QUALITY ASSURANCE REQUIREMENTS AND PROCEDURES FOR THE DISPOSAL OF JET'S OPERATIONAL RADIOACTIVE WASTES

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ABSTRACT

The Joint European Torus (JET) is the world's largest fusion experiment and aims to study plasmas in conditions and with dimensions approaching those needed in a fusion reactor. Over the life of the project, machine modifications and maintenance has produced small quantities of potentially radioactive waste. The local, national and international requirements that must be met for the disposal of the arising radioactive wastes are reviewed to identify technical and quality objectives. To demonstrate compliance with the applicable requirements. JET disposal of its low level radioactive waste according to an approved Quality Document. Specific responsibilities are defined and the activities carried out under a series of waste management procedures to satisfy the objectives are described.

INTRODUCTION

The Joint European Torus (JET) is the world's largest fusion experiment and aims to study plasmas in conditions and with dimensions approaching those needed in a fusion reactor. The JET experiment uses the tokamak magnetic field configuration to maintain isolation between the hot plasma and the walls of the surrounding toroidal shaped vacuum vessel, better known as the torus.

The first plasma pulse was obtained in June 1983. Experimental operation at JET has generally used deuterium plasmas. Over the life of the project the deuterium-deuterium reactions have been strictly rationed to limit radiation levels inside the torus due to the induced activity of the vacuum vessel walls and other components.

For machine modifications and maintenance the vacuum vessel has been opened at various times for man entry . This maintenance work has produced small quantities of potentially radioactive waste.

In November 1991 JET carried out the first experiments with deuterium-tritium mixtures. One of the aims of this First Tritium Experiment (FTE) was to establish safe procedures for handling tritium and tritium-contaminated components. Following the FTE, the vessel was opened for a major shutdown period which is expected to last 19 months. This was the first time that considerable quantities of tritium contaminated components, materials and waste had been handled at JET.

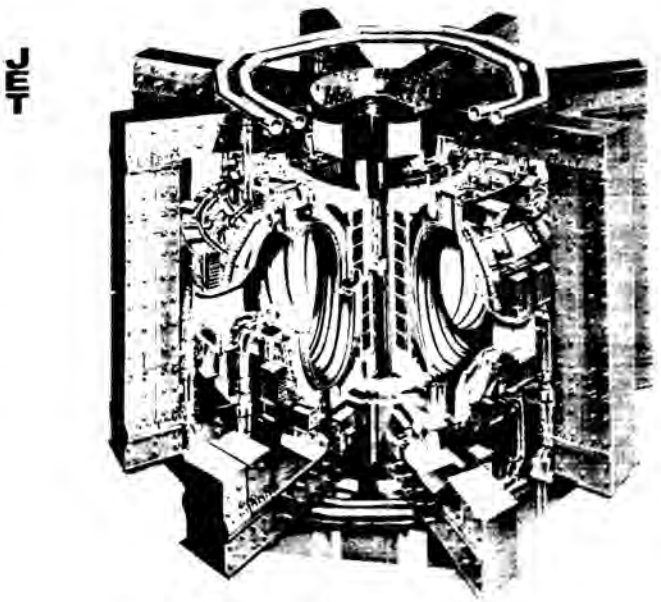

Fig. 1. Diagram of the JET apparatus.

THE REQUIREMENTS

The Radioactive Substances Act (RSA)

The primary purpose of the act is to ensure the control of radioactive wastes in the United Kingdom. It states that no person may dispose of any radioactive waste except in accordance with an authorization or unless excluded by an exemption order.

A key exemption is the Substances of Low Activity Exemption Order which excludes substantially insoluble solids with specific activity not exceeding 0.4 Bq/g.

Her Majesty's Inspectorate of Pollution (HMIP)

All disposals of radioactive waste must be authorized by HMIP, which sets limits for the different types of disposals including specific routes to be employed for solid and liquid wastes. HMIP requires that JET disposes of its solid and organic liquid wastes via the United Kingdom Atomic Energy Authority (UKAEA) and also estimates the total activity of all radionuclides in each waste consignment.

In addition HMIP authorizes JET to discharge its aqueous radioactive waste into the Culham site trade waste system, which discharges into the River Thames, at a level not exceeding 2TBq month for tritium and 20MBq month for activation products.

The National Rivers Authority (NRA)

The NRA requires that specific quality standards are met for all discharges of water that enter the River Thames. These include limits for acidity, beryllium and suspended solids.

The Control of Pollution (Special Waste) Regulations 1980

These set out the requirements for the disposal of hazardous materials, such as beryllium, which is used as first wall material inside the torus. Beryllium is a carcinogen, and any dusty waste containing more than 1% is regarded as a special

waste, requiring disposal to a licensed site with detailed packaging, labelling and consignment procedures.

British Nuclear Fuels plc (BNFL)

The only repository for solid radioactive waste in the UK is the disposal site of BNFL at Drigg in Cumbria. The conditions for acceptance (CFA) at this site, written in accordance with its own HMIP authorization, imposes strict requirements. Prime among these are:

- The average $\beta\gamma$ activity in a consignment must not exceed 12GBq/ton.
- Materials with a fire or explosion hazard, or material likely to produce free liquid when supercompacted, must be excluded.
- Consignors must have a written quality assurance system in place detailing all the activities, resources and events necessary to comply with statutory and CFA requirements.

International Atomic Energy Agency (IAEA)

The IAEA Safety Series No 6 "Regulations for the Safe Transport of Radioactive Material" 1985 Edition (as amended 1990) forms the basis of the standards to be achieved for the the packaging, testing, labelling, consignment and transport of radioactive material.

QUALITY ASSURANCE (QA) PROGRAM

JET disposes of its low level solid radioactive waste according to the JET Quality Document, ref QAJ 040 " Disposal Program for Solid Low Level Radioactive Waste (SLLRW)". The objectives of the disposal program are to enable JET to demonstrate that the applicable requirements are implemented. Specific responsibilities are defined.

Area Waste Officers (AWOs)

AWOs are in charge of waste in their areas of supervision. Work is carried out in accordance with Waste Management Group's instructions.

JET Waste Officer (JWO)

The JWO is the leader of the Waste Management Group whose duties include:

- Prepare, maintain and apply procedures to implement the disposal program.
- Describe the duties of all personnel involved in waste handling and to ensure that they receive adequate training.
- Remove waste from AWOs and consign it off-site.

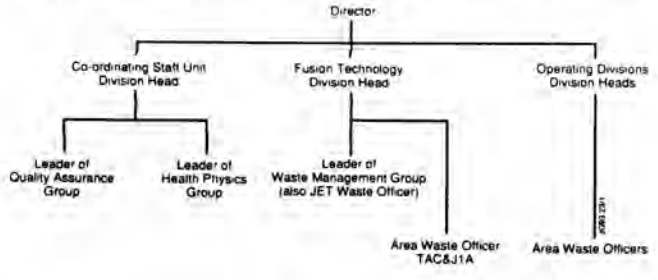

Fig. 2. Responsibilities for JET's radioactive waste management.

Leader of Health Physics (HP) Group

The Leader of Health Physics Group is responsible for providing expertise to enable the assessment of the level of radioactivity of waste and its safe handling.

Leader of Quality Assurance Group

The Leader of Quality Assurance Group, who prepared QAJ 040, is responsible for auditing the effectiveness of the disposal program.

JET WASTE MANAGEMENT PROCEDURES

A series of Waste Management Procedures have been written to cover the handling and disposal of materials where technical and quality objectives must be met to satisfy on and off-site requirements. These are written around a common format to define the control documents, the records generated and the person responsible for each item of a list of activities necessary to carry out the required procedure. The procedures for the collection and despatch of solid radioactive waste and for the disposal of aqueous waste are following:

WMP-1 The Collection and Preparation for Disposal of Potentially Radioactive Solid Wastes

The flow diagram in Fig. 3 lists the activities to be carried out by generators of waste under the supervision of the AWO.

The baglist also acts as an on site transfer document for waste handled according to Waste Management Procedures and with contact dose rates $< 2.5\mu$Sv/hr. Otherwise the Health Physics Group must provide a separate transfer document. Following the collection of waste, the role of the Waste

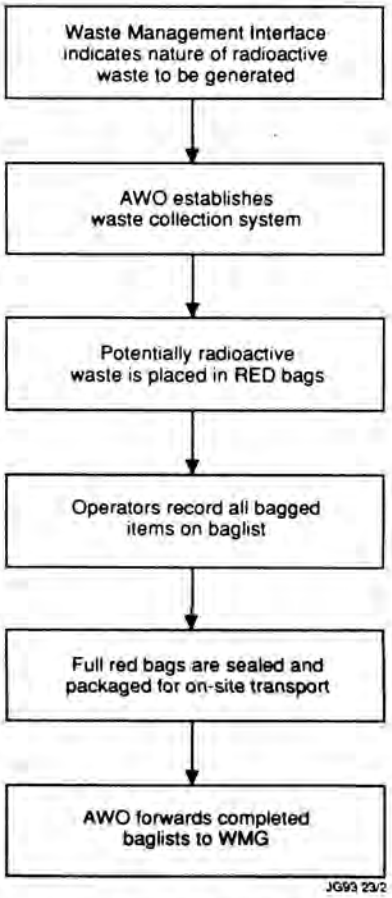

Fig. 3. The Generation of potentially radioactive waste.

Management Group is to despatch the waste along the appropriate route as economically as possible. This work is carried out in the Waste Handling Facility (WHF). The waste is consigned in as low a category as possible through assessment and segregation and despatched volumes are minimized through careful packaging and compaction.

Waste is sampled to provide an estimation of the gamma (γ) content, tritium content, other non-gamma/beta content and beryllium content. Filled pots are analyzed for γ activity using a high resolution gamma spectrometer. Tritium content is assessed by sniffing waste bags using a tritium-in-air monitor, a method which unfortunately is unable to detect < 120 Bq/g, or by combustion of small samples. Calculations are carried out using the known neutron yield history of the plasma to obtain the ratio of the activity of non-gamma activity to measured CO^{60} activity. On the basis of analysis results and the baglists, the wastes are streamed and despatched.

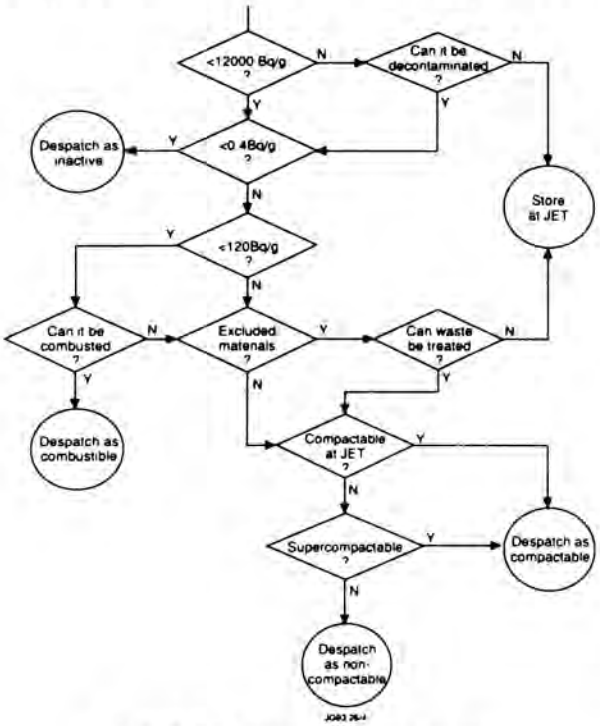

Fig. 4. The streaming of the waste.

The usual package for waste leaving the WHF is a clean sealed black steel 200 liter drum certified to IP2 standard as defined in the IAEA Safety Standards. Alternative packaging would need to be justified in writing. Each waste package is checked for identification number, certification markings, condition, gross weight, contact dose rate, labels and activity and beryllium smear results.

WMP-3 The Preparation for Despatch of Radioactive Waste Off the JET Site

This procedure sets out the arrangements that are to be followed each time a consignment of radioactive waste is despatched from the JET site. They are:

WMP-5 The Disposal of Radioactive and Beryllium Contaminated Aqueous Wastes Off the JET Site

Aqueous wastes mainly come from washing the vacuum vessel and components and the showering of personnel in

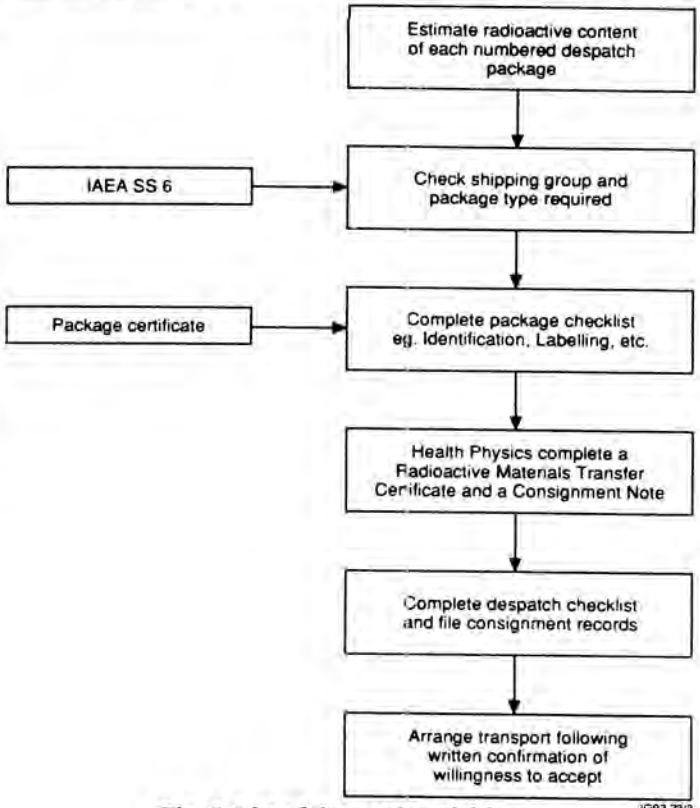

Fig. 5. List of despatch activities.

Fig. 6. JET's monitoring tanks.

pressurized suits. These go into the active drain and are collected in monitoring tanks. The flow diagram of the monitoring activities at the tank farm are shown in Fig. 7.

REVIEW AND CONCLUSION

QAJ 040 defines the review and audit arrangements. JET's QA Group audits the disposal program annually. In addition, the QA arrangements are subject to review and audit by BNFL.

BNFL audited JET SLLRW arrangements in April 1992. There were no specific complaints and a number of areas were commented on favorably, in particular waste segregation and the Waste Management Database, which is used to access management information on the radioactive waste quickly and

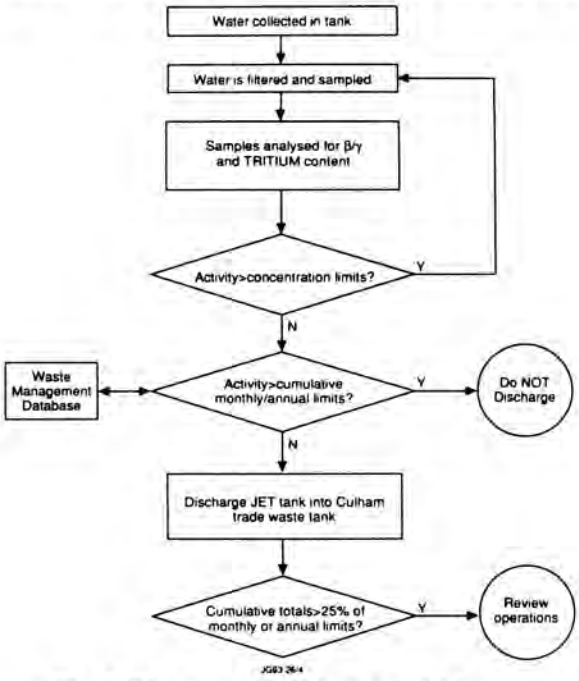

Fig. 7. Waste water discharge activities.

effectively. Following the audit, JET waste was deemed acceptable to the Drigg Disposal Site.

The first consignment of radioactive waste was despatched from the JET site in June 1992. This was an important forerunner of subsequent waste consignments that enabled the current major shutdown at JET to continue without restriction. This successful outcome proved that with the QA arrangements, the allocation of responsibilities, the written procedures, the local rules and the training of AWOs and WMG personnel, both JET and outside bodies have been satisfied that there is a rigorous but flexible means to properly dispose of JET's future radioactive wastes.