Encouraging Community Engagement as a Strategy to Strengthen Nuclear Security in our Borders

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Introduction

We are witnessing and harnessing the growth use of nuclear technology for power production and other applications from both developed and developing countries (IAEA, 2011). Regrettably according to International Atomic Energy Agency (IAEA), more than 100 member States who use radioactive materials that can be used to make dirty bombs are characterized by unsatisfactory control and management system (National Research Council, 2007). It is clear that global security challenges like illicit cross-border trafficking in arms, illegal immigrants, drugs, radiological, chemical and biological weapons which are global threats to international peace and security posed by armed conflict, terrorism, weapons proliferation and transnational organized crime groups cannot be managed by a single country (United Nations, 2016, IFPA, 2010). This is why nuclear and other radioactive materials are required by the IAEA for member States to have a tough alternative protection with effective capabilities to spot and capture their illegal movement both at borders and within their States (IAEA, 2007). Regardless of these international requirements, the porous borders and limited security resources has been critical challenge in developing countries which has left number of nuclear and other radioactive materials out of regulatory control. (Grossman-Vermaas, Huber, and Kapitanskaya, 2010).

The community engagement in security has been emphasized in fight against local and global crimes, for instance community has been engaged in fight against extremist groups, to improve illegal immigration, drug abuse, and other community security challenges (Ginkel, 2012,"ICE initiative to increase community engagement", 2016, Crawford, 2014). Community as one of the stakeholder in nuclear power programs if fully involved in each step as suggested by the International Nuclear Safety Groups (INSAG) from their reports on Stakeholders involvement can improve the nuclear security (INSAG, 2006). Proper community engagement in radioactive materials security across the borders and within States with porous borders and limited security resources can help to improve the response of enforcement agents to illicit and other cross border crimes.

Therefore, in this essay I will highlights the threat and challenges in developing countries with porous borders and limited security control resources, and come-up with the suggestion on how these countries should engage border community which includes public, civil societies and private sectors to improve the nuclear security and other radioactive materials out of regulatory control in their borders and within the States as one of the pledge and act of improving future global nuclear security.

The threat and risk of nuclear and other radioactive materials

The threat for nuclear and other radioactive materials within our countries, across international borders, and through the global maritime shipping system to fall on non-State actors through means such as black market, illicit trafficking, and dual use and cause devastation is real and no country is exempted in this threat (Apikyan and Diamond, 2015). Even with this global threat, still every single country intentional or unintentional is involved in assisting this illegal business in one way or another; a country can be involved as a source, or transit of illegal products or technology (Warden, 2004). , a country can be involved as transaction venue, technology transfer venue, and destination for operation. As a consequence of this nature of crime the United Nations under the Security Council resolution 1540(2004) took a global measure against this global crime, where all member states were obliged to first, 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, second, adopt legislation to prevent the proliferation of nuclear, chemical and biological weapons, and their means of delivery and third to take and enforce effective measures to establish domestic controls over biological, chemicals and radiological weapons of mass destruction materials to prevent their illicit trafficking and other illegal acts (“United Nations Official Document,” Resolution 1540, 2004).

Moreover globalization, privatization and the development of information communication technologies have aided criminal groups and give them access to technology, freedom to move illegal products, and skills to produce weapons of mass destructions. Some of developing countries in sub-Sahara Africa seem to have low to moderate risk for nuclear weapons of mass destruction (Grossman-Vermaas, Huber, and

Kapitanskaya, 2010). However the availability of radiological devices and low enriched uranium which are used in medical, industrial and research can be made to be used as dirty bomb. This global criminal activity can be possible in the presence of information technology such as, E-procurement, E-commerce, E-learning system and others which can be used to acquire illicit products, finance the illicit groups, and access and share knowledge which can enable non-State actors to fulfill their mission.

The instability and increased number of fragile and failed states in developed and developing countries is creating large number of extremist groups. The fact that these groups can use nuclear technology for malicious purpose have put States with porous borders, weak enforcement and low resources at greater risk (Bunn, Malin, Roth, and Tobey, 2016).

The efforts to secure radiological materials has been facilitated by competent International organizations, for example IAEA, UN Security Council, Comprehensive Test Burn Treaty Organization(CTBTO) all are working to control over nuclear and other radioactive materials through cooperation aimed at countering illicit trafficking, improving physical security at nuclear facilities, strengthening relevant international institutions to ensure security of nuclear technology throughout the World, other organization like the World Customs Organizations (WCO) which are coordinating and co-operating with partners and donors in establishing different programs aimed at counter of weapon of mass destruction(WMD) like WCO framework of standard and Operation, the International Criminal Police Organization – INTERPOL are also working with other States and international organizations to prevent the radiological, nuclear weapons. These International Organizations efforts and others, has assisted most of the countries develop domestic controls to prevent the proliferation of nuclear materials and their acquisition by non-State actors from their entire life cycle. However there are number of challenges which slow this tremendous effort, the serious challenge lie on border control and limited security resources available for the countries with porous borders (U.S Department of State, 2016).

In apprehending this, States in the Millennium Declaration resolution agreed that, they should strengthen the efforts to fight transnational crimes in all dimensions these crimes

are drugs, terrorism, illicit trafficking and other crimes (UNODC, 2016). To intensify this, the need for effective coordination and cooperation at local level, regional level and international level is essential (IFPA, 2010).

Challenges in border control

The first challenge lie on the government budget and the country economy, this embraces few equipment with low trained enforcement agents, border control, customs agencies to deter, detect and interdict illicit trafficking of nuclear and other radioactive materials inside their country and across their borders. For instance Sudan has experienced the more volatile economic period in the past, and now priorities are given mostly to agriculture and manufacturing to boost the economy. The country has long porous border with Ethiopia and Eritrea which facilitate the illegal movement of good and people, example of these movement is the Eritrea Islamist Jihad which operated out of Sudan (Davis, 2010). According to UN Humanitarian Chief Jan Egeland the ongoing situation in the regions like instability in Darfur has weaken the border security between Sudan, Chad and northern Central African Republic (Hanson, 2007). The emerge of extremist, illicit traffic, rebels and terrorist groups like Al-Shabaab, Al-Qaida, ISIS and Janjaweed. These groups have different motivation some like Janjaweed are motivated by economic where they move goods and people from Chad to Sudan and vice versa. In such situation the country needs a number of mobile and fixed monitors for example, DetectivEX which are easy to use but very expensive due to current economic situation.

The economic position for most States and priorities for the country are not corresponding with rapidly changing scientific, technological, and commercial environment in which crimes are taking place. For example growth of cybercrimes and cyber terrorism, growth of new way and techniques used by non-State actors requires well trained staff and modern technology to fight the crimes.

The second challenge is the absence of harmonized security laws within and between countries where one country may interpret the requirement different from another country (Dixon, 2009). Also the absence of clear classification of nuclear ,which has dual-use where same technology can be useful for health and development purpose and at the same time used for destruction through creating weapons of mass destruction

(Vestergaard, 2015). Example nuclear technologies, used for health, agriculture, industries and research purposes at the same time this technology can be used by non-State actors for malicious activities. High Enriched Uranium which is used in research reactor or in production of medical isotopes from South Africa, Egypt or any other part of the world can be smuggled across Sudan porous borders and used for malicious activities. The third challenge is the political will, where most of the countries regard nuclear security as a problem for nuclear energy producing countries therefore they have less responsibility on its security, the perception which is proved to be wrong due to porous borders . The terrorist attack in 2013 where at least At least 67 people were killed and hundreds of others were injured in the attack by members of al-Shabab, a Somali group with links to al-Qaeda come with a notion that the terrorist entered Kenya from Somalia in a car in June 2013 through porous border and there were insufficient new surveillance technology to monitor the borders (Kaberia, 2014).

The fourth challenge is the priority of the country; developing countries are facing many challenges which have public attention than the nuclear security, the problems like malaria, Ebola and civil war.

The fifth challenge is the corruption, where enforcement agents, border control, customs agencies at borders are involved in drug trafficking, illegal migration, terrorism, money laundering, piracy, arms smuggling, and other crimes. Despite of great efforts of International Organization like UNODC and the Government, the criminals still takes advantages of corrupt system and weak enforcement in the borders to meet their target.

The sixth challenge is the close relationship which exists between illicit traffic, terrorism, drug illicit, poaching which makes the fight against the nuclear security become more difficult given the availability of technology and our porous borders. It was reported by the Elephant Action league that terrorism has very close link with poaching where a close linked terrorist group Al-Shabaab has generated average of $40000 annually (Poe, 2014).

There are twelve research reactors within African countries which give access to research students and other for isotopes production (IAEA, 2011). Some of these countries like Egypt with regional fragile stability and porous borders have raised concerns over security of nuclear security and other crimes.

The challenges above can be mitigated through engagement of the community in securing the borders from black market, illicit trafficking, terrorism, and hence improve global nuclear security.

Border community engagement in nuclear security

When people are allowed to participate in a formal or informal way, direct or indirect on different decision that affects their community like policy, programs like security programs, development programs and services to communities makes things easy for the government to tap into diverse perspectives and potential solutions to improve the quality of its undertakings (Queensland Government, 2011). The IAEA nuclear power program milestone encourages stakeholder engagement to align them and support the program because of their direct link with safety and security, among the key stake holders are community around the nuclear power plant.

The first step in community engagement is educating the community across the border, well informed community can address the Government budget and the country economic priorities, political will, the notion that the nuclear security threat can't be compared with malaria is not true, nuclear technology in developing countries is used in health, agriculture and industries and therefore the threat associated with nuclear security should be given required priority.

The second step is to engage them in a process of establishing the domestic policies, security programs and services to fight illicit cross-border trafficking for nuclear security and associated crimes. The more the community decision is valued the more it becomes easy to implement the program, policy or service in the community.

The third stage is establishing the communication channels between the community and the enforcement agents and auditing mechanism. Properly engaged community will addressing the challenge of corruption where enforcement agents, border control, customs agencies at our borders are involved in drug trafficking, illegal migration, terrorism, money laundering, piracy, arms smuggling, and other crimes.

The implementation of this system requires trust and legitimacy (Gordon, 2014). Legitimacy and fair procedures practiced by the regulatory and enforcement authorities' shapes cooperation between them and their communities (Tyler and Fagan, 2009).

Conclusion

Developing countries with limited resources and porous borders challenges can engage communities living along the borders in nuclear security within their States. Therefore, I propose that the next nuclear security plan 2018-2021 include this component of community engagement as future strategy for countries with problems of porous borders and limited security resources to combat and strengthen nuclear security within and across their States.

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The Future of Nuclear Security in Southeast Asia: Commitments and Actions

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As is clearly stated in the International Atomic Energy Agency (IAEA) Nuclear Security Fundamentals, nuclear security is focused on the prevention and detection of, and response to, theft, sabotage, unauthorized access and other such criminal or intentional malicious acts involving nuclear material, radioactive material, and associated facilities or activities.[1] Even though each State carries full responsibility for nuclear security within its borders, nuclear security in a State might depend on the effectiveness of the nuclear security regime in other States,[1] particularly neighbouring states and states in the same geographical region. In the current global situation where nuclear security issues could potentially cross several borders, it is increasingly important that States continue to enhance national frameworks and cooperate and engage in collective commitments and action to strengthen nuclear security worldwide.[1]

Within Southeast Asia, nuclear energy currently has a limited role, with many states still in early stages of developing a nuclear power programme. Demand for electricity is increasing as the states in this region continue to develop and industrialize. Thus, the need for more electricity generating capacity could potentially drive the development of nuclear power programmes in some states. Sixteen nuclear energy reactors are planned for construction within the region; although plans and timelines may have changed following the 2011 accident at Fukushima.[2] Industrialization may also create increased demand for non-energy radiological materials including radioisotopes in medicine, agriculture and environmental protection. Indonesia and Viet Nam are two countries in the region with radioisotope production industries.[2]

Southeast Asia faces existing cross-border challenges as a region in the areas of terrorism, maritime piracy, insufficient border and export controls, and insufficient capacity building.[2] These concerns may be further exacerbated after the launch of nuclear power due to increased movement of nuclear and radiological materials in the region that

may present opportunities to malicious parties.[2] It is therefore important to ensure that nuclear security capabilities in Southeast Asia are robust and strengthened.

Viet Nam is the most active country in the region in expanding its nuclear power capabilities and is undertaking site preparation, work force training and the creation of a legal framework.[3] Furthermore, Viet Nam has signed a cooperative agreement with Russia as its vendor to build its first nuclear power plant, including financing of the nuclear plant.[3] An intergovernmental agreement with Japan was also signed for construction of a second nuclear power plant, including financing.[4] Taking the most recent delays into account, construction of the nuclear plant is due to start in 2019 and introduction of nuclear to Viet Nam's energy mix is forecast to take place in 2028.[4] Other Southeast Asian countries including Indonesia, Thailand, Malaysia and the Philippines are similarly exploring the potential for developing nuclear power programmes as part of their energy mix. As such, the variation in nuclear and non-nuclear producing countries in different stages of nuclear development in Southeast Asia in the near future will bring about important implications for nuclear security in the region in any global effort to manage risks in nuclear security.[2]

A sound nuclear security infrastructure is particularly important in a region that is just beginning to generate nuclear power capacity because there is a possibility for malicious parties to take advantage of any loopholes in a less established nuclear security infrastructure system and quickly smuggle nuclear material across a border to a non-nuclear country that may not possess a similarly high level of nuclear trained work force or nuclear security regime. The operation of seven nuclear research reactors in four countries in the region[2] has ensured that some nuclear security infrastructure is already in place; however, it is imperative that each country bordering any potential nuclear country in Southeast Asia has in place a strong nuclear security regime before the first nuclear power plant in the region is in operation. This can be facilitated by close collaborations and working relationships with the nuclear vendor country, other nuclear countries, the IAEA and within the Association of Southeast Asian Nations (ASEAN). ASEAN

currently comprises Viet Nam, Malaysia, the Philippines, Indonesia, Singapore, Brunei Darussalam, Cambodia, Laos, Myanmar, and Thailand. It should also be noted that although each State is wholly responsible for nuclear security within its borders, these recommendations on commitments and actions to strengthen nuclear security on a regional level are in no way binding, and the onus to implement any of these recommendations lies solely on each individual State.

Sustained capacity building and training in nuclear capabilities

In the initial stages of launching nuclear power in a new country and region, capacity building and training of the work force in nuclear engineering, nuclear safety and nuclear security must be prioritized. Technical skills and best practices can be learned from nuclear vendor countries to ensure that there are sufficient capabilities to respond to any nuclear security threats to the newcomer nuclear country and within the region. Cooperation and collaboration with other countries that have established nuclear security infrastructure may also be a route to gain nuclear security expertise. A recommended action to secure the future of nuclear security in a geographical region that is newly launching nuclear power is sustained capacity building and training in nuclear for all states within the region, regardless of whether the state itself is a nuclear country.

Although Singapore is currently not planning to build nuclear power plants in the near future, the country has begun preparing for the launch of nuclear power in the Southeast Asian region by "developing its own pool of local nuclear experts" within the next decade.[5] A key area of expertise that Singapore is keen to develop related to nuclear security is nuclear forensics, which is defined as the detection and tracing of radioactive materials to determine the material's origin and history.[6] Thus, if nuclear security issues in an ASEAN country were to cross borders, Singapore could potentially have the nuclear knowledge and capabilities to assist in responding to the issue. However, Singapore is facing challenges in building capacity in nuclear expertise. The difficulty in attracting local talent to nuclear is likely due to the absence of nuclear facilities and nuclear

industry in the country.[5] Singapore may form new partnerships and collaborations with nuclear institutes to stay firm to its commitment to develop expertise in nuclear safety and security.

Capacity building and training in investigative and response capabilities

In addition to nuclear capabilities, investigative and response capabilities including traditional law enforcement and local authorities need to be developed in the region, and officials need to be trained on nuclear security culture and issues.[7] Increased capacity building and training are key areas for cooperation with regional and international partners such as ASEAN and the IAEA. With sufficient resources, officials would be better placed to detect, prevent and respond to nuclear security threats including terrorism and trafficking.

The Philippines has conducted radiological security incidence response training for the Philippine National Police in 2015 to "train the trainers" and sustainably build capacity in law enforcement towards nuclear security.[8] In order to enhance nuclear security culture, Viet Nam has organized seminars on nuclear security culture specifically for local authorities, radiation facilities and research facilities in 2015 and early 2016.[9] Such seminars and training can also be held on a regional basis or in bilateral cooperation to ensure that all countries in the region are knowledgeable on nuclear security culture. Regional, bilateral and international collaborations may also be helpful in fostering cooperation and sharing of information among countries to address terrorist or trafficking threats and increase nuclear security in the region.

Benefiting from regional and international conferences

As explained by the IAEA Deputy Director General Mr. Mikhail Chudakov, the decision to embark on a nuclear power programme should be based upon "a well-informed national position, comprehensive analysis of the current and required national

infrastructure, energy planning and commitment to safe, secure, peaceful use of nuclear power". [10] Representatives of ASEAN member states would be able to evaluate their options and learn from best practices in nuclear security through attending, organizing or hosting international or regional conferences that are focused on establishing nuclear infrastructure or discussing nuclear security strategies. Gaps and knowledge gaps in nuclear security of a State, especially a new nuclear power State, can be identified and filled on a national, regional and global level. One such recent regional conference is the *Prospects for Nuclear Power in the Asia Pacific Region* that was organized by the IAEA in collaboration with the International Framework for Nuclear Energy Cooperation, and hosted by the Philippines Department of Energy.[10]

Regional nuclear security summits may also be proposed in order to discuss unique nuclear security concerns within the ASEAN region. Alternatively, nuclear security can be included as a usual item on the agenda of semiannual ASEAN Summits or Ministerial Meetings. Regional seminars on export controls and non-proliferation of nuclear and radioactive materials are also already present[11] but opportunities to expand the scope of these seminars and conferences should not be overlooked when nuclear is high on the agenda of some countries in ASEAN.

The participation of country representatives highlights their commitments to nuclear security objectives, thus contributing to global nuclear security infrastructure. The actions to strengthen the security of nuclear and radioactive materials can be carried out with the assistance of other States with nuclear power, the cooperation of regional partners, and/or the IAEA.

Enforcing border and export controls

ASEAN countries have made progress in enforcing border and export controls for nuclear security implementation. To counter smuggling, Malaysia and Thailand have conducted

joint exercises to detect nuclear materials at their shared borders, with the cooperation of the IAEA and have also shared those experiences with other ASEAN countries.[12] More such joint exercises are encouraged at other shared borders, particularly along the shared borders around Viet Nam, where a nuclear power programme is probably the closest to launching in the region.

To prevent illicit nuclear trafficking, ASEAN countries have taken steps to share information on missing radioactive sources on the IAEA Incident and Trafficking Database and to establish mobile expert support teams (MEST). Radiological Portal Monitors have also been installed in greater numbers to monitor and detect movement of nuclear materials in the ports of Indonesia, Singapore, Malaysia and the Philippines, among others.[8,11-13] National and regional emergency preparedness and response capability measures with regard to nuclear and radiological materials can also be carried out to ensure nuclear security. Importantly, corruption in the region must be tackled for an effective nuclear security framework and culture. As nuclear smuggling may potentially cross borders, the risk of regulatory agencies and customs officials allowing nuclear material to be illegally exported must be minimized.

Establishing cybersecurity initiatives

On top of physical nuclear security, it is clear that cybersecurity risks and threats are emerging as we continue to be further reliant on advanced technology infrastructure. It is possible that nuclear power plants may be targets of cyberattacks or cyber-physical attacks. Thus capacity building in nuclear cybersecurity is recommended to protect national systems. For example, Indonesia is establishing a nuclear cyber security doctoral programme[13] and Singapore has set up a Cyber Security Agency.[11] Given the trans boundary nature of nuclear cybersecurity, extensive cooperation with other countries and international partners on cybersecurity initiatives is also highly encouraged for data sharing and joint training exercises. Other ASEAN countries may benefit from considering such initiatives in their national computer security systems.

ASEAN regulatory framework

A future option for nuclear energy in Southeast Asia is regional collaboration, similar to nuclear energy generation and distribution in Europe.[14] Resources could be pooled among ASEAN states, sharing expertise, costs and benefits to build a nuclear power plant in the region and supply electricity to member countries through an electrical grid.[5] To achieve this, ASEAN requires a regulatory framework to address trans boundary issues including nuclear fuel management, nuclear waste and risk management.[14] Nuclear security concerns would also have to be addressed under this framework.

Conclusions

The IAEA supports Member States' efforts to establish and improve nuclear security, and has provided assistance to States upon request. The role of the IAEA in organizing international conferences on nuclear security every three years is vital in bringing States together to participate in high-level policy discussions and serves as a focal point for enhancing international cooperation.[15] Several countries in Southeast Asia have plans to develop nuclear power programmes in the near future, which will require strengthening of nuclear security regimes throughout the Southeast Asian region.

These commitments and actions include enhancing capacity building and training in nuclear, law enforcement, and nuclear cybersecurity for all countries in Southeast Asia, even those with no plans to develop nuclear power, because nuclear security in a State might depend on the effectiveness of the nuclear security regime in other States. Many ASEAN countries have taken steps to address border and export controls, but further work is needed to ensure nuclear security of the region. Cooperation and collaboration between ASEAN member states as well as international partners, and high-level participation in nuclear security conferences, seminars and workshops are highly

encouraged to build towards global nuclear security infrastructure and a safer, more secure region when nuclear power is then established.

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The Future of Nuclear Security: Commitments and Actions

A Medical Physicist's Perspective

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On the 5th April 2009, Barack Obama addressed a huge crowd in Hradcanske Square, Prague, in one of the first major foreign policy speeches of his presidency. He spoke of a post-Cold War world in which the threat of global nuclear war had receded, but the risk of nuclear attack had not. He described the Cold War's legacy of thousands nuclear weapons, and warned of the menace of nuclear terrorism, and the ultimate threat "to our global safety, our security, our society, our economy, to our ultimate survival." [1]

The future of nuclear security is not addressed easily. International, multi-professional conferences are vital precisely because of the scale of the challenges and the diversity of expertise required. As a medical physicist, I am no expert in international diplomacy or nuclear smuggling. Instead, as someone who oversees all aspects of small-scale radiation use, I hope to draw some parallels between medical and nuclear uses of radiation, and make some suggestions for both their futures.

The challenges both communities face are the same: controlling access to dangerous material, creating a strong security culture, cooperating with the wider world and engaging the public.

I would like to focus on three challenges for the future of nuclear security: public engagement, nuclear terrorism and cyber security. The medical sector has benefited greatly from the nuclear community's expertise; perhaps we can contribute some suggestions in return.

The Current Situation

In the seven years since President Obama spoke of "dangers that recognize no borders", much has happened globally. We have experienced the Fukushima disaster and a series of North Korean weapons tests. Syria has descended into bloody civil war, the government has collapsed in Libya, and ISIS, or Da'esh, have taken control of vast swathes of territory. We have endured terrorist attacks in Pakistan, Kenya, France, and throughout the Middle East. Diplomatic tensions have been heightened and populist movements have grown in popularity [2] [3] [4].

There has also been tremendous progress. The USA and Russia signed the New START arms treaty, a historic nuclear deal was struck with Iran, the Amendment to the

Convention on the Physical Protection of Nuclear Materials (CPPNM) came into force, and four Nuclear Security Summits have been held, the latest this year.

These Summits have been hugely valuable in reducing nuclear material worldwide and improving security practices. As they finish in their current form, it would be easy to fall into either despondency, as a period of great progress ends, or complacency, congratulating ourselves on a job well done.

Our responsibility is to do neither. We find ourselves in a critical period in global affairs and in nuclear security in particular. As the Nuclear Security Summit process ends, we must reflect on its achievements, consolidate its successes and plan our next steps.

Public Engagement

2016 has been an interesting year to be British. I have followed the events of the past few months with near obsession and occasional alarm. From the renewal of the Trident nuclear deterrent to strained relations with China over delays to the Hinkley Point C nuclear power station, nuclear issues have been in the public eye to an unusual degree.

However, the story dominating the headlines is not obviously nuclear-related: the referendum on membership of the European Union, and the shock decision to leave: Brexit.

Analysis of the motivations which led to the leave vote will continue for years. It seems clear, however, that one key factor was the feeling, justified or not, that ordinary people were being left behind by a “political elite” [5] who neither understood nor cared about their concerns. Appeals by the government fell on deaf ears. The International Monetary Fund, the Bank of England, security experts, business leaders, ten Nobel-prize winning economists, 5000 scientists and 1000 academics collectively extolled the virtues of the EU and warned of the consequences of leaving; to no avail. As the then Justice Secretary, Michael Gove, said, “People in this country have had enough of experts” [6].

This poses a problem to we who fall into that much-maligned category, “so-called experts”. As discontent with traditional politics increases, evidenced by the rise of

populist movements across Europe and the USA [2], we need to make sure that reasoned and coherent messages are getting through.

Public engagement is sometimes viewed as an optional extra after the technical matters are arranged. Whatever our nationality or political persuasion, recent events should have taught us the danger of this way of thinking. This is particularly true in nuclear security and medical physics, where the focus of our expertise is primarily on advising and supporting governments, hospital boards and industries. These groups become the prism through which the public are kept informed, and sometimes messages are lost in translation.

There is a discrepancy between reality and public perception that is not challenged enough. In 2011, the BBC reported that support for nuclear power had dropped considerably worldwide, with only around 22% of respondents in countries with nuclear programs confident of its benefit and safety [7]. In a 2013 report from the UK Energy Research Centre, only 33% of Britons thought their government adequately regulated nuclear power [8]. An acquaintance of mine, a veterinarian with years of education and professional training, is convinced that the nuclear-powered submarines docking in our nearest port give most of the inhabitants leukemia.

In my work as a medical physicist, I often speak to patients who are anxious about their exposure to radiation from x-rays or nuclear medicine procedures. Their level of understanding of the risks is often low, and the fear for themselves or their families correspondingly high. A proper discussion, where they are not only told the facts but given a chance to express their concerns and ask questions, usually allays most fears and puts the risks and benefits in perspective. This does not normally alter whether or not a procedure goes ahead, but it makes things go much more smoothly, relieves unnecessary worries and gives the patient a better picture of the hospital's work. These patients, and the wider public, are not only capable of understanding the facts; they have a right to, and it is the fault of we "so-called experts" when they do not.

There are many ways of tackling public engagement. In the UK, professionals in a range of industries are encouraged to sign up to the Science, Technology, Engineering and Maths (STEM) Ambassadors scheme, running workshops in schools and talking about

careers in science. The UK Institute of Physics and Engineering in Medicine recently launched a “Science for Patient Benefit” campaign, displaying posters and leaflets in hospital waiting rooms describing the uses of radiation in medicine. Professional bodies and learned societies have a key role in influencing school syllabuses and engaging teachers.

An emphasis on education will not only pay dividends in public support and democratic mandate. It will also produce the next generation of scientists, engineers and policy makers. The medical profession has already seen the benefits of better public education and engagement; the nuclear industry might gain in the same way.

Who, then, should be involved in nuclear security? The answer, surely, is everyone, even only by understanding what is done in their name. From a brutally financial perspective, it is contributions from member states that form the budgets of the IAEA, INTERPOL and other key bodies. Our taxes fund our nuclear security, and our security is on the line.

Of course, this is not just about money. Our governments represent us and act on our behalf. We must not lose sight at large international meetings of who it is we are protecting: first and foremost, nuclear security is there to defend the world’s 7.4 billion ordinary citizens.

Nuclear Terrorism

Since the IAEA’s creation in 1957, the global nuclear security situation has changed radically. As the Institute on Global Conflict and Cooperation note [9], “International security in the 21st century has been transformed from a starkly bipolar confrontation of states and their surrogates, characteristic of the Cold War, to interactions among a wide variety of actors and institutions.”

Huge progress has been made at a state level, but the threat from non-state actors such as terrorist groups has been increasing. The prospect of ISIS obtaining nuclear weapons would keep even the most hardened security expert awake at night; in President Obama’s words, it presents “the most immediate and extreme threat to global security.” It is hard to disagree: ISIS has shown no scruples over causing large-scale loss of life, and there are reports of them using chemical weapons against military and civilian targets.

It would be naïve to expect ISIS not to aim for the ultimate symbol of power: a nuclear weapon. Their forebears Al Qaeda claimed that “acquiring weapons of mass destruction for the defense of Muslims is a religious duty” [10]. It would be just as naïve to assume they would not use it if acquired. The traditional deterrence strategy of Mutually Assured Destruction holds no sway; they “lack the minimum degree of risk-adversity to be capable of being deterred; religious fanaticism has made them immune from fear of death” [11].

ISIS could either steal a complete weapon or aim to produce one themselves, requiring accurate blueprints, scientific expertise and fissile material [12]. We need to ensure all sources are under control, reduce reliance on highly-enriched uranium, and support schemes such as INTERPOL’s “Fail Safe” and “Conduit” operations and the IAEA’s Incident and Trafficking Database. Poor national nuclear security, as well as proliferation, increases the chance of material falling into the wrong hands. We must also counter the false but effective propaganda that brings ISIS recruits, some with scientific expertise.

Instead of acquiring or producing nuclear capabilities, acquiring non-fissile radioactive material for use in dirty bombs or large-scale contamination would be relatively easy, and must be a tempting choice for terrorists. Although the threat to the public is lower in terms of casualties, the psychological impact on a population from a dirty bomb incident would be huge. This is, of course, one of the key aims of terrorism.

Medical and nuclear uses of radioactive material overlap in this area. Hospitals have relatively weak security, particularly for radioactive materials in transit, and use highly radioactive objects such as molybdenum generators or iridium brachytherapy seeds. Guidance such as the IAEA’s “Security of Radioactive Sources” provides a valuable resource for keeping sources safe, but this must be implemented within a strong security culture.

However, attitudes are changing. UK hospitals now include in their departmental rules contingency plans for theft or loss of radioactive sources. This has been valuable, not only in planning for the worst, but in creating a security-conscious mindset in staff not used to seeing themselves as a target. Many medical physicists now train as responders under the “National Arrangements for Incidents involving Radioactivity” scheme, which

provides assistance to the police after a radioactive incident. On the nuclear side, the Berlin workshop in September on the security of sealed sources provides a valuable opportunity to focus on implementing and improving the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources. I suggest that the Code should cover unsealed sources as well as sealed, as they often have weaker security, particularly in medicine.

We should not neglect the personal side of nuclear security. A poorly-paid, overworked employee, or one who is vulnerable to radicalization, is the weakest link in a nuclear facility's security; a well-trained one might be its strongest. Similarly, a hospital physicist competent to restrict access and control disposal of radioactive waste might be the difference between a failed theft and a dirty bomb.

Cyber Security

Cyber security must be urgently developed. The best physical security is useless if it is not matched by equally strong cyber security, in any type of facility. As global infrastructure becomes inseparable from the computer systems that govern it, the importance of cyber security grows.

This is an area of particular weakness in hospitals. Radiology staff are traditionally drawn from academia and medicine and are not natural computer scientists. I suspect this is mirrored in the nuclear world. We need to focus on recruiting not only brilliant engineers, scientists and policy makers, but computer scientists and cyber security experts. The US government agencies including the FBI and NSA hire so-called "white hat hackers" to spot weaknesses in security systems [13] [14]. Despite the challenges involved, including background checks and competing with the private sector, this is a strategy that could be replicated in the nuclear industry, creating the balanced workforce required.

As this balance tips ever more towards computerization, the nuclear industry is well ahead of medicine. Our staff are scientific professionals and computer literate, but they are not capable of building or maintaining a cyber security system. We outsource this task to computer experts and then misuse, or fail to understand, the results. An acquaintance of mine worked in a facility handling sensitive radioactive sources. The

computer security system required all staff to change their passwords daily. The result was that workers would write each new password on a sticky note fixed to the computer monitor.

Just as a physical security system is let down by a careless employee, the weakest point of a cyber security system is the members of staff using it, and seniority is no guarantee of compliance. Cyber security systems need to be comprehensive, usable and respected. The Stuxnet attacks are an indication of the damage that can be wrought on nuclear facilities. Cyber security is the weakest point of hospital systems; the same must not be true of nuclear facilities.

Conclusion

As the Nuclear Security Summit process ends, we must ensure its strengths are harnessed for the future: the focus on tangible outcomes, the attention of national leaders and the emphasis on building relationships. Action Plans must be followed and the Amendment to the CPPNM universalized. We must address the current threats of nuclear terrorism and smuggling, and plan for the future by building strong cybersecurity systems and training upcoming experts.

We should also consider the consequences of failure. It will be ordinary, vulnerable people who suffer from nuclear security lapses: families in bombed out Syrian cities fleeing before ISIS's nuclear capabilities; tourists and commuters in Western cities contaminated by dirty bombs; populations living in fear of a threat they can't see and barely understand.

The global community needs to grasp this, and commit to working across borders, reaching out diplomatically to countries we have little in common with. If we can work with scientists and police forces, industrialists and diplomats, governments and international agencies, in dialogue with the public and remembering that our efforts are all for their safety – then, truly, we will have Atoms for Peace.

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