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TRANSPORTING NUCLEAR FUEL CYCLE MATERIALS SECURELY

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ABSTRACT

The nuclear transport industry has always recognised the importance of safety and security in transport. It has cooperated with the IAEA not only for the development of safety regulations but also for security guidance for the protection of fuel cycle nuclear materials to avoid unintentional exposures to radiation if there were to be inadvertent loss and negligence and also to prevent their intentional misuse.

Safety and security need to be ensured in the transport of the various nuclear fuel cycle materials. The industry has successfully employed a range of protection measures for many years and has enjoyed an excellent safety and security record. Some materials require special security controls but some other materials, by virtue of their properties, do not require such elaborate provisions. If enhanced transport security measures are required for materials that do not warrant such measures this could deter potential carriers, cause unwarranted disruption to transport operations, inflate administrative burdens and exacerbate concern in the local population,

The IAEA safety regime recognises the need for a graded approach to regulation. The current IAEA security policy framework should be capable of being successfully implemented by the nuclear transport industry provided that a stable and graded approach to security is also maintained. However, this appears to have been overlooked in some cases in the approach to the setting of appropriate security requirements. This could make shipments of some nuclear fuel cycle materials increasingly more difficult.

Nuclear material has traditionally been subjected to extensive national protection measures and international agreements express the commitments of almost every country to preventing the proliferation of nuclear weapons. The IAEA carries out comprehensive safeguards activities to verify that these agreements are being properly implemented. However, we are now seeing an increased interest in having such strict monitoring requirements for nuclear materials of lesser consequence.

Exaggerated perceptions of potential risks resulting from transport incidents have serious consequences which have given rise to significant operational problems and

public disorder. It is therefore important that all stakeholders in nuclear transport operations should play their part in dispelling such perceptions of risk in the minds of the public, media and politicians.

1. INTRODUCTION

The World Nuclear Transport Institute comprises close to 50 member companies covering all aspects of radioactive material transport. This paper gives an industrial perspective on security issues based on the experience of its members gained over many years of transport.

Nuclear fuel cycle materials come in a variety of chemical and physical forms and the potential safety and security hazards differ widely. In determining the appropriate requirements for transport operations, it is important to take these factors into account so that appropriate measures to ensure both safety and security can be implemented on the basis of risk, taking into account the nature of the materials as well as the robust nature of the packaging and the record of the industry over many decades.

The main features of nuclear fuel cycle materials are as follows: **Uranium ore concentrate** (UOC) is a material of low radioactivity and it does not present a large radiological hazard. There is a minor risk due to the toxicity of the powder if it is released and is ingested. In this respect UOC is no different from many heavy metal compounds.

Uranium hexafluoride (Hex) also is a low specific activity material and the radiological risk from natural and depleted material is not great. Enriched Hex is fissile and presents a potential criticality risk but this is prevented by the design of the package and the configuration of the packages during transport.

Uranium dioxide powder (UO2), typically of less than 5% enrichment for the manufacture of new uranium fuel elements, is also classified as low specific activity material. The primary hazard is radiological in the event of a criticality incident. This is again prevented by the design of the package.

Uranium fuel assemblies typically consist of sintered ceramic UO2 pellets formed into assemblies. The fuel is refractory, stable and the radiological hazard is low. The design and configuration of the packages during transport ensures that criticality excursions could not occur.

Spent fuel and vitrified high-level wastes (VHLW*)* from reprocessing are intensely radioactive and need to be heavily shielded. However, they are inherently stable and refractory and difficult to disperse.

Mixed oxide fuel (MOX) fuel elements contain sintered uranium/plutonium oxide ceramic pellets and are very similar to uranium fuel elements. The radiological hazard is not great except in the event of a criticality excursion and this is controlled in the same way as for enriched uranium fuel.

Plutonium is a special case. The risks are due to toxicity if it is dispersed and ingested and criticality which is controlled by the package design. When plutonium is transported as MOX, a stable refractory ceramic, it is not easily dispersed.

2. SECURITY IN NUCLEAR FUEL CYCLE MATERIAL TRANSPORT

Security in transport involves the various measures to guard against the consequences of intentional malicious acts. The main concern has been theft and diversion of material with a weapons capability but recent events have raised concern about the potential consequences of terrorist action on the transport of all radioactive materials.

The security challenge depends primarily on the probability and consequences of malicious acts and only national governments have the ability and information sources to assess the relevant factors within their region and some will be confidential. Whereas safety is governed by prescriptive International Atomic Energy Agency (IAEA) Regulations which are stable and adopted by national governments, appropriate provisions for security can vary both in time and place. They cannot be prescribed and it is the responsibility of individual States to establish an adequate security regime for the transport of radioactive materials originating from or obligated to their country.

The United Nations (UN) and the IAEA play a leading role in developing the international regulatory regime and whereas the focus in the past has been on safety, the security of nuclear material during transport has become an increasingly important issue.

Many decades of operating experience has been built upon the transport of nuclear fuel cycle materials for clean electricity generation. A range of protection measures has been employed during transport as deemed appropriate, ranging from the design of the package and the vehicles used as well as security forces, access control, employee screening, electronic/satellite tracking of shipments and co-ordination with local and national security authorities.

Physical protection of such materials during transport has been assisted by minimizing both the total time the material remains in transport and the number and duration of transfers of the material, avoiding the use of regular movement schedules and limiting the advanced knowledge of transport information including date of departure, route and destination to designated officials having a need to know this information.

The international transport of uranium ore concentrate, uranium hexafluoride and new fuel assemblies has been routinely successfully carried out by road, rail and commercial shipping lines.

Spent nuclear fuel assemblies and high level waste containers have been transported by sea in purpose-built dedicated ships, for example between Europe and Japan by Pacific Nuclear Transport Limited as their sole business. Land transport has also been

carried out by dedicated road and rail vehicles with routes planned and approved by the competent regulatory bodies in the countries concerned.

2.1 Security recommendations

The international instruments relevant to security include:

(i) IAEA Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities INFCIRC 225 (1) 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 and special provisions need to be made;

(ii) The UN Model Recommendations on the Transport of Dangerous Goods (2) for the transport of high consequence dangerous goods including radioactive materials which require an enhanced security provision;

(iii) The International Ship and Port Facility Security Code (ISPS Code) and International Convention for the Safety of Life at Sea (SOLAS) amendments (3) which give appropriate security plans for ship and port facilities.

Other bodies including the International Civil Aviation Organization (ICAO), the United Nations Economic Commission for Europe (UNECE) who developed the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), and national jurisdictions, have also formulated security requirements and recommendations.

The security regime and the requirements placed on the transport industry have therefore been fragmented in the past but the transport industry has nevertheless been able to operate within them. The situation has recently been rationalised and the IAEA Nuclear Safety Series (4), coupled with the complementary IAEA Nuclear Security Series (5) now form the basis of national safety and security requirements for the transport of all radioactive materials, including nuclear fuel cycle materials.

2.2 **A graded approach to security**

The policy of the regulatory bodies is to use a graded approach to the setting of security requirements for transport. This approach is supported by the transport industry as it considers the risk associated with the material, packaging, routes, and other considerations.

The following levels of security requirements are examples of this graded approach:

Basic Security Level - this would involve the training of operators, including basic security awareness training, trustworthiness of personnel, verification of conveyances and written instructions. This level of security may be sufficient for materials of low risk transported in industry and Type A packages.

Enhanced Security Level – this applies when the quantity of radioactive material would constitute a danger to an individual and the requirements could include the

identification of carriers and consigners, security plans, advance notification, tracking devices and communication systems. This level of security may be sufficient for materials transported in Type B packages or in Type A packages where there has been an identified concern.

Additional Security Measures - may also be required depending on the threat and the properties of the material being transported. This level of security may be applied to certain sensitive materials transported in Type B packages or in Type A packages where there has been an identified concern.

3. IMPACT ON TRANSPORT OPERATIONS

All those involved in nuclear transport operations have the responsibility for implementing and maintaining the security measures in accordance with the national regulations. In addition they are required to have appropriate contingency and emergency response plans in place.

Bearing in mind the nature of nuclear fuel cycle materials and the operating record of the industry for over 50 years, the current security requirements should be capable of being successfully implemented provided that a stable and graded approach to security is maintained to ensure a viable balance between security requirements, operational efficiency and practicability without imposing unnecessary operational and administrative burdens on the nuclear transport industry.

For example, security requirements such as the need for tracking and monitoring of UOC and low level wastes in transport should be far less onerous than for materials of greater consequence such as mixed oxide fuel (MOX). It is important that the graded approach philosophy is not undermined.

4. PERCEPTIONS OF RISK

Whereas the potential safety and security risks associated with the transport of nuclear fuel cycle materials must not be underestimated, the assessment of the risks must be realistic and quantified, and the requirements placed on the industry appropriate.

The nature of the materials and packages are relevant to this argument. Un-irradiated nuclear fuel cycle materials present a low radiological hazard. The terrorist threat is likely to be low and the radiological consequences of terrorist activity would not be severe. Highly radioactive materials, i.e. spent fuel, vitrified high level waste, 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. It is highly relevant that the nuclear fuel cycle transport industry has had an excellent safety and security record over many years.

Exaggerated perceptions of potential risks resulting from unrealistic transport incidents have serious consequences, e.g. the denial of shipments by carriers or ports and also the public demonstrations to prevent spent nuclear fuel and high level vitrified waste transport both of which have given rise to significant operational problems. The security arrangements which have been made for the transport of some nuclear materials such as these were not so much in aid of security but to deal with the expected public disorder.

It is therefore important that all stakeholders in nuclear transport operations should play their part in dispelling exaggerated perceptions of the risk in the minds of the public, media and politicians. This depends on good communications based on sound science as well as continued improvement and up-dating of information briefs on safety and security issues written in a style which the public and media can readily understand. This is an important part of the role of WNTI in its support of the nuclear transport industry.

5. CONCLUSIONS

1. Security is a serious issue; the nuclear transport industry recognises this, but it is important to project a realistic assessment of the threat and its potential consequences based on the nature of the materials, the robust packaging to ensure safety and the operating record of the nuclear fuel cycle transport industry over many decades. The security regulatory requirements should reflect this situation.

2. The current IAEA security policy framework should be capable of being successfully implemented by the nuclear transport industry provided that a stable and graded approach to security is maintained to ensure a viable balance between security requirements, operational efficiency and practicability without imposing unnecessary operational and administrative burdens on the transport industry.

3. Exaggerated perceptions of the potential risks which might result from unrealistic transport incidents have resulted in significant operational problems, public disorder and inflated costs. It is therefore important that all stakeholders in nuclear transport operations should play their part in dispelling exaggerated perceptions of the risk in the minds of the public, media and politicians.

REFERENCES

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