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Mostafa Kofi
Suez Canal University and PSMCMC

Lamiaa Fiala
Princess Nourah bint Abdulrahman University; and Suez Canal University

May Al-Muammar
King Saud University; Riyadh; Saudi Arabia

Zenobia S. Homan
King's College London, UK

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Developing Nuclear Security Culture at Academic and Educational Institutions

Mostafa Kofi¹, Lamiaa Fiala², May Almuammar³, Zenobia Sabrina Homan⁴

¹Department of Public Health and Occupational Medicine, Suez Canal University, Egypt.

Family and Community Medicine Dept. Prince Sultan Military Medical City, Riyadh, Saudi Arabia

²Department of Public Health and Occupational Medicine, Suez Canal University, Egypt.
Department of Health Sciences; Faculty of Health and Rehabilitation Sciences, Princess Noura Bint Abdulrahman University, Riyadh, Saudi Arabia

³Community Health Sciences Department; College of Applied Medical Sciences, King Saud University; Riyadh; Saudi Arabia

⁴Centre of Science and Security Studies, King's College London. United Kingdom

Contact Information: Prof. Mostafa Kofi; moustafafouad@yahoo.com

Abstract:

In recent years, the use of radioactive and nuclear sources for diagnosis and treatment has become more widespread in the medical field. These sources are present in universities, university hospitals, and academic institutions, making it necessary to develop a strong nuclear security culture among

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academics. There are many widespread and complex challenges to improving security culture, often from scratch. The research solution presented in this paper is how to develop a strong and sustainable nuclear security culture among academics. Workplaces are often culturally diverse, so it can be challenging to achieve a common belief in nuclear security and an institutional commitment to upholding such standards. Researchers have identified obstacles, such as English language barriers, a sufficient commitment from management to develop a strong security culture, the ability to make use of innovative educational resources, and defining a clear nuclear security policy for the institutions in question. Analysis of these issues indicates that there is a need for nuclear security to be implemented more clearly from internal roles and regulations rather than being imposed as an external requirement.

Key Words:

nuclear security, security culture, universities, academia, education, training, research

1. Introduction:

Universities and research centers play an important role, not only in the field of education, but also in the field of scientific research and development. A vast number of nuclear and radioactive sources are used in universities for purposes such as experiments, research, and in the case of nuclear medicine, diagnosis and treatment. Previous studies have shown that establishing a strong security culture can increase the security of nuclear and radioactive materials, their transportation, and associated facilities [1]. Academics have a responsibility to promote nuclear security culture through the development of nuclear security educational programs, materials, and training activities to enhance nuclear security culture in different workplaces.

Security culture in research centers and academic settings has received less attention than industry,[2] and we hope that this work will provide a clear and concise overview of the issues as well as potential solutions.

2. Review of Literature:

It is essential to understand how nuclear safety and security culture affects the behavior of staff in any academic institution. At the 2012 Seoul Nuclear Security Summit, it was recognized that "...investment in human capacity building is fundamental to promoting and sustaining a strong nuclear security culture." They "encourage states to share best practices and build national capabilities, including through bilateral and multilateral cooperation." At the national level they "encourage all stakeholders, including operators, regulators, policy makers and academic to fully commit to enhancing security culture and to maintain robust communication and coordination of activities[3]."

Since then, nuclear security culture education has received increased consideration, in particular, professional development courses [4], curriculum development [5], and the use of table-top exercises [6]. However, while educational materials have received some attention, the situation at educational institutions and universities have received less attention.

Researchers at Purdue University started work on this topic in 2018 and conducted a survey among radioactive material users at a university [7]. They found that students and those with less than five years of experience possessed a greater degree of awareness toward nuclear security than faculty and more experienced radioactive material users. The researchers determined that this could probably be attributed to more recent education and promotion of nuclear security. Academic support staff, ranging from laboratory technicians, managers, and postdoctoral researchers, had difficulties judging how to enforce policies, adequacy of inspection, and job performance reviews related to nuclear security – indicating that the mechanism of review and inspection for procedure compliance required improvement. Overall, this survey showed the need to enhance threat-response preparedness and greater long-term communication among stakeholders, particularly between leaders and students.

Lessons can also be drawn from the life sciences, which have experienced a disconnect between safety and security in academic settings, and limited awareness of material misuse [8]. With particular concerns arising regarding dual use research and the 2001 anthrax attacks, scholars and policy makers have suggested revitalizing engagement between science and security communities [9], composing new statements of mutual assurance between governments and research communities, and reforming the way students are trained in all aspects of their discipline, including security as well as improving institutional codes of conduct [10].

The comments made below will specifically highlight the challenges academic organizations face while establishing a nuclear security culture in academic organizations. These challenges do not only play a role in determining what good security culture means through their work and research but are also in a unique position to improve it. Enhancing the nuclear security culture among academics will lead to an increased understanding of threats to nuclear and other radioactive materials, and their associated facilities and activities. It will also form the basis for a common understanding and awareness of security issues at all levels and enhance coordination among various stakeholders. When all stakeholders are involved in the collective task of promoting the importance of nuclear security culture it yields a supportive mindset and improved teamwork.

There are many challenges in establishing a nuclear security culture and handling radioactive sources in academic settings. These challenges include national cultural differences, poorly structured organizational subcultures, complex hierarchies, as well as the failure to recognize a credible threat. As a result, academics in many countries are experiencing a pressing need for training and improved awareness of nuclear security. This is especially significant in relation to radioactive source security, radioactive and nuclear security culture, material accounting, and defining, characterizing, and mitigating the so-called “insider threat.” [11]

3. Security Culture as a Concept:

Workplace culture and nuclear security often quote Schein's "Three Levels of Culture." [12] The first level is made of visible culture, organizational structures, and processes. This is what you see and observe in any organization. The second level is rooted in beliefs and values involving strategies, goals, and justifications. The third level is deepest and sometimes invisible, including perception, unconscious beliefs, thoughts, and values. It is this last level that drives staff actions and behaviors.

The human factors play a critical role in assuring that security systems are better able to meet the challenges and threats present in today's world. Human factors are all aspects of human performance that can affect Nuclear Security, and its goal is to minimize potential for human errors by addressing factors that may adversely influence human performance.

Because threats are always evolving, it is necessary to continuously assess existing nuclear security culture, improve it, and make it consistent with the current threat environment such as theft or cyber security threats [13].

Only personnel empowered by nuclear security culture can effectively address these challenges. People can be both the strongest asset or the weakest link in a security regime, and the human factor is one of the main pillars of nuclear and radiological safety and security. What is more, research has shown that enhancing nuclear security culture among academics can foster a sense of pride and promote job satisfaction, which is essential to avoid "disgruntled employee" scenarios and mitigate the insider threat [14]. A strong nuclear security culture reduces human error, takes into account lessons learned, and builds an atmosphere of respect for security personnel.

A well-defined security culture does not only establish rules and regulations, but also creates communal awareness of their significance. For example, regulatory bodies such as the United States Nuclear Regulatory Commission (US-NRC) require that radioactive materials are secured from unauthorized removal and placed under constant surveillance when in use [15]. Consequently, radiation safety and security personnel have to establish reasonable security measures for radioactive material consistent with minimizing the potential of serious harm or injury or possible theft or removal of radioactive materials from research centers or universities. However, large academic organizations are commonly spread over multiple sites and structures, where interactions between subcultures are limited. For instance, cyber security professionals and specialists in nuclear plant operation responsible for safety usually work in different buildings. They often do not communicate sufficiently with one another, which exacerbates the cultural divide between these occupational groups [16].

It is important to consider the steps of development for a nuclear security culture as explained in the *IAEA Nuclear Security Series* [17]. Where security culture is at its worst, academic staff are willingly trying to break the security program ("subversion"). Where security is best, staff

assume responsibility and regard security as their program (“ownership”) [18]. Accordingly, the IAEA has identified three stages in which nuclear research centers and academic institutions usually evolve: [19]

Stage 1: Security is based on rules and regulations. Organizations see security as an external requirement, and not as an aspect intrinsic to its successful performance. External requirements may be put in place by government or regulatory bodies. In addition, organizations at this stage lack awareness of behavioral and attitudinal aspects of security. Security is seen as a technical issue to be achieved by compliance with rules and regulations. Problems are not anticipated, and organizations react to each one as it occurs. Communication between departments and functions is poor. Collaboration and shared decision-making are limited. People who make mistakes are blamed for their failure to comply with the rules. There is low participation in learning inside or outside the organization. People are viewed as components of the system (a mechanistic view). There is an adversarial relationship between managers and staff. An example of this stage was the situation at the Bottom Beach nuclear power plant, where armed security guards were found asleep [20].

Stage 2: Security is considered an organizational goal. At this stage, security is regarded as an important part of the organization even in the absence of external requirements. Although there is a growing awareness of behavioral issues, this aspect is largely missing from security management. Management still concentrates primarily on technical and procedural solutions at this stage. Security is dealt with in terms of targets or goals, largely ignoring beliefs and attitudes. The interaction between people and technology is considered, but mostly with the view to increase the efficiency of the technology. This stage is commonly found in developing nuclear states or at new nuclear sites, or alternatively at sites which are struggling due to financial challenges.

Stage 3: Security should always be improved. There is no conflict between the goals of security and facility operation. At this stage, almost all mistakes are viewed as opportunities to improve, with emphasis placed on understanding what has happened, and why, rather than “finger-pointing.” Management roles are considered coaching and exhibiting model behavior. The relationship between management and staff is mutually supportive. People are rewarded for their contribution and their input is considered in the decision-making process. This stage can be observed at more mature nuclear sites including those which are already decommissioning. Security and safety are combined into a graded approach, and “defense-in-depth,” which has been adopted by for instance US and UK industry.

4. Limitations to Improving Nuclear Security Culture

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among Academics:

There are observable differences in workplace cultures, between various organizations handling nuclear materials as well as within the organizations. One of these is the difference between safety specialists and security specialists. For example, safety specialists often prefer to work with transparent and widely communicated information. On the other hand, security specialists prefer to work with information on a need-to-know basis and release as little information as possible and as low-profile as possible [21]. In addition, safety specialists commonly advocate building redundancy into nuclear installations to guard against equipment failure, while security specialists are more skeptical because redundancy furnishes extra opportunities for theft or diversion of sensitive materials. Such divergence in attitudes can create tensions and could potentially have repercussions for nuclear security.

Some of the challenges that can be identified in research centers and academic settings to improve nuclear security culture are:

1. **The language barrier.** Academia is a sector known for having a large number of participants from diverse backgrounds. While the available educational materials are abundant, adaptation is required. For example, materials are often not translated, or not translated well, and they are available in a limited number of languages (mostly English). Nuclear security training uses unique and specific terminology, often abbreviated; this does not always translate well between different languages and further, native, explanation is required [22]. However, diversity is also an asset; participants are able to share their experience from different types and settings of workplaces.
2. **Lack of management support.** Management is a vital component in many nuclear security activities. Managers affect culture, top-down throughout their organization through their leadership. Role-models and management practices can aid in establishing organization-wide patterns of behavior. As Purdue's survey demonstrated, it is possible that more senior staff at universities have not received the same training as newer staff, or perhaps they are not regularly offered updated training.
3. **Absence of innovative educational methods.** Common teaching methods range from lectures (more teacher control) to seminars and simulations (less teacher control).⁵ Since lectures are easiest to share and adapt, they are often chosen over more innovative educational approaches – despite being proven effective to encourage “deep learning” e.g., problem-based learning, case studies, and research. Although this approach requires time and planning to develop, it helps participants retain information and engage with application of the subject matter in the real world, in turn encouraging personal accountability. Many methods are complimentary, and a combination is always preferred. In addition, assessments should be a two-way flow, and cover knowledge, attitudes, as well as skills.

4. **Inadequately defined policies.** For academics it is necessary to show commitment to the university as well as its staff with regard to nuclear security. The part they play in establishing and maintaining a strong nuclear security culture must be clear to all academics on different levels, and their adherence to the policy has to be verified. This means establishing standard operating procedures, and clear division of roles and responsibilities. In addition, continuous training and qualification, self-assessment, and feedback processes are important elements and supporting pillars in the process of enhancing nuclear security culture. Promoting information security and personnel security are also needed, to avoid complacency.

5. Suggested Measures for Improvement of Nuclear Security Culture among Academics:

There is no single solution that fits all: it is always necessary for the institution in question to determine measures suitable for its own location, on-site materials, body of staff, and national requirements.

However, the following guidelines may form a useful starting point:

1. **Introduce an action-plan.** It has been found that one successful approach to enhance nuclear security culture among academics is to put together an action plan [23]. This should include management methods such as a Plan-Do-Check-Adjust (PDCA) [24] as well as potentially new management positions, revised work responsibilities, or organizational restructuring. The PDCA is an iterative cycle used by managers to improve the overall performance and outcomes to be up to expectations. The action plans and defines specific goals, personnel responsible, timeframe, resources required, potential barriers, and an outline of steps to be taken then check for results and then adjust for better performance and improve results.
2. **Conduct self-assessment.** It is recommended by nuclear and radiological safety and security experts to formulate and implement the action plan following completion of a self-assessment, which can identify culture weaknesses and strengths to be addressed or reinforced. However, the action plan may also be triggered by other circumstances, such as security breaches. There are a lot of resources and accumulated experience from different regions on self-assessment and its tools, including IAEA's NSS. 28-T ("Self-assessment of Nuclear Security Culture in Facilities and Activities").²⁰
3. **Consider feedback and communication.** Education and training allow for consistent communication of expected attitudes and beliefs and addresses potential weaknesses.¹ Newsletters or posters on nuclear security can also be issued on a regular basis as an interactive forum. Personnel feedback programs, such as surveys and interviews, provide a vehicle for personnel to propose improvements to management practices, procedures, policies, and so forth.
4. **Agree on a code of conduct.** This should be issued to all personnel as a document to sign and keep in their files. In addition, personnel recognition programs have also been found effective [25]. These are designed to reward individuals for desired behaviors in line with the culture improvement to be achieved.

6. Conclusions:

Education and training in nuclear and radioactive source security is a challenging issue. This is especially true at facilities such as research centers and universities where these sources are widely present, and available to users varying from experienced scientists to new students. Following in the footsteps of life sciences, safety culture at these facilities has usually been developed to a more advanced stage than security culture. Issues such as the insider threat and terrorism have become more prominent over the last decade, but in a nuclear setting this has had a bigger impact on security culture at sites concerned with energy or defense and less so at organizations focusing on health or education.

Collaboration among governmental, industrial, and academic personnel is essential to a thriving, broad-based nuclear security culture. This means that nuclear security culture promotion needs a multi-stakeholder approach, and it should be treated as a continuously evolving educational discipline. Universities and research centers have to support the promotion of nuclear security culture and coordination with stakeholders to overcome obstacles. In terms of future research on nuclear security culture in academic settings, feedback, and communication as well as exchange of experience and information (vertically as well as horizontally) requires further attention. This focus will support ideas and insights, as well as local workshops on developing institutional codes of conduct and action plans in dealing with nuclear and radioactive sources. The need for education on nuclear and radiological security culture highlights the need to address weaknesses and fix them – because a security system is only as strong as the weakest link in its chain.

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