TRANSPORT OF ABNORMAL INDIVISIBLE RADIOACTIVE LOADS

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ABSTRACT

During the decommissioning of nuclear installations many contaminated pieces of equipment are removed from the installation which, were they not to be further dismantled, would be far larger than the loads normally allowed to be transported on the transport infrastructure. Dismantling of such equipment can, however, lead to a risk of release of the activity they contain into the environment. There is often, therefore, a strong ALARP argument that these large components should be transported and disposed of without being further dismantled. Movement of such a load is often as much a transport logistics problem as it is a radiological one. In November 2007 the Great Britain (GB) Department for Transport hosted a seminar focused on this issue as it affects the UK. Although that seminar was focused on GB issues, many of the points raised during it will be of interest to the international community. This paper summarises the key points from the 2007 seminar and also provides an update on the proposed large load provisions for the IAEA Regulations for the Safe Transport of Radioactive Material.

INTRODUCTION

The Radioactive Materials Transport Team (RMTT) in the GB Department for Transport hold an annual stakeholder seminar. The purpose of these seminars is to inform a targeted group of stakeholders on topics associated with the transport of radioactive materials in their industry. In November 2007 the RMTT hosted a seminar, targeted at the Nuclear Decommissioning industry, on the topic of Abnormal Indivisible Radioactive Loads. This seminar was organized in response to a number of requests from industry stakeholders who sought clarity on the GB Regulators position on the permissioning of the transport of radioactive loads which exceed the normally accepted size and mass limits for road transport. The scope of the seminar was widened to look at the issues associated with transporting similar loads by rail, inland waterways and by sea. In total there were nine presentations at the seminar which were followed by a short panel discussion. The main focus of the discussions was the infrastructure issues associated with such transports. These, of course, are unique to GB, although some of these issues may also be relevant in other countries. Since that seminar was held there have been a number of discussions on the radiological issues associated with such loads at the IAEA in Vienna. These discussions have resulted in the inclusion of a new appendix in the latest draft of TS-G-1.1, the Guidance on the IAEA Regulations for the Safe Transport of Radioactive Material. This paper summarises the proceedings of the November 2007 seminar and briefly discusses the proposed guidance in TS-R-G-1.1. In the context of this paper

Abnormal Loads are those which exceed GB's standard gross road vehicle weight limit of 44 tonnes.

TYPICAL GB ABNORMAL LOADS

In the GB context there are typically five abnormal radioactive load moves each week in the form of Irradiated Fuel Transport Flasks. These flasks weighing approximately 50 tonnes are transported by road from the nuclear power stations to the nearest rail transfer facility and then by rail to the fuel reprocessing plant at Sellafield. They are approved as Type B(M) packages under the radioactive materials transport regulations and the road part of the journey is authorized under The Road Vehicles (Authorisation of Special Types) (General) Order 2003, known as the STGO.

In addition to these routine moves there have been some additional one off moves of significantly larger contaminated objects. One example of such was the Heat Exchanger from the GB's prototype Advanced Gas Cooled Reactor (Figure 1). This component was transported approximately 10 miles on public roads from the dismantled reactor to a Low level Wastes disposal facility.

Most of GB's first generation Nuclear Power Stations, the Magnox stations, are now being decommissioned. These reactors contain large graphite cores contained in thick walled concrete pressure vessels. The dismantling of these structures is generating large volumes of Intermediate Level Waste, some of which emits high doses of radiation. This waste is being packaged in heavily shielded containers ready for disposal in the planned GB Geological Disposal Facility (GDF). These storage and transport containers can weigh up to 64 tonnes and are typically certified as a type IP-2 package (Figure 2). The final location of the GDF is yet to be decided but it is likely that it will be several hundred miles from some of the major decommissioning sites. Once the GDF is operational it is anticipated that there will be over 1000 moves of such packages to it per year. Obviously there are incentives, in terms of reducing the transport costs and reducing the disruption to the transport infrastructure, to minimise the number of such moves by maximising the load in each package.

UK ROAD TRANSPORT LOAD RESTRICTIONS

The standard restrictions on road vehicle gross laden weight, axle loading, overall width and overall length are contained in the Road Vehicles (Construction and Use) Regulations 1986 (reference 1). These restrictions are derived from EU legislation and they are common across the most of Europe. For abnormal indivisible loads the width restrictions can be relaxed provided that certain additional marking, notification and escorting requirements are complied with. Further relaxations (150 t gross vehicle weight, 6.1 m max width and 30 m max length) are allowed by the Road Vehicles (Authorisation of Special Types) (General) Order 2003 (reference 2). Again this order places additional notification and marking requirements on the carrier and it also introduces additional speed limits on the vehicles. Even larger loads are allowed subject to a special authorisation either from the GB Highways Agency or from the Department for Transport. Such authorisations may place additional restrictions on the movement such as specifying routes or times of travel. The term "abnormal indivisible loads" is defined in GB legislation as:

> "a load which cannot without undue expense or risk of damage be divided into two or more loads for the purpose of conveyance on a road"

This definition has been the source of much legal debate. It could be argued that a load of decommissioning waste could be divided into two or more loads and therefore cannot be carried outside of the standard load limits without a special authorisation. The Department for Transport has issued legal advice on this topic (reference 3).

The foregoing summary of the legal load size restrictions does not of course take account of the many physical restrictions, such as narrow roads, low bridges and bridge weight limits, which will influence the viability of a proposed road transport route.

UK RAIL TRANSPORT RESTRICTIONS

UK Government policy is for freight to be moved by rail in preference to road. This policy is intended both to reduce the burden on the road network and to reduce the CO_2 emissions as a result of the transport. The rail transport restrictions include limits on both the size of the load and the gross vehicle weight. The GB standard load cross section limits, or the load gauge, are shown in Figure 3. You will see that they are quite limiting in terms of the load width. However, abnormal loads can and have been transported on the GB railways as shown in Figure 4. The normal limit on load length is 22m but loads up to 35m in length can be carried. There are additional width restrictions in these circumstances.

The gross wagon weight restrictions vary according to the class of the railway being travelled on and the construction of the wagon. They range from 27 tonnes for a two axle wagon on a class RA1 railway to 101 tonnes for a four axle wagon on a class RA10 railway. Some of the heaviest Irradiated Fuel Transport Flasks can exceed this maximum weight limit and their movements need special authorisations. The class of the railway depends on its construction and the construction of the features along it, such as viaducts. Restrictions on the loading class of a particular railway can limit the availability of the route for an abnormal load move. Some of the heaviest Irradiated Fuel Transport Flasks moved by rail in GB can exceed the normal 101 tonne maximum weight limit and their movements need special authorisations.

Many of GB's Nuclear Power stations are remote from railways and there is inevitably going to be a portion of an abnormal loads journey which is on roads, even if the majority of the journey is by rail. There is one decommissioned nuclear power station which was the only customer for the local rail branch line. When the power station closed the branch line was also shut and the rails have been removed. There is therefore now no viable rail route from this waste producing site to the GDF.

TRANSPORT BY INLAND WATERWAYS

GB has a long history of transporting commercial goods on its rivers and canals. This method of transporting freight is now seen as one of the least polluting. Abnormally large loads are often carried by inland waterways as illustrated in Figure 5. There is, however, no history of carrying radioactive loads on GB's inland waterways, and very little experience of carrying any dangerous goods on them. For this reason UK has not adopted the European regulations for the transport of dangerous goods on inland waterways, ADN.

Although in theory inland waterways are a practical option for carrying heavy slow moving decommissioning loads, there are a number of obstacles to be overcome before this option could be implemented in the UK. Not the least of these is the public perception issue associated with the transport of radioactive materials on rivers and canals which are the source of much of GB's public drinking water.

TRANSPORT BY SEA

GB is an island nation with a long history of seafaring. The majority of GB's power stations are located on the coast. It should be no surprise then that there is an established infrastructure for transporting abnormal loads to and from these power stations by sea. The GB government has part

funded a sea going barge which has been designed specifically for this purpose, the Terra Marique (Figure 5) This vessel has been used on a number of occasions to deliver abnormal loads, such as power transformers and turbine sets to these coastal stations. Additionally the GB Nuclear Decommissioning Agency owns a fleet of special use vessels which conform to the INF code. One of them, the MV Atlantic Osprey, has a large open cargo bay with a roll on roll off facility and it is particularly suited for the transport of large and heavy abnormal loads. This ship is categorised as an INF 2 vessel. Depending on the final location of the GB GDF, it is envisaged that a significant proportion of GB's decommissioning waste will be transported there by sea.

A RECENT GB ABNORMAL LOAD

It is common practice in steel making to recycle a small percentage of scrap material into the melt. From time to time orphan radioactive sources are found in the scrap metal when it arrives. In GB the steel works are well aware of this problem and they have sophisticated radiation detection devices to eliminate the risk of such sources getting into their product. Unfortunately, however, one orphan source, believed to be the Plutonium battery from a heart pace maker, did get into a steel melt. As a result the steel works was obliged to dispose of four contaminated "slag pots", weighing up to 65 tonnes, as low level radioactive waste. Under the transport regulations the material was classified as LSA II.

The slag pots were transported to the GB low level waste store by road, a journey of several hundred miles. They were each packaged in bespoke IP2 packages (Figure 7). The size and weight of the packages made it impractical to carry out drop tests. Their performance in normal conditions of transport was, therefore, justified by the use of a combination of FEA analysis and reasoned argument.

PROPOSED CHANGES TO THE GUIDANCE ON THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS

The IAEA has recently published a revised draft of its Guidance on the Regulations for the Transport of Radioactive Material, TS-G-1.1 (reference 4). This draft contains a new Appendix 7 entitled Guidance for Transport of Large Loads under Special Arrangements. This guidance is based on experience from the transport of components removed from light water reactor power stations which are mainly surface contaminated objects with masses in the range of a few 10's of tonnes to a few 100's of tonnes. The guidance is, however, applicable to similar components from other reactor types, such as the Windscale AGR Heat Exchanger illustrated in Figure 1. The guidance would not be applicable to many of the abnormal radioactive loads encountered in GB, the majority of which could be transported without the use of a Special Arrangement, as was demonstrated by the transport of the Slag Pots illustrated in Figure 7. I can foresee, however, that the publication of this guidance will give those who are dismantling power station reactors, both in GB and elsewhere in the world, an opportunity to review their plans and to look at reducing both the costs and worker doses associated with their projects, by reducing the extent to which large components are dismantled before they are sent for final disposal.

Figure 1. Windscale AGR heat exchanger

Figure 2. A standard GB waste storage and transport package

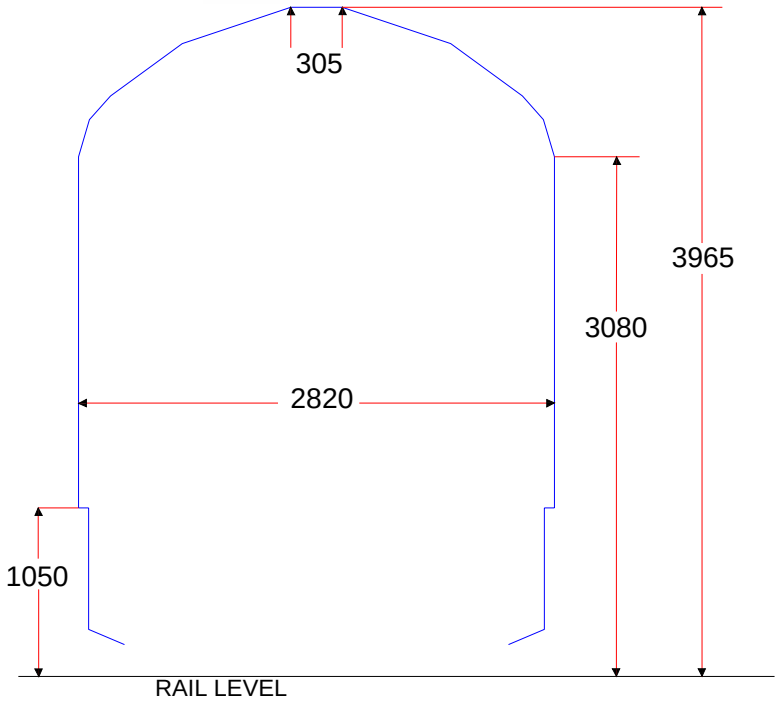

Figure 3. The GB standard rail gauge (dimensions in mm)

Figure 4. An abnormal load on the railways

Figure 5. An abnormal load on the River Thames

Figure 6. The MV Atlantic Osprey

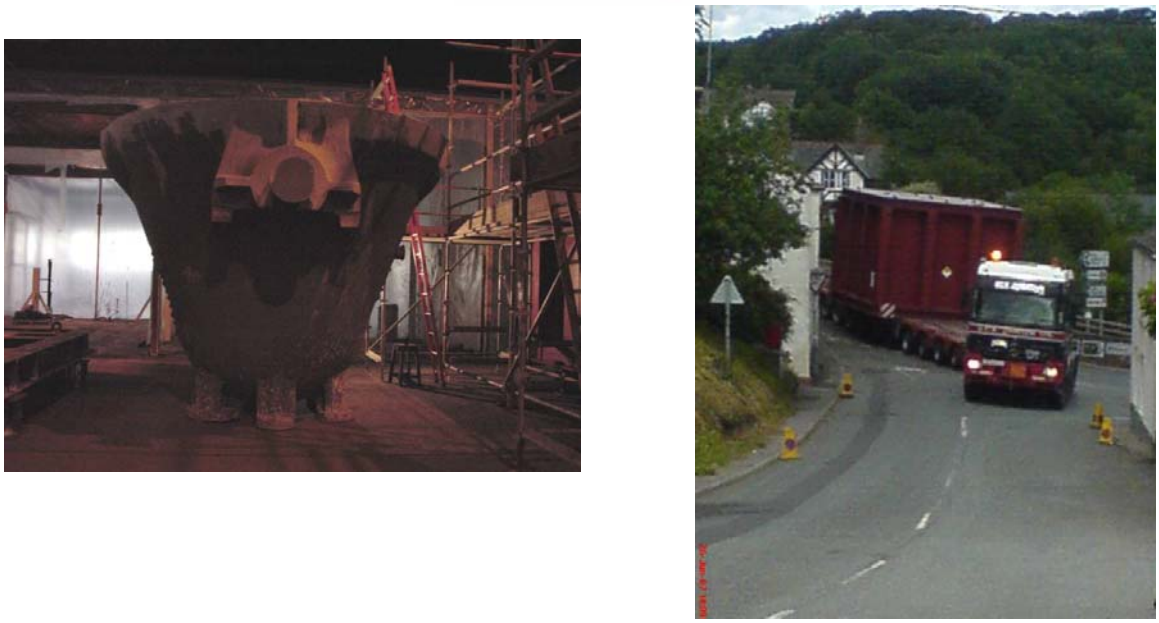

Figure 7. A Slag Pot before and during transport

CONCLUSIONS

The discussions at the November 2007 seminar covered a broad range of issues surrounding the transport of abnormal radioactive loads. These included the legal aspects and the physical restrictions of the road, rail, inland waterway and maritime infrastructures. In GB there are likely to be more and more transports of this nature in the future, as nuclear power stations and facilities reach the end of their operating lives and are decommissioned. Many of those moves will be driven by the current policy to have a single national intermediate level radioactive waste repository, the GDF. If that policy changes then the need for such transports may be reduced.
Although not targeted at the GB reactor types currently being dismantled, the new guidance in the revised draft of TS-G-1.1 is going to be of use to both our waste producers and our Regulator.

ACKNOWLEDGMENTS

The author greatly appreciates the support of those who presented at the November 2007 seminar. Their original presentations can be found at
http://www.dft.gov.uk/pgr/freight/dgt1/road/guidance/meetings/class7seminar/

REFERENCES

1. The Road Vehicles (Construction and Use) Regulations 1986 (SI 1986/1078)
2. Road Vehicles (Authorisation of Special Types) (General) Order 2003 (SI 2003/1998)
3. Carrying loads containing or contaminated with radioactive material by road – see http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/426155/425453/Class_7/abnormalnote15.doc
4. **DS425** - Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material – see http://www-ns.iaea.org/standards/documents/draft-ms-posted.asp

References 1 and 2 can be obtained from the Office of Public Sector Information at
http://www.opsi.gov.uk/