The Transport of Radioactive Materials – Future Challenges

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Abstract. The International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Materials, TS-R-1, set the standards for the packages used in the transport of radioactive materials under both normal and accident conditions. Transport organisations are also required to implement Radiation Protection Programmes to control radiation dose exposure to both workers and the public. The industry has now operated under this regulatory regime safely and efficiently for nearly 50 years. It is vital that this record be maintained in the future when the demands on the transport industry are increasing. Nuclear power is being called upon more and more to satisfy the world's growing need for sustainable, clean and affordable electricity and there will be a corresponding demand for nuclear fuel cycle services. There will also be a growing need for other radioactive materials, notably large sources such as Cobalt 60 sources for a range of important medical and industrial uses, as well as radio-pharmaceuticals. A reliable transport infrastructure is essential to support all these industry sectors and the challenge will be to ensure that this can be maintained safely and securely in a changing world where public and political concerns are increasing. This paper will discuss the main issues which need to be addressed. The demand for uranium has led to increased exploration and the development of mines in new locations far removed from the demand centres. This inevitably leads to more transport, sometimes from areas potentially lacking in transport infrastructure, service providers, and experience. The demand for sources for medical applications will also increase, particularly from the rapidly developing regions and this will also involve new transport routes and increased traffic. This raises a variety of issues concerning the ability of the transport infrastructure to meet the future challenge, particularly in an environment where there already exists reluctance on the part of some commercial transporters, for example shipping lines, to handle radioactive cargoes. The World Nuclear Transport Institute is addressing these issues, for example by facilitating cooperation between consignors and shippers, advice on radiation protection programmes, the provision of a knowledge base to help the various stakeholders in the transport chain and also by its involvement in training courses. There is ample evidence to demonstrate that the real risks to man and the environment from radioactive transport operations are small, not only for severe accident scenarios but also for malicious acts. It is therefore vital that we continue our efforts to dispel irrational fears and reassure the public that under the current IAEA regulatory regime radioactive material transport is a necessary, safe and secure operation.

KEYWORDS: Increasing Traffic; New Routes; Industry Strategy

1. The changing scene

Nuclear power is being increasingly called upon to satisfy the world's growing need for sustainable, clean and affordable electricity. This recent development in the energy policy of several countries is already clear from their new nuclear-build plans. There will be a corresponding demand for increased fuel cycle services. These vital services must be maintained to allow nations to develop nuclear programmes to meet their increasing electricity needs. This will inevitably place new and greater demands on transport.

There will also be a growing demand for other radioactive materials; for example, large sources such as cobalt 60 sources, for a wide range of important health and industrial uses and radiopharmaceuticals for diagnosis and treatment, not least in the developing countries.

A reliable transport infrastructure is essential to support these industries and the challenge will be to ensure that this can be maintained safely and securely in a changing world where there still is evidence of hostility and public/political concerns about radioactive materials, including transport.

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2. Supply and demand issues

Increased demand for uranium concentrates, coupled with a rapid rise in the price, has led to increased exploration and the development of new mines in new locations. This inevitably leads to more transport, sometimes in areas lacking in transport infrastructure, service providers, and experience. An important factor affecting the volume of transport of UOC is that the main sources of supply are in Australia, Africa, North America and Eastern Europe whereas the increasing demand is likely to be greatest in countries of the Far East, South Asia, and Europe that are geographically widely separated from the sources of supply. This raises a variety of issues including the resources to transport safely, familiarity and compliance with regulation, harmonised standards and security requirements

A similar situation exists in the provision of other fuel cycle services, notably enrichment, reprocessing and, perhaps in the future, waste management. It is also the case in the production and distribution of large radioactive sources such as Co60 where there are few production and distribution centres but many markets to supply. This industry also relies heavily on international transport to deliver supplies to a wide range of customers. The consequence of this mismatch between sources of supply and the demand centres is that international transport is essential, and this traffic will increase.

3. International fuel cycle services initiatives

Initiatives are being considered to ensure the supply of fuel cycle services without the proliferation of sensitive nuclear technology. The US DOE Global Nuclear Energy partnership (GNEP) Strategic Plan, launched in January 2007 aims to establish supply arrangements among nations to provide reliable fuel services worldwide for generating nuclear energy, by providing nuclear fuel to utilities and taking back spent fuel for recycling, without spreading enrichment and reprocessing technologies. A significant number of states have shown interest in participating. A similar initiative is being formulated in Russia to provide international uranium enrichment services.

The result of such initiatives would be to restrict the number of supply centres when the number of demand centres is increasing. This would increase the importance of a secure transport infrastructure to support nuclear power programmes and new challenges will need to be addressed. We need to watch closely what directions such programmes might take in the future.

4. Sustaining transport services – the logistics challenge

At the front end of the nuclear fuel cycle, existing commercial liner services will continue to be needed to play a vital role in the transport of uranium ore concentrates and uranium hexafluoride. This is now a well regulated and managed industry with a solid infrastructure in place but new sources of supply and new demand centres are now emerging. There will be a shift somewhat from existing mature transport routings into developing regions as well as increased volumes of traffic. This is the challenge which has to be faced in an environment where there already exists increasing delays and denials of shipments. The reasons for this are many and varied. Some countries and port and terminal authorities are either not prepared to accept radioactive materials or impose onerous constraints. This results in some carriers being reluctant to handle radioactive cargoes which could result in additional complexities and the disruption of shipping schedules when this traffic represents a small part of their total business. The World Nuclear Transport Institute is cooperating with stakeholders to alleviate these problems in order to retain this essential service and to maintain industry standards and best practice.

The future supply and demand scenarios for other nuclear fuel cycle services will involve the transport of new fuel, including mixed oxide fuel (MOX), spent fuel for recycling or disposal, as well as high level and other radioactive wastes. This would also involve new countries and new transport routes for sea, road and rail transport depending on how the Global Nuclear Energy Partnership, GNEP might emerge; and other

scenarios such as regional or international waste repositories, fuel leasing or similar international initiatives also may have a significant influence on some options.

Commercial carriers, currently the normal option for front end fuel cycle services, as well as dedicated carriers as now used for spent fuel, waste and MOX, will both need to be considered. The importance of consignors maintaining a dialogue with carriers as well as with all stakeholders, including IAEA, IMO, IATA, national regulators, en-route countries and the public will continue to be vital to maintain these services.

Due to long lead times for the planning and construction of new plants, transport will have time to adjust. Experience in the industry is plentiful but newcomers may need help to ensure the excellent transport safety record is maintained. New challenges will have to be met in the future as the demands increase and change but the industry is robust, experienced and flexible. There is confidence that these challenges will be met.

5. Transport Safety

The safety philosophy underlying the transport of radioactive materials is that safety is vested primarily in the package. The International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Materials, TS-R-1 [1] set the standards for the packages used in the transport of radioactive materials to ensure safety under both normal and accident conditions. There is a large body of evidence [2] which demonstrates that the current IAEA tests for high duty packages are severe tests which cover all the impact, fire and submergence accident situations which can be realistically envisaged in the transport of radioactive materials.

The industry has now operated under this regulatory regime safely and efficiently for nearly 50 years. It is vital that public and political confidence in the current regulatory regime should be encouraged and not undermined

6. Radiation Protection

The IAEA Transport Regulations now require transport organisations to implement Radiation Protection Programmes to control radiation dose exposure to workers and the public. An assessment has been carried out by the World Nuclear Transport Institute (WNTI) [3] of the likely doses to various types of worker and members of the public involved in nuclear fuel cycle transport operations. This work was based on the extensive experience of actual operations and covered all materials from uranium ore concentrate through to spent fuel and high level waste. It showed that it is very unlikely any group of workers not classified as radiation workers, or any member of the public, will receive annual doses in excess of 1mSv, and at this low level no workplace or individual dose monitoring is required. This study has been included as a reference in the IAEA guidance on Radiaton Protection Programmes for Transport of Radioactive Material and WNTI has used it extensively to advise and assist transport operators.

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7. Transport Security

The main concern in the past has been theft and diversion of nuclear material which has a potential weapons capability and requirements are already in place to ensure its physical protection [4]. However, recent tragic events have heightened sensitivities to security against potential malicious acts and terrorist action.

The physical properties of some types of radioactive materials are important factors. Highly radioactive materials (spent fuel, vitrified high level waste, cobalt 60 sources, etc.) are very refractory, insoluble and not easily dispersed. The same is true of mixed uranium/plutonium oxide, MOX. Uranium ore

concentrate is dispersible but is of low activity. The same is true of uranium hexafluoride although it is chemically toxic.

The properties of the radioactive materials, the robust design of the package to ensure safety under accident conditions combine to reduce the risks due to radiation exposure following malicious acts.

The IAEA has initiated work on the need for enhanced measures to ensure security in the transport of all radioactive materials, including nuclear fuel cycle materials, to complement the security requirements in the UN "Model Regulations" [5]. The 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'. International standards and requirements in some cases are being supplemented by national requirements. It is not apparent, however, that much effort has been devoted to harmonising requirements between national jurisdictions. Different standards and requirements between national jurisdictions can lead to greater complexity with the potential for confusion and misinterpretation, and act as a potential disincentive to transport service providers.

8. Public Perceptions

Based on sound science and engineering as well as many years of operating experience it is fair to claim that the real radiation exposure risks from the transport of radioactive materials under the current regulatory regime to both man and the environment are not great. This is true not only for severe accident scenarios but also for malicious acts. Nevertheless the risks perceived by the public are great and so are the potential consequences of public panic and long term disruptions which could follow an incident, however small. Such misperceptions could have a serious impact not only on transport operations but also on the vital industries which they serve

It is therefore vital that we continue our efforts to reassure the public that radioactive material transport is a necessary, safe and secure operation. We must dispel exaggerated claims and irrational fears. Wider public dissemination of the relevance of the robustness of the current IAEA regulations in ensuring safety under severe accident conditions as well as the results of other tests and public demonstrations to simulate real accidents which have also shown that the integrity of the package would not be compromised.

9. Conclusions

It is vital that safe and reliable transport services for radioactive materials be maintained to allow nations to develop nuclear programmes to meet their increasing electricity needs, and to produce and distribute radioactive products vital to industry and health care. This will inevitably place new and greater challenges on the transport industry but the industry is mature and flexible and there is confidence that these challenges can be met.

There is a large body of evidence which demonstrates that the current IAEA regulatory regime ensures the safe and secure transport of radioactive materials under all accident situations which can be realistically envisaged. This conclusion is also supported by over 50 years of safe and efficient operating experience.

It is vital that public and political confidence in the current regulatory regime should not be undermined. We must continue our efforts to reassure the public that radioactive material transport is a necessary, safe and secure operation even under severe accident conditions. The physical properties of the materials coupled with the security provisions required by the IAEA and UN also ensure that the radiation exposures following potential malicious acts are unlikely to be great.

It is important for all stakeholders to work together to dispel exaggerated claims and irrational fears about the potential consequences of radioactive material transport. There is already evidence that such attitudes

could have a serious impact on the transport operations which are essential to support many vital industries by causing delays, increasing costs, and also by acting as a serious disincentive to transport service providers.

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