel type of reactor, is a difficult undertaking especially taking into account that international well-researched and documented design criteria and rules are not readily available. The NNR is confident that, following the systematic approach summarized above, a considerable amount of thought has been put into the strategy to be employed in the development of a credible safety case and its review against international norms and standards, which ultimately must demonstrate the safety of the PBMR.

3. STAKEHOLDER INVOLVEMENT AND INTERACTION IN THE PBMR PROJECT

In terms of South African legislation there are two major processes for stakeholder involvement and interaction in the PBMR project which are summarized below. Although these two processes are guided by two different legislations there is some interface between them in terms of addressing public concerns related to radiological issues. As required by South African legislation, cooperative agreements between the two relevant organs of State, namely the NNR and the Department of Environment Affairs and Tourism have been concluded to ensure that public concerns raised on radiological issues are well coordinated between the two processes and to minimize the duplication of effort from the two organs of State in carrying out their respective activities.

3.1. Public participation in the PBMR licensing process

One of the most significant changes made to the South African legislation the NNR Act in 1999 was the introduction of the provision for public representation and public hearings in the licensing process of nuclear installations. This also introduced some challenges to the NNR in terms of the PBMR licensing process.

In terms of Section 21 of the NNR Act, based on the public representations made to the NNR following the publication and serving of the PBMR licence application, the NNR board decided that public hearings related to the application would take place once the revised safety case in support of the application for the licence had been submitted to the NNR and that a preliminary review of it completed in order to assess its acceptability for the Board to initiate the public hearing process. Although the planning for public participation has been initiated this process has not taken place as yet.

An important point to consider is that the public representations/concerns will be taken into consideration as an integral part of the NNR review of the PBMR licence application in making a decision to grant or refuse the nuclear installation licence.

3.2. Public participation/interaction in the PBMR environmental impact assessment (EIA) process

In terms of the South African legislation, the Environment Conservation Act of 1989, the approval for the construction of a Nuclear Installation is inter alia subject to the successful completion of an EIA under the jurisdiction of the Department of Environmental Affairs and Tourism. As indicated above, this process is independent of the public participation in the licensing process of the NNR although there is some interface between the two as far as addressing radiological issues goes.

Such an EIA was conducted for the PBMR application made by Eskom to the Department of Environmental Affairs and Tourism in 2001–2002. As the result of design changes made to the PBMR, the EIA process has been re-initiated to consider the impact of these changes.

This EIA process, which was undertaken by an independent consortium, involved many stakeholders' interactions in the form of, for example:

- Identification of interested and affected parties and key stakeholders groupings;
- Holding of open days meetings to disseminate information, educate and discuss relevant issues;
- Provision of background information to interested and affected parties;
- Consultation with potentially affected individuals to ensure that relevant issues and concerns are identified as well as information regarding the project provided;
- Consultation with stakeholders outside of the community such as local authorities, government department, developmental and environmental non-governmental organizations and community based organizations, etc., to gather their input.

The EIA public participation process is a crucial mechanism to inform and educate, but also to understand the issues, concerns, needs and requirements of interested and affected parties. The aim of the public participation process was to create a platform for intensive public consultation that would allow interested and affected parties to express their views regarding their information needs, issues and concerns.

4. CONCLUSIONS

With the development of the PBMR being pursued by South Africa as one of its alternative energy sources, the NNR was faced with many challenges in terms of the adequacy of its internal human resource capacity to undertake a credible licensing review and the adaptation of its regulatory philosophy and processes to the licensing of a first of a kind reactor project.

The NNR is confident that adequate measures have been implemented towards addressing these challenges. However, the NNR still has to face the challenge of engaging in its public participation process and in that regard for the experiences of other nuclear regulatory authorities that are or have been involved in such a process would be very valuable.

APPROACH TO REGULATORY RESEARCH RELATED TO NEW TECHNOLOGIES

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Abstract

Regulatory research can be defined as activities comprising of research, testing and analysis undertaken for obtaining deeper insights into intricate safety issues towards arriving at scientifically sound and better optimized regulatory decisions. Regulatory research may be performed by the regulatory body itself or by the licensee or their technical support organizations. This could be either in fulfillment of regulatory requirements for novel designs or to resolve safety issues in existing facilities. New technologies are often introduced in nuclear power plants (NPPs) for safety enhancement or for improving plant efficiency or economics. The regulators are then faced with the challenging task of reviewing such technologies to assess and confirm their reliability and robustness before consenting for their use in the plant. Regulatory research provides a sound basis to support such regulatory decisions. The Indian Atomic Energy Regulatory Board (AERB) makes significant use of regulatory research, both for addressing safety questions in existing facilities as also for assessing the reliability of new designs. Management of safety of coolant channels in pressurized heavy water reactor (PHWR) based NPPs, safety assessment of unbonded prestressing system for primary containment building of an NPP and, analysis for arriving at the cause of a power rise incident in an NPP are some examples where intense played a key role in AERB's decision making process. This paper aims at elaborating on the different aspects of regulatory research that help eliminate subjectivity in regulatory decisions and also improve the effectiveness of a regulatory organization through contributing to value addition to safety. Some examples of regulatory research in support of AERB's decisions are also covered in the paper.

1. INTRODUCTION

Regulatory research comprises of activities related to research & development, analysis and testing that are essential towards obtaining deeper insights into safety issues for arriving at scientifically sound regulatory decisions. Information obtained from regulatory research also helps in optimizing regulatory decisions. Regulatory research could be used for resolving safety issues in operating installations as also for assessing new designs including those of an innovative kind.

Innovative technologies invariably have issues that are surrounded by uncertainties and would therefore need substantial research and testing support. For some designs, even after extensive research, it may not be possible to have a clear 'black and white' case. Reliance would then need to be placed on defense-in-depth towards ensuring sufficient safety margins. Such decisions however, can be arrived at only after extensive research, testing and analysis have been carried out.

Regulatory research has a wide area of application and is connected with almost every aspect of regulation of nuclear facilities. Since it provides the appropriate scientific basis for regulatory decisions, it removes or minimizes the element of subjectivity in the decision making process and thereby improves the effectiveness of regulatory bodies. The decisions arrived at in this manner are reasonable, defensible and fair to concerned stakeholders.

2. APPLICATION AREAS OF REGULATORY RESEARCH

Regulatory research can be applied in a number of areas in nuclear power plants such as: root cause analysis of events; assessment of adequacy of safety related structures, systems and components; ageing management and long term operation; fire safety including fire PSA; and computer based systems and training simulators. In the case of innovative designs, regulatory research has a major role as the concept itself has to be proved through extensive research, analysis and testing.

In some cases reasons for occurrence of safety significant events cannot be easily explained by the information obtained from plant parameters. For these cases, one has to go in for in-depth analysis to arrive at the root cause of the events. Knowledge obtained from regulatory research is also highly helpful towards modifying operating procedures, developing emergency operating procedure and identifying hardware modifications towards enhancing operational safety. Extensive work in recent years on analysis of severe accidents is a good example which has enabled obtaining proper understanding and development of plans for their management.

In the area of ageing management, regulatory research plays a key role since long term behaviour of several of the critical components of a power plant cannot be clearly established at the design stage. This applies to both in-core and out-of-core components. Extensive research done for assuring safety of coolant channels and to address the problem of thinning of the walls of feeder pipes in PHWR based NPPs is a good example in this context. For long term operation of NPPs including operation beyond their design life, it is essential that all degradation mechanisms that can cause deterioration of components challenging safety be thoroughly understood and appropriate measures are taken to counter them in a timely manner. This requires extensive research and in-depth analysis, especially towards predicting behaviour of construction materials of safety critical components during such extended operation. It also provides a sound basis to the regulators for arriving at decisions in this difficult area.

Fire safety is another area where an improved understanding of fire loads, possibility of propagation of fire and the efficacy of fire detection and extinguishing systems can be obtained through research. Fire PSA provides further insights into these issues. In fact, extensive research done over the years in this field has significantly improved fire safety in nuclear power plants.

Use of computer based systems in reactor regulation and protection systems in nuclear power plants has been a subject of considerable discussion for a long time. Extensive research is being carried out towards establishing the reliability of these systems, especially the failure modes which may not lead to a safe status of plant and susceptibility of these systems to common cause failures. Changing over from analog to digital systems in nuclear power plants also falls in the same category. Research work is also essential for developing training simulators such that they are able to correctly represent all operational states and accident conditions of the plant to provide useful training to plant operators.

3. REGULATORY RESEARCH FOR NEW TECHNOLOGIES

Innovative designs are generally characterized by the claims of inherently safe systems and passive safety features. This is in contrast to evolutionary designs that are based on proven systems with good safety margins towards achieving an adequate level of safety. Since safety-by-design is presently not a proven concept, it is necessary that extensive R&D, analysis and testing is carried out for innovative designs and technologies.

Towards regulation of innovative designs it is useful to carry out a pre-licensing design review wherein all important issues that need to be resolved are identified and safety criteria are developed, which the new design must meet. The proposed design should either be able to address these issues and meet the safety criteria or it should be assessed to be amenable to their resolution through research and testing with a reasonable assurance. A detailed research, analysis and testing programme should then be developed and agreed upon between the design organization and the regulatory body. Results from these activities should be reviewed from time to time with possibility of mid course changes in design based on the review. This type of regulatory review can be termed as concurrent regulation. It is also useful to have the overall operating scheme for a plant with innovative design to be worked out right at the design stage. This should include normal operation, anticipated operational occurrences and also accident conditions. Though the review of the operating scheme together with the proposed technical specifications for the operation of the plant, it may be possible to identify additional safety issues that need to be addressed.

Most of the innovative designs place heavy reliance on passive safety features. However, failure of the passive safety systems cannot be totally ruled out as this can happen either due to component failure or due to phenomenological failure. A very sound understanding is therefore necessary towards licensing of the passive safety features that has to be based on extensive testing and analysis. Some of the innovative reactor designs involve operation of fuel and coolant at temperatures much higher than encountered so far. For these designs, extensive research on materials, equipment and instrumentation that can operate safely at such elevated temperatures during the entire lifetime of the plant would be an absolute requirement. Some of the innovative designs might involve operation of the system under sub-critical condition and involving very high neutron energies. An elaborate safety assessment of such operating schemes is necessary as safety in these operational domains could be highly vulnerable to any disturbances. Development of nuclear data for the involved neutron energies will be another safety requirement for such systems.

4. REGULATORY RESEARCH AND REGULATORY EFFECTIVENES

One of the important indicators of the effectiveness of a regulatory body is whether it has been able to make significant value addition to safety through its actions. The opportunities for such value additions generally come through critical reviews of licensee submissions and other safety issues which lead to identification of areas where further research is needed. The regulatory body can then get such research initiated either in-house or by the licensee or through technical support organizations. Information obtained from such research work, in most cases, results in substantial improvement to safety.

Research and analysis carried out within the regulatory body is of immense value in this context. This could be in the form of analysis of safety significant events, analysis of severe accidents, review of operating experience, independent checks of critical designs and even review of operator responses under different situations towards arriving at modifications to training programmes and licensing procedures for operating personnel. A latent benefit of regulatory research carried out by the regulators themselves is that it improves their technical competence considerably which in turn leads to high quality safety reviews and improved regulation in general.

As mentioned earlier, regulatory research improves the overall competence in the regulatory body. This enables taking objective views on issues without the element of arbitrariness and without placing unnecessary emphasis on trivial matters. Regulatory decisions then tend to be technically sound, reasonable and fair, which is also a good indicator of regulatory effectiveness.

5. INDIAN EXPERIENCE WITH REGULATORY RESEARCH

The Atomic Energy Regulatory Board (AERB) of India accords high importance to research, testing and analysis as part of its regulatory work and in support of its regulatory decisions. One of its technical divisions, the Safety Analysis and Documentation Division, is engaged in safety analysis in the areas of probabilistic safety assessment, thermal hydraulics, severe accident analysis, etc. Research in the field of seismic design of structures and components, high performance concrete, long term performance of concrete structures and use of high volume fly ash concrete in construction of NPP civil structures is carried out by the Civil and Structural Engineering Division of AERB. The AERB also obtains substantial research support from its technical support organizations like the Bhabha Atomic Research Centre (BARC) at Mumbai and the Indira Gandhi Centre for Atomic Research (IGCAR) at Kalpakkam.

Additionally, the AERB sponsors research in a variety of areas of interest at a large number of academic institutions in the country through its Committee on Safety Research Programmes. In 1999, AERB established the Safety Research Institute (SRI) at Kalpakkam. SRI is engaged in research related to shielding design for NPPs and research reactors, radiological safety studies for radiotherapy and accelerator based medical treatment systems, probabilistic safety assessment, radionuclide migration studies, environmental studies using Remote Sensing — Geographic Information System and atmospheric dispersion studies. SRI is a depository for safety analysis computer codes and it also conducts a large number of seminar, workshops, etc., on topics of interest to AERB.

5.1. Examples of regulatory research

A few examples of the use of regulatory research in the AERB's decision making process are presented in the following paragraphs.

5.1.1. Safety of coolant channels in PHWR based NPPs

The older generation PHWR based NPPs in India use pressure tubes (PTs) made of zircaloy material that have two loose-fitting spacers in the form of garter springs around them. The spacers are provided to prevent contact of the hot pressure tube with the cold calandria tube (CT) through which the pressure tubes pass in the horizontal reactor vessel. Movement of the spacers on account of flow induced vibrations and resulting in longer unsupported span of the PTs and sagging of PT due to creep resulting in the PT contacting the CT, uptake by the PT of deuterium generated due to corrosion of zircaloy, migration of deuterium in the PT to the cold spot created by PT–CT contact, possible formation of hydride blisters at contact location and their potential cracking are the important issues that needed to be addressed to ensure safety of PTs.

The possibility of deuterium in the PTs crossing the terminal solid solubility limit leading to their embrittlement and potential failure on account of growth of defects due to delayed hydride cracking (DHC) was another safety issue that would determine the time of the en-masse coolant channel replacement (EMCCR).

Extensive research was undertaken at BARC for developing inspection and analytical tools to determine location of spacers and their repositioning, location of PT–CT contact, estimation of deuterium pick-up rates, thresholds for formation of hydride blisters and their possible cracking and the safe operating life of PTs based on DHC consideration. These computational models were supported by analysis of sliver samples drawn from PTs using specially developed tools, extensive post-irradiation examination (PIE) of PTs removed at various points of time of their operating life and analysis of laboratory grown blisters on unirradiated PTs.

This extensive research and analysis work provided the basis for developing the regulatory criteria for deciding on the permissible operating life of individual PTs, wet quarantining of certain PTs during operation and the time of EMCCR. Highly conservative acceptance criteria were applied in the beginning and these could be progressively relaxed based on the inputs from analysis and inspections including results of PIE.

As of today, EMCCR in 3 PHWR units has been successfully completed and the units brought back into operation and one unit is currently shutdown for EMCCR. It is gratifying to note that no pressure tube failures have been experienced in the Indian NPPs so far.

5.1.2. Prestressing system using unbonded strands

For one of the NPPs, the design proposed use of unbonded prestressing system for the primary containment civil structures. In this design, the prestressing cables are placed inside grease filled HDPE sheaths that are enclosed in metal ducts and cement grout is injected to fill the gap between the metal ducts and the sheaths. The system is expected to suffer reduced loss in prestressing during operating life and re-tensioning is feasible, if required.

To qualify this first-of-its-kind prestressing system for use in a NPP, extensive qualification programme involving experimental work and mock-up testing was undertaken at the behest of AERB. This comprised of accelerated ageing tests on the HDPE sheaths and grease under the most severe operating conditions and mock-up tests on vertical cables as also on horizontal cables with maximum vertical deviation.

The mock-up tests were aimed at demonstrating the threadability and rethreadability of cables, ensuring no damage to HDPE sheaths during threading, feasibility of re-tensioning of cables and proper distribution of cement grout in the ducts. The system was approved by AERB for use based on satisfactory results of the experiments and mock-up tests.

5.1.3. Analysis of unintended power rise incident in a NPP

In one of the 220 MW(e) PHWR based NPPs, an incident of unintended power rise occurred when the reactivity adjuster rods became inoperable on account of loss of power supply to their drive motors. At this time, owing to lack of proper understanding, the operator inhibited the automatic liquid boron poison addition system. As a small positive reactivity existed in the core at this point in time, the reactor power started rising, at a slow rate initially with the rate of rise increasing after some time, till the reactor tripped on high differential temperature across the steam generators. At the time of the incident the reactor was operating in a peaked flux mode as against the flat flux mode adopted normally.

As the reasons for the continued power rise after the initiation of the event could not be explained, the AERB directed that the reactor remain shutdown and detailed analysis be undertaken to identify the root causes. Detailed analysis using 69 neutron energy group cross-section library, as against the 27 group library used earlier, could explain the observed reactor behaviour during the incident where after appropriate corrective actions in procedures and hardware were incorporated. Another regulatory action was to ask the utility to impart formal retraining and relicensing of operators and station management taking into account the implications of actual operating configuration of the reactor.

6. CONCLUSIONS

Regulatory research enables obtaining a good understanding of complex safety issues of operating facilities as well as of new designs including those of an innovative kind. It has a wide area of application in regulatory work and in-house research by the regulatory body helps to improve its competence and effectiveness. Extensive use of regulatory research is essential for conducting safety evaluation of new technologies, especially in the context of uncertainties that invariably attend such designs and for proper assessment of passive safety features and addressing the problems of operating in new domains.

The Indian regulators have placed a strong emphasis on regulatory research and have been using it extensively in all spheres of their activities. The AERB is striving to strengthen its in-house capabilities for safety research and analysis and in this direction a safety research institute has also been established.

IMPLEMENTATION OF THE CODE OF CONDUCT ON THE SAFETY OF RESEARCH REACTORS

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Abstract

The Code of Conduct on the Safety of Research Reactors was adopted by the Board of Governors of the IAEA and endorsed by the General Conference in 2004. The development of the code took place over several years and followed letters to the Director General on research reactor safety from the International Nuclear Safety Advisory Group. The code is a non-binding international legal instrument designed to 'serve as guidance to States for, inter alia, the development and harmonization of policies, laws and regulations on the safety of research reactors'. It contains guidance on best practice directed to the State, to the regulatory body and to the operating organization. As it is non-binding in nature, the code does not itself include a mechanism for implementation based upon the process of ratification and the participation in formal review meetings that implement the Convention on Nuclear Safety and the Joint Convention. Nonetheless, processes for information exchange and a form of peer review are being considered by interested Member States. The non-binding status of the code and the consequently more informal nature of mechanisms for implementation may be an advantage in allowing for a graded approach to the different types of research reactors, their status and the safety issues they face.

1. A SHORT HISTORY

The development of the Code of Conduct on the Safety of Research Reactors can be traced to letters to the Director General of the IAEA from the International Nuclear Safety Advisory Group (INSAG) in November 1998 and April 2000. In these letters, the INSAG drew particular attention to the issues of: the increasing age of research reactors; the numbers of research reactors that are not operating, but have not been decommissioned; and the number of research reactors in countries that do not have appropriate regulatory authorities. The INSAG pointed out that, apart from their removed spent fuel, research reactors were not covered by the international safety conventions. They suggested that a protocol to the Convention on Nuclear Safety be developed to cover research reactors.

In September 2000, the General Conference of the IAEA passed a resolution that requested “the Secretariat … to continue work on exploring options to strengthen the international nuclear safety arrangements for civil research reactors, taking due account of input from INSAG”. In turn, a working group convened by the secretariat in May 2001 recommended as one element of an international action plan on research reactor safety the “preparation of a code of conduct that would clearly establish the desirable attributes for management of research reactor safety.” This recommendation was taken up by the Board of Governors and endorsed by the General Conference in September 2001.

Subsequently, open ended meetings to draft a code of conduct took place in 2002 and 2003. The code was adopted by the Board in March 2004 and endorsed by the General Conference in that year.

2. WHAT IS A CODE OF CONDUCT?

A code of conduct is a non-binding international legal instrument. The non-binding nature of the Code of Conduct on the Safety of Research Reactors is made clear in its text. The preamble to the code states that the IAEA’s Member States “decide that the following code of conduct should serve as guidance to States for, inter alia, the development and harmonization of policies, laws and regulations on the safety of research reactors”. The code itself continually refers to the application of the guidance of the code and it is made up of ‘should’ statements.

Member States have strongly emphasised the non-binding nature of the code. A General Conference resolution in 2004 went no further than encouraging Member States to apply the guidance in the code to the management of research reactors; and requested the secretariat to continue to assist Member States in the implementation of the code and associated safety guidance within available resources.

The Code of Conduct on the Safety and Security of Radioactive Sources, adopted around the same time, is similarly non-binding in nature. The General Conference resolutions adopted for that code of conduct have not only urged Member States to adopt the guidance of the code, but also to write to the Director General to the effect that it fully supports and endorses the IAEA’s efforts to enhance the safety and security of radioactive sources; is working toward following the guidance contained in the Code of Conduct on the Safety and Security of Radioactive Sources; and encourages other countries to do the same. In other words, while staying non-binding, a political commitment was called for from States and by the end of 2005, 79 countries had made that commitment.

3. STRUCTURES OF THE CODE

After the preamble, scope and definitions, the body of the code sets out guidance for the role of the State, the regulatory body and the operating organization, as well as for the IAEA. The code encourages the use of IAEA safety standards, the use of a graded approach related to hazard, and that, if in difficulty, the State may communicate difficulties and required assistance to the IAEA. Major roles for the State are setting up the legislative and regulatory framework; establishing and supporting the regulatory body; ensuring a system for financing safe operation, safe extended shutdown and decommissioning; reviewing the safety of existing research reactors; and ensuring safe management of any research reactors in extended shutdown.

The regulatory body and the operating organization have mirroring provisions dealing with : assessment and verification of safety; financial and human resources; QA; human factors; radiation protection; emergency preparedness; siting; design, construction and commissioning; operating, maintenance, modification and utilization; extended shutdown; and decommissioning.

The role of the IAEA is to disseminate the code and related information widely; to assist States in application of the code; and to continue to collect and disseminate information relating to the safety of research reactors, provide safety review services, develop and establish relevant technical standards and provide for the application of these standards at the request of any State.

4. WHERE TO NEXT?

So, the first regulatory challenge is “How can a non-binding code of conduct help improve the safety of research reactors worldwide?” It can certainly serve as a shining example of a statement of international best practice in nuclear safety. It can shape the further development of research reactor safety standards and the IAEA can use it as high level guidance for missions and can reflect the code in project and supply agreements that it concludes with Member States. These steps are all very good things and to be mightily encouraged.

However, one can not believe that the code will have the extensive impact on research reactor safety that should be hoped for until Member States commit to follow the guidance in the code and there is a mechanism whereby they can share experience and learn from each other.

The international nuclear safety and radiation protection community is becoming used to the notion of 'review meetings' at which there are relatively formal processes that require the submission of country reports, questions being asked by other countries on the basis of those reports and peer review exchanges within country groups. These are the processes that have been adopted through the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management.

At the third review meeting of the Convention on Nuclear Safety (at which some 27 countries had voluntarily reported on research reactors in their national reports), the Contracting Parties passed a resolution reading as follows:

> "Having taken into consideration the positive impact of the incentive nature and the benefits of the Review Process of the Convention on Nuclear Safety on improving nuclear safety, the Contracting Parties to the Convention on Nuclear Safety request the Director General of the IAEA to convene meetings to which all Member States would be invited. The objective of the meetings should be to discuss how best to assure the effective application of the 'Code of Conduct on the Safety of Research Reactors'."

An open ended meeting responding to this resolution was convened in December 2005. At this meeting, representatives from 31 countries discussed ways to assure effective application of the code. The meeting recognized the importance of information exchange as part of international cooperation on improving and harmonizing the safety of research reactors world-wide. It was also accepted that there needed to be flexibility in the mechanisms for information exchange in this area — the full 'bells and whistles' of a formal country report, formal questions and answers and a peer review examination may deter many countries, particularly countries with limited resources, from participating in the information exchange from which they would otherwise derive much benefit.

The open ended meeting agreed that there should be periodic meetings to discuss topics related to the application of the code of conduct in Member States. The meetings would exchange experience and lessons learned, identify good practices in applying the code and discuss future plans for using the code to improve research reactor safety. The meetings should also discuss difficulties that may be being encountered and the international or IAEA assistance that might help overcome these difficulties and allow the country to achieve full conformance with the code.

The suggestion is that the discussions at these periodic meetings should be taken from documents submitted by Member States. It was emphasised that the documents submitted by countries should be informal, submitted for the pruposes of discussion, and not be considered as formal national reports.

In the end, the non-binding nature of the code of conduct and the consequent lack of formality in the mechanisms to exchange information about the application of the code may work to its advantage. The population of research reactors is a diverse one and a graded approach is absolutely necessary. Informal papers and discussions are also more likely to identify the real difficulties that are being encountered and allow for practical and pragmatic assistance to be planned.

Another useful suggestion to emerge from the open ended meeting was that the IAEA secretariat establish a suitable website to support the exchange of information and documents about lessons learned in the context of the periodic meetings.

Further discussions are awaited about how to gain greatest value and most extensive participation in these meetings on the code. Certainly, Australia will be willing to commit itself to applying the guidance in the code and participating enthusiastically in the preparation and conduct of the periodic meetings recommended by the open ended meeting.

Linking timing to CNS review process in some way may be helpful. Also, in preparing for the periodic meetings and starting the information exchange, the value of exchange and discussion at regional level should be considered, as well as exchanges between regulators and operators of reactors of the same type or with similar utilization programmes — ranging from ‘24/7’ operation for neutron beam and isotope production, through research in support of power programmes through to teaching.

5. SOME REGULATORY CHALLENGES IN THE CODE

The code of conduct sets out its guidance in three main sections: the role of the State, the role of the regulatory body and the role of the operating organization. All three will need to be involved in discussion of implementation of the code.

This distinction in roles may in itself represent a regulatory challenge for the regulator of a research reactor. In many countries, some or all of the research reactors may be operated by a government organization, an instrumentality of the State. Often, indeed, that organization — an Atomic Energy

Commission or similar name — has been the origin of the regulatory body itself. Further, the Government will have only a small pool of nuclear safety expertise to draw upon and the regulator may also be the de facto adviser to the State in some of its roles.

Another general regulatory challenge is the application of the ‘graded approach’. The code states:

> “Noting that there are many different research reactor designs and power levels resulting in a wide range of hazard potential, the State should adopt a graded approach to application of the guidance in this Code commensurate with the hazard potential, while maintaining a strong nuclear safety culture.”

The concept is simple enough — but there is the potential for much heated discussion about its application. One regulator’s ‘graded approach’ may be ‘over regulation’ to the operating organization and ‘regulatory capture by the operator’ to the national or local environment groups. It is not just the reactor power that needs to be borne in mind, but the utilization programme. The caveat about maintaining a strong nuclear safety culture within a graded approach needs careful consideration as to its practical meaning.

A particular challenge is likely to be the proposal that the regulatory body “where necessary in national circumstances, establish criteria for the safety of research reactors in extended shutdown.”

The issue of extended shutdown was a controversial area of discussion in the drafting of the code. The preferred position is, of course, that there should be no such state. A reactor should be operating with a utilization programme, or it should be under decommissioning. However, as was pointed out by INSAG in its original advice, there is a legacy of research reactors in this limbo-like state. It appeared to the drafters of the code that the most effective and pragmatic course was to recognise this and allow for the safety of extended shutdown to be addressed directly. The resolve of the State and availability of resources to regulators and operators to address extended shutdown needs to be encouraged.

Certainly, this topic of extended shutdown should be encouraged to be taken up as a priority in the discussions at the first of the foreshadowed periodic meetings. The application of the guidance in the code relating to decommissioning should also be a priority.

6. CONCLUSION

The adoption of the Code of Conduct on the Safety of Research Reactors offers an important opportunity to tackle the issues about the safety of research reactors that have been nagging at the international nuclear safety community for quite a few years. There are regulatory challenges, but the non-binding nature of the code and the more informal mechanisms of the periodic meetings offer an opportunity for a very broad based and effective response to these issues.

BALANCING RISKS AND BENEFITS IN MEDICAL APPLICATIONS AND HOW TO REGULATE

The role of the regulator compared to that of a physician[*]

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

BALANCING RISKS AND BENEFITS IN INDUSTRIAL APPLICATIONS

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Abstract

The paper will attempt to address the need for an effective international cooperation for effective regulatory systems and in particular will concentrate on prerequisites and key factors for an effective national regulatory system — the role of governments and stakeholder involvement. For that purpose specific recommendations are made.

1. INTRODUCTION

The wide range of industrial nuclear applications and current safety and security concerns impose a need for establishing/upgrading effective national regulatory systems to face such increasing challenges.

There are changes in nuclear applications themselves, coming from the progress made to existing nuclear applications or in new ones such as in the field of nuclear forensics. There are changes that come from outside the nuclear industry but have effects on the safety and security aspects, sometimes hidden. These could be economic, political, social, or cultural factors.

There are also new, although illegal, stakeholders, namely, non-State actors and potentially malicious users. All of this adds new risks to industrial nuclear applications as well as to general nuclear applications.

2. INDUSTRIAL APPLICATIONS

There are two points that distinguish industrial nuclear applications from other nuclear applications: the wide range of their use and the great economic benefits these applications offer to stakeholders, which make them an essential element within the framework of sustainable economic growth.

Apart from electricity generation, which is not the subject of this paper, these applications are mostly of a non-destructive nature that include: radiotracer technology, well logging and industrial radiography, industrial irradiation and quality control and quality assessment techniques, amongst others.

2.1. Risks and benefits

There is no doubt that the benefits of nuclear applications in industry are so great that the world cannot function without them. One such case is their role in the oil industry.

No doubt that our collective experiences have lead to improved work standards and practices. Also, from accidents and incidents lessons have been learned, but the important ones are the new applications and the probability of an unexpected accident where even regulations would not have been enough to prevent.

When we take as an example industrial radiographic accidents (the most frequent type), we see that inadequate regulatory control or failure to follow operational procedures are the primary causes of such accidents. Human error, design flaws and equipment malfunction are relatively small in comparison. Therefore, most of the safety risks are not in the nuclear industrial applications themselves but in the weakness in the underlying regulatory systems.

In security matters, the issue has taken a new trend since 11 September. Security requirements for major radioactive sources in industrial applications (category 1 and 2) have become mandatory for any regulatory system if such a system is to be effective. Regulators must be vigilant as they may not necessarily guarantee, for example, that a given material is physically protected. That is because the equation here is different, the more we develop secure procedures, the harder the malicious parties try in turn to breach security. So the measures here should be taken extremely seriously.

3. EFFECTIVE NATIONAL REGULATORY SYSTEMS

The name of the game here involves minimizing risks as a function of effective national regulatory systems. Suffice to state that risks in any industry can never be eliminated; they can however be minimized to the degree that they become normally acceptable in comparison with other risks to life. This is within the letter and the spirit of the basic radiation protection principle of optimization as spelled out in the IAEA Basic Safety Standards. For such effective systems to be built, a number of prerequisites and key factors must be adopted. The role of government as the leader of such a system is essential and stakeholders' involvement will guarantee success.

3.1. Prerequisites and key factors

The first and most important prerequisite/key factor for a successful and effective national regulatory system is the political will at the highest level of government. After all, it is in the national interest to minimize possible risks to people and/or the environment from the hazard of ionizing radiation. The fact that after 9/11 much attention has been and must be given to security matters adds considerable weight for such political will to be forthcoming. This political will manifests itself via the establishment, empowerment and proper financing of an independent and strong/effective national regulatory authority.

The second prerequisite/key factor is the required independence of the national regulatory authority that is properly authorized and empowered by law and by the strongest possible political commitment. This means that the regulatory authority's responsibilities should not be scattered amongst different government parties that are subject to inter-agency interference. This should be clearly defined in national law.

The third prerequisite/key factor is the adherence to international standards and codes of conduct and practice as spelled out in the various relevant IAEA publications, including the recently adopted code and guide, namely, the Code of Conduct for the Safety and Security of Radioactive Materials and the Import/Export Guide, both of which are essential tools to be implemented.

The fourth prerequisite/key factor is the adequate financing and staffing of such a regulatory authority.

The fifth prerequisite/key factor is to establish an effective national system for registration, licensing and inspection which includes a comprehensive national registry. This system must integrate newly developed security requirements, the licensing process and the inspection procedures.

The sixth prerequisite/key factor is to have effective enforcement procedures that make the licensees adhere more to regulations.

3.2. Role of government

Governments should lead national efforts in establishing effective national regulatory systems in accordance with the six prerequisites and key factors stated above. Once such an effective regulatory system is in place, governments should work to sustain the progress being made and create mechanisms to ensure continuous development of such systems in order to face emerging challenges. The case here is the apportioning of an adequate budget for such sustainable development.

One of the key roles of government is to establish national training programmes catering to the national regulatory system in cooperation with stakeholders and relevant expert houses such as universities and academia, in addition to international expertise, particularly the IAEA.

Governments are to work on the integration of radiation protection fundamentals and safety culture within their national education system, as well as disseminate safety culture fundamentals to the public at large. This could be done in cooperation with relevant professional associations, NGO's and syndicates.

Government in a given region can develop regional cooperation for the purpose not only of sharing knowledge and experience but also to create a regional system for common control of radioactive materials amongst others.

Governments are charged with the main responsibility to integrate their national regulatory systems with those of the world at large. Naturally, this is more smoothly done through the IAEA. Clearly, becoming an IAEA Member State is exclusively a governmental decision.

Member States can and are encouraged to join the list of Member States that have expressed a political commitment to both the Code of Conduct for the Safety and Security of Radioactive Materials and the Import/Export Guide.

3.3. Regulators and stakeholders

An effective regulatory system must involve various stakeholders in its activities with a strict understanding that it is in the stakeholders' own interests to have an effective regulatory system. Stakeholders should understand that the risk that regulators are aiming to reduce is the risk that they should also fear. Thus, their cooperation is not only necessary but also natural.

The basic promise that an effective regulatory system brings to stakeholders is that the benefit is a maximum while the risk is a minimum. This promise should be and must be properly advertised and made well-known.

An example is the oil industry (regulators versus oil companies). Many regulators know from experience that companies tend to cut corners in order to maximize profit. This kind of practice may work once or a couple of times but soon enough either they will be caught by the regulators or something wrong will take place, an accident or a security breach. In these cases the cost to the company is immeasurable. The regulators must be able to convince companies of this using existing examples.

National law should contain appropriate measures to punish offenders in radiological accidents, including penalizing companies. The laws and regulations should make it very expensive on the part of companies to break the law.

Regulators should carry out correct and responsible inspections while government should assess the effectiveness and impartiality of such inspections and decisions thereafter.

4. REGIONAL COOPERATION

Regional cooperation has proven to be very effective in a wide range of areas, including the domain of the safety and security of radioactive materials. Despite this, such cooperation is not taking place amongst all regional groups. The aim of regionalizing cooperation amongst regulators is to put together countries with common problems and risks and to find common solutions, with the ultimate goal of creating a strong and effective collective regional regulatory system.

Some of the most important regional characteristics are common culture, language and socioeconomic factors. These common factors are a source of strength within the region if properly addressed. Clearly, training that caters to regional and subregional specifics is one of the outcomes of such regional cooperation.

Comparing notes and experience through workshops, seminars and training activities is taking place in many regions but not in all regions. Not only must all regions conduct such cooperative activities, but it is also desirable to work for a comprehensive regional regulatory infrastructure.

5. INTERNATIONAL COOPERATION

What kind of effective international cooperation is needed for effective nuclear regulatory systems? The major international responsibilities in this regard can be summarized as follows:

First, the international community must push for realizing national political commitments by governments at the highest level possible. This includes convincing States to join the IAEA.

Second, the IAEA should adopt effective regional and international projects to establish/upgrade radiation protection infrastructure in Member States similar to the very famous model project. Such projects are not only comprehensive in nature but also cater to national and regional needs.

Third, the IAEA should pursue aggressive training programmes to assist Member States in establishing/upgrading effective regulatory systems with an emphasis on building nationally sustainable capabilities.

Fourth, donor States must help finance the establishment/upgrading of effective regulatory systems in less developed countries.

Fifth, manufacturers of industrial radioactive sources must work with the IAEA and national regulators to ensure accountability and traceability of sources.

Last but not least, is it time for a legal binding convention in the matter of nuclear safety and security? Perhaps the code of conduct is the way to go.

6. RECOMMENDATIONS

The six prerequisites/key factors and the six international responsibilities listed above are all recommendations of this paper, but the most important recommendations here are:

- If the first and most important key factor in the effectiveness of regulatory authorities is the political will at the highest level, then frankly the question is whether international cooperation should be a catalyst for convincing political leaders to take the necessary decisions.
- Once the political will is there, it is recommended that the IAEA and donor countries provide significant assistance, particularly to less developed countries to help establish/upgrade an effective regulatory system.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to the personnel of NATEC and to Mr. Magdi Mansoor for his assistance in preparing this manuscript.

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RADIATION FOCUS: PREPARATION FOR THE REGULATOR TO BE READY FOR NEW TECHNOLOGIES AND APPLICATIONS

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Abstract

In the Republic of Korea, there are now more than 2700 radiation users and this number is growing annually by about 10%. In recent years new radiation technologies have emerged in various areas including medical and industrial sectors. For example, radiation technologies such as positron emission tomography/computer tomography, tomotherapy systems and ion accelerators have been introduced in the medical area to diagnose and treat tumors. Also, radiation generating machines producing high energy radiations have recently been used for screening containers at sea ports/airports. Some of these new radiation technologies produce complex radiation fields including high energy photons and neutrons. Thus, to ensure the safety of radiation workers and members of the public, the regulatory body should have effective and efficient safety regulation mechanisms through design approval of radiation devices, licensing and inspection procedures. For medical exposures, the national regulatory system should ensure that a quality assurance programme is in place for the delivered dose in therapy and activity of radionuclide in nuclear medicine. On the other hand, some new applications of radiation in industrial processes, such as low energy X ray devices for processing electronic products, usually result in inherently low radiation risks to operators. Thus, relaxation of regulatory requirements can promote the relevant industry whilst ensuring safety. However, for the enhancement of safety and security, additional regulatory requirements may be warranted for the approval of design of those radiation devices using high activity radioactive sources. In order to cope with the increasing number of radiation applications in various areas, the risk informed and performance based regulatory approaches have to be pursued. The graded approaches of exemption, notification and licensing have to be fully employed since available regulatory resources are limited. The IAEA source categorization system for sealed radioactive sources may be a good example of the graded regulatory approach. The Republic of Korea recently developed new regulatory technologies such as the real-time source tracking system that uses GPS/CDMA/RF technology to locate and recover mobile industrial radiography sources. These technologies may be adopted to prepare and respond to an emergency situation in transport of radioactive materials. The Republic of Korea has also developed the radiation source inventory tracking system based on on-line reporting through the web

based network system known as RASIS. These regulatory approaches using new technologies may be employed as an effective and efficient means to assure the safety of radiation sources.

1. INTRODUCTION

Radiations and radioisotopes are used in various areas such as medicine, industry, non-destructive testing, agriculture, research and education. In the Republic of Korea, radiation technology has been steadily increasing its application areas apace with the nation's economic development. There were more than 2700 radiation users in Korea at the end of 2005. The annual growth rate of the number of radiation users is about 10%. It is expected that the demand for radiation technology in the 21st century will continue to increase.

The current regulatory system for radiation protection in the Republic of Korea is based on the 1990 Recommendations of the International Commission of Radiological Protection [1] and the IAEA's Basic Safety Standards (BSS) [2]. These recommendations and standards include the dose limits for radiation workers and members of the public as well as the regulatory system of exemption, notification and authorization (registration, licensing). The country's Atomic Energy Law adopted the BSS exemption criteria for defining the regulatory scope of radioactive materials and radiation generators.

2. CURRENT STATUS OF NEW RADIATION TECHNOLOGIES AND APPLICATIONS IN THE REPUBLIC OF KOREA

In recent years new radiation technologies have emerged in various areas including medical and industrial sectors. For example, some of the advanced radiation technologies in the medical area are positron emission tomography/computer tomography (PET/CT), tomotherapy systems and ion accelerators. These radiation technologies are used to diagnose and treat malignant tumors such as cancers, among others, and to apply radioisotopes and/or radiation dose to a patient. PET is an apparatus that diagnoses the malfunction in the brain blood stream by counting annihilation radiations emitted from a positron emitting radionuclide, which is a short lived radionuclide such as ^{18}F, injected into a patient. Although the PET/CT has been used for some years in the country, its application has increased rapidly since 2004. Along with the increasing use of PET/CT, the supply of cyclotrons has also increased to produce radiopharmaceuticals used for the PET/CT.

Tomotherapy uses software to link a linear accelerator and CT. This therapy system irradiates a patient according to a radiation therapy plan that is established by conducting CT on the patient. It has the benefit of reducing the time interval between the establishment of the radiation therapy plan and the treatment of the patient. Tomotherapy was introduced into the Republic of Korea only very recently.

A proton accelerator was recently installed for medical purposes in the National Cancer Center. The proton accelerator can produce protons with energies of up to 235 MeV and can be used to treat patients by adjusting this energy according to the depth of the cancer. The proton accelerator is expected to be operating in 2007. Besides the medical area, radiation generating machines producing relatively high energy radiations have recently been used for screening containers at seaports/airports by the customs service. On the other hand, some new applications of radiation in the industrial area, such as very low energy X ray devices for processing electronic products, have been introduced.

3. REGULATORY CHALLENGES AND PREPARATION FOR NEW TECHNOLOGIES AND APPLICATIONS

The introduction of new radiation technologies and applications in medical and industrial areas will present new regulatory concerns with regard to ensuring the health and safety of occupational workers, patients and members of the public. Radiation safety considerations in the use of PET/CT technology include protection of radiation workers and the public from the radioisotope injected patients waiting for diagnosis, control of contamination in the patient's toilet and management of radioactivity concentration in gaseous effluent from the facilities in the licensing review. Even though all relevant standards and rules are well established in the Atomic Energy Law, the standards for the above mentioned technical items should be described in detail for the better understanding of users. In addition, regulators should establish the evaluation and inspection system consisting of resources and tools to come up with new technology in radiation diagnosis.

Thanks to the development of technology, there are some useful radiation generators for radioisotope production and therapy such as the cyclotron and linear accelerator (including tomotherapy). These devices inevitably produce neutrons which cause difficulties in evaluation and detection owing to the complexity of their behaviour. Furthermore, in radiation therapy it is very important to obtain accuracy in the delivery of radiation dose to a tumor and therefore quality control of therapeutic installations is of great importance. It is certain that national standards are well established in the country's Atomic Energy Law and in harmonization with international standards and codes of practice. However, it is essential to secure guidelines for neutron evaluation and shielding, and the detailed procedures for quality control and assurance of these radiation generators. Currently, the regulatory staff are equipped with various kinds of radiation detectors that can measure the neutron dose rate around the system. These include bubble detectors, bubble spectrometers, BF_3 proportional counters, tissue equivalent proportional counters, etc. This is an example of regulatory measures that ensure the safety of the new radiation technology. From the governmental perspective, a high tech system for radiation safety diagnosis should be organized and utilized in this field in which radiation users are lacking knowledge and money to deal with the neutron issues.

The proton accelerator installed at the National Cancer Center has rooms for the cyclotron, beam transfer system and treatment. The system will produce high energy gammas and neutrons while accelerating protons. This requires regulatory staff to ensure the adequacy of shielding. In addition, requirements for the quality assurance of the control system to operate the accelerator are needed.

Some of these new radiation technologies produce complex radiation fields, including high energy photons and neutrons, and therefore raise regulatory concerns in the licensing and inspection. Regulatory licensing and inspection experiences have shown that the poor design of shielding outside the linear accelerators used for screening containers at seaports produced unwanted leakage radiations and thus might cause unexpected occupational exposures. To prevent the recurrence of the poor design and installation of the shielding of these high energy linear accelerators, the regulators should be well trained to evaluate possible deficiencies in meeting the radiation protection requirements for the radiation generating systems.

Through the enhancement of radiation application technology and the advancement of the related technology, recently many pieces of equipment and devices that have minimized the health effects from radiation exposure, such as low energy X ray devices for processing electronic products, have been developed and their application in areas that may not require regulation has been expanded. Relaxation of regulatory requirements for these radiation devices can promote the relevant industry. However, these radiation devices are also subject to radiation safety management since they also emit radiations and can cause radiation exposure to humans if not properly handled. Thus, a balanced approach is required between the regulation and promotion of radiation applications in order to ensure radiation safety while pursuing the peaceful application of radiation technologies.

Since the application of radiation in medical and industrial areas is expanding, one of the regulatory challenges is to cope with the increasing number of radiation users. For this, the risk informed and performance based regulatory approaches have to be pursued. The graded approaches of exemption, notification and licensing have to be fully employed since available regulatory resources are limited. The IAEA source categorization system [3] for sealed radioactive sources may be a good example of the graded regulatory approach.

One of the most important elements in ensuring radiation safety for the new radiation technologies and applications is the education and training of radiation protection personnel as well as regulatory staff. The licensees using new radiation technologies in medical and industrial sectors may not be adequately prepared for the management of safety associated with the use of new technologies. However, the operational radiation safety should be demonstrated by well-qualified radiation protection personnel. To strengthen the radiation protection infrastructure the Government established the Nuclear Safety School at the Korea Institute of Nuclear Safety to provide education and training to those who work in radiation protection and radiological emergency response. The school offers training courses not only for regulatory staff but also for those who work in local government and for relevant organizations involved in preparedness and response to a radiological accident. On the radiation user's side, radiation protection services can be of help since they can provide professional services to radiation users in such areas as shielding, radioactive decontamination, radioactive waste management, transport of radioactive materials and consultation of the safety issues associated with new radiation technologies. The Government maintains the registration system for radiation protection services.

4. REGULATORY MEASURES USING NEW TECHNOLOGIES

Radioactive sources such as ^{192}Ir have been widely used in industrial applications such as non-destructive testing. However, the use of mobile radioactive sources especially has some weaknesses in radiation safety management such as loss, theft and malicious use. Thus, the use of these mobile sources requires regulatory measures, although it has proved to be useful and convenient in the related industries. The Government supported the development of the real-time source location tracking system to prevent the theft and loss of radioactive sources and to minimize the radiation hazards by rapid recovery of the radioactive sources in the event of any loss. The radiation source location tracking system consists of the mobile station, the mobile communication network and the central control system. The mobile station is attached to the outside surface of an irradiator container and collects location information on the radiation source using CDMA/GPS/RF which it sends to the communication base every 10 minutes. The central control system receives the information through the mobile communication network from the communication base. The information on the location and route of the mobile radioactive source is then linked to the geographic information system in the central control system and based on the web. The Government now applies this system to the mobile use of all iridium irradiators that are used for non-destructive testing. In particular, the system was employed for monitoring the security of radioactive sources in the neighborhood of the Asia–Pacific Economic Cooperation forum that was held in Busan in November 2005. The system is also being used for the safety management during transport of high activity radioactive sources and nuclear materials through location tracking. This regulatory approach suggests that for the enhancement of safety and security, additional regulatory requirements should be warranted to approve the design of the radiation devices using high activity radioactive sources, such as industrial radiography sources.

The Korea Institute of Nuclear Safety developed the web based radiation source inventory tracking system known as RASIS (radiation safety information system). The development of this on-line network system required Government support for funding over several years and employs the latest information technology. RASIS also reflected various stakeholders' opinions and requirements since the safety management and inventory tracking of radioactive sources and radiation devices from import/manufacture through distribution, acquisition and use to disposition. Related organizations also play their roles. For example, for the import of radioactive sources and radiation devices the Korea Radioisotope Association uses RASIS to confirm whether or not the importer is licensed by the regulatory body. The role of regulators is to ensure that the system fully reflects up-to-date licensing and inspection requirements and procedures so that the radiation users can report on-line periodically to the regulatory body through RASIS. These regulatory approaches using new technologies may be employed as an effective and efficient means of assuring the safety of radiation sources from cradle to grave.

5. CONCLUSION

National regulators should be prepared for new technologies and applications in medical and industrial areas to ensure the health and safety of occupational workers and members of the public. To do this, radiation infrastructure should be strengthened, including the training and education of regulatory staff and radiation protection personnel. Regulators should also be ready for the application of new technologies such as information technology for the enhancement of radiation protection and for the safety and security of radioactive sources. The risk informed and performance based regulatory approaches should be fully employed in order to use the regulatory resources efficiently.

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REGULATORY SECURITY CHALLENGES

(Topical Session 3)

Chairpersons

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SYNERGIES BETWEEN SAFETY AND SECURITY

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Abstract

Safety and security are largely intertwined. A principal aim of nuclear security is to prevent actions that can cause harm to humans — a safety objective. Synergy between safety and security thus seems natural and easily achieved. However, some aspects, principally culture differences between the two communities, may hinder this desirable synergy. Examples of fruitful collaboration between safety and security are detailed and possible obstructions for straightforward synergy are discussed. Ways of overcoming some of the obstructions are suggested.

1. BACKGROUND: LINK BETWEEN SAFETY AND SECURITY

1.1. Safety and security are not easily separated

Safety and security[1] both aim to prevent harm to people. The updated draft IAEA glossary [1] notes that "There is not an exact distinction between the general terms *safety* and *security*." It further clarifies that "In general, security is concerned with malevolent or negligent human actions that could cause or threaten harm to other humans; safety is concerned with the broader issue of harm to humans (or the environment) from radiation." The IAEA's corollary is that "security is an essential (but not sufficient) element of safety: materials or facilities cannot be considered safe if they are not secure, whereas they could be secure without being safe."

An earlier version of the glossary [2] notes "the difference between safety and security in Agency usage" and cautions that "This should be particularly borne in mind in view of the fact that in many languages the same word may be

[1] Safety and security in this paper mean nuclear safety and nuclear security, respectively.

used for both.” Indeed, in Hebrew, the first language of this paper's author, both words share a common root and a similar pronunciation.

We sometimes try to distinguish between safety and security as much as possible, but such a distinction, justified as it may be, cannot disregard the fact that many actions of security bring about a prevention of harm to humans, and therefore enhance safety.

1.2. Evolution in the emphasis of the role of security

Let us contrast an ‘older’ definition of safety [2]: “Measures to prevent the loss, theft or unauthorized transfer of radiation sources or radioactive material” with a newer one[1]: “Measures aimed at preventing, detecting and responding to unauthorized access to or unauthorized human actions involving nuclear material, other radioactive material or associated facilities.”

Classic security measures, not necessarily nuclear related (e.g. car alarms, surveillance or locking devices), aim primarily to guard property and prevent its theft. Contribution to safety, if any, is indirect — a car thief, or a person driving the stolen car, may be inexperienced, or drive carelessly when avoiding pursuers. Inasmuch as these measures propose to protect property, one would not expect them to have a direct contribution to safety, except when there is a concern that the property in question is potentially harmful if fallen into untrained or careless hands.

In the past, security of radioactive sources dealt mainly with the prevention of inadvertent or careless access to the source and exposure of involved persons and bystanders. In recent years, as a result of escalation in global terrorism and its awareness — more so due to the events of 9/11 — a change has occurred. The primary objective of a considerable part of the security of radioactive sources is not to guard the source or prevent unauthorized access, but rather to foil any use of the source that will cause a deliberate harm to beings or the environment, a distinct safety objective. The word malevolent was added to the list of actions that security aims to prevent [1]: “…malevolent or negligent human actions that could cause or threaten harm to other humans”.

2. HOW NATURAL IS THE SYNERGY BETWEEN SAFETY AND SECURITY?

2.1. Synergy between closely connected domains

If indeed security is a prerequisite for safety, or more radically put, security is a part of safety, then the question of synergy becomes almost trivial or meaningless. Actions of security improve safety, and are therefore in complete synergy. It therefore may be pointless to address synergy between security and safety: we do not discuss synergy between the resilience of nuclear facilities during earthquakes and safety; we consider such resilience a part of safety. Generally one does not discuss synergy between a field and one of its subfields. If, for example, we consider a situation where a radioactive source may be dispersed while causing harm to humans as unsafe, and if security aims to prevent such a state, then security's contribution to safety is clear, and their synergy is rather trivial.

2.2. Synergy between safety and security is not trivial

In reality, however, we feel that the synergy is not trivial for a number of reasons (partly overlapping):

— Security and safety experts come from different cultures.
— The knowledge in these two fields is derived from different sources, and must be combined.
— Intelligence, a concept inherent to security, is foreign to safety experts.
— There were few connections in the past between security and safety experts.
— Ignorance of experts in either field to the fact that they can use knowledge and experience of experts in the other field.
— Struggle for power and/or resources between different organizations, or different units inside the same organization.
— Difficulties and bureaucracy in coordination between safety and security experts.
— Lack of traditional licensing organizations for radiation security.

These factors, which impede cooperation between the fields, justify an explicit discussion of the synergy between them – reviewing the aspects in which it contributes most, and the difficulties that may hinder it. If we wish to exploit the synergy between safety and security we have to understand the difficulties of achieving it and how to overcome them.

3. EXAMPLES OF SYNERGY

Earlier we deduced from the tight link between security and safety that many actions designed for security, will also contribute to safety. In the opposite direction, we expect that security actions, aimed at preventing deliberate harm to people might draw upon the knowledge and methods accumulated over time in the safety community. A few examples of such ties are discussed below.

3.1. Matters contributing to both fields

Different sources have different degrees of potential harm, depending on the type of radionuclide and its level of activity. Source classification is of importance both to security and to safety. IAEA's five category division, as manifested first in a technical report [3] and later in a safety standard [4], serves both these purposes. Since this division was made mainly in the context of safety, it can be argued that the help it provides is one way: safety benefits security with the knowledge it gained. However, a closer inspection reveals, as shown above, that the help is two-way: security attempts to prevent harm to people (a safety goal), and it uses knowledge gained from safety to make its actions efficient.

An efficient and user-independent regulatory authority is necessary for both security and safety. Inspection of security guideline formulations for the security regulatory body [5] reveals that they are similar to those of the safety regulatory body [6]. Indeed, the code of conduct on the safety and security of radioactive sources [7] combines the requirements and addresses them jointly, though not ruling out the possibility of two (or more) separate regulatory bodies for security and safety.

Organized records of sources and the maintenance of a database for those records are clear requirements of safety, to allow regulatory control over the maintenance of these sources. Security needs have increased the requirement for such a database, and in many cases the security regulator may use the safety database 'as is'. In other cases, for example in federated countries which maintain a number of databases, the needs of security mandate an incorporation of these databases into one database. This may help safety experts, as one database stands to be more efficient than several, but also requires resources which, had it not been for the growing radiological terrorism threat, might have been utilized otherwise.

To save resources and inflict minimal hindrance to activities with ionizing radiation, safety experts adopted a graded approach as a basic concept for risk-analysis (for example in Refs [8], [9]). Protection and intervention measures in case of malfunction are determined by the gravity of the threat — the possible damage and its probability. Security experts obviously had their own parallel and prioritized their work in a similar way. Security experts can easily assimilate safety's 'graded approach' and unite it with the system under which they prioritized security issues. Indeed, we find references to a graded approach in matters of security, for example in IAEA's security guidelines [5], as well as the summary for a meeting about nuclear security [10].

Measures for mitigation of malfunctions or accidents may be closely similar, whether the event was a result of a malfunction, including human error, or of intentional action. Examples for similar issues for both cases are: levels of intervention determined by IAEA [11], measures of intervention, such as sheltering or evacuation [11], treatment of first responders.

3.2. Matters requiring cooperation

Some tasks are impossible without cooperation between safety experts and their security counterparts. Without such cooperation either side's separate contribution would be ineffective:

- Security system design must draw from safety in all matters concerning source risk-analysis (the aforementioned graded approach) and from security in all matters of prevention.
- Similarly, the search for stolen or potentially harmful sources requires combining safety experts to guide the detection of radioactive sources and the precautions that should be used in their search and apprehension, along with security experts to gather intelligence on the possible whereabouts of the sources and handle their actual seizure.

3.3. Other topics

- Transport of strong gamma radiation sources requires strong protection. This protection is achieved using shielded packages, which, naturally, are quite heavy and make it harder to steal the source.
- Stronger security usually leads to prevention of unintentional and unauthorized access to radioactive sources.
- Maintaining security guards near a high-activity radioactive source, both stationary and mobile, creates a task-force for immediate treatment in case of accident.

4. DIFFICULTIES IN ACHIEVING SYNERGY

The most interesting, fertile part of the discussion about synergy is not presenting the cases in which it is obvious, but rather a study of cases in which achieving synergy is difficult and an attempt to overcome the difficulties and increase the level of synergy.

4.1. Safety culture and security culture

We frequently use the vague definitions of safety culture and security culture; they are (respectively) [1]: "The assembly of characteristics and attitudes in organizations and individuals, which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance" and "Characteristics and attitudes in organizations and of individuals which establish that security issues receive the attention warranted by their significance."

The demand for the coexistence of these two cultures becomes difficult when they are not completely identical (and as mentioned before, if they were completely identical, the question of synergy would become trivial). One culture may, as shown in the next section, set requirements which clash with those set by the other.

4.2. Secrecy

The principal difference between safety culture and security culture may very well be the requirement for secrecy set by security experts, and the lack (and even denial) thereof by safety experts. If, for example, a security measure intends to prevent theft of radioactive material by a terrorist organization, then obviously information about this measure (number of security personnel, or the thickness of the safe in which the source is located) compromises security, and might help the terrorist organization to overcome it. This is not the case for 'classic' safety, absent the threat of deliberate damage. Protection of a package from road accidents and full disclosure of the means of this protection do not increase the chances for such an accident. In fact, as is often the case with people working in a complex technological field, there is a tendency among safety experts to publish their work as much as possible and consult others.

The boundaries for secrecy required by security have not been set yet. On one end of the spectrum one may find present security standards which are in the public domain, while on the other end there is a call to put a stop to coverage of radiological terrorism scenarios, which do not detail security measures solely out of fear that it would give terrorists new ideas.

The clash between the two cultures and the fear that one may overtake the other may lead to lack of cooperation, and an injury to ‘natural’ synergy. For example, we currently encounter reservations about the inclusion of security requirements — which have a direct bearing on safety — in safety standards. The basic solution to this problem appears to be simple; study of IAEA’s basic security guidelines [5] reveals that:

— Security requirements or descriptions of security measures are initially generally formulated, and can be published in the public domain.
— A large part of these requirements have safety connotations (see article 3 above).

Obviously, specific security requirements set by individual countries and organizations, which include, for example, the required number of security personnel, cannot be made public. One possible solution to this problem is that any reference to security which has a bearing on safety will also be published in an appropriate safety standard. While this principle is simple and makes clear use of the synergy, it is still far from general acceptance.

The information conflict between safety and security is more serious regarding actions than it is regarding publications:

— Safety experts will require warning signs on vehicles transporting radioactive materials and will prefer to use the signs to supply information on the strength of the source. Security experts may prefer to transport these materials without any markings.
— The transportation of a high activity source will motivate safety experts to announce the fact beforehand, so people may choose to avoid relevant locations. Security experts will be shocked by this idea.
— In a nuclear facility safety may direct easy emergency access to sensitive locations where a quick intervention may be required, e.g. fire fighting. Security will prefer to limit this access in order to prevent terrorists from exploiting it to cause harm.

4.3. Different methods of representing knowledge

Some of the examples mentioned in Section 3, represent knowledge that can be mutually used, for example the five category division of sources according to their potential risk. Sharing this knowledge, however, is not spontaneous. The aforementioned division is noted in papers such as IAEA’s safety standards and technical reports. This type of documents has been known for years to safety experts, and their format and character have been shaped by safety experts or by regulators whose primary dealing was with safety. They are scarcely known among security experts and their subject presentation may be different from what security experts know or like. It is hardly enough to bring such papers to the attention of security experts, or to hold joint meetings, though this sort of action obviously helps. It is imperative to initiate an active process whereby we determine the way in which security experts would like to examine data coming from safety experts. Obviously this problem is bidirectional. When we want to share knowledge gained by security experts with safety experts, we must present it in way the latter find comfortable. An extreme case of representing data in different ways is the intelligence concept. While being basic to security, it has no parallel concept when it comes to safety.

4.4. Absence of security oriented regulatory body

Nuclear safety is a mature topic, and many countries nowadays have regulatory bodies with a well established tradition, experts on the matter, and a set of well-tested rules. The increasing need for security of radioactive sources against malicious actions is relatively new. Countries may find themselves without a body whose clear function is to address this matter, and the 'classic' regulatory body may lack knowledge and ability to deal with the problem. Security bodies constantly find themselves pressed for resources, and are unlikely to "volunteer" to take on new responsibilities without an increase in budget and manpower. The suggested potential of shared knowledge and joint action cannot therefore be fulfilled. The code of conduct on the safety and security of radioactive sources [7] naturally compels the countries to take action on the matter: "...that the radioactive sources within its territory, or under its jurisdiction or control, are safely managed and securely protected…" Therefore, in such a state of events it is up to the country to form the necessary security body. Resource constraints will require that a vigorous action will be needed to persuade officials of the need for such a body. A suitable organization to raise the problem of the lack of a central body to treat radioactive source security is the old regulatory body that deals with safety.

4.5. Two regulatory bodies (safety and security) or one

Should we implement the needs of safety and security (such as regulation) using a single body or several?

First we must take into account the difference between standardizing bodies and regulatory bodies. A standardizing body, for example a national standards organization, or an IAEA standards committee, can choose to form separate standards for safety and security and leave the task of uniting them to the end user organization or the regulator.

A licensee for use of a radioactive source must, eventually, be able to get a clear and definitive answer as to whether the requested licence is granted or not. The tight link in all matters of radiation between safety and security issues leads to a preference for managing the subject by a single entity. Nevertheless, there are certainly quite a few countries where bodies dealing with safety had no call to address security matters in the past and have instead clear cut security bodies, whose cultures and terms may be inherently different from those used by safety experts. This indicates an advantage in addressing the matter by two different bodies while maintaining a tight link between them.

There are several options for the actions of regulatory bodies in aspects of safety and security:

— A single regulatory body with sub-units dealing with safety and security in coordination. This is probably suitable for countries that have worked this way in the past.
— A regulatory body that concentrates on one topic (safety, excluding prevention of deliberate harm, or security) and is assisted by another body that concentrates on the other topic. This structure will suit countries where the regulatory body hardly had any dealings with security matters, and that already have a dominant security body.
— Two separate regulatory bodies, wherein a licensee must be granted a license by both.

Recognizing that there are different ways of addressing the problem it seems intuitive, while also bearing in mind the constraints details in the next section, that whenever it is possible to incorporate matters of safety and security in an existing structure it is worthwhile to do so.

4.6. Resource constraints

The growing threat of radiological terrorism has naturally brought about increased activity in its prevention, and involvement of security bodies in the matter, which, as stated before, also contributes to safety. Allegedly, there is an increase in resource allocation, but one must keep in mind that these increased resources are meant to address increased threats. Regulators, for example, which in the past hardly gave any thought to the subject of deliberate harm, now have one more task. Parallel increase in resources is not always easy to obtain.

This is a common problem, and its solution (apart from increasing resources) is hinted in the title of this paper — maximal utilization of the potential synergy between safety and security.

5. SUMMARY

There is a tight link between securing a radioactive source and its safety, and in many cases this security is a prerequisite for safety. The same can be said for the actions, emphasized in recent years, taken for the prevention of radiological terrorism.

Seemingly we would expect complete synergy between safety and security. This synergy can be manifested in several ways:

- Securing a radioactive source will make it safer.
- Security and safety endeavours will share similar knowledge, thereby increasing it.
- Techniques for analysis of the importance of different matters will be similar.
- In some fields cooperation between experts from both disciplines may be necessary for effective results.

Indeed, we find many examples for all of these possibilities. On the other hand, there are many aspects in which we encounter difficulties in exploiting this natural synergy:

- Different cultures for safety and security experts;
- The need for secrecy and nondisclosure of information to the public on the part of security, versus the tendency and tradition of safety experts to publish their work and inform the public;
- Different ways of presenting and using data;
- Ambiguity regarding the question of which security body should join the old regulatory body, whose main concern was safety;
- The decision of whether to have one regulatory body or two;
- Limited resources.

Theses difficulties necessitate bringing up these problems, discussing them, and coming up with solutions. Some of the solutions presented are:

- Maximal use of common working tools;
- Inclusion of publishable security standards in safety standards;

— Use of existing bodies, and avoiding creation of new entities;
— A clear definition of the body responsible for security, in a similar way to the existing definitions regarding safety;
— Mutual guidance for the harmonization of concepts and attitudes.

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CONTRIBUTION OF STATE NUCLEAR SAFETY AND REGULATORY AUTHORITY TO THE MAINTENANCE AND LONG TERM SUSTAINABILITY OF SECURITY OF NUCLEAR AND RADIOACTIVE MATERIALS

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Abstract

The safe and secure use of atomic energy and nuclear and radioactive materials seems to be impossible without appropriate measures on maintenance of security of nuclear materials, radioactive substances, radiation sources and associated installations and the enterprises where they are used, in particular, without accounting, control and physical protection. Dynamically varying situations in the new, widely interdependent world generates new, more hazardous and wide ranging threats. As a consequence of this, attention to the problem of nuclear and radiological terrorism, which fortunately so far remains hypothetical, should grow adequately to meet this threat. New challenges generate new issues and problems. One of them is to maximize the use of State regulation of safety and security to maintain an adequate level of security at installations with potential hazards due to nuclear and radioactive materials and their self-sustained maintenance over the long term.

1. INTRODUCTION

The implementation of an energy security strategy that takes account of advanced developments in the nuclear power industry is not possible without wide international cooperation in the field of nuclear and radiation safety enhancement and the strengthening of measures for nuclear non-proliferation and security of radioactive materials.

Within the framework of the Eurasian Economic Community (EvrAzES) summit held on 25 January 2006 in St Petersburg, the President of the Russian Federation, Vladimir Putin declared, that the Russian Federation was firmly going to expand cooperation within the framework of EvrAzES in the area of global energy security. One of the priorities here is the development of cooperation in the peaceful use of atomic energy. He also noted that it is considered necessary to create a prototype of such a global infrastructure, which will allow an equal access of all interested parties to atomic energy under conditions of compliance with the non-proliferation regime requirements.

The key element of such an infrastructure should be a system of international centres rendering nuclear fuel cycle services, including enrichment, under IAEA safeguards and based on non-discriminatory access. The Russian President said that the Russian Federation will propose such an approach to the members of the G-8 within the framework of the Russian presidency. He declared a readiness to create such an international centre within the Russian Federation.

2. STATE POLICY ON NUCLEAR AND RADIATION SAFETY

On 4 December 2003, President Putin approved “The Bases of State Policy in the Field of Nuclear and Radiation Safety of the Russian Federation to 2010 and Beyond.” In this policy statement it is stressed that ensuring nuclear and radiation safety is one of the major components of national safety and security of the Russian Federation. The following activities are mentioned as having high priority:

— Enhancement of State regulation in the field of nuclear energy use, including increased efficiency and effectiveness of licensing activity and safety reviews in this area;
— Strengthening of physical protection of nuclear and radiation hazardous sites against terrorist acts;
— Increasing the role of State nuclear regulation.

The last point links directly with the quality of regulatory documentation in this area. One of the most important factors reflecting the quality of regulatory documents and their compliance with the present day reality is harmonization with publications of the IAEA and other international organizations.

The basic documents, such as the Convention on Physical Protection of Nuclear Material, Recommended Measures on Physical Protection of Nuclear Material and Nuclear Installations (INFC/225), the Code of Conduct on the Safety and Security of Radioactive Sources, Guidance Principles of the State Systems of Accountability and Control of Nuclear Material and other documents of the IAEA and the United Nations are used in the development and improvement of regulatory basis of the Russian Federation.

However, it is necessary to note that an urgent need exists with regard to IAEA publications containing recommendations or guidance on such specific issues as physical protection of radioactive sources and physical protection of nuclear materials and radioactive sources during transportation. Similar documents are already in force or will be put in force in the near future in the Russian Federation.

According to the Law on the Use of Atomic Energy, the fundamental mechanism of normative regulation is based on federal rules and regulations. Rostechnadzor has the authority to organize the development, approval and enforcement of federal rules and regulations.

3. STRUCTURE OF REGULATORY DOCUMENTS

The hierarchical structure of regulatory documents has at the top level the constitution and the federal laws (the Federal Law on Use of an Atomic Energy, the Code on Administrative Violations, the Law on Criminal Code, the Law on State Secrets and others related to safety and security), Decrees of the President, Orders of the Government, Federal Rules and Regulations, normative documents of ministerial level and normative documents of the facilities and operating organizations. Correspondence of documents with each other across each level and correspondence of documents of various vertical levels should be provided.

This issue is linked with the mechanisms by which functions of State regulation of safety and security are carried out. Objectively, these mechanisms are fairly conservative in the favourable sense of the word and quite 'inert'. In particular, the development and enforcement of federal rules and regulations normally take two or three years or even longer. This is due to the complexity and multistage process of development, agreement and legal implementation of this class of documents.

However, the existence of rules and regulations does not guarantee unconditional compliance with them by the operator for a variety of reasons including technical, economic and social. Adaptation of the facilities and operating organizations to new, stricter requirements, needs time and requires additional funds; the latter normally being limited.

4. STRATEGY TO COUNTERACT THREATS

As regards the creation of a new strategy to counteract threats, it is necessary to remain within the existing legal framework as well as to show flexibility and efficiency in the development and implementation of needed measures. Ideally, each country separately and the world community as a whole should aspire to act to prevent newly emerging threats and potential infringers.

What resources and possibilities exist to improve the situation in this area? There are six elements that could make a contribution to a significant improvement, which are discussed below.

(i) Development of regulatory documents

Development of regulatory documents should be organized to facilitate the improvement of regulatory framework on security on the basis of systems approaches with closer interaction between the State structures involved in security issues and the facilities and operating organizations that use (manage) nuclear materials and radioactive substances. The regulatory authority plays a key role in the coordination of activities on the development and implementation of federal rules and regulations. The regulator is responsible for arranging involvement of the interested organizations and the most qualified experts in the development of federal rules and regulations. It is also necessary to ensure that the available departmental documents, the standards and technical documentation of the operating organizations and facilities, and international experience are taken into account to the extent possible.

However, the legislatively established independence of the regulator from the operator should not become a barrier to the organization of such interaction. Regulatory requirements and regulatory control become effective security enhancement instruments if they reflect mutual consent and are characterized by the mutual trust based on the mutual recognition of competence of both sides.

(ii) Licensing

In the Russian Federation, as well as in the majority of countries with an advanced nuclear industry, activities in the use of atomic energy are carried out on the basis of licences. Licence conditions constitute an effective mechanism for regulation of safety and security. However, formulation of licensing conditions, which adequately reflect the current situation and establish specific organizational and technical requirements, is a difficult task of a legal and technical character. Experience shows that the establishment of additional restrictions or requirements in licence conditions causes a response from the licensee that searches the bases or reasons by which the additional conditions/restrictions could be considered as illegal. If it is found that they are not illegal, an objective analysis is carried out to assess whether the specified additional conditions/restrictions promote increased safety. But in the case of nuclear security, this process should be reversed to enhance nuclear security culture. An assessment should first be made to see if the additional conditions/restrictions do improve safety and security and then it should be examined whether these additional conditions/restrictions could be considered illegal for any reason. If so, measures have to be implemented to make the additional conditions/restrictions legal. This licensing aspect is important for establishing regulatory requirements that would facilitate a quick and proactive response to emerging threats.

(iii) Inspection

The main goals of inspections which Rostechnadzor carries out are the following: to detect non-compliance with the requirements of normative documents, regulations and licence conditions; to determine the reasons and the circumstances of violation; and to apply measures aimed at elimination of the detected violations and their occurrence in the future.

Rostechnadzor carries out 200–300 inspections annually both on material control and accounting (MC&A) and physical protection of nuclear materials. Approximately 20% of inspections use non-destructive assay (NDA) instruments for nuclear materials verification. About 1500 inspections per year are conducted on 2170 non-nuclear sites to inspect physical protection of radiation sources.

Usage of NDA instruments and Tamper Indication Devices (TIDs) raises efficiency of control measures in storage, use and transportation of radioactive materials and reduces the risk of the non-authorized actions. Cooperation with customs bodies, exchange of information about verification results helps to improve the control of radioactive materials. It some cases it may be used at the international level. There is already some experience with the usage of TIDs jointly by Gosatomnadzor (former Russian Regulatory body) and EURATOM for control of UF_6 imported from the EU to the Russian Federation. Three basic components define efficiency of inspection activity: (a) regulatory and methodic (procedural) documents, (b) technical means and information, and (c) personal training and improvement of professional skill. Rostechnadzor collaborates with the United States of America and the EU in this area. Targeted and significant assistance comes from the US Department of Energy.

Applying an integrated approach to conducting inspections, with the participation of other national security authorities (the Ministry of Internal Affairs of the Russian Federation, the Federal Security Service), allows the detection of violations that occur in the ‘border zone’ of spheres of responsibility of the oversight authorities.

(iv) Protection of information

The significant part of the information in the sphere of nuclear security is sensitive. This concerns both the general issues, such as design threat, and the specific information on systems of security, especially information on weaknesses and defects of such systems. The necessity to ensure protection of the information reduces an opportunity for information exchange both on the national and international levels, and complicates the exchange of experience and development of specific recommendations within the framework of the international organizations and within the framework of bilateral international cooperation.

At the same time there are mechanisms for information exchange between the special services of different countries which are carrying out anti-terrorist operations.

Without the realization of such mechanisms, cooperation between regulatory bodies will be limited by issues of a general nature.

(v) Scientific support

The specified issues on nuclear security should be solved with the participation of scientific and research organizations. It is important to develop models and to apply mathematical methods for studying the processes and trends in the field of security. It will allow the development of preventive measures to counter any potential infringer. It will also increase the efficiency of nuclear security systems. This concerns not only the development of new security equipment and technologies, but also systemic issues of national and international importance.

(vi) Export control

This is the most important mechanism for preventing the illicit trafficking of radioactive material and illegal proliferation of nuclear technologies. More active inspection activity on the part of the regulator in the procedures linked with export control is one of the ways to increase efficiency. This can be especially shown while transferring technologies and documentation. In this case a resident inspector on the site can easily identify conformity with the declared purposes of export and its actual contents and reveal any discrepancy.

The additional verification of shipped nuclear material using the NDA instruments and TIDs and sending the appropriate information (e.g. TIDs number) to the regulatory authority on the receiving side may work for nuclear security enhancement during export and import.

The relationship that existed between Euratom and Gosatomnadzor now exists between the EU and Rostechnadzor.

It seems useful to extend safeguards cooperation in the form of participation of the national inspector to the inspections conducted by the IAEA, especially in cases where NDA equipment for nuclear materials verification is used, because the national inspector is equipped with such means, standard or specially adapted to a certain nuclear materials template and pattern and uses a mechanism ensuring independence of measurements and their high quality.

The well-organized interaction of the operator and the regulator plays a very important role in the process of radioactive material security strengthening.

Despite a distinction between their responsibilities there is a broad range of issues requiring such interaction in the field of security.

The main issues are as follows:

- Development of federal rules and regulations in the MPC&A (Material Protection, Control and Accounting) area; development of guides, instructions etc.; and development of comments and guidance documents for better implementation of federal rules and regulations in practice;
- The organization and realization of the programme for joint training and education of the inspectorate staff and operator personnel in the field of nuclear materials measurements and verification on a uniform methodical base and on the basis of the same equipment used by the inspector and the operator in the field of nuclear security;
- Development of the organizational and methodological issues connected to interaction of the inspector and the operator in the use of TIDs, NDA and other technical means for access control, as well as other means used for the inspection purposes;
- The coordination of information exchange within the framework of the federal information system for the accounting and control of nuclear materials, the automated system of supervision for the accounting and control of nuclear materials, and the State system of physical protection;

5. CONCLUDING REMARK

The issues mentioned above are proposed for discussion within the framework of an international conference on counteracting illicit trafficking of radioactive materials which is planned by Rostechnadzor for October 2006 in Novosibirsk.

HOW TO DEAL WITH THE RADIOLOGICAL DISPERSAL DEVICE (RDD) THREAT

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Abstract

In the United States of America, the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct) and RS-G-1.9, Categorization of Radioactive Sources, provide a basis for risk informing both safety and security actions to protect against the threat of radiological dispersal devices (RDDs). The US Government, States, and the private and public sectors are working to address a broad range of issues for reducing RDD risk, in a consistent manner, across multi-jurisdictional authorities. Key Nuclear Regulatory Commission safety and security actions for protection against RDDs and implementation of the key elements of the Code of Conduct include developing and implementing increased controls for risk significant radioactive material, enhancing import/export protocols and establishing a national source registry, known as the National Source Tracking System. Challenges arise in coordinating a national threat policy and consequences of concern and implementing protective strategies that balance safety, security and response as well as sharing burdens across diverse operational modes and overlapping regulatory responsibilities. The Nuclear Regulatory Commission participates in several collaborative initiatives with the Department of Homeland Security (DHS) to achieve consistency in the protection and response to national threats. The National Infrastructure Protection Plan describes the integrated activities needed to protect the nation's critical infrastructure/key resources, including protection from an RDD attack. In addition, the National Response Plan provides the protocols for coordinating response to nuclear or radiological incidents. In January 2006, the DHS issued its draft 'Application of Protective Action Guides for Radiological Dispersal Devices and Improvised Nuclear Device Incidents, which was developed within the Government in coordination with State and local agencies. The Government continues to work with State and local governments and commercial entities to implement integrated plans to protect against and respond to potential RDD attacks commensurate with the threat and potential consequences. The USA's regulatory framework is an open, inclusive and democratic process. All levels of the Government are working with stakeholders in a manner that seeks to instill public trust and confidence in the regulatory oversight process and the subsequent safe and secure use of radioactive materials.

1. INTRODUCTION

In the United States of America, the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct) and RS-G-1.9, Categorization of Radioactive Sources, provide a basis for risk informing both safety and security actions to protect against the threat of radiological dispersal devices (RDDs). The objective of these actions is to ensure that the most 'attractive' radioactive sources are not stolen for use in RDDs. The Government, States, and the private and public sectors are working to address a broad range of issues for reducing RDD risk, in a consistent manner, across multi-jurisdictional authorities.

The US framework requires multi-jurisdictional coordination. Several governmental agencies have regulatory authority, sometimes overlapping authorities, over radioactive materials. Both the US Department of Energy (USDOE) and the Nuclear Regulatory Commission (NRC) have developed reports that support the use of the Code of Conduct in their regulatory programmes. The NRC used the IAEA's Categorization of Radioactive Sources to establish priorities for issuing advisories and regulatory actions. Key NRC safety and security actions for protecting against RDDs and implementing the key elements of the Code of Conduct include developing and implementing additional security measures and increased controls for risk-significant radioactive material, enhancing import/export protocols, and establishing a national source registry, known as the National Source Tracking System (NSTS).

2. IMPLEMENTING THE IAEA CODE OF CONDUCT

The NRC issued orders requiring enhanced security and controls for licensed activities involving large panoramic irradiators, manufacturers and distributors, transportation of radioactive material for quantities of concern and other licensed uses based on the authorized possession of individual sources or aggregated quantities of radioactive material exceeding the IAEA Category 1 and 2 threshold quantities.

Because about 80 per cent of commercial byproduct material users in the USA are regulated by Agreement States under an agreement with the NRC to protect public heath and safety and the environment, a Materials Security Working Group (MSWG) consisting of NRC and Agreement State representatives was established to develop, in partnership, enhanced security and control requirements for protecting against RDDs. The MSWG used security assessments and the IAEA's RS-G-1.9 (formerly TECDOC 1344) to establish priorities and inform the new requirements for the various users of radioactive sources. Although the initial orders were issued by the NRC under its authority to protect the common defence and security of the USA (which is an NRC authority not delegated to the States), many of the States have established additional agreements to inspect their licensees for compliance with the security orders. Subsequently, requirements for increased controls that were added by both NRC and Agreement States to protect public health and safety are based on possession of IAEA Category 1 and 2 threshold quantities and their relative accessibility in use, commercial transportation and international trade. Another working group consisting of representatives of the NRC and Agreement States is tasked with ensuring consistent national implementation for the inspection and enforcement of the increased controls. The NRC expects to work closely with the States to incorporate the enhanced security and control orders into regulations over the next couple of years.

Although recent interest has been intense concerning the security of radioactive materials, the US regulatory framework for radiation sources has been based on the integration of safety and security. Existing US safety regulations require licensees to secure radioactive material in storage from unauthorized removal and to report lost, stolen, and missing sources. To enhance prevention and mitigation of an RDD event, the MSWG identified the need for personnel background checks, new access control requirements, and an immediate intrusion detection, assessment, and response capability to rapidly detect unauthorized access and intrusions with malicious intent. Licensees must coordinate with local law enforcement authorities in planning for prompt response to interdict intruders, recover stolen sources, and implement protective actions to mitigate potential consequences. Shippers of radioactive materials must use carriers that implement security and control requirements similar to the orders, use methods to track shipments of radioactive materials, and verify the timely receipt of shipments. Two independent physical controls are now required for portable gauges and for mobile and portable devices containing sources exceeding the Code of Conduct Category 2 threshold quantities.

In fulfilling its obligation to implement the Code of Conduct, the NRC imposed new controls on the import and export of radiation sources in Title 10 Code of Federal Regulations Part 110, Export and Import of Nuclear Equipment and Material. The final rule was published on 1 July 2005, and became effective on 28 December 2005. The new requirements are risk informed and promote confidence in the regulatory framework. The NRC is continuing to work with the US Government and with its trading partners to harmonize controls to address issues related to the detection of smuggled nuclear materials as well as authorized and inadvertent imports of radioactive materials at border points of entry. The majority of incidents of anomalous radiation measurements observed by the Department of Homeland Security (DHS) Customs and Border Protection are related to the improper management of radioactive materials in the fabrication of commercial products (e.g. reprocessing of sources in scrap metal) and are not the result of malicious intent.

The NRC, in coordination with the USDOE, is developing a web based national source registry, known as the National Source Tracking System (NSTS), to track risk-significant sources. Working groups were formed to plan and develop the system and regulatory requirements. A steering committee and a Government interagency coordinating committee were also established to oversee the project to assure that that the tracking system meets the needs of governmental users. The NSTS will include transfers of IAEA Category 1 and 2 sources within the USA. The proposed rule on the tracking system was published in July 2005. Public meetings were held in August and September 2005, to solicit stakeholder input. The comment period closed on 11 October 2005 and the staff is preparing responses to public comments and drafting the final rule for the approval of the NRC.

3. NATIONAL STRATEGY FOR REDUCING THE RISK OF RDDs

The NRC has been working in partnership with other agencies of the Government to protect against RDD threats. One of these organizations is the DHS. Challenges arise in coordinating a national policy on threat assessment and consequences of concern and implementing protective strategies that balance safety, security and response as well as sharing burdens across diverse operational modes and overlapping regulatory responsibilities. The NRC has participated fully in these DHS initiatives that include: the new Domestic Nuclear Detection Office (DNDO) monitoring programme, the National Response Plan (NRP), the interim Application of Protective Action Guides for Radiological Dispersal Devices and Improvised Nuclear Device (IND) Incidents, and the National Infrastructure Protection Plan (NIPP).

The DNDO is developing a comprehensive, integrated and risk informed national radiation and radioactive material monitoring system to detect an adversary's transport of radioactive or nuclear material before an attack occurs. The proposed radiation monitoring system provides infrastructure for a broad range of both security and non-security events. The DNDO and Government agencies are in partnership with State, tribal and local officials to detect import or transport of radioactive material with emphasis on points of entry into the USA. When completed, the radiation monitoring system is expected to provide near real time situational awareness of the movement of radioactive materials at points of entry into the USA and across transportation routes. The NRC has dedicated several full time staff to work with the DNDO in establishing the national monitoring system.

If an RDD attack occurred, the Government's response would be guided by the NRP. The NRP provides an all discipline, all hazards plan that establishes a single, comprehensive framework for the management of domestic incidents. It provides the structure and mechanisms for Government agencies to coordinate and support State, tribal and local incident managers. The NRP defines the roles and responsibilities for coordinating and cooperating agencies of the Government. It also provides for the integration of lessons learned from exercises, such as for terrorist attacks and from real life natural disasters recently experienced in the aftermath of hurricanes Katrina and Rita. The nuclear/radiological incident annex of the NRP, previously known as the Federal Radiological Emergency Response Plan, is the primary government wide guidance document for handling incidents involving radioactive materials, including an RDD event.

On 3 January 2006, the DHS issued draft protective action guides (PAGs) for RDD and IND incidents for public comment. The primary purpose of the PAGs is to support the preparation for, responding to and recovering from terrorist incidents involving nuclear or radioactive material. The PAGs address the characteristics of RDD and IND incidents, differences between acts of terror and accidents, and the phases of response. The PAGs were coordinated among Government agencies, State, and local officials. They were developed using existing guidance, experience from existing programs, and lessons learned from interagency incident response exercises. For the early and intermediate phases of response, the PAGs published in the Environmental Protection Agency Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, are also appropriate for use in RDD and IND incidents. For the early phase, the existing PAG of 10–50 mSv (1–5 rem) projected dose is used for evacuation, sheltering, relocation and protection of emergency workers. For the intermediate phase, the existing PAGs of 20 mSv (2 rem) in the first year and 5 mSv (500 mrem) in any year after the first are used for relocation. New to the proposed guidance is the establishment of an optimization process (decision making framework) for local officials in determining an appropriate cleanup for their community for the long term after completing prompt response and recovery actions. The optimization process will establish cleanup and restoration levels consistent with social, economic and health protection factors considering the overall welfare of the public.

The DHS is responsible for implementing the Homeland Security Act and Presidential directives on critical infrastructure protection. The Government's plan for protecting critical infrastructure and key assets is described in the National Infrastructure Protection Plan (NIPP). The NIPP provides a unifying structure for the integration of critical infrastructure and key resources protection into a coordinated national program, including protection against RDDs and INDs. The NIPP establishes the architecture for conducting strategic operational risk analyses and risk management activities. The NIPP partitions the critical infrastructure and key assets into areas of national concern and requires demonstration of compliance through the development of sector specific plans. The DHS, in coordination with the lead agencies in the critical infrastructure and key resources sectors, is holding meetings with State and local officials, private interests, and members of the public to prioritize and agree upon methods for balancing protection and mitigation strategies with their associated regulatory burden. Although not identified as a lead agency, the NRC, in coordination with the DHS, developed a sector specific plan for the key resources of nuclear reactors, materials and waste as input to the NIPP. This sector-specific plan covers of broad range of NRC and Agreement State regulated activities.

4. NRC FRAMEWORK ASSESSING SECURITY AND CONTROL MEASURES

Both the NRC and DOE are the leading Government agencies responsible for establishing and overseeing security measures for the civilian and defense nuclear facilities and materials, respectively. Both agencies regularly coordinate with the intelligence community and Federal law enforcement agencies to review and assess threat information. The Government incorporates a graded threat concept. For facilities using risk significant radioactive materials, NRC uses a deterministic approach and specifies protection requirements either through regulations or Orders that are based on an implicit referenced threat. Because the NRC and DOE regulate and oversee different types of facilities, differences in the respective threat documents and protection requirements do exist. The NRC and DOE have a long standing working relationship pursuant to a Memorandum of Understanding, and cooperatively share and coordinate assessments of threat information and strive for comparable protection for comparable material.

Similar to the NIPP method for risk analysis and management of critical assets protection, the NRC is using a security assessment decision making framework that provides a process and criteria to evaluate results of security assessments for a broad range of activities subject to the NRC's regulatory authority. This framework serves as a tool to help determine where additional security and control measures or mitigating strategies were needed for materials, fuel cycle, and research and test reactor facilities. Security assessments are performed on a range of threat scenarios for the transportation and licensed uses of IAEA Category 1 and 2 sources. Remote or speculative scenarios and scenarios with insignificant consequences are initially screened out based on threat assessments and engineering evaluations. Asset attractiveness is evaluated using factors that consider the target iconic value, complexity of planning, resources needed, execution risk, and protective measures for the safety of the public. Attractiveness factors are valued and averaged to give overall ranking expressed as an attractiveness category. Effects are expressed, by order of magnitude, as a consequence category. The attractiveness category and the consequence category are then applied to a decision matrix to assess the need to develop additional mitigating strategies.

In an expanding global economy, safety and security are highly dependent on the cooperation and support of our international partners. The IAEA Code of Conduct and Categorization of Sources provide a sound basis for risk informing both safety and security actions to establish effective international and national infrastructures to protect against the threat of RDDs. National risk assessment methods, preventive strategies and mitigating strategies should balance the risks with costs of protection. Open communication and coordination at all levels of government are essential to identify vulnerabilities and regulatory gaps, to achieve consistent safety and protection of radioactive sources over diverse modes of use and to assure adequate emergency preparedness guidance and training to prevent the likelihood of an RDD event and mitigate its consequences.

Although new restrictions on the availability and protection of sensitive security related information have challenged our regulatory system, the US regulatory framework is still an open, inclusive and democratic process. At all levels of the Federal Government, agencies are working with stakeholders in a manner that seeks to instill public trust and confidence in the regulatory oversight, and the safe management, and secure protection of radioactive materials.

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INTERNATIONAL MULTILATERAL COOPERATION FOR DEVELOPMENT OF THE LEGAL BASIS FOR THE PLUTONIUM DISPOSITION PROGRAMME

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Abstract

Within the framework of the AÏDA/MOX programme for utilizing excess Russian weapons plutonium in the form of MOX fuel in Russian reactors (WWER-1000 and BN-600); a collaborative program has been initiated under the leadership of the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostechnadzor) to develop a set of state regulatory documents. Several organizations are involved in this project: ROSATOM, Federal Medical Biological Agency, Ministry of Emergency Situation, SEC-NRS, RAS-IBRAE on the Russian side, the US Department of Energy (USDOE), the Pacific Northwest National Laboratory and the Nuclear Regulatory Commission for the United States of America, the European Commission, the French regulatory body Direction Générale de la Sûreté Nucléaire et de la Radioprotection , the Commissariat à l'Énergie Atomique and a team of RISKAUDIT safety experts (from the Association Vinçotte Nuclear, Gesellschaft für Anlagen und Reaktorsicherheit mbH and Institut de Radioprotection et de Sûreté Nucléaire) on the European side. This programme began in 2001 and must develop 44 documents to define safety standards, rules, principles and requirements. They cover all safety issues (siting, content of safety reports, waste management, radiation protection, internal and external hazards, transportation, emergency planning) for the fuel cycle and also for the MOX fuel to be used in Russian reactors. The USDOE/NNSA and the European Commission (EU Joint Action Russian Federation) have co-financed the writing of 33 documents in the Russian Federation and their review by Western safety experts. The list of documents and their topics, the work plan and the main results of the collaboration between European experts and the Rostechnadzor are described in this presentation.

1. INTRODUCTION

For the utilization of weapons grade plutonium (W-Pu) from dismantled nuclear weapons for the peaceful objective of electric power generation, the Russian Nuclear Safety Authority (the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostechnadzor)) drew up a list of regulatory documents to be developed. The list initially included 39 regulatory documents, but was recently extended to 44. Following negotiations among representatives from Rostechnadzor, the US Department of Energy (USDOE), the European Commission (EC), the French Atomic Energy Commission (CEA) and the French regulatory body (DGSNR), an agreement was reached to finance the development of these regulatory documents.

2. THE AÏDA/MOX 2 PROGRAMME

A reference process to convert Russian W-Pu into MOX fuel was defined. It includes the following stages (Fig. 1):

- Dissolution of the plutonium alloy in a mixture of nitric and hydrofluoric acid
- Purification of the resulting Pu nitrate by solvent extraction (PUREX process)
- Production of Pu dioxide by oxalate precipitation and calcination
- Fuel fabrication by two processes: the Russian COCA process for BN-600 reactor fuel and the Russian MIMAS process for WWER-1000 reactor fuel.

In the AÏDA/MOX 2 reference scenario, the plant capacity will be nearly 60 t of MOX fuel per year, using more than 2.2 t/year of Russian W-Pu. Four WWER reactors at the Balakovo site and three at the Kalinin site have been

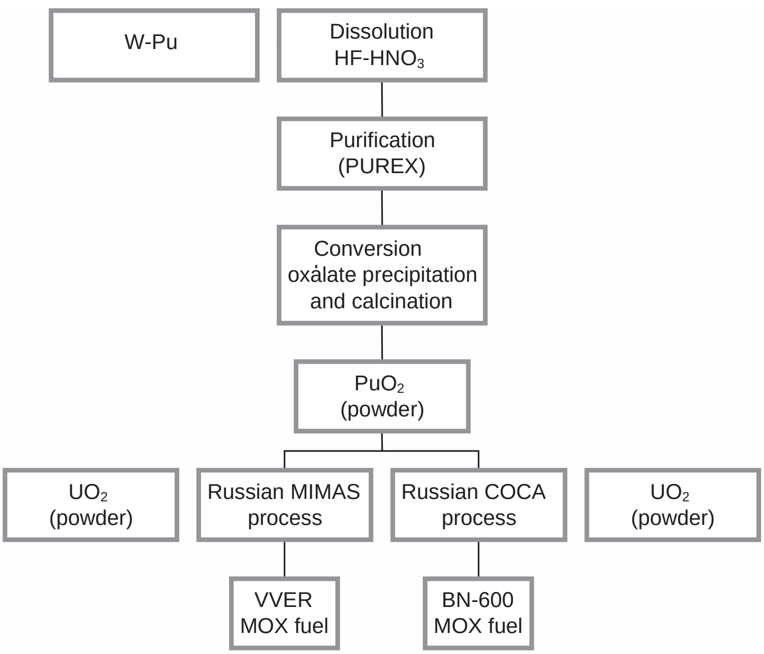

FIG. 1. Process for converting W-Pu to MOX fuel.

chosen to use about 270 kg of W-Pu each year. The BN-600 fast reactor will use about 280 kg of W-Pu each year.

3. REGULATORY DOCUMENTS

The Russian system of legal and regulatory documents applicable to nuclear energy is organized in the form of a pyramid (Fig. 2), at the top of which are Federal laws and international treaties (conventions, agreements). Then there are executive legal documents of the President and Government of the Russian Federation. The next level consists of Federal standards and rules applied to the use of nuclear energy. Almost all documents to be developed within the frame of this international cooperation belong to this level. Then follows a level of documents issued by the State regulatory authorities (safety guides and guidelines) and at the bottom level there are industrial standards. The 44 regulatory documents included in this project are listed in Annex I.

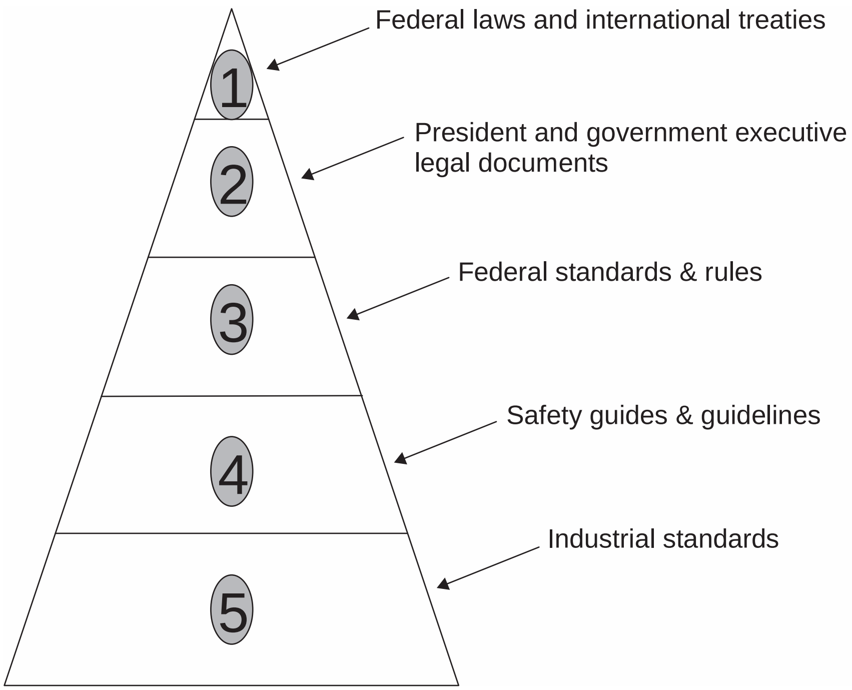

FIG. 2. Pyramidal organization of regulatory documents.

4. DOCUMENT ELABORATION PROCESS

Of the 44 documents, the USDOE is funding 15, the EC 18 and the Russian side the remaining 11. For each document, a contract was concluded between USDOE or CEA and one of the organizations providing technical support to Rostechnadzor. The contracts are based on the technical description of the document content. Rostechnadzor controls the quality of the drafts.

For the documents funded by the EC, the CEA also concluded several contracts with RISKAUDIT to review the documents written by the Russian organizations. A team of experts belonging to the Association Vinçotte Nuclear (AVN), the Gesellschaft für Anlagen und Reaktorsicherheit mbH (GRS) and the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) was set up to do this work. For the documents funded by the USDOE, experts from the Nuclear Regulatory Commission (NRC) and US national laboratories (Pacific Northwest National Laboratories, etc.) review the drafts and provide comments.

The work is being carried out in two main phases. The first is a review of the first draft of a regulatory document under the responsibility of Rostechnadzor. For the documents financed by the EC, RISKAUDIT's comments (a synthesis of the comments by the AVN, GRS and IRSN experts) are submitted to the CEA, which sends this review report to Rostechnadzor and to the USDOE. Russian contractor responsible for regulation development collects all the comments, including those from interested Russian organizations and draws up a general list. These comments are sent to all the organizations involved, with the writer's explanation of how each remark is taken into account. A meeting is then organized to discuss this comment review. Rostechnadzor, the Russian organization in charge of writing, the EC representatives, the DGSNR representative, the RISKAUDIT team, and the USDOE accompanied by representatives of the NRC and US national laboratories representatives all attend this meeting, where the comments and the Russian answers are explained and discussed. Experience has shown that these meetings are very useful and efficient, notably for quickly clearing up any misunderstandings arising from translation difficulties.

In the second phase, Rostechnadzor sends a final draft to the CEA or to the USDOE. The aim of the expert review is then to analyze to what extent the comments during the first draft review have been taken into account. A synthesis of these comments is then transmitted to Rostechnadzor.

The peer review performed by the USDOE/Pacific Northwest National Laboratory or RISKAUDIT on the documents developed respectively with funding by the USDOE or the EC, and the presence of both parties in the technical meetings, allow US and European experts to have an overview of the set of documents and to know the different viewpoints. This also ensures more coherent comments.

In parallel with this process, technical visits (to MELOX, La Hague, and Savannah River Site), workshops and seminars on the fabrication and use of MOX fuel are held to familiarize Russian experts with safety aspects and licensing practices in Western countries, and to enable Russian experts to present their experience to Western experts. Workshops were held addressing the following topics:

— Nuclear criticality safety;
— Electrical, instrumentation and control, human factor and software quality control;
— Environmental safety;
— Radiation safety and accident analysis;
— Chemical safety;
— Fire protection;
— Development of the Standard Review Plan;
— Construction quality assurance and inspection for MOX fuel fabrication facility.

5. PROGRESS AND RESULTS

At this time, the project is considered to be working well. More than 80% of the work on the EC funded documents has been completed. The second drafts of most of the documents have been written or are in preparation. Western experts have completed the final review of 11 of 18 documents; five documents have already been promulgated by the Russian authority in February 2006 and Rostechnadzor has decided to complete the development of all the documents by the end of 2006.

6. HISTORICAL BACKGROUND

The set of documents was developed in the framework of the civilian use of W-Pu. It must be kept in mind that W-Pu is less hazardous in terms of external exposure to the personnel than Pu from commercial LWRs, but it is more reactive in terms of criticality safety. Nevertheless, in the nuclear fuel cycle (including transportation), plutonium disposition generally involves the severest safety related constraints. Its characteristics raise all the internal hazards encountered in nuclear fuel cycle facilities: external and internal exposure (including neutron and gamma radiation), as well as criticality, thermal and radiolysis hazards, toxicity and chemical hazards, and the most serious consequences for the environment in case of an accident.

Although originally adapted to W-Pu process facilities, some of the documents are therefore applicable to different types of facilities with a wide range of capacities and potential hazards (e.g. laboratories or storage facilities). This may sometimes result in overly stringent requirements for small facilities with low potential hazards. One point was highlighted in the comments made on the first drafts: the regulatory documents must specify that the level of safety measures has to be adapted to the hazards. This adaptation must be justified by the licensee.

It must be remembered that the measures described in the documents are generally consistent with most international practices and the IAEA recommendations, including decommissioning activities.

6.1. Main topics discussed

Taking into account the broad scope of the documents, the number of topics discussed is large. The main topics, which required discussion and led to proposals, are described below.

The *defence in depth* concept: this concept is part of the Rostechnadzor safety approach, but will appear more clearly in the documents defining the content of the safety justification reports. These were organized following the different safety related systems rather than according to the different hazards to be taken into account.

Nuclear safety: in the Russian Federation this means criticality safety. The permissible k_{eff} in case of normal and abnormal conditions will depend on various parameters: the type of nuclear material, the calculation code qualification, etc. In general k_{eff} is required to be less than 0.95 including uncertainties. Safety concepts for ensuring subcriticality are the same as in Western countries. Additionally, a classification for the equipment (tanks, pipes etc.) is applied providing different safety levels, e.g. geometrically safe or unsafe, and equipment with a greater safety margin.

The application of the *double contingency principle* for criticality safety, which requires at least two unlikely, independent and concurrent failures (with particular detection conditions) in normal operation before a criticality accident is possible.

Design Basis Accident (DBA) and *Beyond Design Basis Accident* (BDBA); the subject of the discussion was the criteria more than the definition:

- What radiological consequence level could be accepted after a DBA?
- What kind of meteorological conditions must be used to assess the consequences of a BDBA: realistic or worst case?
- What is the criterion for the probability of unacceptable release from a facility: 10^{-7} or 10^{-6} per year?

Concerning *waste management*:

- The notions of near surface disposal and underground disposal will be defined more precisely; in particular, a clear link should be made between the waste characteristics and their final destination (landfill, near surface disposal, subsurface disposal, deep geological disposal).
- It is more efficient to require that the waste package characteristics be defined on the basis of a specified interim storage or disposal repository safety analysis, than in a general way for all sites and all types of facilities.
- The proposed population dose limit of 10 μSv/year is clearly lower than in many Western countries and may lead to difficulties in the demonstration of compliance for the safety analysis.
- The methodology used to design disposal areas has to be better explained. Compliance with IAEA recommendations — particularly concerning institutional control — should be better addressed to remove any ambiguity.

6.2. Further discussion

As mentioned above, some document drafts are still under development and the technical discussion is still in progress or will be in the coming months. Examples include:

- Plutonium encapsulation in glass and related safety concerns, in particular the criticality hazard associated with the combination of Pu pellets in Pu-containing glass;
- The impact of MOX fuel use in reactors;
- The fire safety analysis in the MOX fuel fabrication plant;
- The regulatory requirements to the two-zone design of premises for the Russian MOX fuel fabrication plant.

Moreover, there is the necessity to develop some lower level regulatory documents — site specific requirements on storage/disposal of low level radioactive waste containing transuranic alpha emitting radionuclides, safety guides, inspection procedures, etc.

7. CONCLUSION

In general the discussions between Russian and Western experts were very fruitful and improved the draft nuclear safety documents. The collaboration and the exchanges between European and US colleagues are also very fruitful and productive.

The manner of dealing with the hazards is quite similar to that of the Western experts, as is the overall safety approach and the final objectives are coherent. The project can be seen as a step to improve the common international understanding of safety issues for nuclear fuel cycle facilities.

Annex

LIST OF THE REGULATORY DOCUMENTS UNDER DEVELOPMENT

Title of the document	Type	Current status	Funding source
Siting of non-reactor nuclear facilities. Basic safety criteria and requirements	FS&R	Approved	USDOE
Nuclear safety rules for nuclear cycle facilities	FS&R	Approved	USDOE
Weapons grade plutonium conversion facilities. Safety requirements	FS&R	First draft	USDOE
MOX fuel fabrication facilities. Safety requirements	FS&R	Second draft	USDOE
Basic requirements for MOX fuel	FS&R	First draft	USDOE
Provisions on the procedure of investigation and accounting of operational events at nuclear fuel cycle facilities	FS&R	Approved	USDOE
Requirements for the content of the safety justification report for the realization of research work at nuclear fuel cycle facilities with plutonium containing materials	FS&R	Approved	EC
Safety rules for storage and transportation of nuclear fuel at the nuclear installations	FS&R	Approved	EC
Requirements for the content of the safety justification report for non reactor nuclear installations within the nuclear fuel cycle	FS&R	Approved	EC
Safety rules in non reactor nuclear installations decommissioning	FS&R	Approved	EC
Plutonium immobilization facilities. Safety requirements	FS&R	Final draft	EC
Safety insuring in nuclear material transportation	SG	Second draft	EC
Accounting of external impacts of natural and man-caused origin on nuclear and radiation hazardous facilities	FS&R	Approved	EC
General provisions on ensuring nuclear fuel cycle facility safety	FS&R	Approved	Russian Federation
Safety rules for transportation of radioactive materials	FS&R	Approved	Russian Federation

Title of the document	Type	Current status	Funding source
Requirements for the quality assurance program for nuclear fuel cycle facilities	FS&R	Approved	Russian Federation
Safety in radioactive waste management. General provisions	FS&R	Approved	EC
Collection, reprocessing, conditioning and storage of liquid radioactive waste. Safety requirements	FS&R	Approved	Russian Federation
Collection, reprocessing, conditioning and storage of solid radioactive waste. Safety requirements	FS&R	Approved	Russian Federation
Gaseous radioactive waste management. Safety requirements	FS&R	Approved	Russian Federation
General Safety Rules for Nuclear Fuel Cycle Facilities (revision)	FS&R	Approved	USDOE
Rules on layout and safe operation of fuel cycle facility equipment and pipelines	FS&R	Final draft	USDOE
Designing and manufacturing MOX fuel elements and MOX fuel assemblies	SG	First draft	USDOE
Requirements for the content of the safety justification report of nuclear material storage facilities	FS&R	Approved	EC
Location of storage facilities for nuclear materials and radioactive substances. Safety requirements	FS&R	Approved	EC
Radioactive waste disposal. Safety requirements	FS&R	Approved	EC
Near surface disposal of radioactive waste. Safety requirements	FS&R	Final draft	EC
Disposal of liquid radioactive waste in geological formations. Safety requirements	FS&R	Excluded	
Dry storage facilities for spent nuclear fuel. Safety requirements	FS&R	Approved	Russian Federation
Standard plan of measures to protect workers in case of an accident at a nuclear fuel cycle facility.	FS&R	Second draft	EC
Provisions on the procedure of emergency situation announcement, efficient transmission of information and emergency assistance to NPPs in case of radiation hazardous situations	FS&R	Second draft	EC
Nuclear safety rules of the NPP reactor facilities	FS&R	Final draft	USDOE

Title of the document	Type	Current status	Funding source
Requirements for the content of the safety justification report for NPPs with WWER reactors (addition related to MOX fuel)	FS&R	Approved	EC
Requirements for the content of the safety justification report for NPPs with fast breeder reactors (addition related to MOX fuel)	FS&R	Approved	EC
Accounting for and control of nuclear materials	FS&R	Approved	Russian Federation
Organizational requirements for material balance areas in operating organizations at nuclear installations and nuclear material storage facilities	FS&R	Approved	Russian Federation
Physical protection regulations of the radiation sources, storage facilities, radioactive substances	FS&R	Approved	Russian Federation
Addition to the regulations on radiation control. Methodical instructions	HS	Approved	USDOE
Addition to sanitary rules for NPP design and operation	FS&R	Approved	USDOE
Methodological instructions on control over personnel and population exposure rates. Sanitary hygienic (health) standards	HS	Approved	USDOE
Review procedure for the license applications for construction and operation of the MOX fuel fabrication facility	RG	First draft	USDOE
Sanitary requirements to the design and operation of the MFFF-R. Sanitary rules	HS	First draft	USDOE
Fire safety of the MOX fuel fabrication processes. Technical analysis and safety criteria	FS&R	First draft	EC
Fire safety standards for design and operation of fuel cycle facilities	FS&R	First draft	EC

FS&R - Federal Standards and Rules
HS - Health Standards
SG - Safety Guide
RG - Regulatory Guide

IMPLEMENTATION OF THE CODE OF CONDUCT ON THE SAFETY AND SECURITY OF RADIOACTIVE SOURCES AND OF THE ASSOCIATED IMPORT/EXPORT GUIDANCE

A user's perspective

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Abstract

Ghana's legal framework and the activities of the Regulatory Authority incorporate the essential elements for the protection against ionizing radiation, safety and security of radiation sources. Adoption of the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources and the Guidance on the Import and Export of Radioactive Sources has provided an expanded scope for ensuring the safety and security of radiation sources from 'cradle to grave'. Recent shipment of nuclear fuel through the port of Tema, Ghana, to and from Koeberg, South Africa, is presented as a case study of the practical application of the Code and the Guidance documents.

1. INTRODUCTION

The Ghana Atomic Energy Commission (GAEC) was established by an Act of Parliament (Act 204) in 1963. Ghana also joined the IAEA in 1963. Since then Ghana has benefited from substantial technical assistance in developing the peaceful use of nuclear energy in medicine, agriculture, industry and research, and teaching.

The Radiation Protection Board (RPB) was established in 1993 under the umbrella of the GAEC through an amendment of the Atomic Energy Act 204 of 1963 by the Provisional National Defence Council, Law 308, as the sole regulatory authority for purposes of radiation protection and safety of radiation sources [1, 2]. The powers and functions of the RPB as the national regulatory authority were set out in the Radiation Protection Instrument LI 1559 of 1993 [3].

Ghana has successfully completed the objectives of milestones 1 and 2 of the Model Project, initiated in 1992 by the IAEA. Milestones 3, 4 and 5 are at various advanced stages of implementation.

Through the regulatory control programme, an effective inventory of all radiation sources, including category 1, 2 and 3 sources (see Table 1) of safety and security significance, has been captured using the Regulatory Authority Information System as a management tool.

Ghana also provides regulatory and technical support to some countries in the West African subregion, whose radiation protection infrastructures are either non-existent or incapable of effective control.

This paper presents the challenges of applying the Code and the Guidance documents and the recent transit of nuclear fuel through the port of Tema, Ghana, to and from South Africa and France, as a case study of the practical application of the Code and the Guidance documents.

2. ACCESSION TO THE CODE OF CONDUCT ON THE SAFETY AND SECURITY OF RADIOACTIVE SOURCES

Ghana participated in the meeting of technical and legal experts to develop internationally harmonized guidelines for the import and export of

TABLE 1. INVENTORY OF CATEGORY 1, 2 AND 3 RADIOACTIVE SOURCES

Practice	Radionuclide	Activity of sources (TBq)	A/D* value	Category
Gamma radiation processing	Co-60	1 850	61 666	1
Radiation therapy	Co-60	185	616	2
Radiation therapy	Co-60	201	670	2
Industrial radiography	Ir-192	3.7	46.2	2
Brachytherapy	Cs-137	0.185	1.85	3
Brachytherapy	Cs-137	0.185	1.85	3
Destination inspection of containers	Co-60	3.75	125	2
Neutron activation analysis	Am/Be	0.740	12.3	2

* Ratio of the source activity (A) to the D-value of the specified radionuclide [6].

radioactive sources in accordance with the requirements of the current Code of Conduct on the Safety and Security of Radioactive Sources held at IAEA headquarters, Vienna, on 16–20 February 2004 [4, 5].

Ghana has acceded to the Code. Prior to this, the appropriate infrastructures have been established and are being developed to ensure safety and security of radiation sources from ‘cradle to grave’.

A practice specific guidance document is being developed to promote safety and security culture at practices which make use of category 1, 2 and 3 sources.

3. SAFETY AND SECURITY OF RADIOACTIVE SOURCES

The inventory of radioactive sources is complete but there are likely to be orphan sources not known to the authorities or to the RPB. To locate them, the RPB is using periodic press releases and is gathering information from other national bodies, such as the Environmental Protection Agency, the Customs, Excise and Preventive Service, the Ghana Standards Board, the Factory Inspectorate Division of the Ministry of Employment and the Social Welfare and Civil Aviation Authority and from the public, especially when our inspection teams go on their normal inspection and enforcement activities.

Under the AFRA Project RAF/9/021 on Development of Regional and National Capability in Nuclear Security, a national committee exists for addressing the security and safety concerns of nuclear and radioactive materials including illicit trafficking and malicious acts involving radioactive sources. The committee consists of stakeholders from the regulatory authority, security and law enforcement agencies and the National Bureau of Investigations.

The major challenge we face in this area is the development of (i) physical protection upgrades for sources of security concerns and (ii) radiological surveillance to detect and intercept illicit movement of nuclear and radioactive materials across the borders of the country. In a typical situation when the construction of a building to house a 3700 GBq, ^{60}Co source for destination inspection at the port of Tema was not completed and the source arrived, the RPB took possession of the source for safety and security until the building was ready.

It is expected that the International Nuclear Security Advisory Service mission to Ghana, planned for the first quarter of 2006, will assist in identifying the strengths, weaknesses, opportunities and threats facing Ghana as far as nuclear security challenges are concerned. The outcome of this mission is expected to assist the IAEA in providing focused assistance to Ghana.

It is also expected that the US Department of Energy's Radiological Threat Reduction programme will assist Ghana through a bilateral collaboration to benefit from security upgrades of the following major facilities:

- ^{60}Co gamma irradiator;
- ^{60}Co gamma scanner at the port of Tema;
- Two ^{60}Co radiotherapy centres;
- National Radioactive Waste Management Centre (NRWMC).

4. RADIOACTIVE WASTE MANAGEMENT STRATEGIES

A national strategy for radioactive waste management exists and is based upon the regulations prepared in 1997 for promulgation. The strategy clearly allocates responsibility for all aspects of waste management including waste generators and regulatory control to the RPB.

The NRWMC, which is under the National Nuclear Research Institute, was established in 1995 by GAEC to manage waste generated by registrants and licensees in accordance with the objectives and waste management principles. The NRWMC is developing and establishing the radioactive waste management infrastructure that will meet all Ghanaian needs and international standards. The first phase covers establishment of administrative structure, development of regulations and construction of a national waste processing and storage facility. In the second phase, a national radioactive waste repository will be developed and put into operation. The design of all facilities will take into account the future development of nuclear technologies in Ghana. The basic infrastructure in place was developed with the assistance of the AFRA Project RAF/3/005 on Sustaining the Waste Management Infrastructure.

The draft national waste management regulations include safety requirements and regulations for the handling, treatment, transport, storage and disposal of radioactive waste and the clear allocation of responsibilities, addressing also the transboundary transport of radioactive waste. The RPB is effectively independent and licenses all waste management operations in Ghana, including those of the NRWMC.

The only setback has been the long delay in the promulgation of the Radioactive Waste Management Regulations submitted to Government through the Ministry of Environment and Science. The regulations have now been sent from the Attorney General's Department to the Cabinet and if passed by the Cabinet will be discussed and approved by Parliament for the Minister to sign.

All radioactive wastes are controlled appropriately by a system of notification, authorization and inspection. All disused sealed sources are adequately processed and stored under regulatory control at the NRWMC. Orphan sources found are planned to be sent to NRWMC for safe management. Provision is available for high activity and long lived radiation sources to be returned to the supplier under a contract agreement. This applies to sources which after ten years of purchase will still have activities exceeding 100 MBq.

The sources of radioactive waste generation in Ghana occur in various fields of application of nuclear and nuclear related techniques and technologies. Table 2 provides a summary of the types and forms of wastes generated.

TABLE 2. SUMMARY OF INVENTORY OF RADIOACTIVE WASTES FOR PAST AND CURRENT PRACTICES

Practice	Half-life	Typical activity/quantity per application	Radionuclide	Waste form/ remarks
Research reactor			Several	Spent fuel, to be returned to China
Radium therapy	6200 a	190 mg	Ra-226	Solid, conditioned in temporary storage
Diagnostic nuclear medicine	6.0 h	100 GBq	Tc-99m	Liquid, decommissioned in temporary storage
Tobacco industry	28.1 a	22.2 MBq	Sr-90	Solid, conditioned in temporary storage
Gold analysis	3.0 a	11.5 MBq	Cd-109	Solid, conditioned in interim storage
Nuclear gauges	30.0 a	Up to 10 GBq	Cs-137	Solid, temporary storage
Radiotherapy centre at Korle-Bu Teaching Hospital	5.26 a	185 TBq	Co-60	Solid, to be returned to supplier
	30.0 a	18.5 TBq	Cs-137	Solid, to be returned to supplier
Radiotherapy centre at Komfo Anokye Hospital	5.26 a	222 TBq	Co-60	Solid, to be returned to supplier

The NRWMC is a potential target for malicious attack and therefore there is the need for physical protection upgrades.

The GAEC has presented a proposal for support from the IAEA to help establish a borehole storage disposal system to serve as a more secure facility to take care of those radioactive wastes in our possession. If approved it is expected that the construction, installation and training of both the staff of the NRWMC and the Radiation Protection Institute of the RPB will be completed by 2008.

5. NATIONAL TRANSPORT REGULATIONS

The IAEA's transport regulations (RS-T-1) were adopted in 2000 [7, 8] to regulate the national and international transport of all radioactive material. This was issued by the RPB as Safety Guide GRPB-G6. For its implementation, the RPB collaborates and coordinates with the appropriate Government agencies such as the Customs, Excise and Preventive Service, the Ghana Civil Aviation Authority, etc., to ensure that roles are clearly defined and carried out, gaps and overlaps avoided and the transport of radioactive materials into and out of Ghana is safe. The number, types and frequency of radioactive materials imported are manageable as regards control.

The RPB has a compliance assurance programme commensurate with the extent of transport of radioactive material in the country and the IAEA has assisted in organizing a regional training course hosted by Ghana and national training courses using IAEA training materials. Small quantities of radioactive materials are transported at very low frequencies within and across the borders of Ghana.

The RPB has also ensured that in the national emergency response plan provisions have been made to deal with transport accidents involving radioactive material.

6. TRAINING IN RADIATION SAFETY

Education and relevant training are considered essential parts of building safety and security culture within practices and sources within practices. As such assessment of the licensees and registrants' staff training background and experience in radiation safety is an integral part of the authorization process. Thus, the RPB verifies the relevant practice specific qualifications, training and work experience in radiation safety of the personnel during the authorization process.

Training programmes are provided to meet the requirements of protection and safety and security as and when necessary. For instance, in collaboration with the IAEA and the National Disaster Management Organization, a six day training course for first responders in the event of a radiological emergency was organized from 21–26 November 2005 to equip stakeholders with the necessary skills and knowledge for emergency response. The stakeholders comprised 13 Government agencies and those in private practice, including the law enforcement agencies; the Fire Service; the Customs, Excise and Preventive Service; the National Disaster Management Organization; a medical team and the Information Services Department, among others. The issues addressed included transport of radioactive material with malicious intent and illicit trafficking. Again, the RPB has collaborated with the Customs, Excise and Preventive Service by which customs officers undergoing training and retraining at their training centre would be given lectures on radiation protection, illicit trafficking and handling of radiation monitoring equipment.

There is a need to incorporate the relevant portions of the Code in training programmes for at least category 1 and 2 sources within practices where applicable and in training programmes involving stakeholders.

Case Study

In August 2005, a request for permit was submitted to the RPB for a ship carrying radioactive material to bunker at the port of Tema for refuelling and supply of water. The detailed information on the radioactive material on board the ship covered the following: type of package, shipper, consignee, type of radioactive material, UN number, etc.

Since it was our first time of carrying out such an assignment, an attempt was made to obtain advice from the IAEA for any update of the guidance on transport of radioactive materials. The request had also indicated that the shipment was going to come from France en route to South Africa. Attempts were also made to contact the authorities in France and South Africa for confirmation of the shipment. The applicant was also requested to send copies of the permit granted by the authorities of France and South Africa for the shipment and receipt of the nuclear material. Finally, the IAEA publication on the safe transport of radioactive materials and associated documents and the guidance document on import/export were used as reference materials.

Having satisfied itself of the genuineness of the shipment as per its source and destination and of the materials involved, the RPB granted the shipment as per its permit number GH-TRPRM-05-01 in August 2005. By a copy of the permit, the Ghanaian Navy; the Customs, Excise and Preventive Service and the Ports and Harbours Authority were informed of their respective roles and responsibilities. The permit identifies the applicant and specifies the date and place of issue, permit number and expiry date, apart from the source specification and the conditions of the permit.

The identified staff of the port and the emergency personnel were issued with radiation monitoring badges for the period of their attendance at the ship so that exposure levels could be determined and also to allay the fears of the staff. The applicant was also required to update the RPB on the movement of the ship until after it had set sail. A Ghanaian Navy ship monitored the shipment until it left Ghanaian territorial waters. Following the successful first shipment, two other authorizations and shipments have since been carried out.

From the experience gained in these shipments, and to avoid unnecessary delays in the issuance of authorization (without leaving loopholes for malicious acts), we believe that the IAEA could develop a system similar to that being used by the IAEA's Early Notification and Assistance Centre, into which authorizations issued by regulatory authorities could input their information for other interested regulatory authorities to access.

7. CONCLUSION

The Ghanaian regulatory control programme has been adjudged as being compatible with the IAEA BSS [9]. The adoption of the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources and the Guidance on the Import and Export of Radioactive Sources has provided an expanded scope for ensuring safety and security of radiation sources from 'cradle to grave'.

Practice specific guidance is being developed to promote safety and security culture at practices which make use of category 1 and 2 sources.

The physical security infrastructure needs to be upgraded as a proactive countermeasure to prevent possible unauthorized access to nuclear and radioactive materials for malicious intent. The capacity to detect and intercept illicit trafficking of radioactive materials across our national borders needs to be developed through a collaborative effort between the regulatory authority and the security and law enforcement agencies.

The recent transit of nuclear fuel through the port of Tema en route to South Africa has given Ghana the opportunity to exercise some of the guidance principles in the IAEA guidance document on the import/export of radiation sources.

ACKNOWLEDGEMENTS

The long standing technical assistance received from the IAEA covering: (i) education and training and (ii) equipment and expert services for the development of appropriate infrastructures for radiation and waste safety is gratefully acknowledged.

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ICAO SAFETY AND SECURITY

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Abstract

In November 1944, 52 States attended a meeting in Chicago to discuss the problems facing international civil aviation. The outcome of this meeting was the Convention on International Civil Aviation, also known as the Chicago Convention. The International Civil Aviation Organization is the permanent body charged with administering the principles set by the Convention. One of its major tasks concerns the adoption of international standards and to act as arbiter between contracting States on matters concerning implementation of the Convention in order to maintain the safety, security and regularity of civil aviation operations.

Even at the moment of its birth, the aeroplane was a creation of no one nation or of no one technology. Today, some 100 years after the first flight, the international character of air transport is self-evident. The development of the aeroplane into a major instrument of transport has brought with it international problems — the coordination of techniques and laws and the dissemination of technical and economic information — far beyond the ability of individual governments to solve. The need for safety and regularity in air transport involves the necessity of building aerodromes, of setting navigation aids and of establishing weather reporting systems. The standardization of operational practices for international services is of fundamental importance.

The Second World War had a major effect upon the technical development of the aeroplane, telescoping a quarter century of normal peacetime development into six years. A vast network of passenger and freight carriage was set up but there were many problems, both political and technical, to which solutions had to be found to benefit and support a world at peace.

For these reasons, the Government of the United States of America conducted exploratory discussions with other nations during 1944. On the basis of the talks invitations were sent to 55 States to meet in Chicago in November 1944. Of these 55 States, 52 attended. For five weeks, the delegates considered the problems of international civil aviation. The outcome was the Convention on International Civil Aviation (the 'Chicago Convention') and the International Civil Aviation Organization (ICAO) is the permanent body charged with the administration of the principles set by the Chicago Convention.

The ICAO is an international organization of States, currently comprising 189 contracting States. It has a sovereign body, the Assembly, and a governing body, the Council. The Council and the Air Navigation Commission, as well as other ICAO committees, provide the direction of the work of the ICAO. One of the major duties is to adopt the international standards and act as arbiter between contracting States on matters concerning implementation of the Chicago Convention in order to maintain the safety, security and regularity of operations.

Continuing attention is being given by the ICAO in this respect to the implementation issues at the regional level. Seven ICAO regional offices are maintained for these specific purposes. These offices have, as their main function, the duty of maintaining, encouraging, assisting, expediting and following up the implementation of the air navigation plans. The council gives direction to these implementation efforts.

The aims and objectives of the ICAO are to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport so as to:

— Ensure the safe and orderly growth of civil aviation;
— Encourage the 'art' of aircraft design and operation for peaceful purposes;
— Encourage the development of airways, airports and air navigation facilities
— Meet the needs of the people of the world for safe and efficient air transport;
— Avoid discrimination between contracting States;
— Promote generally the development of all aspects of international aeronautics.

These could be achieved via the creation and updating of the ICAO standards and recommended practices (SARPs) which are included in 18 technical annexes to the Chicago Convention adopted by the ICAO council. The standard is a specification, the uniform application of which is necessary for the safety and regularity of international civil aviation, while the recommended practice is a specification, the uniform application of which is desirable in the interests of aviation safety, regularity and efficiency. So, the necessary international standardization has been achieved by the ICAO primarily through the creation of the above mentioned annexes to the Chicago

Convention. At present there are 18 such annexes. The main parts of each annex are SARPs.

Specifications proposed to be given the status of SARPs are, after consultation with contracting States and interested international organizations, finalized by the Air Navigation Commission and submitted to the council where they require a two-thirds majority for adoption. Following their adoption and provided a majority of contracting States do not disapproved them before the established effective date, the SARPs become applicable at dates set by the council. These SARPs are considered binding. However, if any contracting State finds it impossible to comply with them, the State is required to inform the ICAO of any differences that will exist on the applicability date of amendment. The differences notified are then published by the ICAO in supplements to annexes.

Proposals to amend or add new SARPs may come from the contracting States, ICAO international meetings, deliberative bodies of the ICAO, the Secretariat, the United Nations and its agencies, or interested international organizations. Before work on a task to amend or add new SARPs is initiated, the approval of the Air Navigation Commission is necessary. Only proposals for which worldwide standardization is essential are approved.

The majority of the articles of the Chicago Convention establish the privileges and obligations of all contracting States and provide for the adoption of international standards regulating air transport. For the past six decades, the main technical achievement of the ICAO has been the agreement of its contracting States on the necessary level of standardization for the safe, secure and regular operation of air services.

Through the provision of national regulations, States are responsible for the implementation and enforcement of SARPs. This is one of the fundamental principles of the Chicago Convention. These, and other related principles of the Convention, enshrine States' responsibilities for safety oversight and leave no doubts as to a contracting State's responsibility for control and supervision of all its aviation activities.

A State's responsibility under the Chicago Convention includes, inter alia, the licensing of operational personnel and certification of aircraft, air operator and aerodromes; the control and supervision of licensed personnel, certified products and approved organizations; the provision of air navigation services and conduct of aircraft accident and incident investigation. Ensuring that this responsibility is carried out in the most effective manner is fundamental to the health of aircraft operation across borders and throughout the world.

In 1992, during the 29th ICAO Assembly, a concern was raised on the apparent inability of some contracting States to carry out their safety oversight functions. Major reasons cited for this included a lack of regulatory framework and a lack of technical and financial resources needed to carry out the minimum requirements of the Chicago Convention. As a result, the Assembly adopted a resolution reaffirming individual State's responsibilities and re-established the obligation of States for safety oversight.

The Directors General of the Civil Aviation Conference and 32nd Assembly directed the establishment of the ICAO Universal Safety Oversight Audit Programme, initially comprising voluntary and non-transparent and then regular, mandatory, systematic safety audits by specially trained ICAO auditors. It also called for the application of the programme to all contracting Sates, together with the implementation of greater transparency and increased disclosure in the release of audit results.

The expanded audit programme adopted by the 35th Assembly covers all safety related provisions of the annexes to the Chicago Convention and also transits to a comprehensive systems approach for the conduct of safety oversight audits.

The results of the first audit cycle under the universal safety oversight audit programme revealed that a number of States continued to experience difficulties in implementing SARPs and maintaining an adequate level of safety oversight. Although corrective action plans were being developed by States, some did not have the requisite human, technical and financial resources to fulfil their safety oversight obligations. As a result, the unified strategy to resolve safety related deficiencies concept was launched by the ICAO. The programme will respond to calls for assistance by member States in implementing corrective measures to resolve their safety related deficiencies through the promotion of regional, subregional safety oversight organizations and encouraging partnerships, and will include results oriented management and quality control. The programme is based on principles of cooperation and assistance, increased transparency and disclosure, and the fostering of partnerships among States, industry, financial institutions and other stakeholders. The programme developments were considered by the Directors General of the Civil Aviation Conference on a Global Strategy for Aviation Safety, which was held in Montreal in March 2006.

In the wake of the tragic events of 11 September 2001, the 33rd Assembly adopted resolution A33-1, "Declaration on misuse of civil aircraft as weapons of destruction and other terrorist acts involving civil aviation", which directed the council to consider the establishment of an ICAO universal security audit programme relating to, inter alia, airport security and civil aviation security programmes.

Pursuant to the Assembly, a high level, ministerial conference on aviation security was convened in early 2002, with the objectives of preventing, combating and eradicating acts of terrorism involving civil aviation, strengthening the ICAO's role in the adoption of the security related SARPs and the audit of their implementation and ensuring the necessary financial means for urgent actions by the ICAO in the aviation security field. The conference endorsed a global strategy for strengthening aviation security worldwide. A central element of the strategy is an ICAO aviation security plan of action, which includes regular, mandatory, systematic and harmonized audits to enable the evaluation of aviation security in all ICAO contracting States.

The primary objectives of the ICAO universal aviation security audit programme are to:

— Determine the degree of compliance of the State in implementing the ICAO SARPs; and
— Determine the extent to which a State's implementation of its security system is sustainable through the establishment of appropriate legislation, national policies and a security authority with inspection and enforcement capabilities.

Under this programme, 42 audits were performed in 2005, bringing the total to 103 since the start of the programme in 2002. According to the States' reactions, this programme is promoting positive change and is visibly improving global aviation security as States become increasingly sensitized to international requirements and strive to be in compliance with the ICAO SARPs in anticipation of their upcoming audit or follow-up visit. No hijacking or act of sabotage was reported for 2005.

Finally, the development and implementation of the presented major safety and security measures highlight a year, 2005, when the total number of passengers on the scheduled airlines of the 189 Member States of ICAO reached a record two billion, a seven per cent increase over 2004. "The global air transport system is fundamentally safe, yet a number of accidents in August and September of 2005 focused attention on the urgent need to eliminate remaining systemic deficiencies, so as to further improve aviation safety worldwide", said Dr. Assad Kotaite, President of the ICAO council.

Through the provision of national regulations, States are expected to implement and enforce SARPs contained in the annexes to the Chicago Convention. Article 12 of the Convention is very clear in this respect.

NEED FOR AN INTERNATIONAL LAW OF NUCLEAR SECURITY?

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Abstract

Adopting and implementing legal measures to protect nuclear and other radioactive materials and associated facilities from possible theft, diversion, loss of control, attack or sabotage have traditionally been considered almost exclusively matters for sovereign States under their domestic laws and regulatory systems. However, recent developments, particularly relating to the perceived risks of nuclear terrorism and illicit trafficking of nuclear and other radioactive materials, have led to the promulgation of new or revised international legal instruments to enhance the security of nuclear materials and facilities. This emerging international law of nuclear security has not been systematic or uniform. Some of the relevant instruments take the form of treaties, conventions or agreements and embody so-called 'hard law'. Such instruments typically impose specific legal obligations and may include verification and enforcement measures. Other instruments have the character of guidance documents, embodying a 'soft law' approach. Such instruments, including a range of documents developed under the auspices of the IAEA, typically contain recommendations, voluntarily applied by States, without specific measures of verification or enforcement. Whether of a hard law or soft law character, the norms and procedures established under these instruments can enhance global nuclear security only if they are broadly accepted and efficiently and effectively applied under the legal and regulatory frameworks of States in which nuclear related activities are conducted. This paper examines the process of elaborating an international law of nuclear security, including what norms seem to have gained recognition in the global nuclear community. Several key issues or problems are discussed, including: transparency versus confidentiality in the handling of sensitive information; inconsistent national standards and regulatory arrangements; weak enforcement measures; and lack of human, technical and financial resources for implementation. Finally, some further opportunities for enhancing the international law of nuclear security are discussed, including: further elaboration of IAEA security guidance documents; harmonization of national legislation and regulatory frameworks; possible 'hardening' of soft law instruments; enhanced information sharing; and better utilization of IAEA security related reviews and services.

1. INTRODUCTION

From the outset of the nuclear era, ensuring the security of nuclear and other radioactive materials and associated facilities has been viewed as a matter falling almost exclusively within the sovereign control of nation States. Issues of nuclear security often implicate sensitive matters, such as the exercise of police and law enforcement functions, handling of confidential information, and measures for assessing the reliability of personnel involved in nuclear-related activities. National governments have been understandably reluctant to subject their handling of such sensitive issues to the influence of outside bodies. Thus, with limited exceptions, the nuclear security field has witnessed only a modest role for international law instruments and processes. However, recent events have changed this situation, and a number of initiatives have begun to erect an international legal framework to address nuclear security. Among the key issues regarding this process are the following:

- What are the threats and risks to nuclear security that warrant the development of international law instruments and norms to address them?
- How would an international law of nuclear security relate to other legal norms in the nuclear field; specifically those involving nuclear safety and safeguards?
- What processes are appropriate for the progressive development of an international law of nuclear security?
- What is the current status of legal norms and implementing arrangements in the field of nuclear security?
- How can an international law of nuclear security be usefully developed, without unnecessary intrusion into matters of national sovereignty?
- What future directions would be useful in this field?

This paper offers a general framework for analyzing these issues, including an assessment of existing legal instruments and arrangements.

2. WHAT IS NUCLEAR SECURITY?

2.1. Definition of nuclear security

A critical task in the development of any legal instrument or regime is defining the terminology used in that instrument or regime. Nuclear security has been defined as follows:

"Nuclear security involves the prevention and detection of, and response to theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities" [1].

This definition makes it clear that nuclear security is focused on illegal or unauthorized acts. It also summarizes the three essential functions for coping with such acts; namely, prevention, detection and response. Finally, it makes clear that the scope of nuclear security goes beyond materials that could be used for explosives and covers materials that could be used in a radiological dispersal device (RDD or 'dirty bomb') and relevant facilities.

2.2. Relationship of nuclear security to other legal regimes

Another threshold issue regarding nuclear security is how this term relates to other legal arrangements, some of long standing, that have been developed to protect the public and the environment from radiological injury. Specifically, can a meaningful distinction be made between nuclear security, as opposed to nuclear safety or nuclear non-proliferation? Measures adopted for nuclear safety and non-proliferation purposes clearly contribute to the protection of nuclear and other radioactive materials and associated facilities, thereby contributing to enhanced nuclear security. However, although they overlap, legal measures in these three fields are based on somewhat different considerations and employ different approaches.

- For nuclear safety, the primary focus is on unintended acts or conditions that could lead to radiological releases from authorized peaceful nuclear activities, with responses emphasizing engineered protections (e.g., defence in depth) and safety management.
- For nuclear non-proliferation, the primary focus is on monitoring or restraining activities by national governments that could lead to the acquisition of nuclear weapons, with responses emphasizing international legal and political commitments, technology controls and verification through an international body (the IAEA's Department of Safeguards).
- For nuclear security, the primary focus is on the intentional misuse of nuclear or other radioactive materials by non-State terrorist or criminal elements, with responses emphasizing law enforcement measures, intelligence gathering and physical protection.

Thus, nuclear security is sufficiently distinct in its objectives and approaches to justify its status as a separate legal and administrative field.

3. THREATS TO NUCLEAR SECURITY

The need to protect nuclear materials and facilities from theft, misuse, attack or sabotage has been recognized from the beginnings of nuclear technology. However, recent events have heightened concerns about nuclear security. The most dramatic of these events has been a series of terrorist bombings around the globe. Fortunately, none have yet involved radioactive materials. However, reports that terrorist organizations have sought radioactive materials, with the intention of escalating such attacks to the radiological level is particularly troubling. Also, recent cases involving the illicit trafficking of nuclear technology and materials raise concerns that criminal or terrorist elements may be acquiring the capability to make credible threats or to use radioactive materials for malevolent ends. Even benign developments, such as greater worldwide access to information technology and the expansion of peaceful nuclear programmes, have security implications because they can potentially be exploited for malicious purposes.

The primary threats that have been identified involve the possibility that terrorist or criminal elements might engage in the following conduct:

- Acquisition of nuclear explosive devices;
- Using nuclear material to construct an improvised nuclear explosive device;
- Using radioactive material to construct an RDD;
- Sabotage of a facility or mode of transport where nuclear or other radioactive material is used, with consequent dispersal of radioactivity [2].

These concerns have animated the international nuclear community, with the result that a variety of measures — including new and revised legal instruments — have been developed to address the perceived threats.

4. INTERNATIONAL LAW MAKING

4.1. Sources of international law

To provide a context for further discussion, it may be useful to summarize the recognized sources for international law. They include:

- Conventions, agreements and treaties [3];
- International custom, as evidence of a general practice accepted as law [4];
- General principles of law recognized by civilized nations [5];
- Judicial decisions and teachings of highly qualified experts [6];
- International legislation promulgated by relevant organizations [7].

4.2. Differences among law making instruments

An issue that has resulted in some confusion among both legal experts and other professionals in the nuclear field centers on the question of what norms (rules) or instruments are entitled to be considered as ‘law’. This determination may be a key factor in assessing whether governments consider that they have an obligation to implement a particular norm or instrument. A rather traditionalist — some might say narrow—perspective would deny the status of law to many international instruments. This is because, unlike domestic laws, these instruments do not set forth precise specific rights and duties, and lack effective regulatory arrangements, including rigorous enforcement procedures with penalties and sanctions for violators. From this viewpoint, many international instruments may only be considered ‘quasi-law’ or ‘pre-law’; useful for future development of international law, but not entitled to the full status of law [8].

However, an increasing consensus of legal experts would avoid giving a narrow interpretation to the term law. This approach broadens the range of norms or instruments that can be considered as law. The broader approach typically distinguishes two types of norms — commonly referred to as ‘hard law’ and ‘soft law’ [9]. Under this interpretation, both categories are entitled to be considered law, although they may involve different approaches to implementation. Some of the characteristics of these two types of international law are as follows:

Hard law:

- Considered binding under international law;
- Negotiated by States through a diplomatic process;
- Obligations are typically more specific;
- Contains provisions for verification and enforcement;
- May involve sanctions for violations.

Soft law:

- Involves voluntary policy commitments;
- Developed by experts through informal consultations;
- Recommendations or guidance is typically more general;
- Weak or non-existent verification or enforcement measures;
- No specific sanctions, but may involve review procedures.

The international nuclear security field comprises a range of both hard law and soft law instruments.

5. SOURCES OF INTERNATIONAL NUCLEAR SECURITY LAW

5.1. Conventions, treaties and agreements relevant for national security

Over nearly four decades, a range international conventions and treaties (both global and regional) have been adopted to address specific aspects of nuclear security. The most relevant of these are the following:

- Nuclear Non-Proliferation Treaty (NPT) [10];
- Convention on the Physical Protection of Nuclear Material (CPPNM) [11];
- Convention on Early Notification of a Nuclear Accident [12];
- Convention on Assistance in Case of a Nuclear Accident [13];
- Convention on Nuclear Safety (CNS) [14];
- Joint Convention on the Safety of Spent Fuel and Radioactive Waste Management (Joint Convention) [15];
- Convention on Terrorist Bombings [16];
- Convention on Nuclear Terrorism (NTC) [17];
- Latin American Nuclear Weapon Free Zone (Tlatelolco) Treaty [18];
- South Pacific Nuclear Weapon Free Zone (Raratonga) Treaty [19];
- Southeast Asia Nuclear Weapon Free Zone (Bangkok) Treaty [20];
- African Nuclear Weapon Free Zone (Pelindaba) Treaty [21];
- WCO Customs Convention on Containers [22]
- International Convention on Customs Procedures [23];
- Convention on Mutual Assistance in Customs Matters [24].

Unlike the situation regarding nuclear non-proliferation, nuclear safety or nuclear waste management, no single convention is focused specifically on nuclear security. As is evident from the extensive list cited above, the legal framework for implementing measures addressing nuclear security is far from concise, consistent or readily comprehensible. Also, adherence to this range of instruments is far from universal, even among States utilizing nuclear or other radioactive materials for peaceful purposes.

In this category of instruments it is also relevant to consider bilateral nuclear cooperation agreements that authorize transfers of nuclear materials and technology. Often overlooked in discussions of international nuclear law, these agreements establish important rights and obligations that can impact nuclear security. For example, nuclear supplier nations typically require an agreement by the recipient State to apply ‘effective physical protection’ as a condition of export. This requirement implements voluntary guidelines accepted by most nuclear suppliers [25].

5.2. International custom

As a source of international law, custom is what States do in practice, reflecting a sense of legal commitment or obligation (usually referred to by the Latin term opinio juris). Absent an affirmation of legal obligation, voluntary conduct reflecting political, economic or other interests does not, in itself, contribute to the creation of international law. The practical application of nuclear technology has a substantial degree of uniformity, for a variety of reasons. For example, until recently, training in nuclear science has been concentrated in a few States, thereby creating a profession with many common connections and approaches. Also, because of the special characteristics of nuclear and other radioactive materials, States utilizing this technology have long recognized the need for all users to apply stringent standards to protect the public health, safety, security and environment. The large volume of IAEA standards documents codifying a consensus of expert opinion on necessary measures of control over nuclear materials has contributed to this widespread harmonization of State practice. However, for the most part, governments have not seen their actions in this regard as legally compelled. Thus, it is not clear that custom can be considered a major source of an international law of nuclear security.

5.3. General principles of international law

It is difficult to identify any general principles of international law that have contributed significantly to a law of nuclear security. In fact, the very generality of such principles does not make them very useful in defining legal norms that can contribute concretely to the enhancement of nuclear security. One general principle of international law that is frequently mentioned is the obligation of a State not to permit activities in its territory that could injure other (usually neighboring) States. This principle, summarized in the Latin maxim sic utere tuo, ut alienum non laedas, has been consistently affirmed in decisions of international tribunals [26]. Thus, if a State conducted or allowed activities involving nuclear materials that injured another State's security interests, it could be argued that this conduct violated international law under the sic utere principle.

5.4. Judicial decisions and expert opinion

Heretofore, no significant international judicial decisions have addressed nuclear security [27]. Also, the extensive professional literature on nuclear technology mostly addresses technical, rather than legal topics. Such professional writings are primarily relevant to the development of IAEA standards documents and legal instruments that represent a more concrete source of an international law of nuclear security.

5.5. International legislation

Along with the conventional instruments previously discussed in Section 2.1, international legislative instruments are an important current and future source of an international law of nuclear security. Such instruments are of several types.

A first type is the range of guidance documents developed under the auspices of the IAEA. One of the specific functions of the IAEA has been to establish "standards of safety for the protection of health and minimization of danger to life and property" [28]. Although addressing safety, such standards often contribute to nuclear security. As a result of recent decisions by the IAEA Board of Governors and General Conference, the IAEA is in the process of developing a range of security guidance documents that will parallel the long standing Safety Standards series. The most important current IAEA documents (or those developed with IAEA participation) that address nuclear security include:

- Physical Protection recommendations [29];
- Guidance on the Import and Export of Radioactive Sources [30];
- Code of Conduct on the Safety and Security of Radioactive Sources [31];
- Code of Conduct on the Safety of Research Reactors [32];
- Prevention of Illicit Trafficking of Radioactive Materials [33];
- Detection of Radioactive Materials at Borders [34];
- Response to Events involving Radioactive Materials [35];

- Guidelines for Monitoring Radioactive Materials in Mail [36];
- Legal and Governmental Infrastructure for Nuclear Safety [37].

These and other guidance documents are generally considered as soft law, to be voluntarily implemented by States. However, they can be ‘hardened’ into binding norms in several ways. The first means is adoption or incorporation by reference of such guidance documents into national laws or regulations through a State’s legislative process. A second is actual incorporation of provisions of guidance documents into an international convention or treaty [38]. A variation on this second approach would be a requirement in an international instrument for parties to reflect the provisions of a guidance document in their national laws [39]. A third means would be adoption by an international law making body such as the United Nations Security Council. Yet a fourth means applies to the specific case of IAEA project and supply agreements, where nuclear materials or technology are transferred under IAEA auspices. For such projects, IAEA standards must be applied by the recipient State [40].

The ability of certain international bodies to legislate binding norms has been debated since the creation of the United Nations and indeed, since the League of Nations. There is little disagreement that a recognized international body can adopt binding rules for its own internal governance. However, there is less agreement on whether such bodies can create binding norms for their members beyond internal administrative matters. However, there is one case where such authority seems to be clear; namely, where the United Nations Security Council adopts measures under Chapter VII to address threats to international peace and security. With regard to nuclear security, the Council has adopted several resolutions dealing with terrorism, two of which are particularly relevant in the nuclear field. In 2001 the Council adopted a resolution mandating action by Member States against the financing of terrorism [41]. In 2004, the Council adopted another far reaching resolution [42]. Among other things, the resolution mandates action by all United Nations Member States to combat proliferation of weapons of mass destruction and to combat terrorism and illicit trafficking. The resolution also references the need for United Nations Member States to develop and maintain appropriate physical protection measures. Unlike the Council’s Chapter VII authority, the legislative role of other bodies, such as the United Nations General Assembly, the specialized agencies of the United Nations, and the wide variety of regional organizations is a matter of debate. In the end, each proposed instance of international legislative competence must be evaluated: first, to assess the kind of the authority a body has been given by its members; and second, whether the purported legislative act is consistent with that authority.

5.6. Other international instruments or arrangements

A final category of potential sources of an international law of nuclear security includes instruments initially developed to address the proliferation of nuclear weapons. A number of legal instruments have been developed to implement the IAEA's safeguards verification function [43]. These include the original safeguards measures adopted by the IAEA [44], those promulgated in conjunction with the NPT [45], and more recent provisions designed to strengthen safeguards following the discovery of Iraq's clandestine nuclear weapons programme [46]. Agreements negotiated between the IAEA and States under the terms of these instruments are clearly binding as conventional international law.

In addition to IAEA promulgated safeguards documents, non-proliferation controls have also been implemented pursuant to two sets of guidelines developed by nuclear supplier states. One set is based on the NPT's prohibition against transfers of certain nuclear materials or equipment to non-nuclear-weapon States unless IAEA safeguards are applied to all specified material in that State [47]. A second set is not treaty based and extends to a broader range of transfers [48]. As stated earlier, although these export control guidelines were promulgated to address the proliferation of nuclear explosives, they are also relevant to restraining the illicit trafficking of materials and technology that could be used by terrorist or criminal elements.

6. EMERGING NORMS OF AN INTERNATIONAL LAW OF NUCLEAR SECURITY

As the previous discussion indicates, the nuclear community has witnessed a great deal of recent activity in promulgating both hard law and soft law instruments in the field of nuclear security. It is submitted that a number of norms articulated in these instruments have achieved a sufficient level of approval by nation States engaged in the uses of nuclear energy to represent an emerging international law of nuclear security. It is beyond the scope of this paper to attempt an analysis of all the norms that may have attained this status. However, it is possible to identify the most important of those on which there appears to be a broad consensus. The following list is intended to be illustrative, rather than comprehensive.

6.1. Denial of support to nuclear terrorism or proliferation

Norm: States shall refrain from providing any form of support to non-nuclear-weapon States or non-State actors that may attempt to develop, acquire or threaten the use of nuclear explosive or radiological dispersal devices.
Sources: UNSC Res. 1540, para. 1; NPT Arts. I and II; NTC Arts, 2 and 7; NSG and Zangger Committee Guidelines.

6.2. Legislative framework

Norm: States shall put into place a national legislative framework for the protection of nuclear and other radioactive material and associated facilities.
Sources: CNS, Art. 7; Joint Convention, Art. 19; C of C on Radioactive Sources, para. 8; C of C on Research Reactors, para. 10; CPPNM, Art. 3; CPPNM Amendment, Art. 8; INFCIRC 225, Section 4.2.1.

6.3. Regulatory body

Norm: States shall designate a competent body to exercise regulatory control over the implementation of nuclear security measures.
Sources: CNS, Art. 8; Joint Convention, Art. 20; CPPNM, Art. 5; GS-R-1, parts 3 and 4; INFCIRC 225, Section 4.2.3.2; C of C on Radioactive Sources, paras. 20–22; C of C on Research Reactors, para. 11.

6.4. Physical protection measures

Norm: States shall adopt requirements, including authorization procedures, to ensure a high level of protection of nuclear materials and associated facilities from theft, unauthorized use or diversion and against sabotage.
Sources: UNSC Res. 1540, Art. 3(b); CNS, preambular para (v); NTC, Art. 8; CPPNM, Art. 3; INFCIRC 225.

6.5. Measures against illicit trafficking

Norm: States shall establish measures, including border controls, export and trans-shipment controls and enforcement measures, to detect, deter, prevent and combat illicit trafficking in nuclear materials and related equipment and technology.
Sources: UNSC Res. 1540, paras. 3(c) and (d); NSG and Zangger Committee Guidelines; C of C on Radioactive Sources, paras 23–29 and Guidance on Import and Export of Radioactive Sources; NTC; CPPNM, Art. 4.

6.6. Penalties for conduct threatening nuclear security

Norm: States shall establish and enforce appropriate criminal or civil penalties for violations of nuclear security related laws and regulations.
Sources: UNSC Res. 1540, para. 3(d); CCPNM, Art. 7; NTC, Arts. 2 and 5

6.7. Cooperation and assistance

Norm: States shall provide cooperation and assistance at the request of another State in recovering or ensuring the safety and security of nuclear or other radioactive material that has been unlawfully taken or appropriated or in the event of a radiological emergency.
Sources: CPPNM, Art. 5(2); Convention on Assistance, Art. 2; NTC, Art. 18.2 and 18.3.

6.8. Sharing of information

Norm: States shall exchange information concerning potential threats or actions jeopardizing nuclear security, as promptly and fully as authorized by their national laws.
Sources: NTC, Art. 7.1(b); C of C on Radiation Sources, Art. 12; CPPNM, Art. 5.2.

6.9. Protection of sensitive information

Norm: States shall protect the confidentiality of information received from other States or relevant international organizations where a request for confidentiality has been made.
Sources: CPPNM, Art. 6; C of C on Radiation Sources, para 17; NTC, Art. 7.2.

7. ISSUES AND APPROACHES IN THE INTERNATIONAL LAW OF NUCLEAR SECURITY

As with other aspects of nuclear energy, nuclear security raises a number of issues that should be considered from a legal perspective.

7.1. Transparency versus confidentiality

In the nuclear field there has always been a degree of tension between the need to communicate sufficient information to enable policy makers and the public to understand fundamental issues regarding the technology, while protecting information that could pose unreasonable risks to public health, safety and security. This tension is exemplified in Sections 6.8 and 6.9, above, where norms have been identified for both sharing and protecting nuclear security related information. The balance struck between these two competing considerations can differ considerably from State to State. In the field of nuclear security the balance has tended to favor confidentiality. A common approach is to adopt a 'need to know' principle, by which sensitive information is only communicated to persons or organizations that have a recognized role in using or regulating nuclear or radiological materials and related facilities. So-called 'generic' information on security related policies and practices has been made available in some States to provide a measure of transparency. This approach limits the release of specific information on facilities, transportation routes, types and quantities of material and other technical and operational details.

The current framework for exchanging nuclear security related information lacks coherence, with a wide range of formal and informal arrangements. Information relating to nuclear security is obviously shared on an ad hoc basis between States through diplomatic and intelligence channels. For some years the two nuclear suppliers groups have periodically shared information relating to their export activities. An option that could enhance these arrangements could be development of a model protocol on sharing of nuclear security related information that could be used by States in negotiating bilateral or regional agreements.

Since 1985 the IAEA's Illicit Trafficking Database (ITDB) has been a useful mechanism for tracking incidents of unauthorized activities involving nuclear and other radioactive materials. The ITDB's utility would be improved by broader participation, more prompt and detailed reporting and improved analysis of data in the system. The ITDB is reviewed in periodic meetings of the network's Points of Contact. This mechanism should be used to discuss whether the ITDB could be expanded to include sharing of security related information beyond incidents of illicit trafficking. These consultations could also assess what adjustments to the database's structure and procedures could help make it a more useful nuclear security mechanism.

7.2. Inconsistent national laws, standards and regulatory arrangements

Given that threats to nuclear security are global in nature, harmonized legal arrangements for addressing those threats could be of great benefit. The IAEA is uniquely positioned to play a role in the harmonization process. In the nuclear safety field, the IAEA has long played an important role in helping its

Member States to develop domestic laws and regulations based on international best practice. Indeed, the terms of international law instruments for nuclear safety (e.g. the CNS and Joint Convention) were derived in large part from IAEA standards documents developed over several decades. The process of developing the international law of nuclear security has been somewhat different. With the exception of physical protection (where INFCIRC/225 has provided guidance for 30 years), the IAEA has not prepared detailed recommendations for nuclear security until recently.

Through its nuclear security activities from 2002 to 2005 and under new Nuclear Security Plan for 2006–2009, the IAEA is developing a range of guidance documents that can help to enhance Member State legislative and regulatory frameworks, including greater consistency.

One approach that could be of great assistance to States with poor or outdated laws could be the development of model provisions that could be adopted in national legislation. Such provisions would need to be reviewed carefully by national experts and amended to be consistent with the State's overall constitutional and legal framework. Model provisions could be organized by subject matter, with texts dealing with the key areas of nuclear security law (e.g., physical protection, illicit trafficking, export controls, incident response, and emergency preparedness).

The success of the IAEA's nuclear security initiative depends on a number of factors, most importantly:

- Whether adequate human and financial resources are available to conduct this work on a priority basis;
- Whether the development of guidance documents enlists the active participation of recognized experts in all relevant technical and legal areas;
- Whether documents reflect full consultation with relevant national authorities having responsibility for nuclear security;
- Whether guidance documents are well integrated into the range of IAEA documents in other fields (especially nuclear safety, radiation protection and safeguards);
- Whether adequate legislative assistance from the IAEA is available to Member States who wish to use guidance documents for the development of their own national legal and regulatory frameworks;
- Whether Member States, through their legislative and regulatory bodies, make use of IAEA guidance documents in assessing and amending their domestic instruments and arrangements.

It is important to mention that the IAEA has established several advisory services to assist Member States in reviewing their nuclear security arrangements, including their legislative and regulatory frameworks. These include:

- International Physical Protection Advisory Service;
- International Nuclear Security Advisory Service;
- International SSAC Advisory Service;
- Emergency Preparedness Review.

States should continue to make use of these services, which should include a review of applicable laws and regulations based on the norms of nuclear security law and relevant IAEA guidance documents.

A final mechanism that has proved useful in other areas of international nuclear law (safety, waste management, non-proliferation) is the convening of periodic review conferences to assess how well international instruments are being implemented, including an assessment of national measures [49]. The nuclear security field could benefit from a review mechanism focused on key elements, such as physical protection, illicit trafficking, information sharing, prevention, detection and response. The present Moscow Conference, itself, represents a type of informal review mechanism. Future conferences of a somewhat longer duration and regularly scheduled could be structured to address specific nuclear security issues, including legal questions.

7.3. Weak enforcement measures

International law, in general, typically fails to embody clear and stringent measures for the enforcement of norms and procedures. The emerging international law of nuclear security is no exception. Nuclear security requirements are primarily enforced through the domestic criminal and civil justice systems of nation States. This paper has discussed a number of international legal instruments that obligate States parties to adopt appropriate penalties for violations of security norms and procedures. It may be worth considering whether additional instruments, particularly of a soft law character, could be hardened by adding specific enforcement measures. It may also be appropriate to consider what influences might be brought to bear on States that have failed to adopt appropriate legislation to address violations of nuclear security or have failed to take prompt and effective enforcement action in specific cases where such violations appear to have occurred.

7.4. Lack of human, financial and technical resources

As noted previously, primary responsibility for implementing nuclear security norms lies with national governments and the users of nuclear technologies. A particular difficulty with the development and implementation of nuclear security law in many States is the lack of legal professionals with training and experience in this highly technical field. Opportunities for specialized training in this area of the law have been limited. If adequately supported, some recent initiatives can help address this problem. One example is the International School of Nuclear Law convened each summer at the University of Montpellier in France under the sponsorship of the OECD Nuclear Energy Agency and supported by the IAEA. A new World Nuclear University Summer Institute, sponsored by the World Nuclear Association has included instruction on nuclear security and nuclear law topics. IAEA workshops, conferences and legislative assistance projects also make an important contribution. Some donor countries have also provided assistance in nuclear security that has included legal training. The nuclear community needs to continue its support of these initiatives and look for additional means for broadening human, financial and technical resources in this field.

8. CONCLUSIONS

International law can be an important element in the vital effort to improve nuclear security worldwide. Recent years have seen an acceleration in the development of international norms and procedures in this complex and difficult field through the promulgation of new and revised legal instruments and arrangements. However, this useful development has lacked coherence and consistency. Uneven implementation of these instruments has also adversely impacted efforts to enhance nuclear security. It is time that States and international organizations look for ways to focus on the emerging international law of nuclear security as a high priority and from a more structured perspective.

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ENHANCED INTERNATIONAL REGULATORY COOPERATION

(Topical Session 4)

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OECD NULCEAR ENERGY AGENCY ACTIVITIES TO ENHANCE INTERNATIONAL REGULATORY COOPERATION*

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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 2005–2009 and directs the activities of the NEA programme of work and, in particular, those carried out by the safety committees — the Committee on the Safety of Nuclear Installations and the Committee on Nuclear Regulatory Activities (CNRA). As the nuclear programmess in OECD countries have matured over the four decades of commercial nuclear power operation, this experience has brought many improvements in safety through backfits in technology and programmes and improvements in operational performance of nuclear power plants. In parallel with these changes in nuclear plants' performance there has been a maturation in the safety regulation of nuclear power plants, most notably in the use of new safety analysis methods like probabilistic safety analysis; in the regulatory responses to new information and insights from operating experience, especially from the significant incidents and accidents that have occurred; in the consideration of human factor and organizational impacts upon nuclear safety; and in an increased emphasis on nuclear quality management systems. In light of these insights, the CNRA considered that it was an appropriate time to examine the broad issues of regulatory policy. In this sense, the CNRA has completed different tasks on regulatory effectiveness, regulatory decision making and the regulatory challenges in using operating experience. The reports issued as result of these tasks discuss some basic principles and criteria that a regulatory body should consider when approaching the wide range of decisions faced in the course of its daily responsibilities. In addition, the regulator is aware that its decisions and the circumstances surrounding those decisions, can affect how its stakeholders, such as government policy makers, the industry it regulates, and the public, view it as an effective and credible regulator.

* Although a presentation was given, only an abstract was made available. The author's PowerPoint presentation appears in the CD-ROM of contributed papers accompanying this book.

USING IAEA SAFETY STANDARDS FOR HARMONIZED SAFETY LEVELS
The WENRA experience[*]

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

MULTINATIONAL DESIGN APPROVAL PROGRAMME

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Abstract

The licensing of new nuclear power facilities is likely to pose many challenges to national regulatory organizations. The majority of nuclear power plants to be built around the world in the next 15 years will likely be limited to a small number of relatively standardized designs, purchased from a limited number of multinational corporations. Such standardization creates an opportunity to leverage the resources and knowledge of the national regulatory authorities who will be tasked with the review of the new reactor power plant designs. The Nuclear Regulatory Commission has developed an innovative proposal for a multinational design approval programme (MDAP). This paper describes the stages of the MDAP and the benefits that could be derived from its implementation.

1. INTRODUCTION

With the worldwide resurgence of interest and activity in the construction of new nuclear power facilities, the world's national regulatory authorities will likely be faced with many challenges in the reactor licensing arena. To address these challenges, the Nuclear Regulatory Commission (NRC) has been developing innovative approaches to ensure that it can complete its work in a timely and effective way, while not losing track of its overall safety mission. Unlike the previous generation of nuclear power plants, the majority of nuclear power plants to be built around the world in the next five to 15 years will likely be limited to a small number of relatively standardized designs, purchased from a limited number of multinational corporations. Such standardization in nuclear power plant design creates an opportunity to leverage the resources and knowledge of the national regulatory authorities who will be tasked with the review of the new reactor power plant designs. To address this opportunity, the NRC has developed a proposal for a multinational design approval programme (MDAP).

2. THE THREE STAGES OF THE MDAP

As currently envisioned, the MDAP would be implemented in three stages. Stage 1 of the MDAP will focus on new light water reactor designs for which a vendor is seeking US design certification and the same or similar reactor designs are being reviewed by national regulatory counterparts for licensing in their respective countries. As part of the MDAP, the participating regulatory authorities would share results of their design review activities. Collaborative reviews and collaborative research of identified issues would also be considered as applicable. In the United States of America, the NRC would use its current design certification process, as specified in 10 CFR Part 52. The NRC would, however, incorporate the expertise of other national regulatory bodies into the technical design reviews that are performed by NRC staff. Other governments participating in stage 1 of the MDAP would be free to utilize the MDAP outputs to facilitate their own unique national licensing processes.

Stage 1 of the MDAP has begun and is focused on the planned design reviews associated with the AREVA EPR reactor. The EPR reactor is now being constructed in Finland, has been proposed for construction in France, and is undergoing pre-application reviews in the USA, in anticipation of a late 2007 US design certification application submission. Initial bilateral meetings were held in January and February 2006 between the NRC and its regulatory counterparts in Finland and France, STUK and ASN, respectively. The first steps in stage 1 will be centered on obtaining information on the breadth and depth of the EPR design reviews already completed and planned by the French and Finnish governments. Insights will also be obtained from the reactor designer AREVA–Framatome regarding the process being used to bring the European EPR design into conformance with US design standards. The participating regulatory authorities will then determine what specific technical areas of their planned design review would best benefit from cooperation with their foreign regulatory counterparts. The level of cooperation achievable in stage 1 of the MDAP will depend in large part on the relative standardization of the reactor design across the three participating countries.

Stage 2 of the MDAP, as currently envisioned, would be more extensive and would begin in parallel with the stage 1 effort. At the beginning of stage 2, technical representatives from a group of core countries would be assembled to structure the MDAP process, leading to the formation of a stage 2 steering committee. The steering committee would then formulate the policy direction for the technical modules for future development. The stage 2 modules would be focused on achieving convergence of the regulatory safety goals, design criteria, codes, and standards that are associated with approving a new reactor design in each country. Working groups could then be formed for each of the identified modules. Once the initial set of stage 2 modules is identified, decisions would be made regarding the desire for further participation of each of the countries involved.

Consideration may also be given to a stage 2 module related to the regulatory oversight of international suppliers of reactors and components. The NRC anticipates that with the resumption of reactor construction in the USA and the expected international outsourcing of reactor components, enhanced oversight in this area may be desirable. International cooperation for manufacturing oversight would be advantageous in cases where observation or inspection of fabrication provides the best opportunity to verify that equipment meets aspects of acceptance criteria for the certified design.

As part of the stage 2 initiative, the NRC and other regulatory authorities will utilize the IAEA Safety Standards as the overreaching network satisfying international safety objectives. The IAEA Safety Standards would also be reviewed for completeness by bottom–up and top–down approaches by the participating regulatory authorities. It is expected that the recent review by the Western European Nuclear Regulators Association will inform this process.

For stage 2 of the MDAP, the NRC believes that it would be beneficial to make use of the services of the NEA to act as a secretariat for the following reasons:

- The NEA membership is closely aligned to those countries involved in the development of new nuclear power plant facilities.
- The NEA is currently serving as the secretariat for the Generation IV International Forum (GIF). Much of the infrastructure developed for the GIF can be used for the MDAP initiative, thus saving significant staff effort in developing the necessary administrative framework and associated documents.
- Since the results of the MDAP stage 2 initiatives will be used to facilitate the reviews of the plant designs being developed by the GIF, a close link needs to be maintained between the GIF and MDAP initiatives. Having the NEA serve as secretariat for both the GIF and the MDAP can help to ensure integration of the two initiatives.

The NEA has volunteered to act in the above capacity. It is important to note that the NEA will be serving solely as a secretariat and will not be providing technical direction to the project. The technical direction will come from the MDAP stage 2 steering committee. Interfaces between the NEA and the IAEA will be set up to ensure effective communication and alignment with

IAEA activities in similar areas. This will include having the IAEA participate, ex-officio, in the MDAP stage 2 activities.

Stage 3, the implementation and expansion stage of the MDAP, would use the products of the stage 2 efforts to review the advanced reactor designs emanating from the GIF. Stage 3 should help to maximize the effectiveness of the regulatory design reviews of these advanced reactors.

3. CONCLUSION

It is anticipated that participation in the MDAP programme would help the participating regulatory authorities ensure the safety of new reactor designs. Among the specific benefits that could be derived from participation in the MDAP programme are the following:

- Participation in stage 1 of the MDAP should provide the participating regulatory authorities with additional information regarding potential technical issues likely to arise during their national design reviews. For the USA, sharing information with the French and Finnish regulators will allow the NRC to identify such issues during its pre-application reviews, and will allow the agency to leverage its work with the work done by the counterparts to resolve such issues prior to the actual EPR application submittal.
- Stage 2 of the MDAP should provide an incentive towards developing more internationally standardized reactor designs, which would allow for more meaningful international exchanges of reactor operating experience. This should, in turn, help to enhance both national and international reactor safety.
- Stages 2 and 3 of the MDAP should foster the safety of reactors in those countries which are planning to build and license new nuclear power facilities, but whose regulatory infrastructure is not as extensive or as experienced as that which exists in more developed nuclear nations.
- Stage 2 of the MDAP should enhance the safety of the next generation of nuclear power plants being conceived for deployment. Participation of peer foreign regulators in the development of international design review codes, standards, and regulations should allow for a more comprehensive safety review.
- The convergence of regulatory safety goals in stage 2 of the MDAP should result in enhanced clarity and transparency when communicating the safety of new reactor designs to the general public.

- Working with international regulatory partners in a collaborative manner should provide added insights on how other governments license new reactors. Such insights could potentially be used to improve the effectiveness and efficiency of national licensing processes.

ROLE OF INTERNATIONAL APPRAISALS AND PEER REVIEW MISSIONS

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Abstract

The major accident at the Chernobyl nuclear power plant in April 1986 has triggered many changes in managing nuclear safety matters, two of them being enhanced international cooperation and a strengthened nuclear regulatory regime. First of all, the value of a common view on appropriate safety standards has been recognized. As the worldwide implications of any safety drawback had become quite obvious, international appraisals appeared as one of the important instruments to ensure enhancement of nuclear safety levels at different facilities up to internationally recognized standards. The maximum attention has been given to the old generation of nuclear power units, particularly to the so-called 'Soviet design reactors'. International appraisals performed in the early 1990s resulted not only in general assessments and comments but also in certain recommendations on measures to be implemented. Further implementation of identified measures as well as strengthening nuclear regulatory authorities, which was also based on development of the common view and peer review missions, were closely followed by different stakeholders. It all made a significant input into a global change of perception of nuclear power from moratoria on further development and even early shutdowns of operating units in many countries to a growing acceptance, even though reluctant to some extent, of life extension for old units with an acceptable nuclear safety level and construction of new units. But with new nuclear safety and security challenges the value of international regulatory cooperation becomes even higher and joint appraisals and peer review missions are becoming even more important tools for introducing a new generation of nuclear power.

1. INTRODUCTION

Throughout the years, international appraisals and peer review missions have become a routine part of regulatory practices and international cooperation in the nuclear energy field. Moreover, we are now moving to the next level of regulatory cooperation, including the concept of multilateral approval of design and development of safety criteria to be used as a basis for regulatory decisions to be taken at the international level. It seems an appropriate time to review the efficiency of current peer review tools, so that their benefits will not be lost. This paper is intended to provide only a starting point for the relevant discussion though based on the limited experience and being confined to the conference format.

2. EFFECTIVE REGULATORY SYSTEMS: LOOKING FOR COMMON GROUND

Since the very beginning of the peaceful use of nuclear power, the issue of safety has been given particular attention by national governments, although, there was neither a unified approach nor common principles at that time. Thus, both organization and modus operandi of governmental bodies responsible for nuclear safety in different countries varied significantly. In many cases they borrowed the approaches applied in other high risk level industries (aviation, chemical industry, etc.) and at the initial stage regulatory powers were often assigned either to the governmental bodies responsible for nuclear power development or to environmental or health authorities. But very soon either cooperation on the industrial side or intensive import of related technologies and equipment fostered the first information exchange and then some harmonization of approaches between nuclear regulators of countries where reactors or other facilities of the same design were built. Later on, the common understanding of generic principles for ensuring the proper treatment of nuclear safety issues was reached and formalized with the relevant provisions of both the Nuclear Safety Convention and the Joint Convention on Radioactive Waste and Spent Fuel Safety elaborated in greater detail in the relevant IAEA Safety Standard [1].

Intensified cooperation resulted in establishing the more or less formal international regulatory gatherings. The widest ‘geography’ is represented at the annual senior regulators’ meetings in connection with the IAEA general conferences. Some forums are based on technological principles, such as the Forum of WWER Regulators meeting annually in one of the countries where there is at least one WWER reactor in operation. Others are based on regional or political principles, such as the Western European Nuclear Regulators Association or the former CONCERT Group.

Naturally, at any of the above mentioned forums, one of the major points for discussion concerned the prerequisites and key factors that make for an effective regulatory system. The relevant conclusions and recommendations were published and they provided a good basis, particularly the relevant IAEA guide [2], for further strengthening the regulatory authorities.

Since 1989, the IAEA has provided its Member States with a specific tool to evaluate the effectiveness of their national regulatory body and to receive recommendations and suggestions from the peers on its improvement — the International Regulatory Review Team (IRRT). Ukraine has requested such missions twice: a full scope IRRT mission in 1998 and a follow-up IRRT mission in 2001. Suggestions and recommendations received were carefully considered, some of them were communicated to the Government and to Parliament. As a result, many changes were introduced, including creation of the State Nuclear Regulatory Committee as an independent State authority with a direct line of communication to the highest tier of power, with the increased staff numbers and raised salaries, and all necessary authorities.

3. INTRODUCTION OF MULTILATERAL SAFETY ASSESSMENTS IN INTERNATIONAL COOPERATION

3.1. Peer review missions and advisory services

The peer review concept was introduced to some extent during the early stages of nuclear power development. However, such efforts were mostly confined within geographical or political borders.

The Three Mile Island accident brought increased attention to the nuclear safety issues thus resulting in the strengthening of international cooperation in the field of nuclear safety. One of the outcomes of the accident was the introduction (under IAEA auspices) in 1982 of advisory services on selected operational aspects and on the safety management of nuclear power plants, which are now well known and highly requested as the Operational Safety Review Team (OSART) and Peer Review of Operational Safety Performance Experience (PROSPER , former ASSET) missions. Seven years later, in the wake of another major accident with much more devastating consequences, new peer review services were initiated, including the International Probabilistic Safety Assessment Review Team, the above mentioned IRRT, the Design Safety Review Service and the Seismic Safety Review Service missions.

The first peer review mission to Ukrainian nuclear power plants was the OSART mission to Unit 3 of the Rovno nuclear power plant in December 1988. Actually, it was the first international peer review mission to the then USSR. For many nuclear engineers it was their first opportunity to meet and have discussions with foreign colleagues. They discovered that while engineering approaches to safety issues were basically similar in the so-called Soviet block and Western countries, the relevant activities were planned and organized in quite a different manner.

Then, starting in 1992, different peer review services were requested and arranged for all the Ukrainian nuclear power plants. The value of these missions as well as the involvement of Ukrainian experts in such missions to other countries was extremely high during the early and mid-1990s, when, owing to the overall economic crisis and deep under payments in the Ukrainian electricity market, these missions served as a kind of a bridge, opening channels of communication with colleagues from different countries.

Ukraine still continues to request such services, and both the utility and the nuclear regulator benefit from the relevant findings, whilst the latter complements regulatory inspections and the utility's self-assessment activities.

3.2. International appraisals

The idea of international appraisals came after the Chernobyl accident when discussions concerning the root causes and safety deficiencies of the Chernobyl reactors had been started, and safety of the so-called 'Soviet design reactors' became an obvious target. Thus, in the late 1980s to early 1990s, many activities with broad participation of international experts were devoted to the safety evaluation of WWER and RBMK type reactors, most of them being sponsored and organized by the IAEA.

The most valuable outcome for the safety enhancement of WWER reactors was drawn from activities started with the meeting in Berlin in 1989 of the top nuclear regulators of Bulgaria, the former Czechoslovakia, the former German Democratic Republic and the former USSR. The meeting was devoted to discussion of the safety problems of WWER-440 reactors, and 16 safety issues were identified as priorities for further improvements. Then, a series of meetings under the relevant IAEA projects with participation of experts from both 'WWER operating' countries and others resulted in comprehensive reports, where the safety deficiencies of different WWER reactor models were explained and ranked and relevant safety enhancement measures identified**.**

In Ukraine, these reports, particularly Ref. [3], as well as findings of other relevant reviews were used as a basis for the elaboration of safety enhancement programmes for nuclear power units, both in operation and under construction at that time. The above programmes were then reviewed by international experts and it was concluded that their proper implementation would result in achieving an internationally recognized safety level for the relevant units. Now, all of these programmes are under implementation and the nuclear regulator is closely monitoring their progress as the relevant schedules are incorporated into the licensing conditions.

3.3. The K2R4 case

The more valuable the findings of international appraisals and peer review missions, the more important it is to transform them into specific actions. However, introduction of any major change in the procedures of either the utility or the regulator or in the design of the facility usually requires a special kind of regulatory action and paperwork and thus, the motivation of the persons responsible becomes a key factor.

In this context two recently commissioned units — unit 2 of Khmelnitsky NPP and Unit 4 of Rovno NPP — well known as K2R4 provide a good example. Construction of both units had been started in early eighties and then stopped during early nineties due to a legally imposed moratorium. Later on, its completion was considered as a measure to compensate the early shutdown of the Chernobyl NPP and became a part of the Ottawa Memorandum. The issue of nuclear safety was put as the mandatory prerequisite for the relevant loan. In addition, it was extremely important for improving public perception within Ukraine.

So the basic idea was to make the safety level of both units visibly acceptable from the viewpoint of today's knowledge. In order to achieve this goal the K2R4 modernization programme was developed, taking into account conclusions and recommendations of the above mentioned international appraisal [3]. The programme was peer reviewed by a joint team of Ukrainian and European experts, slightly modified and then agreed as the needed tool provided it was implemented in a timely and adequate manner to ensure achieving the acceptable safety level. Later on, the adequacy of implementation of all measures completed before start-up was verified by another team of European experts, and now the European experts are still involved in monitoring activities related to the implementation of the programme. This kind of transparency appeared to be a very good tool to decrease any speculations concerning the safety of new units. It also enhanced the understanding of some safety issues and helped to modify the implementation approach as needed.

4. ROLE OF COMMUNICATION WITH NATIONAL GOVERNMENTS AND OTHER STAKEHOLDERS

For any country with at least one nuclear power unit in operation, and even for many countries without one, the issue of nuclear safety sometimes raises many concerns and makes major headlines, even without any particular grounds. In this regard, providing both the national government and the public with balanced and accurate information on the findings of peer review missions and conclusions of international appraisals, as well as on how those findings and conclusions are used, can be a very effective tool to provide broad support for different activities intended for safety improvement. The nuclear regulator plays a special role in this respect.

In Ukraine, there are many community groups and organizations that have clearly expressed their legitimate interest in nuclear safety matters. Some of them are well aware of different international activities concerning the safety evaluation of WWER type reactors. Three years ago the public defended its ‘right to know’ in court and the court verdict obliged the Government to consider the status of implementation of the safety enhancement programme quarterly and report on it to the public via the mass media.

During the last year the nuclear regulator enhanced communication activities and has turned to a more open and transparent method of public communication. After a series of meetings with some environmental groups and local communities in the regions where nuclear facilities are situated, frequently asked questions were identified and put as a basis for a further communication strategy. As a result, a good deal of communication was related to the results of international appraisals of WWER reactor safety and how the identified safety deficiencies were dealt with. This policy received quite a good public reception for some very sensitive regulatory decisions, such as issuing the operating licence for the unit 2 of Khmelnitsky NPP.

5. CONCLUDING REMARKS

The role of different international safety review activities in the identification of safety issues and the formulation of the way forward can hardly be overestimated, even if implementation of recommendations of international appraisals and peer review missions to ensure safety improvements at a particular facility or performance improvements within a particular organization may sometimes be slow or limited due to various factors.

Both international appraisals and peer review missions provide an important input to nuclear safety enhancement through new ideas, shared knowledge, and an impetus for improvements as well as further cooperation and harmonization of safety approaches.

Some new initiatives such as risk informed regulation and multilateral regulatory cooperation (in the form of multinational cooperation for design approval and/or the development of multinational safety requirements) may provide new opportunities for more effective and efficient regulation of nuclear safety.

Today the so-called ‘nuclear renaissance’ provides us all with the necessary motivation to make proper use of such tools to improve public confidence in the regulation of nuclear safety of new nuclear facilities, which in turn results in an improved public perception of nuclear energy.

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NUCLEAR SAFETY REGULATIONS AND REVIEW OF NEW NUCLEAR POWER PLANTS IN CHINA

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Abstract

The paper presents an update of the recent nuclear programme in China and provides details of the latest progress made on the compilation of national nuclear safety regulations with respect to the IAEA Safety Standards, and the implementation of the new regulations in the safety review of generation 2+ and generation 3 projects.

1. NUCLEAR POWER IN CHINA

Up to the end of 2005, mainland China had 11 nuclear power units. Of these, nine units are in operation while the other two are still in the commissioning phase. During 2005, the total electricity production from the mainland nuclear power plants amounted to 53 billion KW·h. The total nuclear installed capacity reached 6998 MW(e) which amounted to 1.59% of the total installed capacity of all power plants in the country.

According to the national nuclear development programme, nuclear electricity supply capacity will reach 40 GW(e) by 2020, 4% of the total installed capacity of all the power plants at that time. This means that from 2005 to 2020, it will be necessary to build two or three 1000 MW(e) units every year. This is a big challenge.

In order to help increase the domestic capability to design, manufacture and build nuclear power plants independently, some advanced nuclear power technologies (generation 3 (G3)) will need to be introduced by international bidding. However, for meeting the enormously increased need for electricity in the near future, China will have to continue to build some generation 2+ (G2+) plants and base their design, subject to modification, on existing nuclear power plants before undertaking the large scale importation of generation 3 plants.

Recently, the Government approved the building of four G2+ type units (Qinshan II units 3 and 4, Lingao units 3 and 4). The designs are the copies of Qinshan II and Lingao nuclear power plants, respectively, plus some safety modifications (e.g. LOT93/VD2). The two projects have just received (December 2005 and January 2006, respectively) their construction licences from the National Nuclear Safety Administration (NNSA). Construction has begun at both sites.

The international bidding for four G3 units will finish soon. NNSA sends representatives to observe the bidding. The four G3 units, two at each site, will be built at Sanmen site (Zhejiang Province) and Yangjiang site (Guangdong Province).

2. NUCLEAR SAFETY REGULATIONS

On the top level of China's nuclear safety legal framework is the law on Prevention and Control of Radioactive Pollution, which was approved by Congress in June 2003. This law is applicable to all regulatory control activities related nuclear installations, radiation sources, uranium mining, NORM and radioactive waste management. It sets up the general requirements on nuclear safety and radiation safety. Meanwhile, the Atomic Energy Act or Nuclear Safety Act is still being prepared.

At the second level, there are four regulations issued by the State Council, the latest one issued in 2005 and entitled Regulations on Safety and Protection of Radioisotope and Irradiation Apparatus.

At the third level, there are more than 30 implementation rules or department rules. In 2004, revisions were made to the Code of Safety of Nuclear Power Plant Design (HAF102) and the Code of Safety of Nuclear Power Plant Operation (HAF103), corresponding, respectively, to IAEA Safety Standards NS-R-1 and NS-R-2.

At the fourth level, there are hundreds of safety guides on nuclear safety, radiation protection, radwaste safety and safety of transportation, etc. In recent years, several safety guides have been issued, e.g. Software for Computer Based Systems Important to Safety in Nuclear Power Plants (HAD102/16, 2004). The revision of safety guides in China is currently in progress and these are to be based on IAEA guides. It may take time to complete.

Use is also made of some foreign standards, such as Nuclear Regulatory Commission guides, SRP, ASME codes and French RCC standards, etc.

The new revised HAF102 (2004) emphasizes independent verification of safety assessment, proven engineering practices, severe accident, PSA, etc. It still emphasizes the importance of off-site emergency preparedness even for advanced design of nuclear power plants (G3) and requires that the emergency control centre in a plant must have the capacity to transfer real-time safety important parameters to the regulator.

3. SAFETY REVIEW OF NEW NUCLEAR POWER PLANTS

Generally, the designs of all new nuclear power plants in China, in principle, should meet the requirements of HAF102 (2004). However, for different types of nuclear power plant project, the safety review policies may be a little different.

For the new G3 plants or those which are not referenced with the existing nuclear power plants, it is demanded that the designs should follow the requirements of the new regulations completely and strictly.

For the new plants which are referenced with the existing nuclear power plants, such as the Qinshan II 3/4 and Lingao 3/4, it has been agreed that they will be allowed to have some flexibility, on condition that the designs incorporate safety improving measures as much as possible, especially for any weakness identified in the process of nuclear safety review and from past supervision.

This special policy is based on the following reasons:

— Safety is influenced by many factors, not only design, but also operation, maintenance, management, etc.
— Experience of operation, maintenance, management and the proven technical foundation of existing nuclear power plants in China are considered to be in favour of nuclear safety.
— Undertaking significant and rushed modifications may have the opposite result to that intended and may destroy the solid experience and foundation accumulated, thereby increasing the uncertainties on safety. In this case, safety cost–benefit analysis should be undertaken.

As mentioned above, NNSA received two applications for construction licences from Qinshan II 3/4 and Lingao 3/4 (G2+) at the beginning of 2005. A team of about 60 experts carried out the safety review over a period of about a year. On the basis of the safety review results, the NNSA recently issued the licences to the utilities.

China plans to import four units employing advanced PWR technology (G3). The international bidding is (at the time of writing) still in process. It is estimated that the safety review for G3 projects will start in the first half of 2007.

4. CONCLUSION

IAEA safety codes and guides reflect the nuclear safety experience and technology in the world. The use and acceptance of IAEA safety standards can enhance safety regulation on nuclear installations in developing countries. Since its foundation in 1984, NNSA has employed IAEA safety standards to establish Chinese nuclear safety regulations.

As regards nuclear power plants imported from other countries, China has benefited from the use of the nuclear rules and standards of exporting countries as a supplement for design review.

China will strengthen its technical cooperation with the IAEA on implementation of safety requirements and revision of related safety standards on the basis of Chinese industrial and technological conditions.

In summary, the design review of new nuclear power plants in China will, in the case of G3 plants, seek to meet IAEA safety requirements and guides, and in the case of G2+ plants will principally meet safety requirements and conduct proper management according to the situation and the existing design.

BUILDING INTERNATIONAL INFORMATION AND KNOWLEDGE MANAGEMENT NETWORKS
Development of the Asian Nuclear Safety Network

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Abstract

Pooling, analysing and sharing of nuclear safety related information, knowledge and experience is one of the principal elements of international regulatory cooperation to approach the challenges that are currently faced in assuring nuclear safety on a global basis. The Asian Nuclear Safety Network (ANSN) is a regional network that is being developed as a forum for information and knowledge sharing among the South East Asia, Pacific and Far East countries to further improve the safety of nuclear installations in those countries. Its main focus is on the enhancement of nuclear safety regulatory infrastructures and the improvement of the safety of research reactors and nuclear power plants. The ANSN is composed of the national centres which have their own databases that function as portals to the network and are operated by the member countries individually but in a coordinated manner. It is expected to be not only a passive network but also a dynamic forum or platform for facilitating active knowledge sharing and encouraging sustainable regional cooperation among the member countries. This paper gives the outline and status of the ANSN and presents general issues to be solved for promoting an information sharing network.

1. INTRODUCTION

Asia is the region where the development of nuclear power generation is far more active than in other regions of the world and this trend is expected to continue for coming decades owing to the current energy situation in the region. In such a situation, the need for enhancing nuclear regulatory infrastructures through international cooperation has been recognized worldwide for assuring nuclear safety in the region, as discussed and agreed at the Moscow Nuclear Safety Summit in 1996, which led to the start of the IAEA's extra budgetary programme on the safety of nuclear installations in South East Asia, Pacific and Far East countries (EBP-Asia) in 1997.

After six years of experience in the national and regional assistance activities under the framework of the EBP-Asia, the focus shifted more to the encouragement of self-reliant and autonomous efforts by the member countries. With such a background, the Asian Nuclear Safety Network (ANSN) was initiated under the EBP-Asia as a network for information and knowledge sharing with the aim of enhancing the nuclear safety infrastructures and encouraging sustainable and autonomous safety activities to ultimately achieve a high level of safety of nuclear installations in the South East and Far East Asian countries. The major objective of the ANSN is summarized in Fig. 1. The current member countries are China, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Thailand and Vietnam, with Australia, France, Germany and the United States of America as supporting countries.

2. CONCEPT AND CURRENT STATUS OF THE ANSN

Figure 2 illustrates the concept of the ANSN. The ANSN is a decentralized autonomous network composed of eight ANSN national centres in China, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Thailand and Vietnam, the IAEA's ANSN web site and other web sites of the supporting countries which are interconnected via the internet.

The national centres in China, Japan and the Republic of Korea and the IAEA ANSN site play a central role in providing the entire ANSN with information to be shared as well as relevant necessary services. Other national

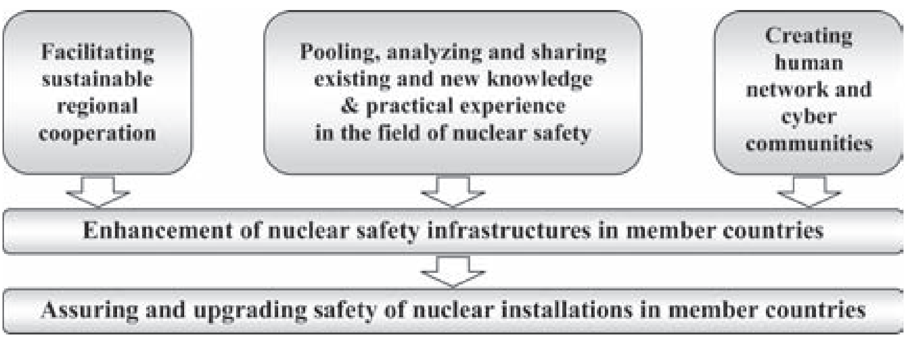

FIG. 1. Objective of ANSN.

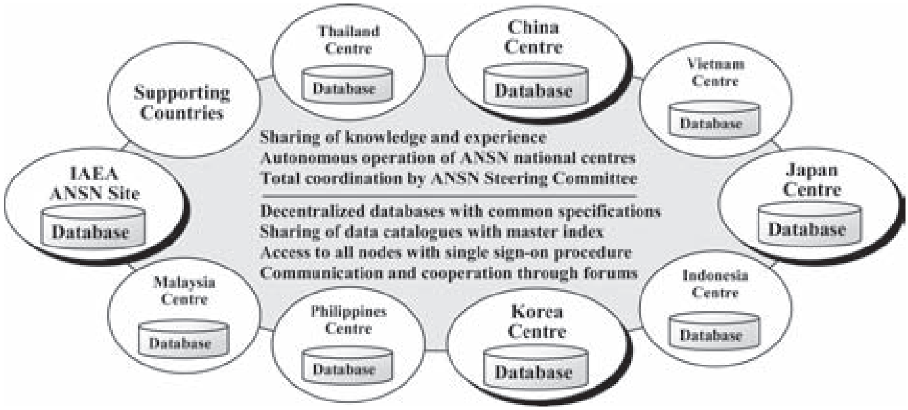

FIG. 2. Concept of ANSN (as of October 2005).

centres are mostly used to provide local services to their local communities including access to the information uploaded on the ANSN and, for the moment, are not expected to maintain large amount of information. They may provide, as appropriate, localized information, for instance in national language, that may not be relevant to the entire network.

All national centres are operated by the designated organizations in individual member countries in line with the overall ANSN implementation policies. They have their own 'many-to-many' relational databases that were designed according to the common specifications. Any information can be uploaded on the databases either for common use or for local use. The information for common use is catalogued in a common list called 'master index' which lists all the information uploaded on all the databases for sharing and can be used by end users to locate information they need. The master index is now centrally maintained by the IAEA, but could be located anywhere else. A system for exchanging the data among the distributed databases using XML (eXtensible Markup Language) procedure is provided to automatically update the master index.

The information uploaded on the ANSN should be disseminated as widely as possible for the purpose of the primary objective of the ANSN, i.e., to enhance the nuclear safety infrastructures. However, for the moment, the ANSN is not open to the public and access is controlled with user IDs and passwords, which are given by the competent organizations in the member countries. To cut through the red tape, the ANSN uses a 'single sign-on' procedure that allows the users to jump to other national centres without being requested to re-enter in their IDs and passwords once they log on from any of the centres. Once dissemination criteria are clearly defined, most of the information in the ANSN will become open to the public except for some information that will remain in a protected domain.

The national centres are basically operated at the discretion of each operating organization, but they should be operated in accordance with a common policy or strategy in order to effectively accomplish the common aims of the ANSN. The ANSN steering committee composed of the representatives from the member countries and the IAEA is in charge of overall coordination in developing and implementing the ANSN. The committee assumes a major role in ensuring efficient and effective planning and implementation of the ANSN activities and the sustainability of the ANSN system.

In addition, several groups called topical groups are working in specific areas. The information technology support group is working to solve common information technology issues to realize the expected functions of the ANSN with the latest information technologies. The topical groups on education and training, operating safety, safety analysis of research reactors, etc. are working as forums to promote the ANSN at the forefront through holding specialists meetings, selecting documents to be shared, finding workable solutions to emerging issues and exchanging their experience in the respective areas.

Uploading of documents is now under way. The EBP-Asia has an 8-year history of assistance activities and during that period a lot of information has been accumulated in the IAEA's Asian Programme Management Database (APMD) including descriptive documents, presentation materials and videos. Many of them can still serve many uses when provided in an appropriate manner. Work is now being carried out mainly by the topical groups to select, reorganize and re-edit useful APMD materials considering the needs in recipient countries. Other existing useful materials are also being uploaded by the national centres.

The ANSN is expected to be not only an information sharing tool but also a forum for communication, discussion, opinion exchange, collaboration, etc. The first step of such dynamic and extended uses of the ANSN includes the utilization of the ANSN as a virtual technical support organization for the EBP-Asia activities, on-line meetings for the topical groups and the operation of cyber communities in specific areas. A typical example of such dynamic use of the ANSN is the Republic of Korea centre's idea to use the ANSN as a forum for the safety analysis of research reactors. Distant learning function is also within the future scope.

3. FURTHER CHALLENGES TO ACTIVATE THE NETWORK

The national centres have been established and put into operation. Most of information technology issues have been solved. However there are still many issues that need to be dealt with, to bring the ANSN to its full operation, including the following:

- Dedicated promoters (promotion under strong leadership, ceaseless effort and collaboration);
- Enrichment of the contents in accordance with clear definitions of the network's objectives and scope;
- Quality assurance of the contents;
- User friendly interfaces (easy to use search systems, etc.);
- Popularization of the network as widely as possible involving decision makers (campaign, newsletter, publication, etc.);
- Increase of users and cooperators;
- Dialogue with users and active involvement of users (collection of needs, feedbacks, proposals and suggestions from users);
- Local services (local contents, translation of documents into local languages, etc.);
- Constant monitoring for improvement;
- Public dissemination;
- Cooperation with other regional and global networks and cooperative frameworks (links, exchange of experience, complementary relationship, collaboration, etc.).

The points listed above are quite general and may be common to other networks similar to the ANSN. The last point, cooperation with other networks or cooperation frameworks, is also an important issue. By now there exist many cooperative networks and frameworks in the world such as the World Nuclear University, the European Nuclear Education Network, Forum for Nuclear Cooperation in Asia (FNCA), the Asian Network for Education in Nuclear Technology, the International Youth Nuclear Congress, the World Association of Nuclear Operators, the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology and the Technical Cooperation projects of the IAEA. The ANSN assumes a stance of safety regulation and oversight, but still has a lot in common with those cooperative activities, typically in the area of human resource development. Appropriate cooperative relationships have to be considered with them, where possible, to maximize the effectiveness and efficiency in total. At least operating experience should be shared in order to seek possible approaches to solving common issues. The first step for the ANSN would be cooperation with the FNCA in the area of nuclear safety culture.

4. CONCLUSION

Sharing of nuclear safety information and knowledge is unquestionably necessary to enhance regulatory competence internationally and networking is one of the approaches for this purpose. The ANSN is a regional network being developed and is intended also to be a mechanism to facilitate regional cooperation and to provide forums to respond to current and future challenges for assuring nuclear safety. The network has just taken shape in terms of information technology, but has a long way to go to become functional as expected. It is not so difficult to form a network but not so easy to make it really functional. The members directly involved in the ANSN project, wish that all the parties including potential ones will actively contribute to further development of the ANSN and as many other parties as possible will take interest in it to support the project.

REGULATORY EFFECTIVENESS FROM THE OPERATOR'S VIEWPOINT

(Closing Session)

Chairperson

L. WILLIAMS
United Kingdom

REGULATORY EFFECTIVENESS FROM THE OPERATOR'S VIEWPOINT
Fuel cycle facilities

V. DECOBERT
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Abstract

Sustainable development is a keystone of AREVA's industrial strategy for achieving growth that is profitable, socially responsible and environmentally respectful. As an operator AREVA is committed to establishing and maintaining the highest level of nuclear and occupational safety in all of the group's operations to preserve public and worker health, and to protect the environment. The same is true when acting as vendors of nuclear facilities, whether nuclear power reactors or other facilities. Achieving a high safety record is also a necessary condition for ensuring the economic performance of these facilities and for strengthening the acceptance of nuclear energy by the local population as well as the decision makers. The existence of a solid international framework and strong and independent national authorities is an important element to support those goals. From an operator's point of view, regulatory effectiveness is resulting from clear and stable rules, designed and applied in a rigorous yet pragmatic way to cater to the specificities of each type of facilities. Clear rules avoid the uncertainty related to the potential for diverging interpretations. Stability of rules ensures that solutions developed to meet the regulations and the investments made are useful and derive real value for both safety objectives and the objectives of the industry. Regulatory effectiveness is also achieved when actual experience and the input of operators can be taken into account to achieve stringent safety objectives in a most efficient way. Finally, it must be recognized that the nuclear industry is now mature and international. To further support the expected development of nuclear energy in the world, it is important to move towards harmonization of the safety regime and increased cooperation between licensing authorities.

1. THE OPERATOR HAS THE PRIME RESPONSIBILITY FOR NUCLEAR SAFETY

Nuclear safety is sometimes described as a constraint coming from the regulator. But from an operator's point of view nuclear safety is primarily an absolute requirement; it is the cornerstone of the sustainability of its activities. Ensuring a stable production and developing a trustworthy relationship with all stakeholders are prerequisites for achieving growth that is economically sound, socially responsible and environmentally respectful. Obviously, a safety failure would compromise the success of a company, and may damage the whole industry. Indeed, the nuclear community can only be as strong as the weakest of its members. Accordingly, AREVA uses an approach in which the technological risk management is embedded in the commitments of the group towards sustainable development.

While assuring a high level of safety in the facilities operated, AREVA is also committed to facilitate achieving a high level of nuclear safety and radiation protection through its services performed at nuclear customer's sites. Safety is also one of AREVA's guiding principles when designing nuclear power plants, the EPR being a good example, or fuel cycle facilities.

This commitment to nuclear safety and radiation protection is publicly adopted in the AREVA nuclear safety charter, anchored in organizational and action principles and is based on transparency. The nuclear safety charter standardizes the group practices in the sensitive domains of nuclear safety and radiation protection throughout the life cycle of the facilities irrespective of the country in which they are located. For example, the objective of reducing the maximum individual dose to workers to 20 mSv/human/year is retained by AREVA as an operator, even in countries where it is more stringent than national regulatory requirements.

2. THE REGULATORY SYSTEM: THE NEEDS AND EXPECTATIONS OF THE OPERATOR

Although the operator has the prime responsibility for nuclear safety, it cannot be achieved by the operator alone. Here, regulators have a key role to play and the nuclear industry needs "strong" regulators.

The nuclear industry is one of the most regulated industries in the world. Moreover, it has been regulated from the very beginning. Born through governmental decisions, in many countries the regulation was national. National regulatory systems were set up and implemented before any necessity was felt to share international standards. Some years ago, most of the national organizations involved in nuclear safety thought that since individual authorization and control of compliance are local matters, an effective regulatory system can be, sometimes even must be, only national. Obviously, that did not encourage the use, at the national level, of the safety standards developed by the IAEA.

But the world has been changing significantly with the phenomenon of globalization of industries including the nuclear industry. Nuclear related activities are performed in an international environment and are challenged by stakeholders, by the civil society, locally and abroad. Differences in safety approaches and in their implementation in each of the facilities can weaken the whole nuclear community, regulators as well as operators, and possibly governments. For example, if a regulator requires a concrete structure for a facility to limit the release of radioactivity in case of an accident, it will be difficult to explain to the stakeholders why another regulator accepted the sister facility without concrete containment based on an assessment that the accidental release was not harmful to the public. These differences in approach to safety would weaken not only the operator but also the regulator; and it cannot be overemphasized that the operators need strong regulatory bodies for their success.

It is not attempted here to offer a ready-made solution to this striking example. Instead, it is suggested to review the concrete needs of operators from two different situations: one from the facility stand-point; and one from that of future operators of an imported technology and what it means in terms of effectiveness of the regulatory system.

Viewed from the facility standpoint, the needs are:

- To obtain timely individual license and authorizations throughout the life cycle of the facility for: initial licensing; subsequent modifications of the facility; or for activities after periodic safety review of an ageing facility;
- To operate the plant in a manner to ensure successful control of compliance with the regulations.

Therefore, we could say that, viewed from a facility standpoint, conditions for an effective regulatory system are:

- Dealing with a local regulator, responsible for decisions and controls by the national government.
- Using clear and stable rules; clear to avoid different interpretations between operator and regulator, and stable to avoid change of rules with huge consequences in terms of cost. Of course, that does not mean that operators are opposed to changes of the rules; it means that for a sustainable development of business, they need to integrate any changes in the rules into their continuous improvement and modification processes.

Viewed from the standpoint of a future operator of an imported technology, running in an other country, the needs are:

- To minimize and to secure the cost of the investment. The reasons why the design was imported include the following: it reduces risks related to the construction or operation since the facility is running in another country; the operating cost is more precisely estimated, since the facility is successfully operated in the other country and expected revenues can be better forecasted; and it minimizes the licensing cost since the facility is already licensed abroad. Thus, this future operator needs consistency between the licensing approach in the supplier country and that in his country, where it needs to be licensed. Securing the cost of the investment also implies limiting the implementation differences to those justified by siting (seismic, inundation, weather conditions, etc.).
- To reach the rated capacity of production by the facility safely and on schedule after the facility has been granted the license by the national regulator. This process is improved when there is a dialogue between the regulator and the operator, rather than limiting the contacts only to bureaucratic exchanges of paperwork.

Thus, for this future operator, effective regulatory system would mean:

- International consistency between safety evaluations and their findings: consistency of the safety standards; consistency of the methods to evaluate the safety of the design; and acceptance of the safety evaluation made elsewhere;
- An efficient dialogue between the regulators of the designer's country and the licensee's country so that one can trust the licensing work of the other;
- The designer having a good knowledge of the licensee's regulatory system; the more the consistency of the regulatory systems in the two countries, the easier it is to achieve.

3. DEFINING EFFECTIVE SAFETY STANDARDS

These are general requirements for the global regulatory system and its implementation. An important aspect of the effectiveness of regulation is the way safety standards are defined. As far as the current technologies of reactors are concerned, especially the light water reactors, the safety standards have been developed over several years of effort and benefit from the experience of more than 400 reactors operating in the world.

The situation is, of course, different for fuel cycle facilities, which are much less numerous and for new technologies such as the high temperature reactors or fast breeders. In both cases, it must be recognized that the safety standards must be adapted to each specific situation.

It is obvious that a fuel cycle facility is not a reactor. Even though the basic hazards to be considered are the same (for example irradiation, fire, criticality, loss of containment, etc.), the technology and the type of accidents are different. The peer reviews and the international feedback from best practices that could provide the data for the standards are very limited because fuel cycle facilities exist only in a few numbers for each step of the fuel cycle. As a consequence, safety standards for fuel cycle facilities cannot be derived from those for power reactors just by replacing ‘NPP’ with ‘fuel cycle facility’. The tendency to have IAEA fuel cycle safety standards strictly corresponding to each of the NPP safety standards should also be resisted for the same reason that makes NPP standards, in most cases, inappropriate to fuel cycle facilities.

Fuel cycle facility safety standards should take a wider view of safety rather than be simply prescriptive. To take an example, the safety standards should not give the number of turns to be used to screw a bolt. They should look at the process to be used to determine the appropriate number of turns. Also, fuel cycle facility compliance with safety standards relies on individual safety demonstration rather than applying generic solutions: the standards set the objective to be reached and requirements of safety demonstrations will give the solutions to reach the objective; solutions that are different from one process to another (conversion, enrichment, fuel fabrication, etc.).

The next question is, at what level are the standards drawn? To be consistent with the operator’s needs and expectations outlined above the following criteria should be satisfied:

- Basic safety standards, those that give reference levels, should be at the international level. It implies a multinational work among national regulators, not forgetting to take into account the feedback from industry. There is definitively a role for the IAEA in the elaboration of those basic safety standards; the experience of WENRA is also very valuable.
- National regulations are necessary for one site licensing, control of compliance and safety evaluation of ageing facilities. Those national regulations have to be consistent between the different countries. It implies that, at the international level, common methods are defined by a network of regulators. And national regulators must consider the possible use, for a licence application, of a safety analysis report made in another country for licensing the same design.

The same process could be applied, in principle, to defining safety standards for reactors using new technologies.

4. CONCLUSION: FACTORS THAT MAKE AN EFFECTIVE REGULATORY SYSTEM

In summary, some views can be offered on an effective regulatory system that would help both regulators and the industry in improving safety, and offering savings.

Enabling factors:

- An international reference/benchmark on what is considered ‘safe’; one that sets objectives rather than prescribing solutions. The solutions have to be left to the operator;
- An international agreement on what is specific to the national level, and what is shared at the international level;
- Common methods to derive national implementation of regulatory control.

Key factors:

- The existence of a dialogue within industry, regulators and stakeholders to foster a shared view towards ways to improve safety. But in this dialogue, each party must be careful to keep to its role;
- Sharing by regulators and operators of best practices drawn from different countries to reinforce knowledge of each other. In this field, there are already some initiatives launched or existing such as WENRA, MDAP, IRRS, WANO, and INSAF.

In conclusion, the two key words that need to be emphasized are *consistency* and *independence*. Consistency should be achieved between the international and national levels as well as between what the regulator requires and the solutions implemented by the industry. Independence of the parties is essential to ensure that each party has its own responsibility.

Finally, the fact has to be recognized that industry commitment towards safety is one of its best assets for its sustainable success.

REGULATORY EFFECTIVENESS FROM AN OPERATOR'S PERSPECTIVE

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World Association of Nuclear Operators

Abstract

The paper presents the operator's perspective on regulatory effectiveness. The nuclear power plant operator, the regulator and various nuclear industry groups such as the World Association of Nuclear Operators are each responsible for ensuring nuclear safety but have different roles to play with different areas of emphasis. The roles of these organizations, how they can assist each other in achieving the common objective and how to facilitate effective communication between them are discussed.

1. INTRODUCTION

The nuclear plant operator, nuclear industry groups like the World Association of Nuclear Operators (WANO) and the regulator clearly have a shared interest in safe and reliable operator performance and public confidence due to the following:

- Each of the organizations is responsible for ensuring safe operation;
- But the organizations have different roles to play, and different areas of emphasis in achieving that objective.

The views of the author on those roles, how the regulator can help the operator ensure safe yet efficient plant operation, and how the operator and regulator can communicate effectively, are discussed below.

2. ROLES OF DIFFERENT PARTIES IN ENSURING SAFETY

The author believes that an operator's fundamental role is to make the regulator redundant by relieving the regulator of the need to ensure safe performance by ensuring that all the basics of sound operation are in place. The operator should recognize that safe and reliable operation can reduce unnecessary regulatory burden.

The basics of sound and safe operation include the following:

- Good procedures in operations, maintenance, engineering, health physics, chemistry, etc., and good execution of those procedures;
- Aggressive event investigation, based on a learning approach;
- Proper handling of critical evaluations;
- A well-trained and qualified workforce;
- Clearly defined roles and accountabilities for senior executives, middle managers, supervisors and workers. Each group and each individual has a role and must be held accountable for performance;
- A self-critical approach;
- Effective oversight of operations and safety.

When these elements are in place, and when they are effectively executed, then the ground work for good operation is in place. An operator must hold high standards of operations. The leadership and the organization must be internally driven to excellence, with that commitment engrained into each individual and the organization's culture. While the regulator has the legal responsibility to determine acceptable performance on behalf of the nation, it is a critical error for the operator to rely solely on that definition in developing his own standards of performance. Excellence, not simply compliance, must be the operator's standard.

In ensuring safety, the operator and the regulator have different areas of emphasis as described below:

- The operator must focus on excellence and continuous improvement:
  - Troubled performers, of course, must identify and correct their problems, seeking assistance and outside review.
  - 'Good' performers must strive to become excellent, through peer reviews and learning from industry operating experience.
  - Excellent performers must continue to raise the bar, and identify breakthroughs for even higher levels of performance. It is especially critical that they avoid complacency and the decline in excellence that will result. Excellent performers must also provide assistance and share lessons learned with industry peers to raise the overall industry level of performance.
- The industry, through WANO and other groups, seeks to drive improvement and raise its own expectations for excellence through the effective use of:
  - Peer evaluations;
  - Sharing of operating experience;
  - Industry assistance;
  - Peer pressure.

- The regulator's emphasis must be on setting the standard for safety and conducting relevant oversight. The standard should be a stable, predictable and clearly communicated standard.

3. REGULATORY EFFECTIVENESS

Regulatory stability is critical due to the following:

- It gives operators a clear target of compliance standards.
- It enables a sustained and focused effort on safety related issues.
- It is not the regulator's role to frequently and unnecessarily increase standards of safety:
  - All operators must be internally driven to excellence and this is not a regulatory function;
  - Regulators encourage improvement, but their key role is to define the basic level of acceptable safety performance.

Regulators must avoid unnecessary regulation that drives the cost up without improving safety:

- Operators have made this plea for years. Regulators are accustomed to hearing it and have responded.
- Regulation must not be allowed to be compromised by economic considerations.
- But by the same token, the operator should not be obligated to invest in compliance requirements, which do not provide real return in safety margins; in fact, unnecessary burden can distract from emphasis on real safety;
- Types of regulatory issues that can drive cost unnecessarily include the following:
  - Unnecessarily prescriptive regulatory requirements.
  - Unnecessarily prescriptive regulatory behaviors:
    - (a) For example, over-zealous inspectors or lower level staff members;
    - (b) Slow or bureaucratic regulatory response to plant issues, when operators must function in real time, in markets that operate 24 hours a day, 7 days a week.
  - Imbalance between risk-informed and deterministic regulation.
  - Unpredictability of regulatory standards and decisions:
    - (a) The standards should be stable, predictable and clearly communicated.

(b) Historically, unpredictability of regulatory requirements has been one obstacle to new reactor development in the United States of America. It impacts not just the operators' ability to make commitments, but investors' willingness to commit funding as well. Significant progress in resolving that uncertainty has been made.

(c) Spent fuel management: the future of spent fuel management is an issue that needs resolution in many countries. Lack of a clear path forward has a detrimental impact on the ability to move on new reactors.

- For example, so many things came out of post-TMI task forces and studies that were not necessary and were not focused on safety that time and resources were committed to things that ended up being a distraction from real improvement. The temptation to respond emotionally to events or take ill-considered action to satisfy public relations without improving safety margins must be avoided.

The author believes that 'regulatory effectiveness' should get the same rigorous review and attention that 'operator effectiveness' gets including the following:

- Both the operator and the regulator must be very self-critical.
- Regulators should conduct self-assessments, and arrange for independent peer reviews as it is good for them.
- It is good to see progress on that front, with IAEA's International Regulatory Review Teams and associated self-assessments.

4. EFFECTIVE COMMUNICATION

Effective ongoing communication between the regulator and the operator is a key to success for the following reasons:

- Failure to communicate, by either party, will certainly lead to problems:
  - If the regulator fails to explain the safety basis for a regulation or a decision, it will result in misunderstanding.
  - If the operator fails to keep the regulator informed on plant operational issues and status, then it will create misunderstanding and problems, a loss of trust, and likely regulatory overreaction.
- The operator and the regulator must keep each other fully informed:
  - That has been a key element of success in the nuclear programmes that were managed by the author:

(a) Periodic briefings were always conducted by the author with Nuclear Regulatory Commissioners when he was Chief Nuclear Officer at his company.
(b) Plant management also ensured continual communication with local and regional regulators.

- All parties must fully understand and appreciate each other's role, and each other's need for information. This basic action will pay off in better interaction, better operation, and better regulation.

Open communication across international boundaries by the regulator is also very beneficial for the following reasons:

- Nuclear power is truly an international business:
  - Commercially, it is an increasingly global business in a global market-place:
    (a) Plant designs are used globally. There are only about 8 major reactor vendors in current world market and such international competition is beneficial for the industry.
    (b) A few major operators are looking at crossing borders as well, as the trend toward generation industry consolidation continues.
  - Operationally, nuclear facilities are also closely connected internationally, since the weakest link affects everyone; that was the very foundation for WANO's creation.
- International regulatory cooperation and 'harmonization' is important since the boundaries are disappearing.
- New reactor development, both in countries that currently have operating reactors, as well as new entrants into the industry, will be expedited by common standards and expectations:
  - New reactors, anywhere in the world, have to be ready to test and operate safely — with no hiccups.
  - All the parties have a stake in that procedures, operations, maintenance and training must all be impeccable.
  - Accepted international standards will contribute to the success of new reactors and to public confidence in their safe operation.
  - Accepted international standards will also improve the efficiency with which new reactors can be designed, constructed and ultimately operated, without the need for excessive 'national customization'.

5. CONCLUSION

In closing, the most important message is the following:

- Operators and regulators have a shared interest and responsibility in the safe and reliable performance of the nuclear power industry worldwide.
- All the parties have a shared interest in high public confidence in safe plant operations, which relies on credibility and transparency:
  - — Requires regulatory independence, from both operators and politics;
  - — Requires effective communication with all stakeholders;
  - — Requires a broad range of skills and experience in the regulatory functions; regulators must be highly skilled professionals, who deeply understand the technology and all aspects of the operation.
- Regulatory credibility is essential to operator success and credibility:
  - — The general public has confidence in what the regulator has to say.
  - — The general public depends on, and must be able to believe, the regulator.
- The job of operators is to support the regulator in that both the operators and the regulator have some very basic obligations to the public:
  - — To ensure that the plant is well managed and safe;
  - — To tell the public the truth about plant operations;
  - — The public must be safe and feel safe.
- The regulator/operator interface is a vital component of successful nuclear power generation, and deserves our best attention, at all times.

SUMMARY AND CONCLUSIONS OF THE CONFERENCE*

L. Williams
President of the Conference

BACKGROUND

The Member States of the IAEA have been working towards the acceptance of a global safety and security regime based on strong national infrastructure for over 30 years. The first IAEA standards were produced in the mid 1970s. After the accident at Chernobyl, two new Conventions were introduced: the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

In 1991, an international conference on the safety of nuclear power facilities was hosted by the IAEA to develop a comprehensive strategy for the future. This conference started the process to develop binding legal instruments that resulted in the Convention on Nuclear Safety (CNS). The CNS, which currently has 56 signatories, has been very successful. Since the CNS, the Joint Convention on the Safety of Spent Fuel and the Safety of Radioactive Waste Management (Joint Convention), the Code of Conduct on the Safety and Security of Radioactive Sources, and the Code of Conduct on the Safety of Research Reactors have been introduced to complement the CNS in these areas. Over recent years the structure, format and content of the IAEA standards have been developed further to become the global reference for the delivery of high standards of safety, radiation protection, radioactive waste management and the safe transport of radioactive materials.

Unlike safety, there are no international standards for security. Nuclear safety is about designing and operating facilities and activities to prevent the accidental release of radioactivity into the environment. Security, however, is about the need to protect materials and facilities from theft, misuse, attack or sabotage. In the case of safety, there has been a tendency to be open and transparent but in the case of security there is a tension between transparency and confidentiality needed to prevent the misuse of information for terrorist or

* The views and recommendations expressed here are those of the President of the Conference and the participants, and do not necessarily represent those of the IAEA.

criminal purposes. However, the IAEA is currently developing guidance on security issues.

The title of this Conference is Effective Nuclear Regulatory Systems, therefore the key theme is related to the delivery of effective nuclear regulation. It is focused on the important role regulators play in the delivery of safety and security. Effective regulation can be regarded as the delivery of independent and efficient oversight of the nuclear industry and other users of nuclear technology so that governments and society can be assured that the nuclear activities in their countries are operating at high levels of nuclear safety and security which are consistent with international norms. The regulatory body is effective, therefore, when it ensures that an acceptable level of safety is being maintained; when it takes appropriate actions to prevent the degradation of safety, when it takes actions to promote safety improvements; when it performs its regulatory functions in a timely and cost effective way and it strives for the continuous improvement of itself, the industry and other users of nuclear technology.

Governments and societies decide whether nuclear energy and associated technologies are used for electricity generation, industrial or medical purposes after taking account of the risks and the benefits. Regulators do not make these decisions. Nuclear regulators exist to ensure that nuclear activities are undertaken safely and securely for the protection of the public and the environment. Currently, the nuclear industry and regulatory bodies are facing new challenges:

- The renewed global interest in the use of nuclear energy for electricity generation and, consequently, the likely global expansion of its use;
- The changed security situation and the consequential need for safety and security to be more closely integrated;
- The increased global use of radioactive materials and the need to ensure adequate safety and security awareness; and
- The need to maintain focus on the safety and security of existing nuclear facilities in a rapidly changing world.

The IAEA has sponsored many meetings over recent years relating to safety and security issues. However, this Conference resulted from a meeting between the Director General of the IAEA Mohamed ElBaradei, the Chairman of the Nuclear Regulatory Commission Nils Diaz and Deputy Head and then Acting Chairman of Rostechnadzor Andrey Malyshev. This meeting recognized that other forums in which regulators collaborated were often constrained by time, membership or subject matter and there was a need for regulators to have their own conference to focus on regulatory matters. This meeting was therefore, the first of a kind because it brought together senior nuclear safety, radiation safety and security regulators from around the world to discuss how to improve regulatory effectiveness and hence the protection of the public and the users of nuclear and radioactive materials.

CONFERENCE OBJECTIVES

The objective of the Conference was to give senior regulators the opportunity to discuss ways of improving the effectiveness of nuclear safety, radiation safety and security regulation as a whole for the benefit of the global community.

KEYNOTE ADDRESSES

Chairman Nils Diaz of the Nuclear Regulatory Commission gave a keynote speech on safety and security challenges. He noted that regulation is done for the well-being of people for the common good with full consideration of national interests and international law.

Deputy Head of Rostekhnadzor, Andrey Malyshev, also gave a keynote speech. He noted that safety and security was mandatory for the use of nuclear energy for peaceful purposes. He reported that major achievements had been made in nuclear safety regulation in the Russian Federation, including the implementation of effective control and supervision in the field of nuclear energy. He concluded that the world community should prepare global answers to the global challenges.

INDEPENDENCE AND REGULATORY EFFECTIVENESS

This session focused on the key elements needed to deliver effective nuclear safety and security regulation so that: the government can be assured that nuclear energy and associated technologies can be used safely; the society can have confidence and trust in the regulator; and the nuclear industry can be assured that it is being regulated competently and fairly. The Conference noted the following points:

- Nuclear safety and security regulators have a vital role to play in providing their government and the public with the assurance they need in relation to the adequacy of the safety and security of the nuclear industry.

- Nuclear safety and security regulatory bodies need to be effective to meet the expectations of the government, society and industry.
- The independence of the regulatory body from those organizations with responsibility for the promotion of the use of nuclear energy was essential for effective regulation. It was recognized that the independence of the regulatory body needs to be both 'de facto' and 'de jure'. The requirements for independence were adequately set out in the IAEA Standard GS-G-1-1, (Organization and Staffing of the Regulatory Body for Nuclear Facilities).
- The independence of the regulatory body was clearer to the public when there was transparency in regulatory decision making and clear understanding of to whom the regulatory body was accountable.
- To be effective, regulatory bodies needed to be adequately resourced. This was essential to ensure that the regulatory body could recruit and retain the numbers of competent staff they need to fulfil their responsibilities.
- The value of regulatory bodies benchmarking their activities and regulatory requirements with the IAEA standards, was significant.
- The use of regulatory management systems based on sound quality management practices have played an important part in delivering effective nuclear safety and security regulation. Effective regulators also had continuous improvement programmes to maintain and develop their regulatory processes.
- Stakeholder engagement was considered important to effective regulation. It was important for regulatory bodies to develop and implement strategies for engagement with their stakeholders in order that trust in their competence, integrity and impartiality can be established. This was regarded as being important because, even though some stakeholders may not always agree with a decision, if there is trust, they will accept the integrity of the decision making process.
- The important role played by the CNS in the development of effective nuclear safety regulation was recognized. There was agreement that the information given in the CNS review meetings should be used to benchmark and improve regulatory effectiveness. The initiative taken after the third CNS meeting was seen as an important contribution to improving the effectiveness of nuclear safety regulation by enabling the sharing of good regulatory practices.
- The importance of leadership to the delivery of effective nuclear safety and security regulation was recognized. It was noted that well-managed

regulatory bodies have management leadership programmes to develop leadership skills and succession management.

- Technical support organizations were recognized to be important for the regulatory bodies of some countries to supplement, enhance and maintain their technical competence.

REGULATORY SAFETY CHALLENGES

This session identified some of the key nuclear safety and radiation protection challenges and discussed how effective nuclear regulatory systems could meet these challenges. The Conference noted the following points:

- It was recognized that new radiation and nuclear technologies are often introduced inter alia, for safety improvement, plant efficiency or for new diagnostic or therapeutic medical practices, thus posing challenges to regulatory bodies.
- To meet these challenges regulatory bodies have to review such technologies to assess and confirm their safety and reduce subjectivity in their regulatory decisions before consenting for their use. In many cases this resulted in adapting or preparing new regulations, developing new licensing requirements and adjusting their regulatory processes. A particular example was the work being done by South Africa's regulator to license the Pebble Bed Modular Reactor.
- Regulators, who put emphasis on regulatory research, performed by the regulatory bodies themselves or their technical support organizations, have improved their technical competence and regulatory effectiveness. However, it was recognized that care had to be taken to ensure that the regulatory bodies did not do the work for the operators.
- The difficulty nuclear regulators face in the regulation of radiation exposure to patients for medical purposes was recognized. The Conference stressed the importance of involvement of stakeholders and co-operation with professional societies, in general, and the medical profession, in particular, for optimizing the radiation exposure to patients.
- It was recognized that application of quality management to radiation practices in the medical field, similar to that used in nuclear facilities and other modern industries, would be an advantage.
- It was recognized that the non-binding status of the Code of Conduct on the Safety of Research Reactors and its informal mechanisms for implementation, could be an advantage in allowing for a graded approach to

the different types of research reactors, their status and the safety issues they face. The Conference supported the development of IAEA safety standards for research reactors but noted that it was important for the regulatory bodies responsible for safety and security regulation of research reactors to be independent of those responsible for operating them or promoting their use. The Conference welcomed the proposal for periodic meetings to consider the application of the Code of Conduct.

REGULATORY SECURITY CHALLENGES

This session looked at how the regulation of nuclear security could be made more effective in the light of the challenges from the changed international security situation. The Conference noted the following points that emerged from the discussions:

- It was recognized that nuclear security threats exist and protection measures to counter such threats needed to be robust and regulatory bodies played an important role in ensuring this.
- The different manner in which nuclear safety and nuclear security regulation have developed were noted. It was recognized that to be effective, nuclear safety and nuclear security regulation could not be carried out independently and there were many good examples where safety and security regulation was carried out within a single regulatory body.
- Safety and security professionals needed to work together to ensure that nuclear facilities were adequately protected from attack or sabotage and nuclear and radioactive materials were, taking account of the risk, secure to prevent theft or misuse.
- Great progress, in the enhancement of nuclear security and control of radioactive material, has been achieved worldwide over the past few years but more needed to be done.
- The work being done by the IAEA to develop comprehensive guidance documents on nuclear and radiation security was noted.
- Important synergies exist among measures adopted for nuclear safety, security and non-proliferation. Measures addressing concerns in one of these areas can make a significant contribution towards enhancing protections in the other areas.

ENHANCED INTERNATIONAL REGULATORY COOPERATION

This session of the Conference addressed the need for international cooperation to enhance the effectiveness of safety and security regulation. The Conference noted the following points:

- An extremely wide range of cooperative activities were contributing to enhanced regulatory efficiency and effectiveness for nuclear safety and security being conducted under a variety of multilateral, regional and bilateral arrangements.
- Binding and non-binding international legal instruments were being promulgated in areas of regulatory interest, including: nuclear reactor safety; safe management of nuclear waste and spent fuel; assistance and early notification of nuclear accidents; physical protection of nuclear and other radioactive materials and associated facilities; non-proliferation safeguards verification; research reactors; radioactive sources; export and import of nuclear materials; and combating nuclear terrorism.
- The development of standards and guidance documents was in progress covering the most important aspects of nuclear safety and security, primarily under the aegis of the IAEA. In some States, the IAEA standards were directly incorporated into national legal and regulatory frameworks, in other States, the IAEA standards were used as a basis for developing national laws and regulations in a manner consistent with international best practice.
- Periodic review meetings were being conducted under relevant conventions and topical meetings to address specific issues relevant to nuclear regulation.
- The use of international assessment and peer review missions by the IAEA and other bodies was increasingly being used to assist States in areas of regulatory concern, including nuclear security and physical protection, radiation protection, regulatory efficiency and effectiveness.
- Extensive programmes of technical cooperation and assistance were being conducted on nuclear safety and security issues by the IAEA and OECD Nuclear Energy Agency as well as on a bilateral basis.
- The establishment and broader use of information networks and databases to enable regulatory bodies to have prompt access to the most current developments in areas of interest, was recognized.
- Special initiatives were being taken to address specific nuclear safety and security issues, including disposition of materials from weapons programmes, establishment of multilateral nuclear fuel cycle and supply

arrangements, and multilateral design review and decommissioning of nuclear facilities.

- A variety of initiatives were in progress to make better use of the IAEA standards in implementing effective national safety and security regulation, in particular through the Western European Nuclear Regulators Association and the IAEA's Integrated Regulatory Review Services.
- The continuing valuable work of nuclear safety committees maintained by the OECD Nuclear Energy Agency in the areas of improving regulatory efficiency, nuclear regulatory decision making, and the uses of operating experience and other areas of regulatory interest was recognized.
- The initiative to establish a multinational design approval process to enhance the clarity, predictability and transparency of the regulatory review of designs for new nuclear power facilities was noted. This process could contribute to more effective regulatory approaches to safety and security issues arising from licence applications for new installations in a number of countries.
- The development of information and knowledge management networks was increasing to enhance the regulation of nuclear safety and security. In particular, the new Asian Nuclear Safety Network provides a potentially useful model of one approach for enhanced sharing of relevant information on regulatory issues among and between States having common interests.
- The value of international cooperation in enhancing nuclear safety and security worldwide was recongnized. It was, however, noted that the dense calendar of international nuclear related activities, meetings, conferences and workshops raises issues of priorities for all regulatory bodies, especially the smaller ones with limited personnel and resources.

REGULATORY EFFECTIVENESS FROM THE OPERATOR'S VIEWPOINT

This session provided an opportunity for two eminent representatives of the nuclear industry to comment on regulatory effectiveness from the operators' perspective. The Conference noted the following points:

- The industry view was that nuclear safety is a prerequisite for sustainable development and that the industry needed effective nuclear safety and security regulation.

- The industry view was that the regulatory body needed to be independent from both operators and politics. The regulatory body needed to have effective communication with all its stakeholders and command the confidence and respect of the public.
- The industry recognized that regulatory credibility is essential and that the regulatory body needs to have a broad range of skills and experience so that it can understand the technology it is regulating.
- The industry desired international regulatory consistency, especially in relation to the global use of nuclear reactors for electricity generation.
- The industry desired that regulatory effectiveness should be given the same rigorous review and attention as that required of the industry.

SAFETY AND SECURITY OUTLOOK: GLOBAL VISIONS AND COMMITMENTS FOR THE FUTURE

A concluding panel of senior regulators addressed a question posed by the Conference President, namely, "What would you do to improve the regulation of nuclear safety and security?" The following are some of the significant points raised during the discussion:

- Although costly in terms of time and effort, international relationships in the regulatory field are an essential means of moving forward. Regulatory bodies should actively encourage the exchange of staff to share knowledge and experience.
- This Conference represents the kind of dedicated forum, rather than marginal meetings at other events, and can have a major impact on nuclear regulation. Hence it should be regularized.
- The interrelated elements of accountability and communications are key to successful regulation. They should be identified at all interfaces and levels of interaction between regulators, operators and other stakeholders.
- Nuclear safety regulation has both technical and political aspects. State regulation of nuclear activities and practices requires that nuclear safety and security issues receive attention at the highest political level in the States using nuclear technology.
- Attention is needed by regulators in all States to the essential functions of standard setting, licensing, inspection and enforcement.
- IAEA standards documents are extremely valuable to guide national regulatory activities. However, they need to be continually updated to reflect new developments.

- Cooperation at the regional level is of great value and regulators should meet to discuss regional cooperation every 2–3 years,
- At the national level, nuclear regulators need to address continual improvement and quality management and to avoid complacency. Sharing of experience and training of a new generation of regulators is needed in view of the retirement of many experienced personnel.
- On the international level, partnerships of nuclear regulators and harmonization of legal and regulatory regimes need to be pursued.

ISSUES FOR CONSIDERATION BY GOVERNMENTS

Governments should:

- Continue to maintain and develop a robust regulatory framework to ensure the safety and security of both the nuclear industry and radioactive sources so that the public and workers are protected from the harmful effects of ionizing radiation;
- Ensure that the regulatory body is independent from those who are responsible for the promotion of the use of nuclear energy and those who are opposed to the use of nuclear energy, to ensure that regulatory decisions are free from influences that may conflict with safety;
- Ensure that the regulatory body is competent and has the necessary resources to fulfill its mission in relation to independent oversight and assurance to ensure public and environmental protection;
- Actively consider the CNS, the Joint Convention on the Safety of Spent Fuel and Waste Management, the Convention on the Physical Protection of Nuclear Material (and 2005 Amendment) and the Convention on Suppression of Acts of Nuclear Terrorism and consider participating in review and other meetings to share good practices and implement lessons learned;
- Support the voluntary commitment to the Code of Conduct on the Safety and Security of Radioactive Sources and the associated guides, and the Code of Conduct on Research Reactors;
- Encourage their regulatory bodies to liaise with regulatory bodies of other counties and with international organizations to promote regional and international cooperation and the exchange of regulatory information and experience feedback;
- Encourage the integration of security and safety regulation in areas where safety and security overlap, such as the physical protection of

nuclear facilities and the protection, storage and use of radioactive sources.

ISSUES FOR CONSIDERATION BY THE REGULATORY BODIES

Regulatory bodies should:

- Adopt regulatory management systems based upon good quality management practices and implement continuous improvement programmes;
- Actively engage with their stakeholders to demonstrate that they are open and transparent in their processes and to build confidence in their regulatory decision making processes;
- Have technical expertise available to perform tasks and to undertake regulatory research or award contracts for research and development projects to deal, inter alia, with new technologies and sustain high level of competence;
- Establish and maintain co-operation with regional, subregional and international partners and professional societies to promote exchange of information and share experience feedback;
- Consider how IAEA safety standards can make an even more significant contributrion to improving the efficiency and effectiveness of national regulatory activities;
- Look at what the IAEA services can do to strengthen their effectiveness;
- Ensure that safety and security professionals work together in areas where safety and security interests overlap;
- Work with industry to develop an appropriate culture to address both nuclear safety and security;
- Make more use of the IAEA Nuclear Security Advisory Services for benchmarking and enhancing national systems for nuclear security.

ISSUES FOR FUTURE INTERNATIONAL COOPERATION

- The IAEA should strengthen its Standards in relation to leadership in regulatory bodies, regulatory management systems, resource evaluation and stakeholder engagement.
- The IAEA and OECD/NEA should improve the system for fostering international cooperation in the field of regulatory effectiveness and the sharing of good nuclear safety and security regulatory practices.

- The IAEA should further develop the IRRS process to promote its value to Member States and regulatory bodies to improve effectiveness and share good practices.
- The IAEA should finalize development of the Nuclear Security Series guidance documents, covering prevention, detection and response to malicious acts with participation of national regulatory bodies and put the documents through the same rigorous quality process offered by the Commission on Safety Standards for nuclear safety documents.
- The IAEA should consult Member States on the need for the development of model nuclear security law and regulations to assist regulatory bodies in Member States in drafting national laws and regulations.
- The IAEA should develop its programmes to assist Member States in human resource development by organizing training courses in radiation protection, waste safety, nuclear safety and security training courses at international, regional, subregional and national level.
- The IAEA should consult Member States on the need to expand the scope of illicit trafficking data base to include security incidents/breaches.
- The IAEA should increase its cooperation with other international organizations dealing with problems of terrorism or regulating other industries that require high level of safety and security.
- International organisations should consider how their activities can be coordinated to enable the most effective participation by the regulators, recognising their limited time, personnel and resources.

CONCLUSIONS

The Conference thanked the Government of the Russian Federation for taking the initiative to host this important Conference, in partnership with the IAEA, in its Presidency of the G8.

The Conference concluded that the delivery of effective nuclear safety and security regulation is vital for the safe and secure use of nuclear energy and associated technologies both now and in the future and is an essential prerequisite for the achievement of global energy security and global sustainable development.

Regulators work for the benefit of society and therefore they play a vital role. To be effective, they must be independent and free to make regulatory decisions solely in relation to the need to maintain safety and security, without pressure from those who are responsible for the promotion of the use of nuclear energy and associated technologies, or those who are opposed to its use.

Regulators must be competent and have adequate resources to deliver their mission, which is to ensure the protection of the public and the environment, and to assure Government and the public that their nuclear industry is safe. The safety and security of nuclear facilities and nuclear and radioactive materials requires effective coordination of safety and security regulation.

The Conference reiterated the importance of continued and improved international cooperation to develop comprehensive international standards for safety and guidance for security. The Conference also stressed the importance of wider participation and fuller implementation of the international instruments such as Conventions and Codes of Conduct. Continued international cooperation to promote good nuclear safety and security practices was seen as being essential for the delivery of effective regulation and the continuous improvement of the regulatory bodies.

The Conference noted the value that would be obtained from conveying IAEA standards to the regulatory design review and safety goals of new reactors.

The Conference valued this forum and agreed that the head regulators should meet again within 3 years to review progress arising from the findings of this Conference and identify emerging regulatory challenges.

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Topical Session 4:	A. DELA ROSA S.B. ELEGBA	Philippines Nigeria
Closing Session	L. WILLIAMS	United Kingdom

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New strategies and approaches to safety and security will be required in the light of renewed global interest in the use of nuclear energy for electricity generation, increased threats to the security of nuclear installations, increased use of radioactive materials and the challenges posed by existing nuclear facilities. The aim of this conference was to enhance the global vision and commitments among the senior regulators to promote experience sharing and international cooperation, thereby continuously improving nuclear safety and security worldwide.

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
ISBN 92–0–110606–8
ISSN 0074–1884