

Assignment

by William Young

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William Young
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Council Request for Safety Report: Siting an ammunition depot on the
SA1 Waterfront

UWTSD
ACDA 6022 OME Safety Management & Law

BEng
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Supervisor: SSO PE Ltd
Associate Supervisor: Gareth Collett
December 2025

Academic integrity declaration

I declare that:

- the thesis submitted has been written by me alone.
- the thesis submitted has not been previously submitted to this university or any other.
- that all content, including primary and/or secondary data, is true to the best of my knowledge.
- that all quotations and references have been duly acknowledged according to the requirements of academic research.

I understand that to knowingly submit work in violation of the above statement will be considered by examiners as academic misconduct.

Abstract

A report to document the requirements for an OME storage facility in Swansea. This report will include a descriptions of the internal and external design of Earth-Cover Explosive Storehouses (EHS), a Quantity Distance (QD) assessment, an assessment of applicable Hazard Division (HD) Compatibility Group storage requirements within five EHSs, and safety issues to be considered for the site.

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1 Introduction

The City and County of Swansea Council (the Council) has received an application for planning permission for the construction of an explosive storage facility on the location shown in Figure 1. The proposal includes five Earth-Covered Explosives Storehouses (ESHs), each positioned east–west across the identified site.

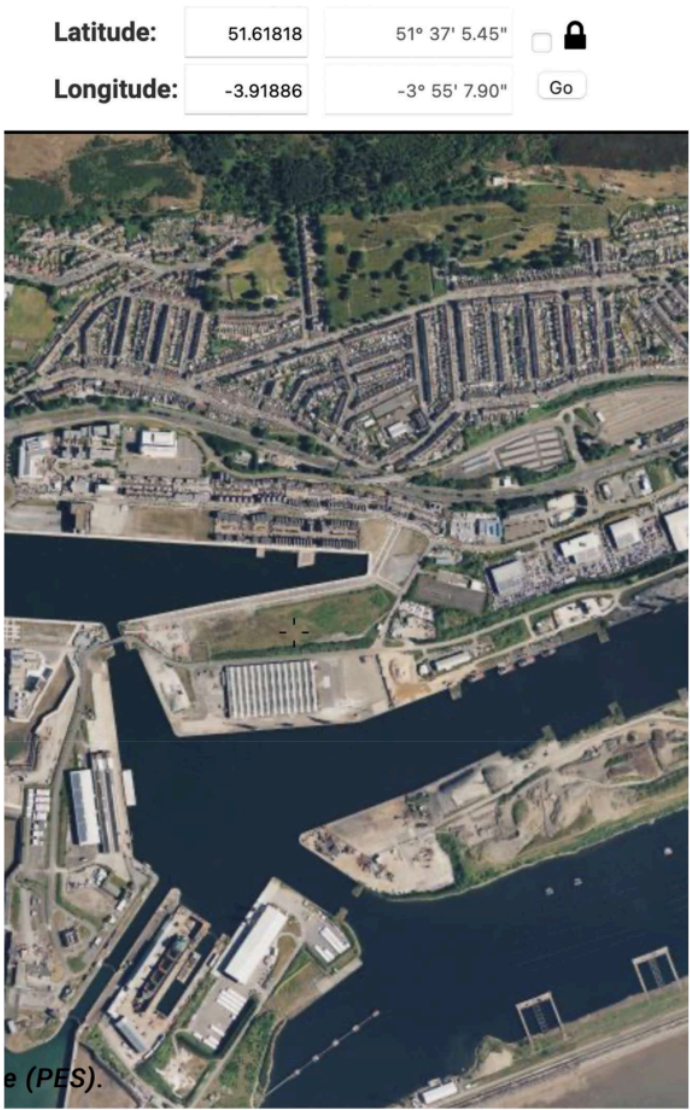


Figure 1 – Location of the proposed explosive facility

Further information regarding the explosive facility has been provided by BigBang Storage Solutions as follows:

- '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.
- The Vulnerable building distance is no more than 300 m for each ESH;
- The Inhabited building distance is no more than 125 m for each ESH
- The Public traffic route distance is 270 m for each ESH
- HD 1.1 is divided as follows:
 - HD 1.1B – 50 kg
 - HD 1.1D – 3200 kg
 - HD 1.1E – 1250 kg
 - HD 1.1F – 500 kg
- HD 1.2 is divided as:
 - HD 1.2C – 350 kg
 - HD 1.2D – 100 kg
 - HD 1.2F – 50 kg
- HD 1.3C – 1000 kg
- HD 1.4S – 1000 kg

The Council has indicated that it does not have an in-house Ordnance, Munitions and Explosives (OME) specialist, and therefore seeks an independent assessment of the information provided by the contractor, BigBang Storage Solutions. The proposed location is on currently unused grassland within the docks complex. This area is in proximity to:

- Residential areas to the north (approx. 250–350 m).
- Commercial and light-industrial premises (approx. 100–200 m).

- Public roads and pedestrian routes (approx. 80–150 m).
- Swansea Marina and associated maritime users.' [1]

This report provides an explanation of terminology, a technical assessment of the storage proposal, an evaluation of the Quantity Distance (QD) claims, identification of risks and concerns relating to public safety, safety advice for maritime users, and safety questions to request further clarification and assurance from BigBang Storage Solutions.

2 Magazine Design

The applicant states that each ESH will be earth covered and constructed to provide directional blast effects, with the side of magazine perpendicular to the direction of the Exposed Site (ES). Each ESH is a separate Potential Explosive Site (PES).

Directional effects refer to intentional shaping of the protective earth cover, structural reinforcement, and venting orientation such that, in the event of an internal detonation, the majority of the destructive pressure and debris is directed upward rather than laterally. This will reduce blast effects from an unintended detonation internal to the ESH as the strongest structural face of the ESH is oriented toward the nearest hazard. Lateral blast waves are therefore reduced in the direction of populated or sensitive receptors, while the earth covering is intended to absorb primary fragmentation and reduce the initial shock front.

3 Quantity Distance (QD) Assessment

The NEQ of each ESH has been combined to treat them as one PES. The site would be required to demonstrate that no sympathetic detonation can occur between the ESHs. Traverses, adequate inter-magazine distances and a valid safety case would allow each ESH to be considered a PES and would significantly reduce the Quantity Distances (QD) of the provided OME. Below are the QDs taken from Annexes D and E of IATG 02.20 using a HD 1.1 NEQ of 5000kg for above ground storage. [2]

The Vulnerable Building Distance (VBD) of this PES is $D_{15} \times 2$, where $D_{15} = 400\text{m}$.

The VBD is therefore 800m.

The Inhabited Building Distance of this PES is D_{15} .

The IBD is therefore 400m.

The Public Traffic Route (PTR) was assumed to be a High Density PTR due to the location of the facility. The marina and nearby area is popular and includes footpaths, roads, and marine vessels. This was a pessimistic judgement and further information may reduce the QD. The High Density PTR of this PES is D_{15} .

The High Density PTR is therefore 400m.

Below is a table comparing the provided QDs with those generated above.

	VBD (m)	IBD (m)	PTR (High Density) (m)
Provided QDs	300	125	270
Updated QDs	800	400	400

Table 1 – Quantity Distance Comparison

There is a significant difference between the values provided and the QDs of the total NEQ of proposed PES. The VBD is a particular challenge given the proximity of the HMT Sancta Maria Hospital as well as the University of Wales Trinity St David. Further work on the proposed site would be required to allow each ESH to be considered individually as a PES, thereby reducing the QDs to more acceptable limits.

4 HD and Compatibility Group Storage

Consideration will be required for the mixing of the four HDs and their Compatibility Groups, both between ESHs and internally between pallets. Compatibility Groups may be stored together where their interaction does not increase the overall hazard, with mixed storage permissible only when specific allowances exist or clear segregation can be demonstrated. [3]

4.1 ESH 1

The first ESH should contain HD 1.1B pallets only. While the NEQ is lower than other ESHs, HD 1.1B is particularly sensitive to unintended initiation as they contain primary explosives designed to initiate less sensitive bulk explosives. If stored with such explosives, risk of a sympathetic detonation is significantly increased. [3] Therefore, they should not be stored with Groups D, E and F except where operational requirements demand immediate assembly. [3] As this does not apply to a storage facility in Swansea, HD 1.1B has been segregated within its own ESH.

Recommendations for the safe use of this ESH would be to include increased internal segregation from other ESHs by stacking pallets to the left of the ESH and limiting access to key personnel only.

4.1 ESH 2

The second ESH should contain HD 1.1D and HD 1.3C, where Group D consists of secondary high explosives and Group C consists of propellants and pyrotechnics. IATG permits storage of these Groups in the same ESH when they are physically segregated and a fire to detonation transition can be demonstrated as preventable within the structure. [3]

Group C OME is more likely to burn than detonate, while Group D is less sensitive than the Groups B and F. Internal segregation will be required to store this OME within the same ESH. Therefore, internal walls would allow the ESH to store the HD 1.1D and 1.3C in separate rooms; with fire detection and suppression systems in place to prevent fire hazards or reduce the risk of fire spreading to stored OME by improving emergency response times.

4.1 ESH 3

The third ESH should contain HD 1.1E and 1.1F, where Group E consists of secondary high explosives with propulsive charges and Group F consists of non-primary explosive with its own means of initiation. Group F should not be stored with other high explosives unless physical segregation prevents sympathetic detonation and a safety case justification is provided for the PES's use.

This may be problematic for the proposed facility and a sixth ESH would allow the facility to provide a separate ESH for HD 1.1F explosives, due to the increased risk of self-initiation from Group F. If this is untenable, a safety case may be required for the use of HD 1.1F on site. An alternative would be to find alternative storage for the facility's HD 1.4S, discussed in the ESH 5 section, which would provide ESH 5 for storage of HD 1.1F only.

4.1 ESH 4

The fourth ESH should contain HD 1.2C, 1.2D and 1.2F, where HD 1.2 presents a projection hazard without mass explosion. HD 1.2 items have been stored in separate PES to HD 1.1 due to the increased risk of initiation of HD 1.1 if HD 1.2 were to initiate. To store this OME in the same ESH, internal segregation would again be required. Fragment trajectories must not be capable of interacting with different Groups stored in the ESH, therefore internal walls would be required to store each Group in separate areas of the ESH, with their storage designed to direct fragmentation away from each internally walled storage compartment.

4.1 ESH 5

The fifth ESH should contain HD 1.4S, where Group S does not mass detonate, produce dangerous fragments, and are unlikely to propagate to nearby pallets. [3]

Storing HD 1.4S in an ESH may be overly safe for the hazard presented, and an alternative storage method, such as an ISO container, may be more suitable for HD 1.4S. If space allows for this on site, ESH 5 could be used to store HD 1.1F, negating the potential need for a safety case for a mixed ESH of HD 1.1E and 1.1F. This would provide significant cost reductions.

5 Safety Considerations

5.1 Storage

The first safety problem to consider is that the facility has a requirement to hold a certain amount of OME, and the UK MOD tender has granted the right to build only to that amount of NEQ for each HD. If the required amount stored on site is the maximum NEQ allowed by the licence, there may be a temptation to exceed the licence during busy periods in contravention of the site's responsibilities. There may also be a requirement to increase the licence's NEQ in the near future. A better alternative may be to slightly increase the allowed NEQ to provide a small buffer.

Stacking pallets three high may also result in problems for the new facility. Higher stacks of stored ammunition will increase the risk of human or mechanical errors occurring during movement of the stored OME, with the consequences of a drop and impact increased due to the higher height of the stacks. If space allows, shorter or no stacks would improve the safety of storage in this facility.

5.2 Transportation

One safety consideration for transportation is that the location of the proposed site is close to both industrial and residential areas. Care will need to be taken to ensure that OME is transported along predefined routes with the approval of the local authority. Further information will be required regarding the frequency of OME movements to and from the facility, as well as the frequency of internal movements between storage areas and associated facilities, before approval should be granted. The transportation of HD1.1 and 1.2 in particular is a significant hazard to the public during transit, given the proximity of the facility to built-up areas and that transport through a major Welsh city would be required.

Consideration will need to be given to the type of vehicle used for transportation, ensuring that it is safe to use both for OME safety as well as OME security. Hostile actors will need to be considered to ensure that OME cannot be stolen during transit by providing secure locks on all doors. If large NEQs of HD1.1 and 1.2 will be approved for transit, a specialised vehicle may be required to minimise external blast and fragmentation to reduce the risk of unintended detonations to the public.

Compliance with the UK Carriage of Dangerous Goods (CDG) Regulations will need to be demonstrated prior to approval of OME transportation within the UK. Prior to approval of transportation, all items of OME will require the correct classifications, labelling and records, the driver will need to be correctly qualified, and the vehicle must be demonstrated to be compliant by using the correct equipment and placards. Emergency procedures will also need to be agreed with the local authority to ensure risks are kept As Low As is Reasonably Practicable (ALARP) in the event of an emergency, such as vehicle breakdown or initiation of the cargo. [4]

If transporting OME from Europe, compliance may also be required with the Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

5.3 Public

The site will need a secure perimeter to ensure no encroachment from members of the public or other unwanted persons. Fences and locked gates will be required and, given the proximity to a large number of non-explosive workers, the site may also benefit from employing security guards to prevent unintended access to the site and to the stored OME.

For maritime users of the nearby area, vehicles should not be stored near to the proposed facility where possible. A permanent exclusion zone would ensure that maritime users can safely travel and moor in the nearby area without encroaching the Public Traffic Route Distance (PTRD) or Inhabited Building Distance (QD) of the storage facility. Temporary exclusion zones may also be used during OME movements. Signage and public outreach from this facility will also benefit maritime users, ensuring they are aware of explosive risks and the site's emergency response plans.

5.4 Environmental

One environmental requirement to consider is the potential contamination from propellants, pyrotechnics and explosives stored on the site. Given the frequency of high-density rainwater at the location, all PES on site should be protected from flooding and flash flooding to ensure that no contaminants are leaked into the soil or nearby bay. A documented prevention plan may be required to assure the Interim

Environmental Protection Assessor for Wales (IEPAW) that contaminants will not be released from the site.

5.5 Emergency Response

A fully planned emergency response will be required to ensure the local authority that the site is safe to operate. An evacuation plan, firefighting procedures and cooperation with local emergency services should be ensured prior to approval for the site.

6 Recommendations

Work is required to reduce the QDs of the proposed site. The current QDs are unacceptable given the proximity of a number of vulnerable and inhabited buildings. Traverses and a safety case justifying that no sympathetic detonation can occur between ESHs are therefore recommended before site approval occurs.

Significant opposition to an explosives storage facility in the middle of Swansea would also be expected. Outreach to members of the public may help reduce tensions, but the location makes protests and unwanted public attention a frequent and likely risk to the safety of staff as well as the safety and security of stored OME.

A safety case should be produced to allow for the mixed storage of OME within ESH 3. If permission can be gained for alternative HD 1.4 storage, ESH 5 should be used to store HD 1.1F OME.

There are significant explosive safety and security concerns with using the suggested area for an explosive storage facility. Unless required for military operations, a more remote location should be used and it is recommended that the Council does not approve this application.

6 References

- [1] UWTSD, *Assignment Brief*.
- [2] UN SaferGuard, "Quantity and separation distances," 2021.
- [3] UN SaferGuard, "UN explosive hazard classification system and codes," UN SaferGuard, 2021.
- [4] Health and Safety Executive, *Carriage of dangerous goods (CDG)*.

Appendices

Appendix A – Further Safety Questions for Risk Reduction

- Why were traverses omitted from the planning application and could they be added to the site?
- Provide a risk assessment justifying the stacking of OME three pallets high.
- Provide OME transit routes, site access plans, vehicle specifications and requirements from the Local Authority/ emergency services.
- Will any vehicles be used on site? Provide specifications and refuelling operations.
- Provide fire risk assessments where applicable.
- What emergency response plans do you have in place? How will you liaise with local emergency services?
- What assessments have been conducted to limit environmental harm? Provide drainage studies for the site and earth coverings. What control measures will prevent the release of contaminated water into the marina?
- Provide internal and external engineering drawings for the ESHs.
- What measures will be in place to prevent unintended access to the site.
- What measures will be in place to prevent disruptive actions from the public to transportation and storage activities?
- Provide blast modelling for all ESHs.
- What hours will the site operate during?

Assignment

GRADEMARK REPORT

FINAL GRADE

50/100

GENERAL COMMENTS

Engagement with Literature Skills 3/10

Although relevant sources were used, only a few references are made throughout (only 4) and these were all given during module content so to gain more marks, use a wider range (scholarly articles, industrial information etc) and higher number of references to demonstrate wider reading and avoid being heavily reliant on sources and information gained through class contact.

The student cites the International Ammunition Technical Guidelines incorrectly, referring to them in the form "UN SaferGuard, "Title", 2021" UN SaferGuard is the publisher, not the document. At this level and in a report to a paying client, it is essential that references should take the reader to the exact regulation, equation or policy.

While they have referred to some of the IATG, there is no evidence of the student having used the 'tools taught', which implies the IATG Implementation Toolkit.

Knowledge and Understanding Skills 18/30

The student has demonstrated good understanding of directional effects and hazard divisions and to some extent compatibility and quantity distances, however this could have been further demonstrated by including context setting of compatibility groups and explanation of how these work, helping to add depth to the justification behind the student's conclusions. All parts of the question seemed to be answered however for further marks it would have been good to see an example/discussion around explosive limits license and consideration of more environmental factors which may have an effect e.g. salt-water and humidity etc.

The student does not explain the logic of treating the block of 5x ESH as a single PES. They state that "The site would be required to demonstrate that no sympathetic detonation can occur between the ESHs", from which it can be inferred that they do not understand that published QDs incorporate such

risk assessment.

In taking this approach, they have missed the opportunity to demonstrate that the total expected holdings are not feasible within the BBSS proposal. It appears that they do not understand the combined effects of the aggregation rules for HD and the mixing rules for CGs.

In Section 3, they state "Further work on the proposed site would be required to allow each ESH to be considered individually as a PES, thereby reducing the QDs to more acceptable limits.", which is incorrect as the minimum VBD for 1000kg of HD1.1 is identical to that for 5000kg, using the tables that they cite.

In the question set at Appendix A – a risk assessment for stacking pallets 3-high is not necessary when string using the IATG, and can be inferred as acceptable from Section 7 of IATG 06.20.

Cognitive and Intellectual Skills 10/20

The student has demonstrated some ability to critically evaluate, and make clear conclusions drawn from the content of the report. Judgements are logical and supported however, for more marks consider using a wider range of evidence to back-up points made. Consider also exploring wider concepts to further demonstrate a good grasp on the broader field – using more literature and references could help with this. In some instances, arguments may be supported by use of diagrams/tables e.g. when discussing QD from Annex D and E as quoted, show the tables or the calculations etc. There is some contradiction when discussing the PES; in section 2 it says they will be separate PES then in section 3 it says they will combine all ESH to one PES (this only took into account HD 1.1) – perhaps consider one worst case ESH.

They suggest that storing HCC 1.4S in an ISO container might be more suitable for this site, which might be cheaper in the short-term, but reduces the flexibility afforded by the building of 5x earth-covered ESH, an attribute that is, from my experience, essential for UK MOD storage.

In Section 6, one of the recommendations is to undertake work to reduce the QDs of the proposed site, which itself implies an assumption that the

Council supports the idea of having the ammunition depot in this location.

Practical Application Skills 15/30

The student has demonstrated a clear appreciation of the context of the application. The student has been able to identify problems with the proposal from BBSS and offer solutions in terms contents stored within each ESH, however this could have been improved by considering the NEQ overall and of each hazard division within each ESH. For further marks, also consider using a quantity distance map to add more depth to your explanations surrounding the discrepancy between proposed QDs and those you have suggested. Although the student has worked out QDs and identified how these differ from those offered by BBSS, it would be good to provide further explanation on why these values are important.

The student should have included images to illustrate the application of QDs and the relationship between the PES and ES considered.

Had they taken the time to evaluate the site as 5 separate ESH, they would have made a stronger case for the inadequacy of the BBSS proposal.

Section 4 would be more readily understood if it were supported by a table comparing the BBSS proposal with the student's considerations.

While the statements made are correct, they need to be substantiated and referred to the proposal. As an example, the points about requiring internal walls can be considered as key information that is not apparent from the BBSS proposal.

Section 5 is crying out for imagery to support the arguments made

References to specific sub-sections of the 'Ports' section of IATG 02.20 are necessary to support and/or explain the risk to maritime users of the port area.

Transferable Skills for Life and Professional Practice 4/10

The report has got a suitable structure to it and ideas and judgements are communicated effectively. In some instances, tables and figures could have

been used to add clarity and present points succinctly. Minor grammatical errors present. When writing a technical paper for a commercial client who has, as stated in the brief “no OME experts on the council staff”, it is essential that the argument is supported by easy to understand images, diagrams and tables, supported by high-quality, specific references in case they wish or need to see the original text.

Overall, they have answered most of the questions in the brief but there is a feeling that they have made the right conclusion before they conducted the analysis.

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