

CHAPTER 4

Organisational culture for safety, security and safeguards in new nuclear power countries

Donald Kovacic

Developing a nuclear power programme is a large undertaking requiring careful planning, preparation, and a major investment in a sustainable infrastructure. This infrastructure must provide legal, governmental, regulatory, financial, technological, human and industrial support to ensure that nuclear power plants are designed and operated in a safe and secure manner, and that nuclear materials are used exclusively for peaceful purposes. For countries interested in incorporating nuclear power into their domestic energy mix, the development and implementation of an appropriate infrastructure is essential.

The International Atomic Energy Agency (IAEA) advises that such countries follow the 'Milestones' approach.¹ This guidance describes the issues and phases involved in building the capacity for planning, constructing and operating their first nuclear power plant. Such capacities are needed across governmental, industrial, technical and educational institutions. This comprehensive approach includes the issues of nuclear safety, security and safeguards—sometimes referred to as the '3S' approach. Security and safeguards are part of the nuclear non-proliferation regime whose purpose is to prevent the spread of nuclear weapons.

The focal point of a nuclear power programme is the operator of a nuclear facility. As such, the operator must comply with a number of national and international requirements in the areas of nuclear safety, security and safeguards. These requirements should be reflected in national laws and in regulations (including those from nuclear regulatory bodies, security organisations and other institutions). To be able to comply adequately with their commitments, operators of nuclear facilities must develop an organisational culture that will embrace these three fundamental requirements.

The concept of nuclear safety culture is well established, and there is much guidance available. In contrast, the concept of nuclear security culture is currently being developed, primarily through the IAEA and the World Institute of Nuclear Security.² However, at present there is no widely accepted understanding of what is meant by a 'safeguards' or 'non-proliferation' culture. Therefore, to understand how non-proliferation fits within a nuclear power programme, this chapter focuses on practical

considerations and realities that exist at nuclear facilities, and the challenges that organisations face in their day-to-day operations to operate safely and to meet their non-proliferation commitments. It also explores how countries with established nuclear power programmes can collaborate with nuclear newcomer countries to support the development of infrastructure that allows them to benefit from the peaceful applications of nuclear technology by seeking the most effective and efficient way of implementing safety, security, and safeguards requirements. It is in the interest of all nations that countries developing nuclear power programmes do so in a way that meets international standards and obligations.

This chapter begins by outlining existing international norms and standards for developing the infrastructure to support new nuclear power programmes. It then discusses the role of organisational culture, and how it can support the safe, secure and peaceful application of nuclear power. The chapter identifies effective and efficient strategies for implementing safety, security and safeguards in nuclear operations and also the challenges that can arise. It concludes by proposing potential areas for future collaboration between countries to support non-proliferation culture.

Existing international norms and standards for developing infrastructure to support new nuclear power programmes

After the Second World War, the world seemed to be headed toward a future where many countries possessed nuclear armaments that could potentially be used in a new kind of war—a nuclear war. Some statesmen and diplomats were concerned with the implications of these new weapons and began proposing ideas on how to avoid widespread nuclear war. One of these early ideas was the Baruch Plan, which was presented to the United Nations Atomic Energy Commission (UNAEC) in 1946.

The UNAEC was established by the then newly created United Nations to

make specific proposals: (a) for extending between all nations the exchange of basic scientific information for peaceful ends; (b) for control of atomic energy to the extent necessary to ensure its use only for peaceful purposes; (c) for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction; (d) for effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions.³

On 14 June 1946, before a session of the UNAEC, US representative Bernard Baruch, presented a proposal for the creation of an international atomic development authority.⁴ Although this plan was ultimately rejected because of tensions between the United

States and the Soviet Union, portions of the plan sound similar to the mandate of the IAEA, which was to be established in 1957, and then later the Nuclear Non-proliferation Treaty (NPT) in 1970.

The IAEA and the NPT collaboratively set up a framework that has the following main pillars:

- Assurances against the proliferation of nuclear weapons (that is, non-proliferation);
- The promise for eventual nuclear weapons disarmament;
- The right for all countries to enjoy the benefits of peaceful uses of nuclear technology.

The NPT prohibits the nuclear weapons states (NWSs)⁵ from transferring weapons material and technology to non-nuclear weapons states (NNWSs). It also prohibits NNWSs from receiving such materials, and also requires them to negotiate comprehensive safeguards agreements (CSAs) with the IAEA. CSAs form the legal basis for the IAEA to inspect and verify that NNWSs are in fact complying with their obligations under the NPT. In return, the NNWSs have a right to benefit from the peaceful uses of nuclear energy. That is why the NPT is sometimes called the 'Grand Bargain.' The NNWSs agree never to acquire nuclear weapons, and in exchange, the NWSs agree to share the benefits of peaceful nuclear technology and to pursue nuclear disarmament aimed at the ultimate elimination of their nuclear arsenals.

The international safeguards regime and verification by the IAEA form the historical foundation of nuclear non-proliferation, but they are not the only components. Security at nuclear facilities is another fundamental component necessary to ensure that applications of nuclear technology are only used for peaceful purposes. How these two elements of safeguards and security are implemented by countries *and integrated with nuclear safety*, as part of a sustainable nuclear power programme is the subject of the rest of this chapter. This will, of course, be put within the context of global nuclear non-proliferation and how a level of transparency can be achieved so that all nations benefit from the 'Grand Bargain.'

Nuclear power is one of the chief peaceful uses of nuclear energy and the one that was primarily envisioned during the creation of the IAEA and the drafting of the NPT. Currently, there are many countries that would like to include nuclear power as part of their energy mix.⁶ Availability of electricity is a principal factor in raising the standard of living for a society. Abundant and reliable power fuels economic growth and industrial competitiveness. Nuclear energy can provide a secure supply of low carbon electricity for this purpose. Of course, there are a number of factors that must be considered when determining whether or not nuclear power can be competitive for a given country's circumstances. This is the reason why sound economic and planning

studies must be undertaken before such a decision can be made. Many countries have done this and have determined that nuclear power can be of benefit to them. Although the accident at the Fukushima Daiichi Nuclear Plant in 2011 had a significant impact on this cost-benefit analysis for many countries, a number of them are still moving forward with their plans for nuclear power programmes, and they are being careful to incorporate lessons learned from the accident. In his address during the Energy Market Authority Distinguished Speaker Programme in Singapore in January 2015, the Director General of the IAEA, Mr. Yukiyama Amano stated that:

... the basic situation concerning nuclear power has actually not changed that much since ... 2010. Many new countries still plan to introduce nuclear power in the coming decades. Global use of nuclear power will grow, although growth rates are likely to be slower than estimated before the accident ...⁷

Once a country makes a 'knowledgeable commitment' to build a nuclear power plant, it must begin considering how to operate that facility safely and securely. As outlined at the beginning of this chapter, the IAEA has been developing a series of guideline documents aimed at helping countries identify what they must do to effectively operate a nuclear power plant and how they might do it. One of these main documents describes the milestones for developing the infrastructure to support a national nuclear power programme: 1) ready to make a knowledgeable commitment to a nuclear power programme; 2) ready to invite bids/negotiate a contract for the first nuclear power plant, and 3) ready to commission and operate the first nuclear power plant. Furthermore, it describes 19 separate issues that must be considered during the three milestones. Nuclear safety, security, and safeguards are only part of this process. If issues such as economic sustainability, financing and public acceptance, etc., do not allow nuclear power to be implemented, then a nuclear programme will not be possible—or at least not until the conditions change.

Once the underlying economic, political and social conditions allow a nuclear programme to move forward, a country must begin preparing the underlying infrastructure necessary for such a programme to be successful. Nuclear safety, security and safeguards are the three parts of this infrastructure where one nation's nuclear programme can have a direct impact on all other nations, and so must be given special consideration. Additionally, it is a fundamental tenant of sustainability that these three areas are well integrated with all the other aspects of a nuclear programme. In other words, a sustainable nuclear power programme requires that safety, security and safeguards are adequately considered as part of the nation's nuclear infrastructure. This is the fundamental premise of this chapter.

For a nuclear power programme, there are three basic levels, which must be considered: the legal basis, the regulatory framework and facility operations. The legal basis refers to a country's laws and statutes and its adherence to international norms and treaties related to nuclear and radiological material. The regulatory framework refers to the manner in which its laws are implemented through second order legislation and how nuclear activities are controlled. This requires a governmental body—or bodies—to be responsible for controlling nuclear activities. Finally, there are the facilities, persons, and activities that must be regulated. Although this chapter is chiefly concerned with the facility and operational levels, some brief points will be made regarding the legal and regulatory levels to provide a proper context for how organisational cultures are developed.

Legal basis

In the IAEA's 2010 'Handbook on Nuclear Law: Implementing Legislation', the 3S concept is used as a guiding approach to emphasise the interrelations between safety, security safeguards, and civil nuclear liability.⁸ It highlights the need for legislation to reflect such interrelations in a comprehensive and synergistic manner. In the context of nuclear law, the 3S concept reflects the three technical areas that need to be addressed in establishing an adequate legislative and regulatory framework to ensure the peaceful uses of nuclear energy. Many IAEA Member States have recognised that measures taken to address one of these areas can contribute to addressing the others. One example is the adoption of suitable physical protection measures for nuclear material: protecting against unauthorised access to nuclear material can also help to ensure that it is used safely and only for the intended peaceful purpose. Another example is that a well-developed national regulatory safety infrastructure can help to ensure the security of radioactive material. Similarly, a well designed and implemented State System of Accounting for and Control of Nuclear Material, which is the foundation of country's safeguards system, can help to enhance security measures by appropriately accounting for nuclear material, which helps deter unauthorised removal of nuclear material.

Regulatory framework

Practical rules must be developed by a government and its organisations to govern and guide how nuclear activities are to be carried out in compliance with the laws. Chief among these governmental organisations is the regulatory body that is charged with controlling nuclear activities. The IAEA Safety Standards state that this regulatory body should be independent and competent.⁹ This independence is crucial if its regulatory functions are to be separated effectively from any efforts to promote

nuclear power and operations. This separation should maintain objectivity, fairness and transparency and avoid conflicts of interest. An important component of such independence is financial self-sufficiency. This helps the regulator to be free of external influences and to make sound technical decisions, be able to control activities using appropriate licenses and have the authority to enforce its rules. Moreover, its regulations should be as straightforward and clear as possible and avoid inconsistencies and inefficiencies. This last point plays a crucial role in how effectively safety, security and safeguards can be implemented by the staff at the facilities that are being regulated.

Laws and regulations provide a basis for all nuclear related activities occurring in a country. In this chapter, however, we are chiefly concerned with the activities in emerging nuclear power states; that is, those embarking on building a nuclear power plant and developing the underlying infrastructure to support nuclear activities. Such a programme will of course significantly increase the level of nuclear activities in a country. How much of an increase will depend greatly on the specifics of the country and the size of its planned programme. But regardless of the ultimate goal, a considerable amount of planning will be needed to deal with this increase in activities and importantly, in responsibilities.

Some of these new responsibilities will be straightforward, such as entering into the appropriate international treaties specific to nuclear power, such as the Convention on Nuclear Safety.¹⁰ Other pre-existing responsibilities may need to be expanded or to become more complex. For example, existing security conventions and safeguards obligations will be significantly increased due to the level of nuclear material, related equipment and information being introduced.

Facility operations

The final level in this framework is the facility operations level. This includes users of the nuclear material and operators of the nuclear facilities. Such users and operators require clear laws and regulations to follow and an understanding of the consequences to their operations if they fail to comply with the laws and regulations. These consequences could be denial or revocation of licenses to use material, ineligibility to engage in nuclear related activities or to operate a nuclear facility, as well as fines and criminal prosecution. This is the level where the individual and the culture of the organisation play the largest role in determining if nuclear activities are performed safely, securely and only for peaceful uses.

The IAEA is developing a series of Safeguards Implementation Practices guides that are intended to provide best practices on the implementation of safeguards as part of a state's infrastructure.¹¹ IAEA Service Series 31 'Safeguards Implementation Practices Guide on Establishing and Maintaining State Safeguards Infrastructure', provides some

practical examples of how safety, security and safeguards are intertwined within the legal, regulatory and operational areas of nuclear facilities and other activities involving nuclear material, such as those in hospitals or industry. It also explores some of the synergies between the 3Ss.¹²

The role of organisational culture and how it supports the safe, secure and peaceful application of nuclear power

The organisational culture can be regarded as the ‘personality’ of an organisation. It guides how employees think and act on the job, and it is a part of their values, beliefs and attitudes. Edgar H. Schein, Professor Emeritus in the Sloan School of Management at the Massachusetts Institute of Technology,¹³ defines organisational culture as:

... a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.¹⁴

Therefore, organisational culture is the group of shared values and perceptions of what are acceptable and unacceptable behaviors. Culture is a socially driven phenomenon where people conform to norms to gain the acceptance of the group and resulting benefits. Although it is not the purpose of this chapter to debate the definition of what constitutes a ‘culture’, it is important to understand what qualities a culture might have with regard to the safe, secure and peaceful application of nuclear power.

Culture cannot be directly imposed by the leaders of an organisation: it is established over time through the influence of a combination of leadership by example, communication and compliance with the management systems. Behaviors that are encouraged or enforced over time influence or define the culture. The best organisations value fairness, encourage taking responsibility for one’s behavior, promote the feeling that individuals matter in an organisation, teach the need to maintaining a questioning attitude, have a common goal of excellence in operations, and meet stakeholders’ expectations. Promoting and building this kind of organisational culture is the best way to achieve all the goals of a nuclear power programme, including its economic sustainability.

This is the key point for the countries developing the infrastructure for a nuclear power programme to understand. The same organisational culture that ensures the viability and (commercial) sustainability of the programme should also value the concepts of safety, security, and safeguards. It is already well established that safety is an

integral part of this equation. This is true not only for the nuclear industry, but throughout manufacturing and heavy industries. Safety was initially seen as a burden, but it was eventually realised that companies with good safety records ultimately saw increased production and profitability.¹⁵ This concept should also be applied to encompass security and safeguards to address the unique aspects of nuclear power.

Regarding safety, there have been concerns about radioactive releases due to system failure or human error since the inception of the nuclear industry. As a result, the nuclear industry benefits from a long-established, comprehensive and sophisticated safety regime. The IAEA supports this regime by establishing safety standards, providing safety services (such as operational safety reviews), and supporting the implementation of legal instruments that aim to achieve a high level of safety in nuclear power plants.

For nuclear security, recent events (in particular the terrorist attack in the US on 11 September 2001) have resulted in a renewed focus by the nuclear community on enhancing protective measures against sabotage or the theft of nuclear material at nuclear power plants. To help in this effort, the IAEA Office of Nuclear Security has recently published a new Implementing Guide aimed at helping countries understand what actions must be taken to establish an effective national nuclear security infrastructure for a nuclear power programme.¹⁶

Unlike safety and security, however, nuclear safeguards are not as well understood by individuals outside of specialised groups dealing with nuclear material, primarily because there are no parallels to it outside of the nuclear industry. Moreover, even if the concepts are understood, they can be easily confused with other terms. For example, the word 'safeguards' in some countries has a very negative connotation. In these countries, the word translated literally implies that people cannot be trusted, which is not the message management wants to convey to its workers. Thus, it is very important to take into account differences in the local cultural sensitivities when introducing the concept of safeguards and to translate the concept and not just the word.

The application of international safeguards by the IAEA depends chiefly on national accounting for and control of nuclear material (sometimes called 'domestic safeguards'). Detailed nuclear material accountancy is unique to nuclear energy, and there is nothing equivalent to it in other industries as there is for safety and security.¹⁷ This is especially true because nuclear material is unique in that it can be created or consumed by decay or transmutation—it can change from one element to another. This can be a limiting factor in how well the need for nuclear material accounting can be understood and accepted by facility staff.

Therefore, for safeguards to become a part of the organisational culture it must be included with safety and security, and their relationship must be clearly established by management. Since safeguards at operating facilities will likely be implemented by

the same organisation that is responsible for safety and security, the integration of this concept into one organisational culture is the most effective and efficient approach.

Nuclear non-proliferation at the facility level not only includes concepts such as accounting for and control of nuclear material and physical protection systems, but also information and cyber security, along with export controls for equipment, information and material related to the nuclear fuel cycle. Non-proliferation is therefore not a standalone concept—a feature that underlines the importance of weaving safeguards issues into the wider organisational culture.

Additionally, nuclear non-proliferation extends beyond a nuclear facility and includes the government, its agencies, the regulatory bodies, academia and commercial and private entities. Nuclear non-proliferation includes adherence to bilateral, multilateral and international treaties, agreements and norms. It includes not only the

Figure 1 Examples of relationships between safety, security and safeguards for the national, regulatory, and operational levels



NPT and the statute of the IAEA, but also national security and control of illicit trafficking in material and information.¹⁸ With such a potentially complex regime, it is doubly important that organisational cultures be cultivated at all levels in the country to include not only safety but non-proliferation as well.

Figure 1 provides a visual representation for some of the relationships between safety, security and safeguards for the national, regulatory, and operational levels.

Effective and efficient strategies for implementing safety, security, and safeguards in nuclear operations

Since nuclear operators must comply with a number of national and international requirements (through its government's international commitments) for safety, security and safeguards, the identification of effective strategies to more efficiently implement these requirements would reduce the burden associated with them. These strategies could help leverage the typically limited resources of countries where nuclear infrastructure development activities may be covered by a few organisations or individuals. Since the same organisations are typically called on to perform multiple duties, they should seek to determine how facility operational safety could be leveraged to benefit security and safeguards. This is because the underlying management and operational practices that are needed to implement all the requirements placed on a facility share a common infrastructure, so the best strategy is to make sure that those practices are compatible, mutually supportive and efficient. The term efficient is used to mean that energy expended in one area should benefit others.

Safely and effectively operating a nuclear reactor requires a high level of management commitment, support and organisational structure. It requires the application of advanced management concepts such as safety culture, quality assurance, self-assessment, risk assessment, configuration management, maintenance, design control, document control and records management, to name but a few. These concepts would also support the nuclear material accounting and control that is a part of the security and safeguards responsibilities of a nuclear operator. The organisational culture that exists for safe reactor operations would therefore support security and safeguards as well.

Another example is that the same technical safety skills required to effectively protect workers and the public from radiation exposure, to measure and characterise radioactive material, and to monitor the environment, all translate to the same core competencies and capacity of personnel and systems that implement aspects of safeguards and security, such as nuclear material accounting and control. The technical

skills that personnel gain in characterising radionuclides for safety are directly transferable to measuring nuclear material (uranium, plutonium, and thorium), which can be applied to the effective application of safeguards.

Striving to develop a level of excellence in the management and operation of nuclear facilities that may exist in countries with small nuclear programmes will help immeasurably with the larger challenges as a country transitions to a future nuclear power programme. As such, the identification of interfaces and synergies between nuclear safety, security and safeguards is one of the chief ways to develop the best strategies that will benefit nuclear operators. The term 3S can be understood to describe a concept by which a country or organisation identifies and applies interfaces and synergies among nuclear safety, security and safeguards to more effectively and efficiently manage its nuclear activities and operations, while complying with domestic and international obligations.

These interfaces and synergies have been a subject of discussion in international venues in recent years. One such event that was held at the IAEA was a Technical Meeting on *Safety, Security and Safeguards: Interfaces and Synergies for the Development of a Nuclear Power Programme* that was held on 26–29 November 2012 in Vienna, Austria.¹⁹ There were 40 participants from 24 IAEA Member States, the European Commission and the World Institute for Nuclear Security. Participating IAEA Member States included some who are embarking on nuclear power, some who are expanding their programmes and some with large, well-established nuclear power programmes.

According to the chairman's summary, most participants expressed a high level of interest in identifying the interfaces and synergies between the three areas of nuclear safety, security and safeguards to identify good practices for improved regulations and operations of nuclear power plants. It states that there are known synergies as well as challenges between safety and security and between security and safeguards. Several countries have discovered how to effectively manage the interfaces and take advantage of the synergies, which have provided tangible benefits to their existing nuclear power programmes. Several more are planning to take into consideration such experiences when building their infrastructures for their future nuclear power programmes.

Nuclear utilities and other operating organisations have found that applying an integrated approach for the implementation of safety, security, and safeguards in their facilities was in line with their business cases. An integrated approach provides for better compliance with regulatory requirements and improves the nuclear power plant's capacity factor, which results in a greater amount of electricity generation and profits.

There are a number of specific areas where good practices have been identified. A discussion of some of these areas is provided below:

- *Common objectives:* safety, security, and safeguards share the ultimate objective of protecting people, society, the environment and future generations from the harmful effects of ionising radiation and the misuse of nuclear material. This ultimate objective can form the basis for close cooperation between organisations of nuclear facilities, regulatory bodies and governmental organisations.
- *Nuclear law:* to avoid inconsistencies among different laws, a country's nuclear law should recognise the interfaces and interrelations between nuclear safety, security and safeguards as well as liability for nuclear damage. Measures to address one subject may contribute to addressing another. A 'comprehensive law' can include common elements that apply to different subjects, avoiding repetitions or cross-referencing of separate laws. Such a comprehensive law can be easier to access and understand by stakeholders.
- *Coordinated regulatory approach:* some countries have determined that a regulatory body that includes safety, security, and safeguards in 'one house' is the most effective and efficient approach. However, other countries prefer separate regulatory bodies for those functions. In both cases, close cooperation is still needed between those responsible for safety, security and safeguards (simply putting them into one house is not enough).
- *Clear requirements for the operator:* for the operator of a nuclear power plant, it is important that regulatory requirements pertaining to safety, security and safeguards are clear and that they do not conflict with each other.
- *Integrated management systems (IMs):* the implementation of an IMS by a nuclear organisation that includes safety, security and safeguards, and their interfaces, ensures that these elements are effectively coordinated with each other, and that they are included in its core processes. Many management processes are common across an organisation's disciplines, functions, and roles and responsibilities.
- *Early design input:* the most effective approach would be to provide for all requirements in safety, security and safeguards during the design stage of a nuclear facility, or as part of the bid specifications. This approach optimises the site-design process and reduces the chance for expensive retrofitting or design changes that would hinder construction of the facility.
- *Human resources development:* human resources and workforce planning should support career development for employees that cuts across the disciplines of safety, security and safeguards. Crosscutting career development contributes to employee satisfaction and interdisciplinary sharing of experiences, and it supports communication channels between sub-organisations. This approach should also extend to contract personnel.

- *Common training programmes:* as part of a systematic approach to training, all relevant personnel should have a basic understanding of how safety, security and safeguards are involved in a nuclear power plant. It is more efficient to have coordinated training programmes that train individuals on common topics.
- *Emergency preparedness and response:* having a coordinated response is crucial during a nuclear incident. This necessitates planning, preparation, communication, collaboration and joint exercises between all stakeholders and organisations that will be involved in, or affected by, an emergency. A lack of coordination between organisations responsible for safety, security and safeguards—that may not be apparent during normal operations—could lead to serious problems in mounting an effective response during an actual emergency.
- *Communication with the public during an emergency:* during an emergency, it is important that information related to safety, security and safeguards be provided to the public (as appropriate) in a consistent and timely manner, and preferably using trained spokespersons (even when the event is occurring outside one's own country). Informing the public in this way can help to avoid miscommunication, instill public confidence and prevent the escalation of public concern.

There are also challenges identified in the implementation of safety, security and safeguards as listed below.

- *Culture:* if it is cohesive and well-oriented, culture can be a positive force in an organisation, but if it lacks these attributes it can also be a negative force. The attitudes and assumptions within the different disciplines of safety, security and safeguards may create problems in communication and cooperation among organisations. However, when the purpose behind each of the areas is communicated to the various stakeholders, they are better able to understand the role that each plays in a new nuclear power programme. This understanding can improve the implementation of each area and avoid problems that would arise from a lack of knowledge and conflicts of interest. The underlying factor is that individuals are usually not experts in all areas, and should therefore be made aware of the other disciplines.
- *Access versus security:* generally speaking, increased security results in less access and convenience. However, if facility personnel are made aware of the reasons behind any increase in security, they will likely respond with greater acceptance and compliance.
- *Lack of consistent terminology:* the terminology used in referring to the interfaces and synergies between safety, security, and safeguards is not consistent in the nuclear

industry and is therefore confusing. As such, it would be useful to develop a common understanding on using such terminology.

Potential areas for future collaboration between countries to support non-proliferation culture

Since several new countries are planning to initiate nuclear power programmes in the coming years, the burden will increase on an already-strained international safeguards system. These newcomer countries will require the infrastructures and related expertise to manage nuclear material and technology associated with the development of a nuclear power programme. The international safeguards system is challenged by evolving proliferation threats, expanding IAEA responsibilities and the diffusion of sensitive technology through illicit networks. It is up to the international community, and especially countries with well-established and mature nuclear power programmes, to collaborate with countries developing such programmes to address these non-proliferation needs.

The experiences of countries such as the Republic of South Korea (ROK) have demonstrated the benefits of partnering with countries that have successful nuclear industries and regulatory systems, and that require adherence to non-proliferation commitments. ROK made the decision to benefit from nuclear power and make it a key part of its energy and industrialisation strategy. It did this while adhering to all the relevant international safety, security and non-proliferation standards and obligations. It began its efforts by purchasing turnkey nuclear projects from countries with nuclear power technology, and built their capacity through technology transfer partnerships to develop its own indigenous capabilities. These partnerships were used to provide experiential learning and technology transfer to speed up domestic development. Even then, it took several decades of dedication to build significant industrial capacity. The development of organisational cultures that promote safety and non-proliferation are critical to this model.

One example of an outreach programme that focuses on international safeguards, security and non-proliferation is the US's International Nuclear Safeguards Engagement Program (INSEP). Its mission is to work with international partners to support and enhance nuclear safeguards implementation at all stages of civil nuclear development. These collaborations aim to improve the effectiveness and the efficiency of safeguards on nuclear material throughout the nuclear fuel cycle, and to support the non-proliferation regime by helping partners develop the appropriate infrastructures that support safeguards. For instance, a number of countries require legislative and technical support to prepare the infrastructure and procedures necessary to provide

timely, correct, and complete declarations pursuant to the Additional Protocol (AP). As such, INSEP works with partner countries to strengthen their AP implementation. INSEP trains many practitioners from newcomer countries each year on international and domestic safeguards by drawing on the extensive technical expertise of the US national laboratory complex.

Organisations in other countries are also providing support for the implementation of security and safeguards for newcomer countries. Two such organisations are the Asia Pacific Safeguards Network (APSN)²⁰ and the European Nuclear Security Training Centre (EUSECTRA)²¹. The APSN is a professional network that draws on safeguards expertise in the Asia-Pacific region to facilitate the exchange of safeguards information, knowledge and practical experience among members to strengthen safeguards capabilities. Launched in 2009, APSN has helped its members improve the quality, effectiveness and efficiency of safeguards implementation by:

1. Supporting sustainable national nuclear safeguards capabilities;
2. Promoting regional cooperation in appropriate nuclear safeguards applications and practices;
3. Facilitating the coordination and the provision of nuclear safeguards technical assistance;
4. Providing a forum for sharing appropriate knowledge on nuclear safeguards; and
5. Developing a network of national nuclear safeguards practitioners in the region.

EUSECTRA instructs front-line officers, trainers and experts on how to detect and respond to illicit trafficking of nuclear or other radioactive materials. EUSECTRA offers hands-on training using a wide variety of radioactive and nuclear materials, and a broad selection of equipment and measurement instruments.

There are also international bodies, such as the IAEA, who work with countries to support them in their efforts. A recent report by the Brookings Institution outlines many of the political, legal and policy areas where experienced nuclear countries can work together or collaborate with third parties to help ensure that non-proliferation goals are achieved.²²

However, there is still a need to find more effective approaches for experienced countries to reach out to countries developing nuclear power to share their experiences in a way that can best promote adherence to international obligations and treaties. What is still needed is *how* countries can achieve this most *effectively* and *efficiently*. This is where lessons learned can be of the greatest benefit for newcomer countries. For example, the experience of South Korea is that of a country that made a clear commitment to the utilisation of safe, secure and peaceful nuclear power for the

benefit of its people, and made it a key part of its industrial development. While many countries do not necessarily seek this level of development, it is nevertheless instructive for them to learn from the experiences of countries like South Korea and others to take away those lessons, which are most relevant and useful.

Good nuclear organisational culture for a large country is not necessarily implemented the same way as a good nuclear culture for a newcomer country. This is because the number of people involved in nuclear activities in a newcomer country can be very limited at the beginning of its programme. Nevertheless, it is helpful for individuals involved in nuclear activities in newcomer countries to have the right 'mentor' at the beginning of their activities to ensure that the appropriate culture is instilled in the programme. This could have a cascading effect in a nascent nuclear programme as the concept of culture becomes ingrained into the mindset of the key individuals and the organisations and structures that they develop. At the very least, countries with well-established nuclear power programmes (or, for the purposes of the following section, 'experienced countries') could have a significant role in working together to share their experiences on how they developed and nurtured the proper organisational cultures to ensure that non-proliferation was integral to them. Below are some of the principal areas where the countries with established nuclear power programmes could strengthen their collaboration for the benefit of newcomer countries:

- *Supporting and strengthening nuclear law:* experienced countries should continue to support the IAEA in its efforts to help countries form the foundation of their nuclear programmes by ensuring that non-proliferation is integrated with safety and other aspects. The IAEA has a unique role in the global non-proliferation regime—one that demands that it maintains its objectivity and neutrality. The IAEA cannot act as both consultant and regulator. This is where collaboration with peers can give a country the confidence it needs to fully examine its nuclear legislation and to implement laws that allow it to fully meet its international obligations.
- *Supporting the development of robust regulatory frameworks:* the nuclear regulatory bodies in experienced countries should work to support the development of a regulatory framework that strengthens the domestic aspects of security and safeguards.
- *Export controls:* experienced countries should work together to support countries in developing robust export controls on trigger list items, as well as dual-use items. This goes beyond just advocating the signing of treaties and agreements, and includes continuing education and training of the countries' government, private and front-line organisations as well as the development of strategic plans and roadmaps to ensure that these efforts become sustainable.

- *Sharing best practices in operations:* this is perhaps the area that is most needed because it is the most neglected by international organisations. This is where true peer mentoring is needed because it is only personnel from operating nuclear facilities that can truly understand and communicate how to build excellence in operations within other facilities. International organisations either lack this cadre of experienced personnel, or do not have the mandate to provide assistance at this level. This is also one of the most difficult because it requires organisations that typically have the least time and effort to spare to provide time and effort toward this cause. Organisations that are truly world-class are such because they are highly focused on their own operations, and do not normally allocate time and effort to train outside organisations. Historically it has been left up to the countries seeking assistance to exert their own significant time and effort to locate such expertise. However, if true global non-proliferation is to be achieved, it is in the best interest of experienced countries to find ways to engage their nuclear power industries and incentivise them to contribute and become structured partners by providing increased opportunities for countries seeking assistance. This has already been done to a significant extent in nuclear safety with organisations such as the World Association of Nuclear Operators because of the accepted reality that ‘an accident anywhere is an accident everywhere.’ Such international mentoring and collaboration should also be established for security and safeguards because the same mantra *should* be true regarding a proliferation incident.
- *Providing access to nuclear facilities:* this goes hand in hand with the previous issue regarding sharing best practices in operations. Access to facilities in countries with large established nuclear programmes is critical if partner countries are to truly experience safeguards and security in action. Humans are hardwired to learn from their own experience and from what they physically see and do. Seeing organisations in action and witnessing how they ‘practice what they preach’ is invaluable in instructing individuals on how these sometimes abstract concepts are actually put into practice. This too is a difficult issue, especially with regard to tightening security requirements at nuclear facilities. These security postures should be implemented with common sense, and the understanding that adequately vetted individuals from legitimate nuclear programmes from eager countries are not just casual visitors or observers, but critical partners in global security and safeguards. It will be a missed opportunity if such individuals are not allowed to experience for themselves and take back the lessons to the organisations in their home countries. It is important to distinguish here between sensitive information and the process of security and safeguards. Students do not need to know about specific security measures such as location and types of security cameras or the location or amount

of nuclear material. What they do need to know are the systems and processes that are in place to secure and control a facility and its nuclear material, and they require information regarding how those systems and process were developed to fit specific situations and requirements. No sensitive information need be exposed; rather there should be a willingness by staff in an organisation to share relevant knowledge about processes.

- *Strengthening emergency preparedness and response to nuclear emergencies:* any dysfunctions in how safety, security and safeguards are implemented and interact will become readily apparent during an emergency involving nuclear material or a nuclear facility. These programmes are strong in countries with large established nuclear power programmes and are part of the facility operations, and include periodic exercises to challenge and improve the system. They should work together to share their experiences to support newcomer countries.
- *Improving communication and stakeholder involvement:* as was already discussed, non-proliferation is not very well understood by the majority of nuclear workers, and even less by the general public. Experienced countries should work together to support outreach and communication with stakeholders and the public in the countries to educate them about safeguards and security and other elements of the non-proliferation regime.
- *Sharing best practices for implementing integrated management systems:* experienced countries have significant experience in this area that could be of great benefit to newcomer countries as practical examples of how domestic elements of safeguards and security are integrated into safety as well as other operational aspects of nuclear facilities.
- *The value of early design input for safeguards and security:* the incorporation of early input of security and safeguards into the facility design can yield not only cost savings, but significant improvements to how the facility and the country can comply with its non-proliferation commitments. Some experienced countries are also nuclear power technology suppliers, and as such they can be influential in supporting this concept as well as providing lessons learned that can benefit newcomer countries.
- *Development of indigenous education and training programmes to develop adequate human resources:* to a degree, experienced countries are already supporting the development of education and training programmes for newcomer countries; this allows the newcomer countries to develop the human resources and workforce needed for their domestic nuclear programmes. However, more work is needed to support the universities and research organisations that contribute the technical expertise

needed in the development and implementation of these programmes. Supporting university curriculum development, encouraging partnerships between universities, supporting visiting professorships and student fellowships, developing training centers and providing access to nuclear facilities will help countries leverage their limited resources.

Concluding thoughts

It is sometimes said that ‘culture is what is left when you have forgotten everything.’ This is an amusing way to state that culture is a hard-to-define quantity that permeates the fabric of day-to-day activities. Translated to an operating nuclear facility, it includes the underlying theme of how the plant is operated, maintained, secured and safeguarded. The infrastructure that supports safety, security and safeguards is the most tangible aspect of this culture. Developing the proper infrastructure as early as possible in a nuclear power programme is very important in ensuring the sustainability of the programme, as well as providing the international community with positive assurance that nuclear activities in the country are for peaceful purposes. As such, security and safeguards are part of this infrastructure, and should have the same standing as safety. But because of their unique application to nuclear energy, these concepts are sometimes not well understood, and thus effective strategies must be crafted to make sure these concepts are given the appropriate consideration during the nuclear programme development period. The integration of security and safeguards with safety, and taking advantage of commonalities between them is one such strategy.

In the end, safety, security and safeguards have a common premise: they are all ‘preventive’ techniques, and as such there is a definite relationship between the legal, regulatory and operational aspects of their implementation. The lessons learned in universal acceptance and adherence to a safety culture in the nuclear industry can be used for the development of an organisational culture that supports security and safeguards as well. Because of their interrelatedness with safety, effective security and safeguards implementation is not possible without the basic framework provided by safety culture. Safety culture is well established, and security culture is becoming better understood, but safeguards culture is not widely understood outside specialised disciplines. However, safeguards are the lynchpin of a state’s compliance with the global non-proliferation regime, and will work best if considered from the beginning.

Regarding the term ‘culture’, there is no sense in trying to develop separate cultures for safety, security and safeguards when dealing with a single organisation. Although each discipline has its own unique attributes, the same basic tenets apply to all of them. A sense of personal responsibility to make sure each job gets done right,

a proactive management that supports and awards appropriate behavior and supplies the necessary resources for its personnel and facilities, a spirit of cooperation between individuals in different job functions towards a common goal, a sense of empowerment by employees such that they know that their concerns will be heard and considered, a workforce that has the necessary education, skills, and training to perform its duties, and a questioning attitude that considers the task at hand rather than rote adherence to static procedures are all hallmarks of a good organisational culture. And with regard to security and safeguards, the main task should be to craft effective strategies to help newcomer countries better integrate them within their respective organisational cultures.

Ultimately, this integration will better meet the needs of the newcomer countries, which is one of the highest priorities for the IAEA and the technical assistance it provides under Article IV of the NPT. Given the limited resources all nations face, support from experienced countries to promote the development of organisational cultures that supports security and safeguards in new nuclear power countries is paramount if they are to achieve sustainable nuclear programmes that are safe, secure and peaceful and provide the maximum in benefit for economic development and prosperity.

The views and opinions expressed herein are of the author and do not necessarily state or reflect those of the United States Government or any agency thereof.

Endnotes

- 1 *Milestones in the Development of a National Infrastructure for Nuclear Power*, NGG3.1 (Rev. 1), International Atomic Energy Agency, Vienna, 2015.
- 2 IAEA Nuclear Security Series No. 7, *Implementing Guide, Nuclear Security Culture*, Vienna 2008.
- 3 United Nations General Assembly Session 1 Resolution 1, *Establishment of a Commission to Deal with the Problems Raised by the Discovery of Atomic Energy*, A/RES/1(I), 24 January 1946.
- 4 US Department of State, Office of the Historian, history.state.gov/milestones/1945-1952/baruch-plans
- 5 Article IX of the NPT, paragraph 3, states that 'for the purposes of this Treaty, a nuclear-weapon state is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967.' At that time, the NWSs were the United States, Soviet Union, United Kingdom, France, and China.
- 6 World Nuclear Organization—Emerging Nuclear Energy Countries. www.world-nuclear.org/info/Country-Profiles/Others/Emerging-Nuclear-Energy-Countries/.
- 7 www.iaea.org/newscenter/statements/atoms-peace-21st-century-1, Atoms for Peace in the 21st Century, IAEA Director General Yukiya Amano, Energy Market Authority Distinguished Speaker Programme, Singapore.
- 8 *Handbook of Nuclear Law*, International Atomic Energy Agency, Vienna, 2008.
- 9 'International Atomic Energy Safety Standards, Fundamental Safety Principles, Safety Fundamentals', SF-1, Vienna 2006.

- 10 The Convention on Nuclear Safety is a 1994 IAEA treaty that governs safety rules at nuclear power plants in state parties to the convention (INFCIRC/449). The convention creates obligations on state parties to implement certain safety rules and standards at all civil facilities related to nuclear energy. These include issues of site selection, design and construction, operation and safety verification and emergency preparedness.
- 11 The term 'State' is used to denote an IAEA Member State (country). In this chapter the term state is used synonymously with country.
- 12 IAEA Service Series 31 'Safeguards Implementation Practices Guide on Establishing and Maintaining State Safeguards Infrastructure,' Vienna, 2015.
- 13 Edgar H. Schein is credited with first using the term 'corporate culture.'
- 14 Schein, Edgar H., *Organizational Culture and Leadership*, Third Edition, John Wiley & Sons, San Francisco, 2004.
- 15 In the past five decades, industries in countries such as the United States have realised that where adequate laws exist and regulations are enforced, organisations and companies that place a prime value on the safety of their workforces and the quality of their products generally also have the highest levels of productivity, competitiveness, and profit (in other words, sustainability).
- 16 IAEA Nuclear Security Series No. 19, 'Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme.'
- 17 The closest analogy would be to financial accounting where currency is strictly controlled and accounted for, and its movement is tracked.
- 18 One example of such an international instrument is United Nations Security Council Resolution 1540, which affirms that the proliferation of nuclear, chemical and biological weapons and their means of delivery constitutes a threat to international peace and security. The resolution obliges states, inter alia, to refrain from supporting by any means non-state actors from developing, acquiring, manufacturing, possessing, transporting, transferring or using nuclear, chemical or biological weapons and their delivery systems. It also imposes binding obligations on all states to adopt legislation to prevent the proliferation of nuclear, chemical and biological weapons, and their means of delivery, and establishes appropriate domestic controls over related materials to prevent their illicit trafficking. www.un.org/en/sc/1540/.
- 19 Technical Meeting on Safety, Security and Safeguards: Interfaces and Synergies for the Development of a Nuclear Power Programme, 26–29 November 2012, International Atomic Energy Agency, Vienna, Austria, www.iaea.org/NuclearPower/Meetings/2012/2012-11-26-11-29-TM.html.
- 20 See www.apsn-safeguards.org
- 21 See ec.europa.eu/jrc/en/research-facility/european-nuclear-security-training-centre
- 22 ROK–US. Civil Nuclear Nonproliferation Collaboration in Third Countries, January 2015, Arms Control and Non-Proliferation Initiative, Fred F. McGoldrick, Robert Einhorn, Duyeon Kim and James L. Tyson. www.brookings.edu/research/reports/2015/01/korea-us-civil-nuclear-nonproliferation-collaboration-einhorn.

