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NUCLEAR SECURITY INTERFACE CONSIDERATIONS FOR REGAINING CONTROL OF DISCOVERED NUCLEAR AND RADIOACTIVE MATERIALS

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ABSTRACT

Regaining control of orphan radioactive and nuclear material is challenging; therefore, the international community has developed requirements and guidance to support countries in addressing this problem. However, limited guidance is available on the practical nuclear security-related issues that arise when nuclear or other radioactive material out of regulatory control (MORC) is encountered and efforts are undertaken to regain control. For example, the International Atomic Energy Agency (IAEA) Specific Safety Guide No. SSG-19, "National Strategy for Regaining Control over Orphan Sources and Improving Control over Vulnerable Sources," (1) provides recommendations on a methodology for establishing a national strategy for regaining control of orphan sources. However, except for ^{239}Pu in radioactive sources, nuclear material is outside the scope of this safety guide, and practical safety and security measures below the level of national strategy are not discussed extensively.

This paper discusses the interfaces between stakeholder groups and the responsibilities of each group when encountering common scenarios that concern MORC transitioning to regulatory control. The stakeholders include, but are not limited to, individuals who encounter MORC, providers of formal and informal transport systems, and traditional and ad hoc storage solutions. This paper explores practical legal, financial, and institutional issues that hinder implementation of required safety and security practices. This paper also offers strategies that can be implemented on the individual, organizational, national, and international level to regain control of MORC.

1. INTRODUCTION

Nuclear and other radioactive material exists either under regulatory control or as material out of regulatory control (MORC). According to the Nuclear Security Glossary (2), published by the International Atomic Energy Agency (IAEA) in 2015, *regulatory control* is defined as

> *Any form of institutional control applied to nuclear material or other radioactive material, associated facilities, or associated activities by any competent authority as required by the legislative and regulatory provisions related to safety, security, or safeguards. [Material out of Regulatory Control] is used to describe a situation where nuclear or other radioactive material is present in sufficient quantity that it should be under regulatory control, but control is absent, either because controls have failed for some reason, or they never existed.*

Orphan source is defined as

> *A radioactive source which is not under regulatory control, either because it has never been under regulatory control or because it has been abandoned, lost, misplaced, stolen, or otherwise transferred without proper authorization.*

Vulnerable source is defined as

> *A radioactive source for which the control is inadequate to provide assurance of long-term safety and security, such that it could relatively easily be acquired by unauthorized persons.*

At what point have sufficient safety and security measures been applied to MORC that is re-entering regulatory control? This critical question is valid for all material types and involves sealed radioactive sources, fissile nuclear material, and other types of nuclear material, including, but not limited to, uranium ore concentrate (UOC) or uranium hexafluoride (UF_6). The challenge is to apply the correct safety and security measures with limited resources and without unduly harming the public interest.

Consider the case of material that exits regulatory control via inadvertent or malicious removal from a facility: an argument could be made that the material re-enters control when it is returned to that facility or the licensee of the facility. Alternatively, material might go out of regulatory control during transit. Material may move through different jurisdictions within one or more states while in transit. If material traveling from jurisdiction A to jurisdiction C, is stolen, and then is found in jurisdiction B, when does the material re-enter regulatory control? Is it at the instant when local law enforcement creates a perimeter around the discovered material, or is it when the material is released by law enforcement and forensics to a licensee for transport back to its origin or destination? This question of regaining control not only has safety and security implications but also touches on legal questions of possession, control, and the responsibilities of authorities and the safety and security procedures in place for material to be secure. The goal of this paper is to highlight real-world conflicts that emerge in regaining control of MORC. These conflicts raise questions related to the interactions of various state, licensee, and other stakeholders in addressing MORC issues. These potential conflicts may not be resolved easily. This paper seeks to highlight issues faced in the real-world and encourage discussion and raise awareness of scenarios that, while common, require much further scrutiny and attention from the international community.

2. LEGAL ISSUES

When framing the scenarios, begin with the premise that nuclear and other radioactive material is under regulatory control. Under the Convention on the Physical Protection of Nuclear Material (CPPNM) (3) and its Amendment (A/CPPNM) (4), nuclear security is the responsibility of the state. As signatories to the Convention and its Amendment, parties are obligated to ensure physical protections are in place during use, storage, and transport and to criminalize and penalize theft and sabotage of nuclear material (3), (4). Although not legally binding, the Code of Conduct on the Safety and Security of Radioactive Sources (5) encourages commitment to principles of nuclear security for the security of sealed radioactive sources during use, storage, and transport.

Whether for radioactive or nuclear material, the development of legislative and regulatory frameworks is critical to ensure continuous physical protection, no matter the stage in the life cycle of the material. In many instances, particularly for transport, multiple competent authorities share regulatory responsibilities for the material. Because nuclear and other radioactive material is also a dangerous good, the competent authority and a transport ministry may share responsibility. Freeman and Rossi (6) call this overlapping of jurisdiction or organizational responsibility a *shared regulatory space***.** In such spaces, whether at the regulatory development stage, the implementation stage, or when material is being moved or recovered, these authorities need to establish coordination frameworks to ensure legal authorities and competencies are respected.

This shared regulatory space can take on different dimensions, particularly when handling orphan radioactive material in transit re-entering regulatory control. For example, if material is in transit and does not leave the borders of state A, but is lost and subsequently recovered by law enforcement, which agencies are involved and identified to respond? Does the presence of law enforcement, an institutional control insofar as they have certain powers bestowed by the state, re-establish regulatory control? Arguably, no; however, their presence establishes security control and possession of the material. At this stage, security control is regained, but regulatory control has not been re-established per se. When material is lost during international transport, the complexity of the scenario is magnified, particularly if the material is nuclear as defined in Article 4 of the CPPNM (3) and Article 2A Fundamental Principle B of the A/CPPNM (4), which describe requirements for international transport. In the international context, transport becomes more complex, particularly when a transit state is involved and the transit state rejects a shipment and thus the material cannot travel through the transit state. The material may still be under security control, but lack of regulatory control, depending on the situation, can lead to material being stranded or waiting to be claimed by a duly licensed individual or the competent authority.

3. REAL-WORLD CONSIDERATIONS: AN INTERNATIONAL PERSPECTIVE

3.1 Single Sovereign State Scenarios

Jurisdictional and regulatory issues are simplified for scenarios in which material transitions from regulatory control to orphan status and then back to regulatory control within a single sovereign state. Approvals for the transport package and temporary and interim storage solutions may be provided by a single entity. This same entity may aid in ensuring the deployment of adequate security measures by coordinating national and local resources. Nevertheless, complications still result from single sovereign state scenarios. The cost of shipping, storing, and protecting the

orphan source may be a significant burden for the state. Acquiring an approved transportation package may be difficult. Many older, spent high-activity radioactive sources (SHARS) were initially transported to their end-use sites using methods that no longer satisfy international transport standards (7), so new solutions are required to move the material to an appropriate storage location. An evaluation may be needed to determine whether the material should be removed from or left in its existing containment and subsequently placed inside a type A or B overpack. Alternatively, if no suitable container can be acquired within the necessary time frame, the competent authority may approve a special arrangement. IAEA Specific Safety Requirements 6 (SSR-6) (8) defines a special arrangement as

> *Those provisions, approved by the competent authority, under which consignments that do not satisfy all the applicable requirements of these Regulations may be transported.*

A special arrangement provides flexibility to transfer the material in a safe and secure manner under unique conditions.

3.2 Multi-State Scenarios

More-complicated issues arise when transitioning an orphan source to regulatory control requires the source to move through two or more sovereign states. This situation may arise when the orphan source is identified in a transnational shipment or suitable storage facilities exist only outside of the state where the orphan source was discovered. Acquiring approvals from each state's competent authority for the shipping container may take substantially longer than acquiring the necessary approvals and equipment to transport a SHARS inside only one state. This delay may necessitate extended storage at a temporary site with adequate security and safety measures.

3.3 Graded Approach

A graded approach to implementing safety and security measures is required by IAEA Safety Standards Series No. GS-R-3 (9) and recommended in IAEA Nuclear Security Series guidance publications. Generally, the safety and security measures required by regulation of the activity and form of the orphan source should be implemented as soon as possible. Unknowns related to the history and current characteristics of a recovered source may require the use of more cautious safety and security measures. After an orphan source has been discovered, emphasis should be placed on safely assessing and documenting the physical and radioactive properties of the source to determine the potential risks associated with handling, moving, or storing the material. Documentation and labeling accompanying the source should be examined if available. Additional investigations, including interviews with individuals who may have handled the source in the past, may also be required. Orphan sources may not have a valid special form certificate, or the inspection may indicate that the existing encapsulation has degraded. These and other reasons may require that the material be viewed as a non-sealed source.

3.4 Functional Gaps

Some sovereign states are unprepared to handle the financial and technical challenges presented by recovered orphan sources. If an orphan SHARS is discovered and must be relocated to an adequate temporary storage site, the local officials and first responders may be ill-equipped to characterize the source's physical and radioactive properties. International aid may be needed to

identify and finance appropriate transport and storage solutions. The IAEA and other organizations have facilitated and continue to facilitate this form of aid upon Member State request. Sourcing adequate containers for orphan SHARS continues to be an issue in many areas. Some vendors are reluctant to loan a Type B container for use in regions with significant risk of theft, and some sovereign states may be unable to justify the purchase of an adequate Type B container for the transport of a single orphan source.

4. REAL-WORLD CONSIDERATIONS: A US PERSPECTIVE

4.1 Response Scenarios

Within the United States, according to the National Fire Protection Association (NFPA) 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents (10), a *hazardous material* is defined as

> *Matter (solid, liquid, or gas) or energy that when released is capable of creating harm to people, the environment, and property, including weapons of mass destruction, as defined in 18 U.S. Code, Section 2332a, as well as any other criminal use of hazardous materials, such as illicit labs, environmental crimes, or industrial sabotage.*

US fire department and law enforcement agency personnel, collectively known as first responders, are trained to respond to events based on a specific set of protocols. The protocols identify what actions to take based on a set of facts or circumstances. While the protocols allow for a "standard response," they also prevent liability by discouraging any actions taken outside of the protocols. Most local protocols in the United States require notification by the licensee to a regulatory body to report the loss of control of radioactive material, which may be identified as a hazardous material (HAZMAT) incident. According to first responders, a HAZMAT incident is defined from an operational perspective in simplistic terms as "bad material in a bad location with a bad container." If all three of these elements are not met, and the loss is not considered a hazardous incident, fire department resources may or may not be deployed.

The following discussion describes speculative responses to common orphan source recovery scenarios based on response protocols, current regulations, and interviews with public security and safety personnel. Interviews were conducted with responders from local, state, and federal agencies regarding response to MORC. The group identified common challenges when applying response protocols.

Scenario 1: Material reported lost, missing, or stolen

> If radioactive material is lost, missing, or stolen from the back of a work truck in the form of a piece of equipment containing a source—a commonly encountered scenario—most local protocols require notification by the licensee to a regulatory body to report the loss. Notification will also be made to the local law enforcement agency (LLEA). The LLEA will document the information and send resources to locate the radioactive material. When the radioactive material is recovered by LLEA, it is secure but is not within regulatory

control. Only when the piece of equipment is returned to the licensee will the regulatory control standard be met.

Scenario 2: Material discovered during routine operations

If stolen radioactive material is discovered and recognized by its trefoil label in a vehicle during a traffic stop, the officer would notify dispatch. The officer's response depends greatly on their training and experience. If trained at a weapon of mass destruction (WMD) awareness level, the officer would initiate an investigation based on a violation of law. Their authority over the crime scene secures the radioactive material but not within regulatory control.

If an officer has no WMD training but recognizes the trefoil, their actions may be different. The officer would notify dispatch of a possible HAZMAT incident. The officer would request a variety of resources, including fire service, an explosive ordinance disposal (EOD) team, and a specialized HAZMAT team. The fire service would respond with standard equipment and personnel to protect people and the community. A HAZMAT team would respond with advanced detection equipment to assess the material. The EOD team, usually provided by the LLEA, would respond with detection equipment to mitigate the threat posed by the material and support the investigation.

If a scene is under the control of both fire service and police officers, the radioactive material would initially be under operational control but not secure. Responding agencies would take actions to secure the crime scene, including the radioactive material. The radioactive material would be seized as evidence and maintained by the LLEA until the investigation is adjudicated. The length of time the radioactive material is held by the LLEA will vary greatly, and the material may not return to the licensee.

4.2 Variability in Response Actions

In the United States, data from the state of Tennessee (11) represent a population of more than 6.6 million people, with 100 emergency communications districts (ECDs) serving 119 primary, 16 secondary, and 29 backup public safety answering points (PSAPs). Whereas the majority of the ECDs have a single PSAP, several ECDs serve multiple PSAPs in their districts. The state network processes an average of 3.26 million calls per year. These data highlight the varying number of potential responses to MORC when reported to the first responder community. Individual PSAPs may dispatch different resources and have diverse understanding of the threat presented by MORC.

Information reported to the first responder community from the public regarding MORC varies greatly in truth and completeness. There is a significant amount of misinformation regarding the threat posed by radioactive material at no fault to the public. Additionally, there are many forms of radioactive material present within a community. To mitigate this challenge, the first response community relies heavily on standard response protocols in any incident involving potential MORC to protect responders. The fire service's medical support to the public highlights how misinformation regarding MORC can strain community resources. For example, when a radiological source is publicly reported to be out of regulatory control, hospitals can become populated with people who think they have been sickened by exposure to radiation.

Misinformation also presents challenges within the first responder community. Most LLEAs are not equipped to safely transport radioactive material under safety and security regulations. The LLEA may falsely rely on the fire service to provide this service in all circumstances. The fire service is not a transport company, and the LLEA must coordinate other options for moving radiological sources. In limited cases, there may be different methods to resolve MORC utilized by the LLEA and the fire service. For example, after the initial assessment, an LLEA may view MORC within a criminal investigation with limited information sharing. The fire service, in contrast, may immediately begin to locate the production company or licensee to return the radioactive material. Additionally, the fire service would contact local and national resources or specifically ask for any licensed source handlers that may be able to support the recovery.

Some source handler resources are

- National Laboratory Radiological Assistance Program team;
- ChemTrac;
- Aniston Chemical Depot;
- State or local fusion centers that would track missing, lost, and stolen material; and
- State or local emergency management agencies.

Different scenarios can generate different responses. In this example, adult children clean the residence of a deceased parent who had been employed as a scientist at a national laboratory conducting radioactive nuclear materials research. The adult children find storage containers appearing to contain MORC of unknown age and identification. The storage containers have trefoil labels, indicating the presence of radiation. The family notifies emergency dispatch to request assistance in disposing of the material. Depending on the dispatcher's experience and line of questions, this situation could be deemed a nonemergency fire service call. The first responder leadership would activate a HAZMAT response, and a fire department battalion chief would function as an incident commander. The incident commander would notify county and state emergency management agencies and apply the emergency response guide protocols to identify standoff distance, consider evacuation of surrounding homes, and conduct a reconnaissance with available equipment. Upon verifying the trefoil label, the commander would have to assess their capability in recovering the potential radioactive material. Recovery would include safely packaging, transporting and storage. If the commander determines they are not qualified to safely conduct the mission, they may depart the location and turn the incident over to county or state authorities. In most cases, resolution would begin by notifying the deceased parent's previous employers in an attempt to identify the owner of the material.

4.3 Discovery of MORC on Public vs. Private Land

Scenario 1: MORC discovered on state or federal public land

In the United States, there would be no automatic law enforcement response if a suspected orphan source were found on state public land. Law enforcement would have no jurisdiction to investigate the matter unless a law was broken. The first firefighter on the scene would complete a site survey and communicate with the incident commander. The survey would include assessing the scene for public safety and security. The firefighter would set up a safety perimeter around the source. At no time would the firefighter collect

the source. The firefighter would request that the regional HAZMAT coordinator come to the scene.

The regional HAZMAT coordinator would be responsible for selecting a contractor to secure the orphan source and clean the area as needed. In limited cases, the local firefighter would call the state fire marshal. (A state fire marshal investigates environmental crimes but has limited law enforcement powers.) The state fire marshal would assume the role of incident commander and coordinate assistance from an office of the state regional coordinator or the EPA.

If the orphan source were located on federal property or within federal jurisdiction, the US EPA would take a lead role to hire a contractor to clean the area and recover the source.

Scenario 2: MORC discovered on private land

If the orphan source were located on private land, the owner of the property would be notified and may need to hire a certified contractor to recover and secure the source as one possible outcome.

Conclusions

It is critical to understand the important role and responsibility of each agency when considering the process of transitioning MORC back under regulatory control. The interface of the roles each agency plays is key to a successful transition. The discussion related to various scenarios dealing with MORC interfaces in this paper yields several conclusions at the international and national levels.

International Level

- Significant logistical, financial, and bureaucratic hurdles continue to restrict access to adequate transport and storage solutions for recovered orphan SHARS.
- Efforts to regain control of MORC are greatly simplified when the material can be transported and stored inside a single sovereign state.
- Competent authorities may rely on the support of international organizations, including the IAEA, to properly characterize, protect, transport, and store recovered SHARS.

National Level

- Although specialized agencies involved in the immediate response to the discovery of MORC typically have strong safety cultures governed by the absolute desire to protect the wellbeing of responders and the public, and have strong internal protocols and training to do just that, security is typically an afterthought.
- Because so many agencies with potentially overlapping or conflicting roles are involved, responsibility may be shifted to others because of confusion related to duties, lack of strict adherence to protocols, or limited desire to be held liable for consequences.

- A strong national system governing many jurisdictions for response to the discovery of MORC does not necessarily equate to consistent levels of understanding of the nature of nuclear and other radioactive material, nor does it imply adherence to established protocols involving actions to be taken upon discovery to safely and securely bring that material back under regulatory control. As funding, training, and resources for response actions to recover this material decrease, so do the understanding and adherence to protocol, if a protocol even exists.
- Regulatory requirements, administrative and response protocols, and operational approaches can vary and cause conflict among agencies. All stakeholders, especially safety and security responders, need to be aware of one another's roles and responsibilities when responding to the discovery of MORC.

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