



# Providing marine services for Offshore Floating LNG production

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## Presenter



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**Business Project Manager LNG**

- Andy has worked in the Oil & Gas Industry for the past 26 years, mainly in LNG shipping and small scale LNG; working on design, specification, installation and commissioning for a number of major LNG ship owners.
- He invented the Float Level Isolation Valve (FLIV) for the secondary level gauging system. He has worked in shipyards in Japan, Korea and China including LNGC service and dry-docking. In the last few years, Andy has been involved on various working groups including Emergency response for support craft for SIGTTO, Salvage of LNG marine fuelled vessel for SGMF and LNG Bunker procedures for ISO TC67. Currently, Andy is involved on several LNG, FLNG, FSRU projects for Smit Lamnalco.
- He is a member of IMarEST and has a Diploma (with Merit) in Technical Marine Superintendency and a Diploma (with Distinction) in Fleet Management.
- Andy is also the Chairman of SGMF Technical Working Group Committee.

# Agenda

## Introduction

- Introduction
- Purpose of Today

## Marine services for FLNG

- General project approach - philosophy
- General considerations for the marine services provider
- Operational profile outline
- Methodology of SBS / STS operations
- Possible marine spread arrangements for Offshore FSRU's
- Crew & Training requirements
- Systems & Procedures supporting Operational Excellence

## Summary





Who are we?

**Business**

**Shareholders**



## Our core markets

**Providing safe, reliable and cost-effective integrated marine service support to Terminals & Floating Production in challenging environments:**

- Support vessels for Floating Production – FPSO / FSO and FLNG
- Tugs for onshore LNG / FSRU, Oil & LPG Terminals
- Tugs and O & M services for Single & Multi-Buoy Terminals



# Operational setup



Over 225 vessels



3000 employees



50 contract



30 countries



5 regions



Local teams with local expertise and international experience



Support & compliance by HQ

- SHEQ
- Operations
- Technical
- HR
- Finance & Accounting
- Business Development



Over 200 vessels



2700 employees



50 + contracts



30 countries

HQ

Australia



## Purpose of Today

- To present an overview of marine services for offshore Floating LNG production and look into options.







**General project approach - philosophy**

# General project approach philosophy for marine services to Floating LNG



## The four requirements

### Operational Profile

- Shore base - Country demographics
- Environmental conditions (weather, wind, wave, current and tide)
- Understand the type and need of the FLNG operation, LNGC type and frequency
- Engage with the FLNG owner and LNG Carrier Owner to determine op profile and Joint Plan of Operation (JPO)
- Escort duties and pilot transfer location to be identified) and safety
- Simulation which may include a LNGC maneuverability study
- International, local legislation and applicable guidelines

### Scope of Work; fit for purpose

- Based on the operational needs, a scope of work (SOW) will be defined
- Based on the scope of work, fit for purpose vessels will be identified – standardization of tugs in FLNG facilities
- Number of offshore support craft Combinations
- Support craft with additional deck space
- General and additional duties
- Support craft should be LNG compatible

### Localization

- National Content
- Onshore support – warehousing, office, accommodation.
- Port fees
- Logistics, mooring buoys,, spares, fuel, food and water
- Environmental & emergency response
- SHE-Q
- Maintenance, Repair and Dry docking
- Competent Crews
- Joint training of Pilot & Tug Masters
- Continuation Training

### Commercial Acceptability

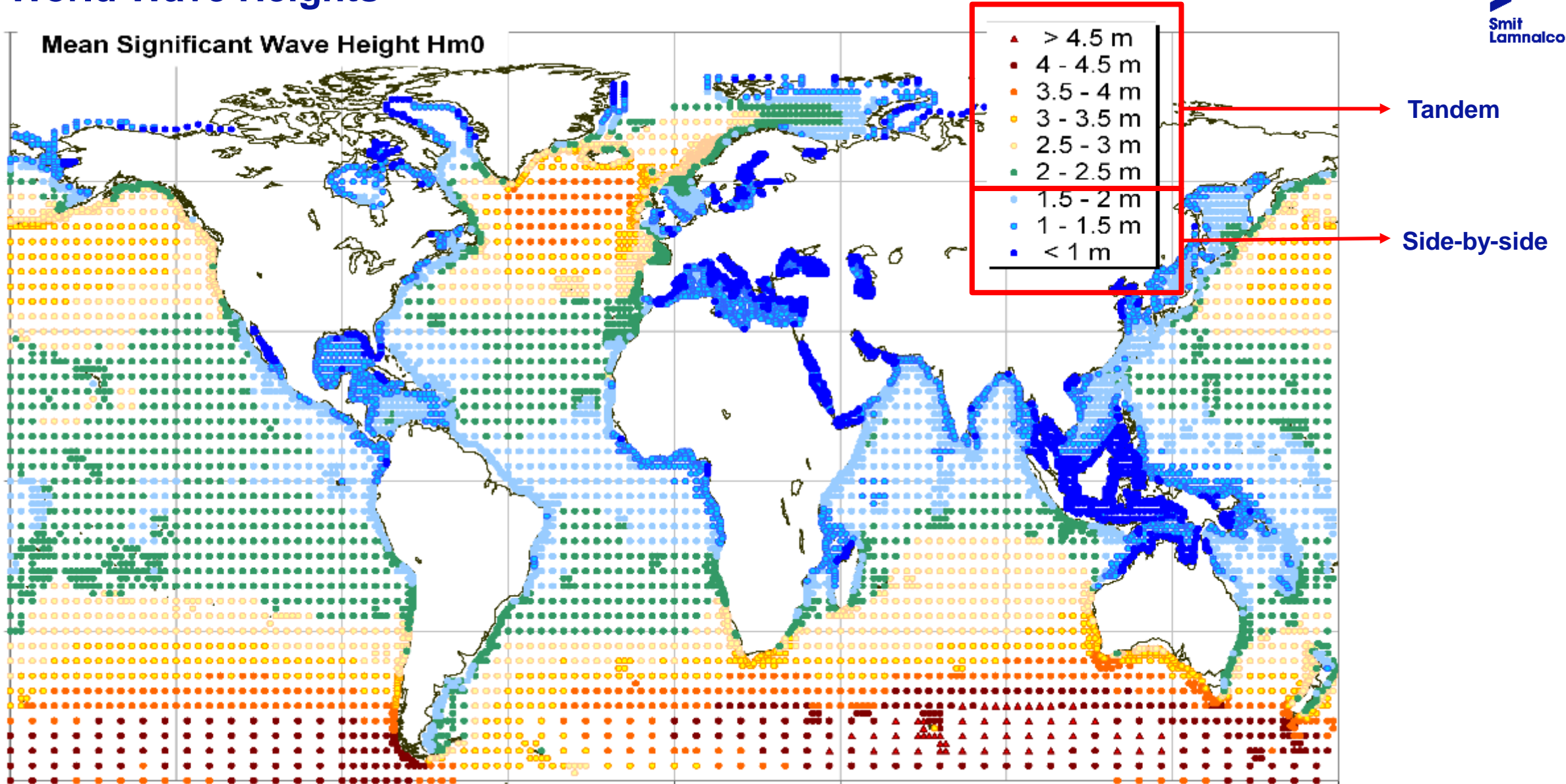
- Commercial acceptability will be achieved based on the understanding of the operational profile, the scope of work, fit for purpose and localization
- Commercial acceptability means acceptable to All parties



**General considerations for the marine service provider**



# World Wave Heights



# General considerations for FLNG operations - in more detail

In order to ensure a safe and efficient operation, the following points should be considered and addressed well in advance of the operation start up

## 1. Geographical location of Operation

- Country Characteristics
- Macro environment i.e. Political, Economical, Social factors
- FLNG location, water depth, navigation and area characteristics
- Environmental Conditions (wind, waves, tides and currents)
- Localisation and Legislation (Port Authority, Pilotage, Vessel Traffic System, requirements & rules of visiting LNG Carriers)
- Assistance to install and commission the FLNG

## 2. Tug design & Features

- Standard design, number, type & size of tugs and Bollard Pull
- Tug specification: LNG compatible, required equipment and outfitting
- Fit for purpose, new vessels are often preferred depending on life span of contract
- Flagging
- Fuel consumption and operating cost
- Gas fuel
- General and additional duties

## 3. Personnel & Crew Competency

- Operational Organogram with roles, responsibilities and crewing requirement
- Qualifications & Experience
- Training in line with the new SIGTTO principles
- Joint training of Mooring & Tug Masters

## 4. Safety, Health, Environment & Quality (SHE-Q)

- Standards, Process & Procedures and bridging plans
- Environmental & Emergency response
- Security

## 5. Start up

- Execution
- Training





# Tug/support vessel selection – fit for purpose

In order to identify the required number of tugs and/or support vessel(s) to be employed, the following should be considered:

## Terminal Operating Parameters - General Terminal hand book requirements

The floating terminal operating parameters should be identified such as:

- LNG Carrier (s) size, frequency and manoeuvrability;
- Weather-vaining (Yoke or SLT) or Spread moored
- Mooring Master transfer location (pilotage);
- Navigation approach and departure open ocean;
- Wave, wind, current – Operability window
- LNGC approach speed, escorting requirements – In open ocean - non active;
- Stopping distance and handling characteristics of the LNG Carrier prior to berthing;
- Mode of Offloading configuration (side-by-side loading arms or hose);
- Security and Emergency response;
- Communication;
- Combined training of Mooring & Tug Masters in all aspects;
- Fender management;
- Supply and Logistics capability;
- General additional duties;
- Mooring facilities on site.





# Marine study for confirmation



## Marine Study

- ✓ To confirm the correct configuration of the required capability, size and number of Tugs/support vessels, a marine study will be needed and should be performed by a reputable simulator company such as HR Wallingford Ltd or BMT Ltd.
- ✓ In some cases the marine service may undertake a marine study to determine the operational assessment- which can be compared with the bridge simulation
- ✓ The objective of the marine study is to confirm the selection of the correct tug/support vessel specification with the operation.

LNGC, LPGC and Condensate Tanker Size vs. Tug Requirements		
LNG Size M <sup>3</sup>	Tug #	Tug BP
140,000	TBD	TBD
180,000	TBD	TBD
Q-Flex / Q-Max	TBD	TBD

# Tug/support vessels standard specification and compatibility for FLNG

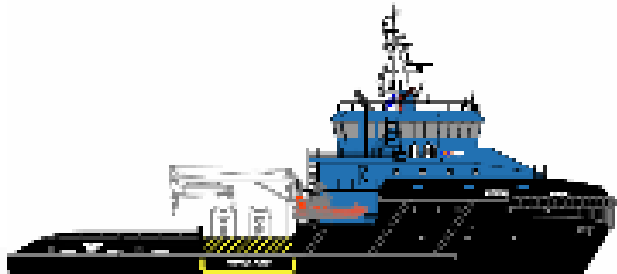
- Suitable for long periods of offshore operations – Seaworthiness and in line with all the relevant rules and regulations
- Explosive proof electrical equipment on deck;
- Gas detection and alarm device system (multiple gas), BA equipment;
- Remote controlled air-inlet valves;
- FiFi 1 minimum – foam, water curtains, water corridors, boundary cooling, full deluge systems;
- Escort notation may not always be required;
- Winch specification; Anti static lines
- No need for all tugs/vessels to have bow and aft winch combination;
- Spark arrestors in exhaust systems;
- Bow fender water spray system for pushing operations in swell conditions;
- Cylindrical fenders mounted with synthetic straps instead of steel chains;
- Thermal imagery;
- Type of fuel including management & monitoring;
- Accommodation;
- Additions – cranes, deck space, FRC, environmental response.



# Tug specifications



ASD



Auxilium



## Main particulars

▪ Length overall	42.00 metres	55.00 metres
▪ Bollard Pull	100 t ahead	100 t ahead
▪ Speed	13.5 knots min. calm weather / seas	14 knots
▪ Deck area	~85m <sup>2</sup>	300 m <sup>2</sup>
▪ Fuel oil	333.0 m <sup>3</sup>	765 m <sup>3</sup>
▪ Potable water, domestic	27.8 m <sup>3</sup>	340 m <sup>3</sup>
▪ Vessel Crew and additions	Crew = 7-10 Rescue capability = 85	Crew = 12 Passengers = 12 Rescue capability = 80 survivors (Tropical Zone)
▪ Winches	Forward + Aft optional	2 x Central winches (working over bow and aft)
▪ Propulsion	2 x ASD	2 x ASD – 2 x bow thrusters
▪ Fire fighting	Class notation 1 (2400 m <sup>3</sup> / hr) with water spray + foam and lifesaving arrangement	Class notation 1 (2400m <sup>3</sup> / hr) with water spray + foam and lifesaving arrangement – MOB boat (FRC)
▪ Foam	19 m <sup>3</sup>	26 m <sup>3</sup>
▪ Dispersant	8 m <sup>3</sup>	30 m <sup>3</sup>
▪ Additional		✓ Class 2 Dynamic Positioning system for more stable positioning ✓ Environment & Green Passport – CLEAN ship notation ✓ (anti) pollution system – spray booms + recovered oil tanks



## Living on board – crew comfort



**Crew comfort is paramount!**



**Marine support duties**



# Marine services - Floating LNG including offshore FSRU's





# Operational overview Berthing and Un-berthing

## 2 or 3 ocean going tugs between 80 – 100 TBP

- Minimal crew 7 – 12 people.
- Tugs are designed in accordance with all rules and regulations and are suited to operate offshore for long periods of time.

## Primary duties

- Mooring;
- Berthing & un-berthing;
- Escorting.

## Permanent moorings

- Permanent moorings may be installed for support vessels to reduce fuel consumption and permit station-keeping in periods where vessels are not in active use.





# Operational overview

## General overview of a Berthing Operation:

- A. The LNGC arrives at the designated location (pilot station) xx miles from the FLNG facility. The approach should be determined by the wind, current, sea and swell.
- B. Pilot transfers to ISV and deploys to pilot station along with 2<sup>nd</sup> tug. Pilot transfers from ISV to the Carrier in accordance with Pilot rules and regulations.
- C. One, Two or Three ISV's take up a passive or active escort and accompany the Carrier on the agreed route and approach. Tugs tether before approach.
- D. LNGC lined up with FLNG, distance of 150 - 200m, ready to begin the berthing process (laser guided system).
- E. Line up and execution of berthing in pull and / or push mode (ASD / Rotor).
- F. Slow speed to fender kiss.
- G. Lines out.
- H. After completion of berthing, the LNGC is moored, ISV's go to designated standby position and exercise standby or security duties.

## General overview of an Un-Berthing Operation:

- A. Prior to un-berthing, the wind, current, sea and swell will be evaluated.
- B. Pilot joins the Carrier if required.
- C. Safe to un-berth.
- D. ISV's tether and unmooring begins. ISV's un-berth the Carrier.
- E. ISV's pull the Carrier back to the designated distance.
- F. Escort to release point. ISV's untether.
- G. Pilot transfers to the ISV, if required.
- H. ISV returns pilot to FLNG.
- I. ISV's go to standby or security positions or return to designated location.





# Operational overview Additional Duties

## 1 x Supply and support tug for logistics for FLNG

- required for supply and logistics support.
- can act as an additional tug if required.





# Operational overview

## Additional duties

- Logistics (including chemicals, refrigerants, consumables, stores, supplies, spare parts etc.).
- Standby duties.
- Environmental protection (pollution control, oil recovery, skimmers & oil boom).
- Towing duties.
- Transportation of personnel.
- Security surveillance, zone management and watch.
- Hose and Fender management handling and maintenance.
- Helicopter standby.
- Helicopter fuel supply.
- Additional accommodation.
- Dive support.
- ROV platform with limitation.
- Support to FLNG O&M.
- Other duties within capability.





# Operational overview

## Helicopters

- Will be used to transport personnel on / offshore.
- Tugs will be needed for stand by duties

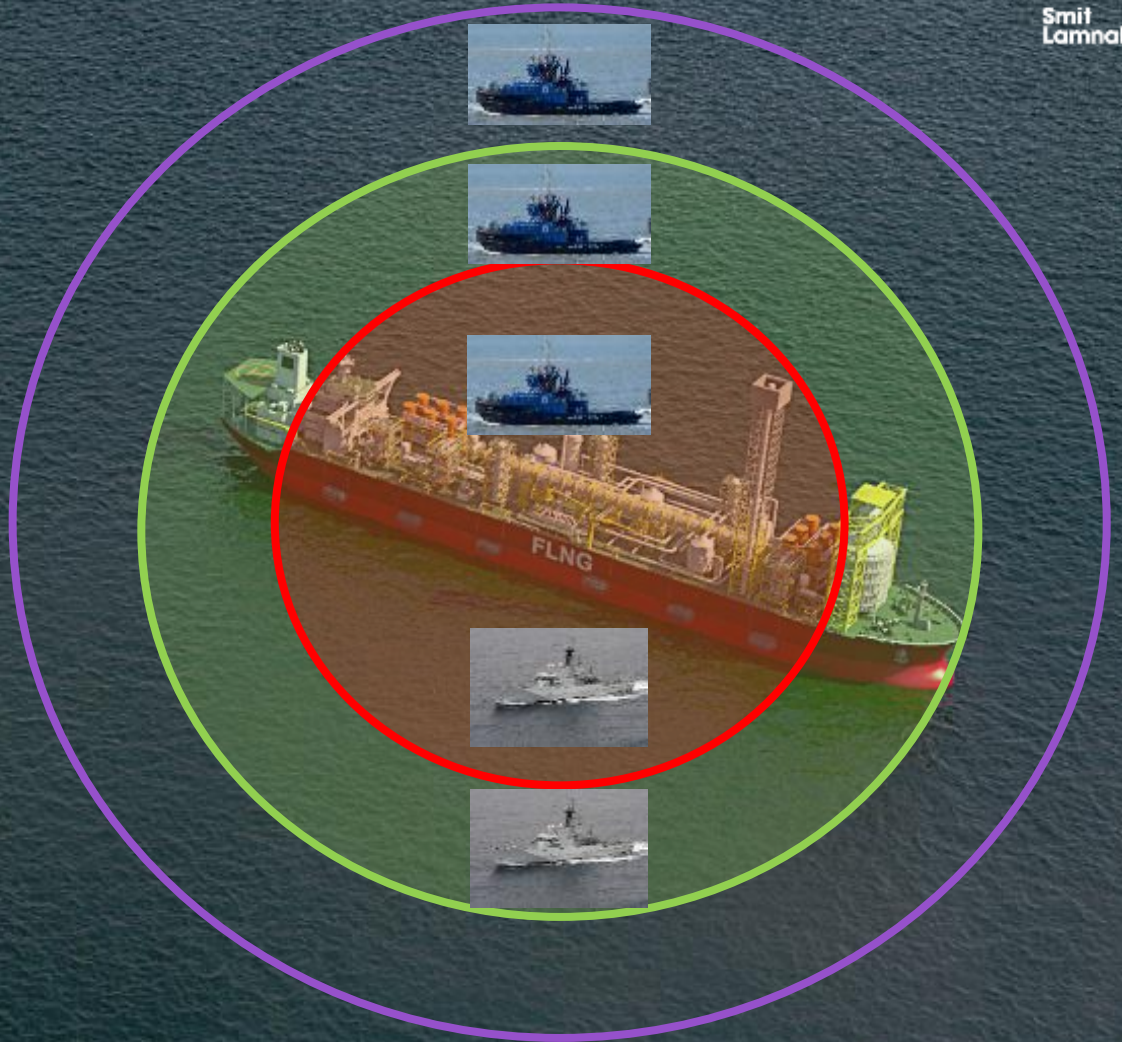




# Zone management duties to the FLNG

- The marine service provider may be responsible and can provide safety zone & security management around the FLNG.
- Three zones could be defined based on client demands and security risk assessment:
  - ✓ **Monitor Zone:** to a radius of **XXX** (suggest 15+) NM around the FLNG.
  - ✓ **Restricted Zone:** to a radius of **XXX** (suggest 10+) NM around the FLNG.
  - ✓ **Exclusion Zone:** to a radius of **XXX** (suggest 500 -1000) meters around the FLNG.

**Reaction time management must be considered  
involving third parties**





# Zone management duties to the FLNG

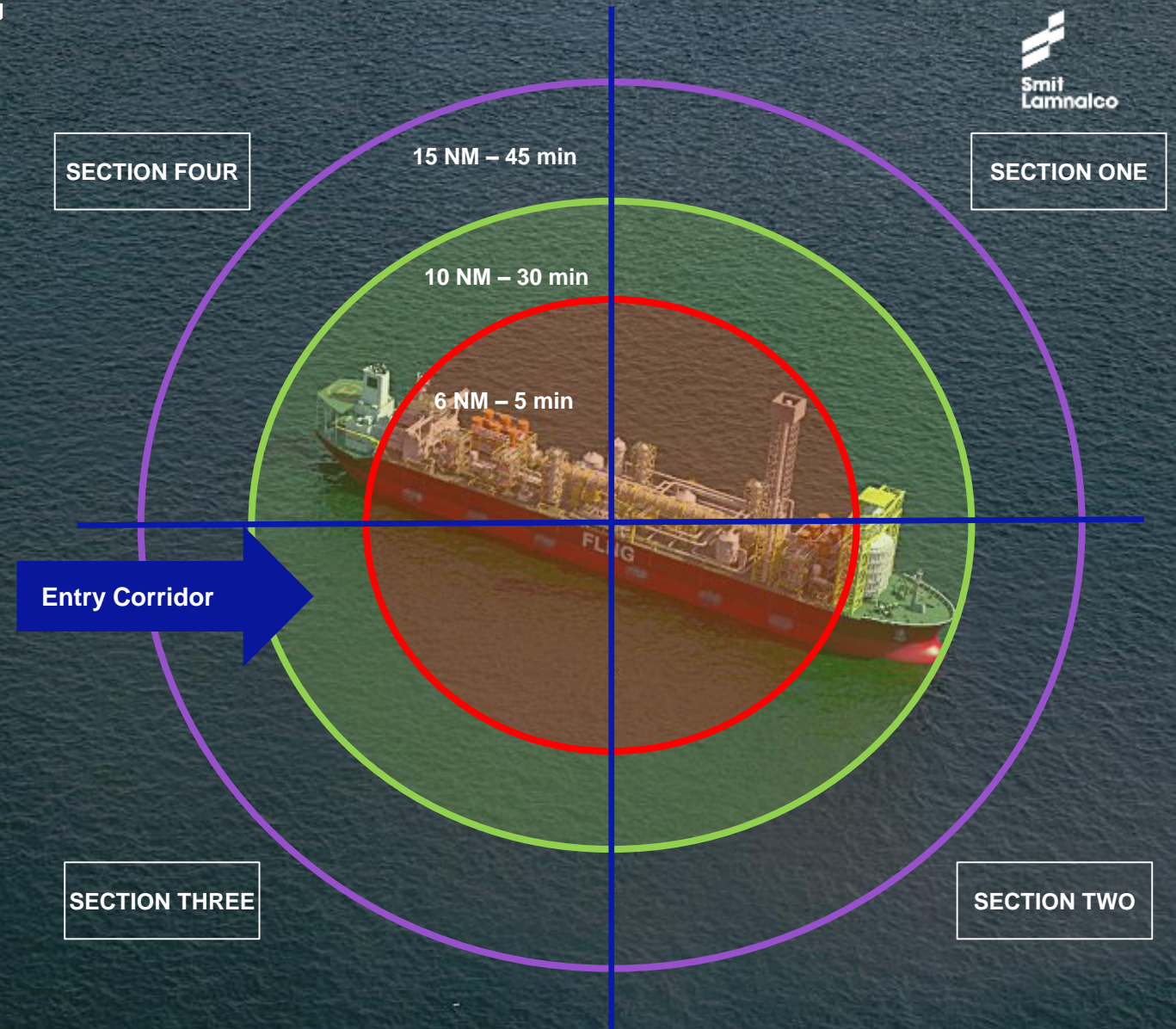
- Eyes and ears - an extension to the FLNG radar monitoring range.
- Ensure earliest warning of unauthorized vessels or aircraft approaching the FLNG location.
- Attempt to identify unauthorized vessels and aircraft and try to establish their intentions.
- Immediately advise the FLNG Central Control Room and provide the following details:
  - ✓ Size and number of vessels / aircraft;
  - ✓ Speed of approach;
  - ✓ Relevant information e.g. number of personnel / armed / unarmed;
  - ✓ Details of the approaching vessels intentions;
  - ✓ Direction of approach;
  - ✓ Location in relation to the FLNG;
  - ✓ Other relevant information.
- Monitor and follow at a safe distance, as directed by the FLNG Central Control Room.
- The Master must never endanger the vessel and the live of his crew (overriding authority).





# Zone management duties to the FLNG

- Command & Control is always with the FLNG.
- Understanding of the security risk assessment.
- Bridging plan with FLNG security arrangement (ISPS).
- The threat.
- Threat code.
- Security vessel interaction.
- Involvement of third-parties.
- Any drills have to be agreed & rehearsed.
- Notice of Arrivals (NOA) & Departures (NOD).
- Designated “entry corridors”.
- Response times.
- FLNG citadel occupation.
- Agreed rendez-vous for evacuation for support vessels and standby to return.
- Marine contracts manager living on the FLNG
- Marine services stores



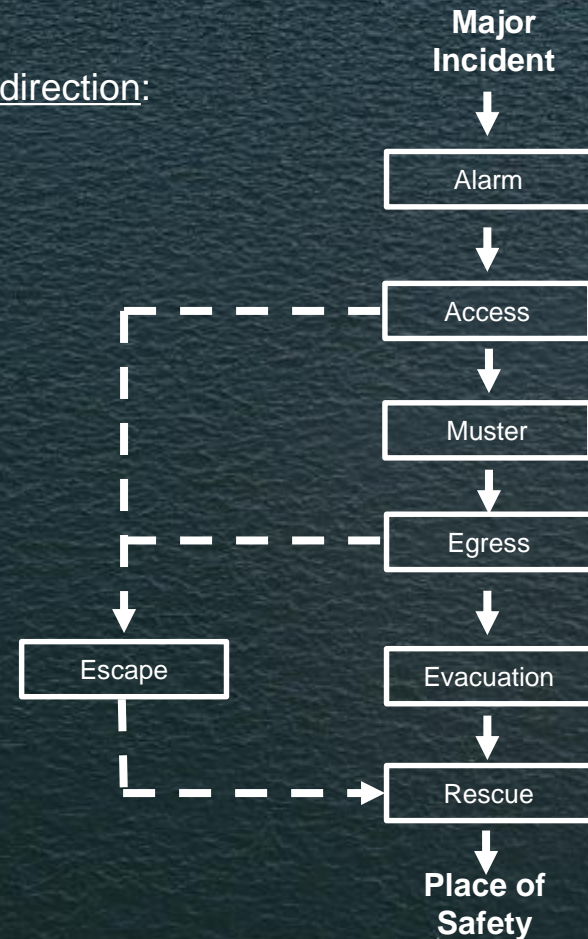


# Evacuation, Escape and Rescue (EER)

- First responder and assistance to the FLNG EER plan in accordance with the rules and regulations.

ISV's can provide the following duties under direction:

- Firefighting.
- Water curtains multi- & single delivery.
- Water corridors.
- Boundary cooling.
- Emergency evacuation platform.
- Marshalling.
- Medical assistance.
- LNGC removal assistance in accordance with ESD 1 & 2 procedures.



Basic EER Stages





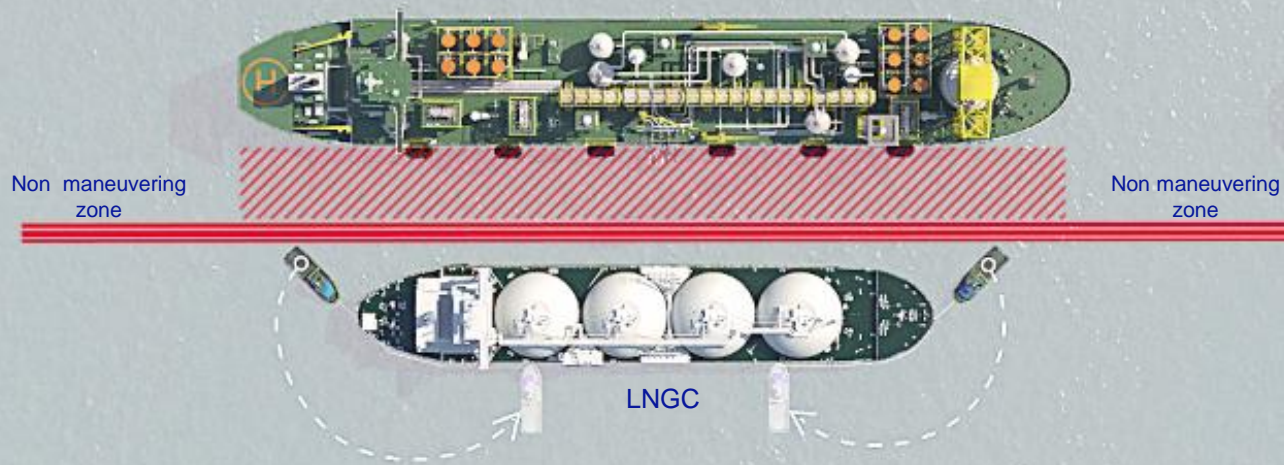


Methodology of SBS operations to FLNGs



# Maneuvering zone management to avoid tug collision with the FLNG

ASD operation



Pull to push repositioning mode

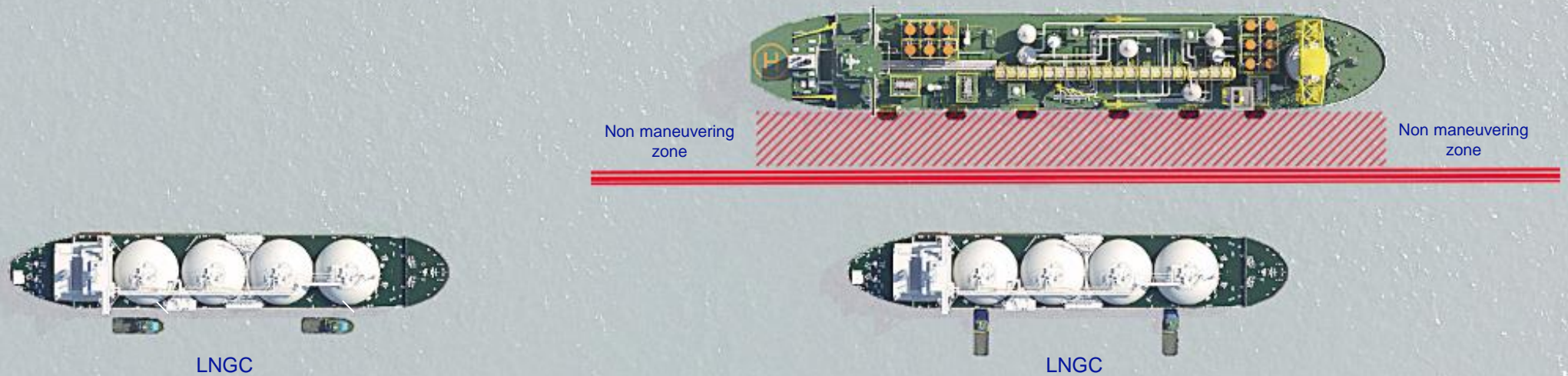
Rotor operation



Pull to push non-repositioning mode



# Calm water - maneuvering zones



Pull non-repositioning mode

Pull to push non-repositioning mode



What about Tandem offload is it possible?



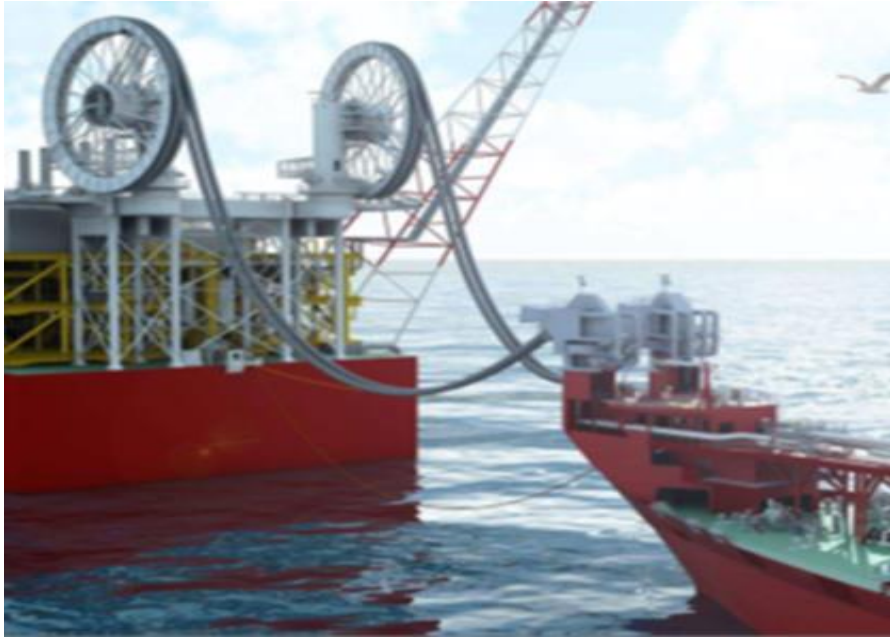
# FLNG Tandem offload

## The process

- The transfer system – A number of options – Aft to bow, hawser and floating hose. SBS none mooring and mooring systems
- Cryogenic transfer – floating and non floating

## The support vessel requirements

- Inert gas system on board the support vessels for purging and inerting.



# Floating Hose Management - the challenges



- Long length floating hoses have the potential to connect a LNG carrier's manifold – no modification
- Size ideally 20"
- Considerable testing has taken place but no cryogenic floating hose in service yet!
- Pressure loss
- Heat loss but what about liquid lock?
- Transfer calculations
- Will we see cryogenic floating hoses?



# LNG Carrier Manifold modification and concerns



- Hose weight consideration
- The Manifold of the carrier is not designed to accept this type of weight and movement
- Modification may be needed to the manifold
- Crane modification may be needed
- Hose management will be required
- Sloshing may or may not be an issue in higher swell

**It is possible that future LNG carriers will be built with DP2 – If this is the case how does the marine support role change?**

# Bunkering offshore from an FLNG to the support vessel

Questions	Answers
Is it beneficial?	<ul style="list-style-type: none"><li>▪ Environmental benefit</li><li>▪ <b>Fuel availability on location – Two options LNG / CNG</b></li><li>▪ Is there a cost advantage?</li></ul>
How do we move forward?	<ul style="list-style-type: none"><li>▪ Research &amp; feasibility study – including bunkering procedures and based on the operational profile</li><li>▪ Present the research &amp; feasibility study</li></ul>
How to implement into the FLNG boundary?	<ul style="list-style-type: none"><li>▪ Include a bunkering capability in the design</li><li>▪ Develop procedures in line with all the rules &amp; regulations i.e. SIGTTO, SGMF, IGF, IGC, ISO, Class etc</li><li>▪ Include in the ISV specification</li></ul>
Can we take power from the FLNG?	<ul style="list-style-type: none"><li>▪ The tugs spend considerable time 'idling'</li><li>▪ Tugs mooring to the FLNG with an umbilical power connection which would offer considerable fuel saving</li></ul>





**Crew & Training requirements**

# Tug Master & Crew Training – qualified and certified



- The Master, Chief Officers, Engineer Officer and Deck hands will need training, knowledge and competence in all aspects of LNG including the FLNG operations.
- Emergency Response Training to be conducted in line with the new SIGTTO Principles.
- Training in Zone Management and security
- Train the Tug masters and Mooring Masters together
- Bridging Plans



Course	Master	Chief Officer	1 <sup>st</sup> Engineer	2 <sup>nd</sup> Engineer	Seaman
Familiarisation with Ship	When first time on vessel	When first time on vessel	When first time on vessel	When first time on vessel	When first time on vessel
Managing Maritime Risk DNV Course	Once-only	Once-only	Once-only	Once-only	Once-only
Emergency Response Tugs & Terminals and FIFI 1	Once-only	Once-only			
LNG Advanced Induction Course	Every 2 years	Every 2 years	Every 2 years	Every 2 years	Every 2 years
Simulator Course	Every 2 years	Every 2 years			
Pilot/LNG Carrier Master/Tug Master Workshop	Every 2 years or when required by change in operations	Every 2 years or when required by change in operations			
STCW Training	Every 5 years	Every 5 years	Every 5 years	Every 5 years	Every 5 years

In addition to the above the vessel crew will take part in regular drills as indicated in the following matrix:

Drill	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Sopep	X						X					
ISPS*		A			B			C			D	
Abandon Ship	P	P	F	P	P	F	P	P	F	P	P	F
Fire	P	P	F	P	P	F	P	P	F	P	P	F
Man-Over-Board			X			X			X			X
Emergency **				X						X		

\* ISPS drills, if applicable (> 500GT)





LNG Carrier Fender Kissing with FLNG



**Summary – Anything is possible Just ask**



Thank You!