

**Best Practicable Means Assessment (BPM) for
Asbestos Waste at the Chapelcross Decommissioning
Site**
Chapelcross Asbestos Waste Project

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CONTENTS

GLOSSARY / ABBREVIATIONS.....	III
EXECUTIVE SUMMARY	IV
1.0 INTRODUCTION.....	5
1.1 PURPOSE.....	5
1.2 BACKGROUND	5
1.2.1 Radiological contamination of asbestos	5
1.2.2 Volume estimates.....	6
2.0 RESULTS OF THE BPEO STUDY	6
3.0 PROCESS ROUTE ON SITE FOR ASBESTOS STREAMS FROM CHAPELCROSS	7
3.1 DISPOSAL ROUTES	9
4.0 TREATMENT OPTIONS FOR ASBESTOS.....	9
4.1 REGULATORY AND LEGISLATIVE BACKGROUND.....	9
4.1.1 Control of Asbestos Regulations.....	10
4.1.2 Landfill Directive.....	11
4.2 TREATMENT OPTIONS FOR LANDFILL.....	11
4.2.1 Injection with dampening agent	12
4.2.2 Double Bagging.....	12
4.2.3 Surface Treatment.....	13
4.2.4 Thermal degradation	14
4.2.5 Acid Digestion	15
4.2.6 The issue of double handling.....	15
4.2.7 Selection of treatment process for exempt and VLLW asbestos	16
4.3 LANDFILL WASTE ACCEPTANCE CRITERIA (WAC).....	16
4.4 SPECIFIED LANDFILL SITES FOR HIGH VOLUME VLLW	17
5.0 BPM ASSESSMENT FOR LLWR DISPOSALS.....	18
6.0 BPM ASSESSMENT FOR ONSITE MANAGEMENT PRACTICES OF EXEMPT VLLW AND LLW ASBESTOS WASTE.....	18
6.1 MINIMISATION OF ACTIVITY	19
6.1.1 Minimisation at source.....	19
6.1.2 Minimisation of discharges	20
6.1.3 Minimisation of solid disposals.....	21
6.1.4 Minimisation of transfers to other facilities.....	21
6.2 PROCESS TECHNOLOGY.....	22
6.3 EASE OF OPERATION	22
6.4 MANAGEMENT CONTROL OF OPERATIONS	23
6.5 EQUIPMENT IDENTIFICATION AND PLANT MAINTENANCE	23
6.6 RECORD MAKING AND RETENTION.....	23
6.7 SAMPLING AND ANALYSIS.....	24
6.8 AWARENESS AND TRAINING.....	24
6.9 REGULATORY NON-COMPLIANCE	24
7.0 CONCLUSIONS AND RECOMMENDATIONS.....	25

TABLES

Table 1 – Summary of the advantages and disadvantages of the treatment options	15
Table 2 – Estimated Waste Quantities.....	19
Table 3 – Summary of responses from landfill site correspondence.....	27

FIGURES

Chapelcross Asbestos Waste BPM
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Figure 1: Asbestos warning label (Ref: Control of asbestos regulations 2006) 10
Figure 2: Double bagging arrangements for asbestos [Ref: HSE Disposal of asbestos waste:
equipment and method sheet] 13
Figure 3: Stabilisation of fibrous asbestos with sodium silicate 14

A P P E N D I C E S

APPENDIX A. LANDFILL SITE CORRESPONDENCE 27
APPENDIX B. PROCESS FLOWCHART FOR ASBESTOS REASSURANCE
MONITORING AND STORAGE 29

GLOSSARY / ABBREVIATIONS

ACM	Asbestos Contaminated Materials
ALARP	As Low As Reasonably Practicable
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means
CFA	Conditions for Acceptance
DEFRA	Department of the Environment, Food and Rural Affairs
EA	Environment Agency
HPA	Health Protection Agency
HSE	Health and Safety Executive
IPC	Integrated Pollution Control
LLW	Low Level Waste
LLWR	Low Level Waste Repository
NDA	Nuclear Decommissioning Authority
PPC	Pollution Prevention and Control
SEPA	Scottish Environmental Protection Agency
SQEP	Suitably Qualified and Experienced Personnel
SNRHW	Stable Non Reactive Hazardous Waste
VLLW	Very Low Level Waste
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

This report presents an assessment of Best Practical Means (BPM) for the direct disposal to landfills licensed to accept asbestos wastes or (for active materials) to the LLWR near Drigg, for the three asbestos waste streams arising from the decommissioning activities on the Chapelcross site:

1. Asbestos contaminated with tritium and activation products (~3,940te)
2. Asbestos contaminated with tritium (~560te)
3. Radioactively uncontaminated asbestos (~2,500te)

This BPM follows a BPEO assessment carried out in conjunction with Chapelcross site to prioritise "New and Emerging" technologies but also direct disposal, for the management of these materials. For health and safety reasons and to meet NDA requirements for 'progressive hazard reduction', removal of asbestos from the plant areas where it occurs must commence as soon as possible. This is also an early Key Milestone in the LTP¹ (for C&M Preparations). Jointly, these require an asbestos management option and disposal route/routes that can be implemented in the shorter term, as well as still considering newer technologies that might be available in the future. Therefore, the currently available and proven options of Direct Disposal to landfill (for exempt or VLLW²) or to the LLWR Drigg (for LLW) have been taken forward for the current BPM assessment. They do not foreclose other management options identified in the BPEO that might be available in the longer term. (¹ Lifetime Plan; ² Very Low Activity Waste)

The BPM assessment investigated the on-site handling and management options available for asbestos waste, required to fulfil the requirements of key legislation relevant to direct disposal of the asbestos wastes, particularly:

- i. The Waste Acceptance Criteria (WAC) for asbestos to be disposed of at licensed landfill sites.
- ii. The Conditions for Acceptance (CFA) for the disposal of active asbestos at the LLWR near Drigg.

Physical, thermal and chemical treatment options were considered, including: injection with dampening agent ('Idenden') coupled to double bagging, surface and thermal treatments and acid digestion. Special emphasis was given to the extent to which these management options were not only consistent and fitted with these WAC/CFA but also how they were consistent with the on-site procedures already approved for the strip-out itself, without recourse to altering such procedures already in-place.

There is an established process route on-site for asbestos streams from Chapelcross. This was assessed against BPM elements to confirm that it is well established, understood and proven for the task and is suitable for purpose. The procedure involves:

- i. Initial sampling and analysis to establish a radioactive fingerprint and initial waste streaming.
- ii. Injection of the asbestos in-situ with an immobilisation agent ('Idenden') to minimise airborne fibres during strip out and then double bagging.

- iii. Segregation of double bagged materials based on their previously characterised (item 1) radioactive fingerprint into Exempt, and Low activity (LLW) waste streams (some of which are also likely to fall into the very low activity waste VLLW, category). Exempt and materials containing only tritium are placed in plastic storage crates and a further round of confirmatory monitoring. Interim storage is likely to result in double bagged asbestos containing tritium only in becoming exempt and/or VLLW . Asbestos containing tritium and activation products is placed in 200 litre steel drums.

Current BPM for exempt materials: Landfill routes can be implemented immediately, if required to meet HSE and LTP requirements and also to minimise storage on-site and associated risks and storage issues. The legislation governing asbestos was reviewed and a selection of 20 landfill sites licensed to accept the Exempt asbestos were contacted to establish their WAC requirements. This confirmed that injection with 'Indenden' and double bagging constituted treatments sufficient to meet their WAC (with transfer to the sites in skips and simple tumble tipping). There is therefore a consistency and fit between the current double bagging of exempt material on-site and WAC for a direct disposal route to landfill. Additional treatments could involve debagging, double handling etc. with associated increased risks and have not been identified as requirements for landfill disposal. Landfills generally suggested that as the asbestos has been used exclusively for insulation, there are no grounds for requiring additional leach testing. *The current on-site management procedure of Indenden injection and then double bagging for this waste stream will allow immediate implementation of the strip out process and consignment of materials to landfill and is therefore the current BPM.*

Current BPM for VLLW: Following a recent publication of the DEFRA LLW Policy Review to operators of landfill sites and recognition of the capacity of the current vaults at the LLWR Drigg, a number of the landfill sites contacted expressed an interest in pursuing acceptance of VLLW containing only tritium (Applications for Specified Site status to accept high volume VLLW). Full WAC have not yet been fully established for such materials. However, double bagging does not foreclose any WAC that may be decided on by landfill sites (including double bagging) but may also allow some decay of tritium to exempt or VLLW levels *and is again therefore considered BPM.*

Current BPM for LLW with tritium and/or activation products: When considering prospective disposal routes for asbestos containing higher levels of tritium and/or activation products, the assessment took account of the specific current requirements of the LLWR. These include a limit on the numbers of loose bags of asbestos allowed per 1/2 height ISO ($\approx 0.8 \text{ m}^3$). However, 1/2 height ISOs may be filled entirely with asbestos sheet/cement or fibrous material that has been double bagged and then placed in 200 litre drums that are super-compacted (into 'pucks') to reduce risk of airborne fibres during grouting of the ISOs at the LLWR. This would maximise volumes of asbestos that could be consigned via this route, minimise transport and meet LLWR requirements to optimise capacity at their site. *Double bagging of the LLW asbestos and then packing into 200 litre drums pending super-compaction and pending final acceptance at the LLWR is therefore considered the BPM for this stream.* Interim storage pending on super-compaction and final acceptance of the stream at Drigg does not foreclose other options for treatment of the intact double bagged material if so required, and contributes to BPM.

1.0 INTRODUCTION

1.1 PURPOSE

The Magnox North Chapelcross site has instructed AMEC to carry out a Best Practicable Means (BPM) assessment to develop the option of direct disposal to landfill or (for active materials) to the Low Level Waste Repository (LLWR) near Drigg for three asbestos waste streams arising from the decommissioning activities on the Chapelcross site:

1. Asbestos contaminated with tritium and activation products.
2. Asbestos contaminated with tritium.
3. Radioactively uncontaminated asbestos.

The BPM assessment will investigate various treatment options for asbestos waste, with the aim of fulfilling the requirements of key legislation, including the Waste Acceptance Criteria (WAC) for asbestos at landfill sites.

When considering prospective disposal routes for radioactively contaminated asbestos waste streams, the BPM assessment will also take account of relevant current issues, particularly the DEFRA LLW Policy Review and potential for future landfill applications for Specified Site status for acceptance of high volume VLLW. This is a pertinent issue as recent characterisation data has given early indications that a proportion of radioactively contaminated asbestos will be classified as VLLW rather than LLW.

1.2 BACKGROUND

Asbestos is a naturally occurring fibrous mineral that was very commonly used for fireproofing, heat, electrical and sound insulation, particularly between the 1950s and 1980s. Subsequent respiratory problems caused by inhalation of asbestos fibres have resulted in this mineral being classified as a hazardous substance. Brown (Amosite) and blue (Crocidolite) asbestos were prohibited for use in this country in 1985 and white (Chrysotile) asbestos and asbestos containing materials (ACM) were classified as prohibited substances in 1992.

Planned decommissioning activities at the Chapelcross site include the removal of insulation materials from the Reactor Buildings (including the Heat Exchangers), Turbine Halls and ancillary buildings and structures where heat transfer has occurred. This insulation material is anticipated to be mainly white asbestos, although brown and blue asbestos are also known to be present.

1.2.1 Radiological contamination of asbestos

Depending on the location, some asbestos is known to be radioactively contaminated with activation products principally Iron⁵⁵, Cobalt⁶⁰, Caesium¹³⁴ and Cesium¹³⁷, and/or with tritium. Sampling and full characterisation of the asbestos is currently ongoing and all waste would be monitored to determine its activity level prior to final consignment.

1.2.2 Volume estimates

It is estimated that approximately 7,000 tonnes of asbestos and ACM will be removed. Three waste streams, based on the radioactive contamination present, have been identified:

1. Asbestos contaminated with tritium and activation products – estimated tonnage: 3,940 te.
2. Asbestos contaminated with tritium – estimated tonnage: 560 te.
3. Radioactively uncontaminated asbestos – estimated tonnage: 2,500 te.

2.0 RESULTS OF THE BPEO STUDY

A detailed Best Practicable Environmental Option (BPEO) study has been carried out in conjunction with Chapelcross to identify the most appropriate available strategies to manage the three asbestos waste streams arising from decommissioning activities on the site.

The scope of this detailed study was for a BPEO to cover options involving “New and Emerging Technologies” becoming available and more viable since a previous BPEO assessment (which addressed tritiated wastes). New technologies included thermal treatments that, whilst suitable for consideration as options, may not necessarily be readily and currently available in practice.

The detailed scoring and weighting process applied to the options determined the BPEOs as follows:

Asbestos contaminated with activation products and tritium:

- Rank 1 – Option 19: On-site GeoMelt®
- Rank 2 – Option 8: On-site incineration, and
- Rank 3 – Option 1: Direct disposal.

Asbestos contaminated tritium:

- Rank 1 – Option 21: On-site GeoMelt®
- Rank 2 – Option 8: On-site incineration, and
- Rank 3 – Option 1: Direct disposal.

Radioactively uncontaminated asbestos:

- Rank 1 – Option 8: On-site incineration.
- Rank 2 – Option 21: On-site GeoMelt®, and
- Rank 3 – Option 1: Direct disposal.

The BPEO is a tool to assist in decision making and acts as a record for information and decisions and is not intended to give a fixed and final solution and may be revised as additional information becomes available. Other factors may influence the prioritisation and selection of the final options and may change options favoured in the longer term.

For health and safety reasons, work on the asbestos strip out must begin as soon as possible. Areas of the asbestos in the buildings are beginning to degrade due to exposure to the environment and climate conditions, falling off in adverse weather. There is potential for such asbestos to become airborne, leading to serious health and safety implications as well as potential release of asbestos to the wider environment. For these reasons, there is regulatory pressure from the HSE to remove the asbestos as soon as possible. Whilst some interim storage of such materials may be available, disposal routes must be addressed.

Therefore, a waste management and disposal option that is ready and available for implementation is required. On-site GeoMelt® and On-site Incineration facilities, although favoured by the BPEO study, are not currently in place on the Chapelcross site and would require a significant time period to set up, demonstrate and implement; which is unlikely to be possible under the current circumstances. They would also require some form of ultimate disposal route (e.g. glassy material from geomelt could be used as a road fill).

Direct disposal, which was also favoured by the BPEO study, is a route that is currently and readily available for management and disposal route for the asbestos waste, which has been proven in practice. Furthermore, the weighted scores for the top performing options as a result of the BPEO process were relatively close, with each of the top three options for each asbestos waste stream performing favourably against the attributes.

In conclusion, although On-site GeoMelt® and On-site Incineration options scored slightly higher at the end of the BPEO study, the current lack of availability of either of these technologies on the Chapelcross site precludes them from being adopted for this particular project. Therefore Direct Disposal is a suitable option to carry forward for the BPM assessment.

3.0 PROCESS ROUTE ON SITE FOR ASBESTOS STREAMS FROM CHAPELCROSS

In-situ, on-site sampling and analysis indicate the following broad categories of asbestos waste:

- On 7 of the 16 heat exchangers, in-situ sampling and lab analysis suggests that the bulk of the asbestos is exempted material. This is based on industry accepted methods of sampling frequencies and subsequent treatment of the analytical data.
- On two heat exchangers, the activity of the asbestos waste is borderline on exempt and LLW levels.
- On 2-4 of the heat exchangers (mainly associated with reactor 2), based on in-situ sampling and subsequent laboratory analysis, the asbestos is classified as LLW due either to tritium, or tritium with small amounts of activation products (Co⁶⁰). Further radiological analysis of this material is pending. Main nuclides likely to be present are soft beta emitters Fe⁵⁵ and C¹⁴. The gamma emitting nuclides in this can be used as the basis for fingerprinting of the asbestos in this category (see below).

Asbestos from the pumphouses and bottom ducts are either contaminated with tritium only or are exempt.

Initial strip out of the asbestos from these various areas is carried out according to relevant best industry and HSE guidance for worker protection. This centres on:

- Reduction of the hazard at source. To reduce the risk of loose asbestos fibres becoming airborne, it is proposed that the asbestos lagging is initially injected in-situ with the compound 'Idenden' Dampstrip Asbestos Penetrant 30-330'. The compound ingredients include ~1% ethanol. This compound is absorbed by the asbestos fibres.
- Use of relevant PPE (and asbestos in air personnel monitors).
- Containment systems.
- Initial bagging is carried out in the containment. The bags are then passed out through a series of air locks during which the red inner bags are enclosed within the outer transparent bag (to aid later inspection and effect double bagging). The final outer bags can therefore be guaranteed free from contamination by loose fibres.
- This is applied to all types of asbestos on the site (brown, white and blue) and irrespective of activity class

Subsequent handling and interim storage of the asbestos is according to the expected activity of the material (based on the earlier in-situ sampling and laboratory analysis campaigns):

- Material expected to be exempted: The double bags are colour code labelled, then placed in 1,200 x 1,000 x 750 mm plastic pallet boxes and transferred to the site's 'asbestos monitoring facility'. Each box is monitored using a large volume detector (type). Any boxes of what was expected to be exempt (based on the earlier sampling/analysis) but which trigger the gamma detector are unpacked and the individual bags monitored. The rogue bags are segregated and placed into steel 200 litre drums to join the route taken by active materials (see below). The remaining bags showing no activity are repacked in the pallet box.
- Asbestos expected to contain tritium only: This will be double bagged at source and again colour code labelled and packed in the plastic pallet boxes. These are taken to interim storage (to allow exempt materials priority in the monitoring station). Interim storage is in full height ISO containers. As and when required, the boxes are taken to the monitoring station and any triggering the gamma detector are unpacked and the individual bags monitored. Rogue bags are placed into 200 litre drums. The remaining bags are repacked in the plastic pallet containers and returned for interim storage. It is expected that during interim storage significant numbers of bags of asbestos containing low levels of tritium will decay to below exemption levels.
- Asbestos containing tritium and activation products: This will be double bagged at source, colour code labelled and then transferred directly to 200 litre steel

drums. Generally, 3-4 bags can be packed in each drum. Interim storage of drums is in full height ISO containers.

- 200 litre drums of rogue bags from: the exempt route, the tritium contaminated route and the drums from the LLWR route will be interim stored in full height ISO containers. When enough have been accumulated, the WMT High Force Compactor will be brought onto site. Drums will again be monitored using a drum monitor and the bags in each drum punctured (this avoids excessive pressure build up and bursting of the bags during subsequent compaction and thus potential increased risk of airborne fibre). Drums will then be supercompacted into pucks. Each puck will be removed from the supercompactor and immediately double bagged (to effect containment of any fibres on the outside of the drum due to loss of containment during supercompaction). Double bagged pucks will be stacked into standard 1/2 height ISO freight containers ready for disposal to the LLWR near Drigg. Normally, Drigg limit double bagged but otherwise loose fibrous asbestos to small volumes per 1/2 height ISO freight. However, in its supercompacted form, the LLWR consider the asbestos to be in as immobile state as, for example, sheeting and do not limit the proportion allowed in each consignment.
- Any water draining from the 200 litre drums during supercompaction will be captured and grouted into 200 litre drums. These will be consigned to the LLWR Drigg in the standard 1/2 height ISO containers.

3.1 DISPOSAL ROUTES

Exempt asbestos in bags will be unpacked at the Chapelcross site and man-handled into standard road transport disposal skips. Any bags bursting in this process will be double re-bagged again. At the landfill disposal site, the transport skips will be opened and the bags of asbestos tumble tipped into the appropriate disposal cells. The landfill site will then use its standard procedures for daily cover.

The ½ height ISOs containing supercompacted 200 litre drums (pucks) will be consigned to the LLWR at Drigg in preparation for grouting and in vault emplacement, according to standard LLWR procedures.

Further detail on the process route is shown in Appendix B.

4.0 TREATMENT OPTIONS FOR ASBESTOS

4.1 REGULATORY AND LEGISLATIVE BACKGROUND

There are a number of important legislative requirements to consider when determining suitable treatment and disposal routes for asbestos wastes. The main considerations are the Control of Asbestos Regulations 2006 that apply all through the life cycle for asbestos (use, strip out, disposal). For disposal to landfill, the EU Landfill Directive places additional constraints.

4.1.1 Control of Asbestos Regulations

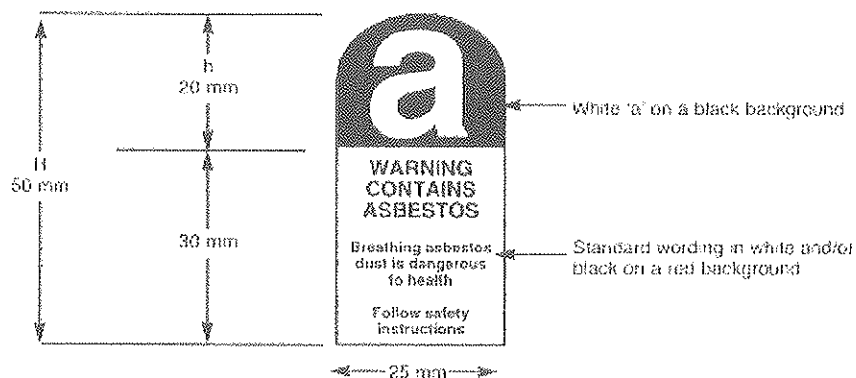
The Control of Asbestos Regulations 2006 replaced the Control of Asbestos at Work Regulations 2002. The regulations impose requirements for the protection of employees who might be exposed to asbestos at work, of persons who might be affected by such work, and also certain duties on employees concerning their own protection from asbestos exposure.

Regulation 24 concerns the storage distribution and labelling of raw asbestos and asbestos waste, stating:

1. *Every employer who undertakes work with asbestos shall ensure that raw asbestos or waste which contains asbestos is not -*
 - a. *Stored.*
 - b. *Received into or despatched from any place of work.*
 - c. *Distributed within any place of work, except in a totally enclosed distribution system, unless it is in a sealed container clearly marked in accordance with paragraphs (2) and (3) (below) showing that it contains asbestos.*
2. *Raw asbestos shall be labelled in accordance with the provisions in Schedule 2 (see below).*
3. *Waste containing asbestos shall be labelled -*
 - a. *Where the Carriage of Dangerous Goods (Classification, Packaging and Labelling) and the Use of Transportable Pressure Receptacles Regulations apply, in accordance with those Regulations.*
 - b. *Where the waste is conveyed by road in a road tanker or tank container in circumstances where the Carriage of Dangerous Goods by Road Regulations 1996 apply, in accordance with those Regulations.*
 - c. *In any other case, in accordance with the provisions of Schedule 2 (see below).*

Schedule 2 of the regulations describes the requirements for labelling of asbestos waste:

Figure 1: Asbestos warning label (Ref: Control of asbestos regulations 2006)



Note that where the waste contains blue (crocidolite) asbestos, the words 'Contains Asbestos' in the diagram should be replaced with 'Contains Crocidolite/Blue Asbestos'.

4.1.2 Landfill Directive

The Landfill Directive is implemented in Scotland by the Landfill (Scotland) (Amendment) Regulations 2003. The legislation requires that there are separate landfills for Inert, Non-hazardous and Hazardous wastes, effectively heralding the end for co-disposal of different classes of wastes. A dedicated hazardous waste cell may be established on an otherwise non-hazardous landfill, to ensure the hazardous waste cannot come into contact with non-hazardous waste.

The legislation requires that hazardous wastes must only be deposited in a hazardous waste landfill, and only if they meet defined Waste Acceptance Criteria (WAC). For asbestos, WAC are as follows:

1. *The waste must contain no hazardous substances other than bound asbestos, including fibres bound by a binding agent or packed in plastic.*
2. *Construction material containing asbestos or other suitable asbestos waste can only be accepted in a landfill dedicated to these wastes or in a separate cell of a non-dedicated landfill, provided it is sufficiently self-contained.*
3. *The zone of deposit must be covered daily and before each compacting operation with appropriate material and, if the waste is not packed, it is regularly sprinkled.*
4. *A final top cover is put on the landfill or cell in order to avoid the dispersion of fibres.*
5. *No works are carried out on the landfill or cell that could lead to a release of fibres (e.g. the drilling of holes).*
6. *Appropriate measures are taken to limit the possible uses of the land after closure of the landfill in order to avoid human contact with the waste.*

Additional provisions that affect the way in which asbestos wastes are disposed to landfill include a requirement for treatment. This is addressed in section 4.2.

4.2 TREATMENT OPTIONS FOR LANDFILL

The Landfill Directive requires the operator of a landfill shall ensure that the landfill is only used for land filling waste which is subject to prior treatment unless –

- d. *It is inert waste for which treatment is not technically feasible.*
- e. *It is waste other than inert waste and treatment would not reduce its quantity of the hazards which it poses to human health or the environment.*

The definition of treatment is: *Physical, thermal, chemical or biological processes (including sorting) that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery.*

To meet this definition, a treatment should fulfil three criteria:

1. The treatment must be a physical, thermal, chemical or biological process including sorting.
2. The treatment must change the characteristics of the waste.
3. The treatment must do so in order to:
 - a. Reduce its volume, or
 - b. Reduce its hazardous nature, or
 - c. Facilitate its handling, or
 - d. Enhance its recovery

Asbestos is an insoluble inorganic waste which displays the hazard H7, carcinogenic. The hazard can be manifested as an impact on a receptor if the fibres are inhaled. Therefore in order to meet the requirements of the legislation, asbestos waste must be treated prior to disposal in a licensed landfill. This section considers the treatment options available for asbestos, constituting physical, thermal or chemical processes and their pros and cons.

4.2.1 Injection with dampening agent

The contractors involved with the asbestos strip out intend to use the dampening agent 'Idenden' Dampstrip 30-330 to suppress the asbestos fibres. This would be carried out in situ, involving complete saturation of the asbestos with the 'Idenden' before its removal; making it an effective treatment for fibrous asbestos. The use of 'Idenden' will facilitate the handling of asbestos and, by suppressing the fibres, reduce the hazard during removal.

4.2.2 Double Bagging

Consideration has been given to whether the existing practice of double bagging asbestos can be regarded as '*physical treatment*', as bagging or wetting of the asbestos can control the risk during placement, but do not change physically the characteristics of the waste. Double bagging reduces the potential for releasing hazardous fibres into the air and does facilitate the handling of asbestos.

There is also the issue that, unless other treatment is carried out at the point of the production, the asbestos would need to be released from its containment, introducing double handling for treatment. This would require extensive precautions for worker health and safety protection and for isolation of the asbestos from the environment. Therefore, if double bagging fulfils the requirements of the legislation, further treatment does not need to be carried out in addition to the specific Waste Acceptance Criteria (WAC) for asbestos (see Section 4.3).

Fibrous asbestos must be double bagged, first in red then clear polythene bags, with the neck of the bag sealed with duct tape. These bags must be in UN approved packaging with CDG Hazard Sign and Asbestos code information being visible. Skips for storing asbestos should be enclosed and lockable.

Figure 2: Double bagging arrangements for asbestos [Ref: HSE Disposal of asbestos waste: equipment and method sheet]



All waste should be double-bagged or double-wrapped in plastic sheeting, with the correct hazard warning signs attached.



Use a lockable skip for asbestos cement sheet



It is not good enough to throw sheeting over a standard skip

Double bagging is a simple and effective means of managing the hazard of asbestos waste. It currently forms the Best Available Technique for fibrous asbestos containment and is acceptable at landfill sites licensed to take asbestos wastes. It quickly and efficiently isolates the asbestos from people and the environment and, if the asbestos is double bagged in situ, eliminates any requirement for double handling.

Double bagging does not physically change the asbestos, leading to a greater chance of fibres becoming airborne when the asbestos is initially stripped out prior to double bagging. However, the double bagging of the asbestos can be carried out following injection of the asbestos (in situ) with the dampening agent 'Idenden' dampstrip 30-330. This suppresses the asbestos fibres, and would decrease the hazard when the asbestos is being stripped out and double bagged. This would simplify the process of double bagging, with little delay to the strip.

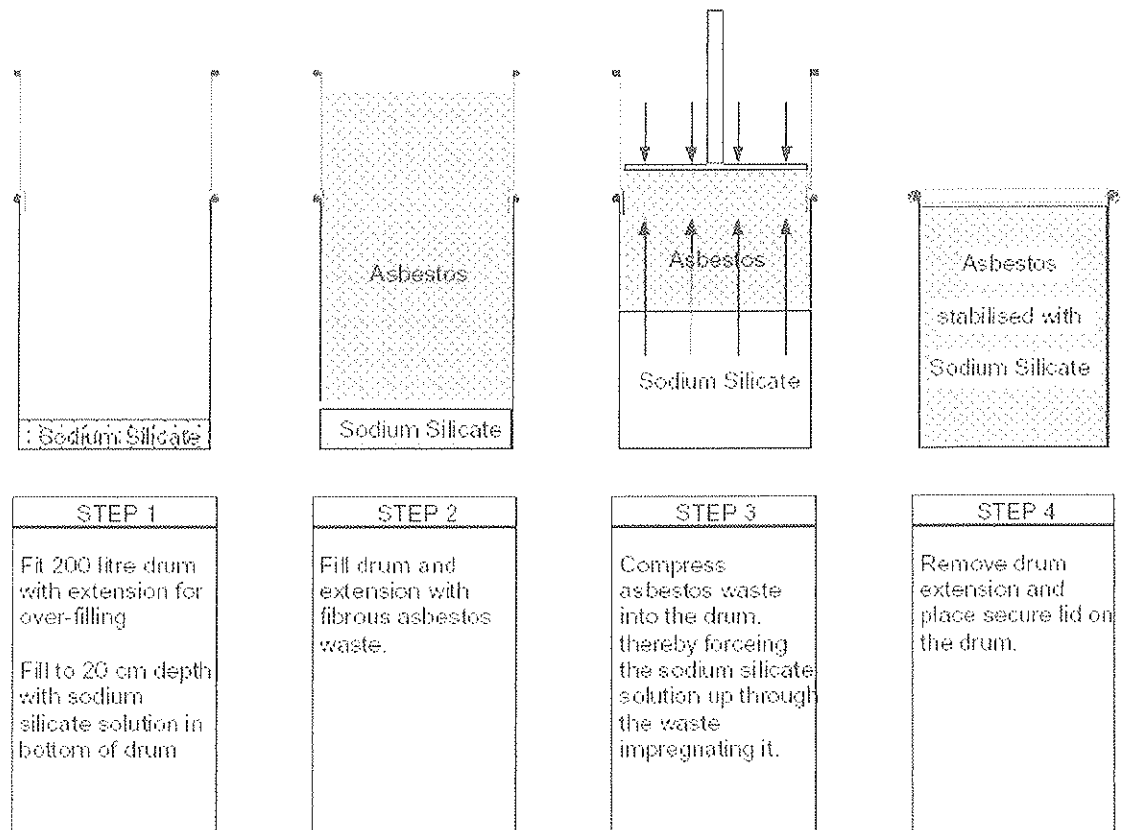
4.2.3 Surface Treatment

Surface treatment of asbestos would involve coating or impregnating the waste with a material to reduce the potential for emission of fibres. Examples of such treatments include the spraying of PVA or sodium silicate solution onto the waste.

For bonded asbestos, simply spraying the surface would be acceptable to stabilise the surface layers and make them less susceptible to abrasion and release of the fibres.

For fibrous asbestos the treatment would need to ensure that the asbestos waste was thoroughly impregnated with the treatment agent for effective stabilisation, and treating only the surface would be ineffective. This could be achieved by compressing the fibrous asbestos into a drum containing sodium silicate solution, to ensure thorough distribution of the treatment agent.

Figure 3: Stabilisation of fibrous asbestos with sodium silicate



Surface treatment using sodium silicate would decrease the hazard from the asbestos by fixing the fibres. This is a relatively simple process for bonded asbestos, but more complicated and time consuming for fibrous asbestos, requiring compression of the asbestos in drums with the sodium silicate. This leads to double handling issues and delay in isolating the hazard from people and the environment.

4.2.4 Thermal degradation

Brown and blue asbestos can be treated by heating to 1100°C, where the form changes to non-fibrous. This has, however, not been demonstrated for white asbestos. This process has also only been subject to laboratory test and not carried out in practice.

Test facilities (in the USA) successfully processed 4.5 tonnes of asbestos using this technology, but the technology could probably not be operated on a large scale without a dedicated Thermo-chemical conversion technology (TCCT) plant. Significant volume reduction (20-30%) is claimed with asbestos wastes. The capital

and operating costs would be similar to a dedicated hazardous waste incineration plant.

Thermal degradation has the advantage of destroying the asbestos fibres, eliminating the hazardous component of the asbestos. It also allows significant volume reduction (20-30%). However, this treatment would require a large, dedicated facility to be capable of dealing with large volumes of asbestos; and the technology has only been proven on a small scale. To reach and maintain the high temperatures required, significant energy usage would be involved. The treatment is also only suitable for brown and blue asbestos, and a separate treatment would be required for white asbestos waste.

4.2.5 Acid Digestion

Asbestos has been widely used due to its excellent thermal insulation properties and because of its resistance to chemical degradation. For this reason, chemical treatment of asbestos is very difficult. However, it has been demonstrated under laboratory conditions that white asbestos is susceptible to digestion by strong acids, including phosphoric acid, sulphuric acid, hydrofluoric acid and fluorosulphonic acid. Elevated temperatures (greater than 50°C) are required with extended processing times in order to digest the asbestos. The acids involved, particularly any containing fluorine, are very hazardous materials and require careful handling.

Acid digestion also has the advantage of destroying the asbestos fibres, eliminating the hazardous component of the asbestos. However, this treatment involves extensive use of very strong acids that pose a significant hazard to health. Working with these acids would require additional risk assessment and stringent health and safety precautions. It is difficult to justify the introduction of another significant hazard when treating the asbestos, when other methods such as double bagging are available that will quickly and efficiently isolate the asbestos hazard from operators and the environment. The treatment is also only suitable for white asbestos, and a separate treatment would be required for the blue and brown asbestos waste. This would complicate treatment such as thermal degradation and acid digestion further, as the asbestos waste being stripped out is a mixture of white, brown and blue, requiring a treatment method that is effective for all three types of asbestos.

4.2.6 The issue of double handling

The surface treatment with sodium silicate, thermal degradation and acid digestion treatments are likely to involve debagging of the asbestos that has already been packaged at source, leading to the undesirable aspect of 'double handling'. Double handling should be avoided wherever possible to minimise operator exposure to the asbestos hazard.

4.2.7 Selection of treatment process for exempt and VLLW asbestos

Due to the restrictions described, surface treatment with sodium silicate, thermal degradation and acid digestion are unlikely to be feasible treatment options for the purposes of this project in the shorter term. A total of 7,000te of asbestos waste is estimated to arise from the planned strip out, requiring a reliable, uncomplicated treatment technology that is capable of managing large volumes at a steady rate to avoid a backlog of asbestos waste and to meet timescale requirements.

Whilst surface treatment is relatively straightforward for treating bonded asbestos, it is more complicated and time consuming for fibrous asbestos, which will comprise the majority of the asbestos strip out. Acid digestion is unproven for all three types of asbestos, but a mixture of blue, brown and white asbestos is also expected to arise during the strip out.

From the discussion of the advantages and disadvantages of the various treatment options outlined above, it can be concluded that double bagging in conjunction with 'Idenden' injection is the BPM for treating the asbestos to facilitate its handling and to reduce the hazard.

Injection with 'Idenden' prior to stripping out the asbestos suppresses the fibres, reducing the hazard during the strip. Following this, the asbestos would be double bagged before being taken out of the building and placed in interim storage ready for consignment (to landfill for exempt, to Drigg LLWR for radioactively contaminated asbestos). This ensures that the asbestos is isolated from people and the environment as soon and as safely as possible.

It has also been established that double bagging fibrous asbestos is sufficient to meet the WAC of landfills licensed to accept asbestos wastes (see Section 4.3 below).

4.3 LANDFILL WASTE ACCEPTANCE CRITERIA (WAC)

In order to research WAC and industry expectations for disposal of asbestos to landfill, a number of landfill sites across the UK were contacted, as part of the BPM assessment, with the following queries:

1. *What are the Waste Acceptance Criteria (WAC) for fibrous asbestos at your site - most sites appear to accept double bagging (in correct specified bags) with delivery in skips, that are then tumble tipped.*
2. *Are the WAC the same for fibrous white, brown and blue asbestos?*
3. *The asbestos contractors involved in strip out will use 'Idenden' dampstrip 30-330 to suppress the fibres. Is this also covered in your site licence (and does it assist in meeting WAC at your site)?*
4. *The asbestos may contain small amounts of other inert items, e.g. wood, metal, electrical tape, overall, masks etc. The waste will be segregated at source but small amounts of inert items may remain. Will this be acceptable under your site licence?*

5. *The asbestos waste is from a nuclear power station (mostly turbines etc) and will be monitored (as required by SEPA) and only that suitable for 'free release' will be consigned.*

But, a separate asbestos stream containing very low levels of tritium may also arise. Government Policy states this might be acceptable for disposal at certain landfill sites (see DEFRA 2007 LLW Policy document). Could you advise us if your site has or could apply for Specified Landfill site status for high volume Very Low Level Waste as proposed in this guidance? Please phone for more information if required.

6. *What is the cost per tonne for asbestos disposal?*
7. *Based on the above would your site be interested in being considered as a recipient for some/all of the asbestos waste (up to 3,000te at present)?*

A summary of the responses from the landfill sites contacted is shown in Appendix A. From the information gathered, WAC for asbestos waste disposal to landfill appears to be double bagging as current site practice, with no expectation of additional treatment beyond this. *This provides further justification for selection of double bagging (plus 'Idenden' injection) as the BPM, with landfill as an acceptable routine disposal route for (exempt) asbestos.*

4.4 SPECIFIED LANDFILL SITES FOR HIGH VOLUME VLLW

For the purposes of this BPM assessment, it has been assumed that the asbestos contaminated with activation products and/or tritium would be classified as LLW and consigned to the LLWR near Drigg. However, recent characterisation data has given early indications that some of the asbestos is more likely to be classified as high volume VLLW.

Subject to the recent DEFRA 2007 LLW Policy, government policy indicates that high volume VLLW is acceptable for disposal at certain landfill sites that have successfully applied for Specified Site Status. As a result, efforts are ongoing to identify potential landfill sites that can accept high volume VLLW, with the intention of Specified Sites being a potential waste route for VLLW asbestos.

However, this is not confirmed, as the Chapelcross site is not currently authorised to consign high volume VLLW to Specified landfill Sites. However, there may be potential to include this as a variation on a current authorisation.

It is anticipated that exempt asbestos can be sent to a suitable landfill in a relatively short time period. But, radioactively contaminated asbestos is expected to be subject to interim storage on site for 2-3 years awaiting consignment to the Drigg LLWR. Therefore, there is potential for the current situation regarding disposal authorisations to change and also for more landfill sites to achieve Specified Site Status.

Therefore, it is recommended that further consideration be given to using Specified landfill sites as a potential waste route for high volume VLLW asbestos, subject to future developments in the situation.

5.0 BPM ASSESSMENT FOR LLWR DISPOSALS

In-situ sampling and laboratory analysis is used to establish fingerprints for the asbestos prior to strip out and double bagging. All such materials are subject to further monitoring to detect "rogue" bags that are then directed to the LLW route (200 litre drums) if found.

The most likely off site disposal route for the LLW in 200 litre drums is the LLWR near Drigg. Conditions for Acceptance of LLW at the LLWR near Drigg are subject to frequent update and for this reason, the requirements are now issued via the LLWR Web Site. Chapelcross have frequent meetings with LLWR to confirm acceptance and disposal via this route.

The LLWR state that only small volumes of loose double bagged asbestos are allowed in each 1/2 height ISO and these must be weighed down to prevent floating when the ISOs are grouted at the LLWR site. There is less limitation on asbestos cement and sheet as this is much less susceptible to fibre loss and floating during grouting. Loose double bagged asbestos may be converted to this form by, for example, cementation in drums or by super-compaction in drums.

Cementation would produce heavy drums with special handling requirements on the Chapelcross site (floor loading issues etc) and would foreclose other potential future management options (for example, those identified in the BPEO). Double bagging and then packing in 200 litre drums allows ease of handling in any interim storage period. During this, further monitoring can be carried out and, if required, further treatments for alternative disposal routes implemented.

Once consignment to Drigg is finalised, drums will be super-compacted using a mobile plant, minimising the final volume of LLW, minimising transport requirements and maximising capacity at the LLWR Drigg.

6.0 BPM ASSESSMENT FOR ONSITE MANAGEMENT PRACTICES OF EXEMPT VLLW AND LLW ASBESTOS WASTE

It has been established that double bagging in conjunction with 'Idenden' injection is the BPM for treating the asbestos waste to facilitate its handling and to reduce the hazard. The process route on site for asbestos waste streams on Chapelcross is set out in Section 3 above.

The option 'Direct Disposal' for exempt asbestos waste requires consignment to a landfill site licensed to accept asbestos wastes. This must be a Hazardous Waste Landfill or a landfill with a designated Stable Non Reactive Hazardous Waste (SNRHW) Cell for asbestos wastes. The asbestos waste must meet the WAC of the landfill (see Section 4.1.1), particularly: *The waste must contain no hazardous substances other than bound asbestos, including fibres bound by a binding agent or packed in plastic.*

The option 'Direct Disposal' for radioactively contaminated (LLW) asbestos waste (i.e. asbestos contaminated with activation products and/or tritium) requires consignment to the Drigg LLWR.

This section will discuss the application of BPM elements set out in the Sellafield BPM codes and supporting assessment methodology guidance to the chosen treatment and process route for the asbestos wastes:

1. Minimisation of activity- at source, discharged, disposed and transferred
2. Process technology
3. Ease of operation
4. Management control of operations
5. Equipment Identification and plant maintenance
6. Record making and retention
7. Sampling and analysis
8. Awareness and training
9. RSA93 non-compliance

6.1 MINIMISATION OF ACTIVITY

6.1.1 Minimisation at source

This element is concerned with minimising the creation and discharge/disposal of radioactive and chemical wastes by adopting all practicable measures to reduce wastes created at source.

The asbestos waste streams are summarised in Table 2 below:

Table 1 – Estimated Waste Quantities

Type of waste	Low Level Waste (tonnes)	Exempt material (tonnes)
Asbestos contaminated with activation products and tritium	3940	
Asbestos contaminated with tritium only.	560	
Radioactively uncontaminated asbestos		2500

No activity above LLW levels is expected to be associated with any of the wastes arising. This is to be substantiated by further characterisation work to be carried out prior to commencement of operations. To avoid cross-contamination of exempt asbestos, the waste streams will be segregated, ensuring volumes of radioactive waste are minimised.

Possibilities for reducing the total amount of asbestos waste at source are limited to minimising the generation of secondary wastes, as the asbestos strip out represents an essentially fixed amount of waste. The selected methods to carry out the asbestos strip will not require significant amounts of additional material to be used, beyond the required PPE, temporary containment materials and the 'Idenden' and double bagging necessary to safely treat, handle and dispose the asbestos waste.

Due to the hazardous nature of asbestos, it is not feasible to reuse or recycle this material. Health and safety implications from the degrading asbestos on the Chapelcross site constitute an unacceptable hazard to health. Therefore, safely disposing of the asbestos wastes to destinations licensed to accept them is the required course of action.

It should be noted that recent preliminary characterisation carried out on the radioactively contaminated asbestos waste indicates that some of the waste may be classified as VLLW. Wherever possible, this should be segregated from any LLW asbestos, to minimise the classification of the waste. The planned waste route for radioactively contaminated asbestos is the Drigg LLWR, based on anticipation that the asbestos would be LLW. Where asbestos waste with VLLW classification is identified, alternative waste routes should be considered, to conserve space at the Drigg LLWR and determine the most appropriate destination for the VLLW.

Extensive consideration has been given to potential options for addressing the asbestos wastes from Chapelcross site, through a thorough optioneering study to identify the BPEOs. Along with the commissioning of this BPM study, this demonstrates that the project team is actively seeking the best practicable environmental management strategy for the asbestos wastes.

It has been demonstrated that although possibilities for reduction of the total amount of asbestos waste are limited due to the nature of the process, measures are in place to ensure the amount of active waste is minimised.

To demonstrate further improvements are being sought, further consideration might be given to using the most appropriate disposal route for asbestos classed as VLLW, to minimise requirements to dispose to the Drigg LLWR, if practicable.

6.1.2 Minimisation of discharges

This element is concerned with minimising the creation and discharge/disposal of radioactive and chemical wastes by considering all practicable opportunities for abatement of aerial and liquid streams.

The asbestos strip out will result in no routine sources of any radioactive liquid or aerial discharges. Potential for aerial release of asbestos fibres is minimised through the proposed use of the dampening agent 'Idenden' dampstrip 30-330. This will be injected into the asbestos in situ prior to the strip out, and is intended to impregnate the whole volume of the fibrous asbestos, to suppress the fibres. Following this, the asbestos will be double bagged to ensure complete containment of the hazard and prevent any aerial release of asbestos fibres.

Double bagging of asbestos would be carried out in a contained area. The double bagged asbestos would be passed through a three section air lock to ensure that no asbestos fibres were present on the exterior surface of the bagging. The asbestos would also be subject to radiological monitoring to confirm its classification before consignment to its ultimate disposal destination. Radioactively contaminated asbestos and exempt asbestos will be sent to separate interim storage facilities on site, prior to final consignment. Double bagging will also

provide containment for the radioactively contaminated asbestos, to minimise any spread of radioactive contamination.

Therefore, the above demonstrates that measures will be taken to ensure that no routine aerial or liquid wastes will be discharged to the environment. Measures are in place to contain the hazard from the asbestos fibres and the radioactive waste, to ensure negligible environmental release.

6.1.3 Minimisation of solid disposals

This element is concerned with minimising the creation and discharge/disposal of radioactive and chemical wastes by considering all practicable measures for reducing disposals of solid wastes.

The solid asbestos wastes generated (as shown in Table 2, Section 5.1.1) will be fully characterised and disposed of via agreed disposal routes, i.e. for exempt asbestos waste – consignment to a landfill site licensed to accept asbestos wastes and for radioactively contaminated (LLW) asbestos waste – consignment to the Drigg LLWR. It is recommended that alternative disposal routes for VLLW asbestos are further considered.

As noted in Section 5.1.1, volumes of solid wastes are essentially fixed. However, waste segregation will allow the minimisation of solid radioactive asbestos wastes requiring disposal. Where possible, volume reduction of the LLW asbestos will be carried out by supercompaction in drums, as required prior to consignment to the Drigg LLWR.

It has been demonstrated that waste routes are agreed and in place for the asbestos waste streams produced during the strip out and volume reduction will be carried out where possible. However, it is recommended that further consideration be given to alternative waste routes for VLLW asbestos, to conserve valuable space at the Drigg LLWR.

6.1.4 Minimisation of transfers to other facilities

This element is concerned with minimising the creation and discharge/disposal of radioactive and chemical wastes by considering all practicable measures for reducing transfers of solid wastes.

Exempt asbestos will be disposed of to a landfill site licensed to accept asbestos waste and LLW asbestos will be disposed of to the Drigg LLWR. Therefore, transfer of the waste from the Chapelcross site to other facilities will be required. Wastes transferred to other facilities will be fully characterised, as required by the landfill WAC and Drigg LLWR CFA.

As transfers to other locations are unavoidable, consideration could be given to minimising the distance that waste must be transported. For example, where practicable the closest suitable landfill site(s) to Chapelcross could be selected for exempt asbestos waste. Consideration could also be given to the idea of establishing a rail link agreement (if feasible) for transporting large volumes of waste, to minimise the total number of journeys.

6.2 PROCESS TECHNOLOGY

This element is concerned with assessing the appropriateness of specific plant process equipment and/or technology for minimising discharge/disposals. For the design of new plant, the assessment should be against relevant design and construction standards or best practice guides. For existing plant the assessment should consider performance against design flowsheet, and the age and condition of the process equipment.

The process route on site for asbestos waste streams on Chapelcross is set out in Section 3 above. This process route is well established, understood and proven for the task. The asbestos strip out will be carried out in compliance with relevant best industry and HSE guidance for worker protection. The equipment to be used for the asbestos strip out shall be proven and effective, satisfy industry standards and must comply with current site instructions, to meet all current standards appropriate to the task.

To mitigate accidental discharge or spread of contamination events (asbestos fibres or radiological release), the asbestos strip out will be carried out within a temporary containment area. All containment measures must use the most up to date technology, meet current industry and design standards and comply with best practice.

Throughout the process radiological monitoring systems need to be employed to ensure that working conditions remain safe for operators and accurately model and predict contamination levels. Monitoring asbestos waste during removal and processing will be essential to substantiate waste categories so that waste can be disposed of by the appropriate routes. All monitoring systems should comply with the relevant procedures and guidance.

6.3 EASE OF OPERATION

This element is concerned with assessing the operability of the process and should consider the complexity and frequency of operations and whether this is detrimental to environmental performance (that is, do complicated tasks impede control of discharges?).

The asbestos strip out should be a relatively straightforward operation, with a well established process route complying with the relevant best industry practice and HSE guidance for worker protection. Method statements and instructions for carrying out the work will be completed and put in place.

The injection of the fibrous asbestos with the 'Idenden' to suppress the fibres before commencing the strip out will simplify the handling of the asbestos and mitigate against any fibre release to the environment. Double bagging of the asbestos facilitates its handling, by isolating the hazard. Once the asbestos is double bagged and has passed through the monitoring and airlock precautions, no further treatment is required prior to interim storage and subsequent disposal. This minimises the handling time and eliminates any possibility of double handling. Any bags bursting during the process will be double re-bagged again.

Therefore, the treatment selected facilitates ease of asbestos handling and a safer operating environment.

6.4 MANAGEMENT CONTROL OF OPERATIONS

This element is concerned with assessing the adequacy of written procedures, how they are applied and their effectiveness in ensuring management control of the process/operations.

At the time of project implementation, the Method Statement shall be fully developed and will clearly and comprehensively define all aspects of operations during the asbestos strip out processes at Chapelcross.

Relevant site procedures shall be well defined, available and understood by all contractors on site. Clear lines of communication and accountability will be defined for the project as the date of implementation draws closer. It is assumed that the Principal Contractor will have day to day control over the operations, reporting to the Project Delivery Manager, who will have overall responsibility for the asbestos strip out. All working methods will comply with the Work Control Authorisation Procedure.

6.5 EQUIPMENT IDENTIFICATION AND PLANT MAINTENANCE

This element is concerned with ensuring all environmental equipment is identified and assessing the adequacy of plant maintenance programmes to ensure that maintenance is performed in a timely and appropriate manner.

Maintenance of the equipment brought on site for carrying out the asbestos strip is the responsibility of the contractor, who shall work within Chapelcross site requirements. There will be maintenance requirements for the equipment, to ensure it is working properly and avoid any potential health and safety or environmental incidents. The maintenance programme (for equipment brought on site) must be stringent and meet current industrial standards. The maintenance programme for site activities has proved effective over several years.

Environmental equipment e.g. temporary containment measures, has been identified for the project.

6.6 RECORD MAKING AND RETENTION

This element is concerned with assessing the adequacy of environmental records for the process/operation. The assessment should consider how records are made and kept, and how the information recorded is used or applied. An auditable trail should be visible for all records.

Good systems are in place for the making and retention of environmental records that minimise the potential for error and provide a clear auditable trail. An auditable trail of records will be made and archived including, for example QA records, monitoring certificates and records of sampling and characterisation data. Each batch of waste should be given a unique identification number to allow tracking. This will be useful to facilitate compliance with The Hazardous Waste (England and

Wales) Regulations 2005. Each consignment of waste must be accompanied by a Waste Consignment Note which details notification details, description, carrier's details, consignor's certificate and consignee's certificate. The amount of LLW asbestos consigned to the Drigg LLWR shall also be recorded.

6.7 SAMPLING AND ANALYSIS

This element is concerned with assessing the adequacy of environmental sampling and analysis arrangements for the process/operation.

A sampling and analysis campaign to characterise the asbestos wastes is already underway and ongoing to ensure that the asbestos waste classification is accurately determined and reasonable estimates on the volume of each asbestos waste stream could be made.

Throughout the asbestos strip out process, radiological monitoring systems need to be employed to ensure that working conditions remain safe for operators. The asbestos will also be subject to further radiological monitoring to confirm its classification before consignment to its ultimate disposal destination.

6.8 AWARENESS AND TRAINING

This element is concerned with assessing the adequacy of arrangements for environmental training and awareness of the process/operation. The assessment should consider staffing levels, reporting responsibilities and SQEP arrangements.

The contractors and workers involved in the asbestos strip out will be adequately trained, SQEP operators and appropriate staffing levels will be organised. Reporting procedures and lines of communication are well established around the site and will be defined in the systems of work for each job.

Risk assessments will be produced for each aspect of the work. The operators carrying out the work will be involved in the risk assessment process to ensure they are familiar with the health and safety and environmental hazards posed by the asbestos.

6.9 REGULATORY NON-COMPLIANCE

This element is concerned with assessing compliance with environmental authorisations and permits and in particular the frequency of non compliance events (for example, accidental discharge events or significant 'near misses'). The assessment should consider the arrangements for recording incidents and how subsequent improvements are implemented.

The potential for an environmental event is small, but standard company procedures would be followed if an environmental event occurred as a result of the asbestos removal work. In the event of an incident or near miss, measures to identify potential improvements to prevent reoccurrence would be considered.

7.0 CONCLUSIONS

This report presents the BPM assessment for the development of options for direct disposal to landfill or (for active materials) to the LLWR near Drigg for the three asbestos waste streams arising from the decommissioning activities on the Chapelcross site. The assessment investigated suitable treatment options available for asbestos waste required to fulfil WAC for asbestos. The process for the asbestos strip out and consignment to the disposal routes was also assessed against BPM elements.

The asbestos removal must go ahead as soon as possible for health and safety reasons and to meet HSE expectations. It is also an early Key Milestone in the LTP. Newer technologies have a number of advantages but currently do not meet the requirements of immediacy offered by direct disposal to landfill or to the LLWR at Drigg.

Current BPM for exempt materials: Landfill routes can be implemented immediately, if required to meet HSE and LTP requirements and also to minimise storage on-site and associated risks and storage issues. The legislation governing asbestos was reviewed and a selection of 20 landfill sites licensed to accept the Exempt asbestos were contacted to establish their WAC requirements. This confirmed that injection with 'Indenden' and double bagging constituted treatments sufficient to meet their WAC (with transfer to the sites in skips and simple tumble tipping). There is therefore a consistency and fit between the current double bagging of exempt material on-site and WAC for a direct disposal route to landfill. Additional treatments could involve debagging, double handling etc. with associated increased risks and have not been identified as requirements for landfill disposal. The current on-site management procedure of Indenden injection and then double bagging for this waste stream will allow immediate implementation of the strip out process and consignment of materials to landfill and is therefore the current BPM.

Current BPM for VLLW: Following a recent publication of the DEFRA LLW Policy Review to operators of landfill sites and recognition of the capacity of the current vaults at the LLWR Drigg, a number of the landfill sites contacted expressed an interest in pursuing acceptance of VLLW containing only tritium (Applications for Specified Site status to accept high volume VLLW). Full WAC have not yet been fully established for such materials. However, double bagging does not foreclose any WAC that may be decided on by landfill sites (including double bagging) but may also allow some decay of tritium to exempt or VLLW levels and is again therefore considered BPM.

Current BPM for LLW with tritium and/or activation products: When considering prospective disposal routes for asbestos containing higher levels of tritium and/or activation products, the assessment took account of the specific current requirements of the LLWR. These include a limit on the numbers of loose bags of asbestos allowed per 1/2 height ISO (≈ 0.8 m³). However, 1/2 height ISOs may be filled entirely with asbestos sheet/cement or fibrous asbestos that has been double bagged and then placed in 200 litre drums that are super-compacted (into 'pucks') to reduce risk of airborne fibres during grouting of the ISOs at the LLWR.

This would maximise volumes of asbestos that could be consigned via this route, minimise transport and meet LLWR requirements to optimise capacity at their site. Double bagging of the LLW asbestos and then packing into 200 litre drums pending super-compaction and pending final acceptance at the LLWR is therefore considered the BPM for this stream. Delaying super-compaction pending on final acceptance of the stream at Drigg does not foreclose other options for treatment of the intact double bagged material if so required and contributes to BPM.

These do not foreclose other management options identified in the BPEO that might be available in the longer term.

8.0 RECOMMENDATIONS

Recent characterisation data from Chapelcross site gave early indications that some of the radioactively contaminated asbestos is likely to be classified as VLLW. Therefore, the major recommendation arising from the BPM study is to give further consideration to the issue of VLLW asbestos. Continued investigation into prospective Specified landfill sites for high volume VLLW is recommended.

