Royal HaskoningDHV
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Technical Note

HaskoningDHV UK Ltd.
Maritime & Waterways

To: York Potash Ltd.
From: Richard Parsons
Date: 30 July 2015
Copy:
Our Ref: PB1586 – N019 – Rev 2
Classification: Project Related

Subject: Formal Safety Assessment, York Potash Ltd.

Executive summary

The York Potash Harbour Facilities Project is currently at a stage whereby formal consultation has been undertaken with the Consultees including river users and associated stakeholders as part of the Development Consent Order (DCO) application process. A number of questions have been raised regarding the potential impact on marine operations.

A Formal Safety Assessment (FSA) in accordance with the Port Marine Safety Code (Department for Transport, 2015) was requested by the Marine and Coastguard Agency as a Relevant Representation. (The purpose of FSA was to consider risks associated with the operational phase only - marine construction related issues, including dredging, were considered to be in a separate exercise.) The FSA was undertaken on 21st July in a workshop with the Harbour Master and representatives from the Tees Bay Pilots, Foy Boatmen (the organisation responsible for mooring of vessels), Svitzer (the tug providers), York Potash Ltd (YPL) and Royal HaskoningDHV.

The workshop concluded that:

- The Harbour Master and operational services foresees no problem in dealing with YPL associated increase of traffic in the same as existing operations. The current volumes, circa 4,200 vessel calls per year, are far below previous peaks in 2005-2007 which experienced peaks in excess of 5,500 calls per year.
- The size and type of vessels are within the experience of the Harbour Master, tugs, Pilots and Foy Boatmen.
- Support services will be expanded as necessary to service the increased demands.
- The modelling demonstrates that largest delays would be experienced by YPL.
- A separate construction phase review of operations in the river is still required.
- The Harbour Master confirmed that there will not be a significant impact to the other users on the river due to the operations from YPL. The inclusion of the YPL activities is business as usual.

1.0 Introduction

The York Potash Harbour Facilities Project is currently at a stage whereby formal consultation has been undertaken with the Consultees including river users and associated stakeholders as part of the

Development Consent Order (DCO) application process. This process has raised a number of issues and concerns. These are concerns associated with marine operation and marine constructability issues including the interface with existing operations and infrastructure within the river.

The purpose of this document is to consider risks associated with the operational phase only - marine construction related issues, including dredging are to be considered in a separate exercise. In order to assess the future vessel movements of polyhalite vessels at Tees River, York Potash Ltd. (YPL) has commissioned Royal HaskoningDHV (RHDHV) to prepare a Marine Risk Assessment Study (PB1586/R003-Rev 3, July 2014). In addition, a Traffic Simulation Addendum has been prepared (PB1586 - N013 - Rev 1, 15 July 2015). The purpose of the addendum is to assess the potential impact of the vessel movements associated with the revised operational berth length and vessel characteristics for Phase 2 (13 mtpa), as this represents the more critical scenario based on previous analysis.

The FSA, as additionally required, has been carried out by RHDHV on behalf of YPL. The FSA in particular assesses the potential safety impacts associated with the forecasted increase in vessel movements of polyhalite exports from YPL.

This note is structured with the following headings:

- Abbreviations
- Methodology - discussion on the approach taken
- Conclusions
- Recommendations

1.1 Abbreviations

The following abbreviations are used in this report:

AIS	- Automatic Identification System
ALARP	- As Low As Reasonably Practicable
ARPA	- Automatic Radar Plotting Aid
ATBA	- Area To Be Avoided
AtN	- Aid to Navigation
CPA	- Closest Point of Approach
DWT	- Dead Weight Tonnes
ECDIS	- Electronic Chart Display and Information System
EIA	- Environmental Impact Assessment
GIS	- Geographical Information Systems
GPS	- Global Positioning System
GRT	- Gross Register Tonnage
HAZID	- Hazard Identification (workshop)
FPSO	- Floating Production Storage and Offloading
FSA	- Formal Safety Assessment
HSE	- Health and Safety Executive
IMO	- International Maritime Organisation
ISPS	- International Ship and Port facility Security Code
LOA	- Length Overall
MJ	- Megajoule
Mtpa	- mega ton per annum

nm	- Nautical Miles (1 nm = 1,852 metres)
NtM	- Notices to Mariners
OGP	- International Association of Oil and Gas Producers
OIM	- Offshore Installation Manager
PPU	- Portable Pilot Unit
RACON	- Radar Beacon
RAM	- Risk Assessment Matrix
RCO	- Risk Control Option
SAN	- Shipping advisory group North Sea
SMCP	- Standard Marine Communication Phrases
SBV	- Standby Vessel
TSS	- Traffic Separation Scheme
VHF	- Very High Frequency
VTS	- Vessel Traffic Service

2.0 Methodology

2.1 Objective

The major objective of the FSA is early identification and risk assessment of safety hazards in order to provide essential input to project decisions. The FSA is a process for proactive identification of hazards and is characterized by:

- Identification of safety hazards at the earliest practicable stage.
- Assessment of risks against standards of acceptability
- Reduction of risks to an acceptable level.

The HAZID study technique has been developed specifically to reflect the importance of HSE issues on the fundamental decisions that are made at this (relatively early) engineering stage of the project. The HAZID study is the first opportunity to assemble experienced operational, engineering and HSE staff together to address, in a short time frame, the HSE issues surrounding the project.

2.2 FSA Standards and Risk Assessment process

The Port Marine Safety Code [Department for Transport, 2015] and the IMO FSA guidelines [approved by IMO, 2002] have been applied within this study. The FSA is a structured and systematic methodology based on risk analysis and cost benefit assessment (if applicable). In addition, the Guide to Good Practice on Port Marine Operations [Prepared in conjunction with the Port Marine Safety Code] is applied. The relationship of Port Management System and Risk Assessment is demonstrated in Figure 1.

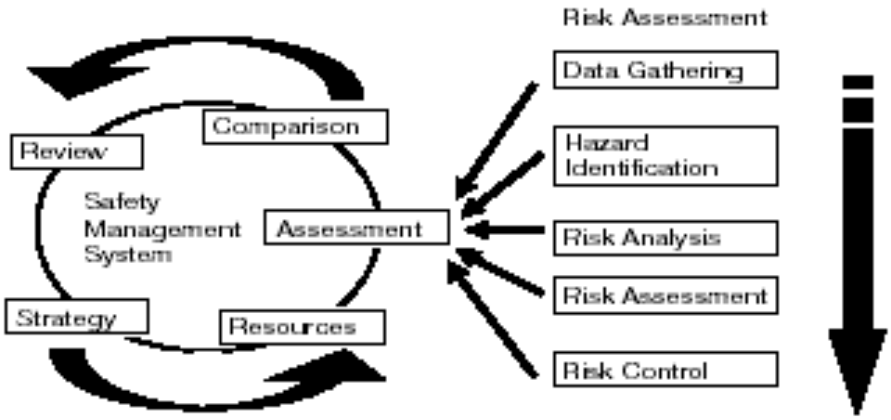

Figure 1 Relationship of Port Management System and Risk Assessment.
Source: "Guide to Good Practice on Port Marine Operations, §4.1.5. Risk assessment and safety management systems

2.3 Approach

The FSA stages include:

- Stage 1: Data gathering and preliminary identification of hazards.
- Stage 2: Hazard Identification (HAZID) Workshop with stakeholders in order to include local knowledge and experience in the FSA. The workshop is a meeting, employing a highly experienced multi-discipline team using a structured brainstorming technique, based on a tailor made checklist of potential failure cases.
- Stage 3: Decision making, on basis of conclusions and recommendations.

For the FSA, reference is made to the Marine Risk Assessment and the Addendum, including marine traffic simulations, as prepared by RHDHV previously. The FSA focusses on the potential safety impacts associated with the forecasted increase in vessel movements of polyhalite exports from YPL. The FSA considers both the related consequences of marine operations related to the port, as well as the effects on existing navigation and port and terminal operations and polyhalite vessel berthing occupancy.

The FSA activities include:

- Step 0: Data gathering (the potential impact of polyhalite vessel movements).
- Step 1: Hazard identification (a list of all relevant failure cases with potential causes and outcomes).
- Step 2: Risk assessment (evaluation of risk factors, both with- and without risk control options).
- Step 3: Identification of Risk Control Options (RCO's) (devising regulatory measures to control and reduce the identified risks).
- Step 4: RCO Effectiveness Assessment (determining the residual risk and the (cost) effectiveness of risk control options).
- Step 5: Conclusions and recommendations (for decision-making, i.e. information about the hazards, their associated risks and the (cost) effectiveness of risk control options).

2.3.1 FSA Stages

The FSA Stages and FSA Activities are summarized in Table 1.

	FSA Stages		
FSA Activities	**Stage 1: Desk study [RHDHV]**	**Stage 2: HAZID Workshop [HAZID Team]**	**Stage 3: Decision making [YPL]**
Step 0: Data gathering	X		
Step 1: Hazard identification	(X)	X	
Step 2: Risk assessment (without RCO)	(X)	X	
Step 3: Identification Risk Control Options	(X)	X	
Step 4: RCO Effectiveness assessment		X	
Step 5: Conclusions and recommendations		(X)	X

Table 1 FSA Process
(X) : Preliminary information
X : Determined information

Stage 1: Desk Study

The desk study was carried out by RHDHV based on the DCO plans and Marine traffic simulation results. The desk study included a preliminary identification of hazards (step 1), preliminary risk assessment (step 2), and suggestions for possible RCO's (step 3). The findings from the desk study, along with the Risk Management Matrix (RMM), were summarised into a preliminary HAZID worksheet.

Stage 2: HAZID Workshop

A HAZID workshop was held on 21 July 2015 in the Harbour Master's Office at Teesport in order to assess hazards, risks and RCO's. During the workshop the data gathered and preliminary hazards identified are presented and discussed. Outcomes are fine-tuned, optimized and determined.

The HAZID Workshop attendees (i.e. the "HAZID Team") are noted in Table 2.

Name	Position / Title	Organisation
Mr. James Barrie	Port Area Project Manager	York Potash Ltd.
Mr. Will Woods	Project Development Manager	York Potash Ltd.
Mr.Jerry Drewitt	Harbour Master	Teesport
Mr. Paul Brooks	Deputy Harbour Master	Teesport
Mr. Andrew Knox	Pilot	Rep of Tees Bay Pilots

Mr.Stephen Brown	XXXX	Rep. of Svitzer
Mr.Gavin Allen	XXXX	Rep. of Foy Boatmen
Mr. Richard Parsons	Project Manager	Royal HaskoningDHV
Mr. Tim Raby	Project Maritime lead	Royal HaskoningDHV
Mr. Johan van Middelaar	Marine Safety Specialist FSA Process Leader	Royal HaskoningDHV
Mr. Jacco Valstar	Marine Navigation Specialist	Royal HaskoningDHV

Table 2 HAZID Workshop participants

Stage 3 Decision making

Following the HAZID workshop, the initial HAZID worksheet was updated to final, incorporating the risk assessment and RCO's agreed during the workshop.

2.3.2 FSA Activities

An initial ranking of the hazards was carried out following the HAZID workshop to identify the priority failure cases requiring further risk assessment. This was based on RHDHV's maritime safety, process & chemical and oil & gas experience, taking into account the discussion at the workshop and the baseline data review.

Step 1: Hazard Identification

The identification of hazards is done by analysing the nautical processes of port approach (incl. pilotage), port entry, berthing and departure to and from the port. The loading and unloading process of ships with polyhalite is considered outside the scope of the FSA.

In each part of the process failure cases are identified per incident category. For each failure case the typical causes and potential consequences are identified. Four (4) typical marine incident categories have been preselected for YPL i.e. potential increase of polyhalite traffic movements:

1. Pilotage; Port approach (Pilot station to/from North/South Gare Breakwater).
2. Port entry; Main port area (North/South Gare Breakwater to/from Bran Sands quay/Tees Dock).
3. Berthing operations; incl. assessment of construction (Bran Sands quay/Tees Dock).
4. General; calamity on board of polyhalite vessel (all area's).

For each incident category, failure cases were identified, including potential causes and consequences.

Step 2: Risk Assessment

As per the IMO FSA guidelines, a Risk Assessment Matrix (RAM) was used to rank the hazards by applying the frequency and consequence categories shown below. The second step of the FSA consisted of qualitatively assessing the expected impact of each hazard based on expert opinion and (local) incident statistics.

The expected impact of a risk depends on both the probability of occurrence and the potential consequences and is generally summarized by the formula:

*Risk = Probability of occurrence * Consequence*

Since the risk is defined as the product of probability of occurrence and the consequences, the risk assessment focused on “non-frequent high impact” events as well as “frequent low impact” events.

In Figure 2 the RAM is depicted. On the top right the different frequencies/probabilities of occurrence are shown. The probability of occurrence of the various risks is categorised in 5 categories of expected frequency of occurrence. On the left side the consequence classification is shown with the classes. The consequences are grouped in the following categories;

- People (human injuries and casualties).
- Assets (financial and economical consequences).
- Environment (damage to natural habitat).
- Reputation (damage to image).

The combination of a consequence and a probability of occurrence results in a risk. The colours of the matrix indicate whether further action is required/ advised/ unnecessary.

						A	B	C	D	E
		Consequences				Frequency / Probability of occurence				
		People	Assets	Environment	Reputation	Improbable 1. Has occured in the world, but not in this country	Remote 2. Has occured in another facility/terminal in the country	Occasional 3. Has occured at this port/location/facility	Probable 4. Happens several times each year at this port/location/facility	Frequent 5. Happens several times per year at the same location/facility
5	Catastrophic	Multiple fatalities	Extensive damage	Massive effect	International impact	5	10	12,5	15	20
4	Severe	Single fatality or permanent disability	Major damage	Major effect	National impact	4	8	10	12	16
3	Critical	Major injury or health effects	Local Damage	Localised effect	Considerable impact	3	6	7,5	9	12
2	Marginal	Minor injury or health effects	Minor damage	Minor effect	Minor impact	2	4	5	6	8
1	Neglegible	Slightly injured or health effecs	Slight damage	Slight effect	Slight impact	1	2	2,5	3	4

Figure 2 Risk Assessment Matrix

The colours in the prioritization matrix indicate the level of risk of the considered hazard:

- Green: Broadly Acceptable region (Low Risk): Generally regarded as insignificant and adequately controlled. None the less the law still requires further risk reductions if it is reasonably practicable. However, at these levels the opportunity for further risk reduction is much more limited.
- Orange: Tolerable Region (Medium Risk): The risks are as low as reasonably practicable (ALARP). The risks are tolerable however action would be beneficial. Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks

are properly assessed, appropriate control measures are in place, residual risks are ALARP and that risks are periodically reviewed to see if further controls are appropriate.
- Red: Unacceptable Region (High Risk). Generally regarded as unacceptable whatever the level of benefit associated with the activity.

Step 3: Risk Control Options

The third step was identification of Risk Control Options (RCO's) for the risks with the expected largest impact. After the determination of the RCO's these were evaluated in the workshop on the basis of completeness and their effectiveness.

The RCO's are targeted to:
- Reduction of the probability of an incident.
- Reduction or mitigation of the consequences of an incident.
- Alleviate external circumstances in which an incident occurs.

Step 4: RCO Effectiveness Assessment

The fourth step was used to indicate the perceived effect of the suggested RCO's. With the RCO's in place the probability and/or consequence of a failure case were reduced to either Low Risk or Medium Risk (ALARP) level.

Step 5: Conclusions and recommendations

Drawing up conclusions and recommendations is the final step in the FSA process.

3.0 Discussion Points Arising and Conclusions from the Wokshop

In this section the general conclusions from the HAZID workshop, are summarized.

1. Risk level [reference to HAZID worksheet]:
   - High risks: none of the failure cases is reassessed as 'high risk'.
   - Medium risks (ALARP): Medium risks identified are related to:
     - [1.c] Wrong weather forecasts, local weather changes.
     - [2.b] Marine traffic in (main) port area: intense marine traffic due to congestion, in particular from Seaton turning area up to Tees Dock.
     - [2.c] Marine traffic in (main) port area: hazards due to manoeuvring errors and engine/rudder failure at Tees River.
     - [2.d] Marine traffic at channel/river/turning area: drifting/non-powered vessel at turning area; Failure of tug operations.
     - [3.a/b/c/d] Construction activities w.r.t. Jetty construction, Delivery of materials behind jetty, Dredging activities and Survey activities (water-side) respectively.
     - [3.s] Emissions to the environment; (Unintended) release of polluted materials (e.g. waste/cleaning water).
     - [3.u] Emissions to the environment; Waste Disposal.

- The HAZID team concludes that medium risks are acceptable and no additional RCO's are required, taking recommendations (see next section) into account.
- Low risks: risks identified are considered as acceptable; no additional RCO's are required, taking recommendations (see next section) into account.

2. At present the port does not experience any material delays. With about 27 vessels moves per day there is no perceived delay and all vessels receive a time slot within 1 to 2 hours around their requested time. With the YPL development the traffic increases to 28 vessel moves per day. The Harbour Master and operational services see no problem in dealing with this increase of traffic in the same manner.

3. During the peak year of 2005 the port successfully and without significant delays or incidents managed approximately 5,900 vessel calls per year including large size and tidally restricted tankers. Currently there are circa 4,200 vessel calls per year. YPL will provide an additional 252 YPL vessel arrivals with an additional 104 vessel movements per year. Consequently the Harbour Master and operational service providers (pilot, tugs and boatmen) see no problem in dealing with the future forecasted traffic. It is noted that due to a reduction in North Sea pipeline imports tanker traffic on the Tees has declined (assessed by the Harbour Master as equivalent to 10 mtpa) and is not expected to return to the port.

4. The type and dimensions of the vessels that will visit the YPL facility are within the range of vessels that at present visit Teesport. The Harbour Master and operational services are familiar with these vessels.

5. The largest vessels foreseen for YPL are the 85,000 DWT bulk carriers. The vessels arrive in ballast and can navigate to the berth in all states of tide. At departure these vessels are loaded and have a draught of about 14.5m, which gives them a tidal window of 4 hours before HW to 4 hours after HW (an 8 hour window every 12 hours). This means that the vessel although tidally restricted is flexible with plenty of opportunities for other tidal restricted vessels.

6. Traffic simulation suggests that at present there is a total average delay of 3 minutes per day for all vessel movements combined. This is a delay that can, in practice, hardly be noticed. With the YPL development of the reduced berth length being considered and the phase 2 (13 mtpa) cargo volume this combined delay increases to 9 minutes and when adding the forecasted additional bulk carriers (3 mtpa) for the Tees Dock the combined delay increases to 20 minutes. When these delays are distributed over all vessels it will be less than 1 minute per vessel, and even if all delay is absorbed by one vessel, the delay is still marginal.

7. The maximum delays resulting from the simulations show values that are twice the average delay. Even these maximum delays of 40 minutes on one day over 27 vessels movements are insignificant and within the normal margin of the operational planning of the port.

8. The need for support services such as pilots, tugs and boatmen is continuously monitored and adapted to the demand. The port does not have experience with delays due to shortage of support services and will respond adequately to any change in demand.

9. Port closure due to environmental conditions can happen and are independent of the YPL activities. YPL however must consider these periods for the required storage at the terminal.

10. Most convenient and shortest disruption of the other traffic is achieved when the vessels for YPL are turned at arrival when they are in ballast condition. This should be taken into account when designing the equipment and logistic operations at the berth.

11. Not included in the traffic studies are delays caused by deficiencies on board of vessels.

12. The Traffic Simulation Addendum (PB1586 - N013 - Rev 1, 15 July 2015) noted that ro-ro traffic was given priority. It was confirmed by the Harbour Master that this is not the case. (**Post meeting note***: the removal of the Ro-Ro Ferry priority rule would likely only have a small impact. Delays to Ro-Ro vessels may increase marginally but the overall delays would likely remain at a similar level or reduce slightly as an overall combined total.)*

13. Conoco Philips shipping has reduced in the last few years as oil production arising from the North Sea has reduced.

14. The General Management requirements for operating in the river are defined in Notice to Mariners No. 18 of 2015 which sets out the requirements for vessel travelling in the river. Topics discussed include requirement for pilots, anchorages, VTS and hazardous cargo.

15. Pilots for large vessels are picked up 3 miles out from the channel entrance. Smaller vessels will be picked up approximately 1.8 miles from the channel entrance.

16. The risk of YPL utilising poor quality vessels was highlighted as this potentially had a direct impact on YPL's business operations. Vessels in poor condition and untrained crew (e.g. in the use of lifeboats) are potential grounds for impounding a vessel until changes are made. The vessel may not be moved until the required changes are completed and therefore will therefore seriously limit the loading of potash. This risk can be avoided by using vessels maintained to a high standard with a competent crew.

17. The Harbour Master will supply York Potash details of weather events when the port was unable to operate. This will be useful if YPL';s operational planning.

18. Currently it typically takes approximately 1 hour for a vessel to enter the channel, swing, and get alongside. In total a vessel should be ready for loading/unloading within 1.5 hours including mooring.

19. The Harbour Master offered to advise on optimal berthing arrangements.

20. The Harbour Master confirmed that there will not be a significant impact to the other users on the river due to the operations from YPL. The inclusion of the YPL activities is business as usual.

4.0 Recommendations

In this section the recommendations are summarized.

[1.c Adverse weather conditions]

- Wrong weather forecasts, local weather changes:
  - Investigate impact of weather delays on material storage.
  - Consider appropriate mitigation activities.
  - Review impact of wind on loading operations.
  - Weather delay information for range of vessels anticipated (from Harbour Master).

[2.l. Berthing operations]

- The impact of increased berthing operations ("delays up to 94 mins/day, only for polyhalite vessels, single berth, phase 2 option - 13 mtpa") applies to polyhalite i.e. YPL only. Action: YPL to manage. Actual berthing does not impact other operations on the river.

[3.a/b/c/d. Construction activities]

- Requirement for proposed construction operations to be subject to a separate development and agreement with the Harbour Master. Findings of constraints from that study will be adopted in the construction contract requirements.

ANNEX 1 Agenda HAZID Workshop

Objective : Formal Risk Assessment, York Potash Ltd.
Scope : Marine Risks due to additional vessel movements of vessels from polyhalite exports
Location : Harbour Master Office Tees Port
Date, time : July 21st 2015; 10:00 h – 15:00 h

1. Welcome, introduction
2. Formal Safety Assessment:
    - Summary, findings Tees Marine Risk Assessment Study and additional modeling
    - Scope, objectives and methodology
    - Hazard Identification, Risk Assessment, team recommendations - part 1
    - Lunch break
    - Hazard Identification, Risk Assessment, team recommendations - continued
3. Planning, actions, follow up
4. Closure (15:00 h)

ANNEX 2 HAZID Worksheet

MARINE HAZARDS		HAZARD IDENTIFICATION			RISK ASSESSMENT						RISK CONTROL OPTIONS		RISK ASSESSMENT						RECOMMENDATIONS		
Incident Category		Failure Cases, Threats and Consequences			Risk Level without Risk Control Options						Risk Control Options (RCO)		Effectiveness of Risk Control Options						Post HAZID meeting		
No.	Incident Category	Failure Case	Cause	Consequence	Prob. (P)	Consequence (C)				Risk (R)	Threat Control	Recovery Preparedness	Prob. (P)	Consequence (C)				Risk (R)	No.	Actions and Recommendations	Action Owner
					Probability	People	Assets	Environment	Reputation	Risk Level	Mitigating Probability	Mitigating Consequence	Probability	People	Assets	Environment	Reputation	Residual Risk			
					A-E	1-5	1-5	1-5	1-5	R			A-E	1-5	1-5	1-5	1-5	R			
1	**Pilotage Port Approach/Departure**	**Failure Case**	**Cause**	**Consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**Mitigating Probability**	**Mitigating Consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**No.**	**Actions and Recommendations**	**Action Owner**
a	Pilotage Port approach/departure	Non availability of pilot Pilot does not board at the usual place Vessel proceeds (without pilot) further inbound than planned	No pilot available Excessive wind/wave/current conditions Boarding incident Failure of pilot (human failure, fatigue, accident, sickness) Non availability of pilot cutter	Proceeding without pilot: - grounding - collision (ship-ship, contact with aids to navigation) - delay in arrival/departure time	C	3	4	3	2	10	Pilot resource planning Waiting in/near (approach) channel Instruction to proceed to waiting area/anchorage Non admission policy if no pilot available (approach, departure) Procedures (incl criteria) for boarding of pilots Well trained and competent pilots Standby cutter availability Ongoing reviews on capacity of pilots/tugs/boatman	<u>W.r.t. "Grounding"</u> Up to date admiralty nautical charts or Electronic Chart Display & Information System (ECDIS) software (and other info resources) Vessel Traffic Service (VTS) and pilotage Adequate staff, competency criteria, education, (simulation) training Maintenance of equipment (e.g. echo sounder) Maintenance dredging Maintenance of Aids to Navigation Marine operational procedures (approach, departure), e.g. safe speed, engine/steering tests, limiting weather parameters. Portable Pilot Units (PPU) Marine procedures, aids to navigation: collision regulations, fog signals, etc. Pre-entry checks and vetting procedures Under Keel Clearance (UKC) calculation check procedure <u>W.r.t. "Collision":</u> Pilotage compulsory for all ships Adequate information resources (Ship's ECDIS, PPU) VTS Adequate staff, competency criteria, training (simulation) Port (operational) procedures (e.g. approach, departure, safe manoeuvring distance between vessels at particular locations in channel) Pilotage marine operation procedures by port service provider, aids to navigation (collision regulations, fog signals, etc.) Standard VHF communication	A	2	2	1	1	2.0			
b		No availability of tugs Insufficient tug capacity at port entrance	Too few tugs available Inadequate tugs	Delay in arrival/departure (waiting for additional tugs) Soft grounding (slow speed, low energy impact)	E	1	3	2	1	12	Capacity management of tugs (ensured availability) Previous assessment, Port regulations	Anchoring area	B	1	1	1	1	2.0			
c		Adverse weather conditions	Wrong weather forecasts, local weather changes Misjudgement of weather conditions by pilot or VTS	Delays Grounding, hull failure, loss of cargo Capsize, sinking	C	4	4	5	2	12.5	Good seamanship w.r.t. weather, meteorology and forecasting Marine operational procedures (approach, departure), including limiting weather parameters. Pilot judgement, Adequate anchorage	See above "Grounding"	B	1	2	1	1	4.0		Investigate impact of weather delays on material storage, Consider appropriate mitigation activities Review impact of wind on loading operations, Weather delay information for range of vessels anticipated (from Harbour Master)	RHDHV
d		No/wrong communication between port (authority) and vessel	Failure of communication equipment Language problems Misinterpretations between port and vessel	Miscommunication or wrong interpretation of information between port and vessel Delays or grounding due to no/wrong instructions Ship-to-ship collision, hull failure, loss of cargo Close quarters encounter	C	3	4	3	2	10	Port communication procedures/information Well maintained VHF (Very High Frequency) Capacity management VTS Competent staff (incl. English language capabilities) Use of Standard Marine Communication Phrases (SMCP) Waiting (anchoring) area back up VHF radio carried by pilots	See above "Grounding"	B	1	1	1	1	2.0			
e		Absence of aids to navigation (e.g. drifting buoys, missing RACON (Radar Transponder Beacon), no lighting, etc.)	Inadequate maintenance of aids to navigation Adverse weather conditions	Grounding, hull failure, loss of cargo Contact with aids to navigation	D	1	4	3	2	12	Pilotage Maintenance management system for navigational equipment, Redundancy in lights, buoys etc.	<u>W.r.t. "Contact with aids to navigation"</u> Pilot trained (incl. ECDIS) Adequate information resources (PPU, ECDIS and AIS Port pilotage procedures Verification of ships' operating procedures (e.g. testing of rudder, telegraph, etc.) at departure/proceeding	A	1	2	1	1	2.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			

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					Probability	People	Assets	Environment	Reputation	Risk Level	Mitigating Probability	Mitigating Consequence	Probability	People	Assets	Environment	Reputation	Residual Risk			
					A-E	1-5	1-5	1-5	1-5	R			A-E	1-5	1-5	1-5	1-5	R			
2	**Port Entry Main Port Area**	**Failure Case**	**Cause**	**Consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**Mitigating Probability**	**Mitigating Consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**No.**	**Actions and Recommendations**	**Action Owner**
a	Marine traffic at port entry (sea side)	Intense marine traffic due to converging/merging vessel movements (sea side)	High shipping intensity Peaks due to tidal restrictions Failure of VTS/Port Control Communication failure Peak time/seasonality shipping (recreation vessels, ferry)	Congestion at port entry Delay Close encounter, ship-ship collision Damage to vessel, loss of cargo Aquatic environmental impact Waiting time, delay Downtime of port Teesside	D	3	4	4	2	12.0	Traffic Management System (Port Operation) VTS Pilotage One way traffic (wrt collision - reduced capacity) Rigid arrival schedule Planning/schedule w.r.t. state of tide (deep draught vessels) Anchorage	Tugs Salvage equipment Port Emergency Response Arrangements (equipment, staff, terminals)	A	1	2	1	1	2.0			
b	Marine traffic in (main) port area	Intense marine traffic due to intensity of vessel movements in port area	High shipping intensity Peaks due to tidal restrictions Failure of VTS/Port Control Communication failure Peak time/seasonality shipping (recreation vessels, ferry)	Congestion (in particular) at - Seaton turning area to Tees Dock Ship-ship collision at approach/estuary Damage to vessel, loss of cargo Aquatic environmental impact Waiting time, delay Downtime of particular port area/dock/terminal	D	3	4	4	2	12.0	Traffic Management System (Port Operation) VTS Pilotage Rigid arrival/departure schedule Planning/schedule w.r.t. state of tide (deep draught vessels) Temporary berthing	Tugs Salvage equipment Port Emergency Response Arrangements (equipment, staff, terminals)	B	1	2	1	1	4.0			
		Manoeuvring error Engine/rudder failure Human failure	Mechanical failure vessel equipment (rudder, engine) Excessive wind/wave/current/conditions Poor visibility Engine/rudder failure Human fatigue (captain/pilot) Communication failure	Drifting, ship collision, contact with aids to navigation Grounding Uncontrolled contact with the berth Damage to vessel, loss of cargo Aquatic environmental impact Waiting time, delay Downtime of particular port area/dock/terminal	E	3	5	4	4	20.0	Anchoring Pilotage Temporary berthing Confirmation of vessel worthiness prior to port entry to pilots/	Tugs Salvage equipment Port Emergency Response Arrangements (equipment, staff, terminals)	B	1	3	1	1	6.0			
c	Marine traffic at channel/river/turning area	Drifting/non-powered vessel at turning area Failure of tug operations	Manoeuvring error Engine/rudder failure Tug failure	Ship collision at: - turning area of Tees Dock - river channel adjacent to Simon Storage Damage to vessel, loss of cargo Aquatic environmental impact Blockage of waterway, waiting time, delay	E	3	5	4	4	20.0	Port Operation procedures VTS/Traffic Management System Speed limit Pilotage Rigid arrival schedule Anchorage	Vessels' Emergency Response equipment Tugs Salvage equipment Port Emergency Response Arrangements (equipment, staff, terminals)	B	1	3	1	1	6.0			
		Ship collision at river (with recreation vessel/barge/ferry/…)	Excessive wind/current Poor visibility Manoeuvring error Engine/rudder failure Human failure	Ship-ship collision at river Congestion Damage to vessel, loss of cargo Aquatic environmental impact Waiting time, delay River blockage (when sinking/grounding)	B	3	2	1	1	6.0	VTS	Lifeboat Hospital	A	2	1	1	1	2.0			
		Vessel sails too fast to catch the tidal window	Wrong planning Failure of communication Pilot/tugs too late Increase/too high speed ("vessel in a hurry")	Too high speed Taking shortcut over shallow water Collision, grounding Damage to berthed vessels	B	1	3	2	1	6.0	Reporting procedure Port Operations Pilotage Strict arrival/departure schedule, Port Control		A	1	2	1	1	2.0			
f	Infrastructure/objects at channel/river	Contact with obstruction over channel/river (bridge, conveyor, pipe bridge, …)	Misjudgement of height / clearance Lack of (port) information Current Wrong passway/position	Damage of vessel Damage of crane/loader	B	1	1	1	1	2.0			A	1	1	1	1	1.0			
		Direct contact with obstruction beneath channel/river (cable, pipeline, **tunnel**)	NA	NA	A	1	1	1	1	1.0	NA		A	1	1	1	1	1.0			
		Contact with obstruction at/in channel/river (wreck, shoal, moored vessel)	NA	NA	A	1	1	1	1	1.0			A	1	1	1	1	1.0			
g	Berthing/mooring operations	Not sufficient tugs available Not sufficient mooring gangs available	Too few tugs available Too mooring launches/lines man available	Delay Drifting of vessel Personal injury or fatality (due to heavy lifting of cables/mooring lines) Limited berth availability	D	2	4	1	3	12.0	Resource planning (tugs, staff) Sufficient and adequate resources Training Berthing plan Exception meetings		A	1	1	1	1	1.0			
		No berthing capacity upon arrival (e.g. vessel too long in length)	Wrong planning Misjudgement of length Communication failure	Board-board mooring Extend of ship (at end of jetty) Ship returns sea	C	1	1	1	1	2.5	Berthing capacity planning	Temporary berthing at other quay Proceed to anchoring area	A	1	1	1	1	1.0			
		Increased berthing operations for 13 mtpa and 1 berth	Increased number of vessel movements	Delays up to 94 mins/day only for polyhalite vessels (single berth, phase 2 option - 13 mtpa)									A	1	1	1	1	1.0		This impact applies to YPL only. YPL to manage. Actual berthing does not impact other operations on the river.	
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			

MARINE HAZARDS		HAZARD IDENTIFICATION			RISK ASSESSMENT						RISK CONTROL OPTIONS		RISK ASSESSMENT						RECOMMENDATIONS		
Incident Category		Failure Cases, Threats and Consequences			Risk Level without Risk Control Options						Risk Control Options (RCO)		Effectiveness of Risk Control Options						Post HAZID meeting		
No.	Incident Category	Failure Case	Cause	Consequence	Prob. (P)	Consequence (C)				Risk (R)	Threat Control	Recovery Preparedness	Prob. (P)	Consequence (C)				Risk (R)	No.	Actions and Recommendations	Action Owner
					Probability	People	Assets	Environment	Reputation	Risk Level	Mitigating Probability	Mitigating Consequence	Probability	People	Assets	Environment	Reputation	Residual Risk			
					A-E	1-5	1-5	1-5	1-5	R			A-E	1-5	1-5	1-5	1-5	R			
3	Incident at Berth	Failure Case	Cause	Consequence	Pr.	P	A	E	R	Risk	Mitigating Probability	Mitigating Consequence	Pr.	P	A	E	R	Risk	No.	Actions and Recommendations	Action Owner
a	Construction activities	Jetty construction	Construction activities	Personal injuries Transport accidents	C	1	3	2	1	7.5	No export during jetty construction Contractor(s) to prepare Construction HSE Plan	Hospital, First Aid								Requirement for proposed construction operations to be subject to a separate development and agreement with the Harbour Master. Findings of constraints from that study will be adopted in the construction contract requirements.	
b		Delivery of materials behind jetty	Movement of barges (Heavy) Lifting lift off		C	1	3	2	1	7.5	Logistic planning									Requirement for proposed construction operations to be subject to a separate development and agreement with the Harbour Master. Findings of constraints from that study will be adopted in the construction contract requirements.	
c		Dredging activities	Limited manoeuvrable dredging vessel Excessive wind/current Poor visibility Manoeuvring error Engine/rudder failure Human failure or fatigue (captain/pilot) Communication failure	Ship-dredging vessel collision Grounding Contact with object	B	1	2	1	1	4.0										Requirement for proposed construction operations to be subject to a separate development and agreement with the Harbour Master. Findings of constraints from that study will be adopted in the construction contract requirements.	
d		Survey activities (water-side)	Limited manoeuvrable dredging vessel Excessive wind/current Poor visibility Manoeuvring error Engine/rudder failure Human failure or fatigue (captain/pilot) Communication failure	Ship-survey vessel collision Grounding Contact with object	B	1	2	1	1	4.0										Requirement for proposed construction operations to be subject to a separate development and agreement with the Harbour Master. Findings of constraints from that study will be adopted in the construction contract requirements.	
e	External hazards and threats	(Extreme) Weather conditions (natural hazards)	Waves, current, swell	Damage to vessel, dolphins, fenders Emergency evacuation of the vessel	C	1	3	2	1	7.5	Good seamanship w.r.t. weather, waves, meteorology and forecasting Line tension - and ship position monitoring	Port emergency procedures	B	1	1	1	1	2.0			
f			Wind, storm, (heavy) rain fall	Damage to vessel, dolphins, fenders, quay walls Spill to environment due to over flooding of drainage system Damage to Unloading arms or to Unloading terminals Gas leaks – Explosion risk	C	1	3	2	1	7.5	Good seamanship w.r.t. weather, waves, meteorology and forecasting Line tension - and ship position monitoring	Port emergency procedures	B	1	1	1	1	2.0			
g			Settlement, sedimentation	Damage to onshore structures due to ground displacement and differential settlement.	B	1	2	1	1	4.0	Soil surveys, geotechnical analysis Displacement measurement equipment and surveys	Dredging	A	1	1	1	1	1.0			
h			Earthquake	Damages to onshore and offshore installations Leaks / loss of containment Fire	A	2	2	2	1	2.0	Design Hard wiring for critical signals (acc. BS 5308) Redundancy of critical control & maintaining functions ESD	Early Warning System Stop activities (loading/unloading)	A	1	1	1	1	1.0			
i			Tsunami	Not regarded as credible		na	na	na	na					na	na	na	na				
j			Fog	CCTV ineffective Ship approach (mooring ops at terminal), slow speed collision/contact due to bad visibility	B	1	2	2	1	4.0	Weather forecast Port procedures (increase speed limit, separation distance between ships, exclusion zones) Communication procedures (ship-shore)	Stop activities (loading/unloading)	A	1	1	1	1	1.0			
k			Flooding	Flooding of drainage network Soil erosion	C	1	2	1	1	5.0	Weather forecast and shut down Design of installation/equipment Design of drainage network according to worst case scenario	Port Emergency Response Arrangements (ER equipment, ER staff, ER terminals)	B	1	1	1	1	2.0			
l	Security threats at terminal	Security Hazards (Man-made hazards)	Internal security threats Sabotage	Damage of technical equipment Loss of Containment, gas dispersion, fire Severe damage to people, public or vessel Social impact (political, public, reputation)	B	4	4	4	4	8.0	Compliance with ISPS Code requirements, incl. staff screening.	-	A	1	1	1	1	1.0			
m			External security threats Terrorist Activity	Damage to structures/vessel(s) Damage to installation/equipment Gas release Fire Loss of lives Emergency evacuation of the vessel	B	4	4	4	4	8.0	Compliance with ISPS, incl. Management system (e.g. gated (24/7) access) by company security personnel and Critical Infrastructure & Coastal Protection Authority (CICPA)	-	A	1	1	1	1	1.0			
n	Industrial hazards	Incident at terminal	Loss of containment of: - flammable gas/liquid - toxic gas/liquid	NA	A	1	1	1	1	1.0			A	1	1	1	1	1.0			
o	Emissions to the environment at terminal	Continuous Plant Discharges to Air	Dust, fugitive emissions	Non compliance Damage to environment (air quality)	C	2	1	2	1	5.0	Environmental impact assessment Environmental legislation Inspection and enforcement by authorities	Emission control equipment	B	1	1	1	1	2.0			
p		Continuous Plant Discharges to Soil	(Minor) Spills	Damage to environment Soil pollution, ground water pollution	B	1	2	1	1	4.0	Environmental impact assessment Environmental legislation Inspection and enforcement by authorities	Emission control equipment	A	1	1	2	1	2.0			
q		Continuous Plant Discharges to Water	Cooling water, accidental spill, equipment leak	Non compliance Pollution sea water Damage to environment (Marine Protected Area)	C	1	2	3	1	7.5	Environmental impact assessment Environmental legislation Inspection and enforcement by authorities	Emission control equipment	B	1	1	1	1	2.0			
r		Rupture of loading facilities	Excessive movements of vessel at jetty	Rupture of loading facility Spill to environment	B	2	3	3	1	6.0	Design of loading installation Loading facility monitoring system Proper maintenance of loading facility Ensuring tight mooring lines during operations	Auto stop Spill containment system	A	1	2	1	1	2.0			
s		(Unintended) Release of polluted materials (e.g. waste/cleaning water)	Human error (unintended release)	Spill to environment	C	1	1	3	1	7.5	Environmental regulations Ship's management system Inspection and enforcement by authorities	Emission control equipment	B	1	1	2	1	4.0			
t		Oil spill	Accidental spill, equipment leak	Non compliance Pollution Damage to environment	B	1	1	3	2	6.0	Spill Response Plan Spill Response responsibilities and Response capabilities	Spill control and clean up equipment	A	1	1	2	1	2.0			
u		Waste Disposal	(Un) Intended disposal of waste	Damage to environment Soil pollution, ground water pollution	E	1	1	2	1	8.0	Waste disposal plan	Clean up	C	1	1	2	1	5.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			

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No.	Incident Category	Failure Case	Cause	Consequence	Prob. (P)	Consequence (C)				Risk (R)	Threat Control	Recovery Preparedness	Prob. (P)	Consequence (C)				Risk (R)	No.	Actions and Recommendations	Action Owner
					Probability	People	Assets	Environment	Reputation	Risk Level	Mitigating Probability	Mitigating Consequence	Probability	People	Assets	Environment	Reputation	Residual Risk			
					A-E	1-5	1-5	1-5	1-5	R			A-E	1-5	1-5	1-5	1-5	R			
4	**General: Calamity on board**	**Failure case**	**Cause**	**Consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**Mitigating probability**	**Mitigating consequence**	**Pr.**	**P**	**A**	**E**	**R**	**Risk**	**No.**	**Actions and recommendations**	**Action owner**
a	Calamity on board	Accident on board (during transit, manoeuvring, or moored)	Cargo on fire	NA for polyhalite	A	1	1	1	1	1.0			A	1	1	1	1	1.0			
b			Heating of cargo	NA for polyhalite	B	1	3	2	1	6.0			A	1	2	1	1	2.0			
c			Cargo loss, e.g. from deck due to extreme weather Leaking/loss of containers on deck	Floating/sinking object: collision/contact, damage to vessel Spill to environment Objects on see bottom Blockage of marine access routes Downtime of port	D	1	2	3	1	9.0	Good seamanship w.r.t. weather, meteorology and forecasting Proper loading	Equipment for salvage objects	A	1	2	1	1	2.0			
d			Leaking/loss of vessels' fuel	Spill to environment Downtime of port due to salvage operations	C	1	2	3	3	7.5	Local inspection authorities (inspection from air, sea, land)	Emergency Response Arrangements (ER equipment, ER staff, ER terminals)	A	1	2	2	1	2.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			
					A	1	1	1	1	1.0			A	1	1	1	1	1.0			