

OME Safety Management & Legislation Assignment

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ACDA 6022 – OME Safety Management & Law

COUNCIL REQUEST FOR SAFETY REPORT: SITING AN
AMMUNITION DEPOT ON THE SA1 WATERFRONT
FINN MALLON

Contents

Purpose.....	2
Introduction	2
Background –	2
Scope –.....	2
Limitations –	3
The Proposed Site	3
Location & Boundaries –.....	3
Surrounding Environment –	5
Proposed Facility	5
Explosive Storehouses (ESH) –.....	5
Storage Limits & Hazard Divisions –	5
Internal Layout –.....	6
Hazard Identification	6
Hazard Types –	6
Safest Storage Solutions (SSS) –	7
Specific Internal Layout of all ESH in the SSS –.....	8
Maximum Credible Event Scenario (MCE) –	9
QD Calculations	10
Relevant Standards & Regulations –.....	10
Net Explosive Quantity Inputs –	11
Safety Distance Requirements –	11
Recommendations	Error! Bookmark not defined.
Safety Questions for Risk Reduction.....	17
Conclusion.....	18
References	19
Figure 1 - Explosive Site	4
Figure 2 - Explosive Site - Exposed Buildings.....	4
Figure 3 - ESH Layout.....	12
Table 1 - Exposed Sites	5

Table 2 - Hazard Effects	7
Table 3 - ESH to ESH ILD's	10
Table 4 - Exposed Sites Quantity Distances	17

Purpose

This report will supply a full explosive safety assessment to establish whether a new explosive facility can be constructed by Big Bang Storage Solutions. The report will explore all areas related to the safety of constructing an explosive facility and a decision will be made whether these plans can go ahead or not.

Introduction

Background –

The sponsor of the project is Big Bang Storage Solutions who have recently won the UK MOD Tender. Their plan is to erect a new explosives facility within the Swansea marina, housing no more than 5 Explosive Storehouses (without traverse) and have proposed this idea to the Swansea Council. As the council do not employ any safety engineers, their requirement is for a qualified engineer to determine whether this is a safe and reasonable area for this type of facility to be situated.

Scope –

Big Bang Storage Solutions have put forward the idea of storing the following quantities of ammunition:

HD 1.1 – 5000 kg. HD 1.2 – 500 kg. HD 1.3 – 1000 kg. HD 1.4 – 1000 kg.

The storage company are wanting to store the ammunition under the following conditions:

- Each of the ESH will have the capability to store up to 1000kg of each type of hazard division, where pallets will be stacked 3 high.
- The ESH should be built East to West along the wasteland where the storage facility is planned to be erected.
- The distance from each ESH to any vulnerable building must not exceed 300m.
- The distance from each ESH to any inhabited building must not exceed 125m.
- The distance from each ESH to any public traffic route must not exceed 270m.
- The HD being stored are broken down into:
 - HD 1.1 –
 - HD 1.1B – 50kg

- HD 1.1D – 3200kg
- HD 1.1E – 1250kg
- HD 1.1F – 500kg
- HD 1.2 –
 - HD 1.2C – 350kg
 - HD 1.2D – 100kg
 - HD 1.2F – 50kg
- HD 1.3 –
 - HD 1.3C – 1000kg
- HD 1.4 –
 - HD1.4S – 1000kg

Limitations –

The council believe that this is a significant hazard to the local area and from a civilian stand point this does look like a big risk to the general public. With the selected area being situated in a major city with a high density population, meaning major roads and highways around the area, as well as vulnerable buildings such as hospitals/schools and also many inhabited buildings. Being situated around a maritime area also brings other levels of safety concerns.

Although these concerns are obvious, this report will do a deep dive into all of the concerning areas to see if this is a safe project to go ahead.

The Proposed Site

Location & Boundaries –

The proposed new explosive storage facility is situated within the city of Swansea. The exact location is at the marina on a piece of wasteland. The co-ordinates for the piece of land are: Latitude - 51°37'5.45". Longitude - -3°55'7.90".

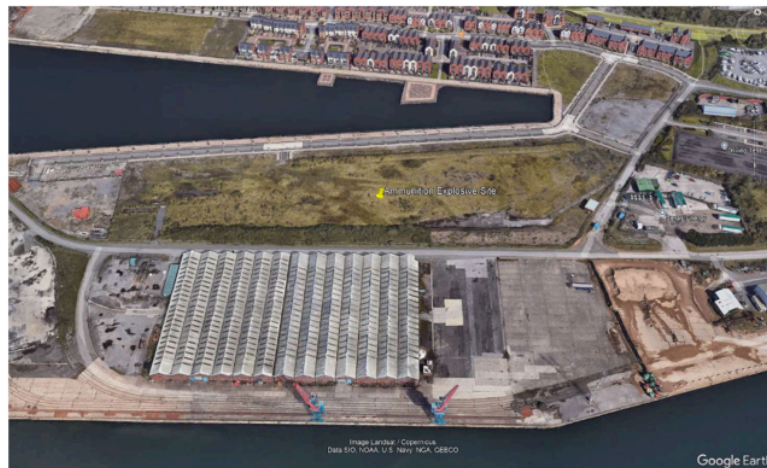


Figure 1 - Explosive Site



Figure 2 - Explosive Site - Exposed Buildings

The figure above highlights seven distances around the centre of the explosive storage facility. These distances highlight, 100m, 200m, 300m, 400m, 500m, 750m and 1000m.

Within these areas there are lots of vulnerable buildings such as schools, hospitals, churches etc. As well as this there are lots of inhabited buildings such as housing and

places of work. And finally, there are lots of public traffic routes all around this area with it being situated in a major city.

Surrounding Environment –

As previously stated, there are lots exposed sites around the proposed explosive storage facility. These include inhabited buildings, vulnerable buildings and public traffic routes, which in this case are highly dense.

The table below shows the total number of inhabited buildings, vulnerable buildings and traffic routes within chosen distances from the new facility.

Distances	Areas of concern		
	Inhabited Building	Vulnerable Building	Public Traffic Route
100m	180	0	2
200m	500	0	7
300m	950	0	14
400m	1450	0	10
500m	2250	3	24
750m	3600	4	35
1000m	4500	5	107

Table 1 - Exposed Sites

Proposed Facility

Explosive Storehouses (ESH) –

The proposed facility is for 5 x Explosive Storage Houses which are to built from East to West on the wasteland the coordinates are situated.

Storage Limits & Hazard Divisions –

The hazard divisions of the explosives that need to be stored are:

- 1.1 – Mass Exploding Hazard
 - 1.1B – Contains a primary explosive which present a mass exploding hazard
 - 1.1D – Contains a significant amount of secondary explosive that are capable of mass exploding
 - 1.1E – Contains a secondary explosive that do not present a mass exploding hazard
 - 1.1F -
- 1.2 – Projection Hazard

- 1.3 – Fire Hazard or Minor Blast / Projection Hazard
- 1.4 –No Significant Hazard

Internal Layout –

According to JSP 482 (DSA 03.OME Part 2) Chapters 9 and 12 describe the specific internal layouts for ESH. All ESH must have:

- Anti-sparking floors
- A clear 1.5 – 2m walkway
- Stable racking for ammunition pallets to be stacked onto, no higher than 2.5m unless approved by regulators
- Temperature & Humidity monitoring and controls
- Correct signage
- Marked emergency exits

Hazard Identification

Hazard Types –

There are lots of hazards related to an ammunition storage facility, especially in a busy residential area such as the Swansea Marina. Some of the hazards related to this scenario and the effects these hazards have on the surrounding areas are shown in the table below:

Hazard category	Example of effects
Primary Explosion & Blast Hazards	Mass detonations, blast overpressure, flying debris and fragments can cause severe damage to the public as well as structural damage to the surrounding buildings.
Fire & Thermal Hazards	Facility fires, secondary explosions and ignition of nearby fuels and vegetation. This can be very damaging and can increase the severity of the primary hazards potentially leading to even more severe and costly damage to the local area.
Chemical & Contamination Hazards.	The release of toxic explosive residues and chemicals into soil, groundwater and air which can lead to human health issues.
Unexploded Ordnance Hazards	Projection of live but undetonated ammunition around the facility during an event can create an unsafe area after the initial primary hazards / secondary hazards have died.
Security Hazards	Theft of ammunition and explosives as well as a risk of encroaching into the facility leading to potentially catastrophic results.

Structural & Environmental Hazards	Structural collapse of storage buildings due to blast as well as long-term land denial around the facility due to unexploded ordnance, contamination or damage, which will limit safe use to the public
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Table 2 - Hazard Effects

Safest Storage Solutions (SSS) –

After evaluating what ammunition needs to be stored across the 5 ESH the best possible storage grouping should be as follows:

ESH 1 – 1.1B only

- 1.1B: 50kg – Isolate the most sensitive donor, NEQ is low therefore the QD is relatively modest.

ESH 2 – Main 1.1D Bulk

- 1.1D: 3,200kg – This is the primary dominant mass-explosion contributor. Keeping it alone and segregated from the other ammo simplifies NEQ and QD calculations.

ESH 3 – Remaining 1.1 (1.1E & 1.1F)

- 1.1E: 1,250kg
- 1.1F: 500kg
 - ESH 3 NEQ = 1,750kg of HD1.1 – Compatible high explosive and propellant items kept together but kept separate from the large 1.1D bulk of ammo to reduce risk. This is partially compliant with JSP 482 if compatibility groups match, e.g. both non-fuzed HE projectiles then compliant.

ESH 4 – HD 1.2 & 1.3

- 1.2C: 350kg
- 1.2D: 100kg
- 1.2F: 50kg

- HD 1.2 explosives don't produce a mass explosion hazard; however, they do present a severe fragment hazard.

ESH 5 – HD 1.4S & 1.3C

- 1.4S: 1,000kg – 1.4S is very insensitive and presents a very low risk hazard. Storing it separately will avoid it being treated as a HD1.1 or HD1.2 for siting purposes.

- 1.3C: 1,000kg - HD 1.3 mainly present a fire and blast hazard. HD 1.3C + HD 1.4S can be stored together under JSP 482 as they are both non-mass explosive and it keeps the QD minimal if there is no compatibility group conflicts. Meaning another question to ask Big Bang Storage Solutions.

Having the ammunition spread across the 5 ESH in this formation will allow the most dangerous present explosive HD1.1 which is stored across three separate ESH to have the maximum single NEQ to be lowered as well as being segregated from lower HD ensuring they don't unnecessarily drive the QD.

For ESH 3 and ESH 4 it all depends on what type of projectiles are being stored inside. This will then highlight whether they can be stored in this formation or not. As the briefing from the council doesn't confirm what type of ammunition correlates to each Hazard Division then this is a question that needs to be asked to Big Bang Storage Solutions.

Specific Internal Layout of all ESH in the SSS –

ESH 1: HD 1.1B (50kg)

High sensitive primaries are stored in this ESH, for this to happen there must be minimal handling zones, the ammunition must be single pallet stacked, centred and against the rear wall. No higher than 1m, with 2m walkway around all available sides. There must be an isolated fuze inspection bench at the ESH entrance with blast shielding and intrinsically safe lighting.

ESH 2: HD 1.1D (3,200kg)

If bulk mass detonators are to be stored inside, there must be robust stacking available within the ESH. Double stacked pallets in a 4x4 grid, divided by 300mm concrete internal traverses into 4 compartments. 2m walkways all around and a forklift turning circle at the main entrance. [1]

ESH 3: HD 1.1E (1,250kg) + 1.1F (500kg)

HE projectiles with propellants, compatibility groups need to be verified to see if compliant, as long as both projectiles have had fuzes removed then compliant with JSP 482. There must be separate pallet bays, on one side there is a row of 1.1E, 6 pallets, 1.5m high. On the opposite side a row of 1.1F, 3 pallets. A 2.5m central walkway running down the centre of both stacks. Dunnage must be placed under each stack keep it off the ground, free from any moisture damage.

ESH 4: HD 1.2C (350kg) + 1.2D (100kg) + 1.2F (50kg)

This ESH's main risk is that it has a very high chance of projection. Therefore, the internal layout must be fragment containment focused. Single layer pallets no higher than 1.5m spaced 1m apart from each other in an open grid setting. Minimum 3m walkway to gain access with fragment catching mesh walls in case of an incident.

ESH 5: HD 1.4S (1,000kg) + 1.3C (1,000kg)

ESH 5 must house both 1,000kg of HD 1.4S & 1,000kg of 1.3C, for this to take place the ESH must be 2.4 high, with vents for air flow, temperature and humidity monitored and controlled with deluge above head. The ESH must be divided into two bays with a 1.5m high concrete or steel mesh wall in between the two articles. 60% of the area for HD 1.3C and 40% for HD 1.4S.

Maximum Credible Event Scenario (MCE) –

In this situation the maximum credible event scenario as a worse case single ESH effect would be a full mass explosion in one of the higher NEQ HD1.1 magazines, with realistic knock-on effects to the rest of the ammunition facility and the surrounding area. ESH 2 is storing 3,200kg of HD1.1D this controls the facilities MCE due to having the largest mass-explosion NEQ across all 5 ESH. This ESH has expected approximate effects which include destruction within 50-100m, lethal overpressures from 400m – 800m and fragment hazards up to 1-2km. [2]

However, if Intraline distances (ILD's) are not complied with under JSP 482 and multiple ESH are situated too close together then the MCE from one ESH to another will significantly multiply. For example, if ESH's 2, 3 & 4 are situated too close together and less than required the MCE will increase to approximately 6,500kg total of HD1.1/1.2 NEQ detonation power, amplifying the blast radius effects etc. With the addition of 1.3C in ESH 4 this will add greater fire and thermal effects over a greater distance. [3]

In such a residential area such as Swansea this would be catastrophic to the public and to infrastructure as well as long term contaminated areas.

Therefore, it is essential that the ESH's are situated at the correct distances away from each other depending on what is being stored inside.

Some of the following mitigations can be put in place when planning the exact location of each ESH to ensure the MCE is ALARP under the Health & Safety at Work Act 1974. JSP 482 and ER2014 highlight these mitigations for any unplanned MCE:

Structural Mitigations –

- Earth covered explosive storage buildings with a minimum of 1-2m of cover, for HD 1.1 the traverses must be at least 12m high with the thick blast doors being oriented away from the populated areas to help contain blast/fragments within the ammunition storage facility. [4]

- According to JSP 482 Chapter 10 QD Tables, the inhabited building distance for ESH 2 containing 3,200kg of HD1.1D explosives is 500m+. [4] JSP 482 – Chapter 10.

Initiation & Fire Mitigations –

- Fire detection systems (specifically for HD 1.3C propellants, deluge systems can be used). Daily inspections and a strict no smoking policy on the facility.
- Lightning protection grounded anti-sparking flooring. [4] JSP 482 – Chapter 8.

Security Mitigations –

- Perimeter fencing around the whole facility, CCTV, Alarms & armed guards all active 24/7 according to JSP 482 Security section.
- SOP's, trained personnel, stock rotation and ESSP in place which have been approved by DOSR.
- Full Emergency plans in place, including sirens throughout the whole facility and fire guards on call if not on site.

The table below will highlight all the required Intraline Distances for the proposed ammunition facility in Swansea to ensure that the rules and regulations for ESH in JSP 482 are being followed.

To & From ESH Pair	The approximate ILD from JSP 482	MCE Risk if breached
ESH 2 to ESH 3	100m – 200m	High: Mass detonation chain
ESH 2 to ESH 4	50m – 100m	Medium: Fragments & spreading fire
ESH 1 to others	30m – 50m	Low: Small NEQ but sensitive
Any ESH to ESH 5	<30m	Negligible: No mass explosion

Table 3 - ESH to ESHILD's

QD Calculations

Relevant Standards & Regulations –

There are lots of relevant Standards & Regulations that explain the ins and outs of QD calculations and how they can decide whether a new ammunition storage facility like the example can be erected.

The information on QD distances in The UK can be using the following pieces of documentation:

- JSP 482 Chapter 10 (Permanent Peacetime Storage) – This document and chapter covers the IBD's, PTRD's, ILD's and other QD's based on the total NEQ and HD's. [3]
- JSP 482 Chapter 11 (Operational Storage) – This document and chapter covers Reduced QD's where full peacetime standards cannot be met, this is where acceptance comes in from explosive safety cases. [4]
- NATO AASTP-1 (Edition 1, ADAPTED IN JSP 482) – This is the basis for UK QD tables that covers mass exploding HD 1.1, projection and fragment HD 1.2 and fire and thermal HD 1.3.
- Explosives Regulations 2014 (ER2014, HSE L135 Guidance) – This website covers all to do with OME safety, specifically in this case covering civilian QD rules for licensed ammunition magazines, minimum separations from dwelling and roads etc. [5]
- ESTC No.6 – This document supports JSP 482 with ESH commissioning and inspection requirements which include QD verification surveys.

Net Explosive Quantity Inputs –

The total NEQ for the whole site is 7,500kg of mixed Hazard Divisions of explosives. These explosives are broken down into 5 ESH and stored in the safest way possible:

- ESH 1: HD 1.1B (50kg)
- ESH 2: HD 1.1D (3,200kg)
- ESH 3: HD 1.1E (1,250kg) + 1.1F (500kg)
- ESH 4: HD 1.2C (350kg) + 1.2D (100kg) + 1.2F (50kg)
- ESH 5: HD 1.4S (1,000kg) + 1.3C (1,000kg)

Safety Distance Requirements –

To calculate the safe distances required, using the formula $D = K \times \sqrt[3]{NEQ}$, the K factor needs to be obtained. To find this information, the type of explosive store needs to be chosen when reviewing Chapter 6 of the DSA 03 OME Part 2, in this case the ESH is classed as a PES due to its position on the explosive storage site and distance from the other PES on the site.

The K factor will vary depending on the type of ammunition it stores, the hazard division it stores and the distance that it is being calculated to. E.g. the K factor will change depending on the infrastructure the QD is being calculated for, either inter-magazine distance, public traffic route distance, inhabited building distance and/ or vulnerable building distance.

The 5 ESH will be positioned on the Explosive Site in the following layout:



Figure 3 - ESH Layout

ESH 1: HD 1.1B (50kg) -

The scaled distance coefficient (K-factor) for ESH 1:

- IMD = 6
- PTRD = 15
- IBD = 22.2
- VBD = 44.4

Therefore, the QD's for ESH 1 are:

IMD -

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 6 \times \sqrt[3]{50}$$

$$D = 22.1m$$

PTRD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 15 \times \sqrt[3]{50}$$

$$D = 55.3m$$

IBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 22.2 \times \sqrt[3]{50}$$

$$D = 81.8m$$

VBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 44.4 \times \sqrt[3]{50}$$

$$D = 163.6m$$

ESH 2: HD 1.1D (3,200kg) -

The scaled distance coefficient (K-factor) for ESH 2:

- IMD = 6

- PTRD = 15

- IBD = 22.2

- VBD = 44.4

Therefore, the QD's for ESH 1 are:

IMD -

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 6 \times \sqrt[3]{3,200}$$

$$D = 88.4m$$

PTRD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 15 \times \sqrt[3]{3,200}$$

$$D = 221.0m$$

IBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 22.2 \times \sqrt[3]{3,200}$$

$$D = 327.1m$$

VBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 44.4 \times \sqrt[3]{3,200}$$

$$D = 654.3m$$

ESH 3: HD 1.1E (1,250kg) + 1.1F (500kg) -

The scaled distance coefficient (K-factor) for ESH 3:

- IMD = 6

- PTRD = 15

- IBD = 22.2

- VBD = 44.4

Therefore, the QD's for ESH 1 are:

IMD -

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 6 \times \sqrt[3]{1,750}$$

$$D = 72.3m$$

PTRD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 15 \times \sqrt[3]{1,750}$$

$$D = 180.8m$$

IBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 22.2 \times \sqrt[3]{1,750}$$

$$D = 267.5m$$

VBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 44.4 \times \sqrt[3]{1,750}$$

$$D = 535.1m$$

ESH 4: HD 1.2C (350kg) + 1.2D (100kg) + 1.2F (50kg) -

The scaled distance coefficient (K-factor) for ESH 4:

- IMD = 3

- PTRD = 6

- IBD = 10

- VBD = 20

Therefore, the QD's for ESH 1 are:

IMD -

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 3 \times \sqrt[3]{500}$$

$$D = 23.8m$$

PTRD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 6 \times \sqrt[3]{500}$$

$$D = 47.6m$$

IBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 10 \times \sqrt[3]{500}$$

$$D = 79.4m$$

VBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 20 \times \sqrt[3]{500}$$

$$D = 158.7m$$

ESH 5: HD 1.4S (1,000kg) + 1.3C (1,000kg) -

The scaled distance coefficient (K-factor) for ESH 5:

- IMD = 8

- PTRD = 14.8

- IBD = 22.2

- VBD = 44.4

Therefore, the QD's for ESH 1 are:

IMD -

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 8 \times \sqrt[3]{1000}$$

$$D = 80m$$

PTRD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 14.8 \times \sqrt[3]{1000}$$

$$D = 148m$$

IBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 22.2 \times \sqrt[3]{1000}$$

$$D = 222m$$

VBD –

$$D = K \times \sqrt[3]{NEQ}$$

$$D = 44.4 \times \sqrt[3]{1000}$$

$$D = 444m$$

ESH	IMD (m)	PTRD (m)	IBD (m)	VBD (m)
1	22.1	55.3	81.8	163.6
2	88.4	221	327.1	654.3
3	72.3	180.8	267.5	535.1
4	23.8	47.6	79.4	158.7
5	80	148	222	444

Table 4 - Exposed Sites Quantity Distances

Safety Questions for Risk Reduction

There are many questions that could be asked to Big Bang Solutions regarding their plans to build an explosive storage facility in Swansea, specifically the waterfront area as from first glance the plan seems very dangerous to the public, which was the first thought of the Swansea council. Some questions that could be asked to Big Bang Storage Solutions are:

- Regarding ESH 5, which stores 1000kg of HD 1.4S & 100kg of HD 1.3C, are there any compatibility group conflicts preventing them from being stored together?

- Regarding ESH 3 & 4, what type of ammunition is specifically being stored inside which falls under the Hazard Divisions and Compatibility Groups that have been provided?
- Why was this location selected?
- Can the total NEQ be reduced and spread across another storage facility?
- If the ammunition is specifically needed in this area for a reason, is there another area close by that offers a bigger plot of land to build the explosive site on?

Conclusion

After initially reviewing the requirements that Big Bang Storage Solutions had requested in their plans for an Explosive Storage Facility, the whole plan looks like it would be a huge hazard and concern to the public and the local area.

From carrying out research in all related areas and by undertaking Quantity Distance Calculations I is clear that the plan from Big Bang Storage Solutions for an Explosive Storage Facility to be built in Swansea, in the specific area they put forward would be too dangerous and could never go ahead.

First off, the plan breaches various rules and regulations under JSP 482, ER2014 and HSE Guidance. There are unachievable QD's and an excessive NEQ that mean the storage facility breaches these regulations.

The total NEQ of the storage facility is 8,000kg and is very HD 1.1 dominant which according to ER2014 local authority limits, this cannot be greater than 2,000kg without a HSE license. HD 1.1/1.2 explosives are classified as relevant explosives which require a LP41 license if greater than 2,000kg. It will also require a DOSR site plan and with it being situated in a residential area, this will be impossible.

With all this taken into consideration, the plan for an Explosive Storage Facility, planned by Big Bang Storage Solutions CANNOT go ahead.

References

- [1 D. S. Authority, "DSA 03.OME Part 2 (JSP 482) - Defence Code of Practice (DCOP)
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OME Safety Management & Legislation Assignment

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

50/100

Engagement with Literature Skills 5/10

The student has used a relevant range of references, some of which have been retrieved independently; however,

The assignment guidance for Engagement and Literature skills clearly states "You will have to use the tools taught during to complete this assignment." The student has not done so. Guidance for Practical Skills clearly states "Guidance specific to this assessment: IATG are specific to this assignment" The student has chosen to use UK MOD explosives regulations.

The reference style is consistent however for more marks a larger number of references could have been used. There are no references made to IATGs, which taught material focused on. For further marks, tools introduced in the lectures such as the United Nations SaferGuard toolset could have been used to show/validate your work. JSP 482 is referred to under the internal layout section of the report but does not have an in-text citation.

Knowledge and Understanding Skills 15/30

The student has demonstrated some knowledge of safety distances and hazard divisions. For further marks, the student should consider a more in-depth analysis on other potential risk factors and what additional public safety, storage or transportation issues likely to affect the decision to approve the site for an explosive facility. The report would benefit from an explanation of explosive compatibility groups and how these have influenced the decision

to allocate different explosives to different ESHs. Consider answering the following from the task: "We have been told the ESH would be earth covered with directional effects for blast described as Side of magazine perpendicular to the direction of the ES. What does that mean?". Furthermore, no advice has been given to maritime users in the area should the proposal be accepted, which was also a part of the task.

The student has misrepresented the stated separation distances. VBD (Vulnerable Building Distance) and IBD (Inhabited Building Distance) are minimum distances. In the Scope section they are presented as maximum distances "the distance from each ESH to any vulnerable building must not exceed 300m"

The student states that ESH 1, where they propose to store HCC1.1B articles, should have an inspection bench within the ESH, albeit in a segregated area with some protection measures. IATG 07.30 Section 7.1 states "Ammunition processing tasks should ideally take place in a building designed specifically for that purpose, although it may take place in a temporary location as long as all safety requirements can be met.". DSA 03 OME Part 2 Chapter 19 Paragraph 1.2.2 states "Any task involving the manufacture, assembly, repair, testing, modification, or disassembly of explosives carries with it an increased risk of accidental initiation. It is therefore regarded as explosives processing and is to be carried out in a facility suitable for the explosives process activity and normally in isolation from the storage of bulk stocks of explosives. Such tasks include any operation where the integrity of the primary package is breached and the explosive item is exposed." The student's proposal is not supported by a Risk Assessment and should be considered a safety-critical error, or poor practice at the very least.

Of further note:

- ESH2 – inaccurate terminology "bulk mass detonators" suggests items of HCC 1.1B rather than 1.1D
- ESH 3 – poor comprehension of Compatibility Groups E (no means of initiation) and F (with means of initiation)

- ESH 4 – ‘fragment catching mesh walls’?

Cognitive and Intellectual Skills 11/20

The student has demonstrated an emerging ability to critically evaluate and analyse the proposed solution by BBSS. Although throughout, arguments are relatively supported, the report would benefit from some more detailed justifications and comparative statements between BBSS proposal and why the student has given alternatives. For example, the student has worked out QDs of their own but has not explained why those given by BBSS are not sufficient.

In their Maximum Credible Event (MCE) evaluation, the student has misunderstood the concept of MCE, which is not necessarily the sum of NEQ stored in adjacent ESH. They state that “For example, if ESH’s 2, 3 & 4 are situated too close together and less than required the MCE will increase to approximately 6,500kg total of HD1.1/1.2 NEQ detonation power, amplifying the blast radius effects etc”; this is incorrect because one would expect a time delay between the initiation of the contents of one ESH and the consequent initiation of another, thus the MCE would be the NEQ of only one ESH. This principle is used by explosives engineers in the quarrying and demolition industries to minimise the blast effects experienced outside the quarry or demolition site, by deliberately initiating the, possibly hundreds, of charges at intervals of milliseconds.

Practical Application Skills 13/30

The student has offered a possible safe storage solution, with details on the specific internal layout of all ESHs within this. Consideration has been given to lowering the overall NEQ as a solution and acknowledgement made to the fact that information is missing regarding types of ammunition to be stored, which could affect overall decisions. In their solution, the student has discarded the information from BBSS stating ‘each ESH will be able to hold up 1000 kg of each type of hazard division (pallets

stacked 3 high), thereby requiring no more than 5 x ESH built east to west along the waste land', however no explanation is given as to why they have done this. The student has worked out QDs but has not elaborated or explained how why these values are important.

The guidance for this assignment quite clearly states "Guidance specific to this assessment: IATG are specific to this assignment ". The student has opted to use UK MOD Regulations, which are not taught, and, while he has demonstrated some understanding of the use of Q factors, they have not applied them appropriately, in fact in the section titled "QD Calculations' they only cite UK legislation and regulations. In this list, they also include DSA 03 Part 2 Chapter 11 – Operational Storage – which only applies to Armed Forces on operations outside the UK. The student also misquotes HSE publication L135 which is the Approved Code of Practice on the Storage of Dangerous Substances and is not applicable to Explosives, which are covered in HSE Publications L150 (Safety) and L151 (Security).

They have some understanding of the effect of ESH construction and imply that all 5 ESH will be earth covered magazines and that the "According to JSP 482 Chapter 10 QD Tables, the inhabited building distance for ESH 2 containing 3,200kg of HD1.1D explosives is 500m+. [4] JSP 482 – Chapter 10". Directional effects through the door and headwall are towards an Exposed Site" [Table 1A of Ch 10), the Inhabited Building Distance can be found in column D13 with a minimum fixed distance of 400m. Following this calculation to Table 1D which gives a QD of 333m for a NEQ of 3500kg, therefore the licence would have to specify that the QD must be 400m.

Table 4 shows various "Exposed Sites Quantity distances", however this does not follow through into an argument and is not illustrated in Figure 3. It is not clear what point they are making.

Figure 3 shows their proposed ESH layout, however, it does not give an indication of the orientation of the front walls of the ESH, nor does it give any indication of distance between the ESH, which are both critical factors in determining the QD.

There was an expectation, stated frequently by the

lead lecturer in the first two weeks, that they would provide draft licences using the IATG Explosives Licensing Tool.

In the Purpose and Conclusion they state that they will make a decision and provide that decision respectively. It is not the role of a consultant to make decisions, only to offer advice and, possibly, options.

Transferable Skills for Life and Professional Practice 6/10

The report is structured in a suitable way and is mostly coherent, however in some instances layout looked unclear (equations could be presented better). Communication of ideas are presented clearly in a concise conclusion. Minor grammatical errors present, occasionally disrupting flow of the report.

The student appears to have attempted to provide a Risk Assessment and Argument but has not used the taught material, techniques and tools to any great effect. They have mixed in some quantitative risk assessment elements with the use of QD tables, which is confusing. I would go so far as to say that they have not presented a paper that would be understood by their hypothetical client, i.e. members of the Council.

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21
