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Reply to: c/o RICC Office, C34.4
Direct Dial: 0118 985 1041
Direct Fax: 0118 985 0886
e-mail: gareth.beard@awe.co.uk
Our Ref: EA 1387R
Your Ref: EA/NRGS/SIP/5/2/4/00324/Y

AWE

Burghfield • Reading
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Tel (0118) 983 3431 Fax (0118) 983 7046

Mr. S Parr
Environment Agency
Red Kite House
Howbery Park
Wallingford
Oxon
OX10 8DB

RECEIVED 26 JUN 2008

16th June 2008

Dear Mr Parr,

Radioactive Substances Act 1993
Authorisation BZ1994
Disposal of Uranium Contaminated Oils to Nexia Solutions Limited, Operating at the Springfields Fuels Limited Nuclear Licensed Site.

AWE wish the Environment Agency to consider a variation to our authorization under the above Act. This follows a review of our requirements, of practicable disposal opportunities and changes in Government policy. The enclosed supporting document provides information to answer your letter dated July 25th 2007. I also enclose copies of agreements in to accepting bulk DU and HEU contaminated oils from AWE for processing by Nexia Solutions Ltd on the Springfields site

Should you require further information please contact me.

AWE is currently considering the Best Practicable Environmental Option for the disposal of surface contaminated metals. We recognise that the Studsvik UK Metals recycling Facility at Workington in Cumbria offers an option higher up the waste hierarchy which has not previously been available within the UK. Should the BPEO identify this to be the best option you are likely to receive a further application within the next 12 months.

Yours sincerely,

G Beard
Head of Environment

Enc:
1. Report AWE/DSDG/B/EC/AD/018, Issue: 2
2. Letters of acceptance from Springfields Fuels Limited and from Nexia Solutions Limited.

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Gerald Blackaller
Environmental Programmes Group
Bldg A106
AWE
Aldermaston
Reading
Berkshire
RG7 4PR

11 March 2008

Direct tel: +44 (0) 1772 762854
Direct fax: +44 (0) 1772 762470

Your ref:
Our ref:

Dear Gerald

RECEIPT OF AWE HEU CONTAMINATED OILS ON TO SPRINGFIELDS SITE

Further to our recent discussions concerning the potential treatment of bulk AWE DU and HEU contaminated oils at Springfields, and the previous statement from Springfields Fuels Ltd (SFL) that they agreed to DU-contaminated oil being accepted on to the Springfields site, I am pleased to confirm that I have received the following additional statement from SFL :

"I confirm that SFL agree, in principle, to accept both DU and HEU oils on to site at Nexia's risk, recognising that receipt of HEU oil is only a future possibility. As per our previous note, this is until such time as an acceptable process for dealing with non-NDA deliveries to A709 is in place. It is also on the understanding that Nexia have an alternative route for processing, which in this case will be a clause within the contract with AWE which states that the uranium will be returned to them if SFL do not wish to take ownership."

As stated previously, Nexia Solutions has options for dealing with the uranic material separated from the oils but, ultimately, should none of these options prove to be viable, the material would be returned to AWE. With this understanding, on behalf of Nexia Solutions and SFL, I confirm that AWE's bulk DU and HEU contaminated oils can be received on site at Springfields.

Yours sincerely

David Farrant

Project Manager
Nexia Solutions

Cc:
Mark Sharpe
John Turner
Robin Gomme

BNFL Commercial

Westinghouse

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e-mail:
meh7@springfieldsfuels
.com

Your ref:
Our ref:

13th May 2008

Dear Mr Blackaller,

Further to your recent discussions with Nexia Solutions concerning the potential treatment of bulk AWE DU and HEU contaminated oils, I am writing to confirm that Springfields Fuels Limited has issued the following statement to Nexia Solutions, confirming their acceptance of this material on site:

"I confirm that SFL agree, in principle, to accept both DU and HEU oils onto site at Nexia's risk, recognising that receipt of HEU oils is only a future possibility. This is until such time as an acceptable process for dealing with non-NDA deliveries to A709 is in place. It is also on the understanding that Nexia have an alternative route for processing, which in this case will be a clause within the contract with AWE which states that the uranium will be returned to them if SFL do not wish to take ownership."

Nexia Solutions have confirmed they have options for processing the uranic materials separated from the AWE oils. However, should any of these options not prove viable, the material will be returned to AWE by Nexia Solutions. With this understanding in place, I can confirm on behalf of Springfields Fuels Limited that AWE's bulk DU and HEU contaminated oils can be received on to the Springfields site. If you have any queries relating to this, please contact me.

Yours Sincerely

Michelle Heath
Commercial Manager
Springfields Fuels Limited

Ref: AWE/DSDG/B/EC/AD/018
Issue: 2
Date: May 2008
Authors: D F Ashcroft & G T Taylor
Directorate: Assurance

Supporting Information for Application for a Variation to RSA93 Authorisation BZ1994 Applying to AWE Aldermaston

1. Summary

This document clarifies and supports AWE's application for a single variation to the existing Radioactive Substances Act 93 Certificate of Authorisation BZ1994[1] applying to AWE Aldermaston. This variation will enable AWE to dispose of oils contaminated by uranium with varying degrees of enrichment at the Springfields Fuels Limited nuclear licensed site. Within the Springfields site, Nexia Solutions Limited operates a process to recover uranium from waste oils generated during the manufacture of uranium components. The process involves 'contacting' the uranium contaminated oil with sulphuric acid to extract the uranium compound. This treatment option provides the Best Practicable Environmental Option (BPEO) for disposal[2], as implementation of this technique has the potential to reclaim the uranium whilst reducing the uranium content of the oil to below controlled exempt release levels. This disposal route may also be used for the small quantities of uranium contaminated aqueous arisings which are generated from the analytical work undertaken on the Aldermaston site. Considerations made in this document relate to:

- Introduction, history and disposal routes into the waste streams;
- Waste characterisation analysis;
- Waste stream descriptions;
- Disposal options;
- Best Practicable Means;
- Application synopsis;
- Management arrangements;
- AWE's proposals in relation to nation policy for radioactive waste disposal;
- Justification;
- Proposed limits for transfers for the recovery of uranium;
- The predicted radiological impacts attributable to the proposed disposals: and
- Conclusions.

2. Introduction

AWE currently possesses uranium contaminated oils that originate from the manufacture of components containing Depleted Uranium (DU) and Enriched Uranium (EU). Examples of such processes are machining and casting of component parts. Manufacturing of DU and EU is undertaken in separate facilities and the resultant DU and EU contaminated oils are segregated. Both the DU and EU facilities are scheduled for a re-kit in the near future, with both existing facilities being replaced at later dates. The processes in the existing DU and EU facilities are practically identical, and the same principles of operation will be adopted for the new DU and EU facilities. Typical operations involve the use of machine tool cutting fluids, lubricating oils and vacuum pump oils.

The legacy of waste DU contaminated oils is held in AWE approved containers which are currently stored in the DU facility. The containers' integrity is stringently controlled through routine inspection as part of the DU facility's local management procedures.

The legacy of waste EU contaminated oils is currently stored in the present EU facility or in the Waste Management area. As with the DU contaminated waste oils, the containers' integrity is also subject to strict routine inspection as part of the EU local management procedures. Although some of the EU oily wastes are contained within old containers, there is a current campaign to decant all EU oily wastes into new AWE approved containers.

AWE also generates small quantities of DU and EU contaminated aqueous, acidic waste, from the chemical analysis of uranium material, conducted within analytical laboratories on the Aldermaston site.

3. Waste Characterisation Analysis

The uranium contaminated oils will be radiologically assayed e.g. by high resolution gamma spectrometry using a Spectral Non-destructive Assay Platform[3] (SNAP), based on a germanium detector. SNAP consists of a trolley mounted platform that houses a collimated High Resolution Gamma Spectrometer. This device can be used to acquire the gamma spectrum of an item in-situ and produce associated isotopic activities. The essential parameters for the assay are knowledge of the counting geometry, the item dimensions, the containment wall thickness, and the composition and the density profile of the contents. Uranium activities are derived from the gamma emissions of uranium and the associated daughter products in temporal equilibrium with the uranium.

Chemical constituents of the uranium contaminated liquids may be analysed as required by Nexia Solutions Limited's acceptance criteria, e.g. by Inductively Coupled Plasma Optical Emission Spectroscopy (ICPOES) and Thermal Ionisation Mass Spectrometry (TIMS).

4. Waste Stream Descriptions

AWE's proposal is predominantly concerned with the disposal of uranium contaminated oily waste via an innovative acid extraction technology utilised by Nexia Solutions Limited. The waste includes both operational arisings and legacies which have been stored pending the availability of a suitable disposal route. The wastes are as follows:

The legacy of waste DU contaminated oils is held in AWE approved containers which are currently stored in the DU facility. There are three different types of waste DU contaminated oils:

1. Spent vacuum pump oils which are derived predominantly from vacuum systems on uranium casting furnaces and machine tools;

2. Spent cutting fluids from machine operations, which have been dewatered by ultra-filtration (UF) to generate an emulsion. The emulsion typically contains cutting oil and water at a nominal 50:50 ratio. This waste is known as UF Retentate; and
3. Cutting fluids containing trichloroethene/trichloroethane (TCE), which were generated in the past when machine tools, such as band saws, were cleaned with trichloroethene/trichloroethane (TCE) that subsequently entered the DU contaminated cutting fluid in the machine tool. Although TCE is no longer used on the AWE Aldermaston site, legacy waste still exists. TCE was replaced in 1994 by more environmentally friendly biodegradable degreasing fluids such as De-solv-it.

The majority of the waste EU contaminated oils are currently stored in the existing EU facility, with some being stored in the Waste Management area. The different types of EU contaminated waste oils are:

1. Spent cutting fluid.
2. EU contaminated tramp oil, which collects on the surface of spent cutting fluid. This waste stream comprises of both lubrication oil from the machine tool and oil which may have separated from the cutting fluid emulsion.
3. After the removal of both the EU contaminated tramp oil and uranium sludges, the spent cutting fluids may be dewatered by ultra-filtration (UF) to produce an emulsion which is nominally a 50:50 oil/water emulsion. This waste stream is known as UF Retentate;
4. EU sludges in oil. This is comprises material that has collected at the bottom of the spent cutting fluid and material from cleaning swarf.

The EU waste streams nos. 1-3 above can be considered to be relatively high volume, low activity wastes, whereas waste stream no. 4 is a relatively low volume, high activity waste.

Further details of each waste stream are given in Table 1.

It is envisaged that the programme of acid washing will start with the legacy of DU contaminated oils. It is anticipated that processing these oils will take approximately six months from the receipt, by Nexia Solutions Limited, of the first batch. The legacy of DU contaminated oils amounts to approximately 5000 kg. It is foreseen that future arisings will amount to approximately 2000 kg per annum. Further waste minimisation should reduce this quantity particularly when the new DU facility is commissioned post 2016.

The legacy of EU contaminated oils equates to approximately 9000 kg. It is hoped to treat the bulk of this material, excluding the sludge, within one year. Future arisings will amount to approximately 600 kg per annum. This amount will not be affected by the re-kit of the facility. However, the new EU facility is being designed to significantly reduce this quantity but it will not be available until after 2016.

Table 1: Oily Wastes for Acid Washing

Waste Category	Waste Form	Radio-active Contaminant	Legacy *			Operational * (per annum)		
			Amount of Oily Waste (kg)	Radio-activity (GBq)	Nominal [Uranium] (g/kg)	Amount of Oily Waste (kg)	Radio-activity (GBq) **	Nominal [Uranium] (g/kg)
Organic Liquid	Vacuum pump oil	Alpha (DU)	1300	0.85	14			
	UF Retentate	Alpha (DU)	2700	0.35	2.8			
	Cutting fluid with 'TCE'***	Alpha (DU)	1000	1.8	39			
	TOTAL	Alpha (DU)	5000	3.0	13	2000	1.2	13
Organic Liquid	Tramp oil	Alpha (EU)	500	2.5	0.12			
	UF Retentate	Alpha (EU)	1000	1.5	0.04			
	Spent cutting fluids	Alpha (EU)	7000	10.0	0.035			
	Sludges in oil	Alpha (EU)	500	22.0	1.1			
	TOTAL	Alpha (EU)	9000	36.0	0.1	600	2.4	0.1

* Legacy is waste which resulted from previous operations and which is stored pending availability of a suitable, authorised means of disposal. "Operational' is waste that will be created as a result of ongoing and future operations.

** Radioactivity of future operational wastes calculated from legacy values.

*** 'TCE' refers to trichloroethene or trichloroethane.

In addition to the uranium contaminated oils, AWE generates small quantities of waste DU and EU contaminated acidic, aqueous solutions. The uranium contaminated aqueous waste is generated in analytical chemical laboratories on the Aldermaston site, from the chemical analysis of uranium material. Typically, the solutions contain phosphoric acid, nitric acid, sulphamic and sulphuric acids. There is no legacy material suitable for acid washing as the waste is currently cemented up in-situ.

Further details of each aqueous waste stream are given in Table 2.

Table 2: Aqueous Acid Washing Wastes

Waste Category	Waste Form	Radioactive Contaminant	100% Operational (per annum)	
			Amount of Acidic Waste (kg)	Radioactivity (GBq)
Aqueous Liquid	Mixed acids	DU	100	0.01
	Mixed acids	EU	50	0.08

All operational arisings denoted in Tables 1 and 2 account for the DU and EU facilities operating for the next eight years. Based on this assumption then the total arisings generated between 2008 and 2016, for both DU and EU wastes are estimated to be 36,000 kg.

One of the batches of the legacy of DU-contaminated oils (a sample of the cutting fluids with TCE shown in Table 1) was found to contain 360 mg/kg of cadmium[4], even though the machining of materials containing cadmium has not been part of normal operations. Current wastes do not contain cadmium at these levels. The chemical properties of cadmium indicate that it will be extracted from the waste oil along with the uranium. Processing of the uranium acid extract will minimise the potential discharge of cadmium, because cadmium will be removed from the aqueous stream and processed along with the uranium. Only residual levels of cadmium may be discharged with the aqueous waste, and will be well within the Springfields Fuels Limited's site aqueous discharge limits (as specified in PPC Permit NP3734SZ). Thus, Nexia Solutions considered that the cadmium content of the waste oils will not present a problem[5].

5. Disposal Options

Throughout the UK nuclear industry, the disposal of radioactively contaminated oils and liquids has been challenging. An early BPEO study for uranium contaminated oily waste disposal[6] recognised that differing levels of contamination between batches may make it necessary to utilise more than one means of disposal. This BPEO study identified incineration as the favoured method of disposal for oily wastes with very low levels of contamination. However it is unsuitable for waste with higher levels of contamination such as those identified in this variation request.

Various immobilisation[7, 8] processes to treat higher activity uranium contaminated oils have been researched, with many failing to meet discharge criteria such as leaching. However, research into this disposal route has also become unproductive, because British Nuclear Group's latest version of the 'Conditions for Acceptance'[9] (July 2007) at the Low Level Waste Respiratory near Drigg has ceased acceptance of all immobilised forms of oil.

A technical assessment by AWE in 2005 identified three processes for treating the more highly contaminated oil as deserving further investigation[8]. These were:

1. Decontamination of waste oils by microwave pyrolysis;
2. Destruction of the waste oils by electrochemical oxidation; and
3. Decontamination of waste oils by acid extraction of uranium.

The three processes are outlined below;

1. Microwave Pyrolysis: The Aldermaston Technical Innovation Fund sponsored a research project at Cambridge University to develop a technique for the pyrolysis of organic material. This process involves mixing the uranium contaminated organic material with carbon which is then heated using microwaves. The organic material pyrolyses and distils out of the heating vessel, with any uranium remaining within the bed of carbon. This project was initiated, with the aim of collecting the pyrolysis products for incineration at Fawley. Although tests with non-radioactive simulants of waste oils achieved a decontamination that would be suitable for the disposal of uranium-contaminated oil, technical difficulties were encountered during the development work. It was concluded that resolving these difficulties for nuclear application would require substantial further development.

2. Diamond-Coated Electrodes: The process involving diamond-coated electrodes is an innovative electrochemical oxidation technology. The diamond on the electrodes is made conductive by doping with boron. This process has the potential to oxidise the oil to carbon dioxide, which in turn could facilitate the recovery of the radioactive material. However, so far the research has failed to demonstrate the required degree of oil oxidation and a process that would meet AWE's current disposal requirements has yet to be developed.

3. Decontamination via Acid Washing: Acid washing has specifically been developed at Nexia Solutions Limited, Springfields to decontaminate uranium contaminated waste oils which originate from the manufacture of nuclear material. Indeed, this option is the most promising one evaluated by AWE thus far. The extracted uranium is precipitated out, in the form of diuranate salts, by neutralising the acidic solution with alkali. The precipitated uranium is removed, washed, re-dissolved in acid and transferred to Springfields Fuels Limited for onward processing. The aqueous solutions are conditioned for discharge as effluent. Laboratory trials performed, by Nexia Solutions Limited, on AWE's contaminated oils have proven

very successful, decontaminating the oil to RSA93 exempt levels[4, 5]. Therefore AWE proposes to use this process to treat its contaminated oily wastes.

The most recent BPEO study[2] considered 14 possible options for the disposal of uranium-contaminated oils. However only 3 options were considered to be sufficiently practicable for full evaluation.

The 3 possible options were:

(a) Filtration to decontaminate the oil to a point at which it can be incinerated at Fawley;
(b) Electrochemical oxidation, based on the Silver II process but also encompassing alternative oxidation techniques;
(c) Acid Washing.

Filtration has been attempted in the past as a pre-treatment process to incineration but with only limited success. This was because of the viscose nature of the oil and the high levels of impurities. So AWE continue to believe that the acid washing process is the most effective method and the BPEO for the decontamination of uranium contaminated oils as the uranium is recovered. Aqueous wastes arising from the analysis of uranium at AWE can be treated in a similar fashion to the spent sulphuric acid from oil washings.

The waste oils will be sent to Nexia Solutions for treatment and then disposal. In the unlikely event that a consignment or part of a consignment of oily waste is found, following transfer, not to be in accordance with the limitations and conditions of this Authorisation, it will be packaged in accordance with the appropriate transport regulations, and returned as soon as is reasonably practicable to the Aldermaston Site. Should it transpire that the acid washing fails to reduce the uranium content of the oils to the RSA93 exemption level, the oils would be returned to AWE, as above.

6. Best Practicable Means

It is a fundamental condition of Authorisation BZ1994 that 'Best Practicable Means' (BPM) is applied to both minimise the creation of radioactive waste and minimise the discharge of such waste into the environment. AWE takes this requirement very seriously and is committed to continuous improvement in this area. Measures in support include (as examples):

- consideration of waste minimisation and discharge abatement at the design stage;
- inclusion of effluent treatment to abate the amounts of radioactivity discharged to the environment;
- process control (including maintenance) to minimise unnecessary creation of waste;
- consideration of waste and discharge issues as part of Change Control (the managerial process employed to ensure that all implications of new plant or method are fully thought through before implementation);
- careful monitoring of discharges to confirm process control, and to guide improvements, as well as to demonstrate regulatory compliance;
- planning and control of decommissioning projects, often with investment in significant additional discharge abatement equipment before decommissioning operations begin;

- application of new technologies and techniques where these are perceived to offer net advantages.

BPM assessments have been applied to the current operations that generate DU[11] and EU[11] contaminated oils and a few waste reduction measures were outlined. These include possible options for prolonging coolant life in the DU plant and planning for the development in the new EU facility[13, 14], whilst current manufacturing operations are covered by waste minimisation plans.

7. Application Synopsis

Following the submission of an application by AWE plc, the Environment Agency granted a renewed authorisation for discharge and disposal of radioactive wastes from AWE Aldermaston in March 2007. This Radioactive Substances Act Authorisation (reference BZ1994) has now been in effect for just under a year.

The limits and conditions imposed by the authorisation allow the Environment Agency to employ an acceptable level of diligence in regulatory control without unnecessarily restraining AWE as site operator from exercising responsible business control of operations. Most of the limits granted in March 2007, including all of the environmental discharge limits, will continue to be appropriate for the next few years.

The approval of this variation would enable AWE to reduce the legacy of uranium contaminated oily waste and avoid the storage of such waste in the future. Furthermore, the process will enable both the uranium and oil to be recycled which is strongly preferred as the Best Practicable Environmental Option (BPEO)[2].

The accompanying application is therefore concerned with a minor variation considered necessary to enable AWE plc to fulfil its present as well as future obligation to manage all wastes responsibly and in accordance with best practice. The variation is concerned only with limits applying to disposal routes to specialist sites that are already appropriately authorised themselves. None of the proposals have any implication at all for environmental discharges from AWE Aldermaston as liquid or airborne wastes, or for the limits allowed for these discharges.

8. Management Arrangements

The drums of waste are produced and stored in compliance to AWE management arrangements. Any accumulation of radioactive waste on the nuclear licensed site is regulated by the Nuclear Installations Inspectorate (NII).

Consignments of uranium liquid waste to the nuclear licensed site operated by Springfields Fuels Limited at Salwick, near Preston, will be undertaken by AWE's Radioactive Special Materials (RAM) Transport Group in full conformity with AWE's transport procedures. AWE's transport procedures ensure that AWE meets all criteria required under the United Kingdom's Radioactive Material Transport Regulations 2002, Carriage of Dangerous Goods and Use of Portable Pressure Equipment Regulations 2004, Hazardous Waste Regulations 2005, and the transport guidance issued by the International Atomic Energy Authority (IAEA). Key factors to comply with these pieces of legislation are:

- AWE to characterise the waste according to Nexia Solutions Limited's conditions of acceptance;

- Packaging and consignment to be undertaken in compliance with criticality requirements;
- Appropriate packaging of the waste in compliance with AWE's Radioactive and Special Materials Transport Approval Panel (RAMTAP);
- Appropriate security measures to be in place (includes the correct levels of security at both consignor and consignee sites, and during transportation);
- Approval and management of the transfer from AWE's Radioactive Moves section;
- Clearance from AWE's Health Physics section;
- AWE's Nuclear Materials Management accountancy database to be appropriately amended;
- Delivery of the waste package(s) to be in compliance with AWE's transport safety case;
- Formal approval of the consignee of any pending consignments; and
- Consignment transport paperwork to be in place for any pending moves.

9. AWE's Proposals in the Context of National Policy for Radioactive Waste Disposals

9.1 The Government Command Paper: "Review of Radioactive Waste Management Policy: Final Conclusions" (Cm 2919):

Although other sections of this policy document have been amended or replaced by the Government's 'Policy for the Long Term Management of Solid Low Level Radioactive Waste in the United Kingdom', Paragraph 10 sets out and endorses the International Atomic Energy Agency's principles of radioactive waste management. These include:

(4) radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today; and

(5) radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.

The AWE proposal is in accordance with both of these principles. The radiological impacts are discussed in Section 13 of this document, while the accomplishment of safe and timely disposal will remove a small but unwarranted burden of management from any future generation. This latter point also affords compliance with the requirement for sustainable development (paragraph 17), defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Timely disposal of waste implies an absence of undue delay if a suitable, safe and authorised means of disposal is available. For the waste stream described in this document, suitable and safe means of disposal are indeed available, and the purpose of the AWE application is to achieve the necessary regulatory authorisation for transfers from AWE Aldermaston so that disposals may be accomplished on "an appropriate timescale". Furthermore accomplishment of the disposals will: "*... minimise dependence on active safety systems, maintenance, monitoring and human intervention*", a factor mentioned in paragraph 113 (f) when discussing interim storage of intermediate and low-level waste.

The same messages appear in paragraph 52, a discussion of the Government's policy aims, which includes the following:

(1) The Government will maintain and continue to develop a policy and regulatory framework which will ensure that:

(a) radioactive wastes are not unnecessarily created;

(b) such wastes as are created are safely and appropriately managed and treated;

(c) they are then safely disposed of at appropriate times and in appropriate ways;

(d) so as to safeguard the interests of existing and future generations and the wider environment, and in a manner that commands public confidence and takes due account of costs;

(2) the regulators ... have the duty to ensure that the framework described above is properly implemented ...

(3) within that framework, the producers and owners of radioactive waste are responsible for developing their own waste management strategies,... They should ensure that:

(a) .... (b) .... they characterise and segregate waste on the basis of physical and chemical properties and store it in accordance with the principles of passive safety (i.e. the waste is immobilised and the need for maintenance, monitoring or other human intervention is minimised) in order to facilitate safe management and disposal;

(c) they undertake strategic planning, including the development of programmes for the disposal of waste accumulated at nuclear sites within an appropriate timescale and for the decommissioning of redundant plant and facilities. ...

In summary, the thrust of Cm 2919 is toward making radioactive waste disposals safely and as appropriate, with discouragement for unnecessary accumulation with its implied dependence on maintenance, monitoring and human intervention. The needs of future generations must not be compromised, nor should our generation leave legacies for which there are already solutions available.

9.2 Draft Statutory Guidance on the Regulation of Radioactive Discharges into the Environment for Nuclear Licensed Sites:

More recently the Government has consulted on draft Statutory Guidance together with an accompanying Explanatory Document. As the title of the consultation document suggests, that Guidance is concerned with discharges into the environment, rather than with transfers of wastes for disposal elsewhere. However, since the transfers proposed by AWE will result in discharges (in the short term from Nexia Solutions at Springfields), a number of points raised by the draft Guidance is addressed here.

When issued, the Guidance will supersede parts of Cm 2919 (paragraphs 63-73), but note that none of the paragraphs quoted above will be affected. Indeed, the principles underpinning Cm 2919 are reiterated but with some extension. Two principles in particular are prominent: Best Practicable Environmental Option (BPEO), and Concentrate & Contain vs. Dilute & Disperse (paragraphs 14 and 15):

Best Practicable Environmental Option (BPEO):

Radioactive discharges may arise in different physical forms, but need not necessarily be discharged in the form in which they arise. The Agency, before granting discharge authorisations, needs to be clear that alternatives, where they exist, are properly evaluated and the choice is made that will have a low environmental impact, i.e. that the Best Practicable Environmental Option is chosen.

Each of the proposals included within the AWE application is the outcome of careful deliberation of possible alternatives, some of them representing the conclusion of a formal BPEO or BPM study. AWE is satisfied that each proposal complies fully with the BPEO principle leading to negligible or (at most) minimal environmental impact. Potential radiological impacts are discussed later.

'Concentrate and Contain' vs. 'Dilute and Disperse'

The alternative to discharging gaseous or liquid radioactivity into the environment, the so-called "dilute and disperse" approach, is to trap it before it can escape from the plant, and then to concentrate and immobilise it, before storing the solid wastes which would be created in containers, either indefinitely, or until they can be disposed of safely in future. This is the so-called "concentrate and contain" approach. Each case will need to be evaluated on its merits, but where possible "concentrate and contain" should be the preferred option.

The 'Waste Stream Descriptions' section earlier in this document provides information about the waste. In those instances where waste creation is necessarily ongoing, as little as possible of the raw material (e.g. oil) is used consistent with achieving the required result (e.g. effective vacuum pump operation which is an important safety-related activity). It is not possible to remove all traces of alpha contamination that might be present. However, "Concentration" is the favoured option for this proposal as the conditioned uranium is recovered from waste and made available once again for process use. Likewise the processed oil may be recycled. Effective containment, i.e. long term storage, could in theory be achieved for the alpha contaminated wastes, but since uranium as the principal alpha-emitter has a half-life of 4.51E+09 years, storage would merely delegate to a future generation the responsibility for dealing with a problem for which we have a safe and effective solution now. This would not be acceptable.

In summary, containment of these wastes is either undesirable in principle or impractical, thus concentration is the best method of treatment. Best practice for management of these wastes therefore requires action resulting in safe and effective disposal in the form of recovery; hence these proposals from AWE.

Paragraph 9 of the Explanatory Document attached to the draft Guidance is as follows:

In recent years there has been greater awareness of the need to cherish the natural environment, and avoid contamination of it, even at levels where the risks posed are small and considered negligible compared to the risks encountered in daily life. This is true for all activities, but is *particularly relevant in the context of radioactive substances; whilst some may be short-lived and present no continuing radiological risk, others may take millions of years to decay. The presumption, therefore, is to avoid adding radioactive materials to the environment where this reasonably can be avoided.*

This point needs to be addressed for the proposed method of waste disposal:

For small amounts of uranium activity in oil then it is feasible to use incineration as the most tangible disposal method as there will be no detectable change in the radiological background in the vicinity of the incinerator. However, when incinerating larger quantities of uranium activity in oils then this shall have a more detrimental effect on the environment due to the long half-life of uranium. In order to alleviate the burden of the long half-life and the detriment that this possesses on the environment, then recovery and re-use of the uranium is the only viable option. As previously emphasised, the acid washing treatment option provides the Best Practicable Means for disposal, as implementation of this technique reclaims the uranium and reduces the uranium content in the oil to below controlled exempt release levels.

9.3 UK Strategy for Radioactive Discharges 2001-2020:

AWE is aware that DEFRA currently has this document under review and the next issue will look forward as far as 2030. The main amendment to the strategy is the inclusion of airborne waste into the new draft. However, AWE believes the changes introduced will not impede this application for the next eight years. AWE's expectation is that the authorisation will not remain unrevised for the next eight years but reviewed every year by both AWE and Environment Agency (EA). This may result in the EA changing the authorisation pending their periodic review.

The Strategy was written as a consequence of the UK Government's commitment to the Oslo-Paris (OSPAR) Convention. The Statutory Guidance discussed above points out that it should be read in conjunction with the Strategy. Although, like the draft Statutory Guidance, the Strategy is about environmental discharges rather than site disposals, it nevertheless contains a few additional points that should be addressed in relation to AWE's proposal.

The Strategy calls for innovative and extensive reductions in radioactive discharges from the UK as a whole, but also acknowledges (section 9.1) that: "*The historic legacy of radioactive wastes and of contaminated plant and equipment must now be dealt with, in the interests of sustainable development, to reduce on-site risks and to avoid leaving a burden to future generations*". Expanding on this, the Explanatory Document attached to the draft Statutory Guidance comments (paragraph 41 in the Explanatory Document): "*The principle of "progressive reduction" is a central tenet of the way in which radioactive discharges should be controlled. It takes primacy over other considerations, apart from safety, and non-conformity to it will only be considered in exceptional circumstances. Circumstances under which exceptions might be envisaged would be in order to deal with the legacy of stored historical waste, or the wastes arising from decommissioning of now defunct plant. In these cases it would be advantageous to deal with, and make safe, these sources of radioactivity in a controlled manner, even if, for a limited period, there was to be some increase in discharges of some radionuclides.*"

As set out in the AWE application, much of the waste descends from historic legacies for which a suitable means of disposal has now been identified. For these specific waste streams AWE's variation proposal provides an alternative means of disposal (by acid washing) which offers greater overall advantage of recovery and reprocessing. It should also be noted that the environmental discharges associated with these proposals, although not from the AWE Aldermaston site, are minuscule in relation to AWE's overall discharges, and make no impact to the reducing profile of UK discharges as a whole. They will certainly have no discernible effect on the concentrations of radionuclides in the marine environment.

The Strategy, largely about liquid discharges, points out in section 5.1.5 that: "In particular, there have been large and sustained reductions in discharges of the most radiologically significant nuclides from the reprocessing sector……mainly due to new treatment plant technologies. This embraces the new advanced technology in reducing aqueous discharges.

Finally, both the Strategy and the draft Statutory Guidance indicate the need to take into account the sustainability of eco-systems without assuming that protection of humans will be adequate. However, the quantities of radioactivity concerned in this variation for disposal by AWE, taking account of the routes requested, are so far below those that could potentially cause adverse human effects that they are certainly also too small to cause adverse effects to eco-systems in the vicinity of the Springfield Fuels Limited site.

9.4 Outcome of Policy Considerations:

AWE's proposals are for safe, efficient, timely and appropriate disposals of radioactive wastes. The disposals are compatible with sustainable development and with the need to avoid leaving unnecessary legacies for future generations. "Concentrate and Contain" is a viable process commissioned by Nexia Solutions Limited at the Springfields Fuels Limited site and the 'acid washing' disposals comply with the BPEO principle. The discharges (taking place from other sites, rather than from AWE Aldermaston) will make negligibly little impact on the UK requirement to progressively reduce discharges and will have no discernible effect on eco-systems close to the discharge points.

10 Justification

In order to facilitate AWE's duties in the production of nuclear atomic weapons, then its continuation is governed by political judgement. AWE is not at liberty to justify the production and continued maintenance of a nuclear deterrent for the United Kingdom. However, the following quotes are from the Government's Strategic Defence Review (Cm 399 of July 1998):

Paragraph 60: "… our minimum deterrent remains a necessary element of our security."

Paragraph 62: "… Trident is our only nuclear weapon. We need to ensure that it can remain an effective deterrent for up to 30 years."

Paragraph 70: "… Our own arsenal … is the minimum necessary to provide for our security for the foreseeable future …"

Paragraph 73: "The effectiveness of arms control agreements depends heavily on verification. The United Kingdom has developed particular expertise in the monitoring of fissile materials and nuclear tests. We plan to add to this by developing capabilities which could be used to verify reductions in nuclear weapons, drawing on the expertise of the Atomic Weapons Establishment at Aldermaston."

These extracts from the Strategic Defence Review prompts the requirement for the existence of AWE and associated operations carried out at its sites, including AWE Aldermaston. The proposals contained in this application are a necessary consequence of carrying out this mission efficiently, safely, and with minimal environmental impact.

11 Proposed Limits for Transfer of Waste Materials to Springfields Fuels Limited for Treatment.

Table 4 depicts the proposed limits for consignment of uranium contaminated liquids to Nexia Solutions Ltd – Springfields based on the data in Tables 1 and 2.

Table 4 Proposed Limits

Waste Type	Activity Type	Proposed Annual Limits		Comments
		Amount (kg)	Radioactivity (GBq)	
Organic / inorganic liquid (oil, solvents, acids, water) for Acid Washing	Uranium	10,000	15	Consignments shall comply with reference 15

GBq = gigabecquerel

12 Predicted Radiological Impacts

The processing of the contaminated oils will only occur in wet systems. Some steps in the subsequent treatment of the extracted uranium to nuclear fuel may require precipitation of the uranium, but the solid material will not be completely dried (although excess water may be removed). The wet solids will then be subjected to further aqueous processing. As a consequence, airborne activity will not be generated under normal operating conditions, and therefore only the external radiological dose implications have been considered in this assessment[16].

AWE and Nexia Solutions Limited have undertaken experimental measurements[16] to determine the low dose-rate associated with the materials described in this document. This entailed undertaking direct dose-rate assessments to demonstrate that the working practices and control measures are appropriate for ensuring that dose-rates for this material are ALARP.

The measured dose-rates from the six drums of AWE's DU contaminated oil that were used for full-scale trials[16] were less than 5 µSv h^{-1}. The measured contents of DU in the 6 drums ranged from 160 g to 690 g, equivalent to 7.4 MBq to 32 MBq. These drums were chosen to represent the bounding case for the majority of the drums of legacy DU contaminated oil. However, there are five drums of legacy DU-contaminated oil that contain appreciably greater amounts of DU, ranging from approximately 1400 g to 4950 g per drum (equivalent to 64 MBq to 223 MBq), i.e. about 10 times more DU. As dose-rate is directly related to activity then it is realistic to estimate that the higher activity AWE DU drums produce direct dose-rates of less than 50 µSv h^{-1}.

The second set of measurements was carried out on a depleted uranium nitrate liquor at 26% DU by mass, which produced a contact dose-rate of 30 µSv h^{-1}. Such a uranium nitrate liquour would be produced during the subsequent processing of the uranium extracted from AWE's oil. The uranium would be initially extracted from the oil into sulphuric acid. It would then be precipitated and re-dissolved in nitric acid to yield a more concentrated uranyl nitrate solution. The dose from the uranium nitrate liquour represented the dose from the product of the acid washing process, except that the concentration of DU was far greater than the expected concentration of uranium in the initial sulphuric acid extract. For example, the maximum concentration of DU in the sulphuric acid extracts that were produced during the full-scale scale trials with AWE's DU-contaminated oils was 0.18% w/w[17].

The final set of direct dose-rate measurements was conducted on drums of depleted uranium oxide material containing more than 70% by weight uranium. This is the product from processing the uranium nitrate liquor that is used in the initial stage of nuclear fuel reprocessing. It is likely that the uranium recovered from AWE's oils would have been bulked with uranium from other sources before reaching this stage. The inherent self shielding effects of the material gave rise to a contact dose-rate of 35 µSv.h^{-1}.

Nexia Solutions Limited considered that the dose-rates associated with the extraction of uranium from AWE's oily wastes would not compromise their operations.

Although no direct dose-rate assessments have been conducted for the EU contaminated oils, it is reasonable to assume that the EU contaminated oils will cause smaller direct dose-rates than the DU contaminated oils, because the external dose is mainly due to the daughter products of U^{238}. The DU contaminated oils contain more uranium (Table 1), a higher proportion of U^{238} and more of the daughter products of U^{238} than the EU contaminated oils.

Based on the findings of the direct dose-rate assessments discussed above, the predicted radiological impacts on the effected populations are:

12.1 To Members of the Public in the neighbourhood of AWE Aldermaston:

The proposed variation, if granted, will cause no discharge to air or water from AWE Aldermaston. There is therefore no dose implication for members of the public in the vicinity of AWE Aldermaston. In addition, the likelihood of spillage and subsequent ground contamination will fall if this variation is approved.

12.2 To Members of the Public in the neighbourhood of the Springfields Site:

The radiological impact to neighbouring members of the public of discharges made at limiting values was considered as part of the Environment Agency's process of determining the RSA93 Authorisation granted to Springfields Fuels Limited. The assessments, not repeated here, concluded the impacts to be acceptably small, thus supporting the authorisation of Springfields Fuels Limited's current discharge criteria.

AWE will supply only part of the radioactive raw material for the Springfields Fuels Limited discharge authorisation and will never cause Springfields Fuels Limited to exceed discharge limits. Disposals from AWE will therefore not add unacceptably to the radiological impact caused by the Springfields Fuels Limited site.

12.3 To Members of the Public on the Road Network:

The radiological impact to members of the public on the road network will be negligible as all wastes will be packaged in accordance with the IAEA's Regulations for the Safe Transport of Radioactive Material, TS-R-1, 2005 Edition, and comply with the Radioactive Material Transport Regulations 2002.

12.4 To Workers at the AWE Aldermaston site:

The wastes will be appropriately packaged and transported to the Springfields site. The wastes classed as "Spent Cutting Fluids" may be treated by ultrafiltration to remove water before packaging. Each of these stages – conditioning, packaging and transport – has the potential to cause radiation dose to involved workers, even though procedures will be planned to keep the doses as low as reasonably achievable.

Estimates of these doses are as follows. The dose assessments outlined at the start of section 12 showed that 5 drums of oil waste may produce dose rates up to 50 $\mu Sv\ h^{-1}$, but with the majority of the waste drums producing dose-rates of < 5 $\mu Sv\ h^{-1}$. The greatest risk of exposure to AWE operatives will probably occur when the drums are placed into overpacks for transport. The estimated time required for this operation is less than 1 hour per drum. Thus, the packing of those drums with a higher content of DU could be associated with a dose rate of < 5 x 1 x 50 = < 250 μSv. Similarly, the packing of the other drums of DU waste (less than 40 in number) could be associated with a dose rate < 200 μSv. It is hoped to complete the treatment of the legacy of DU-contaminated oils within one year. Thus, workers involved in conditioning of the uranium contaminated oils could receive doses no greater than 0.5 millisieverts (mSv) per year. It is concluded that this dose burden is acceptable, particularly given the counterbalancing benefit of reducing to zero the doses associated with continued storage and management of the uranium contaminated oils (the annual doses for this would be small, but could potentially accumulate to a much larger total over a prolonged period of storage).

12.5 Effects on Eco-Systems:

There will be zero discharges to the environment from AWE and thus no radiological impact to the local eco-system.

12.6 Radiological Impact Summary:

- There will be no radiological impact to members of the public close to AWE Aldermaston.
- Members of the public close to Springfield Fuels Limited site are considered in the context of the Environment Agency's determination of the discharge authorisation for that site.
- Members of the public on the road network will not be subject to any adverse radiological impact.
- Workers at AWE Aldermaston will receive marginally more dose in the short term (up to about 5 years), but less in the long term.
- Discharges associated with the proposed disposals will have no effect on eco-systems.

13 Conclusions

- Completion of the proposed disposal will ensure that AWE continues to match "best practice" in its management of radioactive wastes.
- The fundamental environmental discharge limits and conditions of Certificate of Authorisation BZ1994 require no modifications and will continue to apply for the foreseeable future.
- The proposed variation represents a minor amendment to the disposal routes and limits set out in BZ1994. Indeed this variation will not alter the Authorisation's limits for environmental discharges to air and water from AWE Aldermaston.
- The operational need for the proposed disposals has been described and justified.
- UK Government policy for radioactive waste disposals has been considered and it has been concluded that AWE's proposals are fully compliant.
- Radiation dose impacts for members of the public and eco-systems will be trivial.

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ANNEX 1: Summary of Study Concerning Disposal of Uranium Contaminated Oils

In Section 7, the text refers to the BPEO (Best Practicable Environmental Option) study concerning disposal of uranium contaminated oil. This Annex provides a brief summary of the content and outcome of this report.

Best Practicable Environmental Option Oily Waste Management Workshop Report

The BPEO workshop was held to discuss some of the possible strategic options for managing oily wastes generated by AWE's Pegasus facility. This BPEO assessment builds upon substantial work undertaken by AWE to establish options for managing uranium contaminated oils that are both legacy and current arisings of AWE's operations

Fourteen possible disposal options were identified, but based upon the workshop discussions only three options were taken forward for more detailed discussion and assessment. The workshop based the assessments on:

- Options must not generate a secondary waste stream that cannot be disposed of.
- For large scale facilities there must be an existing or planned UK capability.
- The management option must include either long term safe storage (where the final waste product is ILW) or disposal (where the final waste product is LLW or below).

The three options then subjected to detailed assessment were:

a. Filtration
b. Silver II Oxidation and LANL Process
c. Acid Extraction / Washing

Each option was then scored against the following assessment criteria:

Criteria	Comments / descriptions
Secondary waste volume	This assessed the volume of secondary wastes arising from the treatment process (e.g. cementation of ash from incineration).
Secondary waste processing	This assessed the need for additional waste processing, including the difficulties expected in processing wastes and whether final disposal or long term storage is feasible.
Radiological safety – workers	This assessed the radiological impacts on workers and included consideration of the processing of secondary wastes.
Radiological safety – public	This assessed the radiological impacts on the general public and included consideration of environmental releases.

Conventional safety	This assessed the worker safety and included consideration of processing of secondary wastes.
Environment and resource use	This assessed the potential environmental impacts and the use of energy and resources.
Regulatory concerns and authorisations	This considered the effort required to satisfy regulatory concerns, including the need to revise or extend existing authorisations or to make new submissions.
Technical readiness	This criterion considered the effectiveness and maturity of the option and the ability of the Pegasus project to define the option such that it could be incorporated in the project design.

Equal weighting applied to all criteria for the scoring.

The option with highest overall scoring was acid washing. The acid washing technique permits the recovery of uranium and potentially reduces the uranium content in the oil to below controlled exempt release levels. Also this disposal route significantly reduces both the volume of waste arisings and the radioactivity of material consigned as solid waste or discharged to the environment.

ANNEX 2: Schedule of Information Requested by the Environment Agency

The 'Schedule of Information', as requested by the Environment Agency, is detailed in the following sections of this variation document:

2.1 Provide evidence that the proposed recipient of the waste transfer, Springfields Fuels Limited, has agreed to accept the waste.

A letter of acceptance is enclosed in the application pack.

2.2 Provide information relating to how radioactive waste is currently produced and managed including sources of oil waste intended for transfer to Springfields.

This information is detailed in Sections 2, 4 and 8 of this variation document.

2.3 Provide a commentary on the characteristics of the wastes intended for transfer to Springfields including radioactive and hazardous properties.

This information is detailed in Sections 2, 3 and 4 of this variation document.

2.4 Provide best estimates and worst case estimates of current and future waste arisings for the period of up to 8 years. Include information on frequencies of transfers. Identify how estimates have been made, including the work activities from which the waste will arise, the waste type and the site it is proposed to transfer it to.

This information is detailed in Sections 4 and 11 of this variation document.

2.5 For the waste generating and management process on site provide a detailed Best Practicable Means (BPM) review. Address issues relating to minimising activity source items, for example sentencing, and secondary waste arisings.

This information is detailed in Sections 5, 6 and 7 of this variation document.

2.6 Identify and provide a review and substantiation of the methods, including sampling arrangements, techniques and systems used to measure and assess the radioactive and hazardous properties of the wastes proposed for transfer.

This information is detailed in Sections 3 and 8 of this variation document.

2.7 Provide a statement on management arrangements for managing these wastes as well as proposed arrangements for managing the transfers.

This information is detailed in Sections 2, 4 and 8 of this variation document.

2.8 Provide a comprehensive dose assessment covering the proposed transfer and its subsequent treatment at Springfields. Include the assumptions made and the basis of the assessment.

This information is detailed in Section 12 of this variation document.

2.9 Describe the final disposal of waste oils following treatment and removal of radioactive materials.

This information is included in Section 5 of this variation document. Nexia / Springfields Fuels Ltd. have used several oil collectors/recyclers in recent years. At present, Nexia has a general contract with SITA to quote against taking away specific non-radiological/free release exempted wastes, such as oil. It may not be possible to ascertain the ultimate fate of a batch of recovered oil if it is passed on via consolidation.