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**AFTER FUKUSHIMA: IMPLICATIONS FOR NUCLEAR 3S
(SAFEGUARDS, SAFETY AND SECURITY)**

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Abstract

The principal lesson of Fukushima is that nuclear activities cannot be regarded as the exclusive province of individual states—nuclear activities have potential consequences well beyond the borders of any one state. Even if an incident does not result in significant transboundary contamination, there will be an impact on confidence in and support for nuclear energy. Likewise, a nuclear detonation or major nuclear sabotage by terrorists will have global repercussions. Fukushima has also demonstrated that neither individual states nor the international community as a whole are well served by relying exclusively on national oversight of nuclear activities. If a leading state such as Japan has difficulties with nuclear regulation and emergency management, what can be expected with smaller states, and those planning new nuclear programs?

The “3S”—safeguards, safety and security—is a convenient shorthand term covering nuclear governance, i.e. the institutional arrangements for regulating the use of nuclear energy. This paper discusses international governance—the framework of treaties, decisions of international bodies, cooperation arrangements and other mechanisms for balancing national and international interests, particularly in the areas of nuclear non-proliferation, safety and security.

The key international interests can be summarized as follows: that the use of nuclear energy does not lead to the proliferation of nuclear weapons; and that it does not endanger human and environmental health and safety, whether by accident or terrorist action. There is also an international interest in ensuring that nuclear energy is able to realize its potential to mitigate greenhouse gas emissions—this is very much dependent on public and political confidence in nuclear energy, which in turn depends on how well the 3S are implemented.

The international interest in non-proliferation is long-recognised, through a number of treaties and the international safeguards system. The international interest in nuclear safety and security is also of fundamental importance, but unfortunately less well reflected in governance arrangements, too much of which is voluntary. Fukushima—and also the Iranian nuclear crisis—show the need to find a more appropriate balance between national and international interests in the conduct of nuclear energy.

The first six decades of the nuclear age have been characterized by an emphasis on nuclear sovereignty, the predominance of state rights over the international interest. This 20th century attitude is out of step with contemporary needs. Nuclear energy has long since developed beyond military applications and is now an important source of global electricity supply. Nuclear energy should no longer be seen as an instrument of

national policy. Rather, nuclear energy can make a major contribution to the common interests of mitigating climate change and enhancing energy security and economic development. A change of mindset is needed, away from the emphasis on sovereignty, to a recognition of shared interest, shared responsibilities, greater international transparency and accountability, and greater cooperation and collaboration.

Although the need for a new approach is global, such an approach might proceed on a regional basis. As well as regional cooperation in safeguards, safety and security, regional arrangements could encompass such matters as regional fuel cycle facilities, fuel supply assurances and cooperation in fuel management. In regions where there is no experience of operating nuclear power programs, such as the Middle East and South-East Asia, nuclear programs could even be owned and operated on a regional or transnational basis. Our own region could lead on these issues through the development of an Asia-Pacific nuclear energy community.

Introduction

A comprehensive study of the technical aspects of the Fukushima accident will take some time, maybe years. Without preempting the eventual findings, the following observations can be made now:

- (1) Unlike the Three Mile Island and Chernobyl accidents, Fukushima was not caused by human error but natural catastrophe. Despite the reactors being an old design without the additional safety features of modern reactors, they shut down as intended when the earthquake hit—the radiation releases were a consequence of the back-up power systems being overwhelmed by the subsequent tsunami.
- (2) Although the immediate cause was a natural catastrophe, the situation was exacerbated by a number of decisions taken—or not taken—by TEPCO and the regulators, especially the failure to relocate emergency generators above ground in watertight buildings (one of the safety upgrades recommended by the US Nuclear Regulatory Commission following 9/11). After the accident the IAEA pointed to the issue of insufficient regulatory independence in Japan, not the first time it had done so. It is understood this issue had also been raised in the national review process under the Convention on Nuclear Safety. The Japanese government has accepted the point and announced reform of the nuclear safety regulatory arrangements.

Impact of Fukushima

The principal lesson of Fukushima is that nuclear activities cannot be regarded as the exclusive province of individual states—nuclear activities have potential consequences well beyond the borders of any one state. Even if an incident does not result in significant transboundary contamination, there will be an impact on confidence in and support for nuclear energy—demonstrated for example by the German government's decision to phase out nuclear energy as a reaction to Fukushima.

Fukushima has also demonstrated that neither individual states nor the international community as a whole are well served by relying exclusively on *national* oversight of nuclear activities. If a leading state such as Japan has difficulties with nuclear regulation and emergency management, what can be expected with smaller states, and those planning new nuclear programs?

Nuclear 3S and nuclear governance

The Fukushima accident has major implications for the “3S”—safeguards, safety and security. The implications for *safety*, touched on above, are obvious. There are also important implications for *security*—e.g. the need to counter the risk of terrorists attempting to replicate the Fukushima accident conditions through sabotage of reactors and/or spent fuel storage ponds. The implications for the other “S”, *safeguards*, may be less obvious, but are just as real—as with safety and security, there is the need to find the right balance between *national* and *international* interests.

The “3S” is a convenient shorthand term covering *nuclear governance*, i.e. the institutional arrangements for regulating the use of nuclear energy. While nuclear governance has both domestic and international aspects, the focus of this paper is *international* governance—the framework of treaties, decisions of international bodies, cooperation arrangements and other mechanisms for balancing national and international interests, particularly in the areas of nuclear non-proliferation, safety and security.

Today there is no single international nuclear governance system. Instead there are arrangements that vary according to the different treaties involved. The International Atomic Energy Agency (IAEA) is the nearest there is to a global nuclear governance body, but its authority over the activities of states is limited by its Statute and the terms of specific agreements. The IAEA’s decision-making authority is greatest in the area of safeguards. For nuclear safety and security its role is largely to recommend standards, coordinate cooperation, and provide training and advice.

The system of nuclear governance in place today has evolved over many decades, in response to the demands and pressures that arise from time to time. Currently these include:

- the growing interest in nuclear energy, including from many countries without nuclear power experience;
- the proliferation challenges of North Korea and Iran, and the lack of success to date in resolving these;
- a more positive atmosphere for taking substantive steps towards nuclear disarmament; and
- the impact of the Fukushima accident on confidence in nuclear energy.

Many countries, especially in the Asian region, are planning nuclear power programs to meet the rapidly increasing growth in electricity demand. Although the lessons and implications of Fukushima will take some time to clarify, nuclear energy’s capacity to provide low-carbon base-load electricity means there is unlikely to be a major turning away from nuclear. However, Fukushima is likely to prompt a rethink on nuclear safety governance, leading to a greater international involvement in this area.

The current international architecture for non-proliferation, with the 1970 Nuclear Non-Proliferation Treaty (NPT) at its centre, has worked well, but needs improvement to address emerging problems, especially to avoid the spread of proliferation capabilities. Now there is the question of what changes might be made in nuclear safety, and whether the areas of non-proliferation, security and safety will continue to proceed separately, or might in some way be drawn together. The IAEA is working on harmonization of guidelines and requirements in these areas at the technical level—but major changes to governance have to be addressed at the political level.

Nuclear sovereignty and the international interest

The first six decades of the nuclear age have been characterized by an emphasis on *nuclear sovereignty*, the predominance of state rights over the international interest. But the failings revealed by Fukushima—and also the ongoing Iranian nuclear crisis—show the need for a more appropriate balance between national and *international* interests. The international interest should not be seen as some external imposition, contradicting the interests of states, but is essentially the aggregation of the common *national* interest of every state. It is essential for nuclear governance arrangements to properly reflect the international interest.

What is the international interest? The key interests—reflected in arrangements dealing with safeguards, safety and security, the “3S”—can be summarized as follows:

- that the use of nuclear energy does not lead to the proliferation of nuclear weapons; and
- that nuclear energy does not endanger human and environmental health and safety, whether by accident or terrorist action.

There is a broader international interest at stake. If governments are serious about greenhouse gas mitigation, nuclear energy must be part of the energy mix—apart from hydropower, nuclear is the only proven low-emission source of base-load electricity. But if nuclear weapons proliferation, accidents or terrorism cause loss of confidence in nuclear energy, so that nuclear is not allowed to realize its potential for greenhouse gas mitigation, the consequences will be global. Public and political confidence in nuclear energy depends on how well the 3S are implemented.

Nuclear sovereignty—a hangover from nuclear energy’s military beginnings

The international interest in the use of nuclear energy was clearly recognized at the outset of the nuclear age. One of the very first issues addressed by the newly established United Nations in 1946 was “the problems raised by the discovery of atomic energy.” Proposals were advanced for placing nuclear programs under international control in order to prevent the spread of nuclear weapons (at that time held only by the United States). These efforts were unsuccessful, however, and nuclear energy became subsumed in the ultimate expression of sovereignty—national security and preparations for war. By 1968 when the NPT was opened for signature, the number of nuclear-weapon states had grown to five—the United States, Soviet Union, United Kingdom, France and China.

Since then, *nuclear sovereignty* remains the prevailing mindset. This 20th century attitude is out of step with contemporary needs. Nuclear energy has long since developed beyond military applications and is now an important source of global electricity supply. Apart from the aberrant behaviour of North Korea and Iran, and the arms race between India and Pakistan, there is serious interest in nuclear disarmament. The United States and Russia have already achieved major arms reductions, and ideas are being developed to take these reductions much further and to include the other nuclear-armed states. Nuclear energy should no longer be seen as an instrument of national policy. Rather, nuclear energy can make a major contribution to the common interests of mitigating climate change and enhancing energy security and economic development.

Advancing the international interest

The international interest in *non-proliferation* is well recognized. Nuclear proliferation is a threat to every state—and is also a threat to our common interest in nuclear *disarmament*. This international interest is particularly reflected in the NPT and IAEA safeguards. There is also a substantial international interest in nuclear *safety* and *security*, though unfortunately

less well reflected in international governance arrangements. Fukushima has reinforced that major nuclear accidents have global consequences. So too will a major terrorist incident involving a nuclear facility or nuclear or radiological materials.

Nuclear governance arrangements have a long way to go to reflect the international interest appropriately. A change of mindset is needed, away from the emphasis on sovereignty, to a recognition of shared interest, shared responsibilities, greater international transparency and accountability, and greater cooperation and collaboration.

Non-proliferation and safeguards

This is the area where international governance is strongest—the NPT, IAEA safeguards and related treaties and mechanisms: UN Security Council Resolution 1540, various regional and bilateral agreements, the Nuclear Suppliers Group, the Proliferation Security Initiative (PSI), the CTBT (Comprehensive Nuclear-Test-Ban Treaty), nuclear-weapon-free zones, and so on.¹

Commitments given under the NPT by non-nuclear-weapon states include not to acquire nuclear weapons, to use nuclear energy exclusively for peaceful purposes, and to cooperate with IAEA safeguards to verify compliance with these commitments.

International decision-making authority is strongest in the area of non-proliferation. The IAEA has the authority to determine whether states are in compliance with safeguards agreements. In so doing, in effect the IAEA determines whether states are violating the NPT, thereby exercising an essential function under the NPT which itself has no procedures for such decisions. Non-compliance must be referred to the Security Council. The IAEA is also required to report to the Security Council any questions arising that are within the competence of the Council as “the organ bearing the main responsibility for the maintenance of international peace and security.” The United Nations Charter² authorises the Security Council to make legally-binding decisions to maintain or restore international peace and security.

Governance issues in non-proliferation and safeguards

Even in non-proliferation and safeguards, where international authority is strongest, there are major governance shortcomings. One aspect is acceptance—or more particularly non-acceptance—of the most effective form of safeguards, set out in the IAEA’s *Additional Protocol (AP)*. The model AP was agreed by the IAEA’s Board of Governors in 1997 and each state was asked to conclude an AP with the IAEA. The IAEA has made it clear that for states without an AP in place it is unable to assure the absence of undeclared nuclear activities.³ Today over 75% of non-nuclear-weapon states party to the NPT having significant nuclear activities have ratified the AP⁴, demonstrating that the AP is now established by international practice as part of the NPT safeguards standard.

Yet a number of states continue to maintain that the AP is “optional”, and five (or six) non-nuclear-weapon states party to the NPT that have significant nuclear activities have not

1. Also relevant is the CPPNM (Convention on the Physical Protection of Nuclear Material), discussed under Nuclear Security.

2. Chapter VII.

3. That is, nuclear activities which the state is obliged to place under safeguards and has failed to do so.

4. 48 out of 62 such states. A further 7 states with significant nuclear activities have signed an AP but not yet ratified.

commenced negotiation of an AP.⁵ Seven such states have signed an AP but not yet ratified, including Iran which commenced implementation of its AP but then “suspended” it. In addition, there are over 50 non-nuclear-weapon states without, so far as known, significant nuclear activities, that have yet to sign an AP. The number of holdouts and the continuing assertion that the AP is optional are a clear sign that a number of states place their perception of *nuclear sovereignty* above their international responsibilities. It is no coincidence that the holdouts include states in non-compliance with their safeguards agreements, namely, North Korea, Iran and Syria.

A major new proliferation challenge, raised by the Iranian crisis, is how to deal with a nuclear program claimed to be peaceful but evidently having a military purpose. It needs to be recognized that “nuclear hedging”—setting out to establish a nuclear weapon break-out capability—is *not* a peaceful purpose allowed by the NPT. Crucially, there is no international process for approving proliferation-sensitive stages of the nuclear fuel cycle—already a large number of states have the capability to produce fissile material, and if nothing changes this number will increase.

When the NPT was concluded, it was assumed that IAEA safeguards would provide *timely warning* of any misuse of nuclear facilities, giving the international community opportunity to intervene. But a combination of factors—the time taken by international deliberative processes, the rapid breakout potential of modern enrichment technology, the lack of success of international sanctions on Iran and North Korea—demonstrates the need for new institutional arrangements to better give effect to non-proliferation commitments.

Towards a new international framework for the nuclear fuel cycle

It is neither necessary nor cost effective for every state with a nuclear power program to have uranium enrichment and reprocessing facilities. Because possession of such capabilities could increase international tensions—potentially leading to “virtual” arms races—and also because of the technical complexity and high costs, most states have not sought to establish these capabilities.

The NPT does not adequately address this issue. When the NPT was negotiated it was thought that enrichment services, and reprocessing services if required, would be provided by the nuclear-weapon states and a few other advanced states (such as Germany and Japan)—it was not anticipated that proliferation-sensitive technologies would spread. Contrary to Iran’s assertions, the “inalienable right” to use nuclear energy referred to in Article IV of the NPT does not mean an unqualified right to proliferation-sensitive technologies. In fact the Treaty expressly limits use of nuclear energy to *peaceful purposes*—which by no stretch of the imagination includes building a nuclear weapon capability. But developing countries are now sensitized to what they perceive as moves to deny their rights and to preserve the technological advantage of existing nuclear suppliers.

A weakening of the non-proliferation regime is in no-one’s interest. It is essential to move beyond these political arguments, to find a way that ensures the world can benefit from nuclear energy free of the risk of proliferation. In recent years several initiatives, outlined below, have sought to avoid the political arguments about “rights” by instead creating conditions of supply such that states will have no *legitimate* reason to develop national enrichment and reprocessing programs.

5. The holdouts are Argentina, Brazil, Egypt, Syria and Venezuela—and North Korea, where views are divided as to whether it has validly withdrawn from the NPT.

President Obama in his landmark speech on nuclear non-proliferation and disarmament in Prague on 5 April 2009 spoke of the need for “a new framework for civil nuclear cooperation ... so that countries can access peaceful power without increasing the risks of proliferation.” There are several initiatives in this direction, though so far these have not been drawn together into an overall program or vision.

One aspect is the development of *multilateral approaches* to the nuclear fuel cycle—meeting the legitimate concerns of states for energy security, spent fuel management and equity without the need for national enrichment and reprocessing programs. As already noted, international operation of the nuclear fuel cycle was proposed unsuccessfully in the 1940s. This was looked at again by INFCE (International Nuclear Fuel Cycle Evaluation) in the 1970s, and the IAEA’s study of proposals for multilateral approaches in 2005.

Current initiatives include: long-term nuclear supply assurances; international fuel banks; and international fuel cycle centres. The first such centre has been established by Russia, at Angarsk. States can become partners in the centre, with assured supply of product and profit sharing. Russia has given the IAEA a monitoring role at the centre and the associated fuel bank.

IFNEC (the International Framework for Nuclear Energy Cooperation—successor to GNEP), a collaborative effort by currently 29 participating states and 30 observer states, is working towards practical arrangements for long-term supply assurances, international cooperation on spent fuel management, and so on.

Gaining support for multilateralisation of proliferation-sensitive stages of the fuel cycle will be a challenge, but already there are practical precedents—in addition to Russia’s international enrichment centre, there is the long-established Urenco enrichment group. What is needed now is to change the focus from assertions of national “rights” to the common interests of non-proliferation, energy security and strengthened international cooperation.

Nuclear safety

Compared to non-proliferation and safeguards, the international role in nuclear safety is weak. The IAEA has only a recommendatory role. By its Statute, the IAEA is authorised to develop and promulgate nuclear safety standards, but these are only voluntary. As with safeguards, the Statute provides that states may conclude arrangements giving the IAEA authority to apply safety standards. No such arrangements have been concluded to date.

After the Chernobyl accident, governments and industry realized that substantial steps were needed to regain public confidence. This prompted a series of new agreements—including the Convention on Nuclear Safety, the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident.⁶ After Fukushima, international response so far has been surprisingly muted. With some notable exceptions, governments and industry don’t seem to understand the damage to public confidence and the need for change, to move from state primacy to greater international cooperation and accountability.

The principal treaty in this area, the 1994 Convention on Nuclear Safety, which deals with power reactors, is described as an “incentive instrument.” Parties are committed to apply fundamental safety principles but there are no detailed or binding standards. When the

6. Other major treaties on nuclear safety include the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Convention was negotiated some states proposed an active monitoring role for the IAEA, but this was not agreed. The Convention has a broad peer review process, which requires each party to report on its implementation of the Convention. These national reports are discussed at meetings held every three years. While many parties publish their reports, formally these reports and the discussion of them are confidential to the parties.

More specific peer reviews, including at the facility level, are offered by the IAEA and by the non-government World Association of Nuclear Operators (WANO). IAEA reviews are entirely voluntary—there is no obligation to invite a review or to follow its recommendations. In October 2011 the members of WANO agreed to make the WANO peer review process mandatory. This is a welcome development—but the WANO process, like the IAEA process, lacks transparency. Outsiders have no way of knowing how well the process works in practice.

The Fukushima accident led to the calling of two high-level nuclear safety meetings in 2011—by the IAEA Director General on 20-24 June, and by the UN Secretary General on 22 September. The IAEA meeting resulted in the adoption of an action plan on nuclear safety. However, this plan is seen by a number of states as failing to meet international expectations—containing “few new commitments and little in the way of increased transparency or safety peer reviews”.⁷ A number of states, notably France, proposed mandatory, regular and transparent external safety inspections. This was resisted by the US, India, China and Pakistan, amongst others.

At the September 2011 meeting the Secretary General called for “greater transparency and open accountability”, and for stronger international safety standards. French President Sarkozy said that while the IAEA plan was a step in the right direction, the world could not accept different states having different standards. “The highest requirements must be applied to everybody on all continents,” President Sarkozy said. “This must go through a harmonization of technical safety standards.”

Despite the position taken by France and several others, at this stage nuclear safety remains very much a matter of national prerogative. Fukushima shows the risks in this. For example, over a number of years the IAEA and others had identified the issue of inadequate regulatory independence in Japan—only after Fukushima has the Japanese government accepted this and committed to better arrangements.

Currently there is resistance from key states to the idea of binding nuclear safety standards and international safety inspections. While these issues are debated further, a minimal step that should be taken is to strengthen the peer review process, through a commitment by governments to seek more regular and in-depth peer review, and to implement recommendations from peer review. These processes should be transparent, so it is known where peer reviews have been undertaken and where they have not, and whether recommendations have been acted upon, and if not, why not.

Another action, prompted by Fukushima, would be to strengthen the safety certification process for reactor upgrades. The civil aviation industry demonstrates the value of international cooperation in ensuring effective safety regulation and best safety practice. Aircraft manufacturers’ safety upgrade notices are enforced by regulators around the world. Why shouldn’t the same practice apply in the nuclear industry?

7. Quoted from a Canadian delegate.

For the future, governments should consider the possibility of concluding agreements with the IAEA, as is done with safeguards, giving the IAEA an active monitoring role in nuclear safety.

Nuclear Security

The strong international interest in nuclear security is reflected by the Nuclear Security Summit process initiated by President Obama. If terrorists succeed in stealing fissile material in one state, this could pose a threat to other states. A nuclear detonation or major nuclear sabotage by terrorists will have global repercussions. As with nuclear safety, a major nuclear security failure anywhere can impact everywhere. Every state benefits from assurance that nuclear security in other states is implemented at a high standard. Yet today there is a lack of transparency in how well states are performing in nuclear security, and there is resistance to changing this within the nuclear security community.

In nuclear security, the parallels with nuclear safety are striking. Here too the IAEA is denied a monitoring role. The IAEA's authority is limited to recommendations and advice. Underscoring the weakness of nuclear security governance, some states even have challenged whether the IAEA should have a role at all, and much of the IAEA's work in this area is funded by voluntary contributions rather than the regular budget.

The main treaty, the Convention on the Physical Protection of Nuclear Material and its 2005 Amendment, sets out fundamental principles but not detailed standards. Today, six years after the 2005 Amendment was opened for signature, still less than half the number of ratifications required for its entry-into-force have been obtained⁸—a poor reflection on the attitude of most states towards their international responsibilities in nuclear security.

The IAEA issues security guidelines which are only recommendatory. It is entirely up to the discretion of states whether they seek and pay attention to these recommendations. Unlike nuclear safety, there is no mandated peer review process. There are two peer review mechanisms—by the IAEA and more recently by the non-government World Institute for Nuclear Security (WINS). These are entirely voluntary, as to whether the state invites review and whether it follows review recommendations.

Today the idea of an international nuclear security inspectorate is anathema to most national security officials. For the future, states should seriously consider how an international security inspection process could be developed so as to operate to their benefit.

For the present, international peer review may be the most that can be achieved. Peer review is a powerful mechanism for ensuring good security performance. The international interest should be strengthened through a commitment to regular peer review, and a commitment to transparency. Peer review should be established as a regular process, with each state committed to inviting peer reviews commensurate with the nature and scale of its nuclear activities. It is important to appreciate that external review is not just about compliance, but helps share best practice and can be vital in identifying overlooked vulnerabilities.

To the extent compatible with protecting sensitive information, the peer review process should be transparent, with states reporting on reviews undertaken and whether recommendations were followed. Transparency would help to ensure that reviews are taken

8. Entry-into-force requires ratification by 2/3 of the parties to the CPPNM, i.e. 97 ratifications. To date only 49 have ratified.

seriously. Transparency would also help identify where international cooperation should be focused, in areas such as training and capacity-building.

The need to avoid compromising security should not be used as an excuse for avoiding external review. The managed access concept is well established, and states can readily establish appropriate procedures. As noted earlier, the members of WANO have endorsed mandatory peer review. We can hope the members of WINS will do the same, but this may be difficult to achieve while WINS is still building up membership.

It is to be hoped better progress is made on these issues at the next Nuclear Security Summit, in Seoul in March 2012.

Regional collaboration

Pending global agreement on the changes discussed in this paper, states could consider regional arrangements to further these changes. For example, in regions where there is no experience of operating nuclear power programs, such as the Middle East and South-East Asia, not only could there be close consultation and collaboration on regulation, nuclear programs could even be owned and operated on a regional or transnational basis.

The Fukushima accident has highlighted issues with the adequacy of international nuclear safety governance. The Nuclear Security Summit process is looking at similar issues in the security area. At the same time, there is increasing awareness of the need to avoid proliferation risk from the growth in nuclear programs and particularly the spread of proliferation-sensitive technologies. There is discussion of a possible new international framework for nuclear energy, ensuring that states using nuclear energy have long-term security of supply, assistance with fuel management, and cooperation to ensure best practice in the operation of nuclear facilities. While these issues are of global importance, practical steps might proceed more expeditiously at a regional level.

The Asian region is now a major growth area for nuclear energy, and states in the region are increasingly concerned about the need for assurance that nuclear programs in neighbouring states meet the highest standards of nuclear safety, security and non-proliferation. It is timely to study the possibility of a regional framework for nuclear governance for Asia and the Western Pacific.

In our own region, consideration could be given to an idea of an Asia-Pacific nuclear energy community. This community could ensure transparency and build confidence in nuclear programs in the region. Its functions could include: high-level consultation on nuclear plans and programs; regional cooperation and promotion of best practice in safeguards, security and safety; cooperation on emergency management; and collaborative arrangements for energy security and fuel cycle management.

Developing a 3S culture

Fukushima should prompt the nuclear community to do much more to develop a strong professional culture. There has been much discussion of a “3S culture”, drawing together the disciplines of safeguards, safety and security, but no serious effort to take this further. These are still seen as separate compartments in nuclear governance. “Silo-ing” between the three specialisations is all too common, even within the same organisation.

Culture involves a set of shared values—standards and principles—that affect attitudes and behaviours. A 3S culture should exist at the level of the individual, the facility and/or

organisation, and the state. Operators, governments and the international community would benefit from the development of a 3S culture, a professional approach that draws together the disciplines of safeguards, safety and security and builds on the synergies in these areas.

Examples of these synergies include:

- effective control of nuclear material underpins both safeguards and security;
- safety and security are both concerned with protection of the public against radiation exposure; and
- there is a need to ensure that measures adopted for security do not compromise safety or safeguards, and vice versa.

At the individual level, a 3S culture should influence individuals in how they adhere to performance requirements, procedures and facility/organisation policies. At the facility/organisation level, a 3S culture should reflect issues such as the priority assigned to best practice, training and motivation of staff, and commitment to continuous improvement. At the national level, a 3S culture should reflect commitment to international responsibilities and full cooperation with the IAEA and other relevant organisations.

A 3S culture could be reflected not only in nuclear operations, but in governance arrangements, e.g. peer reviews that look at safeguards, safety and security, safeguards inspectors who can advise on safety and security matters, and so on.

We need to see a culture, shared by all sections of the nuclear community, in favour of promoting the public good ahead of commercial and other expediencies. A strong 3S culture should reflect commitment to international responsibilities as well as to international collaboration and experience-sharing.

The establishment of regional training centres on nuclear security and related areas in Japan, South Korea, China and India provide the opportunity to develop and promote a 3S culture in the Asia-Pacific region.

Conclusions

The major lesson of Fukushima—and also the ongoing Iranian crisis—is that the 20th century emphasis on *nuclear sovereignty* is increasingly out of step with international needs for assurance, transparency, accountability and cooperation.

For nuclear energy to make a substantial contribution to global energy needs this century, it is essential to build confidence that it does not present unacceptable proliferation, safety, and security risks. Every state—and the international community as a whole—has a strong interest in how other states conduct their nuclear programs. The potential impact of nuclear programs, positive and negative, transcends narrow considerations of national sovereignty. Better governance arrangements, building on the principles of 3S and greater cooperation, are needed to ensure a more sustainable balance between national and international interests.

At the international level, nuclear governance can be strengthened by vesting more authority in the IAEA in the areas of safety and security, as well as non-proliferation and safeguards. The IAEA—or the Security Council—could also be given the authority to establish rules for location and operation of proliferation-sensitive nuclear activities, though currently it would be difficult to achieve the necessary political consensus for this.

A more acceptable approach would be to develop a new framework for nuclear energy, under which proliferation-sensitive stages of the fuel cycle could be undertaken by international

centres. The principal interest of states pursuing nuclear energy should be *energy security*—a safe, reliable, environmentally sustainable and economic power supply. International arrangements by which states could be guaranteed supply of nuclear fuel for the life of their reactors, assistance with fuel management (including spent fuel take-back), and cooperation to ensure best operational practice, especially in safety and security, will obviate any need for *national* programs in proliferation-sensitive technologies.

Although the need for a new approach is *global*, such an approach might be introduced on a *regional* basis. As well as establishment of fuel cycle facilities, there could be regional cooperation in safeguards, safety and security. In regions where there is no experience of operating nuclear power programs, such as the Middle East and South-East Asia, nuclear programs could even be owned and operated on a regional or transnational basis. Our own region could lead on these issues through the development of an Asia-Pacific nuclear energy community.