Security in the Safe Transport of Nuclear Fuel Cycle Material

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1. Introduction

The term “Security” embraces the various measures to guard against the consequences of intentional malicious acts. This is mainly the responsibility of individual States whose responsibility it is to establish the necessary regulatory framework. The main security concern in the past has been theft and diversion of potential nuclear weapons grade material, but events in recent years have heightened concern about the potential consequences of terrorist action directed against the transport of radioactive materials of all kinds.

2. Security measures

The materials used in the nuclear fuel cycle industry have traditionally been subject to extensive national protection measures. This responsibility extends to the right of the State to oversee the security measures that are taken during the transport of material originating from or obligated to their country. A range of protection measures has been employed during transport, as deemed appropriate by the State, ranging from the design of the transport vehicles, security forces, access control, employee screening, satellite tracking of shipments and co-ordination with local and national security authorities.

The focus in the past has been on strategic nuclear materials which potentially could be used in nuclear weapons. The physical protection of such materials during transport is assisted by minimising both the total time the material remains in transport, the number and duration of transfers of the material, avoiding the use of regular movement schedules, and limiting advance knowledge of transport information including date of departure, route and destination to designated officials on a need to know basis. Spent nuclear fuel assemblies, MOX and VHLW are transported by sea in purpose-built, dedicated ships. Land transport of such materials is also by dedicated road and rail vehicles and routes are planned and approved by the competent regulatory bodies in the countries concerned. Provision of law enforcement and emergency response capability may also be checked.

3. UN and IAEA initiatives

The IAEA plays a leading role in developing the international regulatory regime for the transport of radioactive materials. Whereas the focus in the past has been on safety in transport, the IAEA has also recognised the need for ensuring the security or physical protection of nuclear material during transport. The Convention on the Physical Protection of Nuclear Material, 1980, obliges Contracting States to ensure during international nuclear transport the protection of nuclear materials within their territory or on board their ships or aircraft.

Security is now receiving much more attention within the IAEA and in 2002 work was initiated within the Safety Division on the need for enhanced measures for security in the transport of radioactive materials, including nuclear fuel cycle materials and large sources. This early work resulted in the publication in 2007 of Security Standards for radioactive materials whist in transport. The Standards propose a range of security requirements intended to complement the security requirements in the UN Model Regulations for the Transport of Dangerous Goods.

The UN Model Regulations contain a basic security level for the transport of all dangerous goods, as well as additional requirements for an enhanced security level for goods defined as 'high consequence dangerous goods', which have the potential to give rise to serious consequences. These include such materials as explosives, flammable bulk liquids and gases, potentially dangerous chemicals etc. as well as Class 7 radioactive materials in Type B or Type C packages. For all these so-called high consequence dangerous goods, not just radioactive materials, enhanced security requirements apply. In the maritime sector, the International Maritime Dangerous Goods Code (IMDG Code) became mandatory in 2001; the IMDG Code adopts the UN language and the current edition includes a chapter on security.

In the implementation of national security, competent authorities have to ensure that the organisations engaged in the transport of high consequence dangerous goods, notably carriers and consignors, implement a security plan that, inter alia, includes:

a) the allocation of responsibilities to competent persons;

b) adequate record keeping of materials transported;

c) assessment of vulnerabilities in temporary storage, transfer, handling, etc;

d) clear statements of measures including training, operating practices and resources;

e) the reporting of threats and incidents;

f) the evaluation of effectiveness of plans and procedures;

g) measures to ensure the security of transport information and to limit its distribution as far as possible.

These requirements became part of the UN 'Model Regulations' in late 2003.

4. Security requirements for sea transport

The Safety of Life at Sea (SOLAS) Convention was revisited after the events of 9/11 in the USA to enhance ship and port facility security. The London Conference on Security at Sea held in 2002 resulted in the International Ship and Port Facility Security Code (ISPS Code) and SOLAS amendments to establish appropriate security plans for ship and port facilities. They came into force in July 2004.

In the United Kingdom, the Nuclear Industry Security Regulations (NISR 2003) require all UK shipping operations to be approved and to produce a Transport Security Plan.

5. Special Nuclear Materials

In addition to the UN Model Regulations, the international instrument developed by the IAEA, The Physical Protection of Nuclear Material and Nuclear Facilities, INFCIRC 225 considers nuclear materials which carry a potential risk of being used in a nuclear explosive device. This instrument requires States to take appropriate measures to ensure security, and includes physical protection requirements for nuclear material in use, storage and during transport. Three categories of security are defined depending on the nature of the material.

The elements which a State's physical protection of such materials should include within the framework of its national law are specified and also, the additional requirements for protection during transport. During international transport the responsibility for physical protection should be agreed between the States concerned. The shipping State should ensure that all the States involved in the transport, including transit States, can provide adequate measures for protection. Confidentiality of sensitive information which could compromise the physical protection of the material is an essential element of security.

The nuclear materials covered by INFCIRC 225, which could potentially be of use in the manufacture of a nuclear explosive device, are principally plutonium and highly enriched U235 and U233, for which the highest security category applies. INFCIRC 225 now extends to national as well as international transport.

6. Relevance of security requirements to the nuclear fuel cycle transport industry

Currently there are three International instruments relevant to security in the transport of nuclear fuel cycle materials: (i) INFCIRC 225 for the transport of nuclear materials which carry a potential risk of being used in nuclear weapons and which requires three categories of security depending on the risk, (ii) the UN Model Regulations for the transport of high consequence radioactive materials which require an enhanced security provision, and (iii) the IAEA security standards for the transport of radioactive materials.

The security requirements in the UN Model Regulations classify materials according to their radioactivity content, viz. radioactive quantities greater than 3000A1 for large radioactive sources for medical and industrial use, or 3000A2 for other radioactive materials, such as nuclear fuel cycle materials, as high consequence materials. A1 and A2 are derived from activity values for specific radioisotopes listed in the IAEA regulations.

However the IAEA Standards for Security in Transport have the following activity threshold values for the enhanced security level:

a) For radioactive sources and other forms of radioactive material containing radionuclides covered by the Code of Conduct, 10 D (this includes Category 1 and Category 2 sources) per package; or

b) For all other radionuclides, 3000 A2 per package.

On the basis of the UN Model Regulations, all low enriched un-irradiated uranium, typically <.6% U235, and its intermediates, including Uranium Ore Concentrates, natural and low enriched Hex and wastes from reprocessing operations, will be exempt from the enhanced security requirements; normal prudent precautions should suffice. Large radioactive sources will normally be classified as high consequence materials and low activity sources will be exempt.

Hex could potentially give rise to a chemical hazard in the event of a severe accident because it produces corrosive products on exposure to moist air or water. This subsidiary hazard could be covered by the requirements of the Model Regulations for corrosive materials transported in bulk.

In the IAEA Security Standards this would not alter for nuclear materials but by using the D values all Category 1 and 2, and some Category 3, sources would be classified as high consequence materials.

7. Implications for industry

7.1 Harmonisation of security requirements

While the various transport security initiatives have resulted in some inconsistencies, this should be addressed in the next edition of the UN Model Regulations 2011, and reflected in the Modal Regulations in 2013. Such harmonisation issues can give rise to difficulties in interpretation for international transport. Also any conflicting requirements of national authorities could have the same effect.

7.2 Level of real risk

While the potential threat which terrorist activity poses should not be underestimated, it is important to project a realistic assessment of the threat and its potential risks for the transport industry. Exaggerated perceptions of the danger in the minds of the public, politicians and regulators could have a serious impact on the transport industry and should be dispelled.

The nature of the materials and transport packages are relevant to this argument. Un-irradiated nuclear fuel cycle materials present a low radiological hazard. These are, therefore, unlikely targets and the radiological consequences of terrorist activity would not be severe. Highly radioactive materials, i.e. spent fuel, VHLW and most large sources, are refractory, metallic, ceramic or vitreous materials, not easily dispersed and transported in very heavy, robust containers. These are significant factors in ensuring not only safety, but also, security, both from the point of view of theft and diversion of material, and also from terrorist attack.

7.3 Implications of perceived risk

Insurance is an issue which must be considered. Insurance is a legal requirement in some countries. If industry is required to have cover against the terrorist threat, the question arises how to quantify the consequences.

It is, therefore, important to demonstrate that the real security and safety risks in radioactive materials transport are low, including the terrorist aspect, and to dispel unrealistic perceptions. The risks are manageable because of the nature of the materials and the transport packages, which are designed to ensure safety, but by the same token are robust from the point of view of most realistic terrorist activity.

7.4 The additional burden on industry

There are many new requirements which have been mooted such as:

a) advance notification which in fact could increase the security threat and give rise to unwelcome publicity;

b) comprehensive communication systems involving new equipment and operations;

c) monitoring of shipments under way by GPS equipment;

d) the provision of escorts for higher risk cargoes;

e) stringent requirements for personnel selection and training.

Such requirements would result in additional burdens on the industry and it is important to properly assess their real potential impact on security.

8. Conclusions

Safety of radioactive material transport depends mainly on the integrity of the package; the internationally established design and test standards for the packages for the transport of nuclear fuel cycle materials are intended to ensure safety under both normal and accident conditions. There is a large body of evidence to demonstrate that the standards are high and the IAEA tests are severe tests which cover all accident situations which can be realistically envisaged in transport and, by extension, from the point of view of realistic terrorist activity.

Security is a serious issue but it is important to project a realistic assessment of the threat and its potential consequences based on the characteristics and operating record of the nuclear fuel cycle transport industry; nuclear fuel cycle raw materials, uranium concentrates and hex, present a very low risk. Un-irradiated fuel and the more

highly radioactive materials i.e. spent fuel and VHLW, are very refractory ceramic or vitreous materials, and as such not easily dispersed. They are transported in very heavy robust containers, which are designed to ensure safety but this is also a significant factor in ensuring security.

The potential dangers which terrorist activity now poses must not be underestimated but they are being properly addressed and it is important to dispel any exaggerated perceptions of the danger.

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