Ten Thousand Movements of Irradiated Fuel from CEGB Power Stations—Review of Recent Experience

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INTRODUCTION

Transport of irradiated (spent) fuel is an important part of the services needed to support generation from the CEGB's nuclear power stations. There is a total of 26 gas-cooled reactors at ten locations, with a total capacity of over 9,000 MWe.

Most of the movements involve the despatch of irradiated fuel for storage and reprocessing at British Nuclear Fuel's (BNFL) plant at Sellafield but small numbers of irradiated fuel movements are also required to research laboratories for post-irradiation examination.

CEGB operates two types of gas-cooled reactor. The older type of reactor is of the Magnox type using metallic natural uranium fuel clad in magnesium alloy. The later reactors are Advanced Gas-Cooled Reactors (AGRs) using enriched uranium dioxide fuel clad in stainless steel. Both types of reactor use carbon dioxide as coolant and have graphite moderators.

After discharge from the reactor irradiated Magnox fuel is stored in cooling ponds at most stations. The pond water is dosed with sodium hydroxide in order to inhibit corrosion of the magnesium cans but slow corrosion of the cans does occur and transport and reprocessing of the fuel is desirable within months or a few years of discharge, depending on its condition and environment. The last of the Magnox stations, Wylfa, has a modular gas-cooled store for its irradiated fuel; a much longer period of storage is acceptable there, as corrosion is negligible.

Irradiated AGR fuel is also stored in cooling ponds. It is generally less susceptible to corrosion than Magnox fuel. However some corrosion of its stainless steel cans (approximately 0.38 mm thick) occurs. The CEGB has entered into contracts with BNFL for the reprocessing of the first 1,350 tU of its irradiated AGR fuel arisings. The future policy on storage of later arisings of irradiated AGR fuel is currently under consideration, particularly the possibility of using a central Dry

Buffer Store to permit longer storage without corrosion.

The CEGB organises its own irradiated fuel transport operation, using its own flasks which are pooled in a fleet which also serves South of Scotland Electricity Board (SSEB). The design of the early flasks evolved from designs originally conceived in the 1950's by the United Kingdom Atomic Energy Authority (UKAEA). Over 10,000 CEGB loaded flask movements have now been made, mainly from power stations to Sellafield, with no incidents giving rise to the release of radioactivity.

This paper describes the CEGB's experience in these operations, referring particularly to the experience of recent years.

EQUIPMENT USED

CEGB flasks are basically of cuboid design, the body of the flask consisting of a single forging or a fully welded structure. All designs conform to the relevant IAEA Regulations. The fuel discharged from the reactors is loaded into open-topped boxes (skips) for storage and then transferred into the flasks, sealed and thoroughly prepared for despatch.

The major part of the transport is by rail but short road journeys, up to 13 miles, to the nearest railhead are necessary in the case of many power station sites. For rail transport the flasks are conveyed on purpose-built rail wagons (flatrols), one flask per wagon. All wagons now have sliding covers which reduce the amount of dirt acquired by flasks during their journey, thus reducing the transfer of dirt into cooling ponds and also reducing contamination difficulties, caused by pond water adhering to dirt on the flasks.

Specialised equipment is used for the testing of the seals of flasks before despatch and, in the case of Magnox fuel, adding corrosion inhibitor to the fluid in the flask.

SCALE OF OPERATIONS

For the United Kingdom as a whole the CEGB's experience of over 10,000 loaded flask movements of irradiated fuel is augmented by the movements of other flask operators, namely the SSEB, UKAEA, BNFL and companies associated with BNFL (Nuclear Transport Ltd. and Pacific Nuclear Transport Ltd.). These other operator's movements involve total traffic of about 30% of the CEGB's total.

The CEGB, jointly with SSEB, currently uses a combined fleet of 58 flasks for routine irradiated fuel movements (i.e. excluding small flasks for laboratory samples). A proportion of the flask fleet is, of course, normally out of service for the purposes of maintenance or modification.

The average journey length is approximately 300 miles. Currently about 500 loaded flask movements are made each year, although the number can fluctuate for various operational reasons. It is interesting to observe that the five-yearly totals of CEGB flask movements have not varied by more than about 20% in the past 20 years, in spite of the increase in the number of power stations operating, the main reason being that the increase in irradiated fuel arisings from new stations has been offset by overall improvements in fuel utilisation.

OPERATIONAL EXPERIENCE

Routine transport started 26 years ago. There have been engineering, operational and management problems typical of those expected in such a large-scale and prolonged activity but, as a whole, there have been relatively few problems. This is largely attributable to the fact that the flasks are basically simple in design and have no moving parts such as pumps or motors. Modifications to the designs have been made from time to time in order to improve performance and to take advantage of improvements in knowledge and technology. One such change was the phasing out of the earliest design of Magnox flasks, which had bodies constructed with thick interlocking seam-welded plate, and its replacement by a more modern design of body and lid.

Care and vigilance are necessary in order to maintain high standards. There are some parts of flasks, such as bolts and valves, which may deteriorate as a result of movement during loading and unloading operations and these require regular inspection, maintenance and replacement as appropriate. Apart from inspection and any necessary minor maintenance at each turnround of a flask there is a major overhaul every two to three years which involves detailed inspection of the flask and overhaul of items such as valves.

CEGB flask movement is organised and managed centrally. The arrangements have been changed over the years in order to improve efficiency and adapt to changing external circumstances. An important change was made in 1982 in response to changing patterns of freight on British Rail. Hitherto flask traffic had been incorporated (subject to the stringent regulatory requirements) with other wagon loads in mixed freight trains. At that time the changes in freight traffic made it necessary to change over to dedicated flask trains in order to meet CEGB station requirements. This has proved to be very successful, although there was an inevitable increase in the cost of the service.

PUBLIC RELATIONS

In the early years of flask movement the public had little interest in flask traffic but in the later 1970's public relations problems arose which have since required a considerable amount of management and other staff resources.

One major area of difficulty has been the general public's lack of familiarity with nuclear matters, particularly an appreciation of the radiological significance of various levels of radiation and radioactivity. In addition there is a lack of understanding of the high level of protection provided by conforming to the IAEA regulatory standards.

The first of these problem areas is difficult to overcome. As a consequence it is not difficult for anti-nuclear interests to raise alarm on the basis of levels of radioactivity which are, radiologically, of very low significance. The general public has increasingly questioned the opinions of all kinds of experts in recent years and it is not easy to achieve public understanding of the concept of risk. The nuclear industry in particular has a general problem in presenting information and achieving understanding. Attempts have been made, by comparison with natural background radiation, comparison with dosages received during normal air travel, comparison with risks of cigarette smoking etc. Other analogies have been drawn, but a problem of presentation undoubtedly remains.

The CEGB's action in 1984 in staging a 100 mph train crash directly on to a Magnox flask removed any public misunderstanding about the strength of the CEGB's flasks and also demonstrated the high degree of protection against impact which is conferred by a design which conforms to the IAEA regulatory requirements.

Many other initiatives and responses on public relations have been made, particularly in order to try to inform the general public and opinion-formers. Written enquiries have received detailed replies; talks have been given to MP's, Councils (both elected local government members and their officials), interest groups and various societies; leaflets and booklets have been distributed and explanatory films have been made available.

There has also been extensive, in-depth discussion of many aspects of irradiated fuel transport during three public inquiries. These were the 1977 Windscale Inquiry (into the construction of the Thorp Reprocessing Plant at BNFL's Sellafield site), the 1984 Skateraw Inquiry (into the siting of the railhead for the Torness AGR Station in Scotland) and the 1986 Sizewell Inquiry (into the proposal for a PWR at Sizewell). The reports from each of these independent inquiries resulted in endorsement of the safety of the arrangements being used for the transport of irradiated fuel by the CEGB and, in the case of the Skateraw Inquiry, the similar arrangements used by its Scottish counterpart (SSEB). The Sizewell Inquiry in particular examined irradiated fuel transport in considerable detail and in his report the Inspector, Sir Frank Layfield, concluded "In comparison with most other safety issues ... the safety of spent fuel transport gives extremely little justification for anxiety."

PLANNING FOR FLASK EMERGENCIES

The Irradiated Fuel Transport Flask Emergency Plan for England and Wales provides for the calling out of health physics and other experts in the event of a mishap involving a flask in transit. The Plan errs on the side of caution and requires the calling of experts even for minor events unless they are such that the flask could not have been affected in any way. On average there are two or three call-outs each year under the plan, although the number fluctuates from year to year.

There has never been an event involving damage to a CEGB flask in the 26 years in which these operations have been carried out and all of the call-outs have in fact been to check the condition of flasks after minor events (such as slow-speed derailments of the flatrol in marshalling yard). Only one event involving derailment on running track has occurred; this was in 1970 and involved the derailment of a flatrol with an empty flask which remained upright, the flask being totally undamaged.

The Flask Emergency Plan is exercised regularly, typically involving a full-scale exercise with a mock flask or an unused flask. Such exercises are staged away from power stations and have received the full co-operation of British Rail and the civil Emergency Services. They are useful for training, familiarisation and identifying any possible shortcomings in communications and equipment.

The exercises are themselves a source of interest to the news media, particularly as they provide out-of-the-ordinary visual and dramatic elements which the news media love, even though the scenario is hypothetical. There is also an associated difficulty arising from the fact that, in order to provide useful experience for all participants it is necessary to postulate a fairly severe accident and to exaggerate its consequences. These are reported by the media and may lead the public to the view that they could result from <u>any</u> mishap to a flask. However this is a risk which it is necessary to bear in order to maximise the benefit to emergency planners and participants of the exercises.

FUTURE CHANGES

The next significant technical change for this traffic is the introduction of the new (A2) flasks for AGR fuel. These have a high technical specification, as described in Mk A2 AGR Irradiated Fuel Transport, A New UK Flask Design, R.A. Blythe and I.A. Wood, 1989. The design of the flask, its handling equipment and the design of the skips carried is different from the existing equipment. Operationally and logistically its introduction represents a considerable challenge.

The modifications necessary at stations to handle the new flasks involve a total commitment to the new equipment and once made these are virtually irreversible, since it has not proved practicable to design for the handling of both types of flask. Very careful planning will thus be needed in order to avoid a severe interruption in fuel despatches which could, if prolonged, lead to loss of output.

CONCLUSIONS

The prolonged and large-scale movement of irradiated fuel, which is essential for the security of generation from the CEGB's nuclear power stations, has been carried out successfully over 26 years and involved the movement of more than 10,000 loaded flasks.

The engineering, operational and management problems have been successfully dealt with. In recent years public relations has required careful attention and considerable amounts of management and other staff effort.

Sensitivity to all the technical, political and public relations issues has been necessary in the overall management and continuing efforts to maintain high standards have been applied.

REFERENCES

Blythe, R.A., and Wood, I.A. Mk A2 AGR Irradiated Fuel Transport Flask, A New Flask Design (1989).