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Harmonizing Nuclear Safety Culture and Security Culture

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1. Introduction

The commonality between elements of nuclear security culture and nuclear safety culture has been widely discussed and acknowledged at the conceptual level for over a decade. The need for a cultural basis for nuclear safety was conceived first, as the concept of nuclear security culture evolved years later. The idea behind the development of nuclear safety culture as an important requirement in international nuclear program management was first introduced by an IAEA review conducted in 1986 after the Chernobyl accident. The preliminary concept was further developed by the IAEA in support of nuclear power-plant safety and evolved into a stand-alone initiative that has a direct application for a wide range of nuclear programs.

While the earthquake and tsunami leading up to the Fukushima Daiichi accident could not have been avoided, it is recognized that certain culture-based measures could have been implemented before, during, and immediately after the accident to help mitigate the consequences. The report of the IAEA Director General "The Fukushima Daiichi Accident" identified complacency among the management and workforce as one of the major root causes of the accident: "Because of the basic assumption that nuclear powerplants in Japan were safe, there was a tendency for organizations and their staff not to challenge the level of safety" [1]. The role of the human factor in this accident was the main theme of The Report of the Fukushima Nuclear Accident Independent Investigation Commission submitted in 2012 to the National Diet of Japan. Its chairman called it a "profoundly man-made disaster" whose fundamental causes are in the ingrained conventions of Japanese culture: reflective obedience, reluctance to question authority, devotion to "sticking with the program," groupism, and insularity [2]. In some circumstances after the event, analysis indicates that the safety margins could have been eroding steadily for years. This can result from people gradually accepting declining conditions in work practices and ignoring the risks brought on by the decline which may have unnoticeably drifted towards prioritizing other concerns over safety. Risks might have been played down because "nothing has happened," which can eventually lead to a severe event occurring. This line of reasoning is similar to the one which nuclear security culture is designed for in order to prevent such occurrences in the security domain.

The basic ideas and elements of nuclear safety culture as developed by the IAEA were instrumental in the identification of the need for a parallel nuclear security culture. The necessity for nuclear security culture was specifically stated in a 2001 IAEA report on "Measures to Improve the Security of Nuclear Materials and Other Radioactive Material," issued immediately after the September 11 terrorist attacks on the United States [3]. Detailed guidance for the establishment and promotion of the concept of a nuclear security regime and nuclear security culture was provided in the IAEA's 2008 Nuclear Security Culture: Implementing Guide [4]. Section 2.4 of this document briefly discusses the relationship between security culture and safety culture,

stating that "….the principal shared objective of security culture and safety culture is to limit the risk resulting from radioactive material and associated facilities. The objective is largely based on common principles, e.g. a questioning attitude, rigorous and prudent approaches, and effective communication and open two-way communication."

The IAEA's concept of shared objectives between security culture and safety culture is manifest by the Agency's organizational structure, which places the responsibility for both disciplines within an integrated IAEA Department of Nuclear Safety and Security. The functions of nuclear security and nuclear/radiological safety, however, fall under different divisions within this department. The common elements of these two areas are integral to security and safety operations. Understanding where safety and security intersect, and discerning where there are opportunities to exploit synergies between the two, is critical to nurturing an overarching culture of harmonized security and safety. Since these elements of a comprehensive organizational culture are inextricably intertwined, the most effective and efficient approach to creating a program that fosters security and safety culture demands that leaders determine which functions are complementary and which are not.

"Understanding where safety and security intersect, and discerning where there are opportunities to exploit synergies between the two, is critical to nurturing an overarching culture of harmonized security and safety."

Significantly, the IAEA treats the following nuclear safety legal instruments as relevant to nuclear security: Convention on Nuclear Safety, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Convention on Early Notification of a Nuclear Accident and others. The legal framework for security culture is based on the Convention on Physical Protection of Nuclear Material (CPPNM) and its 2005 Amendment which came into force in 2016. Principle F (security culture) stipulates that all organizations involved in implementing physical protection should give due priority to the security culture, and to its development and maintenance necessary to ensure its effective implementation in the entire organization. Thus, the Amendment upgraded the status of nuclear security culture to the level of international law and is on par with other elements of physical protection.

The 2018 international workshop "A Roadmap for Harmonizing Nuclear Security Culture and Safety Culture" held in Serpong on 29-31 January was yet another event to review benefits and challenges for harmonization and highlight international experiences in this regard. It was funded by the U.S. Partnership for Nuclear Threat Reduction (PNTR) and organized by the Center for International Trade and Security at the University of Georgia (CITS/UGA) and Indonesia's National Nuclear Energy Agency (BATAN). This report serves as a platform to share with interested parties a vision of how nuclear safety culture and security culture can be effectively harmonized and therefore contribute to an enhanced reliability of global nuclear infrastructure.

2. International and National Experience with Culture Harmonization

Nuclear Power Industry Model for Harmonization -- For a number of years there have been requests to the IAEA to come to agreement on a common framework for safety culture between IAEA and the world nuclear industry. It has been apparent that these two factions were using different models to address nuclear safety culture development and implementation. Although there was general agreement that the different models were addressing the same concept, the different models were causing needless rework and confusion. In 2016 a project was begun to address this dichotomy. The goal of this project was to create a harmonized safety model applicable to nuclear facilities and operations under the guidance of the IAEA that could be translated across languages and cultures. This model is under development and will assist in avoiding rework and repetition while still allowing individual models to be made specific for different organizations.

It was recognized that problems occur during the development of these types of guidance documents when new people, people from other types of operations, and/or people with personal agendas are involved in the document development and preparation process. This involvement often changes the path of the document development and may result in a final product that differs significantly from the original intent. Also, the document may be changed to a great degree during the review and acceptance process.

International Atomic Energy Agency (IAEA) Perspective and Experience -- The IAEA acknowledges the synergy between nuclear safety and nuclear security, and addresses the safety- security interface in the IAEA Safety Standard SF-1, "Fundamental Safety Principles." As the objectives for nuclear safety and security suggest, there are common elements and shared traits between the two. Security and safety are of equal importance and have overlap in their objectives. As stated in the IAEA document INSAG-24, "The Interface Between Safety and Security at Nuclear Power Plants," a culture of safety and security should be integrated in the organization's management system. Management should seek the promotion of both safety and security culture. With the consideration of the existence of individuals of diverse backgrounds and experiences, it is necessary to provide both safety and security staff with an appreciation of the importance of each area, while emphasizing the need for a cooperative and balanced approach to achieve reliable operation at an acceptable risk level.

"Management should seek the promotion of both safety and security culture."

The IAEA Department of Nuclear Safety and Security recognized the need to explore a possible harmonization of their approach to nuclear safety culture (culture for nuclear safety) and nuclear security culture. The current IAEA approach to the harmonization nuclear safety and nuclear security is based on the following identified areas of cooperation: an information-sharing network; joint organization of workshops, technical meetings, and working group meetings; implementation of

joint projects; and cooperation for training material development.

Managing the interface between nuclear safety and nuclear security cultures involves: (1) understanding common approaches of nuclear safety culture and nuclear security culture; (2) considering how these commonalities could be managed to enhance both cultures to support both nuclear safety and security; (3) understanding differences between nuclear safety and nuclear security and understanding how these differences could result in different attitudes/approaches between the two cultures; and (4) considering how to manage these different attitudes between two cultures to support both nuclear safety and security.

Approaches and efforts for enhancing the harmonization of the safety-security culture interface may include: (1) raising awareness and understanding of the connection between nuclear safety and security; (2) convening high-level meetings on safety-security protocols on a regular basis to ensure that the interface receives adequate attention and resolve any conflicts on issues; and (3) facilitating communication between personnel responsible for nuclear safety and those responsible for nuclear security.

National Nuclear Energy Agency of Indonesia Experience with Harmonization -- The current BATAN nuclear programs include three research reactors, seven nuclear materials balance areas, and eight radioactive source licensees. BATAN has a comprehensive integrated nuclear security system. BATAN security culture regulations are sent to all facilities for implementation. BATAN conducts international cooperation on nuclear security and physical protection with organizations such as Indonesia's Nuclear Regulatory Agency (BAPETEN), U.S Department of Energy, IAEA, the Japanese Atomic Energy Agency Integrated Support Center for Nuclear Non-proliferation and Nuclear Security (ISCN/JAEA), Center for International Trade and Security (CITS/UGA), King's College in London, and others.

BATAN has conducted a self-assessment for nuclear security culture at nuclear research reactors, and is planning a self-assessment on nuclear security culture at radioactive source facilities. The safety culture team has been invited to participate to promote harmonization. BATAN has a safety culture program that conducts discussions every month with working units in order for everyone to share and learn from experiences. A self-assessment of safety culture is conducted at the end of each year.

BATAN has established an Integrating Management System (IMS) to promote integration implementation of management system elements. Based on IMS audits, the three BAPETEN sites have implemented integration of quality, safety and security management systems. The implementation of the IMS has yielded positive results, such as: more streamlined business processes in all areas; awareness of integrated approach in decision making process; (IMS is regarded as necessity rather than compliance to requirements); more focus on safety and security risk management; and improved adherence to procedures. Obstacles to the success of the IMS have included: complicated tasks and time consuming efforts; complaints regarding paperwork; high cost for safety and security; process

requires multi-talented employees, and insufficient number of personnel interested in both areas of safety and security.

It was stated that there have been issues with harmonization of safety and security elements below the cultural level. It was pointed out that it may not be necessary or feasible to harmonize all aspects of safety and security, and discretion should be utilized when evaluating program elements.

World Nuclear Association (WNA) International Experience with Harmonization -- WNA emphasizes that the harmonization of safety and security culture should be conducted in a manner that minimizes difficulty (keep it simple). Any organizational culture must endorse and support variability in culture elements. If organizational culture conflicts with professional and ethical culture, is it possible that cognitive dissonance can arise that can cause dissatisfaction among personnel. Such displeased personnel could pose insider threats. It is up to the organization, especially the management to ensure that cultural conflicts do not occur by balancing concerns for people, profit, and the environment. Safety and security harmonization, along with self-assessments, can help assure this is being done.

"Societal impacts can be significant, and must be considered when developing a cultural program."

The operator of a nuclear facility is responsible for its safety and security. The operator's organizational culture should build on the society's wider professional and ethical cultures (to work "with the grain" and avoid generating cognitive dissonance and dissent). It is responsibility of the organization's leadership and management to resolve any apparent or real conflict between the organization's values and objectives and the wider professional and ethical norms in society. Societal impacts can be significant, and must be considered when developing a cultural program.

With regard to regulatory oversight, it is important that the organizations under the purview of the regulatory understand the need for independent oversight and cooperate to the fullest extent to achieve common objectives. The regulatory oversight organization should be careful not to attempt to "micromanage" culture, and should be supportive and informative to promote culture development. The nuclear security-safety programs should be mature enough to be evaluated before any significant observations are rendered.

Safety and Security Culture Activities at a Bulgarian Nuclear Power Plant (NPP) -- The Kozloduy NPP in Bulgaria has two operating reactors (Russian designed WWER-1000 units) and three reactors under development. The NPP's values are linked to the IAEA, and are stated as learning, safety first, involvement and respect, personal responsibility, and striving for excellence.

A Safety Culture Project was conducted at the NPP in 2009. The goal was to provide expert support and guidance on how to assess and improve safety culture. The project resulted in the development of three important documents: (1) Guide To Developing And Maintaining Values That Support A Positive Safety Culture; (2) Safety Culture Self-Assessment Guide; and (3)

Safety Culture Continuous Improvement Guide. Other outcomes of the project included: training by the approach of "learning by doing;" self-assessment of safety culture; establishment a Safety Culture Council; and sharing knowledge, experience and practical approaches to assess and improve safety culture. The Bulgarian nuclear organization has established a benchmarking program to facilitate sharing safety culture experience. This program fosters cooperation and exchange of experience with other NPPs situated in Southeastern Europe.

Although the primary focus to date at the Kozloduy NPP has been the development of nuclear safety culture, the NPP also has been active in the development and implementation of nuclear security culture. Preparatory meetings were convened and a team was selected to conduct a security self-assessment. A management opinion of the self-assessment results was that the NPP program has already integrated safety and security culture. (This opinion is not uncommon at NPPs were safety is typically given highest priority, and security functions are considered to be integral to overall safety). Knowledge of the safety culture self-assessments contributed to the development of a security culture self-assessment methodology. This synergy should be utilized whenever possible in the process of safety-security culture harmonization.

The U.S. Nuclear Regulatory Commission Approach for Harmonization and Integration -- The NRC position is that nuclear safety culture is defined as the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment. The NRC issued a Safety Culture Policy Statement (76 FR 34773; June 14, 2011) that addresses the close relationship and considerations between nuclear safety and security cultures. Also, NRC Regulatory Guide 5.74 (2009), "Managing the Safety/Security Interface," states that the interface between safety and security is an important element of both programs relative to ensuring public health and safety.

The NRC Safety Culture Policy Statement states expectation that licensees maintain a positive safety culture, but there is no specific regulatory requirement for safety culture. The NRC acknowledges the importance of security culture with regard to the interface with safety culture programs, but does not have a specific protocol for the evaluation of security culture. NRC Nuclear Safety Culture Assessments do not specifically address nuclear security culture. NRC licensing inspections focus on operational security and do not evaluate nuclear security culture.

"NRC Nuclear Safety Culture Assessments do not specifically address nuclear security culture."

While the NRC cites and acknowledges IAEA guidance, it does not utilize IAEA documents for regulatory program implementation and oversight. All NRC regulation is conducted under internal regulations and guides.

Nuclear Program Oversight by the Nuclear Energy Regulatory Agency of Indonesia – (BAPETEN) has the main responsibility to

regulate the utilization of nuclear technology in Indonesia through licensing, inspection, and regulation supported by assessment. Additional functions include emergency preparedness, education and training, and maintaining an information system.

Government Regulation No. 54 defines nuclear safety culture and Government Regulation No. 2 provides requirements for reactors. Currently there is no regulation directly related to the integration of nuclear safety and security culture. The Nuclear Law (Act No. 10) has been amended to include nuclear security concerns in addition to nuclear safety. Without any clear guidance for the oversight of safety-security culture harmonization, it is difficult to provide any meaningful assessment of this process. Currently BAPETEN has no harmonization or integration concept for assessments under consideration. Harmonization initiatives are taken by individual facilities and implemented as their internal regulations.

3. What is Needed to Make Harmonized Cultures Effective and Sustainable

Below are topics related to nuclear safety/security culture interface that were deemed crucial to the harmonization process.

Visible Commitment from All Levels of Management -- It is necessary for management to show full support for the harmonization of safety and security culture by demonstrating a visible, viable and sustained commitment to this process. This commitment must be evident from all levels of management throughout the organizational structure. Managers must identify the benefits of safety and security culture and communicate them. As an example, management could set aside specific time to address these issues in routine meetings such as a morning briefings. Managers could provide statements and/or presentations that consider current issues in safety and security.

During the management review of documentation, managers should be conscious of the need to include harmonization of safety and security culture in policy statements, guidance, directives, etc. Also, management must commit to participate in training and education programs, and should ensure that there is shared training across safety and security.

"Managers must identify the benefits of safety and security culture and communicate them."

Dissemination of Information, Knowledge, and Data -- The dissemination of information, knowledge and data requires a multi-layered interactive program, and to be effective this program will require continual development and maintenance. Safety and security culture harmonization issues can be facilitated by communicating at jointly held safety and security training sessions the shared results of safety and security self-assessments.

Harmonization could be achieved by providing training on security and security culture for non-security personnel, and ensuring security information among non-security personnel through e-learning

information systems. An effective method of information dissemination is communicating information on training and seminars.

Continual Motivation to Avoid Complacency -- Regardless of how evident it is that a program or concept is good (e.g. harmonization of safety and security culture), there must be continual reinforcement and motivation to ensure that the program or concept becomes integral to routine work processes. Motivational measures include continual training, coaching, and encouragement to staff at the bottom level regarding safety and security culture. While posters, flyers, banners related to safety and security may reinforce key ideas, these reminders are insufficient in themselves to ensure effective motivation. Additional measures to foster motivation include: (1) welcoming feedback and encouraging team spirit to inspire improvements; (2) discussing concerns with complacency at employee gatherings; (3) working to increase the level of trust between employees and management; and (4) creating a long-term change management plan as part of continuous improvement.

Inclusion of Topics at Special and General Meetings -- An important element of harmonization of safety and security culture is raising awareness about the shared responsibility of safety and security. Meetings are an ideal venue for discussions on related topics. Meetings that include discussions of integrated nuclear safety/security culture could be conducted in a wide range of formats, including status update meetings, information sharing meetings, decision-making meetings, problem solving meetings, innovation meetings, and team building meetings.

Organizations often conduct separate internal meetings with regard to safety and security issues. There may be a general reluctance to add additional routine meetings to specifically address nuclear safety and security culture harmonization. A plan should be devised regarding how meetings could be set up and coordinated to include safety-security harmonization while minimizing the impact on time, effort and resources. Also, meetings that are intended to discuss the harmonizing of nuclear safety and security culture could involve a wide range of ancillary issues. It is crucial to narrow the scope to the key issues that should be the focus of such meetings, and to keep the focus on these central issues.

Clearly Defined Responsibilities for Individuals -- There is a high likelihood that the process of harmonization of safety and security culture may become unfocused or given lesser importance unless there are persons specifically tasked with ensuring that this process is sustained until it becomes integral to operations and activities. Although it is understood that ‘everyone is responsible’ for security and safety culture development, it is important to have personnel who are leaders to sustain the ongoing efforts. Activists for safety and security culture should work together for common goals of harmonization/integration.

One of the most important roles of responsible individuals would be to lead the efforts to eliminate or mitigate the competition between safety and security personnel and encourage cooperation. This

could include altering the job description of safety and security personnel to encourage a combined safety and security culture, and changing the perception of safety and security culture from free standing separate concepts to combined one.

Learning and Continual Improvement -- In order for the process of harmonizing safety and security culture to mature and be sustainable, there must be a program of ongoing learning and continual evaluation and improvement to support harmonization efforts. Continual improvement should include openness between safety and security to facilitate communication and learning. This could involve creation of a combined database of lessons learned in safety and security, holding quarterly meetings to review incidents and report on current status, and sharing best practices for harmonizing safety and security. A continual improvement process typically involves a means to capture and track action items and ensure that these actions are resolved as functions of continual improvement. Continual learning is a prerequisite for a robust safety and security culture.

"Continual improvement should include openness between safety and security to facilitate communication and learning."

Tracking Mechanisms to Measure Progress -- It is essential to track progress to determine whether or not initiatives to develop and improve harmonization or integration of security and safety culture are being implemented and are effective. It may be feasible to identify elements of safety and security that can be combined and create milestones towards doing so. This might involve developing landmarks to track whether progress is being achieved. It could involve creating overall and specific safety and security performance indicators to gage progress.

A key parameter to track could be the conduct of simultaneous self-assessments for safety and security to be more efficient. This could help align and harmonize similar safety and security aspects to reduce redundancy and cost. This can serve as one measure of progress during culture self-assessments and enhancement.

Action item tracking systems typically involve a data base that can provide reminder functions regarding unresolved actions. This type of computer-based system can prove effective at tracking issues and can reduce the work required by employees.

Updating Policies, Procedures, and Protocols -- An important part of a sustainable integrated nuclear safety and security culture program is ensuring that the relevant policies, procedures and protocols are updated to reflect the current and evolving nuclear safety and security environment of the operations. A program should be established to ensure that policies, procedures and protocols are reviewed routinely and updated commensurate with safety-security developments.

It is important that all relevant policies, procedures, and protocols be updated to reflect the organization-wide commitment to the harmonization of safety and security culture. Unless the directives that drive this change reflect the commitment, there is a

concern that the process may not be given appropriate priority or status. It is necessary to ensure awareness of changes to policies, procedures and protocols so that everyone can be cognizant of the latest directives and initiatives. A specific, documented approach is needed that can be utilized to ensure everyone is notified of updates and encouraged to become familiar with the materials (e.g. training and briefings, etc.).

Contribution of the Regulatory Authority – An input from the regulatory agency may be beneficial to facilitating safety and security culture harmonization, but the process does not require regulatory requirements or prescriptive documents. Laws related to safety and security harmonization should be updated or added along with needed oversight documents. However, the concept of culture should be treated as guidance rather than as a regulatory directive.

Since the concepts of safety culture and security culture are somewhat philosophical in nature, it is difficult to develop rigid, prescriptive criteria that would be subject to regulatory verification. Regulatory agencies should not attempt to regulate the integration of safety and security as conditions for licensing or acceptable performance of nuclear installations. It should be considered that culture is developed gradually over time, so that any guidance should be given to aid the developmental process and encourage harmonization as a work in progress.

Continuous development of a shared perception of safety and security culture harmonization and establishing a positive dialog with the licensee is of primary importance for performing effective regulatory oversight. Therefore, regulatory oversight is based on three main principles:

- *Common understanding of the harmonization process*. The nature of security culture is unique and needs to be dealt with in a different manner than a compliance-based control. The interface with safety culture is crucial in achieving a common language and framework that supports both the regulatory authority and the licensee in their communication.
- *Dialogue*. To gain a better understanding of safety-security culture harmonization, dialogue is necessary to share information, including precursor events, and communicate ideas and knowledge that is often qualitative. Dialogue supports a more creative and constructive way to find solutions for continuous improvements.
- *Consistency*. Safety and security culture improvement needs continuous engagement of the licensee. Regulatory oversight therefore ideally relies on a process during which the regulatory continuously maintains and encourages the engagement with the licensee.

The regulatory authority should not impose detailed or rigid requirements but rather attempt to regulate the harmonization process as a whole. Mechanisms for regulatory oversight must be established during the entire life cycle of nuclear installations, including major technical and organizational changes.

4. Addressing Specific Areas of Culture Harmonization

Specific areas of culture harmonization can include the following:

Mission Statements and Plans of Action -- The contents of a mission statement should state the goal and objectives of the mission. It should clearly define why safety and security are integrated (e.g. management commitment, benefits of integration, values, time schedule, strategy, etc.). The statement needs to be realistic and achievable. The contents of typical plan of action may include: (1) Assessment of current the situation, which provides the justification for action by identifying needs; (2) clear goals; (3) good measures of those goals -- these measures should be developed before starting the plan; (4) roles and responsibilities; (5) barriers to success; (6) timeline; (7) budget and other resources; (8) enablers and contingencies; (9) milestones and key implementation steps to measure progress; (10) expected results and end date; (11) communication plan to aid in implementation; and (12) list of stakeholders/ interdependencies.

Training and Qualification -- The steps involved in developing effective training are: (1) analyze the current situation and develop a plan for training development; (2) select specialists with appropriate knowledge and qualifications to present the training materials; (3) ensure the use of appropriate training materials on safety, security, and safety and security culture by benchmarking; (4) determine the duration of training sessions and the overall course; (5) identify target groups to be trained and levels of training applicable to the target audience; (6) ensure that everyone is aware and agrees that a credible threat exists, and nuclear safety and security are important; (7) hold ongoing, integrated safety and security training sessions; and (8) conduct joint training to raise safety-security awareness. It may be prudent to review safety and security training materials and seek opportunities to develop integrated training modules wherever feasible.

Self-Assessment and Enhancement -- It could be beneficial to include both safety and security assessors when conducting self-assessments for safety and/or security assessments. In addition, it would be helpful to proceed with the process of seeking opportunities to harmonize safety and security self-assessments to address common elements in a single assessment process.

"It may be prudent to review safety and security training materials and seek opportunities to develop integrated training modules wherever feasible."

The process of developing a harmonized safety-security culture can lead to the development of a comprehensive understanding of safety and security culture, can identify obstacles for enhancing safety and security culture, and can achieve more effective interactions between safety and security culture. This can lead to a better understanding of the shared, common characteristics of the two cultures. Issues for designing a harmonized safety-security self-assessment program include (1) deciding on the composition of the self-

assessment team; (2) defining the scope and targets for harmonization; (3) defining the implementation timeline; (4) allocating responsibility for the process; and (5) identifying possible challenges that must be addressed.

Corrective Action Plans -- Corrective action plans (CAPs) are the final stage of self-assessments from which corrective measures to improve safety and security cultures are developed. The plans are used to determine problems and deficiencies. Corrective actions are based on the findings of root cause analyses to determine required actions, priorities, urgency, and responsibility. The corrective action plan process can be facilitated by the use of a Corrective Action Tracking System (CATS). Preparing a SMART corrective action plan can drive process improvement and support implementation of a routine best practices approach. The elements of a SMART CAP are: Specific, Measurable, Action Based, Realistic, and Timely.

Dissemination of Lessons Learned and Case Studies -- Lessons learned involve utilizing experiences extracted from a project, operation or assignment that should be taken into account in future endeavors. The process of developing lessons learned may include the conduct of root cause analyses to determine the human element in situations. A goal for lessons learned should be to increase communication about harmonization with attention placed on the human element.

Since the lessons learned process includes discussions of failures, it is important to utilize caution and sensitivity when documenting and disseminating information, and to consider the impact on personnel and individuals when preparing the write-ups. Difficulties may arise when lessons learned involve confidential or classified information. Judgement must be applied when decide how and when information should be released for lessons learned dissemination.

Emergency Response Plans -- Safety and security are already integrated to a degree due to the nature of emergency response plans; under emergency conditions, safety and security share some of the same resources. Safety and security representatives should work together to prepare and update emergency response plans to ensure that both safety and security are given equal consideration. Some organizations resist attempts to integrate guidance for nuclear emergency response because there is fear that the resulting guidance could be complex and confusing. Options for an integrated nuclear safety/security culture that could result in improved emergency response planning might include integrating the regulatory process, considering specific interfaces and addressing involvement of all stakeholders.

5. A Six Phase Process for Safety and Security Culture Harmonization

The implementation of harmonized safety-security culture typically may be conducted in a six-phase process as shown in Figure 1:

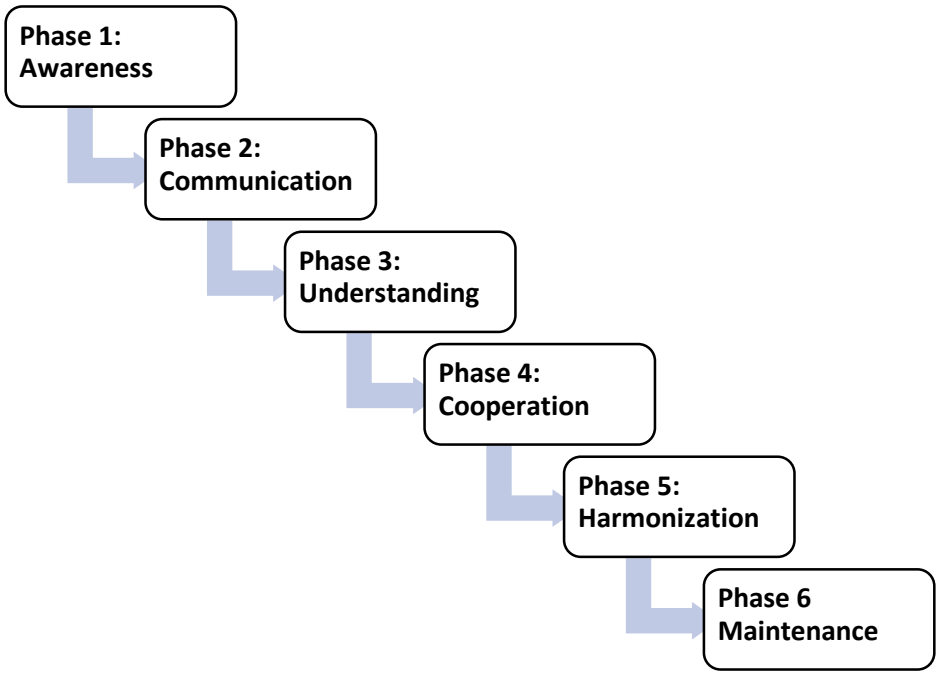

Figure 1
Phased Harmonization Implementation Process

This process allocates sufficient time to ensure that a sound basis for each phase is established before attempting to implement the subsequent phase. For a concept as abstract and as complex as organizational culture, this sequential scheduling is essential for a properly developed program.

In general, the activities that may be included in each phase are:

Phase 1 – Awareness: In the initial phase, it is recognized that the organization has little or no cultural coordination between its safety and security functions. Within this condition, the organization responsible for nuclear safety may not be fully aware (or informed) of security culture, including security decisions, arrangements, protocol, etc. Conversely, the security organization may not be well versed in the safety culture that promotes personnel protection as its highest directive. This dichotomy results in a situation where the actions by one organization may be undertaken that significantly affect the operations of the other without either being fully aware of the impacts of these actions. The first step in the process is instill and increase the awareness of both the safety and security functions of their impacts on each other, their commonalities and points of conflict, and the advantages of working together to the extent practical to achieve mutually beneficial cultural goals.

Phase 2 – Communication: Once the awareness has been established that cooperation between safety and security functions is highly desirable and beneficial, the second step of the process involves establishing effective communications. In most nuclear organizations there is at least some limited communication between safety and security functions with respect to protection of vital areas and response to hazardous or dangerous situation. However, to effect a purposeful harmonization of safety and security cultures, the level of communications must be increased so that both organizations are actively working together to disseminate information and provide each other with updates on issues of mutual concern.

"A comprehensive understanding of the shared cultural elements will establish a basis for recognizing opportunities for cooperation, and proactive actions by all levels within the organization."

Phase 3 – Understanding: The establishment of a working communications regime provides a platform for shared information and a deeper understanding of how the functions of security and safety are interrelated. It is important that the information not only be shared, but it also must be fully understood by both cultures in terms of how safety impacts security and vice versa. A comprehensive understanding of the shared cultural elements will establish a basis for recognizing opportunities for cooperation, and proactive actions by all levels within the organization. Conversely, understanding these relationships also establishes the knowledge that a lack of communication and coordination between its safety and security functions results in an increased risk of threat and vulnerability for both.

Phase 4 – Cooperation: As the level of understanding of the value of safety and security culture harmonization increases, the opportunities for cooperation become more self-evident. At this point the individuals within the organization may be expected to be actively seeking opportunities to cooperate with each other with an understanding of the mutual benefits of such cooperation. In this phase, the safety and security organizations learn to work together whenever possible to streamline protocol, facilitate both safety and security principles, and to manage risks inherent in operations.

Phase 5 – Harmonization: As cooperation increases, the organization can begin to realize a true integration of common elements of security and safety from a functional standpoint. This harmonization does not mean that either organization must sacrifice its internal goals, or give up areas of responsibilities; rather, it means that each organization has implemented a systematic process to ensure that the overall organization benefits from a well-coordinated and harmonized safety/security process. This commitment to a higher cultural goal is the ultimate phase of cultural harmonization, and can be the basis for large benefits such as streamlined operations, reduced costs, and increased safety and security. At this point not only the staff or operations mangers, but the entire organization from top to bottom must be committed to harmonized safety/security culture goals.

Phase 6 – Maintenance: After a program is fully harmonized and established, the continuing program must be maintained to ensure that the harmonization is perpetuated for new personnel, operational changes, and other factors within the organizational culture. This should include periodic evaluation of the nuclear safety-security culture to assess the effectiveness of the harmonization. Maintenance also would involve implementation of corrective actions and sharing of lessons learned.

Based on the preceding evaluation, it is easy to understand that there is a large opportunity to improve the overall operational culture of a nuclear facility or program by seeking ways and means to harmonize elements of both that have sufficient common grounds to make it feasible. However, although there are shared elements at the interface of nuclear security culture and nuclear safety culture, it is important to acknowledge that it is not typically practical to attempt to fully combine (or force) safety and security programs into a single function. Nuclear security culture is sufficiently distinct in its objectives and approaches to justify its status as a separate field. For nuclear safety culture, the primary focus is on unintended acts or conditions that could lead to disruptions, breakdowns and releases from authorized research, production, and transportation chains, with responses that emphasize engineered protection and safety management. For nuclear security culture, the primary focus is on the international misuse of infrastructure and products by terrorist, criminal, or other elements with responses that emphasize intelligence gathering, physical protection, vigilance, and compliance. Their common objective is to protect human lives, society and environment but these objectives are achieved through different means. Therefore, the properly harmonized program will promote some degree of integration where feasible, recognizing that both the security and safety culture programs have enough unique features and specific directives to warrant maintaining each program as an independent function.

6. Conclusions

There are numerous benefits from a properly harmonized program that are certain to outweigh the initial efforts required to evaluate and implement the process. As with all systems-engineering based development processes, the overall process is front-loaded with requirements for resource allocation in order to initiate and evaluate the necessary elements for the desired result. Although this initial outlay of time, materials, and funds may challenge the resource allocation planning for some organizations, the achievement of a harmonized program will provide both tangible and intangible dividends for the effort and resources expended.

7. References and Sources for Additional Reading

[1] International Atomic Energy Agency, “The Fukushima Daiichi Accident,” IAEA Report by the Director General, GC(59)/14, p.7, IAEA, Vienna, 2015

[2] The Office Report of the Fukushima Nuclear Accident Independent Investigation Commission, The National Diet of Japan, July 5, 2012, p.9

[3] International Atomic Energy Agency, “Measures to Improve the Security of Nuclear Materials and Other Radioactive Material,” IAEA Board of Governors General Conference, GC(45)/20, IAEA, Vienna, 2001

[4] International Atomic Energy Agency, “Nuclear Security Culture: Implementing Guide,” IAEA Nuclear Security Series No. 7, IAEA, Vienna, 2008

International Atomic Energy Agency, *Safety Culture*. IAEA Safety Series No. 75-INSAG-4, Vienna, Austria, 1991

International Atomic Energy Agency, *Application of the Management Systems for Facilities and Activities*. IAEA Safety Standard Series Guide No. GS-G-3.1, Vienna, Austria, 2006.

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International Atomic Energy Agency, *the Interface between Safety and Security at Nuclear Power Plants*. A report by the International Nuclear Safety Group, INSAG-24, Vienna, Austria, 2010.

Kuykendall, T.A. and Igor Khripunov, *Examining the Interface between Nuclear Security Culture and Nuclear Safety Culture*. 1540 Compass journal, publication of the Center for International Trade and Security, University of Georgia in cooperation with the United Nations Office for Disarmament Affairs, Issue 8, Winter 2015.

World Institute for Nuclear Security, *an Integrated Approach to Nuclear Safety and Security*. Revision 1.1., A WINS International Best Practice Guide for your Organisation, 2011.

8. Appendix 1 – Workshop Agenda

Monday, January 29		
9:00-9:30	**Registration**	
9:30-10:00	• Opening • Introductions • Review of the Agenda	
10:00-11:00	**Session One: Harmonization or Integration: Benefits and Challenges** • What does Harmonization mean? • The case for Integration of Nuclear Security Culture and Nuclear Safety Culture	1. Dr. Ken Koves, World Association of Nuclear Operators (WANO) 2. Terry Kuykendall, UGA/CITS, USA
11:00-11:20	**Coffee and Tea Break**	
11:20-13:00	**Session Two: Where Are We Now: International Experience Sharing on Culture Harmonization and Integration** • Presentations	1. Dr. Ken Koves, WANO 2. Kazuko Hamada, International Atomic Energy Agency (IAEA) 3. Greg Kaser, World Nuclear Association (WNA), teleconferencing 4. Mate Solymosi, SOMOS Environmental Protection Ltd., Hungary
13:00-14:00	**Lunch**	
14:00-16:00	**Session Two (Continued): Where Are We Now: International Experience Sharing on Culture Harmonization and Integration** • Presentations	5. Terry Kuykendall, UGA/CITS, USA 6. Emily Doncheva, Kozloduy Nuclear Power Plant, Bulgaria 7. BATAN, BAPETEN
16:00-16:20	**Coffee and Tea Break**	
16:20-17:30	1. **"Integrated Chemical Safety and Security Risk Management"** 2. **"Safety and Security Integration in the Aviation Industry"** 3. Discussion	8. Igor Khripunov, UGA/CITS, USA 9. Jason Lowe, UGA/CITS, USA
17:30	**Day One Adjournment**	

Tuesday, January 30		
9:00-11:00	**Session Three: Round Table Discussion** • What is Needed to Make Harmonized/Integrated Cultures Effective and Sustainable. 1. Visible commitment from all levels of management 2. Dissemination of information, knowledge, and data on safety/security interaction 3. Continual motivation and encouragement to avoid complacency 4. Focus on harmonization and integration issues at special and general meetings	
11:00-11:20	**Coffee and Tea Break**	
11:20-13:00	5. Clearly defined responsibilities for individuals tasked with harmonization and integration 6. Emphasis on learning and continual improvement in the process of harmonization and integration 7. Development of a tracking mechanism to measure progress 8. Updating policies, procedures, and protocols to reflect the results achieved and stimulate further progress 9. Contribution of the Regulatory Authority 10. Other • Discussion	
13:00-14:00	**Lunch Break**	
14:00-15:00	**Session Four: Addressing Specific Areas of Culture Harmonization and Integration** Panel 1. Mission Statement and Plan of Action Panel 2. Training and Qualification	Moderators: Panel 1. Ken Koves Panel 2. Emiliya Doncheva
15:00-16:20	**Coffee and Tea Break**	
16:20-17:30	**Session Four (Continued)** Panel 3. Self-Assessment and Enhancement Panel 4. Corrective Action Programs	Moderators: Panel 3. Kazuko Hamada Panel 4. Emiliya Doncheva
17:30	**Day Two Adjournment**	

Wednesday, January 31		
9:00-10:30	**Session Four (Continued)** Panel 5. Dissemination of Lessons Learned and Case Studies Panel 6. Emergency Response Plan • Discussion	Moderators: Panel 5. Mate Solymosi Panel 6. Terry Kuykendall
10:30-10:50	**Coffee and Tea Break**	
10:50-11:20	**Session Five:** Step-by-Step Implementation of Safety/Security Culture Harmonization and Integration	Terry Kuykendall, UGA/CITS, USA
11:20-12:30	**Session Six:** • Concluding Remarks • Highlights of a Workshop Report (structure, content, recommendations)	
12:30	**Adjournment**	