Advancing Transportation Security during the COVID-19 Pandemic

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Abstract

The world observed many negative changes from the COVID-19 pandemic in 2020 and 2021—loss of life, health issues, businesses shutdown, and modified operations for those working to maintain continuity. Workers who support essential functions learned (often with difficulty) how to endure and continue to provide crucial services. The Agence Marocaine de Sûreté et de Sécurité Nucléaires et Radiologiques (AMSSNuR) is one such organization. AMSSNuR serves as the regulatory body in Morocco, responsible for protecting the public and environment against the risks associated with activities involving ionizing radiation. To ensure it continued to meet this goal, AMSSNuR staff maintained operations during the pandemic and even advanced in several areas. One area of advancement was in the secure transportation of radioactive materials. AMSSNuR staff improved their skills and knowledge to support transportation security activities in Morocco via virtual training opportunities supported by the Oak Ridge National Laboratory (ORNL) in an effort sponsored by the US Department of Energy's National Nuclear Security Administration Office of Radiological Security. AMSSNuR and ORNL collaborated on customized training to support the development of a guidance document for transportation security plans. AMSSNuR can provide this guidance document to operators and carriers who support radioactive shipments in Morocco to ensure all activities are in place for shipments to meet regulatory requirements. AMSSNuR staff also improved their skills conducting inspections via specific training on the transportation security regulation. This paper will detail the process and results of these efforts and highlight positive outcomes during a difficult period.

Background

Radioactive materials (RAM) in transit often passes through areas open to the public with minimal physical protection. Because of the vulnerability of RAM during transport, it is absolutely necessary to ensure an adequate level of security at this stage. Over the past decade, the perception of risk associated with the transport of radioactive materials has evolved to encompass both safety and security. Current concerns about transportation security result because, despite the excellent safety record of the transportation of radioactive materials, the threat of malicious acts such as sabotage are now more widely recognized.

Morocco uses RAM for many purposes. Morocco currently has more than 300 gauges used for quality control in different industries with 12 nondestructive control companies. The TRIGA Mark II research reactor of Morocco is part of the National Center of Energy Sciences and Nuclear Techniques (CNESTEN). There are dozens of research and education laboratories, including ^{131}I radiopharmaceutical production laboratories within CNESTEN. Medical facilities include 26 nuclear medicine units, 30 brachytherapy units, and 2 gamma-knife installations. Regarding agriculture, projects to bring a food irradiator and an insect irradiator to Morocco are currently underway.

The number of transportation authorizations granted by AMSSNuR in the past 5 years varies from 4 in 2016 to 88 in 2020, with the number of authorizations in 2020 reduced as a result of the pandemic. Authorizations peaked in 2018 with 183 granted (Figure 1). These authorizations are currently specific to safety requirements because the transportation security guidance is still a draft.

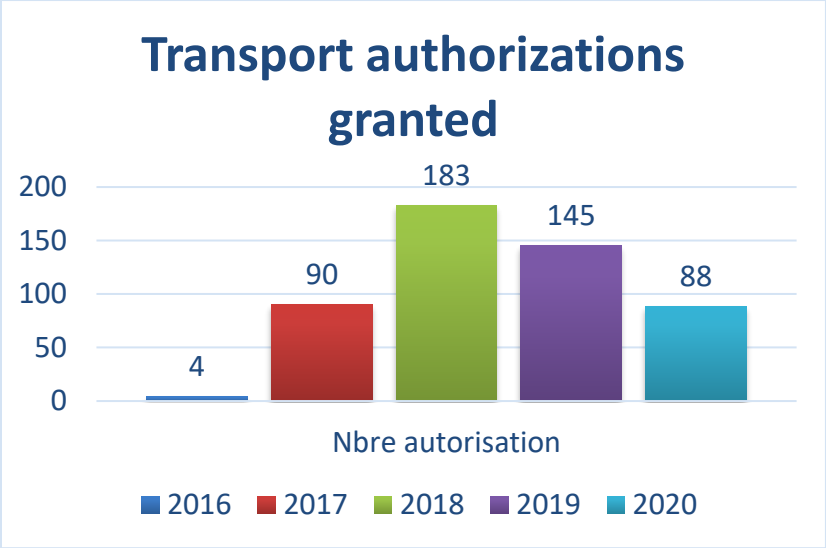

Figure 1. AMSSNuR radioactive materials transport authorizations.

A transportation authorization is granted after reviewing the application for the following operations:

- import (from airport to user)
- export (from the user to the airport)
- transfer (to the storage site)
- use (to locations where radioactive material will be used)

Road and air are the two primary transport modes used in Morocco. Annual authorizations are provided for radiopharmaceutical carriers (^{125}I, ^{131}I, ^{18}F) for diagnostic or therapeutic purposes, whereas one-off authorizations are issued for other transport operations (import, transfer, and export).

Currently, port authorities notify AMSSNuR of a planned transshipment or transit of radioactive material at least 7 days before it occurs. AMSSNuR issues a transit authorization and reserves the right to conduct inspections. The authorization document information includes ships, containers, packaging, certificates, identification of radionuclides, UN designation, date of shipment, expected arrival date, type of package, physical and chemical form, whether it is special form or dispersible, maximum activity, and mass of fissile material if applicable.

Morocco is a party to the Convention on Physical Protection of Nuclear Material and its amendment, the International Convention for the Suppression of Acts of Nuclear Terrorism and expressed support to the Code of Conduct on the Safety and Security of Radioactive Sources. The national legislative and regulatory framework for transporting radioactive material is based upon two primary laws. Law n° 30-05 on the transport of dangerous goods by road, in accordance with international standards particularly the European Agreement concerning the International Carriage of Dangerous Goods by Road and Law n° 142-12 on NRSS and the creation of AMSSNuR. This law assigns responsibility for issuing nuclear

materials authorization and for granting authorization to transport radioactive materials to AMSSNuR. It sets the conditions for granting the authorization of the transport and the qualifications required, assigns primary responsibility for transport of nuclear material and RAM to the holder of the authorization; and prioritizes safety and security requesting the operator to implement the resources necessary to ensure safety and security activities.

Law n° 142-12 requires the establishment of a system for the physical protection of nuclear and other RAM during use, storage, and transport, as well as associated facilities including measures to protect sensitive information and ensure its confidentiality. This physical protection system is based on a threat assessment and assigns primary responsibility for the physical protection of nuclear materials and other RAM and associated facilities with the authorization holder, who must put in place protection measures adapted to the nature and the quantities of material being transported. Lastly, the law assigns responsibility for intervening in the event of a malicious act involving radioactive sources and, if necessary, minimizing the consequences of such an act to the State.

According to the law, duly sworn AMSSNuR inspectors are empowered to conduct inspections to verify compliance with conditions of the authorization and national regulations and to investigate violations. These inspections can be carried out in nuclear installations and facilities or locations or activities involving sources of ionizing radiation (including during transport). The law provides enforcement for breaches of safety and security requirements established under the legislative and regulatory framework. The transport of nuclear or other RAM and other authorized activities involving dangerous mobile sources (such as industrial radiography sources) are considered to be activities that could cause a nuclear or radiological emergency that could justify protective actions and other intervention to achieve the objectives of an emergency response in accordance with international standards.

The carrier/transporter of RAM is required to inform AMSSNuR at least monthly about the planned transport activities and to submit, if applicable, a transportation security plan (TSP) for approval.

Regulations specific to RAM transport include: a decree on authorization modalities and conditions related to Category II facilities and activities; a draft technical regulation on the safety of transport of RAM; a draft regulation on security of radioactive sources in use, storage and transport; and a draft decree on the physical protection of nuclear materials, facilities, and associated activities (including transport).

The draft regulation on the security of radioactive sources during use, transport, and storage addresses technical requirements for Class 1, 2, and 3 radioactive sources during transport. Two levels of security are established, which specify the security system's requirements in a graduated manner. Each level of security has a corresponding objective. The objective defines the overall outcome that the security system must be able to provide for a given level of security. These objectives include two levels:

- Basic security level—provides assurance that the security system will prevent unauthorized removal
- Enhanced security level—provides a high level of assurance that the security system will prevent unauthorized removal (Class 1 and 2)

The main requirements for transport security to be identified include roles and responsibilities related to transport; qualification and training of staff involved in the transport activities; cooperation and communication among transport actors; information protection; human reliability; procedures for package verifications; notifications of incidents; a TSP; and a contingency plan.

One of the methods that AMSSNuR developed to ensure security of RAM during transport involves the integrated managements system that addresses all regulatory processes (Figure 2). The integrated managements system includes an authorization process and inspection process. Each of the processes has procedures that integrate both safety and security.

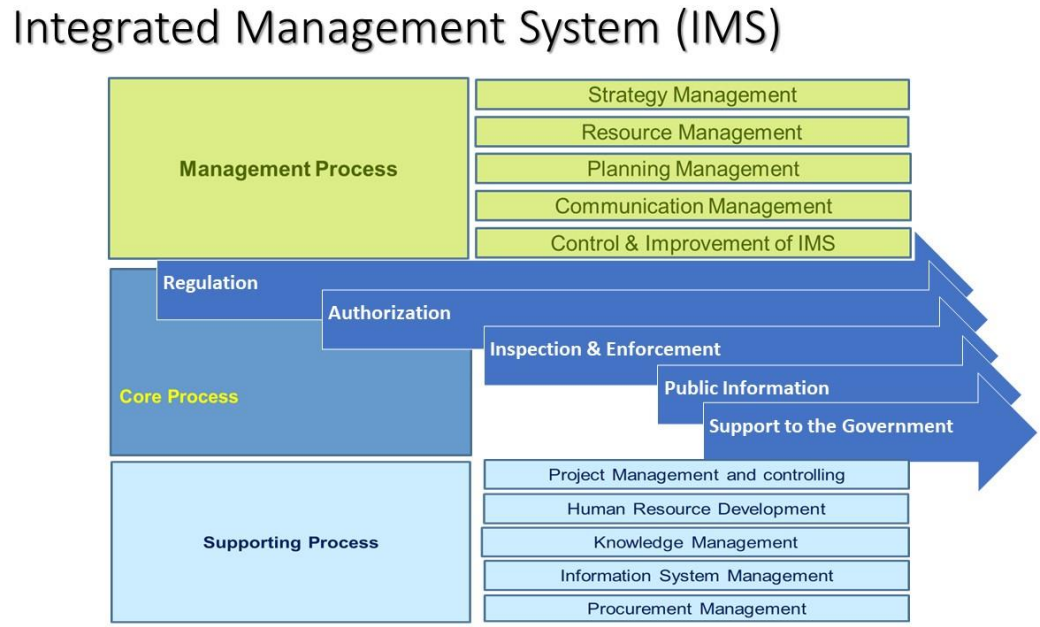

Figure 2. AMSSNuR's integrated management systems.

AMSSNuR started the implementation of the authorization process in 2020 for Category 2 facilities and activities involving radiological sources. Both safety and security conditions are assessed. Authorization involves the elaboration of a "provisional" first version site security plan pending the promulgation of the draft decree, to be followed by a site security plan evaluation plan. AMSSNuR provides recommendations to the operator to implement a TSP for Class 1 and 2 sources and requires escort by police or gendarmerie for class 1.

In 2019 AMSSNuR started conducting joint safety-security inspections of facilities holding high activity sources. The aim of these inspections is mainly to raise awareness among operators about nuclear security. The inspection report includes recommendations about nuclear security and actions that should be implemented or improved within the facility.

Advancements During the Pandemic

AMSSNuR management recognized the necessity of elevating the skill set of its staff to become proficient not only in the inspection of transportation security, but also to guide operators/carriers in adequately planning transport activities. Discussions with the Office of Radiological Security resulted in a plan to engage regulatory staff in a workshop focused on creating a guidance document for TSPs to be provided to Moroccan operators and shippers, thereby strengthening security planning for each future transportation activity. AMSSNuR leadership and ORNL worked together to register participants and to define actual RAM transport activities that regularly occur in Morocco to be used as scenarios for homework assignments during the interactive event.

The ORNL transportation subject matter experts (SMEs) worked with their learning sciences team to design the virtual training. They determined that having a prerequisite course to provide an overview of the responsibilities involved in the secure transport of radioactive materials, information about international norms and documented guidance for transporting radioactive materials, and the fundamentals of implementing an effective transport security program would provide the basis of training enabling shorter virtual training sessions to be more effective. Each Moroccan participant completed the resulting prerequisite "Security Awareness for the Transport of Radioactive Material" eLearning course, which provides an introduction about the need for transport security and regulatory best practices.

In February 2021, ORNL transportation experts and AMSSNuR cooperatively conducted a five-day, virtual instructor-led workshop titled "Security in the Transport of Radioactive Material" combined with TSP guidance. Workshop participants included the entirety of the AMSSNuR Nuclear Security and Safeguards department, along with two representatives from AMSSNuR's radiation safety department. The head of AMSSNuR's Nuclear Security and Safeguards department shared the importance of her team's collaboration with the safety team during inspections to ensure optimal collaboration and synergy between safety and security. The full participation of these groups in the training for the entire week was admirable.

The ORNL producer of the interactive virtual event instructed each participant to download the latest version of Zoom and the quick reference guide for the platform and offered to individually test the platform before the workshop. He also delivered an overview of the most frequently used Zoom features to all participants at the opening of the interactive engagement. Assurance of both adequacy and knowledge of the platform is a critical component to successful virtual learning. Participants were very engaged in using the Zoom platform tools to share input and their thoughts about the various aspects of the shipments.

Since AMSSNuR utilized the International Atomic Energy Agency's Security in the Transport of Radioactive Material (NSS-9G Rev.1) as the basis for guidance related to transportation security, the TSP concept was familiar to all participants. The interactive training began addressing the TSP content in detail but used exercises and the previously defined scenarios for a very practical delivery. Participants were split into two groups, and each was assigned one of the scenarios. At every point in the training, the groups implemented concepts from the learning modules into their TSPs, and they had the opportunity to raise questions or address comments each day during the interactive exchange. Although the concept is simple, at times the application is less straightforward. Videos, exercises, and breakout groups were used with homework assignments to supplement the traditional instructor-led classroom design.

Discussion about an AMSSNuR presentation on the national legal framework for transporting radioactive material, addressing the responsibilities of the operators and carriers based upon legal and regulatory requirements, helped the ORNL team to better understand some of the issues Morocco faces during transportation of RAM. With several of the decrees, regulations, and guidance documents still in draft format, AMSSNuR currently provides recommendations to operators to implement a TSP for Class 1 sources and requires escort by the police or gendarmerie.

AMSSNuR is a relatively new regulatory body; therefore, many course participants had not yet participated in the shipment of Class 1, 2, or 3 radioactive material. A discussion about considerations related to the risks of transporting radioactive materials, putting these risks in perspective, and

examining how transport security enhances risk management generated good discussion. Some of the questions focused on issues like:

- How can we inspect while a transport is being conducted to ensure what is in the TSP is what has been implemented?
- Should we have generic TSPs for similar types of shipments or one required for each shipment?
- How do you handle the transfer of security responsibilities between shippers and transporters?
- Who ensures this transfer of responsibility?
- Will an authorization suffice rather than a TSP?

The SMEs addressed each question, tying responses back to Moroccan law and specific circumstances, while sharing international best practices for each issue.

The team delved into all issues that should be considered when planning to transport RAM. These included addressing how security functions are combined into an effective security system while ensuring the interface between safety communications and security needs is balanced. SMEs identified transport security levels and the measures commonly applied at each level to protect RAM shipments. Discussions included conversations about the thresholds for each of the security levels, the features of prudent management practices, basic security, enhanced security activity levels, and aspects of a transport security graded approach. The instructors provided details about each level of RAM security measures for transport operations, providing multiple examples from their many years of experience shipping sensitive material. Participants raised very good questions involving tying protective measures to the vulnerability assessment and motivation of the adversaries, hazards in shipments, and competencies of staff to perform inspections.

SMEs discussed the rationale behind the selection and application of enhanced security level measures for RAM transport, identifying a risk management approach to evaluate the need for such measures. The group identified the enhanced security level parameters and measures recommended by NSS-9G Rev.1 and addressed security considerations that should be made when shipping radioactive material. This led directly into a discussion about when additional security measures should be applied based upon considerations such as material nature and attractiveness, portability, chemical/physical form, prevailing threat, and potential adversaries and their capability.

Participant engagement increased during the week, with continual questions throughout all presentations, demonstrating both good comprehension of the material presented and a thorough understanding of the platform tool. Some of the questions addressed included:

- Can you clarify what you mean by *continuous communications* during the shipment?
- Are there any recommendations regarding the stop duration of a vehicle carrying Class 1 and 2 radioactive material?
- Do all stops have to be justified?
- Do you define deterrence more like a concept so, when addressing security functions and measures, we should start with detection?
- Should signage be used?
- Should drivers be trained to detect (visual detection) or it is out of their duties?
- Explain the use of local disablement and duress buttons.
- Should each operator have its own transportation control center?

- Is trustworthiness verified periodically or is it verified for individuals involved before each transportation shipment?
- What is a good practice for frequency for trustworthiness checks?
- Who ensures the escort at sea for the international transports?
- Is the threat during international transport part of the design basis threat?

The final presentation addressed the type of factors and risks that should be considered when selecting primary and alternate transport routes and described the emergency response access and risk mitigation capabilities that should be considered in route planning. In smaller group discussions, participants evaluated provided route scenarios, which prompted consideration of factors that influence the suitability of primary and alternate transport routes. The participants engaged actively to utilize knowledge attained in the route planning module to accurately make a valid assessment, with each providing good feedback on their decisions back to the larger forum.

Although AMSSNuR staff will probably not be creating TSPs regularly, they will be both providing guidance and reviewing/commenting on TSPs regularly. If all those performing these functions fully understand the content well enough to design their own TSP for the simulated shipment assigned during this course, they will be better prepared to review TSPs and perform inspections as part of their regulatory duties. Each team had a final opportunity to ask questions before the presentation on their completed TSPs. The SMEs were pleased with the technical questions posed by participants during the week, which indicated their thought processes as they completed their homework assignments.

Every participant participated in delivering their completed TSP to the SMEs, each sharing their screen and explaining multiple sections of the document. The first scenario involved a shipment of a Category 2 radioactive source with an extended stop, and the second focused on a Category 1 radioactive source—a blood irradiator device using a ^{60}Co radioactive source being transported from a Casablanca hospital to the local hospital in Larache City. Both teams did an excellent job, thoroughly addressing the details of the shipments, relaying an understanding of the content of the TSP, and referencing other documents appropriately. They incorporated learning from each module of the RAM-200 course into the exercise, referencing it during the discussion. The SMEs each remarked that the deliverables provided in these exercises were the best example of TSP products they had seen in such a short training engagement.

The workshop concluded with a discussion of taking the lessons learned from the interactive course to develop a guidance document for TSPs for their carriers and shippers who would be performing transport activities in Morocco. The SMEs shared the process the US Nuclear Regulatory Commission and other regulators use when they promulgate a regulation. This involves providing the draft regulation to industry with a request that industry submits any questions or comments regarding that regulation. When the industry writes back with questions, the US Nuclear Regulatory Commission promulgates that list of questions along with the final released regulation, thereby providing a resource to those who will be using the regulation. This type of open communication develops a positive, noncombative atmosphere with open sharing between the regulator and operators/shippers/carriers. The participants relayed they felt confident in moving forward with the completion of the guidance document for the TSP.

In spring 2021, ORNL and AMSSNuR jointly conducted a second virtual workshop. This engagement focused on providing fundamentals, methodologies, and tools for competent authority personnel to manage and conduct radioactive material transport security inspections. It also gave participants the opportunity to engage in scenario-based discussions and exercises.

SMEs addressed inspector behaviors to include competencies and training needed for inspection and enforcement in transport security. Each inspector needs special knowledge, skills, and attitudes to perform their tasks. At a minimum, all inspectors should be knowledgeable of their regulatory framework and have a solid understanding/knowledge of RAM as well as the technologies associated with the security and the RAM transport operation. Discussions addressed how inspectors must demonstrate professionalism throughout the inspection by remaining objective and discreet, listening carefully, communicating effectively, and promoting positivity.

The team discussed the process of planning transportation security inspections, undertaking the appropriate legal, administrative, and technical actions to prepare an inspection in a methodological manner. This includes reviewing required documents, understanding the outcomes/corrective actions of a transportation security inspection, and establishing a transportation security inspection program. Conducting pre-inspection activities, such as creating an agenda, compiling and collecting data for a current transport, and preparing for the inspection process helps support a successful inspection. Inspectors should review the TSP before inspection, estimate the duration of the inspection, take the measures for their accommodation, and handle the administrative arrangements. Preparing for inspections in a methodological manner, such as preparing the inspector checklist, self-reporting, staying abreast of any missing information, and being advised about the external stakeholders will help create a more efficient inspection.

When conducting inspections, the inspection team must plan for and lead an inspection in an autonomous manner and identify ways to resolve conflict during inspection. This usually includes examining security measures, procedures, documents, and information; gathering information and evidence through appropriate means; recording findings; and capturing all remarks for a subsequent debriefing. Inspectors should identify compliance and noncompliance during inspection. When there is any issue with potential impact on a security system, this should be reported to management and resolved.

Outcomes of a transportation security inspection can range from a carrier meeting expectations to a conclusion involving enforcement actions. A structured and clear inspection report should include findings, best practices, areas of improvement, actions, and timelines. Recording findings of inspections should be clear, logical, and discreet.

The participants were split into groups where they initiated a transportation security inspection of a shipment. An inspection checklist was used to ascertain transport security compliance, and the teams were asked to formulate their findings in a report. Via virtual means, the groups each had an opportunity to interview those preparing the shipment, their TSP, and the actual conveyance. As a homework assignment, each team was asked to assemble their findings into a report. On the final day of the virtual workshop, each team debriefed their report, with SMEs providing feedback.

SMEs addressed how to ask questions about what may not have been included in the TSP and how feedback can be delivered in a positive way to promote a good relationship with the operators/carriers. The use of the practical training to promote experience, even in a virtual mode, was beneficial. Instructors were impressed with the competence of the participants in both the engagement during the week and completing their assignment.

Conclusion

Although it is often difficult to replace in-person training with remote training, virtual training was very effective for advancing AMSSNuR's transportation security expertise. The efficiency was greatly improved because of the coordination of AMSSNuR and ORNL to customize the training to specific Moroccan regulations and scenarios. AMSSNuR participant enthusiasm was obvious through their engagement with the instructors, use of the interactive platform, and dedication to completion of the homework assignments, which greatly contributed to the takeaways. Morocco has taken a step forward in advancing its transportation security and contributing to overall global security.