RESEARCH REACTOR FUEL TRANSPORT IN THE U.K.

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Introduction

This paper describes the containers currently used for transport of fresh or spent fuel elements for Research and Materials Test Reactors in the U.K. , their status, operating procedures and some of the practical difficulties.

In the U.K. , MTR fuel cycle work is almost entirely the responsibility of the U.K. Atomic Energy Authority.

Fresh Fuel Container

The type 1612 container (Figs. 1 & 2) is a rectangular box intended to hold eight MTR fuel elements. It is made of sheet steel about 2m thick, and lined with cork about 51mm thick, the fuel elements being supported in blocks of synthetically bonded fibre. It weighs 160 Kg.

A shorter version, Type No. 3104, will be available shortly, and will be more economical to handle or transport for elements up to 1070mm in length.

Spent Fuel Shielded Container

The 'Unifetch' containers (Figs 3, 4, 5, 6) were designed some fifteen years ago to a very severe specification, for road or rail transport - in the latter case the original design requirement being to survive a 40 miles per hour impact against a granite tunnel or bridge abutment. We treated the rail wagon, holding frame and flask as a unit, which is not, even now, general practice.

The flask consists of a solid steel forging providing over 12 inches of shielding, with welded-on fins to increase heat dissipation and provide some energy absorption in the event of impact. It is intended for underwater loading, the lid being removed and replaced underwater.

There are two versions, the type 1112 for short or cropped elements, the type 1113 for longer elements. Various baskets are available, accepting between 24 and 40 elements.

Status

All of these containers were approved under the 1967 IAEA regulations as Type B designs. In the UK we have had to prepare and submit a case for re-approval shewing compliance with the 1973 regulations. These new approvals have not yet been received, so we are operating under Temporary Certificates of Approval (T.S.A.).

The type 1612 being a relatively small and inexpensive box we have retested by both drop testing, flat, corner drop and punch test, then the oil fire testing - all on the one box. This was successful, the elements surviving intact, although the bottom layer were somewhat distorted by the drop test.

Criticality cases are calculated for an infinite array, and cover several likely loadings.

We believe the new permanent UK certificate will be issued without further work. It is interesting that a separate German approval has been obtained for this container.

The Unifetch is too heavy and expensive to destroy in tests, so a quarter scale model was used for drop tests, while the temperatures under fire test conditions were calculated.

The case was put to D.Tp. about 2 years ago, and some additional work has been necessary to deal with comments that have been made. The more important items are a re-calculation of the fire test temperature, because it is now known that a different heat-transfer coefficient should be used to represent flame behaviour - and this in turn means that the thermoplastic seals may have to be inset more deeply. However, it is accepted that with small modifications the Unifetch will meet the full 1973 regulations and that a type B certificate can be issued in due course. Meanwhile the T.S.A. is renewed periodically.

Comment

It can be seen from the above notes that it can now take 2 to 5 years to design, test, and obtain approval for a transport container, so an operator usually has to identify an existing container and extend the range of approved use to the new requirement - not always an economical solution.

It is worth commenting on a particular feature of the UK approval requirement. Leak tightness, both before and after drop test and fire test, is taken to be the limit of testing technology. These extremely high standards seem inappropriate for large flasks, for which temperature control is difficult if not impossible. On the other hand, testing of seals, by means of a connection between trim seal rings, where the trapped volume is very small, is a quick and sensitive test which can be repeated for each journey, if necessary.

One recurring problem is contamination of painted flasks after underwater use. Ponds at reprocessing plants seem to be frequently contaminated, and the paint pigment appears to absorb caesium, which later bleeds out. Tests have shewn that the paint film itself is impermeable and our pragmatic approach is to cover the paint with a coat of unpigmented varnish, which does seem to reduce the problem.

Choice of Transport Method

Transport may be by air, road or rail for fresh fuel - possibly by sea for ferry crossings. Irradiated fuel flasks may travel by road, rail or sea.

The practical problems for the operator multiply if more than one type of transport is used, while security requirements exert a powerful influence to restrict the quantity of fresh fuel in any shipment. There are few cases in the UK where research or materials test reactors have internal access to rail sidings, while in any case any overnight stops must be in a secure establishment.

This leads to the use of air and road transport for fresh fuel. Irradiated MTR fuel flasks are shipped by road, and even in the UK this can mean a journey of 3 to 4 days. Pre-arranged overnight secure accommodation is required at 150 to 200 mile intervals.

Costs

Fuel transport is expensive, requiring a great deal of staff time to obtain approval for containers, or to design and test improved containers, while maintenance, testing and decontamination absorb operator effort. Transport vehicles have to be arranged, and acceptances obtained from the receiving establishment, overnight stop establishments, and in some cases the responsible ministry and the police. This ties up a lot of staff time.

Is there anything we can do to minimise cost ?

Of the equipment, we should reduce the number of different container designs, make the contents as large as possible, within the security limitations, and keep the equipment and handling operations simple. I believe we should have flask surfaces smooth and corrosion resistant - which probably means stainless steel - but there is a good case for an easily stripable coating for ease of decontamination.

Can we simplify administrative procedures ?

I doubt if we can influence regulations, but procedures are simpler if containers have full multilateral approval, and if fewer different designs are in use. This would also help National approving bodies to catch up with the backlog of re-approvals.

Equipment used only within sites is generally allowed to be used for 'Type B' quantities of radioactive material if approved to 'Type A' standards. The application of speed limits and immediate availability of site fire services and radiological and engineering support are accepted as compensating for the lower test standard. The type A approval for non-fissile containers can be given by nominated local staff, and it is therefore a less slow process. The standard of trailers and tie-down fitting has been given particular attention, even for short journeys between buildings.

Summary

This note has briefly reviewed the status and procedures for MTR fuel transport in the UK.

Fig. 1

MTR Type fuel transit container

Design No. 1612

Reference Drawing No. FE 10758

Issue No. 4

Date of Issue 30th September 1980

General Description
Non gas tight mild steel container with removable lid.

No. of Flasks
29.

Unladen Weight
355 lbs (Calculated)

Materials (shielding)
0.128" mild steel.

Cavity size or capacity
6'–4" x 2'–0" x 1'–3¾"
8 MTR fuel elements.

Safe Loading of Lifting Points

Approved Lifting Harness Drawing No.

Max. Loading of Harness

Lifting Harness Plant Item No.

Vehicle
Any suitable vehicle.

Approved Hold Down Equipment Drawing No.

Speed Restrictions

Normal Storage
D 1202

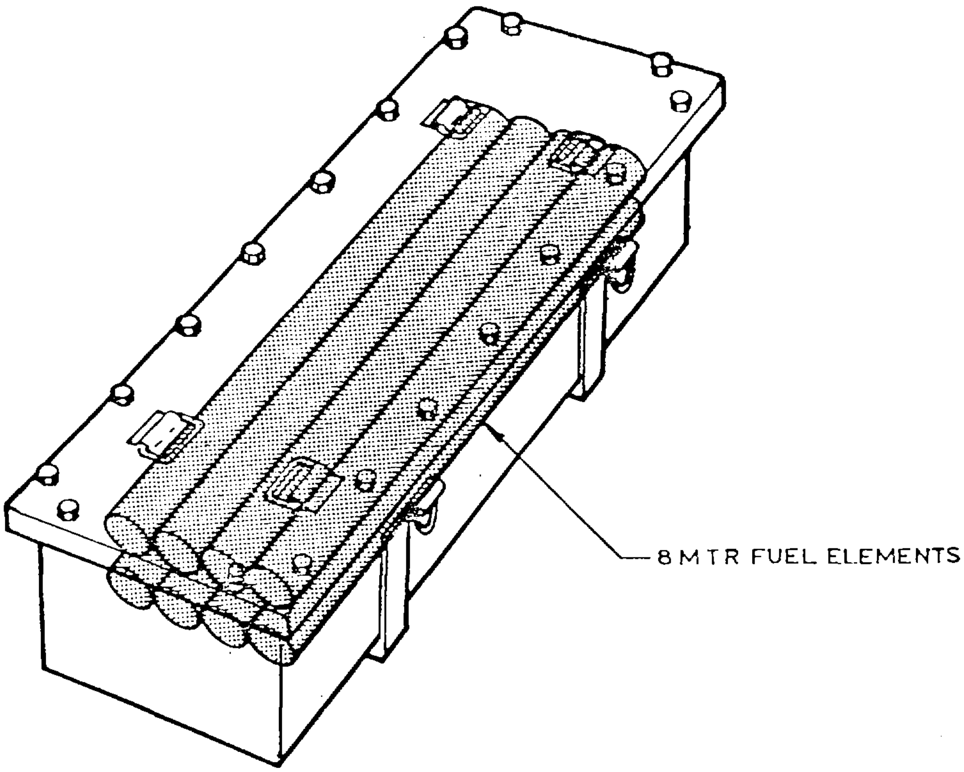
Routes
Domestic and international.

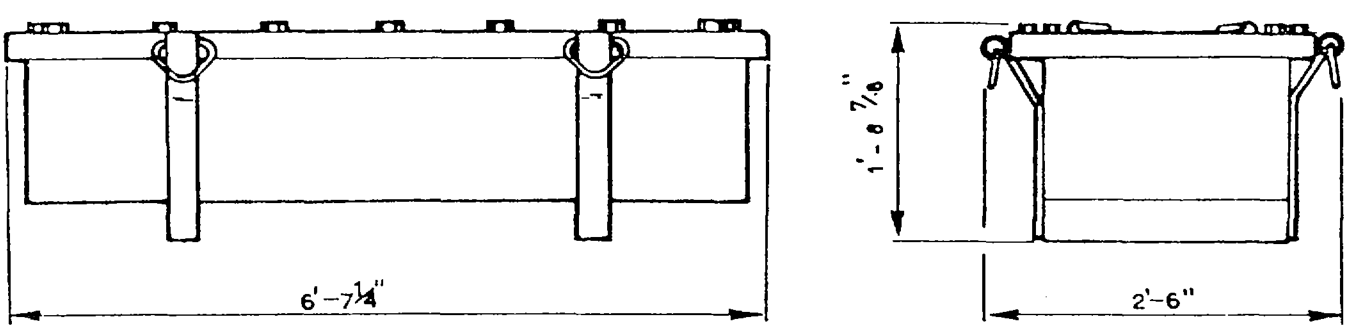
Normal Usage
Transport of M.T.R. fuel elements.

Ancillary Equipment

Fig 2

Design No. 1612





'Unifetch' Type 'H' Transport Container

Design No. 1112

Issue No. 4

Reference Drawing No. DH 1767

Date of Issue 30th September 1980

General Description

Gas tight (test pressure 150 p.s.i.g. hydraulic) vertical cylindrical finned M.S. container with removable lid. Primarily intended for the transport of irradiated M.T.R. type fuel elements, using inner container Design No. 1423.

No. of Flasks

1.

Unladen Weight

15 tons 3 cwts. 3 qtrs. (without inner basket. Design No. 1423).

Materials (shielding)

12½" mild steel.

Cavity size or capacity

2'–6" dia. x 2'–5½"

Safe Loading of Lifting Points

22.5 tons.

Approved Lifting Harness Drawing No.

EH 1767/005 (Lifting frame) and EH 1767/001 (Lifting ear).
Both lift flask complete with hold-down equipment. Total weight 18.52 tons.

Max. Loading of Harness

Lifting frame – 25 tons.
Lifting ear – 25 tons.

Lifting Harness Plant Item No.

Vehicle

Any suitable and approved vehicle also transported by rail and sea.

Approved Hold Down Equipment Drawing No.

By road – rail and sea – EH 1767/003.

Speed Restrictions

5 M.P.H. on site.

Normal Storage

Flask storage compound.

Routes

Primarily intended for the international traffic of M.T.R. type fuel elements.

Normal Usage

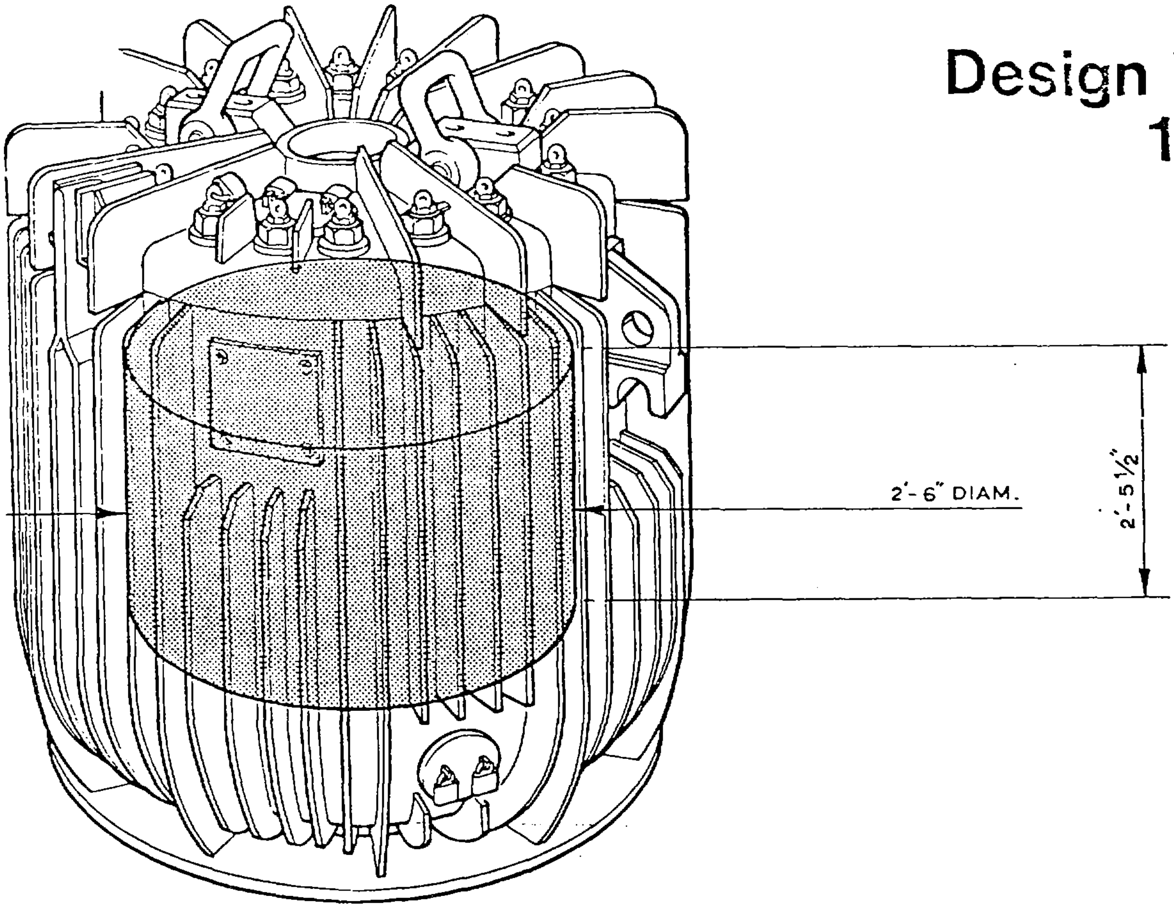
Transport of M.T.R. fuel elements from various sites in U.K. and abroad to D.N.P.D.E.

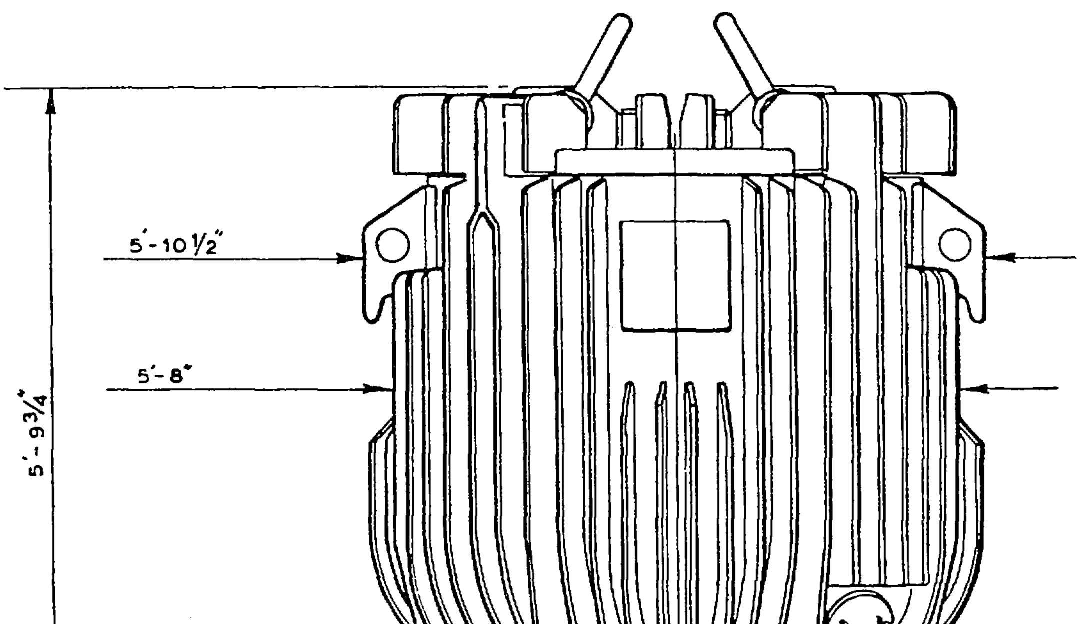
Ancillary Equipment

Inner container, design No. 1432, drawing No. EH 1767/8.

Fig 4

Design No. 1112





'Unifetch' Type 'L' Transport Container

Design No. 1113

Reference Drawing No. AE 231563

Issue No. 4

Date of Issue 30th September 1980

General Description

Gas tight (test pressure 150 p.s.i.g. hydraulic) vertical cylindrical finned M.S. container with removable lid. Primarily intended for the transport of irradiated M.T.R. type fuel elements, using inner container Design Nos. 1331, 1376, and 1753.

No. of Flasks

2.

Unladen Weight

16.8 tons (without inner basket).

Materials (shielding)

12½" mild steel.

Cavity size or capacity

2'–6" dia. x 3'–5" long (approx.).

Safe Loading of Lifting Points

22.5 tons.

Approved Lifting Harness Drawing No.

(a) AE 231580 (this harness lifts flask complete with hold-down equipment when being trans-shipped).
Total weight 21.1 tons (approx.).
(b) AE 231585 (lid removal).

Max. Loading of Harness

(a) 25 tons.
(b) 8 tons (lid removal).

Lifting Harness Plant Item No.

Vehicle

Off site - Any suitable and approved vehicle.
– also transported by rail and sea.
25 ton 'Carrimore' trailer (on site only).

Approved Hold Down Equipment Drawing No.

By road – rail and sea – EH 1767/003.
25 ton 'Carrimore' trailer (on site only) ZAE 61075.

Speed Restrictions

5 M.P.H. on site.

Normal Storage

D.E.R.E. flask storage area.

Routes

Primarily intended for the international traffic of M.T.R. type fuel elements.

Normal Usage

1. Transport of M.T.R. fuel elements between various sites in U.K. and abroad to D.N.P.D.E.
2. Transport of F.R. breeder slugs from D 1206 to Windscale.

Ancillary Equipment

Inner container, design No. 1331 – Drawing No. ZAE 60705.
Inner container, design No. 1376 – Drawing No. AE 231573.
Inner container, design No. 1753 – Drawing No. ZAE 61218.

Fig 6

Design No. 1113