Radioactive Materials Transport
Industry Experience

Dedicated to the safe, efficient and reliable transport of radioactive materials
Radioactive Materials Transport – Industry Experience

Executive summary:
The international resurgence of interest in the generation of electricity through nuclear energy is both an opportunity and a challenge. The responses from regulators and industry will have a significant impact on issues as diverse as climate change, economic progress and scientific development.

The radioactive materials transport industry has established an enviable international safety record – regularly delivering a wide range of products as diverse as medical and industrial isotopes, as well as fresh and irradiated fuel for the commercial nuclear power producers. The strong support for an industry wide “Safety Culture” has ensured the commitment from all elements involved in bringing the peaceful benefits of the atom to a worldwide citizenry. Developed and developing countries alike derive benefits from health therapies using radioisotopes; clean, efficient nuclear power plants; and enhanced isotope monitored industrial procedures.

The movement of these products takes place within a carefully regulated environment, with international oversight of transport regulations, package testing and certification. International political developments have impacted on safety and security procedures, affecting inventory policies and practices, and public concerns about movements of all classes of hazardous materials.

The radioactive materials transport industry has demonstrated an ability to recognise the many challenges which currently exist, and a willingness to interact with regulators, carriers and public groups to ensure the continued safe and efficient delivery of the materials necessary to maintain this essential industry.

Product differentiation
The challenges associated with nuclear fuel cycle material transport are subject to a degree of commercial product differentiation – divided into ‘front end’ and ‘back end’ products. Broadly speaking the transport challenges increase steadily as one moves from the mine towards the reactor, and then further still with irradiated material from the reactor. The research and medical community has its own challenges – research materials are usually divided into commercial products produced in reactors for medical and industrial uses. Limitations on transport of radioactive materials by passenger aircraft are waived in the United States (IATA - USG-10) for materials “intended for use in, or incident to, research or medical diagnosis or treatment”. Other nations, and aircraft operators however can, and do, impose further restrictions, as may the captain of an aircraft.

Waste transport remains one of the most challenging elements in the industry. There are some disagreements as to the definition of ‘waste’. Industry and regulatory consensus appears to rely on the principle that a product being transported for any form of processing and subsequent use is not considered waste. This can lead to a situation where spent fuel from a commercial reactor being sent to a repository is considered waste, whereas the same material being transported for reprocessing would not necessarily carry the same designation. At the other end of the hazard scale, depleted natural uranium can be processed into a number of commercial products (e.g. armour shielding, and counterweights) as a non-waste material, or simply shipped to a disposal site as waste.

While there are ongoing programmes for routine movements of spent fuel and vitrified waste by sea, road and rail, discussions about the establishment of waste repositories challenge many aspects of the current back end transport regimes and also require review of existing packaging and transport regulations in the interest of greater harmonisation and consensus on methods and practices.
Contractual practices
Changes to contractual practices in fuel supply agreements and an expansion of historic supply routes have led to increasing demands being placed on all segments of the transport industry. In the nuclear industry, transport management entails not only the regular movement of products from location to location, but the simultaneous coordination of package acquisition and placement, regulatory certification and scheduling of multiple modes of transport to ensure specific deadlines.

In recent years, interruptions to supply along the delivery chain for fuel cycle materials have been caused by mine flooding, labour disputes, and unplanned facility closures. On these occasions, the limits on inventories are once again the subject of industry debate – leading to discussions between industry and regulators as to how essential delivery schedules are to be maintained. There are licensing restrictions on total quantities of certain forms of fuel cycle materials being held on-site at converters, enrichers and fabricators, and in the event of supply disruptions the transport management companies find that there are restrictions on total quantities which may be loaded on vessels, or held in ports. The ultimate ‘customer’ is the electricity generating utility and in recent years they have resorted to ‘just-in-time’ deliveries of fabricated fuel assemblies. As a consequence, in the event of a medium to long-term supply disruption, the impact could be considerable.

Regulatory compliance
Regulatory compliance takes place at international, regional, national and even local levels. The International Atomic Energy Agency (IAEA) in Vienna coordinates international transport criteria into a consensual document, which serves as a recommendation of ‘good practices’, until incorporation into modal and national legislation provides a pathway to implementation. Delays in individual countries and variations in national interpretation of the IAEA documents can lead to situations where movements of sensitive materials are subject to differing regulatory requirements depending on such criteria as the mode of transport, the packaging, and routing.

Package certificate validation remains one of the most challenging areas for harmonisation in the international arena. Many existing packages have been used successfully in the industry for decades, but are now reaching the end of their approved usage periods. Changes in regulatory attitudes, revised criticality criteria and changes in interpretation of the IAEA recommendations have led in recent years to discussions on retirement of current containers, without a readily available, affordable generation of packages to take their place. The cost of designing and fabricating new containers, particularly if they are to serve an international industry, requires a significant advance financial commitment, without guarantees that foreign partners in business, or regulators, will agree to revalidate theCertificates of Compliance issued by the host country Competent Authority. The financial return on such an investment can be delayed as a result of the review process frequently required to meet technical and criticality examinations required by overseas authorities. Harmonisation of these review procedures, to include the identification and justification of realistic and achievable configurations in both ‘normal’ and accident scenarios would assist greatly in ensuring the continued supply of containers upon which the industry depends.

Delays and denials of shipment
Denial of shipment by carriers, ports and/or labour unions is a reality faced on a regular basis. Air, sea, road and rail carriers routinely carry commercial movements of radioactive materials. Regulatory and corporate policy restrictions apply to virtually all these cargoes and can apply to the overall dimensions, mass (load distribution), loading and unloading capabilities and, of course the willingness of a carrier to accept freight of this nature. Ocean carriers may reject carriage of radioactive materials outright, claiming that their hull insurance, or owner(s) prohibit such transport service. In cases where ocean carriers are willing to accept the cargo, there may be ports on the vessel rotation which refuse to accept such freight, or will only do so following time consuming permit procedures, virtually ensuring that the necessary authorisation will not be available by the time the shipment is scheduled to take place. In a number of ports around the world the stevedoring unions have also created difficulties through refusal to handle radioactive cargoes.

Against a background of increasing quantities of material being moved between countries and continents, one is also frequently faced with regulatory restrictions on the total number of packages that can be carried on a single conveyance, compounded by requirements for horizontal, vertical and diagonal segregation and, ultimately the acceptance of the cargo by the carrier. If the delivery deadline is imminent it may become necessary to negotiate the charter of an aircraft or vessel, which will accept and transport the cargo – usually at significantly higher cost than that which would be incurred if a normal commercial carrier had been used.
Security

The security environment and developments in recent years, with greater sensitivity to new security risks, have had an impact on the manner in which nuclear materials are moved within, and between, countries. Seaports, rail yards and airports have adopted increasingly restrictive policies to try and improve their security procedures to ensure that unauthorised access to radioactive materials within their facilities will be made as difficult as possible. These procedures may however challenge policies and regulations regarding the legitimate transport of radioactive materials.

Ocean ports have also significantly reduced the amount of time that radioactive material may be held at the terminals prior to loading, or after unloading, although the latter is often a function of waiting for customs clearance, before freight can be removed from the port premises. Material in transit now frequently has to be moved to specially guarded, secure facilities, where the total length of time between unloading and reloading is also limited.

Rising security concerns also have an impact on the risk assessments carried out by insurance companies providing coverage for both vessels and cargo. Carriage of dangerous goods, including nuclear materials, raises the issue of environmental cleanup in the event of an incident involving the vessel carrying the freight, in addition to the costs of loss or damage to the material itself. Owners of the materials are concerned about the ‘perceptions of risk’ attached to the movements of their materials, because it affects not only premiums, but the potential for delays as a result of increasing restrictions imposed by ports, Coast Guard or inland transport authorities. Security related communication between all parties involved in shipment of radioactive materials is essential to ensure that current warnings are received in a timely manner for assessment and incorporation into transport plans and to ensure a prompt response from qualified entities in the event of an incident.

An integral component of modern transport practices requires comprehensive assessment of available response capabilities. These requirements entail shipping documentation which carries universally understood descriptions of the material being carried, the hazards associated with it and the extent to which emergency response personnel can react without specialised equipment.

Communication

Communication within and between countries remains a key element in ensuring the continuous, safe supply of fuel cycle materials around the world. National nuclear organisations serve as essential conduits between legislators, regulators and the national utility generators. Given the international nature of the fuel supply market however, it is becoming more and more important to ensure that there is a free flow of key data on policies, regulatory interpretations and pending decisions between all segments of the industry.

While some industry organisations have for years addressed transport issues from a public relations perspective, the increased activities of industry working groups on transport issues over the past several years mirror the growing recognition that the ability to effectively transport radioactive cargoes is a critical function. Significantly, the industry recognised the need for a stand-alone organisation dedicated exclusively to transport activities. In 1998, the World Nuclear Transport Institute (WNTI) was founded to promote sound and objective principles for ensuring radioactive materials continue to be transported safely and efficiently within a secure international framework. Operating with a permanent staff based in London, and with regional offices in Washington DC and Tokyo, WNTI also relies on the collective expertise of its members to provide technical support.

The WNTI membership has expanded from its early days with companies drawn from a wide range of industry sectors, including major utilities, fuel producers and fabricators, transport companies, package producers, and suppliers of large radiation sources. Industry-led working groups meet regularly under WNTI auspices – the SSR-6/TS-R-1 Industry Working Group considers transport safety regulation review and implementation issues, while the HEXT Industry Working Group focuses on packaging issues related to the transport of uranium hexafluoride (Hex). More recent initiatives include industry-led task forces addressing issues related back-end transport, denial and delay of shipments, and the packaging, packing and transport of uranium ore concentrates.

Discussion and participation in appropriate fora at the local and international levels should be encouraged through membership in representative organisations such as the WNTI, and national industry organisations. Industry participation in the consultative meetings held by such organisations as the IAEA, the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO) and International Air Transport Association (IATA) are all key to ensuring a mutual understanding of the challenges facing the continued regular
movement of radioactive materials via commercial carriers. The international bodies however are likely to reflect the viewpoints of the national government representatives. Industry participation as part of the official delegations, or in the drafting of national positions on the issues being debated, also is important if the current structure of international cooperation in the control of radioactive materials transport is to continue.

Insurance

Insurance matters are also currently subject to closer scrutiny. The lack of an international consensus on the key elements of nuclear liability insurance (NLI) causes concerns in the nuclear transport industry. The international conventions (Paris and Vienna), with their respective revisions and enhancements, together with the 1988 Joint Protocol linking the Vienna and Paris Conventions for the purpose of ensuring that the benefits of one convention are also extended to the Parties of the other convention, are not applicable in all countries which dispatch or receive nuclear materials. Ongoing discussions, which seek to broaden the scope of the international conventions, may however impose additional burdens on private sector institutions offering insurance coverage. Some countries rely on national legislation to address damage caused by nuclear materials within their borders, but others do not have defined compensation schedules, or methods to deal with damages from an incident within their country spreading beyond their borders.

Despite these legislative efforts, there are still conditions under which radioactive materials are transported in international waters, where NLI coverage is unclear. In the United States the coverage extended by the Price Anderson Act does not extend to all facilities engaged in producing material for the commercial nuclear fuel cycle – and NLI coverage must be specifically extended for transport of material to or from those facilities by a purchaser of private NLI coverage. The lack of an international consensus on nuclear liability coverage makes movement from regions covered by one form of legislative insurance coverage to that covered by another, unsettling to ocean carriers and transporters.

Public awareness and acceptance

Public awareness and acceptance of the necessity for transport of radioactive materials throughout the industrialised world, presents a challenge for governments and industry. Local communities unquestioningly accept the regular bulk transport of hazardous materials such as gasoline, propane gas and toxic chemicals, through their residential and commercial streets. Many may have limited direct experience of these products, with the exception of gasoline, but in general there appears to be a level of acceptance for the need for transport through ports, and along public roads and railways.

Numerous surveys of risk perception have shown that individuals make such assessments on a daily basis, in most cases without much debate. The risks of smoking, driving a car, flying, signing a waiver for surgery in a hospital, are all assumed to be part of our daily routines, but the introduction of the words “radioactive” or “nuclear” causes a change in the paradigm, which elevates the political and commercial pressures. The challenge for the regulators, the commercial power industry, as well as the medical and industrial isotope users and transporters, is to ensure that any discussion on risk is based upon a realistic, accurate and truthful assessment of scientific facts, and knowledge of the excellent transport safety record established over many decades by the industry.

New challenges are now appearing for regulators, the industry at large and for the transport sector. Existing policies and regulations have been prepared to apply to the current designs of reactors, but new reactor designs raise new challenges. One example is the case of the Pebble Bed reactor, currently being proposed in South Africa, and already operating in China. While existing commercial fuel packages are only approved for enrichments up to 5%, newer designs are looking at enrichment levels of between 8 – 10%. If the new reactor designs become more popular there will be an urgent need for new packages, designed and approved for the higher enrichments in all countries from, through and to which they are likely to be transported. Similar challenges will arise throughout the fuel cycle as these new designs are further developed.
Conclusion

The excellent record of radioactive transport, which has been established over many decades by regulatory bodies and private sector participants is testimony to the dedication to safety and careful attention to detail afforded by those engaged in this industry. The industry has demonstrated an enviable ability to respond positively to unexpected developments in international political affairs, advances in engineering and technological fields and an increasingly complex security environment.

All stakeholders in the transport of radioactive material share a common interest in protecting and promoting safe, cost-efficient and secure transport. Just as the business becomes increasingly international, so too do the complexities of transport. And increasingly transport is becoming an important part of the overall cost-equation. It is also coming under greater public and regulatory scrutiny. The availability of carriers on many routes, access to ports, differing regulatory and other requirements from one jurisdiction to another, differing interpretations of just what is required, a lack of harmonisation in standards; all of these have a direct and potentially costly impact on producers. There is recognition that maintaining transport options requires co-operation among all parties in the industry; this type of co-ordination necessarily transcends competitive pressures between individual companies. Now more than ever it is important that industry share its experiences and ideas, to develop well-researched consolidated positions. The WNTI is a catalyst for bringing industry together to collaborate in ensuring that it continues to meet its commitments to safety and to take a positive and inclusive approach to the important issues before it.

Photographs

1  Preparing drums of uranium ore concentrate for transport
2  Front end transport in France
3  Rail-road transfer at Valognes Terminal, France
4  Preparation of Cobalt-60 container for transport
5  Inspections prior to road transport
6  Unloading a cask of vitrified high-level waste, Mutsu-Ogawara Port, Japan
7  Road transport of spent fuel in Japan
8  Cask for fresh MOX fuel
9  Unloading operations, Barrow-Port, UK
10 Purpose-Built Vessel