

Safe and Secure Transport of Radioactive Materials

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What are radioactive materials?

While we are not always aware of it, we live in a world of, and are surrounded by, radioactivity-it occurs naturally in certain rock formations, including here in Alexandria. If there are smoke detectors in this building then they include a small amount of radioactive material. Certain food products we eat, some spices for example, are sterilised by radioactive sources. So too are medical instruments in hospitals.

Yet sometimes there appears to be a certain mystery surrounding radioactivity-this may be, to some extent, because we can't see, touch or taste it, and yet, we know radiation holds such potential power. And I think, perhaps, that what should be a very positive image for peaceful applications of the atom sometimes becomes blurred, through misperception or lack of information, by such images as apparently complicated scientific formulae from such an obvious genius, but one with a bad hair style, as Einstein, or by the mushroom cloud, by Chernobyl and so on.

There is no doubting that radioactive materials, particularly in certain concentrations, can be highly dangerous, as with many other materials. Indeed, the United Nations has identified no less than nine distinct classes of dangerous goods in transport, including explosives- fireworks for example-infectious substances, certain chemicals, and radioactive materials. All these classes of dangerous goods are shipped all over the world; some if not all will have at some time passed through the Suez Canal.

Regulation to assure safety

Because these materials can be dangerous, it follows that the safety of those who handle them-whether it be workers in the

various sectors of the nuclear industry, those who transport such materials, crews aboard ships, harbour authorities, dock and terminal workers, those who use the materials, and the public-at-large, is paramount. In fact, no sector of the transport industry is more highly regulated to assure safety than the nuclear industry. There exists a closely woven world wide regime of international, regional, modal and national safety regulations for the packaging and transport of radioactive materials. At the heart of this safety network are the model regulations of the United Nations for the safe transport of dangerous goods of all nine classes, and then there are the transport safety standards for class 7 radioactive materials of the international atomic energy agency (IAEA). These regulations and standards, in turn, get reflected in such regional safety regimes. They also feature in the International Maritime Dangerous Goods (IMDG) Code of the United Nations International Maritime Organization (IMO); a code which has been accepted as mandatory by the Member States of that organisation. Then, of course, there are national requirements to assure safety. All these, taken together, form an integral part of the international transport safety regulatory framework. These safety regulations are reviewed periodically to ensure they remain effective.

How safe is radioactive materials transport?

Well, just how safe is the transport of radioactive materials? Thanks to the tight nuclear safety regulatory framework, and the commitment and professionalism of industry-which clearly has a vested interest in assuring safety-there has not been a single maritime transport incident, over many decades, involving radioactive materials, that has caused significant damage to health or the environment. This

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is an enviable record in the annals of dangerous goods transport; but one that must not be taken for granted.

How then is safety assured?

First of all, it is accepted internationally that safety is vested primarily in the package that actually contains the radioactive material-not by the transport conveyance, whether it be a ship, truck, train or airplane. Of course account is taken of the particular means of transport, which has the effect of contributing to a safety in depth in the event of an accident-but the fact remains that first and foremost, the packaging must be got right. The packaging requirements, in turn, are determined on the basis of the degree of risk related to the actual properties of the materials the packages are to contain.

What is being transported by sea?

I mentioned at the outset that there is a vast range of radioactive materials with varying degrees of risk. It is important to register that not all these materials are routinely transported by sea. Radiopharmaceuticals, for example, which may be packed in small cardboard packages, with relatively low measures of radioactivity with very short productive life-sometimes measured in days, must be moved quickly by air or land. Overwhelmingly, it is materials for use in the processes of generating electricity by nuclear power, and large cobalt sources for use in sterilisation for healthcare, medicine and industry, that move by sea.

What are the benefits to mankind?

No doubt unfortunately we all know someone who has contracted a serious illness, or a child who has fallen and broken an arm or leg. Chances are radioactive materials have played an important part in their treatment; for example, over 2 billion x-ray examinations, 32 million nuclear medicine procedures and 5.5 million radiation therapy treatments, are performed worldwide each year. Over 80% of all medical disposable items, such as surgical dressings, syringes, surgical gloves, artificial joints, heart valves are sterilised using gamma radiation from a cobalt 60 source. Over 400 nuclear reactors worldwide produce 16% of the world's electricity, that's keeping the lights on in very many of the hospitals in the world. And, of course, the saving of some 2.4 billion tonnes of carbon dioxide emissions per year.

Here in Egypt, I understand radioactive materials have been used in the assessment of groundwater resources carried out at Wadi Qena and Esna in support of plans for reclamation of new lands on the fringes of the Nile flood plain.

The use of irradiation technology for wastewater and sludge disinfestations has great potential for extending areas of irrigated agriculture with the aim of increasing soil water-holding capacity, which is important for sandy soils.

The national centre for radiation research and technology

(NCRRT) developed a gamma irradiation facility used mainly for medical sterilization.

In 2006, Egypt announced it should pursue nuclear energy to meet its ever growing energy needs and has put forth plans to construct a 1,000 megawatt power station at Al-Dabah, and possibly three other 600 megawatt power stations. It is estimated that the first reactor could be completed within a decade. And it is transport that is common to all these projects- because it is transport that provides the vital link between demand and supply.

Assuring the safe transport

We are talking here of a highly international industry, with sources of supply often remote from the demand centres. The uranium mines, for example, may be in Australia, central Asia, southern Africa or Canada. But the plants where the uranium ores must go through various industrial processes to transform them into usable fuel for reactors are more concentrated in fewer countries. And then, once the fuel is produced, it must be delivered to nuclear power plants in several countries around the world.

This country is an example of the increased interest around the world in nuclear energy as an option to secure supplies of electricity, with the ever increasing cost of oil and gas, and to combat Co2 emissions. In fact, the need for uranium is expected to double over the next decade. The Suez Canal is important as a link between one of the main uranium mining countries and the countries that convert this into fuel for the reactors. Those who transport radioactive materials encourage and welcome the free passage of these materials through the canal.

What are nuclear fuel materials?

To be more precise, what cargoes are we talking about when we mention fuel cycle materials? It all begins with uranium ore concentrates dug from the ground at the mine site-at this stage this material is of low radioactivity, and does not present a large radiological hazard. Further along the production line, uranium hexafluoride, or hex as it is sometimes known, also is a low specific activity material and the radiological risk from natural and depleted material of this kind, is not great. Once hex is enriched, it is fissile, and at this stage presents a higher risk. This risk is met by the regulated design of the package and the configuration of the packages during transport. Uranium dioxide, typically of less than 5 per cent enrichment, for the manufacture of new uranium fuel elements, also is classified as low specific activity material. New fuel assemblies typically consist of sintered ceramic uranium dioxide pellets, formed into assemblies, and transported in specially designed packages. Due to the low level of radioactivity and low risk to persons handling these materials they are transported on normal container vessels using commercial ports. At the so-called, back-end, of the fuel cycle; that is, fuel that has passed through the reactor, and which has the potential of being recycled to extract further fuel from it, along with a much smaller volume of high level residues

of wastes left over from fuel recycling operations, are intensely radioactive, and they need heavy shielding. Mixed uranium and plutonium oxide (MOX) fuel elements contain sintered ceramic pellets, and are very similar to uranium fuel elements. The backend materials are carried on specialist vessels and use dedicated ports.

How are such materials packaged to assure safety?

As I observed a few moments ago, the robustness of the packaging is determined by the risk factors related to the properties of the material the packages are to contain. The design and performance standards for packages used for the transport of radioactive materials are defined in the IAEA regulations for the safe transport of radioactive materials- TS-R-1.

There are various categories of packages used to transport nuclear fuel cycle materials. So-called industrial packages are used for low specific activity materials, typically, uranium concentrates or low-level waste, which can be safely transported in sealed 210 litre drums packed into a standard transport container. Type a packages are used typically for new or fresh fuel. Hex is transported in steel pressure cylinders. Type b packages are high duty packages which are used for the transport of some of the more radioactive nuclear fuel cycle materials, notably spent nuclear fuel, high level wastes and mixed oxide fuel.

Security in transport

Clearly there has been increased concern in recent years about the potential consequences of malicious acts, or terrorism, directed against dangerous goods. This risk is quite different from the accident risk. Increased emphasis on transport security, not only for radioactive materials cargoes, but dangerous goods of all kinds, raises a variety of issues. Of course, concern for security did not begin on September 11, 2001. Indeed, the international convention on the physical protection of nuclear material, which was signed nearly thirty years ago, obliges participating states to ensure, during international nuclear transport, the protection of nuclear materials within their territory, or on board their ships or aircraft. Nuclear materials have traditionally been subject to extensive national protection measures. This responsibility extends to the right of a state to oversee the security measures that are taken during the transport of material originating from, or obligated to, their country.

And so, just as safety has been an absolute prerequisite to the transport of radioactive materials, so too has been security. Security is assured by a variety of measures. Indeed the robust safety features of packaging for the more radioactive materials, although designed primarily for safety, have the effect of adding an important measure of security. A host of other measures are put into place, depending on the cargo and the level of risk, including, but not limited to, access control, employee screening, tracking of shipments, minimising the number and duration of transfers, staggering movement schedules, co-ordination with local and national security authorities.

International transport security standards have been and are being developed. The United Nations International Maritime Organisation (IMO) has in recent years developed an International Ship and Port Facility Security (ISPS) Code, and the International Atomic Energy Agency is developing security guidelines for the transport of radioactive materials, in turn, new and enhanced international standards and requirements in some cases are being supplemented by national requirements.

Sustaining these shipments

Even with the excellent safety record, and robust packaging and security requirements, there is worrisome trend for global supply of class 7 radioactive materials that some shipping companies, ports and terminals, have instituted policies of not accepting radioactive materials.

Experience has shown that many things can affect the willingness of carriers and ports to accept class 7 consignments- maybe the potential service providers are unsure about insurance implications. Perhaps they worry about the perception of other customers whose goods they want to carry. Maybe they think special handling procedures or reporting requirements are too complicated, or too onerous. Perhaps they are put off by problems with ports, or terminals, which themselves are not prepared to accept class 7 cargoes. The decisions taken by shipping companies are based on maximising profit; if the return from carrying class 7 materials does not seem substantial enough, then why bother?

Our WNTI member companies tell us that in some regions service availability and acceptance levels have rapidly declined in recent years. Consignors increasingly confront departure, transit, trans-shipment, and discharge port limitations or restrictions. Shipping companies fear that the carriage of class 7 cargo will result in unexpected delays with port clearance or, at worst, refusal to dock. And, in some instances this is becoming a reality. Shippers too often are met by a lack of standardisation in documentation.

What can the nuclear industry do to help the maritime sector?

I have been talking about an essential service-the cost-effective, safe and secure transport of nuclear and other radioactive materials to where they are needed the world over-materials used to improve the well-being and quality of life for men, women and children-carbon emission-free generation of electricity, health care, medical diagnosis and treatment, industrial applications. The maritime transport sector is absolutely fundamental to serving this important purpose. In this regard, the nuclear industry is mindful of its duty to explain to all in the maritime sector the safety features of its cargoes, and the strict transport safety regulatory regime which is in place and regularly reviewed.

The World Nuclear Transport Institute (WNTI) devotes a major part of its resources to liaising and communicating



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with the various parts of the maritime sector. Several years ago the WNTI, with its 42 member companies worldwide, set up a Maritime Carriers industry working group, with the express purpose of encouraging dialogue with maritime authorities such as here in Egypt, and to be responsive to their needs. We work hard to listen, to understand, and to respond to the particular requirements of the sector you represent. We have an active programme of attending important meetings of this kind, such as here in Alexandria, and actively seek opportunities for smaller meetings with liner services, port and other maritime authorities, to listen, and to share information.

To conclude

The world nuclear transport institute (WNTI) I represent, with its 42 member

companies around the world, accepts its responsibility to reach out to the interests represented in this room. We have a responsibility to allow you to understand the nature of the industry we represent, its purpose, benefits and requirements, and to give assurance that it gives top priority to safety and security. In the same way, it is important to us that we understand well your responsibilities, and the requirements you must meet. We stand ready, and indeed we are eager, to enlarge the dialogue with you, and to co-operate with you, whether individually, or collectively, in the interest of promoting cost-effective transport that is consistent with safer seas and ports.

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