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by Max Fisher

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OME Safety Management and Legislation

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Viability of Energetic Storage Facility on SA1 waterfront:

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Introduction

The following report is based on a University of Wales Trinity St David University assignment, whilst the engineering basis is based on real calculations the overall scenario is fictitious

In September 2025, Swansea City council (the Council) received a planning application on behalf of 'Big Bang Storage Solutions' (BBSS) to construct up to 5 explosive storehouses in a disused section of the SA1 Dockland. As the Council does not have experience with regard to explosives licencing a third party (the author of this report) has been appointed to review the current plans to ascertain if they are compliant with the International Ammunition Technical Guidelines (IATG) and represent best practice with regard to energetics safety. This report will examine the viability of these plans and provide recommendations for both the Council and Big Bang Storage Solutions.

Background

Following the Russian Federation's illegal invasion of Ukraine in 2022, many Western governments have sought to expand their national energetics industries. This has recently been outlined in the United Kingdom's Defence industrial strategy [1]. The UK ministry of Defence awarded a contract to Big Bang Storage Solutions to construct a new Facility [2], capable of storing a range of energetics across compatibility groups and hazard divisions. The current application is to store up to 7500kg of energetics across a maximum of 5 explosive storehouses. There is a definite intention of developing UK sovereign capability within Government, and the

proximity of important Defence locations to Swansea makes the construction of an energetic storage facility an attractive proposition.

Intended storage quantities

The plans provided by the Council suggests that BBSS, intend to store the following quantities of energetics in the site:

Table 1 Overall energetic quantities

Hazard Division	Net Explosive Quantity (kg)
1.1	5000
1.2	500
1.3	1000
1.4	1000
overall	7500

The overall intended storage quantities remain relatively low when compared to large scale storage depots but constitute a high percentage of Hazard division (HD) 1.1 materials. HD 1.1 presents the biggest single risk with regard to the immediate area this is because it signifies ‘Mass explosion hazard’, where all items stored together would likely detonate in one event: each adding the intensity of the explosive. Where items of differing hazard divisions are stored together, the IATG states the following rules must be followed:

Serial	Hazard Divisions			Storage Requirement
	1.1	1.2	1.3	
1	YES	NO	NO	• Use HD 1.1 Quantity Distance.
2	YES	YES	NO	• Aggregate the HD 1.1 and 1.2 NEQ. • Evaluate aggregate as HD 1.1 then as HD 1.2 and use the greater Quantity Distance.
3	YES	YES	YES	• Aggregate the HD 1.1, 1.2 and 1.3 NEQ. • Evaluate aggregate as HD 1.1 then as HD 1.2 and use the greater Quantity Distance.
4	YES	NO	YES	• Aggregate the HD 1.1 and 1.3 NEQ. • Use HD 1.1 Quantity Distance for the aggregated NEQ total.
5	NO	YES	NO	• Use HD 1.2 Quantity Distance.
6	NO	YES	YES	• Assess QD for the NEQ of each HD. • Use the greatest Quantity Distance.
7	NO	NO	YES	• Use HD 1.3 Quantity Distance.

Figure 1 IATG Aggregation rules [3]

The IATG does not consider explosives of Hazard division 1.4 to contribute significantly to an energetic event and as such does not contribute to an aggregated figure; the following is stated:

“Distances from a PES containing ammunition and explosives of HD 1.4 are not a function of NEQ. Separation distances should be based on the fire risks and fire-fighting capability available. The separation distance for a PES of open stacks or light buildings to any type of ES should be greater than 10m. For more robust buildings the separation distance should be that required for emergency access”[4].

The effects of this will be discussed in a later section.

Compatibility

Energetics are divided further into groups known as Compatibility Groups (CG). These groups identify what specific energetics can be stored with others. The full list of definitions can be found within section 6.2 of the IATG Guidelines [5]

Compatibility Group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	X												
B		X	X (1)	X (1)	X (1)	X (1)	X (1)						X
C		X (1)	X	X	X	X (2)	X (3)					X (4)	X
D		X (1)	X	X	X	X (2)	X (3)					X (4)	X
E		X (1)	X	X	X	X (2)	X (3)					X (4)	X
F		X (1)	X (2)	X (2)	X (2)	X	X (2,3)						X
G		X (1)	X (3)	X (3)	X (3)	X (2,3)	X						X
H								X					X
J									X				X
K										X			
L											(5)		
N			X (4)	X (4)	X (4)							X (6)	X (7)
S		X	X	X	X	X	X	X	X			X (7)	X

Figure 2 IATG Compatibility Group Mixing table [5]

BBSS has declared that they intend to store the following groups:

Table 2 Compatibility Group NEQ [2]

Hazard Division	Compatibility group	Net Explosive Quantity (NEQ) (kg)
1.1	B	50
	D	3200
	E	1250
	F	500
1.2	C	350
	D	100
	F	50
1.3	C	1000
1.4	S	1000

BBSS state in their application that 'Each ESH will be able to hold up 1000 kg of each type of hazard division' [2],

It is immediately clear that the total quantity of 5000kg of 1.1 cannot be stored safely in conjunction with the compatibility group rules in only 5 Explosive storehouses (ESH). This conclusion can be reached using the following logic:

Compatibility group D and E can be mixed without issue as such their total NEQ can be combined (3200kg + 1250kg) giving a total of 4450kg. CG F can be stored with both D and E, but only if properly segregated within the building. Assuming this can be done this can be added

(500kg) giving a new total of 4950kg. However, the 50kg of 1.1B can only be mixed with CGs D, E&F if they constitute the fuzing of those munitions, the exact wording is as follows:

“Group B fuzes may be stored with the articles to which they will be assembled, but the Net Explosive Quantity (NEQ) shall be aggregated and treated as Compatibility Group F.” [5]

Given this information is not provided, the author assumed that the munitions cannot be stored together. Using the limit of 1000kg of each Hazard division per ESH as described in provided documentation and the compatibility group rules, a minimum of 6 ESHs would be required to store the above quantities of HD 1.1 assuming that adequate segregation could be provided for CG F items.

Items found in HDs 1.2, 1.3 are somewhat easier to store. If required, the entire stock of 1.2 explosives could be placed in a single ESH (assuming segregation for the CG F items). However this is not required and it is best practice to reduce the risk and severity of an incident by distributing these across several ESH as can be seen in Table 3 (note the 1.2 and 1.3 items can be stored in any store except the one containing the 1.1B items). 1.3 could be stored in magazines containing both 1.1 and 1.2 items, but it would be best practice to reduce the risk by placing it a ESH with a lower NEQ. The 1.4S items can be stored in any of the available ESH, these could be used to aid in segregation for CG F items but have been placed with the 1.1B items to ensure the NEQs of each ESH remains as low as practical. Table 3 is an illustrative example of how the munitions could be stored in compliance with the IATG compatibility guidance and the information provided by BBSS.

Table 3 Minimum number of ESH required (example)

ESHx	ESH 1	ESH 2	ESH 3	ESH4	ESH5	ESH6
Explosives	1.1B 50kg	1.1D 1000kg	1.1D 1000kg	1.1D 1000kg	1.1D 200kg	1.1E 450kg
	1.4S 1000kg	1.2C 250kg	1.2D 100kg	1.3C 1000kg	1.1E 800kg	1.1 F 500kg
					1.2F 50kg	
License	1.1 50kg 1.4 1000kg	1.1 1000kg 1.2 250kg	1.1 1000kg 1.2 100kg	1.1 1000kg 1.3 1000kg	1.1 1000kg 1.2 50kg	1.1 950kg

Location

The proposed site of the facility is the SA1 Waterfront dockland area. This is accessible through rail, road and sea. Whilst this is beneficial with regard to construction and operations that require intermodal transport such as loading and unloading, it presents a significant challenge. There are a large number of vulnerable structures in the immediate vicinity; these include university buildings, a training hospital and numerous port facilities including Ship berths and traffic. Figure 3 shows the location of the site within the Swansea area, note the proximity of the St Thomas Area as well as the A483 known locally as ‘Fabian way’. It is clear that this area of Swansea is densely populated; according to the office for national statistics, the City and

Council of Swansea has a total of 251,300 residents [6] with approximately 7000 people [7] living in the St Thomas ward area, immediately north of the proposed site.

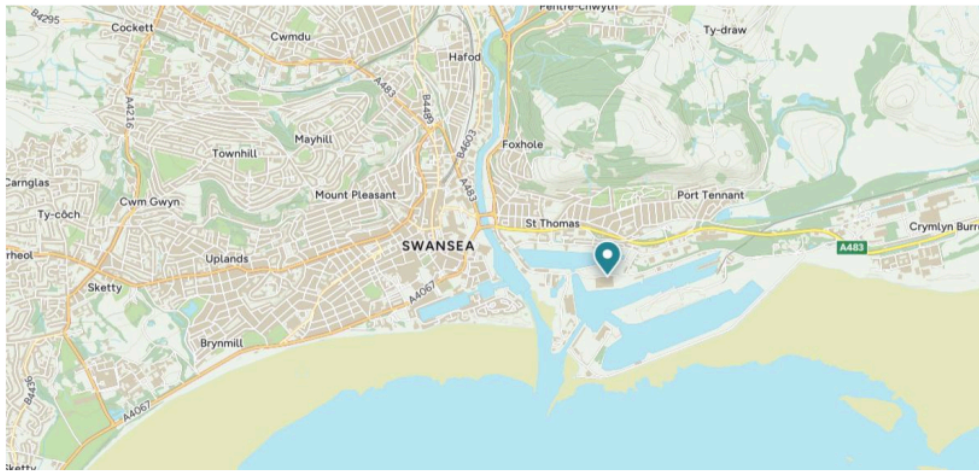


Figure 3 Location of the Site

Figure 4 shows an aerial view of the proposed site, with nearby structures and infrastructure highlighted. Housing is extremely close to the proposed site, with the nearest being less than 16m from the northeast boundary of the site. Additionally, several properties along the Langdon Road, are undergoing development in the immediate vicinity of the site, with construction due to be completed by 2027. Further development is to be expected in the near future, however further encroachment is unlikely in this area due to the presence of the Prince of Wales Dock, which demarcates the northern boundary of the site.

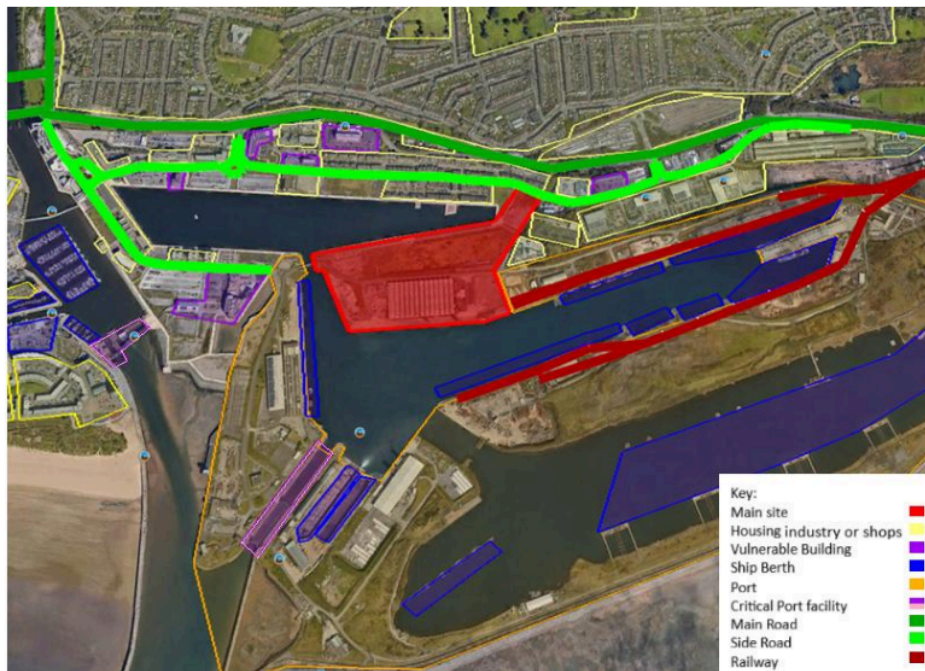


Figure 4 Overview of the site

North-west there are several vulnerable structures including several medical facilities (such as the Sancta Maria training hospital), and a church. Apartment buildings and hotels are also located in the immediate vicinity.

140m West of the site is the University of Wales Trinity Saint David, these buildings are in use 24/7 use by a mix of students and staff. Nearby there is also a number of apartment buildings which border the Prince of Wales dock. Especially close to the site is one of the Port maintenance Berths, where several ships undergo refits or maintenance that does not require dry docking. Additionally, this is the location of the Swansea port 'roll on' 'roll off' facilities for car ferries and passenger ships.

Southwest there is a number of warehouses and ship berths, these appear to be in a state of disrepair and therefore present a heightened risk of collapse in the event of an incident. Located here there is also critical Port facilities such as the harbour control offices and most importantly the harbour lock gates. These control the water level of the port and damage to these would likely render the entire port non-functional (290m SSW).

South the port facilities continue, with the port's two dry docks located adjacent to the lock gates. They represent an important capability for the port, enabling major repairs to be undertaken to small, medium and large vessels up to 204m in length. Surrounding this are its support facilities including waste management and warehousing.

Southeast there is a metal recycling facility which specialises in steel this is served by a little used siding and has ship berths along the quay's length. Further Southwest there is the Queens dock, where a collection of ship jetties are located including the 'no.9 chemical jetty'.

East there is a wide range of structures, adjoining the site is an aggregates facility and wood fuels transportation company. Swansea driving test centre is also located adjacent to the site, with an industrial estate containing multiple car dealerships just behind this. This is also where a number of port infrastructure such as tugboats and unloading docks are present. According to the Associated British ports [8] there are facilities that can handle the following types of cargo:

- Cement,
- Minerals,
- Aggregates,
- Agribulks (e.g. fertilisers)
- Coal,
- Timber products and logs,
- Steel products
- Recycled materials
- General cargoes
- Offshore wind
- Passengers and Cars.

Details can be found in the Appendices.

Expected Safety Distances

To gain an understanding of the limitation of the site, an initial estimate was taken based upon the understanding that each ESH was required to store the required 1000kg of each HD (disregarding for the moment the earlier compatibility group findings) as written this would result in a aggregated NEQ of 3000kg of HD 1.1, using the United Nations SaferGuard toolset an estimation of the, Public Traffic Route Distance (PTRD), Inhabited Building Distance (IBD) and Vulnerable Building Distance (VBD) was calculated, with the assumption the ESH was built to the 'Earth covered ESH or Igloo' requirements. These quantity distance (QD) calculations are based on the Hopkinson-Cranz scaling law [9], which has been modified based on NATO experiences. [10]

Table 4 UN SaferGuard QDs

Line	Colour	Distance (m)
PTRD	Green	270
IBD	Yellow	400
VBD	Purple	640

When confirming with the IATG the following is generated assuming the building is considered a 'standard Earth Covered Magazine (ECM)'

Table 5 IATG Calculated QDs

Type	(subtype)	Distance (from rear of ESH) [m]	Distance (from side of ESH) [m]	Distance (from door of ESH) [m]
PRTD	Low	163	163	163
	Medium	>270	>270	>270
	High	>400	>400	>400
IBD	n/a	>400	>400	>400
VBD	n/a	650	650	650
Other ESH (inter magazine distance)	Front	37	37	70
	Side	26	26	26
	Rear	16	16	26

Another set of quantity distances are required for port facilities (note this list is not exhaustive) can be found in Table 6.

Table 6 IATG Port QDs

Type	Subtype	Equation	Distance
Passenger terminal /ship loading /unloading	Explosives being loaded or unloaded	$22.2Q^{1/3}$	321
	Explosives stored normally	$16.7Q^{1/3}$	241
POL tanker	No loading or unloading on either ship	$16.7Q^{1/3}$	241
	Concurrent loading or unloading	$22.2Q^{1/3}$	321
	Single ship loading unloading	$16.7Q^{1/3}$	241
Bulk Carrier vessel (Dangerous goods)	n/a	$11.1Q^{1/3}$	160
Port operating facilities	n/a	$11.1Q^{1/3}$	160
Transit storage for dangerous goods	n/a	$16.7Q^{1/3}$	241

Many approaches can be taken to generate a quantity distance map; the author has decided to generate several options based on a 'best case solution'. A geographical centre of the proposed site has been identified and a single ESH (standard ECM/ Igloo) placed on that location. The author has not generated specific QD tables for each ESH, as the exact proposed locations are unclear. It is likely that multiple ESHs will have to be placed closer to the site boundaries due to the requirements to observe the inter magazine distances (16-70m dependent on ESH orientation). This will undoubtedly move quantities distances lines closer to populated areas and present a higher hazard that the lines generated within this section of the document. When BBSS proposes the exact siting of each ESH facility, it is of utmost importance to produce accurate Quantity distance maps. All examples demonstrate that the proposed distances in the BBSS application for both Inhabited and Vulnerable building distances are inaccurate and underestimate the risks present. The proposed PTRD is accurate if considering medium density traffic routes, but roads such as Fabian way will fall within the High Density PTRD QD.

Figure 5 Shows an ESH placed in the centre of the site containing 1000kg of each HDs 1.1, 1.2, 1.3 and 1.4 this produces an aggregated total of 3000kg HD 1.1 explosive. The QD distances used are those from the UN SaferGuard tools.



Figure 5 3000kg 1.1 equivalent in an ESH at centre of site (UN SaferGuard)

Figure 6 shows the distances 160m, 241m and 321m each represent differing zones. The outer ring shows that under IATG the Chemical Jetty is not present within the immediate risk zone. However, due to the location of the harbour locks the majority of vessels would have to pass within the transit storage (Dangerous Goods) distance (241m). This may prove disruptive to port operations, especially as the munitions depots will be distributed East-West across the site, extending the radii further. The port infrastructure distance is relatively low, representing 160m however this would still preclude loading directly onto the expected site.

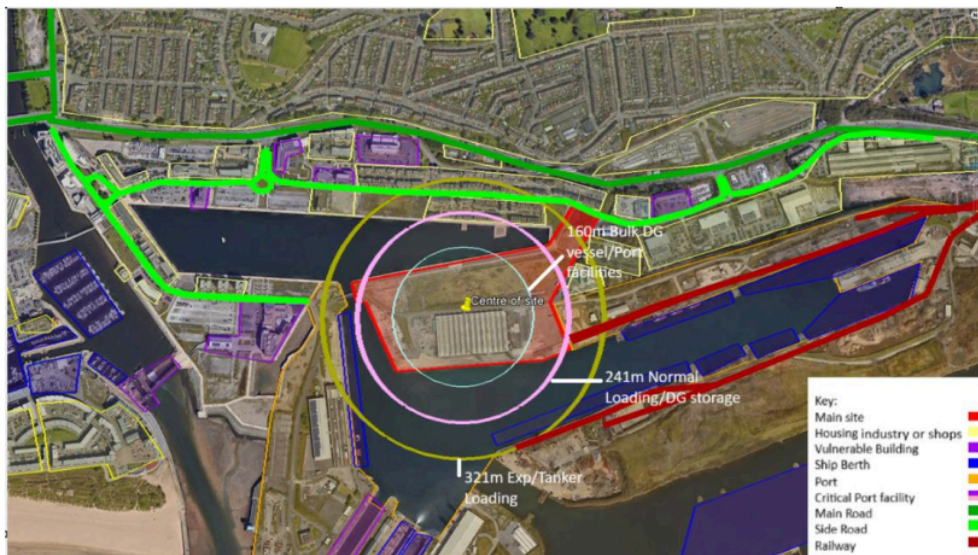


Figure 6 shows an ESH placed in the centre of the site containing an aggregated total of 3000kg HD 1.1 with port quantity distances).

Figure 7 Shows an ESH placed in the same location, but with only 1000kg of 1.1 and 1.3 the maximum likely to be stored as calculated in Table 3. This would provide an aggregated total of 2000kg HD 1.1 The QD distances used are those from the UN SaferGuard tooling.

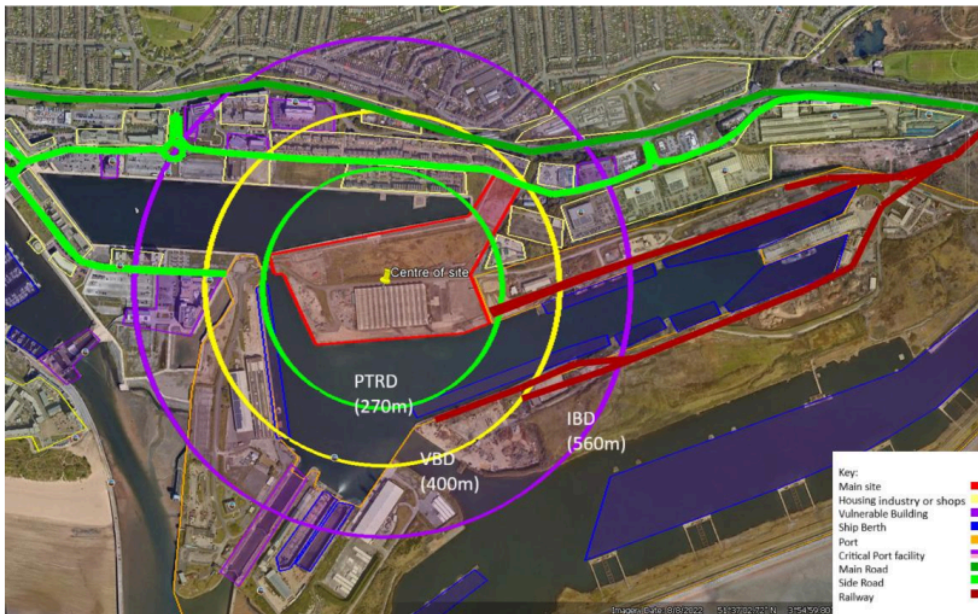


Figure 7 2000kg 1.1 equivalent in an ESH at centre of site (UN SaferGuard)

Figure 8 shows an ESH placed in the same location with a comparatively small charge of 50kg HD 1.1. The QD distances used are those from the UN SaferGuard tooling. Note that the IBD and PTRD do not change as they represent minimum distances.

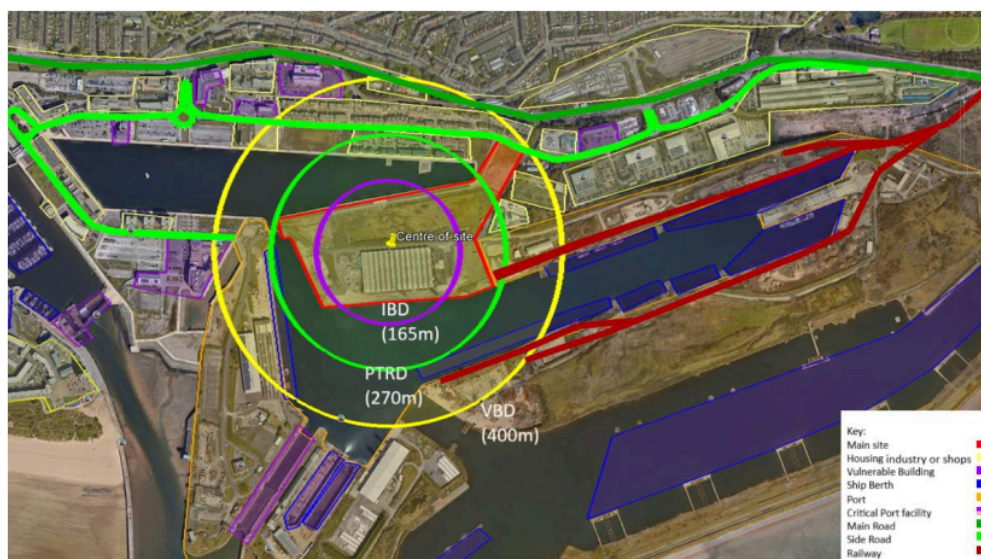


Figure 8 50kg 1.1 equivalent in an ESH at centre of site (UN SaferGuard)

Additional Risk Factors

Whilst the access to the site is excellent when considering normal traffic. Each access point would require a vehicle to pass a vulnerable structure immediately before accessing the site, this is true for road, rail and sea.

Outside of the immediate quantity distances but near the site are two industrial facilities of concern; Gower Chemical located 2km East-North-East of the site is a registered COMAH site [11] producing and packaging a large number of chemical products including Sulphuric and Nitric acid. Many chemicals held by this company could present a serious risk; in the event of a simultaneous accident local response teams including Fire and Rescue would struggle to resource both events.

Also located to the East of the site is the Yara limited fertiliser bagging facility and warehousing. Similar to Gower Chemicals, in the event of a simultaneous incident occurring at these facilities, local resources would be exceptionally stressed.

Local crime is a major concern. The areas surrounding the city centre and docks experience very high crime rates [12]. This will mean that security matters must be especially heightened, above and beyond what would normally be appropriate. Many of these included violent crimes or theft, adding to the overall risk profile of the site.

Finally with the expected quantity of energetics on site, it is impossible to locate an office within the grounds under a standard licence. This would create significant difficulties in day-to-day operations and management of site access. Additional considerations for this and site security should be provided to the council by BBSS.

Mitigation

Mitigations could include a construction of below ground magazines; these require much smaller quantity distances and therefore may be in extremis located closer to vulnerable facilities. Additionally, the construction of additional traverses may be considered as a way of reducing the effects of blast and fragmentation on the surrounding areas; potentially allowing the use of a non-standard explosive licence; this may be used if there are exceptional circumstances. Based on the information in the application provided from BBSS, it is unlikely that the applicant would meet the criteria currently. Another approach would be to only store munitions of lower Hazard divisions e.g. only items in HD 1.2-1.4, this would significantly reduce the risk to the surrounding areas.

Advice to Mariners

In the event that the facility was to be approved in its current state the Advice to mariners would be provided in Appendix B

Conclusion

Based on the evidence provided thus far, the author of the report recommends that the application made by Big Bang Storage Solutions is **REJECTED**. This is due to the large number of vulnerable and inhabited buildings located within the expected quantity distances of the ESH locations. Even if only 50kg of Hazard division 1.1 was stored in the most remote location on site, nearby populations would be exposed to unacceptable risks. BBSS may consider additional measures to mitigate the risks presented by the proposed site, this includes items such enhanced measures to control blast and fragmentation. The author of this report is concerned that the lack of detail presented by BBSS in their application shows an unwillingness to be open and transparent about their operations and is concerned about BBSS ability to operate the site given the failure to accurately provide critical safety information. The author would recommend that if the Council and BBSS wish to continue development of the site that the questions found in Appendix C.

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Appendix A

Swansea Port maps

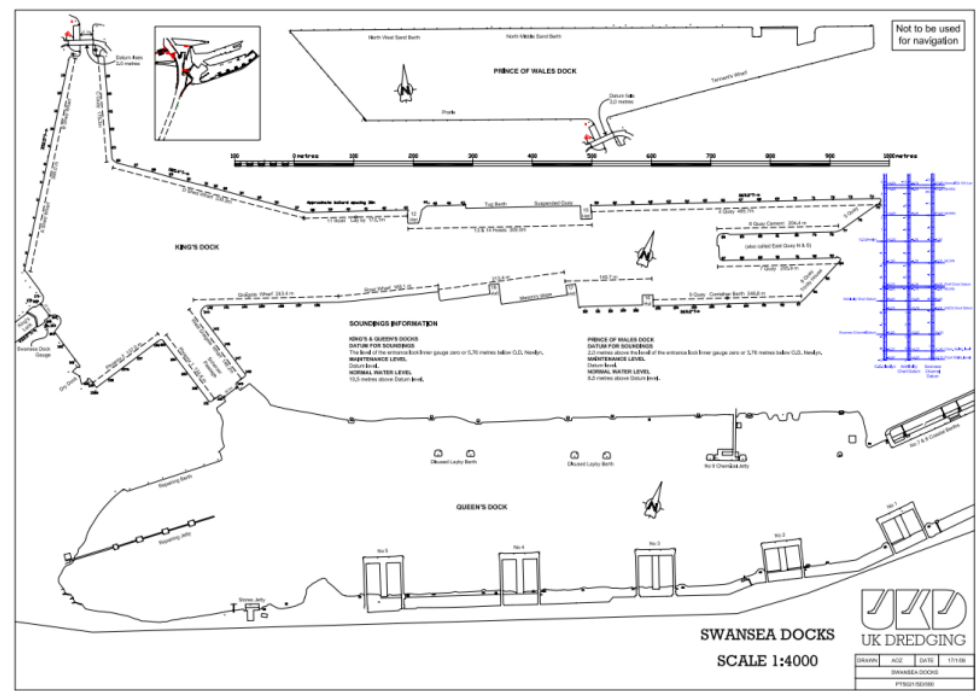


Figure 9 Berthing Map [8]

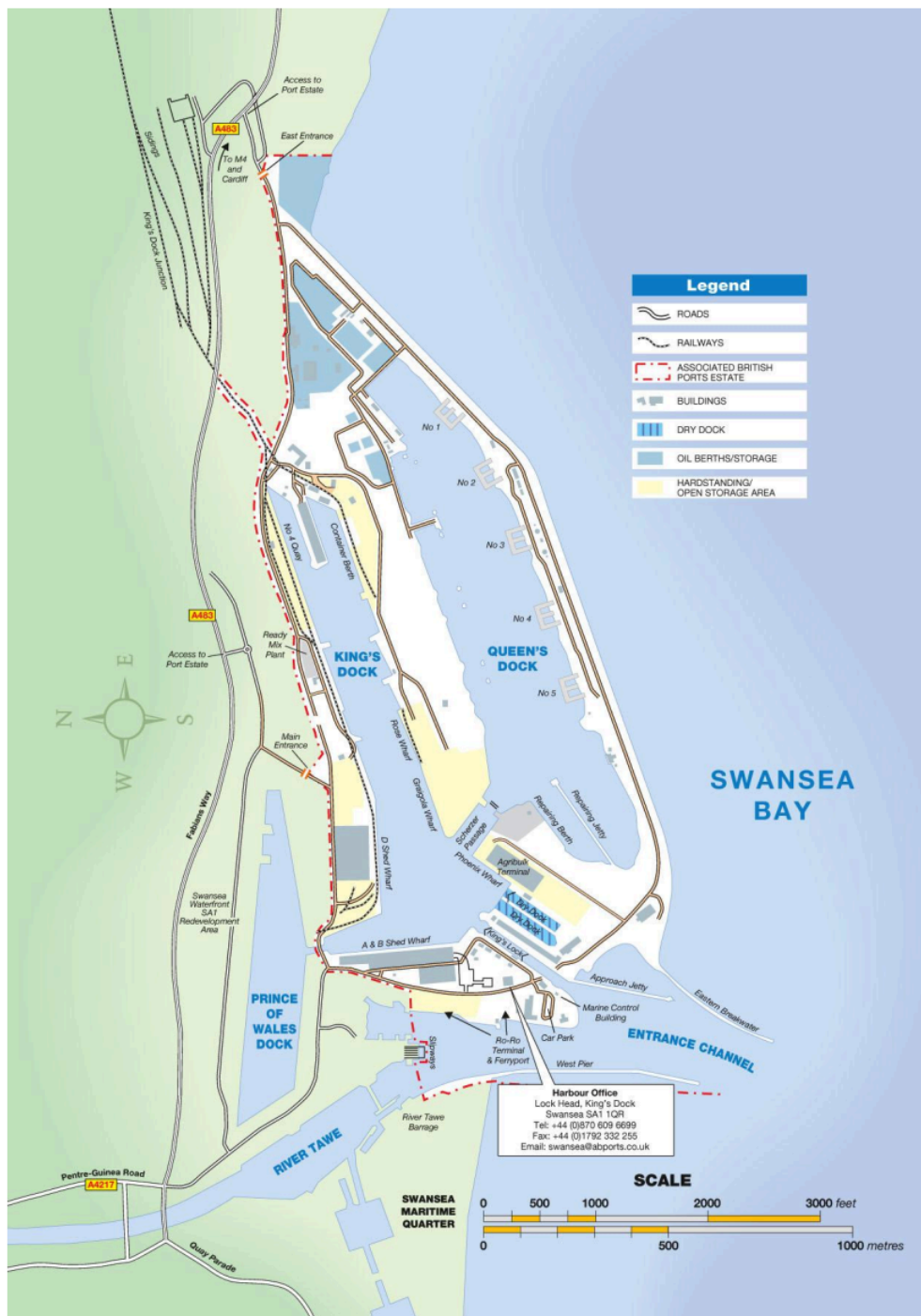


Figure 10 Port overview map [8]

Appendix B

LOCAL NOTICE TO MARINERS

STORAGE OF EXPLOSIVES SWANSEA DOCKS

This Local Notice to Mariners is issued by Swansea Harbour Commissioners on behalf of Big Bang Storage Solutions

Mariners are advised to keep a minimum of 160m from the C Quay and D Shed Wharf. If Vessels are transporting Passengers or Dangerous Goods are to maintain a minimum distance of 241m at all times.

Pleasure craft are not to be admitted to the Kings Lock Basin unless written permission from the Harbour Master is obtained.

Any vessels that require Berthing in the Prince of Wales or Kings docks contact the Harbour Master at least 7 days ahead of entry to the port to arrange safe transit.

Owners, Agents, Charterers, Marinas, Yacht Clubs and Recreational Watersports Organisations should ensure that the contents of this Notice are made known to the masters or persons in charge of their vessels or craft

HARBOUR MASTER

Association of British Ports (SWANSEA)

Appendix C

Critical Safety Questions:

- Has the UN SaferGuard Risk Reduction been followed?
 - If so, can this be shared with the council?
- What are the administrative arrangements?
 - Where will the site office be located?
 - How will access/egress to site be managed?
- Will additional process buildings be constructed?
- Will there be issue/receipt building be constructed?
- Has BBSS consulted with structural engineers?
- What are the exact locations of the intended ESHs?
- Has the Harbour Master / Association of British ports been informed of your plans?
- Is there a plan for waste disposal of both energetic and non-energetic waste?
- Have BBSS considered the flood risk of the site?
- Have Emergency Response plans been drafted?
 - Have South Wales Police been involved in response planning?
 - Have Mid and West Wales Fire and rescue service been involved in response planning?
 - Is Gower Chemicals aware of the plans?

- Are 1.1B munitions the fuzing of the 1.1D, E or F munitions?
- Will suitable segregation be available for the compatibility group F munitions?

FINAL GRADE

78/100

GENERAL COMMENTS

Engagement with Literature Skills 6/10

References used throughout are all relevant and dated mostly within the last few years - up-to-date information has been used in support of decisions throughout. For further marks, the student should consider using a wider range (e.g. use of scholarly articles) and number of references (only 12 used for 3000-word assignment). The UN SaferGuard toolset is said to have been used but this is not explicitly given an in-text citation but should be referenced properly.

Knowledge and Understanding Skills 24/30

The student demonstrates excellent knowledge of hazard divisions and compatibility groups for explosives, expected quantity distances and further risk factors which may affect the decision to approve the proposal are also considered. For further marks, consider what is meant directional effects and provide answers to: "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?" The student argues that a minimum of 6 ESH would be required to store the quantities of HD1.1 listed. Table 3 illustrates a valid distribution option. Excellent understanding of factors other than those mentioned in the brief, e.g. that Gower Chemical is a registered COMAH site, which could potentially be both a hazard and a specific area of concern as an ES. Provision of additional traverses on-site could indeed provide some protection from fragmentation, but the effect on a propagating blast wave from explosions in the order of 3000kg HD1.1 might not be mitigated as much as the student implies.

Cognitive and Intellectual Skills 16/20

The student has been able to demonstrate excellent critical thinking and evaluation of different possible solutions. Arguments made are supported by valid judgements and a clear conclusion is given at the end, derived from the context of the work, supporting the analysis done throughout. There is some evidence of independent thought however for further marks this could be developed to demonstrate a grasp of wider concepts, 'thinking beyond the question'.

Figure 4 highlights inhabited buildings, vulnerable buildings and critical infrastructure and it is important to note that there are vulnerable buildings and critical infrastructure to the North, Northeast, South, West and North West of the proposed site. As such, they could have highlighted that the BBSS statement "side of magazine perpendicular to the direction of ES" is achievable only if the ESH are orientated such that the doors all face Southeast, which might affect the construction of the ESH and associated road system within the facility, plus licensing thereof.

Excellent consideration of the port facilities as a separate risk assessment. It would be entirely reasonable to ask a question of the client and BBSS to make a determination of the importance and therefore vulnerability of critical port infrastructure.

Practical Application Skills 24/30

The student has demonstrated an excellent use of the tools given in lectures (relevant IATGs and UN SaferGuard toolset) to offer alternative solutions to the one proposed by BBSS and justify any possible issues with those put forward by BBSS. For further few marks, consider delving deeper into the latest research and use this to offer innovative solutions. It may have also been beneficial to have shown a deeper analysis and examples of the explosives license limits for this scenario.

Sound logic for the generation of QD maps with PTRD, IBD and VBD lines from the potential aggregated maximum NEQ of 3000kg HD1.1. This student has assumed that the unused land and building form the proposed site, whereas others have assumed only the unused land. It can be seen from their QD maps that the latter would bring about a worse picture.

Good understanding of security issues in this area of

Swansea. An excellent set of high-level questions that should be asked by the client of BBSS, with an expectation that answers to the critical underlying science and engineering questions would be incorporated.

Transferable Skills for Life and Professional Practice 8/10

The report is well-structured with all expected sections present. Information is organised coherently, and conclusions are justified and presented clearly. A few minor grammatical errors present.

This report was a pleasure to read.

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