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BE&R CONSULTING

Northern Endeavour End-of-Life Options Analysis

Summary Report

Prepared for:

Department of Industry, Science and Resources

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1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to identify and assess options for the redeployment or recycling of the Northern Endeavour FPSO. The report provides the high-level information relevant to assessing the viability of these options. More detailed information, including costing and regulatory requirements, will be required to enable the Commonwealth to make informed decisions on the best pathway forward for FPSO disposal.

1.2 Background

The Department of Industry Science and Resources – Northern Endeavour Branch (DISR) has engaged BE&R to assess the end-of-life options available to the Northern Endeavour, define a pathway to proceed with the disposal of the FPSO, and describe the risks involved with the disposal options for the vessel.

Incorporated within this document, BE&R describes an overview of the disposal options, the relevant regulations, the costs, schedule, risks and processes associated with the execution of the vessel disposal.

The following activities were conducted to support this guidance:

- Establishment of key drivers and criteria for option selection
- FPSO Redeployment global market review
- Recycling market and recycling regulations review
- Vessel lay-up and towing options
- Asset valuation
- A high-level risk assessment for the disposal
- Comparative review of options against key drivers
- Disposal execution strategy

1.3 End-of-life disposal options

Four potential opportunities were identified as available to the Northern Endeavour:

1. Redeployment as an FPSO / FSO

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2. Green Recycling in Europe (Denmark or Norway)(EU-SRR compliant yard)
3. Green Recycling in Türkiye (EU-SRR compliant yard)
4. Green Recycling in Australia (EU-SRR compliant)

1.4 Inventory of Hazardous Materials and decontamination

Prior to actioning either redeployment or recycling options, the FPSO Inventory of Hazardous Materials (IHM) must be completed for the Northern Endeavour. The findings will be critical for the project as the disposal vendors will only provide firm offers once they have these details.

Feedback from some of the European yards who were sent enquiries indicated that they can handle removing contaminants, including NORM. Denmark will not allow the long-term storage of hazardous materials from other countries. Norway has not advised of its status regarding long-term storage. The Turkish yards have indicated that they can handle some contaminants. However, NORM and mercury would have to be removed before arrival at the yard.

Under the Basel Convention Ban Amendment, a party that has ratified the amendment must prohibit all transboundary movements of hazardous waste destined for final disposal or recycling operations to States not listed in Annex VII of the Basel Convention. Australia is an Annex VII country. Malaysia and Indonesia are not listed in Annex VII. All three countries have ratified the Amendment; therefore, hazardous waste must not be transferred from Australia to either country.

Hazardous waste from an Australian FPSO can be stored at the Sandy Ridge facility owned and operated by Tellus Holdings in Western Australia. Further discussions are required with the relevant stakeholders to establish the required licenses to be obtained for removal and transportation and which party is required to hold the licenses.

1.5 Regulations

The Hong Kong Convention (HKC) aims to ensure safe and eco-friendly ship recycling by enforcing design, operation, and dismantling standards. The HKC, which enters into force on 26th June 2025, has been ratified by 22 states, covering 45.81% of world shipping. The EU Ship Recycling Regulation (EU-SRR), which applies to the ships flagged in EU member states, aligns with the HKC, with additional safety and environmental requirements for ships of 500GT and above, including leakage control, hazardous material handling, and waste management. The EU-SRR is the most stringent level of regulation for the ship recycling industry.

Australia has not ratified either the HKC or EU-SRR.

1.6 Redeployment as an FPSO / FSO

The previous extensive Northern Endeavour marketing activities undertaken by a secured creditor (CCMA) and the market survey results from this review indicate that there is currently very little interest in the Northern Endeavour as a redeployment candidate or as a speculative purchase for a future opportunity. This is primarily due to:

- The Northern Endeavour is only suitable for redeployment in oil and gas regions with benign weather conditions, thus limiting its redeployment opportunities
- Lack of close-fit redeployment opportunities in the immediate future
- FPSO operators are unwilling to take on the risk of speculatively purchasing an FPSO over 20 years old where they don't have a detailed knowledge of its operating history

If the Commonwealth were to lay-up the FPSO with the aim of a future sale of the FPSO, the FPSO would be expected to be laid up for at least 3 years and possibly longer. AN FPSO lay-up for three years in Batam, Indonesia would cost at least US$18mill, and the FPSO will most likely need to be decontaminated before being towed to Indonesia (US$10-20mill). If an opportunity is found for the FPSO, the sale price would be expected to be slightly higher than the scrap steel value (US$15-21mill). If a buyer is not found within a reasonable period, the FPSO will still need to be scrapped.

For the reasons highlighted above, it is recommended that the option of redeploying the Northern Endeavour be discarded from further evaluation.

1.7 Green Recycling in Europe (EU-SRR compliant yard)

Responses to the market survey were received from yards in s 47(1)(b) and Denmark (Modern American Recycling Services – MARS). Both yards have extensive experience in the recycling of large FPSOs and indicated that they have yard availability in 2024-2025. They will accept the FPSO in a contaminated state, thereby removing the risk associated with decontaminating it in Australia before departure. Neither country is expected to accept the long-term storage of the contaminated material. In accordance with the Basel Convention, the hazardous waste will need to be returned to Australia or transported to another country that will accept the waste.

The lowest risk method of transporting the FPSO to Europe is via a Heavy Lift Vessel (HLV). Given the increased permitting risk and the requirement to remove or shorten the flare tower if the Suez Canal route is used, the Cape of Good Hope route has been identified as the lower risk option. The transportation schedule would need to be developed to avoid the worst winter weather months. Only two HLVs are large enough to transport the Northern Endeavour, so it will be critical to secure a contract with one of the vessels in a timely manner.

Given the indicated availability of the yards, it is anticipated that the Northern Endeavour will not be required to be laid up prior to departure.

The study has shown that the Europe option is most aligned with the Commonwealth's agreed key drivers: minimising health & safety risk, environmental risk and reputation risk.

It is estimated that the Europe option will cost the Commonwealth US$31-38 mill (Accuracy -30% / +50%). If the FPSO is disconnected in October 2024, the recycling should be approximately completed at the end of 2026.

1.8 Green Recycling in Türkiye (EU-SRR compliant yards)

Responses were received from two entities in Türkiye, s 47(1)(b) s operates three yards in s 47(1)(b) has experience recycling FPSO, whereas s 47(1)(b) has only recycled large tankers. Both entities have indicated that they have yard availability in 2024-2025. Türkiye has regulations limiting the importation of different types of contamination, such as NORM. Thus, the FPSO will require decontamination before it enters these yards. The decontamination could take place while laid up in Australian waters or in a third-party country that is permitted to import hazardous waste. Any hazardous waste would most likely have to be returned to Australia in accordance with the Basel Convention. The risk associated with the Commonwealth having to contract the decontamination separately from the recycling contract is considered to be high due to the currently unquantified extent of the hazardous materials on the FPSO, the potential level of difficulty associated with the decontamination process and the disposal of the hazardous waste.

As per the Europe option, the FPSO would be transported to Türkiye on a HLV via the Cape of Good Hope.

It is estimated that the Türkiye option will cost the Commonwealth US$22-41 mill (Accuracy -30% / +50%). If the FPSO is disconnected in October 2024, the recycling should be approximately

completed at the end of Q1 2027. The additional duration is driven by the need to decontaminate the FPSO prior to being delivered to Türkiye.

The study has shown that the Türkiye option is more aligned with the Commonwealth's agreed key drivers than the Australian option but less than the Europe option.

1.9 Green Recycling in Australia (EU-SRR compliant)

Three entities in Australia expressed their interest in the opportunity to recycle the Northern Endeavour:

s 47(1)(b)

All three indicated that they had yard availability in 2024-2025.

None of the companies have experience recycling FPSOs or vessels as large as the Northern Endeavour. s 47(1)(b)

s 47(1)(b)

The Australian vendors have indicated that they will be able to comply with the EU-SRR but are not certified.

The risk associated with the Australian companies having insufficient experience or confirmed infrastructure to recycle vessels of the size of the Northern Endeavour and the demands of satisfying the requirements of the EU-SRR is considered to be high.

Decontamination will be required prior to entry to the yard in Henderson, WA. The Whyalla yard (SA) requirements are to be confirmed. A location for the lay-up and decontamination of the FPSO in Australian waters is still to be identified. Hazardous waste from the FPSO can be stored at the Sandy Ridge facility owned and operated by Tellus Holdings in Western Australia. Further discussions are required with the relevant stakeholders to establish the IMS/biosecurity requirements, the licenses to be obtained for removal and transportation, and which party is required to hold the licenses. As per the Türkiye option, the risk associated with the Commonwealth contracting the decontamination separately from the recycling contract is considered high.

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The FPSO could be wet towed to the Australian yards. However, the structural integrity of the Northern Endeavour hull will be required to be verified.

The study has shown that the Australian options are the least aligned with the Commonwealth's agreed key drivers. This is driven by the higher relative risk around practical execution experience, schedule and financial value, even though these drivers have the lowest weighting in regard to the level of importance to the Commonwealth.

It is estimated that the Australian option will cost the Commonwealth US$67-107mill (Accuracy -30% / +50%). If the FPSO is disconnected in October 2024, the recycling should be approximately completed at the end of Q1 2027. The additional duration is driven by the need to decontaminate the FPSO prior to entry to the recycling yard.

1.10 Disposal Execution Strategy

The disposal strategy is structured around four phases:

- Identify /Assess
- Select
- Define
- Execute

The Identify and Assess Phases have been completed. The Select Phase will act as a transition period in which further details will be gathered to make decisions in the Define Phase.

The primary focus of the Select phase will be to pre-qualify the recycling vendors, both Australian and international. A key decision to be made early in the prequalification process will be whether to tender:

- Australia only
- International only
- Australia and international

Initially, a detailed prequalification of the Australian vendors will be undertaken to determine if they are viable. This will involve site visits to examine the facilities available at each yard and their capability. For the Australian vendors, the prequalification process may include a paid feasibility study to develop a detailed execution plan demonstrating how they will mitigate the risks associated with their inexperience in dealing with a large FPSO.

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A desktop prequalification of the international recycling yards will be conducted in parallel based on information provided in the market study, data collected from previous recycling yard site visits by the Centre of Decommissioning Australia (CODA) and feedback from recent assessments conducted by oil and gas companies for other asset disposals.

Should the Australian option be deemed unviable or insufficiently competitive, the international prequalification will be extended to a formal prequalification process. This may lead to site visits to the front running yards. The Select Phase is expected to take approximately 4 months. Refer to Table 1-1 for an estimate of the Select Phase cost.

The Define phase will be focused on tendering and defining project elements to a level sufficient to support a final investment decision and tender award. The scope and strategy for this phase will be further developed during the Select Phase. The Define Phase is expected to take approximately 4 months. Refer to Table 1-1 for an estimate of the Define Phase cost.

Execute phase definition will be further developed during the Define phase. At the start of this phase, tenders will be awarded, and final permits and certification will be approved. The aim will be to commence the Execution Phase 3-4 months prior to the disconnection of the Northern Endeavour. The Execute Phase cost in Table 1-1 includes:

- Lay-up costs for decontamination (Australia and Türkiye options only)
- Decontamination costs where the decontamination is not undertaken in the recycling yard (including transportation of any hazardous materials to a final storage location)
- For the Europe option, the cost for the transportation of the hazardous materials to the final storage location. The actual decontamination cost is included in the vessel and topsides recycle cost
- The cost of a tow to a sheltered location for the loading of the FPSO onto the HLV for transport to Europe. For the Türkiye option it has been assumed that the FPSO would be loaded onto the HLV at the decontaminant site
- The cost of the wet tow or dry tow to the recycling yard. For the Europe and Türkiye options a dry tow has been assumed
- The cost of the vessel and topsides recycling and any associated scrap steel rebate
- The project management and engineering support for the Execute Phase (Estimated to be 5-10% of the capital cost)

The cost accuracy is assumed to be -30% / +50%.

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The estimated Total Project in Table 1-1 includes the Select, Define and Execute phases.

Table 1-1 Total Project Cost Estimates

	Australia	Türkiye	Europe	Comment
Select Phase	US$1.1mill	US$1.1mill	US$1.1mill	
Define Phase	US$1.5mill	US$1.5mill	US$1.5mill	
Execute Phase Cost	US$67-107mill	US$22 – 41mill	US$31-38mill	
TOTAL Project Cost	US$70-110mill	US$25 – 44mill	US$34-41mill	Accuracy -30% / +50%
Total Cost Assumptions	Lay-up and decontamination in Australia	Lay-up and decontamination in Australia Dry tow to Türkiye	Dry tow to Europe Decontamination at yard in Europe	

1.11 Recommendations

The following recommendations were developed as a result of the disposal options review:

- Redeployment should no longer be pursued as an option for the disposal of the Northern Endeavour
- The IHM be completed and verified as soon as possible
- Confirm if there are any options available in Australia for the lay-up and decontamination of the Northern Endeavour
- For the Europe and Türkiye recycling options, use the dry tow method to transport the Northern Endeavour and sail via the Cape of Good Hope
- Proceed with the Select Phase, which will focus on the prequalification of the recycling vendors, both Australian and international. A key decision to be made early in the prequalification process will be whether to tender:
    - Australian only
    - International only
    - Australian and international
- Engage with Government procurement function to enable prompt preparation of documentation when required

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2 INTRODUCTION

2.1 Background

The Department of Industry Science and Resources – Northern Endeavour Branch has engaged BE&R to assess the end-of-life options available to the Northern Endeavour, define a pathway to proceed with the disposal of the FPSO, and describe the risks involved with the disposal options of the FPSO.

2.2 Scope of Work

The scope of work included the following two phases:

Phase 1: Identify

A high-level overview of options, risks and process upfront so the Department of Industry and Science has an early understanding of the landscape and is well positioned in the event of an early decision not to take on the asset by the creditor.

Phase 2: Assess

In-depth assessment of disposal options and pathways to execute them to allow for informed decisions and prompt, responsible action.

2.3 Northern Endeavour FPSO – General Description

Table 2-1 List Northern Endeavour FPSO Vessel Particulars

Particular	Quantity	Unit
Topsides		
Oil	170 000	bpd
Produced Water	174 000	bpd
Total Liquids	241 000	bpd
Gas Compression	80	mmscfd
Water Injection	NA	bwpd
Gas Injection	19	mmscfd
Total Gas Processing	60	mmscfd
Lift Gas	60	mmscfd
Power Gen	Approx 9	MW
Hull		
Flag State	Australia	
Build	New	

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Particular	Quantity	Unit
Size	Suezmax	
Config	Double Sided	
Design life	60 years for hull	Years
Length Overall	274.7	m
Beam	50	m
Depth	28	m
Design draught	18.76	m
Deadweight	179,300	Tonnes
Gross Tonnage	108,406	Tonnes
Built	1999	Year
Storage	1,400,000	bbls
Offtake Volume		bbls
Mooring	Int. Turret	
Accommodation	64 (94)	PoB

2.4 Abbreviations and Definitions

A list of the abbreviations and definitions used in this report are noted below.

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Table 2-2 List of Abbreviations and Definitions

Abbreviation	Description
bbls	barrel of crude oil
bpd	Barrels per day
bwpd	Barrels of water per day
CAPEX	Capital Expenditure
CCMA	Castleton Commodities Merchant Asia
CODA	Centre of Decommissioning Australia
COT	Cargo Oil Tanks
DAFF	Department of Agriculture, Fisheries and Forestry
DISR	Department of Industry, Science and Research
EU-SRR	European Union Ship Recycling Regulation
FLNG	Floating LNG Production
FMECA	Failure modes, effects, and criticality analysis
FPSO	Floating Production Storage Offloading
FPS	Floating Production System
FSO	Floating Storage Offloading
FSRU	Floating Storage Regassification Unit
GA	General Arrangement
HKC	Hong Kong Convention
IHM	Inventory of Hazardous Materials
HM	Hazardous Materials
LDT	Light Displacement Tonnage
m	Metres
mmscfd	Million standard cubic feet per day
MOPU	Mobile Offshore Production Unit
MW	Megawatts
NE	Northern Endeavour
POB	Persons on Board
Pratique	Permission granted to a ship to have dealings with a port, given after quarantine or on showing a clean bill of health.
RLE	Repair and Life Extension
ROI	Return on Investment
ppm	Parts per million
SA	South Australia
SIMOPS	Simultaneous Operations
TECOP	Technical, Economic, Commercial, Operational, Political
WA	Western Australia

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3 OPPORTUNITY ASSESSMENT

As part of the Identify Phase, a high-level overview was developed of the potential opportunities available to the Northern Endeavour:

1. Redeployment as FPSO / FSO
2. Green Recycling in Europe (Denmark or Norway) (EU-SRR compliant yard)
3. Green Recycling in Türkiye (EU-SRR compliant yard)
4. Green Recycling in Australia (EU-SRR compliant)

These opportunities have several permutations, as illustrated in Table 3-1. These permutations impact the cost schedule and risk associated with each opportunity.

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Table 3-1 Key Permutations of the Opportunities

	Redeployment	Recycling in Europe (EU-SRR compliant yard)	Recycling in Türkiye (EU-SRR compliant)	Recycling in Australia (EU-SRR compliant)	Notes
Location					
West Africa	■	■			
Malaysia	■				
Timor Sea	■				
Europe		■			
Türkiye			■		
Whyalla, SA				■	
Henderson WA				■	
Departure / Loading location					
Northern Endeavour Site	■	■	■	■	
Sheltered Location		■	■		To load HLV
Lay-up locations					
Labuan, Malaysia	■	■	■		Decontamination required
Batam, Indonesia	■	■	■		
Australia		■	■	■	(location TBC)
Decontamination Requirement					
Yes			■	■	
No		■			
Possibly	■				
Tow type					
Wet	■	■	■	■	
Dry		■	■		
Route					
Via Suez		■	■		
Via COGH		■	■		
Direct	■			■	

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4 INVENTORY OF HAZARDOUS MATERIALS (IHM)

Information captured in this section was based on current requirements and conventions at the time of the review.

4.1 Definition

The IHM is a list of hazardous materials that are present on a ship. The IHM quantifies and locates hazardous materials on board ships that are known to represent a potential hazard to people and the environment [1].

The two regulations that govern the requirements of the Inventory of Hazardous Materials (IHM) and authorization of ship recycling facilities are:

- The EU Regulation on Ship Recycling (EU) No. 1257/2013 (EU SRR) is in force for European flagged vessels and 3rd party flagged vessels visiting European ports or anchorages equal to and above 500 GT.
- Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 SR/CONF/45 (HKC), which will enter into force in June 2025.

4.2 Hazardous Materials

Hazardous waste refers to any biological, chemical, physical, or radiological substance that poses a threat to living organisms or the environment. Hazardous materials particulars are subject to the definition outlined within specific regulations. The EU-SRR defines the hazardous materials most relevant to this study. The EU-SRR is based upon the HKC but contains regulations for two additional substances. The hazardous materials defined in the EU-SRR are shown below:

- Any hazardous materials listed in Table 4-1
- Cadmium and Cadmium Compounds
- Hexavalent Chromium and Hexavalent Chromium Compounds
- Lead and Lead Compounds
- Mercury and Mercury Compounds
- Polybrominated Biphenyl (PBBs)
- Polybrominated Diphenyl Ethers (PBDEs)
- Polychlorinated Naphthalenes (more than 3 chlorine atoms)

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- Radioactive Substances
- Certain Short chain Chlorinated Paraffins (Alkanes, C10-C13, chloro)
- Brominated Flame Retardant (HBCDD)

Table 4-1 Table of Hazardous Materials Defined in the EU-SRR

Hazardous Material	Definitions	Control measures
Asbestos	Materials containing asbestos	For all ships, new installation of materials which contain asbestos shall be prohibited.
Ozone-depleting substances	Controlled substances defined in Article 1(4) of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to that Protocol in force at the time of application or interpretation of this Annex. Ozone-depleting substances that may be found on board ships include, but are not limited to: Halon 1211 Bromochlorodifluoromethane Halon 1301 Bromotrifluoromethane Halon 2402 1,2-Dibromo-1,1,2,2-tetrafluoroethane (also known as Halon 114B2) CFC-11 Trichlorofluoromethane CFC-12 Dichlorodifluoromethane CFC-113 1,1,2-Trichloro-1,2,2-trifluoroethane CFC-114 1,2-Dichloro-1,1,2,2-tetrafluoroethane CFC-115 Chloropentafluoroethane HCFC-22 Chlorodifluoromethane	New installations which contain ozone-depleting substances shall be prohibited on all ships.
Polychlorinated biphenyls (PCB)	'Polychlorinated biphenyls' means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to ten chlorine atoms	For all ships, new installation of materials which contain Polychlorinated biphenyls shall be prohibited.
Perfluorooctane sulfonic acid (PFOS) (1)	'Perfluorooctane sulfonic acid' (PFOS) means perfluorooctane sulfonic acid and its derivatives	New installations which contain perfluorooctane sulfonic acid (PFOS) and its derivatives shall be prohibited in accordance with Regulation (EC) No 850/2004 of the European Parliament and of the Council (2).

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Hazardous Material	Definitions	Control measures
Anti-fouling compounds and systems	Anti-fouling compounds and systems regulated under Annex I to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (AFS Convention) in force at the time of application or interpretation of this Annex.	1.No ship may apply anti-fouling systems containing organotin compounds as a biocide or any other anti-fouling system whose application or use is prohibited by the AFS Convention. 2.No new ship or new installations on ships shall apply or employ anti-fouling compounds or systems in a manner inconsistent with the AFS Convention.

Other conventions, regulations, and legislations that define hazardous substances of biological, chemical, physical, or radiological nature and that are relevant to this study include but are not limited to the following:

- The Basel Convention [2]
- The Waigani Convention [3]
- Timor-Leste imports [4]
- MARPOL [5]

4.3 NORM Assessment

RadProAust was engaged to conduct a Naturally Occurring Radioactive Material (NORM) gamma radiation assessment UPS200601 on the Northern Endeavour FPSO topsides facilities in September 2020 [6].

The scope of work was to conduct a gamma survey on the external surfaces of the process vessels, pipes and equipment at specific test points to identify any items with elevated radiation measurements that could indicate the presence of NORM. No internal surface contamination testing measurements were conducted. A summary of the scope and results is shown in Table 4-2.

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Table 4-2 Location of Test Sampling Points and Areas Detected with Elevated Radiation

Location	Elevated External Radiation Levels Present
“Corallina 1st stage Separator - V – 2101”	Yes
"Laminaria, Corallina and test Separator Hydro - Cyclones"	
" Coalescer - V - 2302 "	Yes
"Oil Heater E - 2202A"	Yes
"Topside / Production Swivel Interface"	
"Produced Water Degassing Drum - V - 4301"	Yes
"Test Separator - V - 2901"	Yes
"Laminaria 1st Stage Separator - V - 2001"	Yes
"HP Flare Knockout Drum - V - 4501"	
"Debutaniser Reflux System V – 3702”	
"Debutaniser Column - V - 3701 "	
"Closed Drain Drum - V - 4801"	Yes

The Closed Drain sample had a total radioactivity concentration of 200.7± 8.4 Bq/g, well above the regulatory levels as per the ARPANSA National Directory for Radioactive Protection schedule 4 adopted by the Northern Territory Radiation Protection for classification of a radioactive substance.

The Coalescer sample 3B showed total radioactive concentrations below the regulatory levels. However, the sample assayed may not be a true reflection of the radioactivity concentration of the NORM waste that may be present. Further sampling of ALL removed waste is to be carried out for the accuracy of reporting.

Coalescer V-2301 on-site gamma measurements were affected by the proximity of the 1st Stage Separator V-2101, as the elevated background radiation levels around this vessel were dominated by this vessel.

An external waste profile measurement was carried out by gamma emission radiation measurement plotting. A summary of the estimated internal volume of anticipated NORM (solid) waste quantities is shown in Table 3-3.

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s 47(1)(b)

4.4 TBT Antifouling

The International Convention on the Control of Harmful Anti-fouling Systems on Ships, adopted on 5 October 2001, prohibits the use of harmful organotin compounds in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. The Convention entered into force on 17 September 2008.

Under the terms of the Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard, or offshore terminal of a Party.

The Convention was developed to immediately ban Tributyltin (TBT) use globally in antifouling paints to "protect the marine environment". The ban on TBT has come about because TBT has detrimental effects on non-target marine organisms.

Annex 1 attached to the Convention states that by an effective date of 1 January 2003, all ships shall not apply or re-apply organotin compounds which act as biocides in anti-fouling systems, and by 1 January 2008, ships either:

- Shall not bear such compounds on their hulls or external parts or surfaces or
- Shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems

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This applies to all ships except fixed and floating platforms, floating storage units (FSUs), and floating production storage and off-loading units (FPSOs) that have been constructed before 1 January 2003 and have not been in dry-dock on or after 1 January 2003.

4.4.1 Implications for the Northern Endeavour

The Northern Endeavour was constructed before 1st January 2003, has classification designation as an FPSO and has never been to drydock. Therefore, it is currently exempt from the terms of this convention. This exemption will stand even in lay-up if the existing AFS is not interfered with.

However, under resolution 2 of Article 6 amendments of the AFS convention/Annex 1, it will be prudent to conduct a desktop survey and develop a strategy for managing the existing AFS system. MEPC.208(62) is the guiding reference for the inspection of anti-fouling systems on ships. Class societies can assist under direction of the flag administration. The resultant report would assist in cross-border lay-up and opportunities for further deployment. IMO AFS circular AFS 3 22/07/2009 describes a plan to manage existing TNT coatings in ports and drydocks and is an accepted practice.

For an AFS with TBT to be effective, the vessel must be in motion at a speed of at least 7 knots and be stationary in tropical waters for no more than 3 weeks. As the Northern Endeavour has been stationary at its location for over 20 years, the effectiveness of the existing AFS will have long been dissipated. This would be evident by the extensive existing marine growth on the hull.

If the existing AFS/marine growth is not disturbed, no further action is required if laid up. However, if drydocked for further deployment, the existing AFS must be managed in compliance with the existing IMO resolutions and MEPC circulars. Most major repair/drydock yards in Southeast Asia and the Middle East will comply with these requirements. Additional costs/time will be involved as this type of management of hull cleaning is not common today.

For recycling, EU-SRR approved yards will comply with TBT disposal as part of their certification. The Australian contractor s 47(1)(b) has indicated that their recycling process can handle the presence of TBT on the hull. Southeast Asian recycling yards are an unknown. The beaching method of recycling within these countries makes it very difficult to meet/monitor IMO AFS Annexures/MEPC resolutions and the actual convention.

4.4.2 Bringing the Northern Endeavour into an Australian Port

The Northern Endeavour is considered a non-SOLAS vessel (non-propelled) under the Navigation Act. If the loading of the Northern Endeavour onto a Heavy Lift Vessel (HLV) takes place at least 12NM away from the Australian coastal boundary, there is no requirement to comply with any of the Australian regulations related to Biosecurity/Invasive marine species. Thus, there will be no requirement to clean the hull.

However, if the intent is to load the vessel within the 12NM limit, the vessel will be subject to pre-arrival reporting, pratique, assessment and inspection at the first point of entry on arrival.

However, given the unique situation and location of the Northern Endeavour, it is strongly recommended that all relevant stakeholders be actively engaged to discuss options for variation of the application of the regulations. This has been done recently for pipe-laying vessels coming into Australian Commonwealth waters, where a low-risk ruling was obtained as required by the Department of Agriculture, Fisheries and Forestry (DAFF).

Under the Antifouling Performance Standards for The Maritime Industry: Development of A Framework for Assessment, Approval and Relevance of Effective Products [7], the responsibility for managing the risks of translocating marine pests for all vessels travelling between Australian ports lies with the States and the Northern Territory. The Australian Government manages the risk of the introduction of marine pests internationally.

The National Biofouling Management Guidelines for The Petroleum Production and Exploration Industry, 2009, provides recommendations for the management of biofouling hazards by the petroleum industry in the Australian Territory [8].

4.5 Handling contaminated waste

4.5.1 Basel Convention

The provisions of the Convention centre around the following principal aims [9]:

- The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal
- The restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management
- A regulatory system applying to cases where transboundary movements are permissible

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Fifty-three countries are signatories of the convention, including Australia, Türkiye, Denmark, Norway, Malaysia and Indonesia.

In 2019, the Basel Convention Ban Amendment came into force [10]. Under the Ban Amendment, a party which has ratified the amendment must prohibit all transboundary movements of hazardous waste which are destined for final disposal or recycling operations to States not listed in Annex VII of the Basel Convention. Annex VII countries are those countries of the OECD or European Community, and Liechtenstein. Australia is an OECD country, so it is an Annex VII country. Malaysia [11] and Indonesia [12] have ratified the amendment and are not listed in Annex VII therefore they must not accept hazardous waste from Australia. [13]

4.5.2 Europe

s 47(1)(b) have indicated that they can handle and temporarily store a range of hazardous materials, including NORM. s 47(1)(b) has previously indicated that Denmark will not allow the long-term storage of hazardous materials from other countries. s 47(1)(b) Offshore Decom AS have indicated that they can dispose of hazardous waste but have not provided any details.

4.5.3 Türkiye

The Turkish yards indicated that they are able to handle and dispose of some contaminants. However, this is subject to the quantity and type of contaminant. The s 47(1)(b) previously indicated that the FPSO would have to be decontaminated of NORM and mercury prior to arrival at a Turkish yard.

4.5.4 Australia

The Sandy Ridge facility, owned and operated by Tellus Holdings in Western Australia, is licenced to accept low-level radioactive waste (LLW), such as NORM, and mercury-contaminated waste from anywhere in Australia [14]. Sandy Ridge is currently the only facility in Australia with this license.

s 47(1)(b)

Licences for the removal and transportation of the waste would need to be obtained from the relevant state and federal government departments. The transport of NORM-contaminated waste is governed by ARPANSA's Code for the Safe Transport of Radioactive Material (Australian Radiation

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Protection and Nuclear Safety Agency). It is based on internationally accepted standards set by the IAEA8 and has been adopted in legislation by all states and territories in Australia.

There is no apparent WA state legislation that restricts the acceptance of NORM-contaminated waste from a vessel that was based in Australian waters. Further discussions are required with the relevant stakeholders to establish the required licenses to be obtained for removal and transportation and which party is required to hold the licenses.

Western Australia has the Nuclear Waste Storage Facility (Prohibition) Bill 1999 [15], however this relates to nuclear waste, not LLW, where nuclear waste is defined as any radioactive material derived from the operations of a nuclear reactor, nuclear weapons facility, nuclear reprocessing plant or isotope enrichment plant except for nuclear waste that has been generated in 10 Australia or material that has been used under licence for scientific, industrial or medical purposes in accordance with the provisions of the Radiation Safety Act 1975. Similarly, South Australia has the Nuclear Waste Storage Facility (Prohibition) Act 2000 [16]

5 FPSO MARKET REVIEW

Information captured in this section was based on available data at a global level at the time of the production of the report.

5.1 Regional and Global

As of April 2023, there are 301 active floating production systems (FPS), FPSOs account for 54%, defining a majority in the floating production system market. This is 2 units less than 2022, defining a decline in the total active units. There are 74 FPS units on order, of which 50% are FPSOs. Conversions and redeployment account for 18 of the FPSO orders. The remaining 19 are new builds. [17]

Orders for FPS units in 2023 as of April have reached 8, of which 4 are FPSO units and 2 are FSOs. All four of the FPSO awards are for redeployment of existing units. Brazil leads the demand for FPSO orders, accounting for the 16 FPSOs in the order book, as shown in Figure 5-1. Demand for FPSOs in Brazil is driven by rising international energy demand and the Brazilian government's support to strengthen the country's oil and gas sector [17].

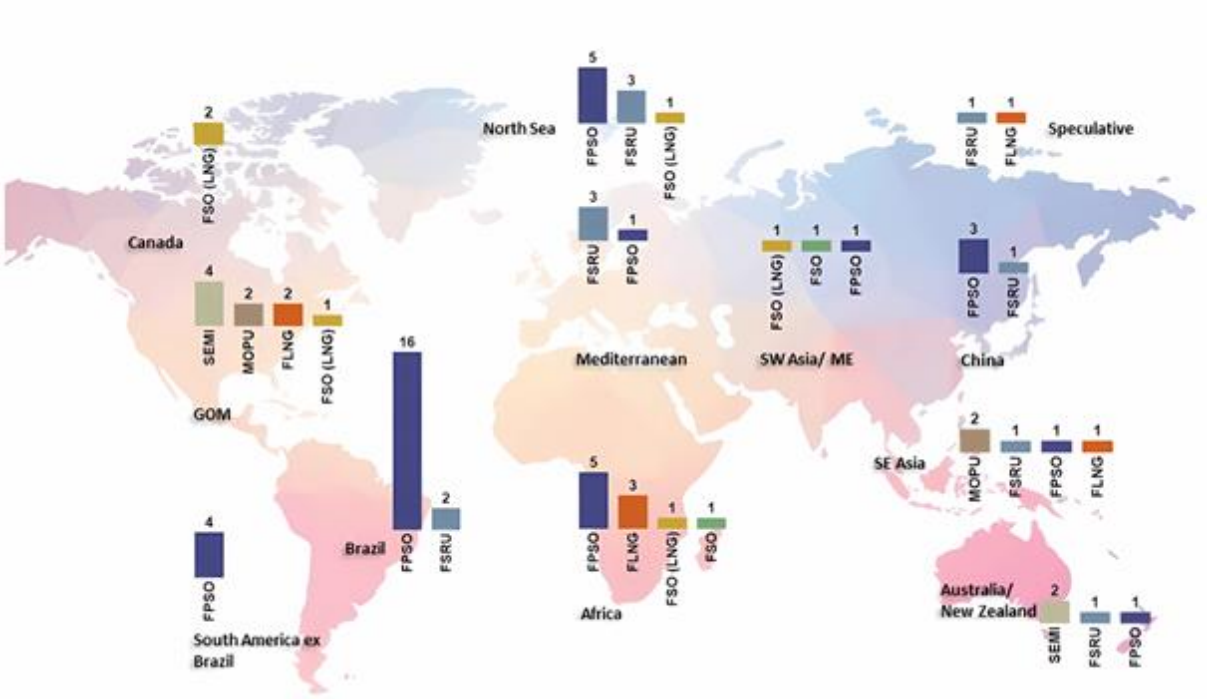


Figure 5-1 FPS Unit Orders by Unit Type and Region [17]

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A further 11 FPSOs are available for redeployment, most of which have been laid up for at least 3 years. Northern Endeavour faces competition from FPSOs with similar specifications and fewer years of operation, as shown in Table 5-1.

Table 5-1 2023 Awarded FPSO and FSO Units

Unit Name	Floater Owner	Storage (000s bbl) LNG in m3)	Oil Process (b/d)	Gas Handling *(mmcf/d)*	Mooring	Hull Type	Contracting Date	Install Date	Available for Lease	Years available for lease
Piranema Spirit	Altera	250	25,000	127	Spread	NEW	2005	2007	2021	2
Dhirubhai 1	Aker Energy	1,300	60,000	315	Int. Turret	CONV	2006	2008	2018	5
Enquest Producer	EnQuest	600	57,000	0	Int. Turret	CONV	2012	2015	2020	3
Glas Dowr	Bluewater	675	60,000	80	Int. Turret	Redeploy		2011	2015	8
Munin	Bluewater	595	75,000	0	DP, STP	Redeploy			2011	12
Northern Endeavour	**Australian Gov't (Petrofac O&M)**	**1,400**	**170,000**	**80**	**Int. Turret**	**NEW**	**1997**	**1999**	**2024**	**-**
OSX 1	Lenders	900	40,000	130	Int. Turret	Redeploy			2015	8
P 33	Petrobras	2,000	63,000	53	Int. Turret	CONV	1996	1998	2020	3
P 37	Petrobras	1,600	180,000	161	Int. Turret	CONV	1998	2000	2020	3
Song Doc Pride MV 19	SPO	360	30,000	0	Spread	CONV	2007	2008	2020	3
Tamara Tokoni	Century Energy Services	1,106	40,000	66	12 pt Spread	CONV	2008	2009	2018	5

Similar tank storage capacity
Similar Oil Processing capabilities (b/d)
Similar Gas Handling (mmcf/d) capabilities
Similar Mooring Type

5.2 Trends and Pricing

The estimated total CAPEX for the awarded FPSOs in 2023 is significantly lower than in 2022. CAPEX of the 3 awarded FPSOs in Q1 2023 approached US$2 billion, while the figure was greater than US$7 billion in Q4 2022 for the same quantity of FPSOs. The significant increase of redeployed FPSOs versus new build FPSOs is driving the reduced total CAPEX. Several factors, including field location/water depth, field life, production rates and project CAPEX restraints, drive the choice of redeployment versus new build.

Table 5-2 2023 Awarded FPSO and FSO Units [17]

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Quarter of Contracting (2023)	Type Unit	Location	Unit Name	Construction Yard	Estimated CAPEX ($US Million)	Lease / Own	Hull Type
Q1	FPSO	Türkiye	BW Opportunity (ex-Cidade de Sao Mateus)	Keppel	$350	Own	Redeployment
Q1	FPSO	China	Nan Hai Fen Jin	CMHI - Shenzhen	$250	Own	Redeployment
Q1	FPSO	UK	Petrojarl Knarr	Dubai DD	$1,250	Lease	Redeployment
Q1	FSO	Yemen	Safer	-	$55	Own	Converted tanker
Q2	FPSO	Core d'Ivoire	Voyager Spirit	Dubai DD	$400	Lease	Redeployment
Q2	FSO	Core d'Ivoire	Nordic Brasilia	Dubai DD	$125	Lease	Converted Shuttle Tanker

5.3 Factors Influencing Redeployment Pricing

Redeployment of an existing FPSO asset will be dependent on the following factors:

- Compatibility with target field/opportunity
- Timeline to opportunity realisation
- Likelihood of buyer winning opportunity for redeploying the FPSO
- Condition of FPSO
- Market interest – Competition from other buyers for the FPSO
- Alternatives – Competition from other FPSOs for redeployment

The attraction of a redeployed FPSO is that it has the potential to reduce the cost and schedule associated with an FPSO project. To realise the maximum value from this, the FPSO must be a close fit to a specific opportunity the buyer is certain to be awarded and the re-used components in reasonable condition.

Ideally, a buyer will be in a prime position to be awarded a project the FPSO is a close fit for in the immediate future. Should the award be uncertain or further into the future, the less the buyer will be willing to pay. As part of this, the buyer will also factor in the time they need to maintain the FPSO before it goes to the shipyard to be upgraded and refurbished. This can cost around US$2.5m a year plus a mobilisation cost and has proven to extend well over 5 years for speculative purchases.

The condition of the FPSO will carry risks around the emergent scope. Unless they know the FPSO very well, the buyer will build in a discount factor accordingly to manage the risk. Many FPSO

redeployment projects have been caught out by unknown integrity issues, which have had a significant impact on cost and delivery schedule.

Competitive tension from multiple parties interested in buying the FPSO for the same or different opportunities will result in a higher sale price. This tends to be unusual unless the FPSO is a good generic fit for a wide range of up-and-coming oil and gas fields and newbuild prices are high. Alternatively, a market full of FPSOs of similar specifications for redeployment will devalue the asset.

It is common for 5- to 10-year-old oil tankers in good condition to be purchased for conversion into an FPSO. The price to purchase such a tanker will typically be considered the alternative by a potential buyer. The FPSO can leverage a higher price than an oil tanker if it requires fewer upgrades to meet the opportunity specification. Examples would be it already has a turret mooring system, expanded accommodation, high output power generation and some suitable topside process facilities.

As shown in Figure 5-2, due to current market demand, 5-year-old tanker prices are only marginally lower than a newbuild tanker. Historically, new build and used tanker prices have been much lower. This will inflate the value of the FPSO to a buyer with a close-fit project they are likely to be awarded. Note it is unlikely to impact a speculative purchase as the buyer will account for market fluctuations and uncertainty over the ability to redeploy.

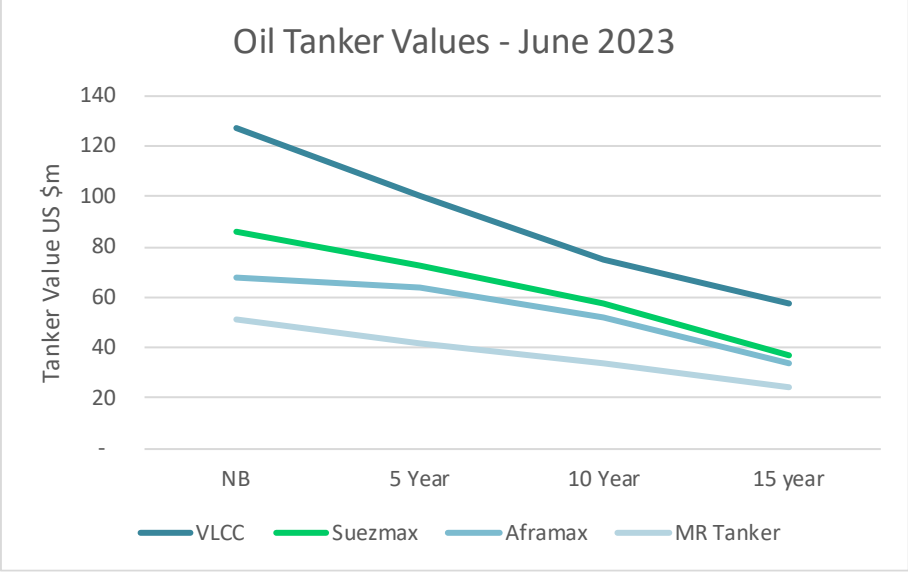


Figure 5-2 Oil tanker values (Allied Quantumsea S.A – June 2023)

5.4 Pathways for Recently Decommissioned FPSOs

Pathways for recently decommissioned FPSOs are shown in Table 5-3. The decommissioning data highlights a trend for recycling FPSOs >40 years old with a slight bias towards European green recycling yards.

Table 5-3 Pathway of Recently Decommissioned FPSOs

FPSO	Owner	Year of Production Cessation	FPSO Age	Decommissioning Pathway
Liberdade	Santos	2023	20	Likely to begin recycling in Türkiye in 2024. No contract has been awarded to date.
Fluminese [18]	Shell	2020	49	Expected to scrap in 2024 by Modern American Recycling Services Europe.
Curlew [19]	Shell	2019	40	AF Gruppen began recycling the FPSO in the AF Environmental Base Vats Offshore decommissioning and recycling facility in 2022.
Umuroa [20]	BW Offshore	2019	42	The FPSO is being scrapped in Baijnath Melaram yard in India for USD 13.5 million. A lack of redeployment opportunities for older FPSOs was cited as the reason for recycling.
Cidade de Sao Vicente [21]	BW Offshore	2020	46	Began recycling in Priya Blue Industries Ltd yard in India in 2022.
Capixaba [22]	SBM	2022	49	To arrive at Modern American Recycling Services in Europe at the end of 2023/beginning of 2024 for green recycling.

5.5 Projects and Regions Suitable for Redeployment

The Northern Endeavour is only suitable for redeployment in oil and gas regions with benign weather conditions. The primary design constraint is the 100-year significant wave height. The design data of the Northern Endeavour is shown in Table 5-4. A comparison of the wave height over a 100-year period against regional wave data is shown in Figure 5-4. The identified regions that may be applicable for redeployment include West Africa, the Timor Sea, and Malaysia. As an upper limit, some Brazilian locations may be suitable.

Table 5-4 Northern Endeavour – Basic Design Data

Return Period (Years)	Significant Wave Height (m)
1	1.34
10	4.30
100	7.40

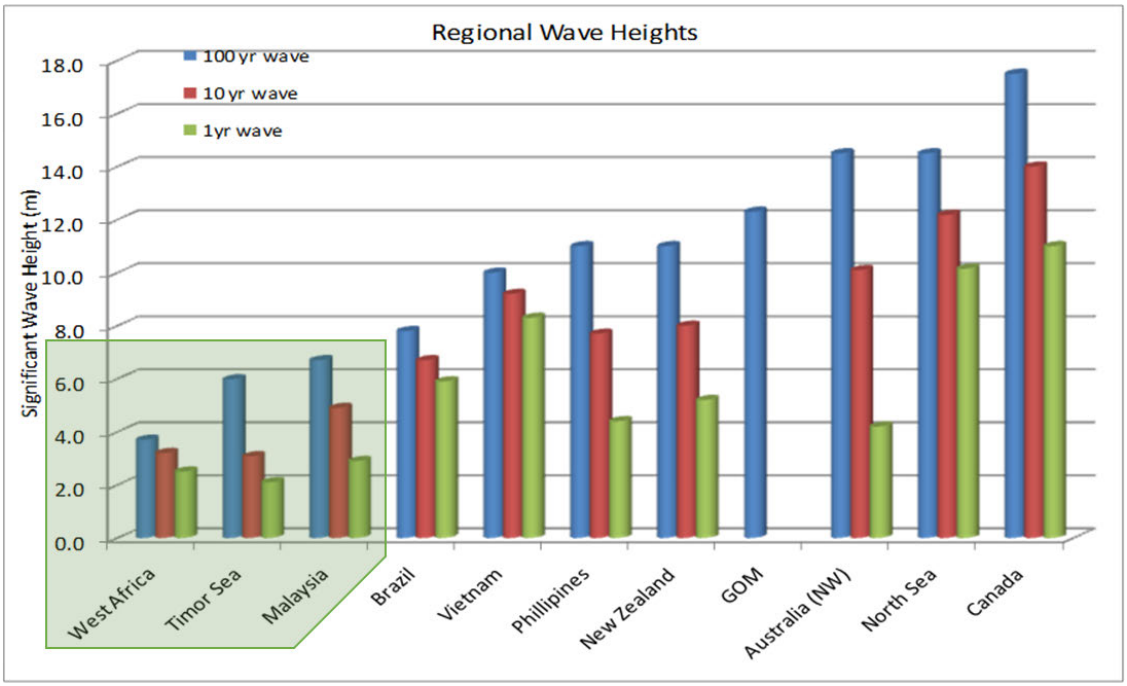


Figure 5-3 Applicable Regions for Redeployment

Table 5-5 lists the potential project opportunities for Northern Endeavour as of April 2023. Redeployment is not recommended if the requirements are not a close match, as the opportunities rarely turn out to be viable. The seven listed projects have been limited to regions likely to have suitable metocean conditions for the NE hull and have a water depth greater than 70m due to the Northern Endeavour's internal turret. The minimum allowable riser bend radius, riser loads and clashing drive the minimum water depth.

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Table 5-5 2023 Northern Endeavour Project Opportunities

#	Status	Region	Project	Location	Block	Operator	Possible Award Date	Possible Production Start Date	Contracting Strategy	Estimated Hull Type	Estimated Capex (Mill USD)	Water Depth (meters)	Possible Floater Solution
1	PL	AFRICA	Zabazaba / Etan	Nigeria	OPL 245	ENI	2025-2026	2028-2030	Lease	New/Conv	$2,800	1700-2000	FPSO
2	PL	SEA	Salam / Patawali	Malaysia	WL4-00	ConocoPhillips	2024-2025	2026-2027	Lease	Conv/Redeploy	$600	100-150	FPSO
3	PL	AFRICA	Ogo	Nigeria	OPL 310	Optimum	2024-2025	2026-2027	Lease	Conv/Redeploy	$400	100	FPSO or MOPU+FSO
4	AP	AFRICA	Azul	Angola	23	Total	2026-2028	2030-2031	Lease	Conv	$1,000	923	FPSO
5	AP	AFRICA	Colorau	Angola	32	Total	2025-2027	2027-2029	Lease	Redeploy	$700	1700-2000	FPSO
6	AP	SEA	Nahara	Malaysia	306	Petronas	2027-2029	2029-2032	Lease	Conv/Redeploy	$250	50-100	FPSO or FSO
7	AP	SEA	Sirung	Malaysia	405B	PTTEP	2026-2028	2028-2031	Lease	Conv/Redeploy	$500	50-100	FPSO or FSO

5.6 Reputable FPSO Contractors

There is the potential for the Northern Endeavour to be sold to an FPSO/FSO contractor or an O&G company. Reputable FPSO/FSO contractors operate multiple vessels and contract to major O&G companies. Figure 5-4 displays a list of FPSO/FSO contractors that operate multiple vessels.

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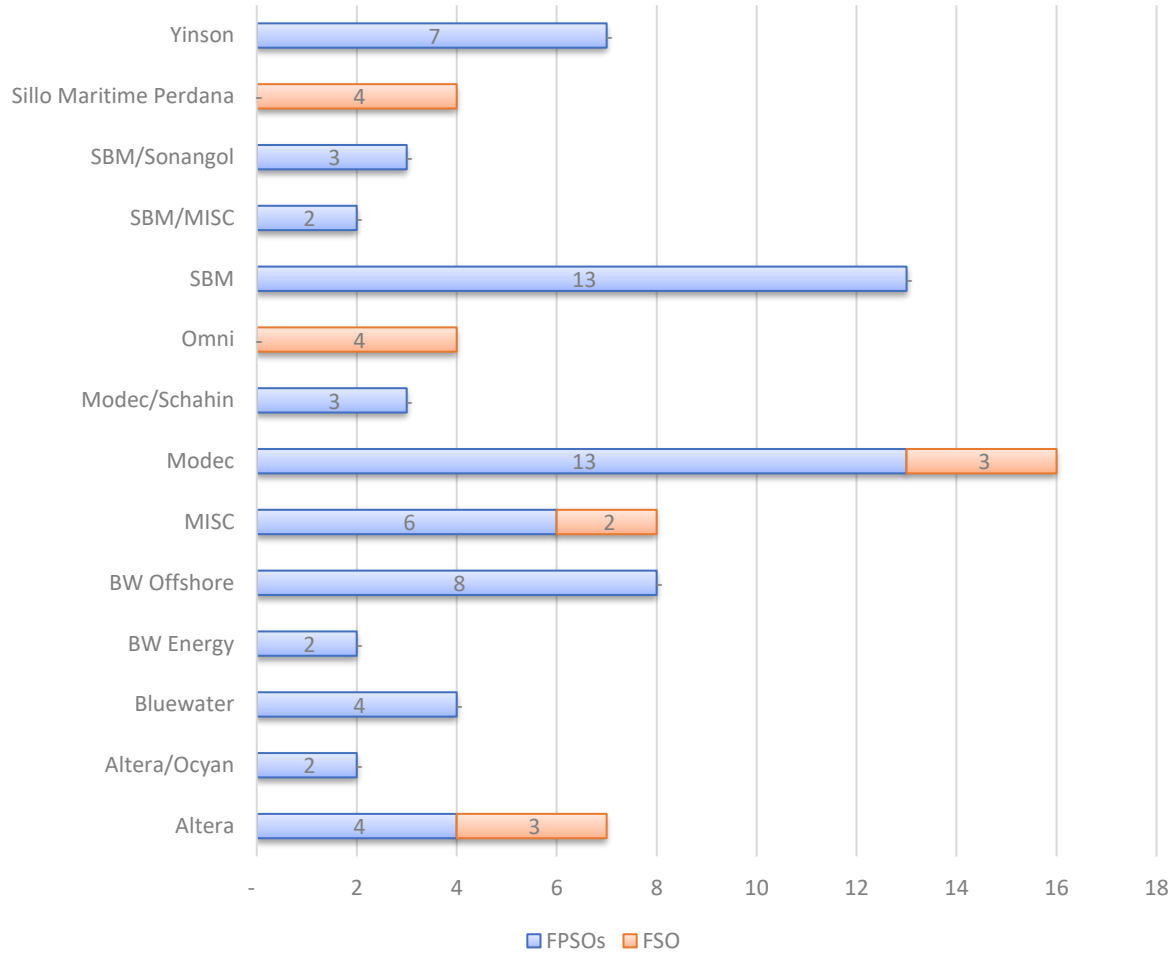


Figure 5-4 FPSO/FSO Contractors with Multiple Vessels

6 REDEPLOYMENT / SPECULATIVE PURCHASE REVIEW

6.1 Market Research

A market research exercise has been conducted to gauge the interest in the acquisition and redeployment of the FPSO Northern Endeavour.

Table 6-1 lists the fourteen companies the enquiry letters were issued to and identifies the entities that responded. Four companies provided responses.

Table 6-1 Redeployment Enquiry List

Name	Agreed to Participate	Response Received
s 47(1)(b)	Yes	Yes
	Yes	Yes
	No Reply	No
	Yes	No
	No Reply	No
	No Reply	No
	No Reply	No
	No Reply	No
	Verbal only	No
	No Reply	No
	No Reply	No
	Declined	No
	Declined	No
	Verbal only	No

6.2 Response Summary

6.2.1 s 47(1)(b)

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s 47(1)(b)

6.2.2 s 47(1)(b)

6.2.3 s 47(1)(b)

6.2.4 s 47(1)(b)

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s 47(1)(b)

6.2.5 Summary

s 47(1)(b)

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7 RECYCLING MARKET REVIEW

7.1 Regional and Global

As of June 2023, 533 vessels, including dry bulkers, tankers, containerships and gas carriers, have been scrapped over the past 12 months, of which 135 (or 25%) were scrapped in Bangladesh, as shown in Table 7-1 [23]. Dry bulk and tanker vessels consisted of the highest vessel types scrapped in the past 12 months, accounting for 74 and 73 units, respectively [23].

Table 7-1 Destination of Vessels Scrapped over the past 12 months [23]

Country	Vessels Scrapped	% of Market Share
Bangladesh	135	25.3
India	111	20.8
Türkiye	38	7.1
Netherlands	31	5.8
Denmark	24	4.5
Other	194	36.4

The demand for the scrapping of vessels in Bangladesh, India and Pakistan is driven by the high scrap prices offered by these countries (refer Figure 7-1) s 47C

These three countries commonly use the beach method for ship recycling. The beached vessel is progressively slid up the beach during successive high tides as the dismantling operations proceed. A major issue with dismantling ships on tidal mudflats is that any spills of oil or cargo remaining on board or contaminants are likely to be swept out to sea by the next tide. [24] s 47C

As shown in Figure 7-1, there is a significant cost associated with taking vessels to European or Turkish yards which are EU- SRR compliant and provide green recycling services.



Figure 7-1 Tanker Scrap Prices in US$ / ldt [23]

2023 has seen a decrease in the number of global vessels being scrapped. This is consistent with a recent trend that has seen a year-on-year decrease in the number of vessels decommissioned for recycling (refer Figure 7-2). The average age of the world fleet has increased by 2.5 years over the past 10 years [25], indicating that there has been an increase in operational life expectancy and deployment duration for vessels.



Figure 7-2 Cumulative recycling activity [23]

7.2 Market Research

A market research exercise has been conducted to gauge the interest in the recycling of the FPSO Northern Endeavour.

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Table 7-2 lists the twenty-one companies to which the enquiry letters were issued and identifies the entities that responded. In summary, one response was received from Norway, one from Denmark, five from Türkiye and three from Australia. Three of the yards in Türkiye are part of the s 47(1)(b)

.

Table 7-2 Recycle Enquiry List

Name	Country	Agreed to Participate	Response Received
s 47(1)(b)	Denmark	Yes	No
	Denmark	Yes	Yes
	Italy	No Reply	No
	Lithuania	No Reply	No
	The Netherlands	No Reply	No
	The Netherlands	No Reply	No
	Norway	No Reply	No
	Norway	Yes	Yes
	Norway	No Reply	No
	Norway	No Reply	No
	Ireland	No Reply	No
	Türkiye	Yes	No
	Türkiye	No Reply	No
	Türkiye	Yes	Yes
	Türkiye	Yes	Yes
	Türkiye	Yes	No
	Türkiye	No Reply	No
	UK	No	No
	Australia	Yes	Yes
	Australia	Yes	Yes
	Australia	Yes	Yes

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7.3 Recycling Yards Response Summary

s
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(b)

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s 47(1)(b)

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s 47(1)(b)

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s 47(1)(b)

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s 47(1)(b)

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s 47(1)(b)

7.4 Indicative scrap value

The FPSO's scrap value depends on the location chosen for recycling and the enforced regulatory system. Scrap prices for tanker vessels as of June 2023 in countries where recycling is most predominant are shown in Figure 7-1. Tanker prices have been used as a comparison as the build of the Northern Endeavour is comparable to a tanker.

Using the weight specifications of the Northern Endeavour in Table 7-3, the above tanker scrap values and the ranges provided in the responses to the market survey, an indicative scrap price for the Northern Endeavour can be determined for comparison purposes between the various location options. The results are shown in Table 7-4. The resulting indicative prices vary significantly between countries. s 47C

.

The decontamination cost is excluded from the scrap values given in Table 7-4.

It is noted that the scrap prices specified for the Australian option exclude the cost of recycling the FPSO. s 47(1)(b) has indicated that this cost would be in the order of US$50-60mill.

s 47(1)(b) has previously indicated to other FPSO operators that the price to decontaminate and recycle a vessel of the size of Northern Endeavour would be US$9-11mill. This cost estimate included the scrap steel rebate and excluded the cost of transporting any hazardous waste to its final storage location (estimated to be US$2-4mill)

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There is also a range of pricing within Türkiye. The price depends upon the vessel's flag (EU or non-EU flagged vessel), as EU flagged vessels must adhere to the EU-SRR, having additional requirements for the enforced regulatory system.

Table 7-3 Northern Endeavour Weight Specifications

Lightship	Topsides	Total
Tonnes	Tonnes	Tonnes
30,300	11,000	41,300

Table 7-4 Indicative Tanker Scrap Prices

Scenario	USD / Light Displacement Tonnage - Tonnes	2023 Scrap Value US$ m
Bangladesh	$683	$28
India	$617	$25
Pakistan	$595	$25
Türkiye (1)	$364	$15
Türkiye (2)	$276 - $353	$11-$15
Norway(3)	$400 – $550	$16-$23
Denmark(3)	$320 - $380 [26]	$13-$16
Australia (4)	$210 - $315	$9-$13

Notes:

1) Non-EU-SRR compliant, excludes decontamination cost
2) EU-SRR compliant, excludes decontamination cost
3) EU-SRR compliant, excludes decontamination cost and the cost of dismantling the vessel
4) Non-EU-SRR compliant, excludes decontamination cost and the cost of dismantling the vessel

7.5 Recycling Yard Availability

The availability of ship recycling yards depends on factors including current market demand, regulatory requirements imposed by the owner or flag state, ship size, and the level of vessel contamination. From 2018 to 2021, the overall market demand for shipbreaking remained reasonably consistent, while a significant reduction was observed in 2022 [27]. However, global demand is anticipated to increase from 2024 to 2026, potentially leading to a shortage of yard capacity by 2026 [28]. The market demand for regulated yards has remained relatively constant in

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the European Union over the past five years [28]. However, an increase in demand for green recycling may drive a capacity shortage in EU-SRR compliant yards sooner than in other non-compliant yards [28].

The yards listed in Table 7-5 all confirmed in the market survey that they have availability in 2024 and 2025. The notification period required by the yards prior to arrival varied (Refer Table 7-5), with a number of yards having no fixed requirement. It is noted that the notification period for the South Australian option will be driven by the number of modifications that will be required at the Whyalla yard to accommodate the Northern Endeavour.

Table 7-5 Recycling Companies who indicated availability in 2024-25

Company	Country	Preferred notification period
s 47(1)(b)	Denmark	1 year (will accept 3 or 6 months)
	Norway	No fixed period
	Türkiye	15 days
	Türkiye	No fixed period
	Türkiye	No fixed period
	Türkiye	No fixed period
	Australia	3 months
	Australia	As long as possible
	Australia	Dependent on yard modification works required

Note: s 47(1)(b) have nominated Whyalla as their recycling location

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8 VESSEL RECYCLING REGULATIONS

Guidelines and information captured in this section were current at the time of writing.

8.1 Hong Kong Convention

The aim of the Hong Kong Convention is to ensure “that ships, when being recycled after reaching the end of their operational lives, do not pose any unnecessary risk to human health and safety or the environment” [29].

The purpose of the HKC is to [30]:

1. Ensure that ships are designed, built, operated, and prepared in a way that enables safe and eco-friendly dismantling while maintaining the safety and efficiency of the ships' operations
2. Enforce safe and eco-friendly functioning of the ship recycling facilities
3. Implement certification and reporting requirements to enforce eco-friendly ship recycling.

The key convention proposals aim to ensure safe and environmentally responsible ship recycling. They include conducting initial, periodic, and final surveys to verify and assess the ship’s Inventory of Hazardous Materials (IHM) [29]. A Ship Recycling Plan would be required, outlining procedures and disposal methods for hazardous materials during recycling [29]. A prohibited or restricted hazardous materials inventory would be developed for shipyards, ship repair yards, and member states [29]. Additionally, a ship recycling completion report would include information on incidents and accidents affecting human health and the environment [29]. These proposals promote proper management of hazardous materials, safer working environments, and the mitigation of environmental risks during ship recycling.

8.1.1 Conditions for enforcement

Three conditions must be met for the HKC to come into effect, after which it shall enter into force 24 months after the date [29]:

1. A minimum of 15 States has either signed or accepted in accordance with Article 16
2. The combined merchant fleets of the States constitute not less than 40% of the gross tonnage of the world’s merchant shipping

3. The combined maximum annual ship recycling volume of the States during the preceding 10 years constitutes not less than 3% of the gross tonnage of the combined merchant shipping of the same States

As of 26 June 2023, the convention fulfilled the conditions for enforcement. The HKC has been ratified by 22 states, accounting for 45.81% of the World Merchant Shipping gross tonnage [31]. The Hong Kong Convention will enter into force on 26 June 2025.

8.2 European Union Ship Recycling Regulation

The EU's Ship Recycling Regulation is currently the only dedicated legally binding framework regulating ship recycling. The objective of the EU-SRR is to "prevent, reduce and minimise accidents, injuries and other negative effects on human health and the environment related to the recycling of ships flying the flag of European Union countries" [32].

The EU-SRR applies to ships on international voyages of 500GT and above flying the flag of a Member State or the Flag of a third country under the conditions of Article 12 of the Regulation [33]. Article 12 requires the ship to have a compliant IHM whilst in port or anchorage of a Member State [33]. The Regulation also outlines a "European List" of EU-SRR compliant shipyard recycling facilities. Yards located in non-EU States must apply if they wish to recycle ships registered with EU flag States [33].

The Regulation implements the requirements of the Hong Kong Convention for the safe and environmentally sound recycling of ships into EU law but also includes additional safety and environmental requirements. This includes but is not limited to [33]:

- Leakage control, specifically in intertidal zones
- Handling of Hazardous Material (HM) and waste
- Recycling can only take place on impermeable floors with effective drainage systems.
- Additional standards for downstream waste management
- Two additional hazardous materials:
- Perfluorooctanesulfonic acid (PFOS)
- Hexabromocyclododecane (Brominated Flame Retardant) (HBCDD)
- Additional regulation for Hydrochlorofluorocarbons (HCFC)

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8.3 Compliant Countries

A notable disparity exists regarding the ratification of the Hong Kong Convention (HKC) and the European Union Ship Recycling Regulation (EU-SRR) among different countries. It is worth noting that shipyards located outside the European Union (EU) can still register as EU-SRR compliant. Consequently, countries may have EU-SRR compliant and non-compliant yards within their jurisdictions.

A comparison of regulatory compliant countries is shown in Table 8-1. A list of EU-SRR compliant shipyards that may be suited to the Northern Endeavour is shown in Appendix A. Applicability is based upon the length, beam, depth, design draught, and the gross tonnage of the Northern Endeavour. The top sides and hull machinery could be removed prior to arrival at the shipyard to reduce the draught.

Table 8-1 Comparison of Compliant Countries

Country	Contracting states of the Hong Kong Convention	States with Certification or Statement of Compliance to the EU Ship Recycling Regulation (EU-SRR)
Bangladesh		
Belgium		
Republic of the Congo		
Croatia		
Denmark		
Estonia		
Finland		
France		
Germany		
Ghana		
India		
Italy		
Japan		
Latvia		
Liberia		
Lithuania		
Luxembourg		
Malta		
Netherlands		
Norway		

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Country	Contracting states of the Hong Kong Convention	States with Certification or Statement of Compliance to the EU Ship Recycling Regulation (EU-SRR)
Panama		
Portugal		
Sao Tome and Principe		
Serbia		
Spain		
Türkiye		
United Kingdom - Northern Ireland		
United Kingdom		
United States of America		

Although Australia is not formally obliged to adhere to either regulatory framework and the Northern Endeavour is not an EU-flagged vessel, the Commonwealth has selected to comply with the EU-SRR as it is the most rigorous framework regulating ship recycling.

8.4 ISO Standards

In addition to the HKC and EU-SRR, several ISO standards pertain to the safe disposal and recycling of vessels. Table 8-2 presents a list of ISO standards specifically addressing the safe disposal of vessels.

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Table 8-2 Ship Recycling and Disposal ISO Standards

Title	Regulation
ISO 30000:2009 [34]	Ships and marine technology – Ship recycling management systems – Specifications for management systems for safe and environmentally sound ship recycling facilities
ISO 30002:2012 [35]	Ships and marine technology – Ship recycling management systems – Guidelines for selection of ship recyclers (and pro forma contract)
ISO 30003:2009 [36]	Ships and marine technology – Ship recycling management systems – Requirements for bodies providing audit and certification of ship recycling management
ISO 30004:2012 [37]	Ships and marine technology – Ship recycling management systems – Guidelines for the implementation of ISO 30000
ISO 30005:2012 [38]	Ships and marine technology – Ship recycling management systems – Information control for hazardous materials in the manufacturing chain of shipbuilding and ship operations
ISO 30006:2010 [39]	Ship recycling management systems – Diagrams to show the location of hazardous materials on board ships
ISO 30007:2010 [40]	Ships and marine technology – Measures to prevent asbestos emission and exposure during ship recycling

8.5 Australian Ship Breaking Regulations

The Hazardous Waste (Regulation of Exports and Imports) Act 1989 primarily governs ship recycling in Australia. The act originally regulated waste movements lacking financial value that were destined for final disposal [41]. Amendments were made in 1996 to include wastes with financial value for recycling and recovery operations to meet Australia's Basel Convention obligations [41].

Table 8-3 outlines additional legislation that addresses maritime safety, pollution prevention, flora and fauna protection, and disease management. Furthermore, the Department of Infrastructure, Transport, Regional Development, Communications, and the Arts is considering Australia's accession to the Hong Kong International Convention for Safe Ship Recycling [42]. A public discussion paper was released for comment from February 17 to March 17, 2023.

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Table 8-3 Australian Ship-Breaking Legislation

Title	Legislation
Navigation Act 2012 [43]	The legislation which covers international ship and seafarer safety, protects the marine environment where it relates to shipping and the actions of seafarers in Australian waters.
Australian Maritime Safety Authority Act 1990 [44]	The main purpose of the Act is to promote maritime safety, to protect the marine environment from pollution from ships and other environmental damage caused by shipping, and to provide for a national search and rescue service. Australian Maritime Safety Authority (AMSA) is an independent statutory established under the Act.
Occupational Health and Safety (Maritime Industry) Act 1993 [45]	The Purpose of this Protocol is to provide guidance on the application of AMSA's Compliance and Enforcement Policy as it relates to powers contained within the Act
Environment Protection and Biodiversity Conservation (EPBC) Act 1999 [46]	The Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places.
Biosecurity Act 2015 [47]	This Act is about managing diseases and pests that may cause harm to human, animal or plant health or the environment. All vessels must clear Quarantine before being granted access to a port.

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9 LAY-UP OPTIONS

Information captured in this section was based on available data at the time of the production of the report.

9.1 Requirement

After the FPSO is disconnected from the moorings and removed from the field, there may be a requirement to lay-up the FPSO prior to transporting it to its destination for redeployment or recycling.

Lay-up for the redeployment option could be for a number of years.

The need to lay-up Northern Endeavour prior to the FPSO being transported for recycling will be dependent on the following:

- Time required to obtain export and import permits
- Whether or not decontamination is required prior to transporting the FPSO to the recycling yard

It is expected that FPSO lay-up will not be required if the recycling yard is in Europe as:

- The export and import permits should be able to be secured with an OECD country prior to the Northern Endeavour being disconnected from the mooring
- Decontamination will not be required prior to arrival at the recycling yard

Potential locations for lay-up include:

- Labuan – Malaysia
- Batam – Indonesia
- Australian location (to be determined)

9.2 Market Enquiry

Enquiries were issued to two lay-up contractors:

s 47(1)(b)

9.2.1 s 47(1)(b)

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s 47(1)(b) has proposed Batam, Indonesia, as their recommended lay-up location. They have laid up 2 similar vessels in this location and are contracted to lay-up a third in 2024.

They can provide vessels to tow the FPSO from the site to the lay-up location, or tow vessels can be contracted separately.

They envisage that a bespoke 3-point mooring will be required to moor the Northern Endeavour. A subcontractor will undertake the design and installation of the mooring.

The manning on the FPSO during lay-up will depend on various factors. A discrete accommodation could be set up if required.

Refer to Table 9-1 for a budgetary estimate of the lay-up costs for Batam.

s 47(1)(b) do not currently operate in Australia. They are willing to look at the scope required to lay-up an FPSO in Australian waters.

Table 9-1 Lay-up Budget - FPSO Northern Endeavour

S.Nr	Description	Total Budgetary Costs (USD)	Comments
1	**PHASE 1 - DESKTOP STUDIES**		
1.1	Desk Top Study	$200,000	Project planning and compiling the Final Detailed Proposal for Project Award
2	**PHASE 2 - PROCUREMENT / T & I**		
2.1	Procurement of LLI (Long Lead Items)	$1,653,000	Dehumidification for Accommodation + Engine room + Cargo Tanks + Piping
2.2	Procurement of Preservation Material and Equipment	$300,000	Lump Sum Estimate
2.3	Procurement Mooring System - Material	$1,463,500	Mooring Analysis and customization of the Mooring system for the FPSO
2.4	Mooring System Installation	$705,600	Estimated as Vessel Charter and Fuel Rates are unpredictable
3	**PHASE 3 - Mobilisation and Transit**		
3.1	Un-Manned Tow- 20 Days Voyage from Darwin to Batam + 2x Days for Connection + 2 x Days for Hookup at Lay-up Location+1xDay Monitoring	$4,500,000	Estimated as Vessel Charter and Fuel Rates are unpredictable
3.2	Un-Manned Tow- Contingency 15%	$ 675,000	
4	**PHASE 4 - Preservation Execution**		

S.Nr	Description	Total Budgetary Costs (USD)	Comments
4.1	Preservation 5xPax team for execution of Preservation for the Vessel	$275,000	Preservation Specialist and a team of Preservation Technicians
	Total of One Time Costs (CAPEX)	**$ 9,772,100**	
5	**PHASE 5 - Lay-up Management Annually (a minimum period of 12 months)**		
5.1	Lay-up and Preservation + ongoing monitoring and reporting	$2,550,000	Subsequent years are subject to revision with a discount based on the economic conditions and reductions to be negotiated with local authorities.

Batam has the capacity to handle a range of contaminants, including NORM. s 47(1) believe that there are systems in place to provide full accountability for handling the contaminants. However, the Indonesian Ministry of Trade (MOT)issued Regulation 18 in 2021 which prohibits the importation of a range of goods including hazardous waste. Thus the Northern Endeavour will have to be decontaminated prior to lay-up in Batam.

9.3 s 47(1)(b)

s 47(1)(b) is a class-certified lay-up service provider based in Malaysia. They have been providing professional lay-up management since 2009. Their anchorage locations are in Brunei Bay – off Labuan, East Malaysia.

As pers 47(1)(b), they will provide a class-approved anchor system.

Following is a summary of the Malaysian lay-up requirements provided by the relevant Lay-up Authority:

- Tank De-Mucking Operations: Tank de-mucking operations are strictly prohibited within the lay-up area. It is mandatory for vessels to ensure that all tanks are completely discharged and cleaned of any cargo and cargo residues, including NORM, before they arrive at the lay-up site
- Disposal of Other Contaminants: Vessels must also take measures to discharge or properly dispose of any other contaminants before entering the lay-up area
- Explosive Gas-Free Tanks: It is a prerequisite that all tanks within the vessel are free from explosive gases before reaching the lay-up site

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- TBT Anti-Fouling Regulations: While the department typically adheres to its existing regulations, it might be possible to approve an FPSO with TBT anti-fouling. This aspect should be highlighted clearly when applying for a lay-up permit
- Anchoring Requirements: A Dynamic Mooring Analysis (DMA) must be submitted for vessels lacking anchors. This analysis will provide essential support for the proposal of implementing a pre-laid anchor system at the lay-up site

The Northern Endeavour will have to be decontaminated before arrival at Labuan.

9.4 Lay-up at Australian location

It is noted that if the FPSO is to be recycled in Australia, there will be considerable benefit in laying up the FPSO in Australian waters, as there will be no requirement for multiple export and import permits. At this stage it has not be confirmed that a lay-up location is available in Australia. For budget purposes it has been estimated that a lay-up in Australia for a period of 2-3 months for decontamination may cost US$10-20mill.

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10 TOWING OPTIONS

10.1 Dry Tow to Europe/Türkiye

Dry tow options have been investigated for the transportation of the Northern Endeavour FPSO to the recycling yards in Europe/Türkiye. There are two semi-submersible heavy lift vessels (HLV) capable of transporting the Northern Endeavour FPSO, the Boka Vanguard owned by Boskalis as shown in [48], and the Hua Rui long owned by the Chinese Ministry of Transport [49]. Table 10-2 outlines the indicative rates and transit times for the Hua Rui Long and the Boka Vanguard vessels.

10.2 Tow to sheltered location for HLV loading

A relatively sheltered location will be required to load the Northern Endeavour onto the HLV. The vendors have supplied the following preliminary limiting conditions.

Table 10-1 HLV Loading Limiting Criteria

Criteria	Limitation
Period of operation:	Daylight
Minimum Visibility:	500m
Maximum wind speed:	15knots
Maximum wave height:	0.50 meter/period 5s
Maximum swell:	0.30 meter/ period 7s
Maximum surface current:	1.0 knot.

It is anticipated that a suitable sheltered location will be available between the Northern Endeavour site and the Australian coast, as there is a range of atolls in the region that may provide some protection. To determine the tow cost and duration, it has been assumed that the location is within 300km (Refer Figure 10-1). It is also noted that it is preferable to be located outside the 12nm coastal limit to avoid potential biosecurity issues.

Based on the data provided by the wet tow vendors, it is estimated that this tow will cost US$1.0-1.5mill (excluding any costs associated with disconnection).

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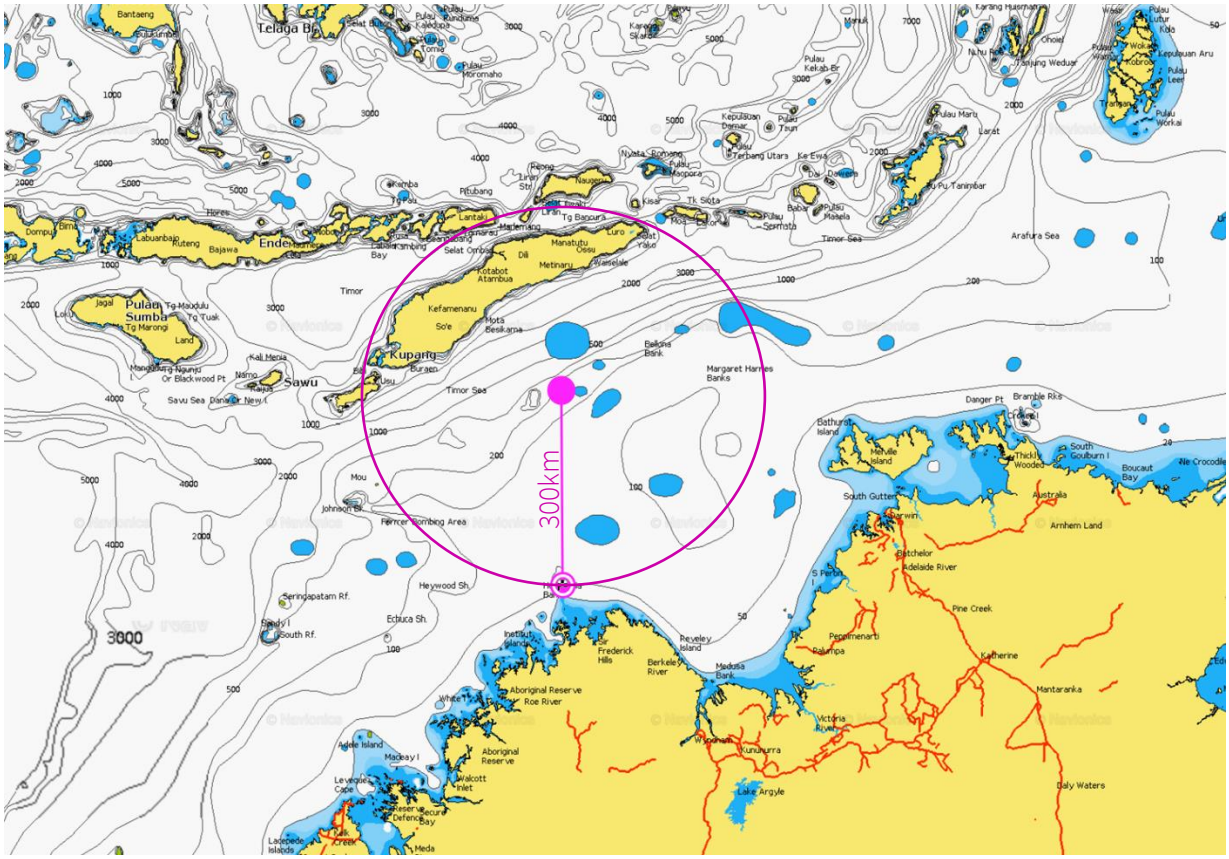


Figure 10-1 Estimated tow to the sheltered location

10.3 Wet Tow

Two vendors were approached for the wet tow of the Northern Endeavour FPSO. The following vessels were proposed:

- ALP Keeper – 302MT Bollard Pull
- s 47(1)(b)

It has been assumed that a reserve tug will be required to always be present during the tow. The structural integrity of the Northern Endeavour hull will be required to be verified for the wet tow scenario.

Indicative rates and transit times for the tow to the recycling yards in Europe/Türkiye are provided in Table 10-2.

The data for the wet tow vessels has been interpolated to determine equivalent costs and transit times for the wet tow to the Australian options.

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10.4 Route to Europe/Türkiye

There are two main routes that the FPSO tow can take to reach Europe/Türkiye from the Timor Sea, via the Suez Canal or Cape of Good Hope. The vessel vendors have indicated that either route is potentially viable for the wet tow or dry tow.

10.4.1 Weather Delays

Weather-related delays are a possibility.

The route via the Suez Canal can be impacted by the southwest monsoon season, typically occurring from June to September in the western parts of the Indian Ocean, such as the Arabian Sea. The eastern parts of the Indian Ocean, including the waters around northern Australia, can also experience adverse wave conditions during the southeast monsoon season, typically occurring from December to March.

The Cape of Good Hope route is known for its challenging maritime conditions. The worst wave conditions are typically encountered during the Southern Hemisphere's winter months, particularly from May to September. Adverse conditions are more likely to occur on this route than the route via the Suez Canal.

Adverse weather is more likely to impact the wet tow than the dry tow, as the FPSO will be travelling slower and will be restricted by the capacity of the tow vessel to maintain the tow in rough weather.

Indication of the likelihood of weather delays or their potential cost impact cannot be estimated at this point.

10.4.2 Suez Canal

The Suez Canal charges for transport through the Canal. However, that route provides a commercial advantage by shortening the tow duration.

It is noted that the Suez Canal Authorities will oversee the passage. The Suez Canal Authorities may decide to use their towing vessels for the transit, which is common. Also, on some occasions, the passage through the Suez has been prevented by restrictions made under the export clearance documentation. This is noted to have been incurred when transporting the FSO Dampier Spirit.

The vendors have not indicated that there are length/breadth/draft restrictions that would impact the tow via the Suez Canal. However, it is understood that there is a height restriction of about 68m.

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The height restriction would likely have implications for the flare tower on the FPSO. Further studies would be required to assess whether and where the flare tower can be removed prior to the tow.

10.4.3 Cape of Good Hope

Although there are potential weather delays associated with this route, these can be managed by timing the tow to avoid the worst winter months. There are no dimensional tow restrictions or additional permit requirements for passage past the Cape of Good Hope.

10.5 Notice Period prior to Tow

Availability of the transport vessel cannot be guaranteed until a contract has been signed. The dry tow vendors have advised the following notification schedule. A similar schedule would apply to the wet tow vessels:

- 3-month window on the signing of an agreement
- 120 days prior to the first day of the window, the window narrowed to 60 days
- 90 days prior to the first date of the new window, the window narrowed to 45 days
- 60 days prior to the first date of the new window, the window narrowed to 30 days
- 45 days prior to the new window, the window narrowed to 15 days
- 30 days prior to the new window, the window narrowed to 7 days
- 15 days prior to the new window, the window narrowed to a firm date

10.6 Towing Cost and Schedule Comparison

Table 10-2 summarises the estimated costs and schedule for the various tow options considered. The data is based on information provided by the tow vendors and factored to suit the various tow options. Costs for mobilisation and demobilisation are included in the estimate. A contingency of 30% has been added. The data accuracy is considered to be +40%/-30%.

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Table 10-2 Comparison of Tow Options to Europe/Türkiye for the FPSO Northern Endeavour

	Wet Tow Options						Dry Tow Options			
	Türkiye via Suez	North Sea Port via Suez	Türkiye via COGH	North Sea Port via COGH	Henderson WA	Whyalla SA	Türkiye via Suez	North Sea Port via Suez	Türkiye via COGH	North Sea Port via COGH
Vessel	s 47(1)(b) / ALP Keeper						MV "Boka Vanguard / HUA RUI LONG			
Departure Location	Northern Endeavour Site						Sheltered location in Aust waters			
Destination	Türkiye	North Sea	Türkiye	North Sea	Henderson WA	Whyalla SA	Türkiye	North Sea	Türkiye	North Sea
Estimated Cost (USD)	$12.9mill	$17.5mill	$20.7mill	$20.7mill	$5.7mill	$8.1mill	$15.1mill	$17.3mill	$18.6mill	$18.2mill
Demurrage	US$ 25,000 -35,000 per day in port; US$60,000 per day at sea						US $ 90,000 - 100,000 per day			
Transit Time	45- 62 days	63 - 90 days	73 -111 days	73 - 112 days	21 days	32 days	28 – 30 days	37 - 39 days	44 - 45 days	44 days
Schedule	Q4 2024						Q4 2024			

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10.7 Decontamination Requirements Prior to Tow

The responses from the recycling yards indicated a range of FPSO decontamination requirements prior to arrival at the yard. The MARS yard has indicated they will accept all contamination, whereas Türkiye has regulations limiting the importation of different types of contamination, such as NORM.

s 47(1)(b) have indicated that if additional licensing is obtained for NORM, Mercury and BTEX, as a minimum, no decontamination would be required prior to arrival at Whyalla. s 47(1)(b) has indicated that their preference would be for the decontamination to be completed prior to arrival at the s 47(1)(b) , either at the s 47(1)(b) or possibly in s 47(1)(b) . This would involve awarding additional contracts to specialist decontamination contractors with the appropriate licenses.

Until the IHM is completed, it will not be possible to determine the potential FPSO decontamination cost with any accuracy. Assuming that there is minimal or no mercury contamination in the FPSO, it is estimated that the cost could be in the order of US$10-20mill (+50%/-30%).

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11 ASSET VALUATION

Information captured in this section was based on available data at a global level at the time of the production of the report.

An overview of the asset valuation process is shown in Figure 11-1.

Once the client agrees with baseline assumptions, a high-level asset and opportunity assessment is conducted. This includes:

- Evaluating the current condition of the asset
- Based on its specification, condition, and the market, assessing potential redeployment and recycling opportunities

From this assessment, valuation scenarios are developed. In this case, low and high scenarios have been developed.

For each scenario, the capital expenditure (CAPEX) is estimated for asset refurbishment or remaining life extension (RLE). The refurbishment assessment is tailored to the asset's condition and includes any necessary upgrades for redeployment.

In parallel, an estimate is developed for the CAPEX required to convert a second-hand oil tanker into the equivalent FPSO. This is considered the base case and competes with the Northern Endeavour redeployment.

The oil tanker conversion case is used to calculate the competition earning potential. Finally, the potential asset value is calculated based on the FPSO earning potential and the required ROI for the FPSO contractor. A discount factor is then applied to represent risks around the asset and market.

Overall, the asset valuation process for redeployment involves assessing the asset's condition, refurbishment requirements, evaluating competition earning potential, and calculating the asset value range based on various scenarios.

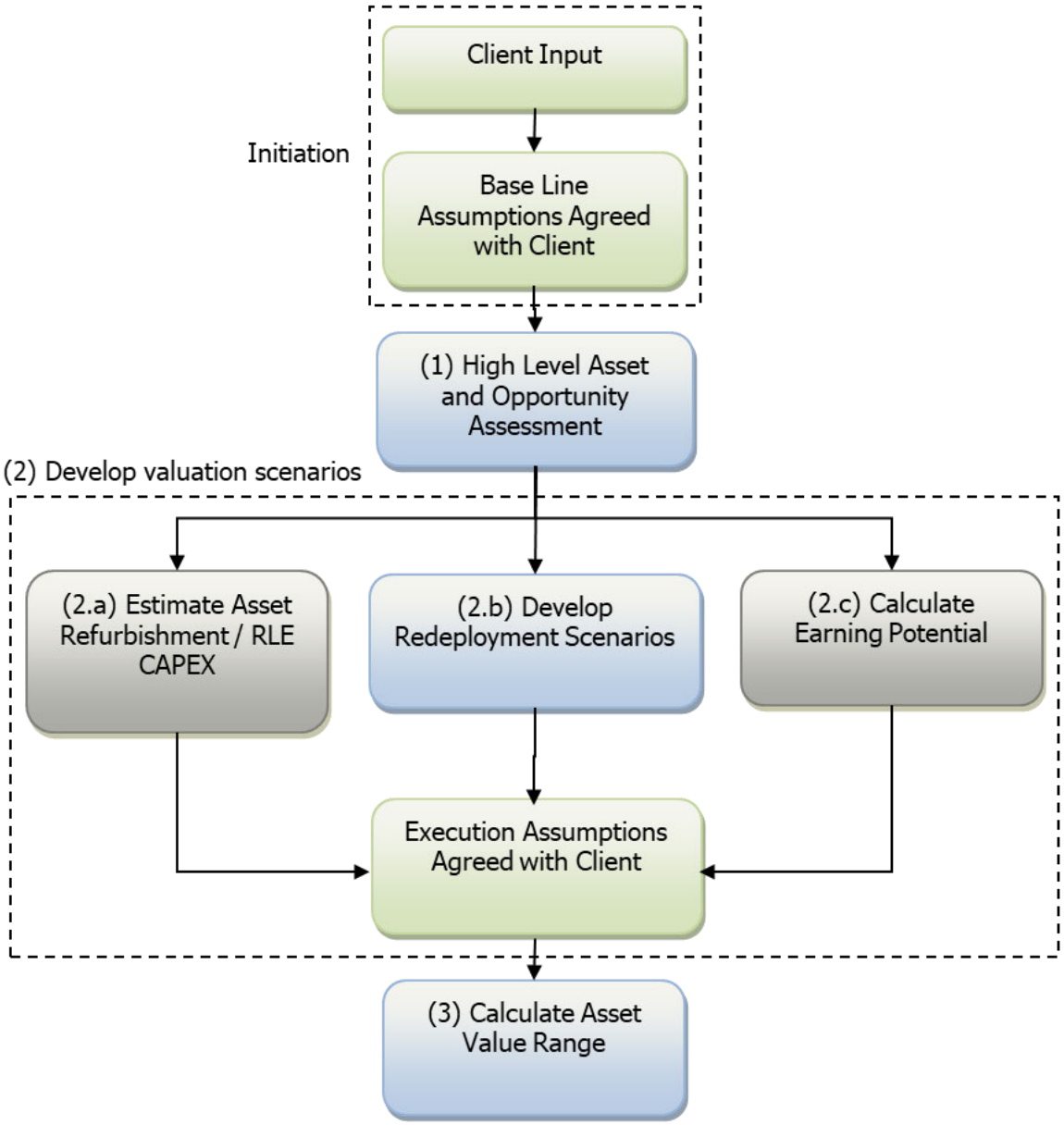


Figure 11-1 Asset Evaluation Process

11.1 Valuation Scenarios

No specific redeployment project has been selected as each potential buyer's end use will differ. The generic redeployment opportunity project specification has been developed to reasonably reflect what might be expected for the regions identified.

- **Low case (poor fit):**
  - Redeployed as a turret FSO with more storage than required
  - Topsides facilities are no longer required
  - Accommodation is refurbished but oversized

- 10 Year lease contract + options to extend
- This case represents an FSO contractor purchasing the hull on speculation

- **High case (reasonable fit):**
  - Redeployed as a turret-moored FPSO
  - Hull storage is a good fit
  - Some topsides and utilities, based on specification have the potential to be refurbished, however, the decision was made not to re-use based on condition risk. Utilities also carry the risk of being wrong-sized for the redeployment
  - Gas turbine power generation refurbished
  - Accommodation is a good fit and refurbished
  - 15-year lease contract
  - This case represents an FPSO contractor purchasing the hull for a project they are actively chasing

The valuations consider that in the absence of the Northern Endeavour FPSO redeployment option, the FPSO contractor's base case will be to convert a 10-year-old trading oil tanker that is in good condition. This forms the basis of competition for the Northern Endeavour in the following valuation.

Table 11-1 Northern Endeavour and Opportunity Project Specifications

Specification area		Northern Endeavour	Opportunity Project	
			Low Case	High Case
Particular	**Unit**	**Quantity**		
Topsides				
Oil	bpd	180,000	120,000 via flowline	120,000
Produced Water	bpd	174,000	None	180,000
Total Liquids	bpd	241,000	None	230,000
Gas Compression	mmscfd	80	None	100
Water Injection	bwpd	0	None	240,000
Gas Injection	mmscfd	19	None	40
Total Gas Processing	mmscfd	60	None	100
Lift Gas	mmscfd	60	None	60
Gas Export	mmscfd	0	None	0
H2S	ppm	25	None	20

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Specification area		Northern Endeavour	Opportunity Project	
			Low Case	High Case
Particular	**Unit**	**Quantity**		
CO2	Mol%		N/A	5.3%mol
GoR		170	N/A	170
Power Gen	MW	4 x 8 MW Solar Mars	4 MW	40 MW
Hull				
Build		New build	Base case: Tanker conversion	Base case: Tanker conversion
Type		Large Suezmax	Suezmax	VLCC
Configuration		Double Sided	Double Sided	Double Sided
Build	Year	1999 (24 years old)	2013 (10 years old)	2013 (10 years old)
Design life	Years	20 (60 years for hull)	+15 years without drydocking	+15 years without drydocking
Storage	Bbls	1,400,000	1,000,000	1,400,000 – 1,600,000
Offtake Volume	bbls/24hr	905,000	600,000	~1,000,000
Mooring		Internal Turret (380m water)	Turret moored (900m water)	Turret moored (900m water)
Riser/umbilical's		3 x 10" Prod , 2 x 6"GL, 1 x 6"GI, 2 x Umbilical	1 x 12" Prod, 1 x umbilical	4 x 10"Prod + 1 x 6"GL + 1 x 10"WI + 2 x umbilicals
Swivel		To match above	To match the above using an inline production swivel	To match above
Accommodation	PoB	64 (94)	30 (50)	60 (90)

The following assumptions have been made common to all scenarios:

- The Northern Endeavour is delivered to the FPSO contractor decontaminated. The cost of decontamination is not covered by the FPSO contractor.
- The residual scrap value of the Northern Endeavour after cleaning and tow to Europe for green recycling is zero dollars. This is on the basis that the sale of the Northern Endeavour to an FPSO contractor will be conditional on the FPSO being green-scrapped at an EU-SRR approved yard at end-of-life. This condition will be required to cover the event where the Northern Endeavour is only redeployed for a very short period of then sent to a recycle yard.

- The competing option of converting a tanker to an FPSO will not necessarily be green scrapped in Europe by the FPSO contractor at end-of-life. Hence, a residual scrap value of US$5 million is assumed after cleaning and tow.
- The FPSO contractors target an IRR of 8% to 12%. 10% was selected for the estimates.
- Annual CPI of 2.5% applied.
- Estimates made in the money of 2023.
- 20% contingency applied
- Exchange rates (based on approximate average over the last 5 years)
  - 0.95 AUD/SGD
  - 0.7 AUD/USD
  - 0.73 SGD/USD

11.2 FPSO Upgrades and Refurbishment

A high-level comparison of the Northern Endeavour specification against the valuation scenarios was undertaken to establish the requirements for upgrades and refurbishment.

Based on findings from previous work conducted on Northern Endeavour and recently provided information, the following approach has been taken.

- Topsides
  - Low case: No topsides required
  - High case: While some of the topsides are suitable for re-use, it was assumed that the topsides are removed and replaced due to integrity issues and potential risks of missing equipment. It is understood that topsides trains are no longer required due to low production rates have been cannibalised to keep others running
- Utilities
  - Topsides utilities depend on the process and, therefore, would be at risk of being under or oversized. It is assumed they are replaced
- Power
  - New power generation is installed for the low case. Existing power generation is assumed to be refurbished, and additional turbines are added for the high case. This is supported by correspondence from Solar on refurbishing the existing unit.
- Marine systems
  - General overhaul and refurbishment of existing marine systems

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- Hull
    - 750 tonnes of steel replacement, 150 tonnes of fatigue detailing and full coating replacement based on the review of previous work on the FPSO and latest condition assessments
- Accommodation
    - Understood to be in reasonable condition and specified to a high standard. Refurbishment is assumed
- Turret mooring system
    - Upgraded and refurbished to meet specification

11.3 Hull Condition

A hull in poor condition with significant remediation required prior to redeployment has the potential to make the purchase unviable for potential buyers. With regard to this, a high-level review was conducted on the hull design specification and current condition. This considered previous work on numerous assessments by BE&R on the FPSO and the most recent FMECA update.

11.3.1 Fatigue life

The Northern Endeavour is a purpose-built FPSO hull with a minimum allowable fatigue life of 60 years. She was built in Samsung Heavy Industries shipyard in South Korea in 1998, which has a good reputation for quality control. Twenty-five years of fatigue life have been consumed to date. It is noted that no fatigue defects have occurred over its life. There are examples of 30–40-year-old hulls being redeployed in the industry (Pertojarl 1, Lewek EMAS). From a structural fatigue aspect, it is feasible that the FPSO can safely be redeployed with some additional fatigue detailing specific to the final location. 150 tonnes of steel have been assumed for fatigue detailing.

11.3.2 Coatings and Corrosion

As expected for an FPSO of this age, there is a high level of coating breakdown throughout the FPSO, leading to the onset of corrosion. All coatings must be fully removed and replaced to a high quality for deployment.

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Most of the hull corrosion is in the water ballast tanks. It tends to be concentrated in the top 1/3rd of the tanks and mostly on structural members around weld seams. In the cargo oil tanks and slop tanks, there is some coating breakdown and some associated corrosion approaching the allowable limit.

The main deck corrosion requires some repairs, and the side shell has high levels of weld seam corrosion in some areas. Aside from some areas of coating damage, nothing significant is reported for the underwater hull.

The FMECA updates [50] indicate that around 300 tonnes of direct steel replacement is required to address identified corrosion repairs and 8000 anomalies. Given shipyards typically replace steel in large crop and renew sections rather than small, localised areas, this has been uprated to 500 tonnes. A further 250 tonnes have been allowed for emergent scope discovered during the shipyard campaign.

While considered high, a total of 750 tonnes of steel replacement due to corrosion repairs is not a showstopper, as other redeployed hulls have had to replace up to 2000 tonnes in bulk crop and renew campaigns.

The steel replacement risk may deter speculative buyers. However, those with a specific project they are confident of winning may overlook it due to the current high price of 5- to 10-year-old trading oil tankers that would be the alternative for conversion.

11.4 Valuation Modelling and Basis of Estimate

Based on the assumption that the topsides will not be re-used, there will be no differential with respect to the new topsides requirements between the Northern Endeavour and a converted oil tanker. Consequently, estimating the topsides CAPEX is unnecessary as it will not influence the valuation. The same applies to almost all the topsides' utilities.

As such, the residual value of the Northern Endeavour lies in:

- The bespoke FPSO service hull design
- Power generation and
- Turret mooring system
- High specification accommodation.

The basis of estimate used to develop the CAPEX for the Northern Endeavour and competing oil tanker conversion utilises the following:

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- Previous redeployment estimates conducted for the Northern Endeavour by BE&R
- Shipyard schedule of rates
- Analogue project costs
- Industry market pricing (10-year-old oil tanker)
- Market intelligence

11.5 Valuation Results

The CAPEX estimates for the low and high valuation scenarios for the Northern Endeavour redeployment and oil tanker conversion are summarised in Table 11-2 CAPEX Estimates (differential costs). These estimates exclude the following as they are the same for both cases, hence have no impact on the valuation (only differential costs need be included):

- Topsides procurement
- Transit to the shipyard and from shipyard to the new project location
- Project management and engineering
- Installation, hookup and commissioning

Table 11-2 CAPEX Estimates (differential costs)

Case	Scenario	*CAPEX (US$ million)	
		Exc. contingency	Inc. 20% contingency
Oil tanker conversion	Low	$146.61	$175.93
Oil tanker conversion	High	$365.72	$438.86
Northern Endeavour redeployment	Low	$106.12	$127.34
Northern Endeavour redeployment	High	$241.93	$290.32
*Differential CAPEX – only includes costs that will be different			

A more detailed breakdown has been provided in Appendix C.

Using the oil tanker conversion as the base case to calculate the earning potential, the following daily charter rates were established:

- Low case: $82,250 per day
- High case: $167,370 per day

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The daily charter rates were applied to a financial model with an IRR of 10% to calculate valuations for the Northern Endeavour, as summarised in Table 11-3. The 25% risk discount covers the buyers' considerations for emergent scope, including unknown integrity issues and potential lay-up costs.

Table 11-3 Northern Endeavour Valuation Range

	Valuation (US$ million) per Scenario	
	Low	High
No risked discount	$28.58	$142.00
Including a 25% risk discount	$21.43	$106.50
Scrap value (to buyer)	$15 (based on recycling in Türkiye)	

Should a buyer have an immediate close fit opportunity that they are confident they will be awarded, the buyer benefits from the Northern Endeavour already having a high specification accommodation, high-capacity turret mooring system and gas turbine power generation as these facilities would not be on a 5- to 10-year-old oil tanker. The price obtained for the FPSO in this scenario may be close to the high valuation. Given the response to the market survey, this is not considered a likely scenario.

The other option would be a speculative purchase of the FPSO by an FPSO contractor with the target to lay-up the FPSO for a period in the hope of a future project opportunity. Under such a scenario, the buyer will likely offer between the low scenario valuation and scrap value. No interest has been indicated in this option's market survey responses.

It should be noted that the current purchase value for the oil tanker has been inflated by the tight market for oil tankers that can be used for conversion now. The oil tanker market is highly cyclic. When the market falls, it will subsequently lower the valuation of the Northern Endeavour.

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12 RISK ASSESSMENT

A high-level TECOP (technical, economic, commercial, operational, and political) risk assessment of the End-of-Life options for the Northern Endeavour FPSO has been completed. The risk assessment focussed on the recycling options as the likelihood of redeployment was very low.

A total of 27 risks were identified, consisting of 16 low risks, 9 medium risks and 2 high risks. A summary of the medium and high risks is shown in Table 12-1.

The highest risks were associated with:

- The Australian contractors having insufficient experience in recycling a vessel of the size of the Northern Endeavour and the demands of satisfying the requirements of the EU-SRR.
- Recycling of the Northern Endeavour ends up costing significantly more than budgeted due to more extensive hazardous materials than expected, the difficulty of decontamination and disposal of the waste

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Table 12-1 Northern Endeavour Recycling Risk Assessment Summary

No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before the event)	Risk
1	Aus	Bidder has insufficient knowledge of recycling requirements	Lack of experience with recycling vessels of NE size Lack of experience with working to EU-SRR standard	Aust bidders do not pre-qual for tender Political impact Forced to use incompetent contractor / additional costs and schedule for assistance	Early pre-qualification Engage with Dept of Defence for their experience.	High
2	Aus/Tur	Decontamination of the NE ends up costing the Gov more money than budgeted	More extensive hazardous materials than expected Difficulty and Cost of decontamination Decontamination undertaken in Australia Disposal of the waste	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Detailed IHM Use experienced decontamination contractor	High
3	Eur/Tur	Wet tow delayed/takes longer than expected	Weather during tow, storms to be avoided. Mechanical failure of tow vessels, tow ropes, N.E. Bow/structure Piracy Failure to obtain permits Safety Incident	Reputation damage from Delay Additional cost Potential Loss of control Miss recycling/redeployment yard slot/ lay-up location slot	Experienced tow contractor Experienced tow master Pre-nominated ports of refuge Weather monitoring / planning Detailed tow plan, contractor reviewed, route, redundancy, Emergency prep. Tow vessel vetting plan / marine warranty	Medium

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before the event)	Risk
4	Eur/Tur	Wet tow delayed due to issues in Suez Canal	Weather Mechanical failure Failure to obtain permits Height restrictions Political issues, Barge goes sideways, gets wedged Insufficient tugs to manage the canal	Reputation damage from Delay Additional cost Potential Loss of control Miss recycling / redeployment yard slot/ lay-up location slot	Detailed knowledge of requirements to pass through Suez Canal Experienced tow contractor Experienced tow master	Medium
5	Eur/Tur	Either HLV not available (Vanguard, HUI RUI)	Failure to book HLV early enough (3 to 6 months). Prices increase 25% for late booking HLV delayed by other contracts HLV breakdown Refer above Tow Delay Risks	Delay Additional cost Requirement to lay-up NE, costs to maintain class	Book HLV with adequate cancellation clauses and delay penalties Experienced HLV contractor Chose lay-up location not affected by cyclones, <0.5m seas	Medium
6	Aus	Recycling of the NE ends up costing the Gov more money than budgeted	More extensive hazardous materials than expected NE needs to be laid up due to unavailability of yards Project is forced to Aust recycling option rather than international options Cost of recycling in Aust Lack of experience causes costs to blow out	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Federal funding envelope, application for. Project controls (schedule, Budget). Local tow - lower cost than tow to Europe. Recycling contract terms Financial pre-qual of contractors.	Medium

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before the event)	Risk
7	Eur/Tur	Recycling of the NE ends up costing the Gov more money than budgeted	More extensive hazardous materials than expected Tow to Eur/Tur cost more than scrap value offered by Recycling Yard NE needs to be laid up due to unavailability of yards	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Federal funding envelope, application for. Project controls (schedule, Budget). Recycling contract terms	Medium
8	Eur/Tur	Deterioration of Commercial Advantage or Interest	Too many rounds of questions to contractors from Commonwealth. Commonwealth - not experienced in this area. Unstructured vendor engagement Yard confused CODA vs DISER vs Other Australian Entity.	Vendor Fatigue Loss of commercial reputation (especially with Euro/Tur contractors)	Provide single point of contact	Medium
9	Aus	Deterioration of Commercial Advantage or Interest	Too many rounds of questions to contractors from Commonwealth. Commonwealth - not experienced in this area. Unstructured vendor engagement Yard confused CODA vs DISER vs Other Australian Entity.	Vendor Fatigue Loss of commercial reputation	Australian yard/contractors better understand Australian Regulatory context	Medium

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before the event)	Risk
10	Aus	Choice of an Australian recycling location driven by policy requirements rather than technical and commercial. E.g., Australia vs Europe, and then WA vs SA vs Vic etc.	Policy requirements Union pressure Industry pressure Australian industry not experienced in handling large scale hazardous wastes projects	Additional cost (ultimately passed onto O&G industry) for e.g., Hazardous waste handling, disposal, mercury handling. Reputational impact Delay	Commercial Briefing for govt, detailing knock-on costs and benefits of local options. Prepared to fully inform govt on decision impacts (HOLD - reword). Consider starting from "Local Recycling - if not, why not".	Medium
11	Eur/Tur	NE Disposal sets poor precedent for Decommissioning - too high or too low	First time project EU-SRR standards drive project Risk aversion	Industry impacted by future higher costs.		Medium

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13 COMPARATIVE REVIEW OF OPTIONS AGAINST KEY DRIVERS

13.1 Key Drivers

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13.2 Options Comparison

The comparative review intends to rank the options against the key drivers. Four options were considered:

- Recycling in Europe

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- Recycling in Türkiye
- Recycling in Whyalla, Australia
- Recycling in Henderson, Australia

The specific yard for recycling in Europe or Türkiye will be selected in a future phase. The option of FPSO redeployment has been discounted based on the responses retrieved from the market research.

The option for export to Europe was selected as the reference concept against which all other options are compared. For the reference concept, each item associated with a driver is given a score of 2. The other concepts were then scored as the same risk (2), slightly higher (2.5), higher (3), slightly lower (1.5) or lower (1). Lower scores represent lower risk.

The scores against each driver were averaged for each concept, and the agreed weighting was applied to arrive at the weighted totals for each concept.

The results of the options comparison against the key drivers are shown in Figure 13-1. Details of the review are given in Appendix F. The results indicate that the Europe option aligns most with the specified drivers. The higher scores for both of the Australian options are driven by the higher relative risk around practical execution experience, schedule and financial value, even though these drivers have the lowest weighting in regard to the level of importance to the Commonwealth.

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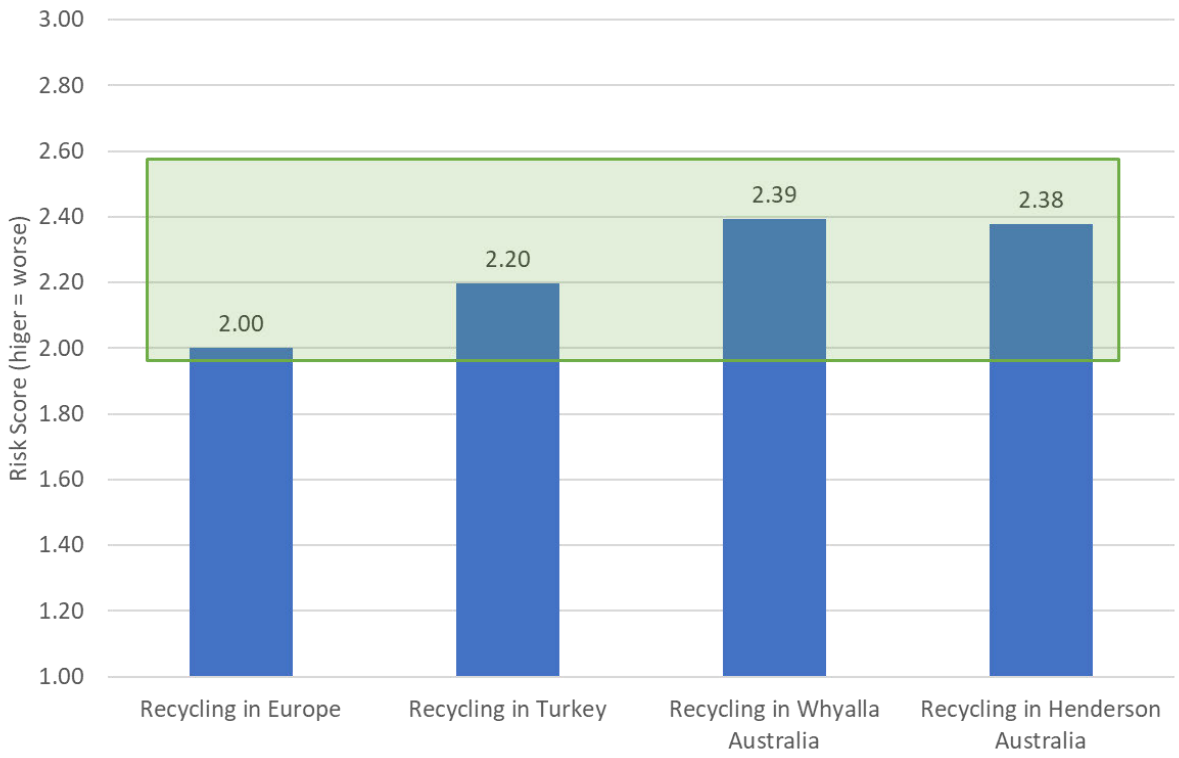


Figure 13-1 Options Review (Lowest = Best)

Türkiye scores slightly higher than Europe in Health and Safety, Environment, and Financial Value due to Türkiye's limitations and restrictions on hazardous materials and the additional contamination cleaning created by the imposed limitations and restrictions.

The Henderson and Whyalla options have been assumed to have higher risks associated with Health and Safety, Reputation, and Practical Execution and Operations. The higher relative risk was assigned for the following reasons:

- Australian contractors have limited vessel recycling experience and no experience in recycling a vessel the size of Northern Endeavour
- Australian contractors has not demonstrated the capability to handle all the different types of contaminants
- More exposure of encountered issues to the Australian public
- Australian contractors are yet to demonstrate that they operate in adherence with best practice (EU-SRR)
- The credibility of Australian 3rd parties may be difficult to establish due to lack of experience in FPSO recycling, despite having recycling experience in other industries

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- The visibility of the Australian option may cause the Australian government to carry a publicity risk past the point of handover
- Australia has minimal use of technology/processes and no experience with this size of vessel
- Whyalla and Henderson facilities may require modifications

Furthermore, Whyalla does not have an ongoing ship building/maintenance workforce, whereas Henderson has a larger industry presence and has ongoing Oil and Gas recycling projects.

Despite the issues outlined above, none have been classified as showstoppers, and therefore, the option for recycling in Australia cannot be discounted based on the outcome of this review.

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14 DISPOSAL EXECUTION STRATEGY

14.1 Introduction

The following preliminary disposal execution strategy has been proposed for the Northern Endeavour, subject to requirements of the Commonwealth procurement systems.

This execution strategy will developed further in future phases of the project.

14.2 Delivery Framework

The delivery framework has been developed around a gated decision process, as illustrated in Figure 14-1.

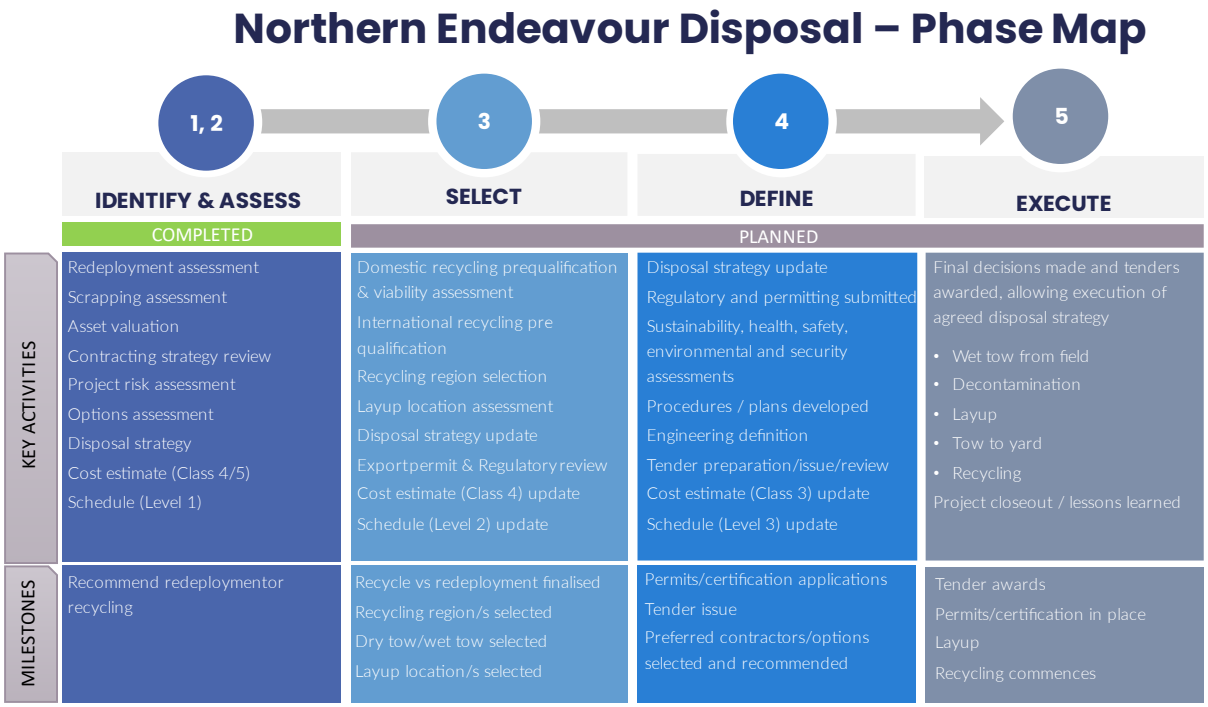


Figure 14-1 Disposal Framework

14.3 Current Status

The Identify and Assess Phases have been completed. The Select Phase will act as a transition period in which more details will be gathered to enable decisions to be made in the Define Phase.

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14.4 Purpose

This disposal strategy describes the planning and execution to complete the Select and Define phases of the project. It also covers the execute phase at a higher level.

14.5 Work Plan

A detailed Work Breakdown Structure (WBS) has been developed for Select and the following Define phases (refer Appendix D). This has been extended to the Execute phase at a high level (Level 2) to allow input into the overall project schedule and estimates.

The level of definition and associated estimate accuracy for each phase follows that defined by AACEi [51] and summarised in Table 14-1

Table 14-1 AACEi estimate Accuracy for Each Phase with Project Set Contingency.

Phase	Estimate Clase	Level of Definition	Methodology	Expected accuracy	Project Contingency
Assess & Select (Pre-FEED)	Class 4	1% to 15%	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	+30%
Define (FEED)	Class 3	10% to 40%	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	+20%
Execute (design/tender)	Class 2	30% to 70%	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	+10%
Execute	Class 1	50% to 100%	Detailed Unit Cost with Detailed Take- Off	L: -3% to -10% H: +3% to +15%	+5%

14.6 Select Phase

For this project the Select Phase will act as a transition period in which more details will be gathered to enable tendering and decisions to be made in the Define Phase.

The assumption has been made that there is agreement on the recommendation to recycle instead of redeployment.

The primary focus of this phase will be to pre-qualify the recycling vendors, both Australian and international. A key decision to be made early in the pre-qualification process will be whether to tender:

- Australian only
- International only
- Australian and international

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Initially, a detailed prequalification of the Australian vendors will be undertaken to determine if they are viable. This will involve site visits and, considering that recycling of a vessel of the size of Northern Endeavour has not been undertaken in Australia before, will likely include a paid feasibility study.

A desktop prequalification of the international recycling yards will be conducted in parallel based on information provided in the market study, data collected from previous recycling yard site visits by the Centre of Decommissioning Australia (CODA) and feedback from recent assessments conducted by oil and gas companies for other asset disposals. Should the Australian option be deemed unviable or insufficiently competitive, the international prequalification will be extended to a formal prequalification process. This approach will be taken to avoid international vendor fatigue, given the assumption of a government-preferred Australian option.

Should the Australian option be deemed unviable or insufficiently competitive, the international prequalification will be extended to a formal prequalification process. This may include site visits to the front running yards.

The outcome of the prequalification process will be a short list to take forward to tendering in the Define phase.

Once there is a line of sight to the potential locations for recycling, decisions will be able to be made around the potential requirements for lay-up and decontamination and the method of towing the Northern Endeavour.

The objectives of the Select Phase are as follows:

- Formally finalise the recycle versus redeployment decision
- Pre-qualify Australian recycling yards and establish the viability of an Australian solution
- Pre-qualify international recycling yards
- Select Australian and/or international recycling vendors who will be invited to bid
- Refine lay-up and decontamination locations
- Refine wet or dry tow methods from lay-up to recycling yard and pre-qualify contactors
- Understand regulatory and permitting requirements
- Provide further clarity on cost and schedule estimates

The following key deliverables are in service of achieving these objectives

- Disposal strategy (updated)

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- Regulatory assurance review
- Cost estimate (Class 4) (updated)
- Schedule (Level 2)
- Vendor shortlists (after prequalification)
- Summary report

For a detailed list of Select Phase deliverables/activities, refer to the WBS in Appendix D. During the Select phase, the opportunity to bring forward some critical path Define Phase scope will be reviewed. This will likely be around tender definition and issue.

14.7 Define Phase

The Define phase will be focused on tendering and defining project elements to a level sufficient to support the final investment decision and tender award. The scope and strategy for this phase will be further developed during the Select Phase.

The key activities within the Define Phase are:

- Disposal strategy update
- Regulatory and permitting submission and approvals.
- Sustainability, health, safety, environmental and security assessments
- Procedures/plans developed.
- Engineering definition
- Tender preparation/issue/review
- Cost estimate (Class 3) update
- Schedule (Level 3) update

The following key milestones are in service of achieving these objectives.

- Permits/certification applications and approvals (some may still be outstanding)
- Tender issue
- Preferred vendors/contractors selected and recommended for final award
- Early commencement of critical path activities, where necessary
- Early issue of critical path contracts, where necessary

Table 14-2 presents several activities or contracts that may require early commencement/award. This list will be reviewed during the Define phase. Note that these activites can occur in parallel where nescessary.

For a detailed list of Select Phase deliverables/activities please refer to the WBS in Appendix D.

Table 14-2 Activities / Contracts and Lead Times to Secure Slot

Activity / Contracts	Lead time required to secure a slot
Hazardous waste export permits	6 months
Hazardous waste import permits	6 months
Wet tow from field to lay-up	1 month
Decontamination (inclusive of hull cleaning)	4 months
Lay-up/preservation	4 months
Tow to the recycling yard	3 months (dependent on location and method)
Recycling	4 months (dependent on vendor)

14.8 Execute Phase

Execute phase definition will be further developed during the Define phase. At the start of this phase, tenders will be awarded, and final permits and certification will be approved. Following this, the project will sequentially implement the following planned activities/contracts:

14.9 Lessons Learnt

A lessons learnt session will be held on project closeout to allow input to future Australian decommissioning activities. The project may also hold a lesson learnt session at the end of each phase for incremental input.

14.10 Schedule

Figure 14-2 provides a high-level schedule overview.

A sample level 1 schedule has been developed from Select to Execute phases (Refer Appendix G) based on the WBS in Appendix D. It has been developed based on the option of scrapping in Türkiye, lay-up in Australia where decontamination is conducted, a dry tow to Europe and an FPSO ready for disconnection in October 2024.

Recycling in Europe has the potential to reduce the schedule with no lay-up and decontamination before a dry tow. Other factors that may impact the schedule are weather, permitting delays and

failure to secure the HLV or preferred recycling yard slot. The different schedule scenarios are illustrated in Table 14-3.

Phase	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	.....	2027
Select																
Define																
Execute																

Figure 14-2 Schedule Overview

14.11 Key Milestones

Indiciative dates for key project milestones, based on the following assumptions, are presented in Table 14-3.

- Recycling in Türkiye
  - Requires decontamination before towing to the yard
  - It is assumed decontamination is done at lay-up in Australia before a dry tow
  - Recycling at the yard takes 2 years
- Recycling in Europe
  - Yard selected that can undertake all decontamination.
  - Assumed dry tow to the yard from sheltered waters near the field immediately after disconnection
  - There is a risk that the dry tow vessel cannot be secured in time or that the yard is not available, so consideration will need to be given to a potential lay-up period
  - Recycling and decontamination in the yard takes 2 years
- Australian Recycling
  - Assumes a wet tow to Henderson, or nearby, for lay-up and decontamination
  - Recycling continues at this location over a 2-year period
  - There is a risk that the yard may not be ready, so consideration will need to be given to a potential lay-up period

Lay-up after disconnection may be required for all options if there are delays in securing the tow vessel or yard.

The overall schedule is considered to have an accuracy of +/- 3-4months. Each scenario has multiple sensitivities which may impact the schedule. These will be assessed in the Select Phase.

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Note that these key milestone dates have been developed without reference to the DISR internal schedule.

Table 14-3 Key Milestones

Phase	Milestone	Indicative Target completion Date			Additional comments
		Australian	Türkiye	Europe	
Select	Complete recycling vendor prequalification Complete Cost Estimate (Class 4) and Level 2 Schedule	Dec 2023	Dec 2023	Dec 2023	
Define	All major tenders issued	Mar 2024	Mar 2024	Mar 2024	
	Secure permits and approvals	Jun 2024	Jun 2024	Jun 2024	
	Completion	Jun 2024	Jun 2024	Jun 2024	
Execute	Tow to lay-up / sheltered loading location - award contract	Jul 2024	Jul 2024	Jul 2024	Contract not required if: wet tow, decontamination is not required or lay-up not required
	Lay-up/preservation contract award	Jul 2024	Jul 2024	NA	Contract not required if lay-up does not occur
	Decontamination contract award	Jul 2024	Jul 2024	NA	
	Tow to recycle yard - award contract	Jun 2024	Jun 2024	Jun 2024	Depends on the final location and selected option. May need to be issued earlier to secure a yard slot.
	Recycling contract award	Jun 2024	Jun 2024	Jun 2024	3-4 month lead time to secure slot
	Disconnect and tow to lay-up / sheltered loading location	Oct 2024 (wet tow – 4 weeks)	Oct 2024 (4 weeks)	Oct 2024 (tow to dry tow loading location 1 week)	
	Commence lay-up and preservation/loading	Nov 2024	Nov 2024	Oct 2024	
	Commence decontamination	Nov 2024	Nov 2024	NA	Cannot be definitive about duration until IHM is completed and reviewed. 2 - 3 months assumed
	Decontamination completed	Feb 2025	Feb 2025	NA	

Phase	Milestone	Indicative Target completion Date			Additional comments
		Australian	Türkiye	Europe	
	Tow to the recycling location	N/A	Mar-Apr 2025	Nov-Dec 2024	40 - 45 day dry tow assumed
	Start of recycling	Mar 2025	Apr 2025	Dec 2024	
	Completion	Mar 2027	Apr 2027	Dec 2026	Depends on final location and selected option – Assumes 2 years duration

14.12 Cost Estimate – Select & Define

A preliminary estimate of the costs was determined for the Select & Define Phase based on the WBS and associated schedule. These are considered Class 5, include a 30% contingency and are summarised in Table 14-4. These costs will be further refined prior to the commencement of each phase.

Table 14-4 Cost Summary

Phase	Cost (AU$)				Cost (US$)			
	External	Project team	Total	Total inc. 30% cont.	External	Project team	Total	Total inc. 30% cont.
Select	$620,000	$680,000	$1,300,000	$1,690,000	$410,000	$450,000	$860,000	$1,118,000
Define	$880,000	$860,000	$1,740,000	$2,262,000	$590,000	$570,000	$1,160,000	$1,508,000

The following assumptions have been made in developing the cost estimate.

- US$/AU$ rate of 1.5
- External costs cover:
    - Flights, accommodation and expenses
    - Specialist/external scopes – For example, those conducted by Petrofac, tow contractor and Australian recycling contractor feasibility studies
    - There is a potential that some of these will be rolled into overall contractor costs (e.g. tow contractor costs)
- The Project team assumes an integrated team of DISR personnel and external consultants

14.13 Cost Estimate - Execute

Table 14-5 summarises the potential costs during the execution phase. There are multiple different scenarios under consideration. At this stage, cost data is not available for all elements of the

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execution, so budget estimates were used based on industry knowledge, where necessary. The total Execute Phase cost includes:

- Lay-up costs for decontamination (Australia and Türkiye options only)
- Decontamination costs where the decontamination is not undertaken in the recycling yard (including transporting hazardous materials to the final storage location)
- For the Europe option, the cost for the transportation of the hazardous materials to the final storage location. The actual decontamination cost is included in the vessel and topsides recycle cost
- The cost of a tow to a sheltered location for the loading of the FPSO onto the HLV for transport to Europe. For the Türkiye option it has been assumed that the FPSO would be loaded onto the HLV at the decontaminant site
- The cost of the wet tow or dry tow to the recycling yard. For the Europe and Türkiye options a dry tow has been assumed
- The cost of the vessel and topsides recycling and any associated scrap steel rebate
- The project management and engineering support for the Execute Phase (Estimated to be 5-10% of the capital cost)

The cost accuracy is assumed to be -30% / +50%.

Table 14-5 Execute Phase Cost Estimates

	Australian	Türkiye	Europe	Comment
Lay-up in Batam, Indonesia		One time cost: US$9.8mill Annual Cost: US$2.6mill Total: US$12.4 mill	NA	Min lay-up charge period is 12 months
Lay-up in Australia	US$10-20mill	US$10-20mill	NA	Budget Estimate only (2-3 months for decontamination)
Decontamination	US$10-20mill	US$10-20mill	US$2-4mill	Budget estimate only Decontamination cost assumes minimal or no mercury. Europe cost is for transporting hazardous materials to the final storage location only. Europe FPSO decontamination is included in FPSO recycle price.
Tow to a sheltered location	NA	NA	US1.0 -1.5mill	For loading the FPSO onto HLV
Dry Tow	NA	US$15.1–18.6mill	US$17.3–18.2mill	
Wet Tow	US$5.7-8.1mill	US$12.9-20.7mill	US$17.5-20.7mill	
Vessel and Topsides Recycle	US$50-60mill	Included in Scrap Steel Rebate	US$9-11mill	Budget Estimates only. European option includes decontamination of the FPSO
Scrap Steel Rebate	-US$9-13mill	-US$11-15mill	Included in Vessel and topsides Recycle cost	Dependent on scrap steel market price
Sub-Total	US$63-99mill	US$20-48mill	US$29-35mill	
PM & Eng Support	US$4-8mill	US$1.7-3.4mill	US$1.6-3.2mill	5-10% of av sub-total
TOTAL Execute Phase Cost	US$67-107mill	US$22 – 41mill	US$31-38mill	Accuracy -30% / +50%
Total Cost Assumptions	Lay-up and decontamination in Australia	Lay-up and decontamination in Australia Dry tow to Türkiye	Dry tow to Europe Decontamination at yard in Europe	

14.14 Project Organisation

A preliminary organisation chart for the Select Phase is provided in Figure 14-3. This organisation chart will be refined to develop an integrated team approach prior to kick-off the Select phase. The Define phase organisational chart will be developed during the Select phase. Site representative resources will not be used until the Execute phase.

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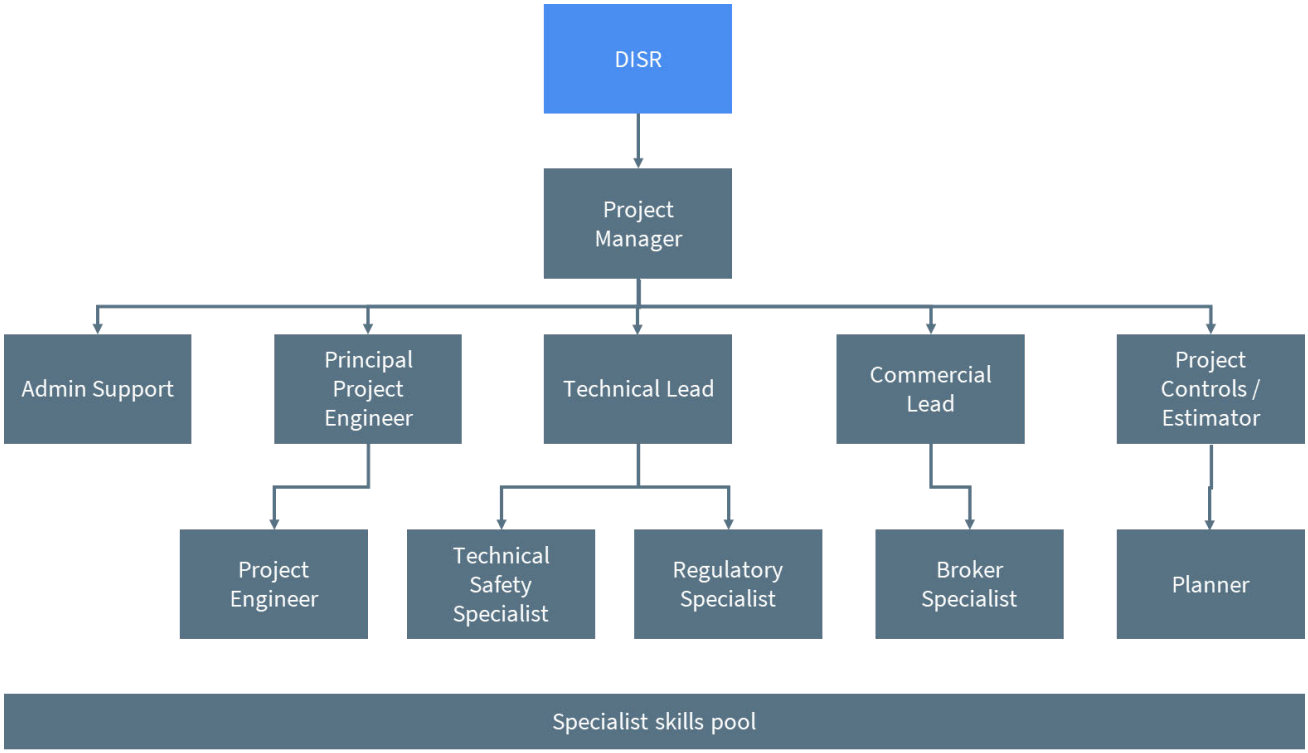


Figure 14-3 Organisation Chart – Select Phase

14.15 Decisions

A decision register will be maintained throughout each phase of the project. Where necessary, documentation will be developed to support the decision. Figure 14-4 and Table 14-6 provide an example of an applicable decision-making workflow.

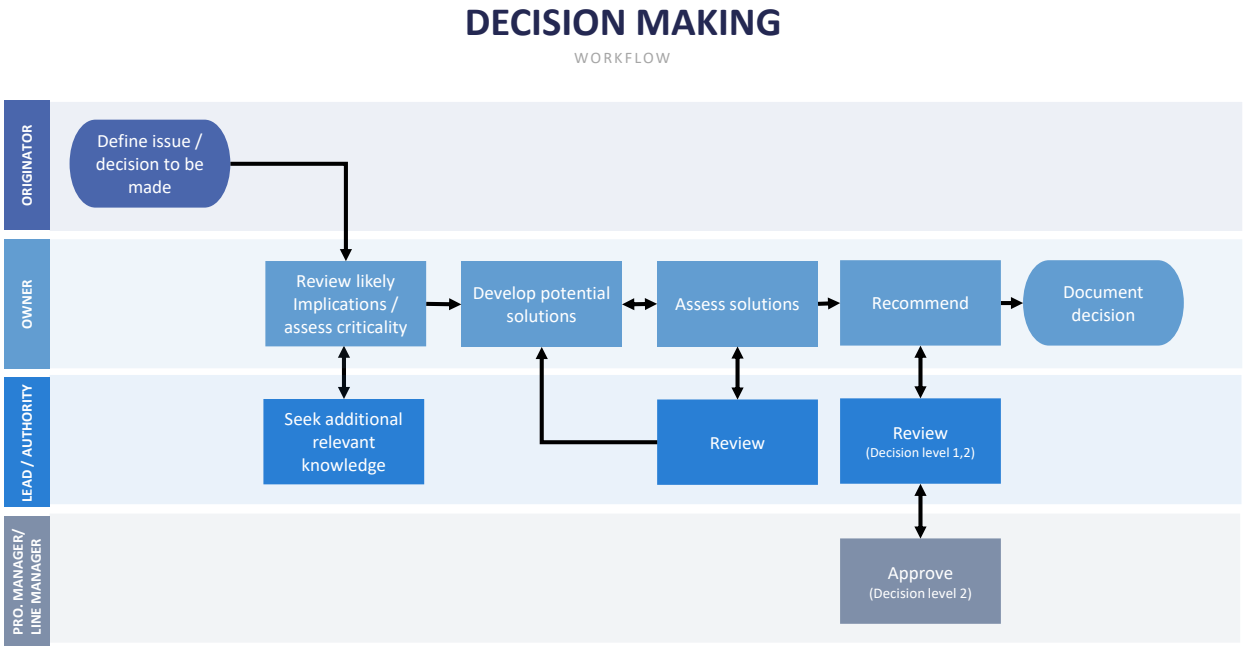


Figure 14-4 Decision-making Workflow

Table 14-6 Example of Decision Levels

Decision Level	Financial impact*	Strategic impact*	Decision Approver(s)	Examples
1	>5% CAPEX	Defines project basis	Project Manager & DISR	Concept change/selection, addition/ deletion of significant scope, contracting strategy, progression to next phase of work, engagement with government entities
2	<5% CAPEX	Clarifies project basis	Project Manager	Defines physical parameters (e.g., flow rate, connection types), defines technical basis (e.g., codes & standards)

14.16 Contracting and Procuring Strategy and Responsibilities

A contracting and procurement strategy and responsibility matrix will be developed during the Select and Define Phase.

Key contracts will be as follows:

- Wet tow from field to lay-up location
- Decontamination
- Preservation (at lay-up location)
- Wet/dry tow from lay-up to recycling location.
- Recycling

The timing of the issue of these contracts has been reviewed at a high level in section 14.11.

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Contracting and procurement will be applied as per DISR processes.

14.17 Risk Management Plan

Risks for the project have been identified, assessed, and mitigations identified and summarized in Section 12. The project risk register will be updated periodically. Risk action statuses will be reviewed monthly. The Project Manager will be accountable for maintaining the Risk Register.

14.18 Stakeholder, Interface and Communications Plan

A Stakeholder and interface management plan will be developed during the Define Phase. All project team members must be aware of the plan and adhere to the communication pathways for all project-related tasks.

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15 CONCLUSIONS AND RECOMMENDATIONS

15.1 Hazardous Materials

The completion of the Inventory of Hazardous Materials (IHM) and its findings are critical for the project schedule.

The European yards have indicated they can handle removing contaminants, including NORM. Denmark will not allow the long-term storage of hazardous materials from other countries. Norway has not advised of its status regarding long-term storage. The Turkish yards have indicated that they can handle some contaminants. However, NORM and mercury would have to be removed prior to arrival at the yard.

Hazardous waste from an Australian FPSO can be stored at the Sandy Ridge facility owned and operated by Tellus Holdings in Western Australia. Further discussions are required with the relevant stakeholders to establish the required licenses to be obtained for removal and transportation and which party is required to hold the licenses.

15.2 Regulations

The Hong Kong Convention (HKC) aims to ensure safe and eco-friendly ship recycling by enforcing design, operation, and dismantling standards. The HKC, which enters into force on June 26, 2025, has been ratified by 22 states, covering 45.81% of world shipping. The EU Ship Recycling Regulation (EU-SRR) aligns with the HKC, with additional safety and environmental requirements for ships of 500GT and above, including leakage control, hazardous material handling, and waste management. The EU-SRR is the most stringent level of regulation for the ship recycling industry.

Australia has not ratified either the HKC or EU-SRR. The Hazardous Waste (Regulation of Exports and Imports) Act 1989 primarily governs ship recycling in Australia.

15.3 Redeployment

The previous extensive Northern Endeavour marketing activities undertaken by CCMA and the market survey results indicate that there is currently very little interest in the Northern Endeavour as a redeployment candidate or as a speculative purchase for a future opportunity. This is due to:

- The Northern Endeavour is only suitable for redeployment in oil and gas regions with benign weather conditions, thus limiting its redeployment opportunities

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- FPSO operators are unwilling to take on the risk of purchasing an FPSO over 20 years old which they don't have a detailed knowledge of its operating history

If the Commonwealth were to lay-up the FPSO with the aim of selling the FPSO in the future, the FPSO would be expected to be laid up for at least 3 years and possibly longer. The lay-up would cost at least US$18-20mill, and the FPSO may need to be decontaminated before sale (US$10-20mill). If a buyer is not found within a reasonable period, the FPSO will still need to be scrapped.

15.4 Recycling

The market survey has indicated that there are opportunities for the recycling of the Northern Endeavour utilising proven FPSO recycling yards in Türkiye and Europe. Responses were received from contractors in Australia which indicated that there is also the potential to recycle the FPSO in Australia. However, there is no experience handling a vessel of this size and the potential level of contamination.

Responses to the market survey received from the vendors are listed in Table 15-1.

All these vendors have indicated that they will have yard availability in 2024-2025. The notification period required by the yards prior to arrival varied from 3 – 6 months to no fixed requirement. The European and Turkish yards adhere to the Hong Kong Convention and are certified compliant with the European Union Ship Recycling Regulations (EU-SRR).

The Australian vendors have indicated that they will be able to comply with the EU-SRR but are not certified. Two of the Australian vendors have indicated they are currently undertaking feasibility studies for an O&G entity regarding the recycling of an Australian based FPSO. s 47(1)(b) has clearly indicated that they have no direct responsibility or experience with recycling large vessels. They have also indicated a recycling duration of 4 months. This proposed schedule is not considered realistic when compared to the schedules provided by other vendors. Consequently, their response is considered to have less validity than the other Australian vendors.

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Table 15-1 Recycling Vendor Summary

Name	Location	Experience with Recycling FPSOs	Decontamination is required prior to arrival	Estimation duration for recycling
s 47(1)(b)	Denmark	Yes	No	2 years
	Norway	Yes	No	3 years
	Türkiye	No. Tankers only	Yes. Can handle some contaminants	9 months
	Türkiye	Yes	Yes. Can handle some contaminants	8 – 14 months
	Whyalla, South Australia	No	Yes	4 months
	Henderson, Western Australia	No. Smaller navy vessels only	Yes	2 years
	Whyalla, South Australia	No. Smaller navy vessels only	Yes	Not specified

15.5 Indicative Scrap Value

The indicative prices vary between the EU-SRR compliant countries (Refer Table 15-2). It is noted that the scrap prices specified for the Norwegian and Australian options exclude the cost of recycling the FPSO.

Table 15-2 IndicativeTanker Scrap Prices

Scenario	USD / Light Displacement Tonnage - Tonnes	2023 Scrap Value US$ m
Türkiye (1)	$276 - $353	$11-$15
Norway(2)	$400 – $550	$16-$23
Denmark(2)	$320 - $380 [26]	$13-$16
Australia (3)	$210 - $315	$9-$13

Notes:

1. EU-SRR compliant, excludes decontamination

2. EU-SRR compliant, excludes decontamination, excludes the cost of recycling
3. Non EU-SRR compliant, excludes decontamination, excludes cost of recycling

15.6 Lay-up Options

After the FPSO is disconnected from the moorings and removed from the field, there may be a requirement to lay-up the FPSO prior to transporting it to its destination for recycling. This will be dependent on:

- Time required to obtain export and import permits
- Whether or not decontamination is required prior to transporting the FPSO to the recycling yard

It is expected that FPSO lay-up will not be required if the recycling yard is in Europe as:

- The export and import permits should be able to be secured with an OECD country prior to the Northern Endeavour being disconnected from the mooring
- Decontamination will not be required prior to arrival at the recycling yard

Potential locations for lay-up and budgetary costs are summarised in Table 15-3.

Table 15-3 Lay-up Locations

Location	Export / Import Permit Required	Decontamination Required prior to arrival	Budget Cost (USD)
Labuan – Malaysia	Yes	Yes	Not provided
Batam – Indonesia	Yes	Yes	One time cost: US$9.8mill Annual Cost: US$2.6mill
Australian location (to be determined)	No	TBD	Est. US$10-20mill

If the FPSO is to be recycled in Australia, there will be considerable benefit in the FPSO lay-up being in Australian waters as there will be no requirement for multiple export and import permits. It has not yet been confirmed that lay-up in Australia is possible.

Further investigation into the options for FPSO lay-up will be required in the future phases of the project.

15.7 Decontamination Requirements Prior to Tow

The responses from the recycling yards indicated a range of FPSO decontamination requirements prior to arrival at the yard. The MARS yard has indicated they will accept all contamination, whereas

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Türkiye has regulations limiting the importation of different types of contamination, such as NORM. Decontamination will be required prior to entry to the yard in Henderson, WA. The Whyalla yard requirements are to be confirmed. Until the IHM is completed, it will not be possible to determine the potential FPSO decontamination cost with any accuracy. It is estimated that the cost could be in the order of US$10-20mill assuming that there is minimal or no mercury contamination in the FPSO.

15.8 Towing Options

15.8.1 Dry Tow

Two semi-submersible heavy lift vessels (HLV) are capable of transporting the Northern Endeavour FPSO, the Boka Vanguard, owned by Boskalis and the Hua Rui Long, owned by the Chinese Ministry of Transport. A relatively sheltered location will be required to load the Northern Endeavour onto the HLV. Refer to Table 15-4 for a potential cost and transit duration summary.

Table 15-4 Dry Tow Options Summary

	Türkiye via Suez	North Sea via Suez	Türkiye via COGH	North Sea via COGH
Estimated Cost (USD)	$15.1mill	$17.3mill	$18.6mill	$18.2mill
Transit Time	28 – 30 days	37 - 39 days	44 - 45 days	44 days

15.8.2 Wet Tow

The structural integrity of the Northern Endeavour hull will be required to be verified for the wet tow scenario. It has been assumed that a reserve tug will be required to always be present during the tow.

Indicative rates and transit times for the tow to the recycling yards in Australia, Europe and Türkiye are provided in Table 15-5. The data for the wet tow vessels has been interpolated to determine equivalent costs and transit times for the wet tow to the Australian options.

Table 15-5 Wet Tow Options Summary

	Türkiye via Suez	North Sea Port via Suez	Türkiye via COGH	North Sea Port via COGH	Henderson WA	Whyalla SA
Estimated Cost (USD)	$12.9mill	$17.5mill	$20.7mill	$20.7mill	$5.7mill	$8.1mill
Transit Time	45- 62 days	63 - 90 days	73 -111 days	73 - 112 days	21 days	32 days

15.8.3 Tow recommendations

15.9 Asset Valuation

The asset valuation process for the redeployment of an FPSO involves assessing the asset's condition, refurbishment requirements, evaluating competition earning potential, and calculating the asset value range based on various scenarios. Table

Table 15-6 Northern Endeavour valuation range

	Valuation (US$ million) per Scenario	
	Low	**High**
No risked discount	$28.58	$142.00
Including a 25% risk discount	$21.43	$106.50
Scrap value (to buyer)	$15 (based on recycling in Türkiye)	

15.10 Risk Assessment

The risk assessment identified two high risks and nine medium risks:

High Risk - Australia

- The risk associated with the Australian contractors having insufficient experience in recycling vessels of the size of the Northern Endeavour and the demands of satisfying the requirements of the EU-SRR.

High Risk – Australia / Türkiye

- Recycling of the Northern Endeavour ends up costing significantly more than budgeted due to more extensive hazardous materials than expected, the difficulty of decontamination and disposal of the waste

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Medium Risk - Australia

- Recycling of the NE ends up costing more than budgeted due to more contamination on the FPSO than expected, decreased scrap metal rates, the project being forced to use an Australian recycling option rather than international options, lack of experience causing a cost blowout or additional lay-up time due to unavailability of the recycle yards
- Choice of an Australian recycling location driven by policy requirements rather than technical and commercial

Medium Risks – Europe / Türkiye

- Wet tow delayed/takes longer than expected due to issues such as weather, mechanical failure, piracy, failure to obtain permits or a safety incident
- Tow delayed due to issues in the Suez Canal, such as height restrictions, insufficient tugs available to manage the FPSO in the canal or the FPSO getting wedged in the canal
- HLVs not available due to failure to book early enough, HLV breakdown or HLV late arrival due to delay on other contracts
- Recycling of the NE ends up costing the Government more than budgeted due to more contamination on the FPSO than expected, increased tow costs, decreased scrap metal rates or additional lay-up time due to the unavailability of the recycle yards

Medium Risks –All

- Deterioration of commercial advantage or interest due to unstructured vendor engagement, protracted negotiations or lack of Government experience in this market
- Northern Endeavour disposal sets a poor precedent for decommissioning – standards too high or too low

15.11 Comparative Review of Options Against Key Drivers

The results of the options comparison against the key drivers are shown in Figure 15-1. The results indicate that the Europe option aligns most with the specified drivers. The higher scores for both of the Australian options are driven by the higher relative risk around practical execution experience, schedule and financial value, even though these drivers have the lowest weighting in regard to the level of importance to the Commonwealth.

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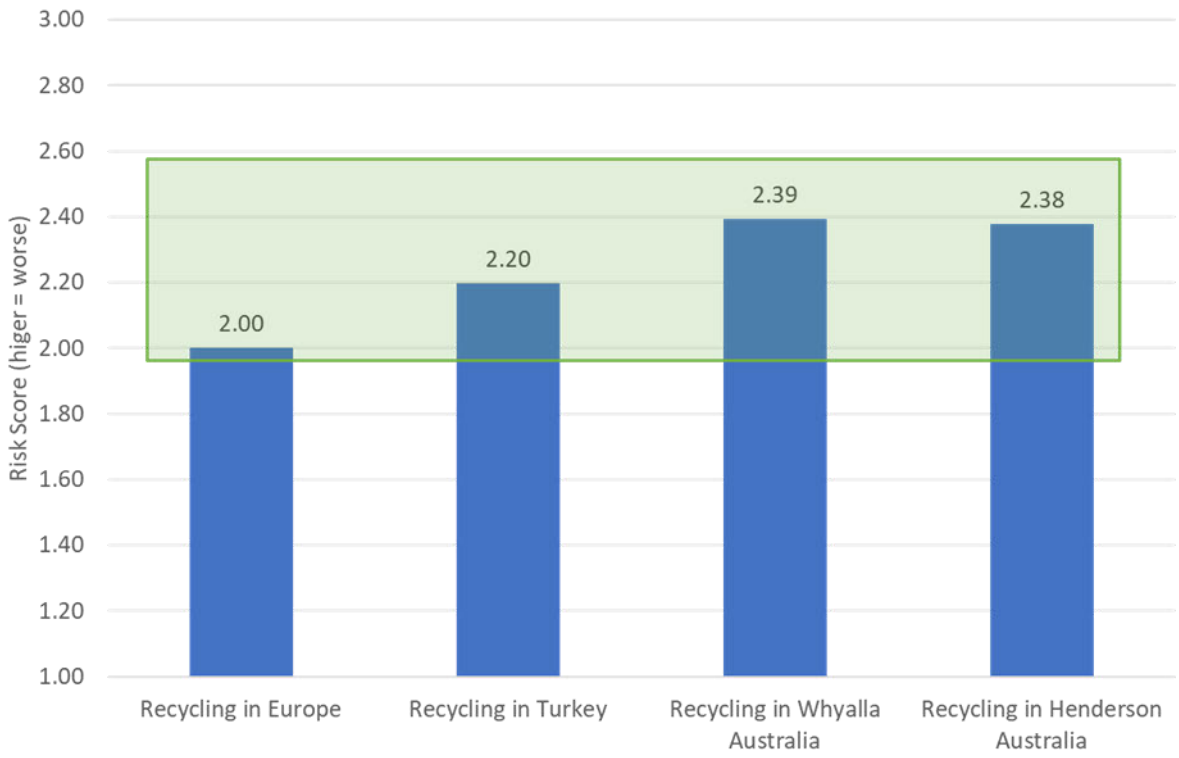


Figure 15-1 Options Review (Lowest = Best)

15.12 Disposal Execution Strategy

The execution phase is structured around four phases:

- Identify /Assess
- Select
- Define
- Execute

The Identify and Assess Phases have been completed. The Select Phase will act as a transition period in which more details will be gathered to enable decisions to be made in the Define Phase.

The primary focus of the Select phase will be to pre-qualify the recycling vendors, both Australian and international. A key decision to be made early in the pre-qualification process will be whether to tender:

- Australian only
- International only
- Australian and international

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Initially, a detailed prequalification of the Australian vendors will be undertaken to determine if they are viable. This will involve site visits to examine the facilities available at each yard and their capability. For the Australian vendors, the prequalification process may include a paid feasibility study to develop a detailed execution plan that demonstrates how they will mitigate the risks associated with their inexperience in dealing with a large FPSO.

A desktop prequalification of the international recycling yards will be conducted in parallel based on information provided in the market study, data collected from previous recycling yard site visits by the Centre of Decommissioning Australia (CODA) and feedback from recent assessments conducted by oil and gas companies for other asset disposals.

Should the Australian option be deemed unviable or insufficiently competitive, the international prequalification will be extended to a formal prequalification process. This may include site visits to the front running yards. It is expected that the Select Phase will take approximately 4 months.

The Define phase will be focused on tendering and defining project elements to a level sufficient to support the final investment decision and tender award. The scope and strategy for this phase will be further developed during the Select Phase. It is expected that the Define Phase will take approximately 4 months.

Execute phase definition will be further developed during the Define phase. At the start of this phase, tenders will be awarded, and final permits and certification will be approved. The aim will be ready to commence the Execution Phase 3-4 months prior to the disconnection of the Northern Endeavour.

15.13 Schedule and Milestones

Table 15-7 summarises the key milestones and indicative schedule dates. The overall schedule is considered to have an accuracy of +/- 3-4months. Each scenario has multiple sensitivities which may impact the schedule.

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Table 15-7 Key Milestones

Phase	Milestone	Indicative Target completion Date			Additional comments
		Australian	Türkiye	Europe	
Select	Complete recycling vendor prequalification Complete Cost Estimate (Class 4) and Level 2 Schedule	Dec 2023	Dec 2023	Dec 2023	
Define	All major tenders issued	Mar 2024	Mar 2024	Mar 2024	
	Secure permits and approvals	Jun 2024	Jun 2024	Jun 2024	
	Completion	Jun 2024	Jun 2024	Jun 2024	
Execute	Tow to lay-up / sheltered loading location - award contract	Jul 2024	Jul 2024	Jul 2024	Contract not required if: wet tow, decontamination is not required or lay-up not required
	Lay-up/preservation contract award	Jul 2024	Jul 2024	NA	Contract not required if lay-up does not occur
	Decontamination contract award	Jul 2024	Jul 2024	NA	
	Tow to recycle yard - award contract	Jun 2024	Jun 2024	Jun 2024	Depends on the final location and selected option. May need to be issued earlier to secure a yard slot.
	Recycling contract award	Jun 2024	Jun 2024	Jun 2024	3-4 month lead time to secure slot
	Disconnect and tow to lay-up / sheltered loading location	Oct 2024 (wet tow – 4 weeks)	Oct 2024 (4 weeks)	Oct 2024 (tow to dry tow loading location 1 week)	
	Commence lay-up and preservation/loading	Nov 2024	Nov 2024	Oct 2024	
	Commence decontamination	Nov 2024	Nov 2024	NA	Cannot be definitive about duration until IHM is completed and reviewed. 2 - 3 months assumed
	Decontamination completed	Feb 2025	Feb 2025	NA	
	Tow to the recycling location	N/A	Mar-Apr 2025	Nov-Dec 2024	40 - 45 day dry tow assumed
	Start of recycling	Mar 2025	Apr 2025	Dec 2024	

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Phase	Milestone	Indicative Target completion Date			Additional comments
		Australian	Türkiye	Europe	
	Completion	Mar 2027	Apr 2027	Dec 2026	Depends on final location and selected option – Assumes 2 years duration

15.14 Cost Estimate – Select & Define Phases

A preliminary estimate of the costs was determined for the Select & Define Phase based on the WBS and associated schedule. These are considered Class 5, include a 30% contingency and are summarised in Table 15-8. These costs will be further refined in the period prior to the start of the Select Phase.

Table 15-8 Select & Define Cost Summary

Phase	Cost (AU$)				Cost (US$)			
	External	Project team	Total	Total inc. 30% cont.	External	Project team	Total	Total inc. 30% cont.
Select	$620,000	$680,000	$1,300,000	$1,690,000	$410,000	$450,000	$860,000	$1,118,000
Define	$880,000	$860,000	$1,740,000	$2,262,000	$590,000	$570,000	$1,160,000	$1,508,000

15.15 Cost Estimate Execute

Table 15-9 summarises the potential costs during the execution phase. There are multiple different scenarios under consideration. At this stage, cost data is not available for all elements of the execution, so budget estimates are based on industry knowledge where necessary.

The total Execute Phase cost includes:

- Lay-up costs for decontamination (Australia and Türkiye options only)
- Decontamination costs where the decontamination is not undertaken in the recycling yard (including transporting hazardous materials to the final storage location)
- For the Europe option, the cost for the transportation of the hazardous materials to the final storage location. The actual decontamination cost is included in the vessel and topsides recycle cost
- The cost of a tow to a sheltered location for the loading of the FPSO onto the HLV for transport to Europe. For the Türkiye option it has been assumed that the FPSO would be loaded onto the HLV at the decontaminant site

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- The cost of the wet tow or dry tow to the recycling yard. For the Europe and Türkiye options a dry tow has been assumed
- The cost of the vessel and topsides recycling and any associated scrap steel rebate
- The project management and engineering support for the Execute Phase (Estimated to be 5-10% of the capital cost)

The cost accuracy is assumed to be -30% / +50%.

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Table 15-9 Execute Phase Cost Estimates

	Australian	Türkiye	Europe	Comment
Lay-up in Batam, Indonesia		One time cost: US$9.8mill Annual Cost: US$2.6mill Total: US$12.4 mill	NA	Min lay-up charge period is 12 months
Lay-up in Australia	US$10-20mill	US$10-20mill	NA	Budget Estimate only (2-3 months for decontamination)
Decontamination	US$10-20mill	US$10-20mill	US$2-4mill	Budget estimate only Decontamination cost assumes minimal or no mercury. Europe cost is for transporting hazardous materials to the final storage location only. Europe FPSO decontamination is included in vessel recycle price.
Tow to a sheltered location	NA	NA	US1.0 -1.5mill	For loading the FPSO onto HLV
Dry Tow	NA	US$15.1–18.6mill	US$17.3–18.2mill	
Wet Tow	US$5.7-8.1mill	US$12.9-20.7mill	US$17.5-20.7mill	
Vessel and Topsides Recycle	US$50-60mill	Included in Scrap Steel Rebate	US$9-11mill	Budget Estimates only. European option includes decontamination of the FPSO
Scrap Steel Rebate	-US$9-13mill	-US$11-15mill	Included in Vessel and topsides Recycle cost	Dependent on scrap steel market price
Sub-Total	US$63-99mill	US$20-48mill	US$29-35mill	
PM & Eng Support	US$4-8mill	US$1.7-3.4mill	US$1.6-3.2mill	5-10% of av sub-total
TOTAL Cost	US$67-107mill	US$22 – 41mill	US$31-38mill	Accuracy -30% / +50%
Total Cost Assumptions	Lay-up and decontamination in Australia	Lay-up and decontamination in Australia Dry tow to Türkiye	Dry tow to Europe Decontamination at yard in Europe	

15.16 Recommendations

- The redeployment option should no longer be pursued as an option for the disposal of the Northern Endeavour
- The IHM be completed and verified as soon as possible

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- Confirm if there are options available in Australia for the lay-up and decontamination of the Northern Endeavour
- As there is no significant cost saving using a wet tow, the transit time is considerably longer than the dry tow and risks associated with the wet tow method are higher, it is recommended that the dry tow method be adopted for the tow to Europe or Türkiye. A wet tow is most likely suitable for the tow to the Australian yards but is subject to verification.
- Given the increased permitting risk and the requirement to remove or shorten the flare tower if the Suez Canal route is used, it is recommended that the Cape of Good Hope route be considered the base case and the tow schedule be developed to avoid the worst winter weather months.
- Proceed with the Select Phase, which will focus on pre-qualifying Australian and international recycling vendors. A key decision to be made early in the pre-qualification process will be whether to tender:
    - Australian only
    - International only
    - Australian and international
- Engage with Government procurement function to enable prompt preparation of documentation when required

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APPENDIX A EU-SRR COMPLIANT SHIPYARDS

A1. FACILITIES LOCATED IN EU MEMBER STATES

Name of the facility	Method of recycling	Type and size of ships that can be recycled	Maximum ship dimensions				Date of expiry of inclusion in the European List
			Length(m)	Width(m)	Draught(m) (Note 2)	Gross Tonnage(T)	
DENMARK							
FAYARD A/S	Drydock	Note 1	415	90	7.8	No Limit Stipulated	7-Nov-23
Modern American Recycling Services	Slipway	Note 1	290	90	14	No Limit Stipulated	23-Aug-23
ITALY							
San Giorgio del Porto S.p.A.	Alongside, drydock	Note 1	350	75	16	130000	6-Jun-23
THE NETHERLANDS							
Damen Verolme Rotterdam B.V.	Drydock	Note 1	400	90	12	No Limit Stipulated	21-May-26
NORWAY							
ADRS Decom Gulen	Alongside, slipway, dry/wet dock	Note 1	360	No Limit Stipulated	No Limit Stipulated	No Limit Stipulated	1-Oct-24
AF Offshore Decom	Alongside	Note 1	290	No Limit Stipulated	No Limit Stipulated	No Limit Stipulated	28-Jan-24
Lutelandet Industrihamn	Alongside	Note 1	No Limit Stipulated	No Limit Stipulated	No Limit Stipulated	No Limit Stipulated	28-Jan-24
UNITED KINGDOM – NORTHERN IRELAND							
Harland and Wolff (Belfast) Ltd	Dry dock and wet berth	Note 1	556	93	7.5	550,000	16-Jun-25

Note 1: Ships as defined in point (1) of Article 3(1) of Regulation (EU) No 1257/2013, except for rigs

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A2. FACILITIES LOCATED IN NON-EU MEMBER STATES

Name of the facility	Method of recycling	Type and size of ships that can be recycled	Maximum ship dimensions				Date of expiry of inclusion in the European List
			Length(m)	Width(m)	Draught(m) (Note 2)	Gross Tonnage(T)	
Türkiye							
Avsar Gemi Sokum San. Dis Tic. Ltd. Sti.	Landing	Note 1	No Limit Stipulated	50	15	No Limit Stipulated	2-Dec-25
Isiksan Gemi Sokum Pazarlama Ve Tic. A.Ş	Landing	Note 1	No Limit Stipulated	75	17	No Limit Stipulated	7-Jul-24
EGE CELIK SAN. VE TIC. A.S.	Landing	Note 1	No Limit Stipulated	50	15	No Limit Stipulated	12-Feb-25
LEYAL GEMİ SÖKÜM SANAYİ ve TİCARET LTD.	Landing	Note 1	No Limit Stipulated	100	15	No Limit Stipulated	9-Dec-23
LEYAL-DEMTAŞ GEMİ SÖKÜM SANAYİ ve TİCARET A.Ş.	Landing	Note 1	No Limit Stipulated	63	15	No Limit Stipulated	9-Dec-23
ÖGE GEMİ SÖKÜM İTH. İHR. TİC. SAN.AŞ.	Landing	Note 1	No Limit Stipulated	70	15	No Limit Stipulated	12-Feb-25
Simsekler Gida Gemi Sokum Insaat Sanayi Tic. Ltd.Sti	Landing	Note 1	No Limit Stipulated	95	15	No Limit Stipulated	2-Dec-25
Sök Denizcilik Tic. Ltd. Sti	Landing	Note 1	No Limit Stipulated	90	15	No Limit Stipulated	12-Feb-25

Note 1: Ships as defined in point (1) of Article 3(1) of Regulation (EU) No 1257/2013, except for rigs

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APPENDIX B SUMMARIES OF FPSO TOW VENDOR BUDGETS

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APPENDIX C VALUATION – CAPEX ESTIMATES

Oil tanker conversion – low case

Suezmax FSO Conversion Cost - Low Case			Exclude	Comments
CAPEX Area		**'000 US$**		
Hull		**55,000**		
A.1.0	Hull Procurement	55,000	No	10 year old Suez
Yard Costs		**59,006**		
A.2.1	Hull Refurbishment	11,169	No	
A.2.2	New Hull Systems	15,961	No	
A.2.3	Major Equipment Preparation	1,795	No	
A.2.4	Turret Equipment Preparation	5,305	No	
A.2.5	Yard Service Costs	5,115	No	
A.2.6	Major Equipment Supply	19,660	No	
A.2.7	Topsides Installation	0	No	Only integration of power generation
Turret Procurement		**28,333**		
A.3	0	28333	No	External turret
Topsides Procurement		**0**		
A.4	Topsides Packages	0	No	Not required for FSO
Subsea		**0**		
A.5.1	Risers and Umbilicals	0	No	Not included
Miscellaneous		**0**		
A.6.1	Personnel Transfer Bridge	0	No	Not included
Transport and Transit Costs		**1,644**		
A.7.1	Topsides Transport	0	No	No topsides
A.7.2	FSO Transits	1,644	Yes	
Installation Costs		**7,129**		
A.8.1	Phase 1 - Mooring Line Installation	4,754	Yes	
A.8.2	Phase 2 - FPSO Hookup	2,375	Yes	
Class/Third Party Costs		**4,270**		
A.9.1	Class	1,423	No	Assumes entire FSO is classed
A.9.2	Insurances	2,847	No	Assumes entire FSO is insured
Sub total (excl PM & E)		**155,381**		
Project Management & Engineering				
C.1.1	FEED	2,331	Yes	
C.1.2	Detailed Design	12,430	Yes	
Total Cost (inc. exclusions)		**170,142**		
Contingency (20%) (inc. exclusions)		34,028		
Total Cost (incl Contingency & exclusions)		**204,170**		
Total Cost		**146,608**		
Contingency (20%)		**29,322**		
Total Cost (incl Contingency)		**175,930**		

Oil tanker conversion – high case

Suezmax FSO Conversion Cost - High Case			Exclude	Comments
CAPEX Area		**'000 US$**		
Hull		**55,000**		
A.1.0	Hull Procurement	55,000	No	10 year old Suez
Yard Costs		**61,134**		
A.2.1	Hull Refurbishment	11,169	No	10 year life extension
A.2.2	New Hull Systems	15,961	No	
A.2.3	Major Equipment Preparation	1,795	No	
A.2.4	Turret Equipment Preparation	5,305	No	
A.2.5	Yard Service Costs	5,115	No	
A.2.6	Major Equipment Supply	19,660	No	
A.2.7	Topsides Installation	2,128	No	
Turret Procurement		**75,060**		
A.3	Internal turret and swivel	75,060	No	Vendor quote (Inc. Moorings)
Topsides Procurement		**163,080**		
4	Topsides Removal	0	No	
4.1	New power generation module 40MW	162,000	No	
4.2	New topsides installation (40MW)	1,080	No	
4.4	New topsides installation (8MW)	0	No	
4.6	Refurbished Power Gen & WHRU installation	0	No	
Subsea		**0**		
A.5.1	Risers and Umbilicals	0	Yes	Eq for all options
Miscellaneous		**0**		
A.6.1	Personnel Transfer Bridge	0	Yes	Not required
Transport and Transit Costs		**2,461**		
A.7.1	Topsides Transport	818	No	
A.7.2	FSO Transits	1,644	Yes	Eq for all options
Installation Costs		**0**		
A.8.1	Phase 1 - Mooring Line Installation	0	Yes	Eq for all options
A.8.2	Phase 2 - FPSO Hookup	0	Yes	Eq for all options
Class/Third Party Costs		**10,628**		
A.9.1	Class	3,543	No	
A.9.2	Insurances	7,085	No	
Sub total (excl PM & E)		**367,363**		
Project Management & Engineering				
C.1.1	FEED	5,510	Yes	
C.1.2	Detailed Design	29,389	Yes	
Total Cost (inc. exclusions)		**402,263**		
Contingency (20%) (inc. exclusions)		80,453		
Total Cost (incl Contingency & exclusions)		**482,716**		
Total Cost		**365,720**		
Contingency (20%)		**73,144**		
Total Cost (incl Contingency)		**438,864**		

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Northern Endeavour redeployment – low & High case

Configuration	CAPEX US$	Schedule (FID to FO) months	Exclude	Comments
Northern Endeavour redeployment (Low case)				
PM and Eng (FEED)	$2,802,800		Yes	Contractor and client teams. 2% of CAPEX
PM and Eng (Detailed design)	$13,559,000		Yes	Contractor and client teams. 10% of CAPEX
FPSO purchase	$0		No	Not included in this estimate.
Topsides	$26,460,000		No	Demolition of existing topsides and new power generation
Hull structure	$22,235,629		No	Moderate steel replacement, fatigue detailing and stern extension
Accommodation	$1,732,574		No	Accomodation refurbished
Marine systems	$20,407,000		No	Refurbished
TMS & swivel	$16,271,520	**18**	No	TMS systems and structures refurbished, new swivel and mooring lines
Installation	$7,520,000		Yes	
Preparation and transit	$9,480,000		No	Transit to shipyard from Timor Sea and preparation for sailaway from
Commissioning	$4,375,000		Yes	
Other	$9,530,174		No	General, yard services, class fees and 2 years operational spares.
Total (inc. exclusions)	$134,373,697			Including exclusions
Total (inc. exc. + 20% cont.)	$161,248,437			Including exclusions and 20% contingency
Total	**$106,116,897**			Exclusions removed
Total (+ 20% cont.)	**$127,340,277**			Exclusions removed + 20% contingency
Northern Endeavour redeployment (High case)				
PM and Eng (FEED)	$6,115,200		Yes	Contractor and client teams. 2% of CAPEX
PM and Eng (Detailed design)	$33,560,800		Yes	Contractor and client teams. 11% of CAPEX
FPSO purchase	$0		No	Not included in this estimate.
Topsides	$116,580,000		No	Demolition of existing topsides and refurbished/upgraded power generation
Hull structure	$22,987,529		No	Moderate steel replacement, fatigue detailing and stern extension
Accommodation	$1,782,574		No	Accomodation refurbished
Marine systems	$20,457,000		No	Refurbished
TMS & swivel	$36,922,280	**23**	No	TMS systems, swivel and structures refurbished. New mooring lines and utility swivel
Installation	$7,520,000		Yes	
Preparation and transit	$9,480,000		No	Transit to shipyard from Timor Sea and preparation for sailaway from
Commissioning	$20,100,000		Yes	
Other	$33,721,387		No	General, yard services, class fees and 2 years operational spares.
Total (inc. exclusions)	$309,226,770			Including exclusions
Total (inc. exc. + 20% cont.)	$371,072,124			Including exclusions and 20% contingency
Total	**$241,930,770**			Exclusions removed
Total (+ 20% cont.)	**$290,316,924**			Exclusions removed + 20% contingency

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APPENDIX D WORK BREAKDOWN STRUCTURE (WBS)

Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
DIS						Northern Endeavour End of Life Options Analysis	
	1					Identify	Completed
	2					Assess Phase	Ongoing
		1				Kick-off	
		2				Redeployment / speculative purchase review	
		3				Scrapping review/engagement	
		4				Asset valuation	
		5				Contracting strategy review	
		6				Review of options against key drivers	
		7				Risk assessment for redeployment and scrapping	
		8				Define disposal strategy and execution plan for the next phase of the project (incl execution team)	
		9				Define estimated level 1 project schedule for redeployment and scrapping options	
		10				Final Report (allow for 1 revision)	
		11				Presentation	
	3					Select Phase	Not Started
		0				Key Milestones	
		1				Project Management	
			1			Disposal Strategy	Project execution plan - update
			2			Regulatory Assurance Review	
			3			Registers	
				1		Project Risk & Opportunity Register	

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
				2		Project Lessons Learned Register	
				3		Project Decision Register	
				4		Project Interface Register	
				5		Action register	
			4			CL4 Cost Estimate	Update if any
			5			Level 2 Integrated Schedule	Update if any
		2				IHM	
			1			Status Update	Review
		3				Recycle vs Redeploy Final Decision	
			1			Additional market research	If required after reviewed by client
			2			Evaluate and select	
		4				Recycle Australian Pre-qualification	Recycle option selected
			1			Additional market research	
			2			Evaluate and select	
				1		Yard Audit / prequalification	Including risk assessment
				2		Feasibility study	2 yard options – note they are doing feasibility studies for other oil and gas clients looking to scrap FPSO's
				3		Yard visit	2 x yards (2 people)
				4		Yard ranking	Scoring against criteria
				5		Yard short list	Based on findings - eliminate some options
			3			Evaluate Australian recycling viability	Make recommendation
			4			Select dry tow or wet tow	Depends on location
		5				Recycle International Pre-qualification	Redeploy option selected
			1			Additional market research	Input from CODA and Santos

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
			2			Evaluate and select	
				1		Yard Audit / prequalification	Including risk assessment
				2		Yard visit	2 x yards (2 people)
				3		Yard ranking	Scoring against criteria
				4		Yard short list	Based on findings - eliminate some options
			3			Evaluate and select Australian or international	Make recommendation
			4			Select dry tow or wet tow	Depends on location
		6				Lay-up Location Selection	More detailed assessment of lay-up options
			1			Australian lay-up assessment	Support
			2			Batam lay-up assessment	Support
			3			Labuan lay-up assessment	Support
			4			Evaluate and select	Support
				1		Location and service provider audit / pre-qualification	Including risk assessment
				2		Location visit (if required)	2 x people $10k each in SEA
				3		Location and service provider ranking	Scoring against criteria
				4		Location selection	
			5			Service provider short list	
		7				Client Support	Providing support to the client for interactions with other government entities
		8				Reporting	Supporting Petrofac
			1			Summary report update	
			2			Summary presentation update	
			3			Decision note	In format required for government decision making
	4					Define Phase	Assuming recycling

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
		0				Key Milestones	
		1				Project Management	
			1			Disposal strategy	Project execution plan - update
			2			Project Quality Plan	
			3			Project Controls Plan	
			4			Interface Management Plan	
			5			Communications Plan	
			6			Stakeholder Management & Engagement Plan	
			7			Registers	Update
				1		Project Risk & Opportunity Register	
				2		Project Lessons Learned Register	
				3		Project Decision Register	
				4		Stakeholder Register	
				5		Interface register	
				6		Action register	
				7		Master document register	
				8		Disposal Readiness Checklist	
		2				Definition	
			1			Plans, procedures & specifications	
				1		Wet tow to lay-up plan	
				2		Wet tow procedure to lay-up	Can be done in execute
				3		Lay-up plan	Required for tender
				4		Lay-up specification	Required for tender
				5		Decontamination plan	Required for tender

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
				6		Decontamination specification	Required for tender
				7		Dry tow to yard plan	
				8		Dry tow to yard procedure	Can be done in execute
			2			Engineering and design	
				1		Wet tow Analysis	Required for MWS review, fatigue, strength etc
				2		Wet tow rigging design	Required for MWS review
				3		Emergency access point design	May have a ladder or similar
				4		Anchoring design	Required for MWS review
				5		Dry tow loadout and discharge analysis	Required for MWS review
				6		Dry tow analysis	Required for MWS review
			3			Estimates	
				1		Level 3 Integrated Schedule	
				2		Basis of Estimate	
				3		CL3 Cost Estimate - CAPEX	
				4		Cost and schedule risk analysis	
				5		Cost improvement review	
		3				Commercial	
			1			Contracts & Procurement	
				1		Contracts & Procurement Strategy / Plan	
				2		Preparation of tender documentation	
					1	Wet tow from site to lay-up	Support
					2	Lay-up	Support
					3	Decontamination	Support
					4	Recycling	

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
					5	Dry tow / wet tow to recycling	
				3		Tender issue and clarification response	
					1	Wet tow from site to lay-up	
					2	Lay-up	
					3	Decontamination	
					4	Recycling	
					5	Dry tow / wet tow to recycling	
				4		Tender assessment	
					1	Wet tow from site to lay-up	Support
					2	Lay-up	Support
					3	Decontamination	Support
					4	Recycling	
					5	Dry tow / wet tow to recycling	
				5		Tender notification	
					1	Wet tow from site to lay-up	
					2	Lay-up	
					3	Decontamination	
					4	Recycling	
					5	Dry tow / wet tow to recycling	
		4				Ad hoc client support	
		5				Regulatory & Legal	
			1			Identify Required Legal Compliance / Approvals	
			2			Permitting & Consent Plan	
			3			Regulatory Roadmap	

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
			4			Classification approval	
			5			Marine warranty	
			6			Insurance	
		6				Sustainability & HSES	
			1			Hazardous waste management plan	
			2			GHG Emission Forecast	
			3			HSE Management Plan	
			4			Project Environmental Plan	
			5			Environmental Impact Assessment	
			6			HAZID	
				1		Wet tow	
				2		Lay-up	
				3		Dry tow / wet tow	
		7				Submission for FID	
			1			Define phase summary report	
			2			Define phase presentation	
		8				Execute Transition	
	5					Execute	
		0				Key Milestones	
			1			Tender award	
			2			Wet tow from site to lay-up	
			3			Lay-up	Includes preparations for mooring
			4			Decontamination	
			5			Recycling	

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Codes		Levels				Description	Comments
Project	Phase	L1	L2	L3	L4		
			6			Dry tow / wet tow to recycling	
		1				Wet tow from site to lay-up	
		2				Lay-up	
		3				Decontamination	
		5				Dry tow / wet tow to recycling	
		4				Recycling	

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APPENDIX E RISK ASSESSMENT

No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
1	All	Tow to lay-up/ sheltered water delayed	Weather - around current location Mechanical failure Failure to obtain permits for disconnection (Environmental, Biosecurity - within 12 nmiles). Missed a key requirement for approvals - IMS Survey, Environment Unable to demonstrate approval requirements met (Include. Class Cert, Customs,) Import permits not complete	Reputation damage from Delay Additional cost Potential Loss of control Miss recycling / redeployment yard slot/ lay-up location slot	Approvals plan (all disconnection requiremetns) Disconnection Punchlist / Checklist Detailled scheudle, inlcuding all approvals activities Experienced tow contractor Experienced tow master Don't disconnect		3: Moderate	2: Unlikely	L	O
2	Eur/Tur	Wet tow delayed / takes longer than expected (E.g. Dampier spirit 120 day tow)	Weather during tow, storms to be avoided. Mechanical failure - of tow vessels, tow ropes, N.E. Bow/structure Piracy Failure to obtain permits Safety Incident	Reputation damage from Delay Additional cost Potential Loss of control Miss recycling / redeployment yard slot/ lay-up location slot	Experienced tow contractor Experienced tow master Pre-nominated ports of refuge Weather monitoring / planning Detailed tow plan, contractor reviewed, route, redundancy, Emergency prep.		3: Moderate	4: Probable	M	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
					Tow vessel vetting plan / marine warranty					
3	Eur/Tur	Wet tow delayed due to issues in Suez Canal	Weather Mechanical failure Failure to obtain permits Height restrictions Political issues, Barge goes sideways, gets wedged Insufficient tugs to manage the canal	Reputation damage from Delay Additional cost Potential Loss of control Miss recycling / redeployment yard slot/ lay-up location slot	Detailed knowledge of requirements to pass through Suez Canal Experienced tow contractor Experienced tow master		4: Serious	3: Possible	M	O
4	Aus	Wet tow delayed	Weather - around current location Mechanical failure of tow vessels, equipment, N.E. structure Failure to obtain permits for disconnection (Environmental, Biosecurity - within 12 nmiles). Missed a key requirement for approvals - IMS Survey, Environment Unable to demonstrate approval requirements met	Delay Additional cost Loss of control SEE ABOVE	Experienced tow contractor Experienced tow master SEE ABOVE		3: Moderate	3: Possible	L	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
			(Include. Class Cert, Customs,) Import permits not complete							
5	Eur/Tur	Either HLV not available (Vanguard, HUI RUI)	Failure to book HLV early enough (3 to 6 months). Prices increase 25% for late booking HLV delayed by other contracts HLV breakdown Refer above Tow Delay Risks	Delay Additional cost Requirement to lay-up NE, costs to maintain class	Book HLV with adequate cancellation clauses and delay penalties Experienced HLV contractor Chose lay-up location not affected by cyclones, <0.5m seas	1. Wet tow plan (Plan B) 2. Plan to remain at lay-up for longer. 3. Revert to Australian recycling (low probability)	4: Serious	3: Possible	M	O
6	Eur/Tur	Dry tow delayed	Weather Delay in loading vessel onto HLV Mechanical failure Failure to obtain permits SEE ABOVE Wet Tow Dleayed	Delay Additional cost	Detailed analysis of loading environmental limitations Experienced HLV contractor HLV Contractor Vetting, and check of contingencies.		2: Minor	2: Unlikely	VL	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
7	Eur/Tur	Dry tow delayed due to issues in Suez Canal	Weather Mechanical failure Failure to obtain permits Height restrictions, failure to remove flare tower prior.	Delay Additional cost Loss of control Denied access to Suez Canal	Detailed knowledge of requirements to pass through Suez Canal Experienced HLV contractor Experiecned HLV Master 4. Provide for early arrival at Recycling Yard		4: Serious	3: Possible	M	O
8	All	No recycling yards available to meet preferred schedule	Failure to book early enough (yards need up to 3 months notification) Busy recycling market, ~20 yards available Delays in procurement process (yard and recycler contracting)	Delay Additional cost Vessel lay-up until issue resolved	Commence contracting process as early as possible 1. Tender to multiple yards Allow float in project schedule 3. Multiple yard strategy 4. Consider combine tow/recycling contract strategy (One Contractor responsible for all).	1. Plan for extended Lay-up	4: Serious	2: Unlikely	L	O
9	Eur	Failure to transfer ownership of the vessel at the yard	Rejection of Hazardous materials inventory (IHM) Failure to agreed value of the vessel Yard not ready to accept the vessel Contractor renegs on terms	Delay Additional cost Vessel lay-up until issue resolved	1. Recycle yard to inspect N.E. prior to departure. 2. Contracting Strategy, key terms 3. Comprehensive pre-qual process for yards 4. Verified IHM in accordance with EU-SRR Contract executed (subject to conditions		4: Serious	2: Unlikely	L	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
					precedent)prior to departure from Aust Experienced commercial personnel included in project team					
10	Tur	Failure to transfer ownership of the vessel at the yard	Rejection of Hazardous materials inventory (IHM) - NORMS not acceptable Failure to agreed value of the vessel Yard not ready to accept the vessel Contractor renegs on terms	Delay Additional cost Vessel lay-up until issue resolved	Comprehensive pre-qual process for yards Verified IHM in accordance with EU-SRR Contract executed (subject to conditions precedent) prior to departure from Aust Experienced commercial personnel included in project team		4: Serious	2: Unlikely	L	O
11	Aus	Failure to transfer ownership of the vessel at the yard	Rejection of Hazardous materials Failure to agreed value of the vessel Yard not ready to accept the vessel - yard upgrades/permitting late Union resistance. Refer ABOVE for other detail	Delay Additional cost Vessel lay-up until issue resolved	Comprehensive pre-qual process for yards Verified IHM in accordance with EU-SRR Contract executed (subject to conditions precedent) prior to departure from Aust Experienced commercial personnel included in project team		4: Serious	2: Unlikely	L	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
12	Eur/Tur	Vessel not scrapped in accordance with EU-SRR (Ship Recycling Regulations)	Poor process control Yards do not meet their SRR certifications Turkish earthquake. Lack of commercial control/leverage over yard activities	Impact on reputation of Aust Gov Legal dispute with vessel purchaser	Detailed and proven recycling procedures in accordance with EU-SRR Extensive previous experienceoperating in accordance with EU-SRR Yard audit by DISER team, pre-qualiification including site visit.	Ongoing monitoring of SRR.	3: Moderate	2: Unlikely	L	O
13	Aus	Vessel not scrapped in accordance with EU-SRR or equivalent	Poor process control First time for Australian yardn (unkowns) Yards seek to apply Hong Kong standard or alternative to SRR Yards do not achieve or then meet their SRR certifications Lack of commercial control/leverage over yard activities	Impact on reputation of Aust Gov Legal dispute with vessel purchaser Regulatory gap anlaysis (HOLD)	Detailed and proven recycling procedures for handling smaller vessels Previous experience with recycling vessels	Frequent yard inspections possible.	3: Moderate	3: Possible	L	O
14	All	Change of regulations (EU-SRR)	Change in regulations in regard to handling waste from other countries Increase in regulatory standards EU-SRR revised Australia adopts EU-SRR++	Delay Additional costs and scope for disconnection, and/or recycling Vessel lay-up until issue resolved	Engagement with CODA - monitor development of Austalian regulations. (e.g Bass Strait prep) Liaise with Aust. Decommissioning Taskforce.		3: Moderate	2: Unlikely	L	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
15	All	Hazardous waste spillage during tow	Leak from hull Collision	Pollution / environmental incident Reputational impact Political incident Delay Additional cost	Pre-tow inspections and approvals Minimisation of Hazardous inventories prior to disconnect Extensive previous experience of towing contractors Minimise exposure to tow risks (use dry tow instead of wet tow)	Tow contractor's spill management plan.	3: Moderate	2: Unlikely	L	O
16	Eur/Tur	Hazardous waste spillage at yard, or mis-directed from yard.	Leak from hull Poor handling of waste at yard Yards not maintaining compliance with regulations	Pollution / environmental incident Reputational impact Political incident Delay Additional cost	Detailed and proven recycling procedures (EU-SRR compliant) Extensive previous experience SEE ABOVE - yard prequalification		3: Moderate	2: Unlikely	L	O
17	Aus	Hazardous waste spillage at yard, or mis-directed from yard.	Leak from hull Poor handling of waste at yard Yards not maintaining compliance with regulations More NGO and media attention because of local site	Pollution / environmental incident Reputational impact Political incident Delay Additional cost	Detailed and proven recycling procedures for handling smaller vessels Previous experience with recycling vessels Pre-pared strategy on "Aust will be receiving the hazardous wastes back regardless"	Media communication strategy	3: Moderate	2: Unlikely	L	O
18							3:	4:	M	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
1	Aus/Tur	Decontamination of the NE ends up costing the Gov more money than budgeted	More extensive hazardous materials than expected Cost of decontamination Decontamination undertaken in Australia Disposal of the waste	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Detailed IHM Use experienced decontamination contractor		4: Serious	4: Probable	H	O
1	Aus	Recycling of the NE ends up costing the Gov more money than budgetted	More extensive hazardous materials than expected NE needs to be laid up due to unavailability of yards Project is forced to Aust recycling option rather than international options Cost of recycling in Aust Lack of experience causes costs to blow out	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Federal funding envelope, application for. Project controls (schedule, Budget). Local tow - lower cost than tow to Europe. Recycling contract terms Financial pre-qual of contractors.		4: Serious	3: Possible	M	O
2	Eur/Tur	Recycling of the NE ends up costing the Gov more money than budgetted	More extensive hazardous materials than expected Tow to Eur/Tur cost more than scrap value offered by Recycling Yard NE needs to be laid up due to unavailability of yards	Additional cost (ultimately passed onto O&G industry) Reputational impact Delay	Federal funding envelope, application for. Project controls (schedule, Budget). Recycling contract terms		4: Serious	3: Possible	M	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
1	All	Failure to agree terms for sale	Aust Gov terms unacceptable to bidder / deter bidders Bidder terms not acceptable to Gov Material deviation from Industry standard contracts.	Delay Additional cost Vessel lay-up until issue resolved	Early engagement on Contract terms. Include discovery of contractor preferred terms during pre-qualification Review of Naval vessel scrapping contracts. Pre-brief / early briefing of Govt on likely T&Cs	Negotiation with contractors.	4: Serious	2: Unlikely	L	O
2	Eur/Tur	Deterioration of Commercial Advantage or Interest	Too many rounds of questions to contractors from Commonwealth. Commonwealth - not experienced in this area. Unstructured vendor engagement Yard confused CODA vs DISER vs Other Australian Entity.	Vendor Fatigue Loss of commercial reputation (especially with Euro/Tur contractors)	Provide single point of contact		4: Serious	3: Possible	M	O
4	Aus	Deterioration of Commercial Advantage or Interest	Too many rounds of questions to contractors from Commonwealth. Commonwealth - not experienced in this area. Unstructured vendor engagement Yard confused CODA vs DISER vs Other Australian Entity.	Vendor Fatigue Loss of commercial reputation	Australian yard/contractors better understand Australian Regulatory context		4: Serious	3: Possible	M	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
1	Aus	Bidder has insufficent knowledge of recycling requirements	Lack of experience with recycling vessel of NE size Lack of experience with working to EU-SRR standard	Aust bidders do not pre-qual for tender Political impact Forced to use incompetent contractor / additional costs and schedule for assistance	Early pre-qualification Engage with Dept of Defense for their experience.		4: Serious	4: Probable	H	O
2	All	N.E. Disposal Project team inexperienced	Insufficient O&G and marine project experience Insufficient scrapping experience Insufficient commercial experience Insufficent knowledge of government systems and processes	Delay Additional cost	Integrated team Source Subject matter experts		3: Moderate	2: Unlikely	L	O
1	Eur/Tur	Political tension increases risk to Aust Gov	Change of government at recycling location Change of government in Aust	Delay, to renegotiate per new Govt policy. Additional cost	Impacts and consequence assessment for Australian recycling option (detail costs, benefits, downstream requirements)		3: Moderate	1: Remote	VL	O
2	Aus	Choice of an Australian recycling location driven by policy requirements rather than technical and	Policy requirements Union & industry pressure Australian industry not experienced in handling large scale hazardous wastes projects	Additional cost (ultimately passed onto O&G industry) ofr e.g. Hazardous waste handling, disposal, mercury handling. Reputational impact Delay	Commercial Briefing for govt, detailing knock on costs and benefits of local options. Prepared to fully inform govt on decision impacts (HOLD - reword).		4: Serious	3: Possible	M	O

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No	Location	Top Risk Event	Cause - Child Risks	Consequence/Effect	Existing Treatments (before event)	Existing Treatments (after event)	Conseq	Likelihood	Risk/Opportunity	Status
		commercial. E.g. Australia vs Europe, and then WA vs SA vs Vic etc.			Consider starting from "Local Recycling - if not, why not".					
3	All	NE Disposal sets poor precendent for Decommissioning - too high or too low	First time project EU-SRR standards drive project Risk aversion	Industry impacted by future higher costs.			4: Serious	3: Possible	M	O

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Risk Matrix

							LIKELIHOOD – Probability of Loss / Gain					
						Category	Remote	Unlikely	Possible	Probable	Frequent	Highly Likely
						Occurrence	< 1 / 100yrs	10-100 yrs	2-10 yrs	every 1-2 years	1-3 times/yr	>3 / yr
						%	<5%	5-25%	25-50%	50-75%	75-90%	>90%
						Qualitative	Requires exceptional circumstances	Has occurred elsewhere	Has occurred before in industry	Has occurred before at OCE	Occurs in most circumstances	Occurs in almost all circumstances
CONSEQUENCE - Significance of Loss / Gain	SAFETY (Loss only)	ENVIRONMENT (Loss only)	REPUTATION (Loss)	REPUTATION / Business operations (Gain)	FINANCIAL (US$)	Category	1	2	3	4	5	6
	Minor, able to continue work straight away	Minimal pollution effect, contained locally	No impact	No impact	< $100k	Minimal 1	VL	VL	VL	L	L	M
	First aid only, can return to work same day	Minor pollution, slight or negligible impact, negligible remedial/ recovery work.	Limited community impact or interest. Reportable to Regulatory Authorities.	Limited impact or interest.	> $100k < $1mm	Minor 2	VL	VL	L	L	M	M
	Minor LTI, complete recovery expected	Pollution with some onsite impact & recovery work, possible outside assistance required to contain.	Internal disruption that could require outside help to manage. Community discussion, adverse local or financial publicity.	Moderate internal impact and improvement to ongoing business. Local interest.	> $1mm < $10mm	Moderate 3	VL	L	L	M	H	H
	LTI, irreversible health effects without loss of life. Part recovery	Significant pollution with offsite impact & recovery work.	Serious internal disruption adversely affecting ongoing business and requiring third party help. Widespread interest, lawsuits possible.	High internal impact and improvement to ongoing business. Widespread interest.	> $10mm < $50mm	Serious 4	L	L	M	H	H	VH
	Fatality or permanent disablement from occupational illness or disease	Massive pollution with significant site impact & recovery work.	Very serious business disruption and impact on company operations. National interest, adverse publicity. Litigation almost certain.	Very high impact on company operations. National and international interest	> $50mm < $100mm	Major 5	L	M	H	H	VH	VH
	Multiple Fatalities or multiple permanent disabling injuries from occupational illness or injury	Massive pollution with significant recovery work.	Catastrophic, International media interest. Litigation certain, potential for Director Criminal Charges.	Extreme, International media interest.	> $100mm	Critical 6	M	H	H	VH	VH	VH

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		ASSESSMENT / ACTIONS	CONTROL ACTION
Loss	Very Low	Risk to be managed via related work processes.	Manage/Monitor
	Low	Risk is generally acceptable / ALARP and presents minimal risk to personnel. Employees should be informed the risk exists. Management and control of risk will typically be procedural and/or via personal protective equipment.	Manage/Monitor
	Medium	Risk presents moderate impact to personnel and must be assessed to determine whether ALARP. If ALARP, risk management and control will be via procedures/PPE. If not, additional controls to be identified and implemented by management and workforce to reduce risk to ALARP.	If ALARP, Manage/Monitor If not, reduce to 'Low'
	High	Risk presents high impact to personnel and is beyond effective administrative management. Risk must be avoided by the adoption of elimination, substitution, isolation or engineering control.	Reduce to 'Medium'
	Very High	Risk presents unacceptable impact to personnel or plant. Once identified, activity must stop until controls are implemented to reduce risk to 'High' or lower.	Immediately Reduce to 'High'
Gain	Very Low	Very low opportunity: manage by routine procedure and do not prioritise unless all other opportunities exhausted	Manage/Monitor
	Low	Low opportunity; manage by routine procedures	Manage/Monitor
	Medium	Moderate opportunity: management responsibility must be identified	Assess
	High	High; Significant opportunity; Planning at senior levels to prepare to capture opportunity	Planning
	Very High	Very high; Step-change opportunity; Prioritised planning at executive/board level to prepare to capture opportunity	Prioritised Planning

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APPENDIX F OPTIONS REVIEW

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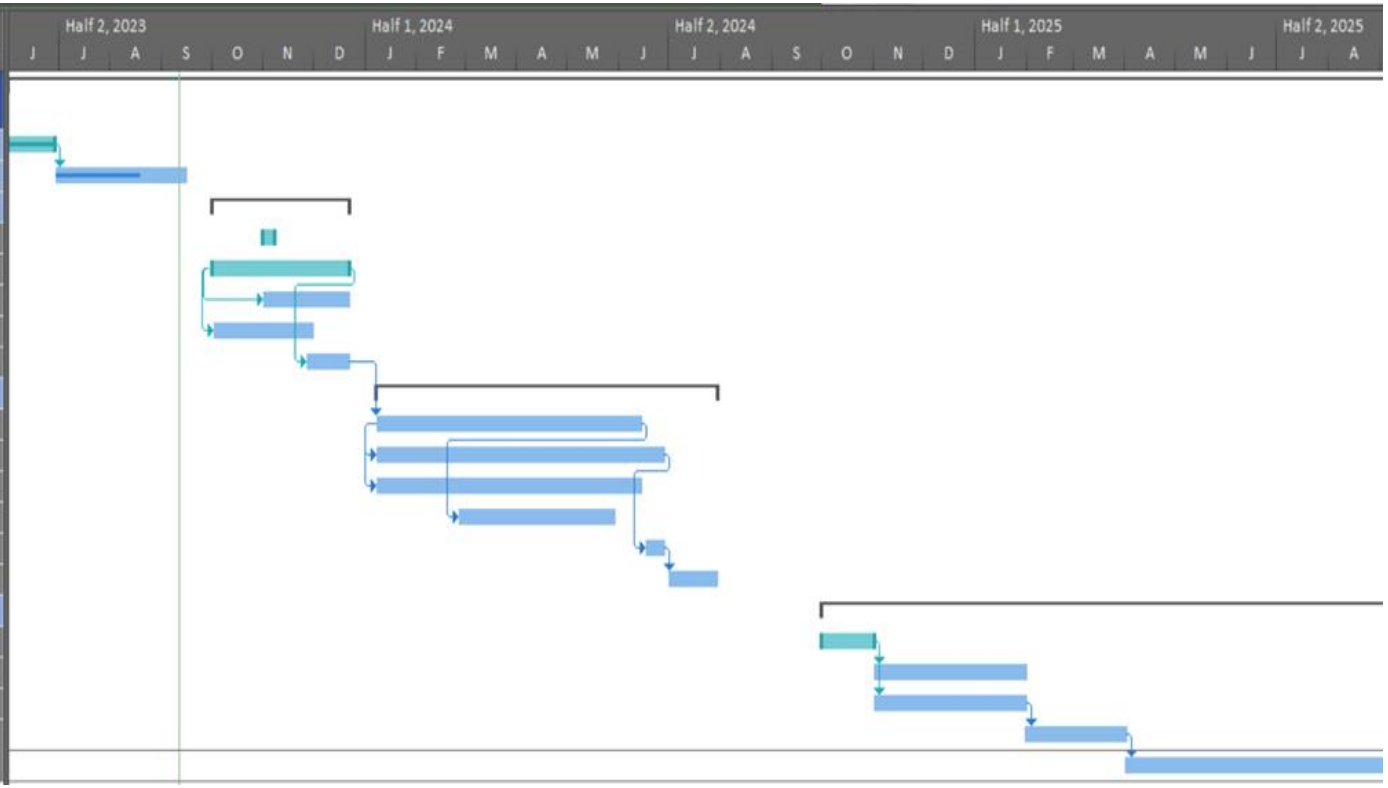
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APPENDIX G SCHEDULE

Schedule has been developed based on the option of scrapping in Türkiye, lay-up in Australia where decontamination is conducted, a dry tow to Europe and an FPSO ready for disconnection in October 2024.

Nu	Nu	Task Name	Start	Finish
0	0	Northern Endeavour End of Life Options Analysis	Thu 1/06/23	Fri 2/04/27
1	0	Identify	Thu 1/06/23	Wed 28/06/23
2	0	Assess Phase	Thu 29/06/23	Fri 15/09/23
3	0	Select Phase	Sun 1/10/23	Fri 22/12/23
3	1	IHM Review	Wed 1/11/23	Tue 7/11/23
3	2	Recycle Domestic Pre-qualification	Sun 1/10/23	Fri 22/12/23
3	3	Recycle International Pre-qualificatio	Wed 1/11/23	Fri 22/12/23
3	4	Layup Location Selection	Mon 2/10/23	Thu 30/11/23
3	5	Reporting	Mon 27/11/23	Fri 22/12/23
4	0	Define Phase	Mon 8/01/24	Tue 30/07/24
4	1	Definition	Mon 8/01/24	Fri 14/06/24
4	2	Commercial	Mon 8/01/24	Fri 28/06/24
4	3	Regulatory & Legal	Mon 8/01/24	Fri 14/06/24
4	4	Sustainability & HSES	Mon 26/02/24	Wed 29/05/24
4	5	Submission for FID	Mon 17/06/24	Fri 28/06/24
4	6	Execute Transition	Mon 1/07/24	Tue 30/07/24
5	0	Execute	Tue 1/10/24	Fri 2/04/27
5	1	Wet tow from site to layup	Tue 1/10/24	Fri 1/11/24
5	2	Layup	Fri 1/11/24	Fri 31/01/25
5	3	Decontamination	Fri 1/11/24	Fri 31/01/25
5	4	Dry tow to recycling	Fri 31/01/25	Tue 1/04/25
5	5	Recycling	Tue 1/04/25	Fri 2/04/27



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APPENDIX H LIST OF CLIENT SUPPLIED DOCUMENTS

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