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HM NAVAL BASE DEVONPORT

Safety Statement for Proposed EfW Plant at North Yard

Issue 1

DOCUMENT AUTHORISED

Signature J. Meaken **Date 20 October 2010**

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PURPOSE	The purpose of this work is to identify any hazards that could potentially be introduced to the Dockyard Site by the construction, commissioning and operation of an Energy from Waste (EfW) plant. Safeguards and mitigating factors that are required to reduce the risk posed by such hazards to an acceptable level are also be identified.
SCOPE	The overall scope of the Safety Statement is the construction, commissioning and operation EfW plant at the proposed North Yard site.
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EXECUTIVE SUMMARY

The Naval Base Commander Devonport, NBC(D), seeks a sustainable solution to fulfil the Naval Base and their Dockyard Partner's long term energy and waste requirements. An Energy from Waste (EfW) plant has been proposed as a long term sustainable energy solution, providing heat and power to the Devonport site and aligned with the disposal of Devon, Torbay and Plymouth City Council (PCC) waste, which currently goes to land fill.

Implementation of an EfW plant and a Combined Heat and Power (CHP) network may introduce new hazards to the Dockyard Site, which consists of the Naval Base and associated commercial Dockyard owned and operated by Babcock. To ensure the plant does not interfere with the operation of the Dockyard Site, new hazards must be identified and managed appropriately.

NBC(D) has requested that a Safety Statement be produced of suitable depth for submission to NBC(D) and Babcock Nuclear Safety Committees.

The hazard assessment described in this report has identified four hazards (faults) with a potential to affect the Dockyard Site. However, it has been demonstrated that these hazards do not have the potential to have any direct nuclear safety related consequences.

The assessment has concluded that no hazard is likely to arise to the public, NBC(D) and Babcock activities from the build, commissioning, operation and eventual decommissioning of the proposed EfW Plant.

During the basic design phase of the EfW implementation project a HAZOP analysis will be carried out to provide a systematic and thorough evaluation of conventional safety risks to plant workers and the public from process hazards, and will ensure that the necessary control and safety systems are in place.

LIST OF ABBREVIATIONS

Abbreviation	Description
Cat A,B, C	Category of Safety Case (A being highest Risk)
CHP	Combined Heat & Power
DESAG	Devonport Explosive Safety Advisory Group
DRDL	Devonport Royal Dockyard Limited
DSR	Design & Safety Report
E	East
EfW	Energy from Waste
FSC	Facility Safety Case
LOP(R)	Long Overhaul Period (Refuel)
m	metres
N	North
NBC(D)	Naval Base Commander Devonport
NEMSFAC	Nuclear Engineering, Maintenance & Storage Facility
NTR	Nuclear Transfer Route
PRT	Power Range Testing
PSC	Plant Safety Case
QHM	Queens Harbour Master
RAMM	Radio Active Material Movements
SRC	Submarine Refit Complex
SSC	Structures, Systems and Components
SSN	Ship Submersible Nuclear
TSSBN	Trident Ship Submersible Ballistic Nuclear
TXB	Tidal X Berths
X Berth	Nuclear Submarine Berth
Z Berth	Nuclear Submarine Berth

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1 INTRODUCTION

1.1 OBJECTIVE

Implementation of an Energy from Waste (EfW) plant and a Combined Heat and Power (CHP) network may introduce new hazards to the Dockyard Site, which consists of the Naval Base and associated commercial Dockyard owned and operated by Babcock.

The objective of this Safety Statement report is to demonstrate that any risks introduced by the proposed EfW plant at the proposed site in North Yard will be tolerable and As Low As Reasonably Practicable (ALARP).

1.2 SCOPE

The scope of this work is the proposed EfW plant located at the North Yard, including the associated CHP network and associated systems. The scope includes plant construction, commissioning and operation.

1.3 OWNERSHIP

The sponsor for this document is The Naval Base Commander Devonport, NBC(D).

2 PRODUCTION OF SAFETY STATEMENT

2.1 METHOD

A desk based hazard identification study was chosen as the primary method to identify hazards that may be introduced by the proposed EfW plant and associated systems.

The potential impacts on all aspects of Dockyard Site operation from all credible hazards and accident scenarios were considered, together with any impacts the Dockyard Site may have on the EfW plant.

Additionally, a HAZOP 1 study previously undertaken for a comparably sized biomass power station (Reference 1) was reviewed to take advantage of those hazards identified from that study. Hazards identified in the HAZOP study were discussed and any potential further hazards to the Dockyard site were recorded.

Where the potential for the EfW plant to affect the Dockyard Site was identified, this has been recorded and presented in Table 1.

Safeguards and mitigating measures to ensure the hazards presented by the EfW do not impact upon the Dockyard Site were also identified and recorded.

The study was undertaken by John Inman, Andrew McAlley (expertise in hazard identification) and Hugh Maguire (expertise in EfW plant design, commissioning and operation).

2.2 ASSUMPTIONS

The following assumptions are made regarding the proposed EfW Plant and CHP network:

- Three possible plant layouts were initially considered, as illustrated in Figures 1-3. However, for the purpose of this document, the shorter distances between the EfW Plant and the Dockyard Site in relation to the earlier study work will be taken for simplicity (the distances do not vary by much between each of the layouts).
- The following plant operating parameters have been assumed from data provided by the EfW plant supplier (Reference 2),:
    - Plant boiler design steam conditions are pressure 60bar(a), temperature 420°C. To ensure calculations are appropriately conservative, 65 bar(a) / 420°C has been assumed as a worst case.
    - Boiler size estimate at 1.6m diameter and 12m in length, based on 275,000 tonne/year (waste) - a thermal capacity of around 97MWth (LCV basis).

- Steam turbine 28.2MW electrical gross output.
- Waste fuel is domestic refuse, CV of 10 GJ/tonne net.
- 275,000 tonnes/year waste

- The CHP supply network heat demand has been estimated at 78.185 MWh (Reference 3)

3 POTENTIAL HAZARDS TO DOCKYARD

The desk study identified four hazards (faults) with a potential to affect the Dockyard Site. These were as follows:

- Turbine Blade Ejection (Missile Hazard) (Faults 20 and 21, in Table 1)
- Burst Steam Drum (Explosion Hazard) (Fault 19)
- Burst High Pressure Gas Cylinder (Missile Hazard) (Fault 2)
- Exploding Acetylene Gas Cylinder (Explosion Hazard) (Fault 7)

These hazards are considered in detail below.

3.1 TURBINE BLADE EJECTION (MISSILE HAZARD)

There is a risk that in the event of catastrophic turbine failure a turbine blade might be ejected with considerable force and could be propelled towards the dockyard site.

A turbine blade will be ejected by centrifugal inertia in a direction perpendicular to the axis of rotation of the turbine rotor. A well documented example of catastrophic turbine failure occurred at Hinkley Point 'A' nuclear power station (closed in May 2000) when the No. 5 turbine generator suffered a catastrophic failure on September 19, 1969. The rotor shaft fractured completely in five positions, and three discs of the low-pressure A rotor came free from the unit and were ejected from the turbine house – all three discs were ejected in a direction approximately perpendicular to the axis of rotation of the turbine rotor (Reference 4).

In each of the plant layouts currently being considered, the orientation of the turbine is such that no part of the Dockyard site is close to the line perpendicular to the axis of rotation of the turbine rotor. Therefore under the three plant layouts under consideration, catastrophic turbine failure does not threaten the dockyard site.

3.2 BURST STEAM DRUM (EXPLOSION HAZARD)

There is a risk that a steam drum exploding at the EfW plant will produce a shock wave of sufficient magnitude to be a hazard to the Dockyard site. The closest and therefore most vulnerable part of the Dockyard site is 14 Wharf, which the DESAG report identifies as 320 to 550 metres from the EfW plant (Reference 5). It is noted that the original DESAG report was produced in consideration of an earlier (circa April 2009) plant layout, which placed the EfW plant slightly closer to the Dockyard site than the three layout options currently being considered.

The steam drum at the EfW site in the current design has a diameter of 1.6m and is 12m in length, has a volume of 24.13m^3 and is assumed to operate at 65 bar(a).

Steam at 65 bar(a) has a specific enthalpy of 2.78E+06 J/kg (Reference 6) and a saturation temperature of 280.9℃. Steam at 65 bar(a) has a constant volume specific heat of 2621.86 J/kg, so 3.65E+05 J/kg are required to raise the steam from 280.9℃ to 420℃.

The specific enthalpy of steam at 65 bar(a) and 420℃ can therefore be calculated as 3.14E+06 J/kg.

The specific enthalpy of water at atmospheric pressure and 25℃ is 1.05E+05 J/kg. Therefore the energy required to raise water from 25℃ at atmospheric pressure to steam at 420℃ at 65 bar(a) is 3.04E+06 J/kg.

Steam at 65 bar(a) and 420℃ has a density of 22.12 kg/m^3 (Reference 3) therefore the 24.13m^3 steam drum will contain 534kg of steam.

Pessimistically assuming an explosion releases all of the energy required to raise 534kg of steam at 420℃ at 65 bar(a) from 25℃ at atmospheric pressure, the explosive energy will be 1.62E+09 J.

The explosive energy of 1 kilo of TNT is equivalent to 4.18E+06 J (Reference 7). Therefore the explosive energy of the exploding steam drum can be equated to 387.57 kg of TNT.

The HSE recommends that the minimum safe distance between brick built, unmounded buildings containing 300-400 kg of HT1 category explosives and inhabited buildings, public traffic routes and public spaces is 320m (Reference 8).

Considering the pessimism in the above calculation, an explosion from the steam drum will not threaten the nuclear safety implicated buildings of the Dockyard (which are all greater than 320m from the proposed EfW plant) or ships at 14 Wharf (the minimum distance from 14 Wharf to the proposed EfW plant is 320m. Note the distance from the steam drum to the 14 Wharf will be greater than 320m).

3.3 BURST GAS CYLINDER (MISSILE HAZARD)

A burst gas cylinder (e.g. gas bottles that might be used in stack emissions monitoring or found as an item of non-conforming waste) has the potential to threaten the Dockyard site if the gas cylinder is propelled by the escaping gas and forms a missile.

A burst high pressure gas cylinder has the potential to threaten the Dockyard site if the gas cylinder is propelled by the escaping gas and forms a missile.

The worst case is that in which the energy of the gas contained in the cylinder instantaneously propels the gas cylinder into the air towards the Dockyard (this pessimistic scenario is unrealistic but bounding).

The energy of explosion of a pressurised gas cylinder instantaneously discharging its content is equivalent to the energy required to raise the pressure of the gas at constant volume from atmospheric pressure to the initial or burst pressure. It is thus the difference in the internal energies of the gas at the initial and final pressures. The internal energy is:

$$E = \frac{PV}{\gamma - 1}$$

Where E is the internal energy, P is the absolute pressure in the cylinder and V is the volume of the cylinder. γ is the adiabatic index of the gas (= 1.66 for monatomic gases, 1.4 for diatomic gases).

This leads to Brode's equation for energy of explosion (Reference 9):

$$E_{Br} = \frac{(P_1 - P_0)V}{\gamma_1 - 1} \qquad (1)$$

Where E_{Br} is the energy of explosion and the subscripts 1 and 0 denote initial vessel and atmospheric respectively.

Pessimistically assuming all the energy of explosion is converted to kinetic energy, the cylinder will be propelled with a velocity v_{cyl}. The Newtonian equation for kinetic energy E_{KE} of cylinder with mass m_{cyl} can be rearranged to calculate v_{cyl} :

$$v_{cyl} = \sqrt{\frac{2E_{KE}}{m_{cyl}}} \qquad (2)$$

Substituting Brode's equation (1) above into (2) gives the velocity of the cylinder in the event that all of the energy of explosion is converted to kinetic energy:

$$v_{cyl} = \sqrt{\frac{2(P_1 - P_0)V_{cyl}}{(\gamma_1 - 1)m_{cyl}}} \quad (3)$$

Neglecting air resistance, the distance that a projectile will travel is at a maximum when the initial vector is 45º from the horizontal. A projectile launched at 45 degrees over level ground will travel a maximum distance d_{max}:

$$d_{\max} = \frac{v^2}{g} \quad (4)$$

Where g is gravitational acceleration. Substituting (3) into (4) gives an equation for the maximum distance a gas cylinder will travel if all of the internal energy of the stored gas is instantaneously converted to kinetic energy:

$$d_{\max} = \frac{2(P_1 - P_0)V_{cyl}}{(\gamma_1 - 1)gm_{cyl}} \quad (5)$$

The highest pressure gas cylinders used may operate at up to 300bar(a) (3.06E+07Pa). Taking atmospheric pressure at 1.01E+05Pa and the acceleration of gravity as $9.81ms^{-2}$, equation (5) above can be used to calculate d_{max} for a range of BOC pressure cylinders:

BOC Cylinder Size (Air Products Code)	Average Tare Weight (kg) (Reference 10)	Average Internal volume (m^3) (Reference 10)	d_{max} (m)
300 (A)	62	0.0498	757
200 (B)	54	0.0439	766
80 (C)	26	0.0159	576
30 (D-1)	12	0.0074	581
12 (D)	4	0.0028	659
LB (LB)	0.9	0.00043	450

The calculation suggests that there is potential for a gas cylinder missile to reach the Dockyard site, although the calculation above is extremely pessimistic (it may be unrealistic to assume all of the energy of the compressed gas will be instantaneously converted to kinetic energy, it is highly unlikely that the cylinder would be propelled at an angle of 45 degrees to the horizontal plane).

Since the EfW plant is more than 320m from nuclear safety implicated locations, it is highly unlikely that burst gas cylinders at the EfW plant could threaten the Dockyard Site. However, to ensure the risk is ALARP, it is recommended that HSE guidance on the use of gas cylinders be strictly adhered to at all times (Reference 11).

It is interesting to note that the hazard posed by burst small commercial gas cylinders is explored in the Cranfield University Department of Materials and Applied Science paper *Effects of fire on small commercial gas cylinders* (Reference 12). This paper compares burst gas cylinders as projectiles with the ballistics of rubber bullets and concludes that the range over which the kinetic energy of a burst gas cylinder is likely to be capable of creating injuries is estimated to be less than 30m.

3.4 EXPLODING ACETYLENE GAS CYLINDER (EXPLOSION HAZARD)

The most energetic gas used in cylinders at the EfW plant is acetylene, which may be used in plant construction and may be kept on site for undertaking welding repairs to components. There is potential for an exploding acetylene gas cylinder to threaten the Dockyard Site.

The full and empty weights of various sizes of acetylene cylinders are given in Reference 13. The empty and full weights can be used to calculate the mass of acetylene in each cylinder. The enthalpy change for an acetylene gas explosion can be calculated as 300.096 kcal/mol (Reference 14). This can be used to calculate the explosive energy in the acetylene in each size of cylinder, which can be expressed as a TNT mass equivalent, as below:

Acetylene Cylinder Size	Empty Weight (lbs)	Full Weight (lbs)	Empty Weight (kg)	Full Weight (kg)	Mass of Acetylene (g)	Gram Moles of Acetylene	Energy of explosion (Kcal)	Equivalent TNT (kg)
MC	7.5	8.5	3.41	3.86	455	17.48	5.25E+03	5.25
B	22.5	25.5	10.23	11.59	1364	52.45	1.57E+04	15.74
1	47	52.5	21.36	23.86	2500	96.15	2.89E+04	28.86
2	70	79	31.82	35.91	4091	157.34	4.72E+04	47.22
3	100	113	45.45	51.36	5909	227.27	6.82E+04	68.20
4	175	197.75	79.55	89.89	10341	397.73	1.19E+05	119.36
5	185	209.75	84.09	95.34	11250	432.69	1.30E+05	129.85

An explosion of the largest acetylene cylinder could produce an explosive energy equivalent to 129.85kg of TNT. This is considerably less than the explosive energy of the steam drum calculated above.

An acetylene cylinder exploding at the EfW plant will therefore not pose a threat to the Dockyard site.

3.5 NUCLEAR BERTH IMPLICATIONS

The nearest wharf to the proposed Energy from Waste (EfW) plant is 14-Wharf located adjacent to Western Mill Lake. 14-Wharf lies between 320 to 440 metres from the EfW Plant. It is a further 300m from 14-Wharf to the 9-Wharf Tidal X Berth giving a total separation distance of ~720m from the EfW Plant to the nearest nuclear safety related berth at risk from an explosion at the EfW plant. The blast effects will typically scale with the inverse cube law which relates radius to volume. Thus at a distance of 720m from the explosion, the energy effects would be significantly reduced from that at the source.

The quiescent explosive limit for vessels berthed at 14-Wharf in relation to nuclear safety is 106,000 kg TNT (Reference 15). The total NEQ for the EfW Plant from the most significant failure identified in the document is circa 387 kg TNT. This equates to 0.37% of the 14-Wharf berthing limit at a distance of 300m from 9-Wharf.

Therefore allowing for attenuation of the blast energy due to distance of the EfW Plant from the nuclear berths coupled with the likely ENEQ from the plant being < 387 kg TNT it is possible to state that the EfW ENEQ is fully bounded by the existing berthing ENEQ limits at HMNB Devonport.

3.6 BABCOCK NUCLEAR FACILITY IMPLICATIONS

Certain Babcock nuclear facilities are of a similar order of distance to the EfW plant compared to 14-Wharf but these are considered bounded in terms of nuclear safety by the use of a MoD / Babcock Joint Procedure for Surface Vessel and Conventional Submarine Berth Allocation at Devonport and the fact that the NEQ of the EfW is very much smaller that the current berth limits.

4 POTENTIAL SAFETY CHALLENGES TO THE EFW PLANT FROM NBC(D) & BABCOCK PROCESSES ON THE DEVONPORT SITE

The purpose of this section is to broadly overview processes that take place on the Devonport site as a whole and ensure no safety shortfall is transferred to the proposed EfW Plant located in North Yard that might affect the workforce at that workplace or result in a failure that would endanger a member of the public.

The processes considered are:

- NBC(D) – Explosive Munitions embarked in HM vessels.
- NBC(D) – Authorised Site Nuclear activities
- Babcock – Licensed Site and Authorised 5 Basin activities
- Babcock and NBC(D) Emergency arrangements

4.1 EXPLOSIVE MUNITIONS EMBARKED IN HM VESSELS

Devonport Explosive Safety Advisory Group (DESAG) has undertaken a review of the Berthing of HM Vessels with munitions embarked regarding potential explosive damage occurring to the EfW/CHP facility proposed location. (Reference 5)

This concludes that there is no reason to object to the EfW Plant site since it lies outside the embarked munitions damage criteria range.

The DESAG review did recommend one Risk Reduction Measure (RRM), namely to minimise glazing in the building and where glazing is required, to fit shatterproof glass or alternative mitigation measures.

4.2 NBC(D) AUTHORISED SITE NUCLEAR ACTIVITIES

Nuclear activities included in each NBC(D) Authorised Site Safety Case have been considered and an assessment of the hazard that may be transferred to the EfW Plant has been made for each activity.

Table 6 lists each NBC(D) Authorised Site Safety Case together with the associated nuclear activities, approximate distance from the activity to the boundary of the proposed EfW Plant (accurate to within 50m) and the assessment of the hazard to the EfW for each Safety Case.

The assessment concluded that the EfW Plant will be relatively immune from interaction with NBC(D) Authorised Site nuclear activities with the exception of the occurrence of a reactor accident, in which case the EfW Plant may have to shut down as a precautionary measure (See Section 4.4 below).

4.3 BABCOCK LICENSED SITE AND AUTHORISED 5 BASIN ACTIVITIES

Nuclear activities included in each Babcock Licensed Site and Authorised Site Safety Case have been considered and an assessment of the hazard that may be transferred to the EfW Plant had been made for each activity.

Table 7 lists each Babcock Licensed Site and Authorised Site Safety Case together with the associated nuclear activities, approximate distance (accurate to within 50m) from the activity to the boundary of the proposed EfW Plant and the assessment of the hazard to the EfW for each Safety Case.

The assessment concluded that the EfW Plant will be relatively immune from interaction with Babcock Licensed Site and Authorised Site Safety Case nuclear activities with the exception of the occurrence of a reactor accident, in which case the EfW Plant may have to shut down as a precautionary measure, as noted above in Section 4.2 and below in Section 4.4.

4.4 BABCOCK AND NBCD EMERGENCY ARRANGEMENTS

HMNB and Babcock have joint Emergency arrangements in place, principally to deal with Reactor Accidents and minimise the consequences of such an accident to submarine crews, workers on site and off-site members of the public. However, it should be noted that whilst this event is extremely unlikely legislation requires that an on-site and off-site emergency plan is published for the evacuation of personnel.

A proposal has been made to construct an Energy from Waste (EfW) plant on land in the northern part of the Naval Base. The land designated for the EfW plant will be fenced out of the Naval Base with its own access routes and no direct access to the Naval Base site. The plant will be on land leased to the EfW developer. The key issues arising from the introduction of the EfW plant and the emergency arrangements are as follows:

1. Does the operation of an EfW plant introduce any additional hazards that might effect the assessment of a Reasonable Foreseeable event on which the current emergency arrangements are based?
2. Are there any potential temporary or permanent changes required to either the on-site or off-site Emergency Arrangements as a result of the EfW plant?
3. Will there be any requirements placed upon the EfW plant operator during construction or operation of the plant?

This safety statement has identified the hazards that could potentially be introduced to the Dockyard Site by the construction, commissioning and operation of an EfW plant. Safeguards and mitigating factors that are required to reduce the risk posed by such hazards to an acceptable level were also identified. This safety statement identifies that there are no additional hazards that might affect the assessment of a Reasonable Foreseeable event on which the current emergency arrangements are based.

Within North Yard all areas within the Naval Base security fence are currently defined in DEVNUSAFE as requiring sheltering in the event of a radiation emergency. Currently the site for the proposed EfW would fall within that zone. However the plans are to change the boundary of the Naval Base security fence to ensure the EfW plant although on Naval Base leased land is not within the Naval Base. The proposed site is at approximately 720m from 9 wharf and therefore not within the Automatic Countermeasures Zone of 500 m. As an off-site facility the EfW plant would fall within the scope of the Plymouth City Council off-site plan. Essentially the site is no different to the school outside the entrance to Camels Head Gate. In conjunction with the process to develop the lease the NAEA FO will need to change the specified size of the sheltering zone relating to shelter station B (Wyvern Centre) to reflect the change in the Naval Base boundary.

During the normal operating regime the EfW plant is expected to have no more than 40 people working on site. During the operating phase the plant will have direct line communications to the Babcock Control Engineer as it will be supplying heat and electricity into the Naval Base. Plants of this type are easily and swiftly able to be shutdown and so an operating philosophy in event of a radiation emergency would need to be agreed between the EfW plant operator, the Naval Base and Plymouth City Council.

The construction and commissioning phase however will result in a much larger number of people on site, upwards of 300. The supporting documents for the EfW plant will need to identify the potential hazards from the adjacent Naval Base, radiation emergency, helicopter flights, presence of munitions amongst others and the requirement for the EfW plant project to liaise with the Naval Base and Plymouth City Council over these aspects. Once the project is initiated then the emergency arrangements of the contractor would need examination by the Naval Base and Plymouth City Council. Site emergency arrangements are required by the contractor under the CDM regulations. These will need to reflect the hazards associated with the Naval Base. The EfW implementation contractor will be required to instigate site emergency plans to respond to any potential emergency on the adjacent Naval Base site and be able to communicate with those at the strategic and tactical level within the Naval Base and Plymouth City Council responding to the event.

5 POTENTIAL HAZARDS TO THE PUBLIC

A number of domestic dwellings and public highways lie within close proximity of the proposed EfW plant location. Planning applications for the EfW Plant will need to consider the risks and environmental impact to the public and demonstrate that they are acceptable.

During the basic design phase of the project a HAZOP analysis will be carried out to provide a systematic and thorough evaluation of process hazards and ensure that the necessary control and safety systems are in place.

The potential supplier of the proposed EfW plant, MVV Umwelt GmbH supplied a Safety Statement that identifies the measures that will be taken to ensure any hazards to the public from the EfW plant will be appropriately managed. A copy of the Safety Statement produced by MVV Umwelt GmbH is included as Annex 1.

6 CONCLUSIONS

The study has concluded that the hazards presented by the EfW plant to the Dockyard site are steam drum explosion, gas cylinder explosion, gas cylinder missile and turbine blade missile in the event of catastrophic steam turbine failure (the most onerous cases are steam drum explosion and turbine blade ejection).

The orientation of the proposed turbine in each of the proposed EfW plant layout options ensures that if a turbine blade fragment were ejected, the vector of turbine blade fragment would not be in the direction of the Dockyard.

The total energy required to raise the steam in the steam drum is equivalent to the explosive energy of ~380kg of TNT, however it is unrealistic to expect that all of this energy would be released as explosive energy if the steam drum burst. In any case, the proposed EfW plant is a suitably safe distance from any vulnerable locations in the event that this energy was released as an explosion.

A gas cylinder missile propelled from the EfW plant by the rapid escape of gas e.g. in the event of a damaged valve or regulator could present a hazard at the Dockyard Site but the number and nature of assumptions make the risk very low, especially if construction site precautions are considered.

Gas cylinder explosions would not produce an explosive energy sufficient to pose a threat to the Dockyard site.

No explosion identified in the document has the potential to have any direct nuclear safety related consequences.

It is recommended that NBC(D) advises the EfW contractor of the safeguards and mitigation identified in the hazard study in order that they may be fully incorporated in the final plant design and CDM File as appropriate and that also includes the requirements to integrate with the Naval Base and Local Authority emergency arrangements.

It is recommended that NBC(D) ensures that the Safety Statement Assessment is maintained throughout the life of the proposed EfW Plant, and that a management arrangement is contractually implemented to ensure that the EfW Plant is not modified in design, build, commission and operation that will invalidate this Statement, except under a controlled procedure which ensures that any design or operational changes take account of the conclusions of this Safety Statement and conversely that the Safety statement is maintained to be consistent with accepted changes to the design and operation of the EfW plant.

7 REFERENCES

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2 Provisional Devonport EfW Plant data provided by MVV, email from Jan Grotmann-Hoefling dated 18th February 2010.

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13 Air Products Acetylene Safetygram-13, www.airproducts.com/nr/rdonlyres/9d325c49-7c62-41e5-aa0b-8411db4d84f8/0/safetygram13.pdf

14 Section 17/24, Loss Prevention on the Process Industries, Hazard Identification, Assessment and Control, Second Edition, 1990, Frank P Lees.

15 NBC/FSC/100 Annex R FSC 100 ANNEX R – OPERATING RULES AND OPERATING INSTRUCTIONS, Issue 03 Dated July 2004

Table 1 – Fault Sequences with potential to affect the EfW site

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010						
ID	**Fault Sequence**	**Consequence**	**Frequency**	**Safeguards/Mitigation**	**Risk to Dockyard Site**	**Comment**
Construction						
1	Damage to gas bottle or valve resulting in loss of gas containment, ignition from heat source or spark resulting in exploding gas bottle.	Exploding gas bottle. Serious Dockyard consequence.	Remote	Standard construction site safety measures.	Too far away to give credible risk to Dockyard Site. **Broadly acceptable.**	
2	Damage to gas bottle regulator or valve resulting in catastrophic loss of gas, and bottle becoming a projectile to cause impact damage adjacent to plant.	Impact damage beyond EfW plant. Serious Dockyard consequence.	Remote	Standard construction site safety measures.	Gas bottle projectile hazard. **Tolerable with demonstration of ALARP**	
3	Leak from gas main resulting in loss of gas containment, ignition from heat source or spark resulting in explosion.	Explosion or fire on construction site. Minor Dockyard consequence.	Remote	Construction sequence will ensure gas is not piped onto site until appropriate equipment is installed to mitigate the hazard.	No credible risk to Dockyard Site. **Broadly acceptable.**	
4	Cranes used in construction topple, impact hazard.	Impact damage from toppling cranes. Minor Dockyard consequence.	Remote	Cranes will be at least 350m from the nearest submarine berth (Reference 5)	Too far away to give credible risk to Dockyard Site. **Broadly acceptable.**	

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010						
ID	**Fault Sequence**	**Consequence**	**Frequency**	**Safeguards/Mitigation**	**Risk to Dockyard Site**	**Comment**
Commissioning						
5	High Voltage electrical switching faults, particularly during plant commissioning.	Potential to affect the electrical supply at the Dockyard site. Minor Dockyard consequence.	Remote	The Commissioning will be integrated via the Cross Site Services Authorisation Group (XSAG) and de-conflicted from intermittent higher risk activities in other Safety Cases.	No credible risk to Dockyard Site. **Broadly acceptable.**	The CHP electrical output is of similar size to Dockyard Site demand.
Waste Fuel Handling						
6	Heat source / source of ignition in waste bunker ignites waste, resulting in fire in the waste bunker. Potential sources of ignition include hot ash or smouldering fires in waste trucks, auto-ignition of waste, other ignition sources e.g. cigarette lighters in waste.	Fire in waste bunker. Negligible Dockyard consequence.	Occasional	Fire detection/suppressant systems (water sprinklers / deluge systems) will be used and are proven in use at other plants. In the event of a large bunker fire it may be appropriate to allow the fire to burn out.	No credible risk to Dockyard Site. **Broadly acceptable.**	The distance from the EfW plant to submarine berths / nuclear safety implicated buildings at the Dockyard is much greater than that which would cause radiation heat concerns.
7	Gas bottle (e.g. acetylene cylinder or cartridge) in waste. Damage to gas bottle or valve resulting in loss of gas containment, ignition from heat source or spark resulting in exploding gas bottle in tipping hall, waste bunker or waste chute.	Exploding gas bottle. Minor Dockyard consequence.	Occasional	Tipping wall / waste bunker / waste chute are contained inside a building.	Too far away to give credible risk to Dockyard Site. **Broadly acceptable.**	

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
8	Trucks delivering waste to site interfere with traffic routes for other Dockyard facilities.	Disruption to other activities at Dockyard Site. Negligible Dockyard consequence.	Occasional	Truck will have dedicated route to the EfW plant.	No risk to Dockyard Site. **Broadly acceptable.**	
9	Biohazard in raw waste allowed to spread across Dockyard Site.	Biohazard at Dockyard. Minor Dockyard consequence.	Remote	Tipping hall and waste bunker are kept under negative pressure by the furnace primary induction fans to maintain ventilation containment.	No credible risk to Dockyard Site. **Broadly acceptable.**	Clinical waste will not be accepted.
Furnace (including air supply, start-up fuel and ash handling)						
10	Fast burning material (e.g. gas bottles, etc) in waste incinerated leading to explosion in furnace.	Explosion in furnace. Minor Dockyard consequence.	Occasional.	Furnace is designed to contain explosions resulting from fast burning fuel. MVV states that the furnace is designed to withstand an internal blast from a Calor gas cylinder explosion.	No credible risk to Dockyard Site. **Broadly acceptable.**	
11	Startup fuel (light fuel oil) ignites in storage resulting in an explosion.	Explosion. Minor Dockyard consequence.	Occasional	Fuel oil will be a light fuel oil and would not present a significant risk of explosion. Fuel tank would be double skinned	No credible risk to Dockyard Site. **Broadly acceptable.**	

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
12	Seismic event (e.g. earthquake) results in loss of containment of startup fuel oil and coincident loss of bunding containment. Fuel oil leaks into the Weston Mill Lake and subsequent oil pool catches fire and flows towards ships, submarines and facilities.	Oil fire in Weston Mill Lake. Serious Dockyard consequence.	Remote	Light fuel oil is non-explosive. Oil tanks will be double skinned. Bunded areas around oil tanks will be carefully designed.	In consideration of safeguards, **broadly acceptable.**	The EfW Plant will be constructed to commercial standards. Collapse or dislocation of systems will not affect distant nuclear facilities, ships or the public.
13	Emissions from incinerating waste cause respirable hazard at Dockyard.	Health hazards to Dockyard Site workers or public (N_2O, SO_2). Minor Dockyard consequence.	Remote	N_2O – design (staged combustion) + ammonia (flue gas monitored). SO_2 – controlled by adding lime.	No credible risk to Dockyard Site. **Broadly acceptable.**	EfW plant will be designed to stringent emissions standards and come under Environment Agency (EA) authorisation for emissions.
13	Corrosions to boiler tubes resulting in boiler tube failure, high pressure steam ejected into furnace resulting in furnace overpressure spike.	Furnace overpressure spike. Negligible Dockyard consequence.	Remote	Standard boiler design / plant systems; safety valves and appropriately specified pipework. Boiler tube thicknesses will be measured regularly. In event of leak, plant would be shutdown and repaired. Detection is simple. Furnace overpressure spike would not result in furnace containment failure but would result in pressure spike through FGT plant. FGT plant is design to cope with pressure spikes.	No credible risk to Dockyard Site. **Broadly acceptable.**	
Flue Gas System (including fly ash handling)						

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
14	Damage to flue gas ductwork resulting in loss of flue gas containment.	Flue gas leaks. Negligible Dockyard consequence.	Remote	Good plant design. Pressure control systems ensure flue ducts are held at negative pressures. Flue gas treatment is enclosed in a separate building. Flue gas is acidic but will not be highly corrosive over any feasible period of loss of containment.	No credible risk to Dockyard Site. **Broadly acceptable.**	
15	Spilt fly ash.	Loss of control of fly ash. Minor Dockyard consequence.	Occasional	Good plant design and construction. Fly ash is a dust which will be contained by design. Possibly toxic but is inert.	No credible risk to Dockyard Site. **Broadly acceptable.**	Control of fly ash also subject to EA monitoring.
16	Spilt process chemicals (activated carbon, sodium bicarbonate, lime, etc).	Chemical hazard. Minor Dockyard consequence.	Occasional	Process chemicals (activated carbon, sodium bicarbonate, lime) are not hazardous.	No credible risk to Dockyard Site. **Broadly acceptable.**	
Steam and condensate, including steam turbine						
17	Corrosion to steam pipes and condensate systems leading to steam leaks.	Steam leaks. Negligible Dockyard consequence.	Occasional	Design and maintenance of plant.	No credible risk to Dockyard Site. **Broadly acceptable.**	Steam leaks have potential for injury to personnel and disruption to operations however present no risk to surrounding Dockyard Site.

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
18	Steam drum explosion.	Explosion, potentially resulting in missile ejection beyond EfW site boundary. Critical Dockyard consequence.	Remote	Steam conditions are monitored and controlled. The steam drum will be designed and constructed to recognised standards and have typical protection features. All pressure systems within the facility will be tested annually by a specialist insurance inspection authority	Steam drum burst explosion. **Tolerable with demonstration of ALARP**	No credit is taken for the building shielding effect since the steam drum may be higher than the structures between the steam drum and the Dockyard Site.
19	Turbine oil vaporises and explodes while running, catastrophic turbine failure, turbine blades are ejected.	Turbine blades ejected in worst case. Critical Dockyard consequence.	Remote	Turbine protection systems monitor and protect the turbine.	Ejected turbine blade - missile hazard. **Tolerable with demonstration of ALARP**	Turbine orientation removes the threat to the Dockyard Site.
20	Mechanical failure of turbine components, catastrophic turbine failure, turbine blades are ejected.	Turbine blades ejected in worst case. Critical Dockyard consequence.	Remote	Turbine protections systems.	Ejected turbine blade - missile hazard. **Tolerable with demonstration of ALARP**	Turbine orientation removes the threat to the Dockyard Site.
Feed Water System						
21	Component failure in feed water system leading to burst.	Feed water system burst. Minor Dockyard consequence.	Remote	Will not be energetic enough to threaten Dockyard.	No credible risk to Dockyard Site. **Broadly acceptable.**	
Levels and layout						

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
22	Spillage during deliveries.	Chemical spills. Minor Dockyard consequence.	Occasional	Delivery points are bunded areas where appropriate. Where hazardous chemicals are delivered, bunding capacity will be at least 110% of the largest tank volume. Exclusion zone during chemical deliveries. Evacuation zone away from chemical tanks during deliveries.	No credible risk to Dockyard Site. **Broadly acceptable.**	Plant designed to contain spillages of chemicals.
23	Fire in plant (various possible initiating events).	Plant fire. Minor Dockyard consequence.	Occasional	Fire barriers within structure. Fire water tank. Hydrants located around site, with good access.	No credible risk to Dockyard Site. **Broadly acceptable.**	The distance from the EfW plant to submarine berths / nuclear safety implicated buildings at the Dockyard is much greater than that which would cause radiation heat concerns.
24	Site floods, waste is washed out of the plant.	Waste washed into Dockyard Site. Minor consequence to Dockyard.	Remote	Site is elevated or will have barriers to prevent uncontrolled water run-off..	No credible risk to Dockyard Site. **Broadly acceptable.**	Environmental Impact Assessment statement will demonstrate that flooding will not result in a loss of material off site as far as is reasonably practicable.
25	Site floods, process chemicals are washed out of the plant.	Process chemicals washed into Dockyard Site. Minor consequence to Dockyard.	Remote	Site is elevated or will have barriers to prevent uncontrolled water run-off..	No credible risk to Dockyard Site. **Broadly acceptable.**	

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
26	Site floods, bottom ash treatment area floods, suspended solids in water.	Potential to affect cooling water systems in ships berthed at Dockyard Site. Minor Dockyard consequence.	Remote	Site is elevated or will have barriers to prevent uncontrolled water run-off..	No credible risk to Dockyard Site. **Broadly acceptable.**	
27	Stack topples.	Danger of stack falling on Dockyard buildings / berths. Minor Dockyard consequence.	Remote	Stack will be 90-100m tall and will be positioned at least 400 metres from the nearest Dockyard Site vessel berth (Reference 5).	No credible risk to Dockyard Site. **Broadly acceptable.**	The stack should be sited clear of collapse radius from the HV North incomer route. Prevention of collapse of steel chimneys is subject to special HSE advice.
28	Increase in bird / rodent population attracted to waste materials accumulated at EfW Plant. Transfer of activity from Nuclear Licensed and Authorised Site by birds / animals.	Transfer of activity from Nuclear Licensed and Authorised Site to surrounding areas. Minor Dockyard consequence.	Remote	Modern buildings limit bird / animal access. Limited accumulation of legacy waste.	No credible risk to Dockyard Site. **Broadly acceptable.**	In 1999 feral pigeons contaminated a private garden at Seascale from the Sellafield Site. The key deficiency there was accumulated activity in old buildings or areas that had insufficient protection from bird access.
29	Mixing of municipal waste with active waste leaving Licensed Site.	Active waste burned in EfW plant. Minor Dockyard consequence.	Remote	Active waste leaves Babcock site via a route that is totally geographically separated from the route taken by trucks delivering municipal waste to the EfW plant.	No credible risk to Dockyard Site. **Broadly acceptable.**	Active waste subject to consignment controls which mean that mixing with waste bound for EfW not credible.

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
30	Munitions explosion at Authorised Site resulting in a pressure pulse. Sheet metal detaches from the building structure with potential to cause injury to personnel.	Injury to personnel and damage to plant. Minor Dockyard consequence.	Remote	Design calculations to ensure that the sheeting cannot be sufficiently detached to cause worker injury. CDM File will include an entry to ensure sheeting construction is specially checked and maintained in view of this hazard.	No credible risk to Dockyard Site Plant. **Broadly acceptable.**	DESAG report (Reference 5) recommends an EfW/CHP plant Risk Reduction Measure (RMM) to minimise window glass and use blast resistant glazing. The DESAG work has raised no objection to the siting of the EfW/CHP regarding the ship berth arrangements. However a pressure over pulse will be experienced at the plant which will likely be a skeletal sheeted structure.
31	Low flying risk – tall structures (stack, also transient construction risk introduced by cranes used during construction and during Major Outage periods). Collision hazard to low flying aircraft e.g. helicopters.	Increased risk of low flying aircraft collision with plant structures / cranes. Minor Dockyard consequence.	Remote	Pilots will be made aware of any tall structures introduced in the vicinity of flight paths through an amendment to the Helicopter Landing Handbook. However, stringent management arrangements are in place to mitigate the risk from Low flying aircraft Tall structures will be fitted with navigation lights in compliance with the Civil Aviation Authority Regulations and MoD Joint Service Procedure 554.	No credible risk to Dockyard Site Plant. **Broadly acceptable.**	Whilst aircraft crash is a contributor to NBC(D) and Babcock safety case risk, the crash frequency in the Licensed/Authorised Site is very low and the EfW plant would not present an unacceptable hazard to helicopters operating from the WML helo landing site.

Proposed Devonport EfW CHP Plant HAZARD ANALYSIS 11th February 2010

ID	Fault Sequence	Consequence	Frequency	Safeguards/Mitigation	Risk to Dockyard Site	Comment
32	Increase in the bird population attracted to waste materials accumulated at site. Increased bird hazard to low flying aircraft e.g. helicopters.	Increased bird strike hazard to low flying aircraft . Minor Dockyard consequence.	Remote	Waste is handled and stored inside a building. Any waste spillage outside the building will be carefully controlled.	No credible risk to Dockyard Site. **Broadly acceptable.**	Helicopter flight paths are included on the Plant layout diagrams in Figures 1-3.
High Voltage Electricity						
33	Transformer fire, oil in transformer explodes.	Injury to personnel and damage to plant. Minor Dockyard consequence.	Remote	Transformer will be surrounded by a blast wall around it capable of containing any possible explosion fragments.	No credible risk to Dockyard Site. **Broadly acceptable.**	
Decommissioning						
34	Conventional safety hazards arising during plant decommissioning (e.g. during demolition).	Injury to personnel. Minor Dockyard consequence.	Remote	Standard demolition site safety measures.	No credible risk to Dockyard Site. **Broadly acceptable.**	Hazard analysis for eventual decommissioning must be completed to ensure that no Safety Issues will arise as a consequence of demolition works and return to Greenfield status of the EfW Plant site.

Table 2 – Consequence Definitions

Consequence	Definition
Catastrophic	Multiple deaths on site, or single death off site.
Critical	Single death and/or severe injuries to more than one person, or occupational illness on site; injury or illness off site.
Serious	Single severe injury or occupational illness (more than 3 days absence) and / or minor injuries to more than one person, or minor occupational illness.
Minor	Single minor injury/short term absence (3 days or less).
Negligible	Trivial injury (first aid treatment)

Table 3 – Frequency Definitions

Frequency	Definition of likelihood of event
Frequent	Likely to be experienced several times.
Probable	Likely to occur. An event to be expected.
Occasional	Could occur at some time.
Remote	Unlikely to occur, though conceivable.
Improbable	Highly unlikely, but may exceptionally occur.
Incredible	Extremely unlikely that the event will occur at all.

Table 4 – Risk Assessment Matrix

RISK		Consequence				
		Catastrophic	Critical	Serious	Minor	Negligible
Frequency	Frequent	A	A	A	A	B
	Probable	A	A	A	B	B
	Occasional	A	A	B	B	C
	Remote	A	B	B	C	C
	Improbable	B	B	C	C	C
	Incredible	C	C	C	C	C

Table 5 – Risk Acceptability

Risk Class	Acceptability
Class A	**Intolerable** - Such risks are unacceptable and measures shall be taken to reduce the risk.
Class B	**Tolerable with demonstration of ALARP** - Such risks are tolerable provided proper justification is provided in terms of 'ALARP' and Best Practice (see CSP 875) and compliance with statutory regulations.
Class C	**Broadly acceptable -** Such risks are broadly acceptable provided there is compliance with statutory regulations and with normal safety management systems and controls.

Table 6 - NBC(D) Authorised Site Nuclear Activities

Safety Case/ Category	Activity	Approx Distance to EfW Plant (m)	Hazard transferred to EfW Plant
FSC 100 (Cat A)	TXB Safety Case for Berthing submarines at 7(N), 8 and 9 Wharves	720	Nil transferred. Note includes consideration of loading munitions.
FSC 120 (Cat D)	Long Term Berthing of De-fuelled Nuclear Submarines in 3 Basin	1550	Nil transferred
FSC 130 (Cat B)	Long Term Berthing of Fuelled Nuclear Submarines in 3 Basin	1550	Nil transferred
FSC 200 (Cat A)	Plymouth Sound. Z Berths	>5000	Nil transferred
FSC 300 (Cat A)	QHM and Submarine Movements in Dockyard Port	700 (min)	Nil transferred
FSC 500 (Cat C)	Defiance (active materials movements)	720	Nil transferred
FSC 600 (Cat B)	RAMM (Nuclear Fuel movements on/off site)	600 (min)	Nil transferred
NAEA (Cat A)	Nuclear Accident and Emergency Arrangements	Not Applicable	Nil transferred

Table 7 - Babcock Licensed Site and Authorised 5 Basin activities

Safety Case/ Category	Activity	Approx Distance to EfW Plant (m)	Hazard transferred to EfW Plant
PSC 240 (Cat A)	SRC 14 Dock SSN Dockings	700	Nil transferred. Note includes consideration of loading munitions.
PSC 250 (Cat A)	SRC 15 Dock SSN Dockings	750	Nil transferred
PSC 220 (Cat A)	SRC In preparation – Commissioning starts 2011. SSN Defuel facility	700	Nil transferred
PSC Various (Cat B, C)	Various locations – SRC taken as major site. Waste management (solid, liquid & Gaseous)	800	Nil transferred
PSC 180 (Cat A)	By SRC Entrance. Low Level Refuel Facility (Fuel & Neutron Source Storage)	600	Nil transferred
PSC 300	Primary Circuit Decontamination	1200	Nil transferred
PSC290 (Cat A)	9 Dock. TSSBN LOP(R) Docking and defuel/refuel	1200	Nil transferred
PSC 800 (series) Cat C	5 Basin East NEMSFAC	770	Nil transferred
PSC 1100 (Cat A)	9,14,15 Dock to Marshalling Yard. NTR	500 (min)	Nil transferred
PSC 260 (Cat A)	5 Basin Authorised Activity (Submarine X Berths)	520 (5B(E)(N))	Nil transferred
PSC 270 (Cat A)	5 Basin Authorised Activity (X Berths & Power Range Testing at PRT Berth)	700 (PRT Berth)	Nil transferred
PSC 280 (Cat A)	5 Basin Authorised Activity (Submarine Movements & Berthing)	520 (5B(E)(N))	Nil transferred
N/A (Cat 2 SSC)	Site-wide. Cross Site Electrical Distribution (See DSR 033)	Not applicable	Interaction considered in EfW Plant Hazard Analysis. Assessed no additional risk transferred from existing systems to new EfW Plant spur.
N/A (Cat 3 SSC)	Site-wide. Cross Site Mechanical Services (see DSRs)	Not applicable	Nil connection anticipated.
N/A (Cat 2)	Site-wide. Cross Site Communications (See DSRs)	Not applicable	Nil connection anticipated

Figure 1 Plant Layout – Option 1

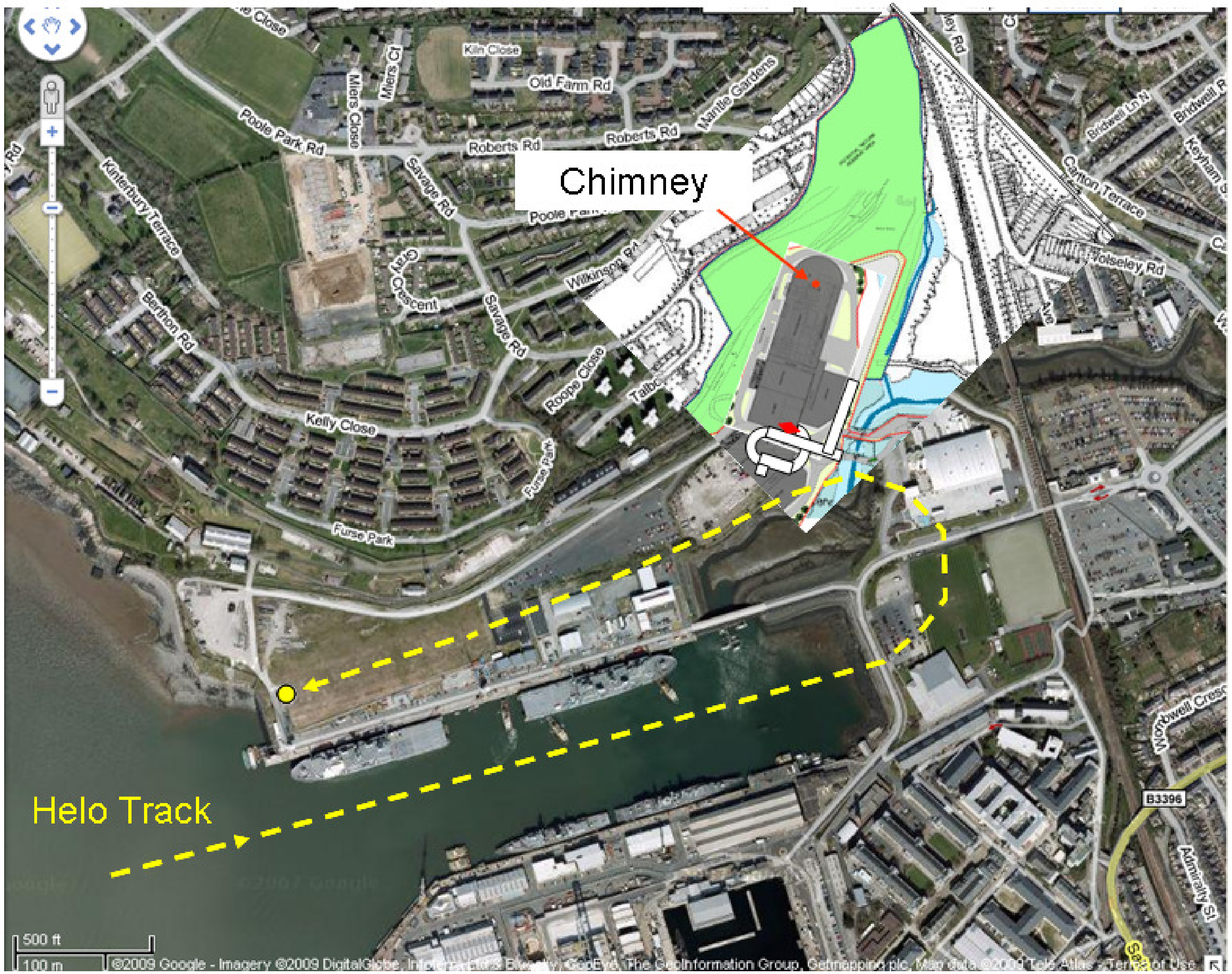


Figure 2 Plant Layout – Option 2

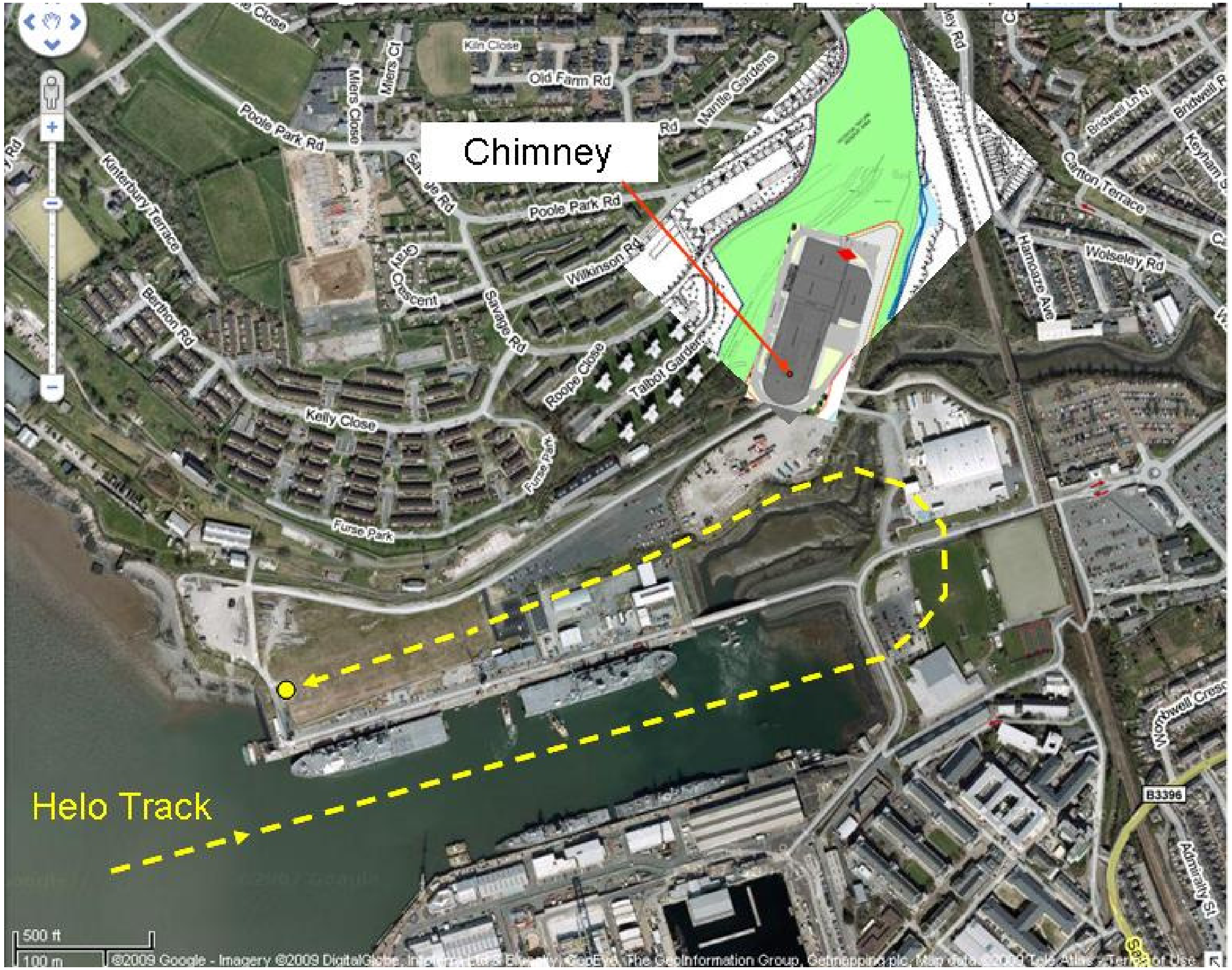
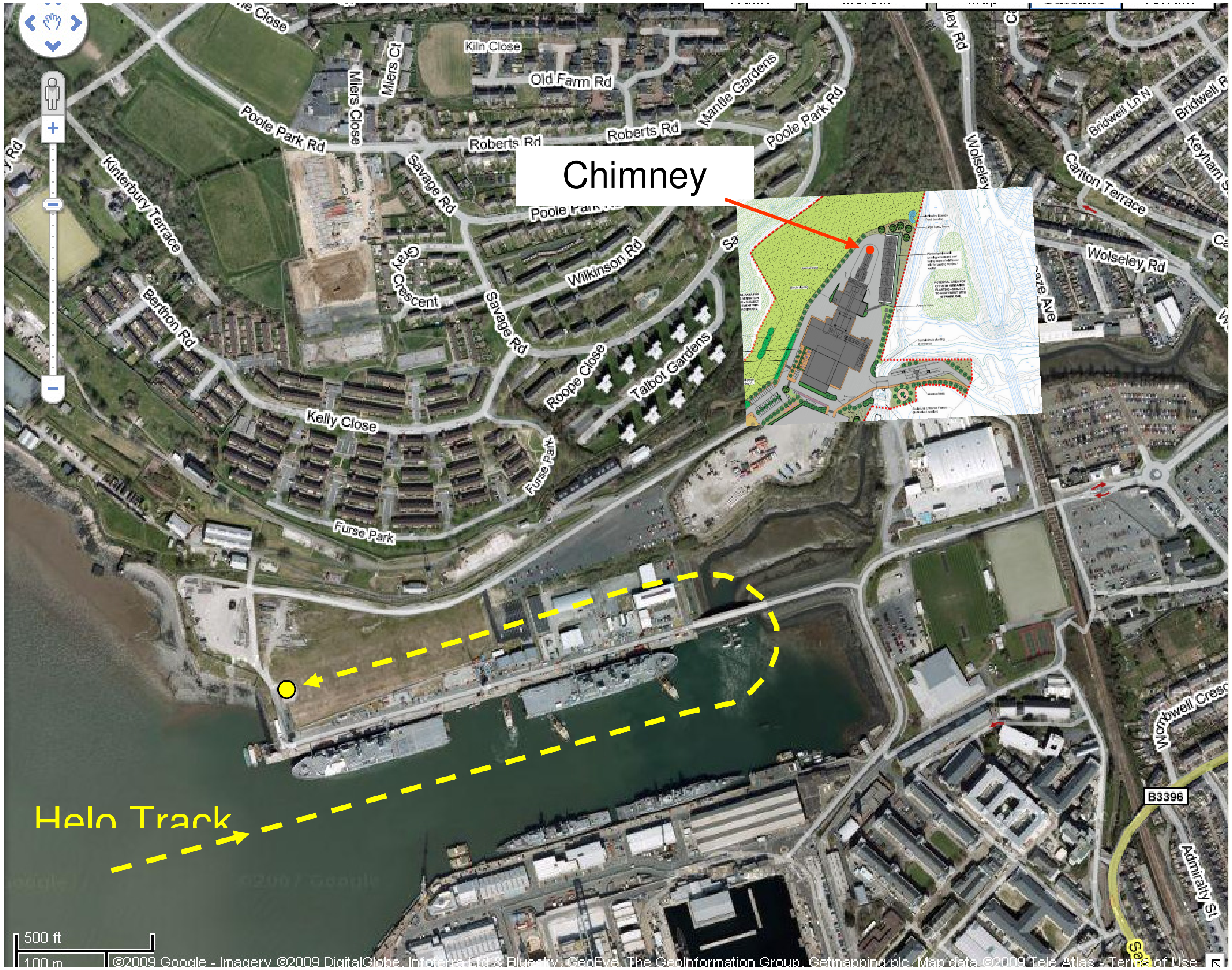


Figure 3 Proposed Plant Layout – Option 3



ANNEX 1 – MVV UMWELT GMBH SAFETY STATEMENT

Topic:

Proposed EfW CHP facility at Devonport Royal Dockyard (North Yard) – Camels Head land shown edged red on attached plan (APDX 1).

Background (as per emails from Dave Jarvis and John Meaken from 8th and 10th February 2010)

MoD need to produce a safety statement which captures the potential hazards and effects an EfW plant situated at Weston Mill could have on Naval base safety.

A recent Plymouth City Council question sought confirmation that the MOD and Civil nuclear regulators had been consulted over the proposed CHP plant.

The Dockyard site is home to Naval ships and submarines that carry weapons. In addition, nuclear refuelling activities take place in North Yard. Each activity is covered by a Safety Case that assesses the internal hazard in the vessel or shore hazardous process against any external hazards (manmade and natural). The proposed CHP plant represents a new external hazard to these vessels and processes. Whilst I do not envisage the hazard from the CHP plant to be unacceptable, a Safety Statement needs to be drafted and presented to the Naval Base Site Safety Committee(SSC) and the Babcock Nuclear Safety Committee(NSC) for noting, followed by review by the Regulators.

I have commissioned Poyry Energy to draft a CHP Safety Statement by 19 Feb 10, for review by the SSC and NSC, to allow a statement to be included in the 5 Mar submission to the SWDWP. In order to achieve this date early information flow would be most appreciated.

The MOD needs the following information in order to assess if there are any risks:

1. Precise location and configuration of the plant, the proposed plant design & materials
2. Construction
3. Technical data about the steam/energy systems
4. Any previous hazard analysis conducted on the proposed or similar type of plant
5. Any documented historical information about previous incidents or any other information which would contribute to identifying hazards/safety risks the plant, through its whole of life operation, could pose to the Naval Base/operations/personnel.
6. Any information you can provide regarding how issues/risks are managed would be useful. (For example, how would none conforming waste eg: a gas cylinder, be dealt with?).

Responses MVV Umwelt

1. **Precise location and configuration of the plant, the proposed plant design & materials**

The technology proposed for the site will be a conventional, proven, grate Energy from Waste (EfW) combustion system.

For the location please see the attached plan (APDX 2). The access route is shown in APDX 3. The position of the various elements of the plant is shown on the drawings. Basically the facility comprises one central building containing all main parts of the process. The only detached parts are the weighbridges and the incinerator bottom ash (IBA) processing plant. The IBA processing plant which will be positioned on the area currently used for dockyard storage adjacent to Weston Mill Lake contains no hazardous operations, plant or materials.

The position of the chimney is indicated on the drawing. The chimney will typically be between 80 and 100m in height.

We believe the plant contains no processes which could be classified as inherently hazardous. Apart from the use of waste as the primary fuel there are auxiliary burners used primarily for start up and shut down which will be fuelled by light fuel oil which is stored in a bunded storage tank within the plant building with appropriate fire protection and detection.

Only small quantities of chemicals are stored on the plant for water and flue gas treatment purposes. Water treatment chemicals (HCl and NaOH) are stored internally in bunded storage tanks. Flue gas treatment reagents are either stored in totally enclosed silos (sodium bicarbonate and activated carbon) or bunded storage tanks (urea or ammonia solution) installed with in the building.

The principal materials of construction of the main facility building are anticipated to be metallic cladding materials (steel or aluminium) on a structural steel frame work with all foundations and internal load bearing structures in reinforced concrete. The chimney will be a steel fabrication. The only use of glass externally will be in the administration building façade which faces away from the dockyard.

2. **Construction**

Construction of the facility will involve the use of the full range of mobile plant including excavators, mobile cranes and piling rigs. It is also anticipated that one or two tower cranes will be installed on the construction site. These cranes would be the tallest structures on site during construction and typically be in the order of 100m total height with 50m to 75m jib radius.

Construction works for the IBA processing facility are minor compared to those on the main site comprising construction of concrete slabs, a low height enclosure (approx 8m max in height) and installation of mechanical plant. Excavators and mobile cranes will be the main plant used for these works.

During the construction of the plant a site office and welfare facility area will be established on the site (exact locations are to be decided). Normal construction hours are expected to be 07:00 to 19:00 during week days with a shorter period applying at week ends. During construction the workforce will be working in all areas of the site with the concentration of manpower varying depending on the phase of construction. The number of workers on site will peak at approximately 350 during the most intensive phase of construction.

3. **Technical data about the steam/energy systems**

Combustion of the waste takes place in the totally enclosed grate/furnace chamber which is robustly constructed, refractory lined and provided with membrane water tube walls. The operating steam parameters of the boiler are 420 ^{0} C and 60 bar. All pressure systems of the boiler and water steam system are designed, constructed and tested to the relevant European codes and Standards and have all relevant safety systems (relief valves, level controls etc.) required by such codes and Standards. The pressure systems will be tested annually by a specialist insurance inspection authority.

High pressure and temperature steam is created by the evaporation of the water which circulates by natural buoyancy through the evaporator sections and super-heaters of the boiler. The high temperature and pressure steam from the boiler will be expanded in a steam turbine which is used to drive an electrical generator. In a project like this, provision will be made in the design of the steam turbine for steam to be extracted at various intermediate pressures to provide low grade heat for the process itself or to provide heat to a commercial or a community heating scheme in Combined Heat and Power (CHP) mode. At this stage MVV is in discussions with the MoD/ Babcock regarding the supply of steam to their existing steam and hot water network.

4. **Any previous hazard analysis conducted on the proposed or similar type of plant**

During the basic design phase of the project a HAZOP analysis will be carried out to provide a systematic and thorough evaluation of process hazards and ensure that the necessary control and safety systems are in place.

MVV has conducted hazard analysises for their sites in Germany. An example of such an analysis can be provided upon request (It is currently only available in German and would have to be translated).

5. **Any documented historical information about previous incidents or any other information which would contribute to identifying hazards/safety risks the plant, through its whole of life operation, could pose to the Naval Base/operations/personnel.**

MVV Umwelt confirms that there were no incidents at MVV's EfW plants in the past which have posed a risk to adjacent structures or people in the surroundings.

Two areas on which MVV puts special emphasis are:

a) Fire hazard

We do not believe the facility presents any significant fire hazard to vessels berthed nearby due to the location of the site and distance (>150 metres) from the nearest vessel berth. The submarine base and refit area is even further away. In addition the facility is provided with comprehensive fire protection and detection systems which are a requirement of MVV's insurers. Also, MVV will maintain an Accident Management Plan in accordance with Environment Agency Guidance 'Getting the basics right'. The AMP will contain emergency response procedures in relation to fire events which will be adopted if a fire occurs on the site.

b) Emissions

The facility will be designed to meet the requirements of the Waste Incineration Directive (WID) and the relevant Environment Agency Sector Guidance Notes. The plant will be equipped with a redundant Continuous Emission Monitoring System (CEMS) which will continuously display and record the concentration of Oxygen, Carbon monoxide, Oxides of nitrogen, Volatile organic compounds, Particles, Hydrogen chloride and Sulphur dioxide. The CEMS enables the operations team to shut down the plant in the unlikely event of emissions excursions beyond the WID limits.

6. Any information you can provide regarding how issues/risks are managed would be useful. (For example, how would none conforming waste eg: a gas cylinder, be dealt with?).

General approach:

Throughout construction and operation of the plant MVV will adopt UK good practice and adhere to all relevant UK Health, Safety and Environment (HSE) legislation. MVV will develop and implement a Health and Safety Management System (HSMS) that will comply with OHSAS 18001 standards.

MVV intends to implement an overarching Integrated Management System (IMS) that brings together Quality, Environmental and Health & Safety standards and that will comply with ISO 9001, ISO 14001 and OHSAS 18001 respectively.

During construction MVV will prepare a Construction Phase Health and Safety Plan in accordance with the requirements of the CDM regulations which will contain site specific method statements, risk assessments and intended control methods. In addition a construction environmental management plan will be implemented to control the various potential environmental impacts of the construction works.

During the operation of the plant MVV will apply a Health and Safety Management System (HSMS). One important element of the MSMS is a risk assessment which covers:

- Hazard identification
- Risk categorisation
- Risk mitigation measures
- Method statements for safe systems of work
- Management of activities with significant risk
- Change control procedures for safe systems of work

The risk assessment will take into consideration the specific issues and risks at North Yard and the Naval Base in general. The risk assessment will then form the basis for the site rules and the operational Health and Safety procedures that will be implemented.

MVV Umwelt

Waste Acceptance and rejection of Waste

We do not believe that any waste delivered to the facility will pose a risk to the Naval Base or its personnel. MVV Umwelt will put a system in place to control the types of waste which are delivered to and treated at the facility by:

- agreeing on the types of waste that can be delivered to the plant by the Waste Partnership or a third party. The types of waste that can be processed at the plant will be specified in the environmental permit .
- only accepting authorised vehicles or by assessing the load of unauthorised vehicles in detail,
- inspecting waste at the tipping hall/ bunker, and removing unacceptable waste (e.g. gas canisters exceeding 1kg in weight) from the bunker and setting them aside in a quarantine area.
- moving hazardous waste to a designated area in the tipping hall until it can be disposed of,
- disposing of waste which can not be treated as quickly as possible (eg gas bottles exceeding 1kg in weight).

ANNEX 2 – DIAGRAM ACCOMPANYING MVV UMWELT GMBH SAFETY STATEMENT