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LNG BUNKERING: ADDRESSING SIMOPS

CONDUCTING SIMULTANEOUS OPERATIONS WHILE BUNKERING LNG FUELED VESSELS

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This document has been developed by ABS Group to assist the decision-making process for allowing simultaneous operations (SIMOPS) to be conducted on regulated waterfront facilities in the vicinity of liquefied natural gas (LNG) bunkering operations. Information included in this document was developed and provided by ABS Group to the LNG Sub-Committee of the Chemical Tanker Advisory Committee (CTAC) for the purpose of providing advice and consultation to the Coast Guard's Marine Safety and Environmental Protection Directorate.

On June 8, 2017, the US Coast Guard (CG-OES) issued Policy Letter No. 01-17 titled, *Guidance for Evaluating Simultaneous Operations (SIMOPS) During Liquefied Natural Gas (LNG) Fuel Transfer Operations*. This policy letter provides guidance to Coast Guard Captains of the Port (COTPs) when considering safety issues associated with SIMOPS while conducting LNG fuel transfer operations. The policy encourages COTPs to determine in advance whether the facility and vessel owner/operator intend to conduct SIMOPS in the waterfront facility's marine transfer area. If planned, the COTPs should consider the discussions and recommendations provided in the policy when evaluating and/or approving operations, transfer and emergency manuals for LNG facilities. The policy guidance includes risk analyses as a tool to determine the consequences and possible mitigation for reducing risk during LNG bunkering while SIMOPS are occurring.

A Field Notice (01-2017) was issued on August 14, 2017, by the Liquefied Gas Carrier National Center of Expertise (LGC NCOE) titled, *Recommended Process for Analyzing Risk of Simultaneous Operations (SIMOPS) During Liquefied Natural Gas (LNG) Bunkering*. The field notice provides amplifying information for implementing the guidance found in the subsequent policy letter.

BACKGROUND

Over the past few years, the idea of using LNG as a marine fuel has gained popularity. The use of LNG as a marine fuel is driven by several factors, including reduced emissions to meet stricter emission standards, development of new domestic natural gas deposits which increases the supply of LNG fuel, and the lower cost of LNG compared to petroleum-based fuels.

Transfers and bunkering with LNG is considered to be more of a safety risk than with petroleum-based fuels because of the hazards associated with LNG. In the past, with few exceptions, LNG marine transfers in the US have been limited to large export terminals that do not engage in other operations. SIMOPS while transferring LNG at these facilities have been limited by choice or the limitations of dock access by vehicles.

Vessel owners and operators note that the amount of time that a vessel is not underway directly affects their profitability. Therefore the less time that a vessel remains at berth the better. Vessels are usually on a tight schedule. As such, they commonly need to conduct non-disruptive flow of vessel and port operations while bunkering with petroleum-based fuels at the same time.

With the introduction of LNG-fueled vessels and an emerging need to bunker at facilities that are engaged in other operations (e.g., passenger, cargo, or loading vessel stores, removing garbage, etc.), SIMOPS (bunkering and other operations) is considered essential if vessels are not to increase their time at berth.

Since the request to conduct SIMOPS will be included in many operations that involve the bunkering of a LNG-fueled vessel, this paper has been prepared to assist in evaluating the risk to the vessel being bunkered, the facility where the vessel is berthed, and all workers (directly involved or uninvolved) at the facility involved in SIMOPS.

EVALUATING RISK

Risk Assessment: Currently there is limited experience addressing the concept of conducting SIMOPS while LNG fuel transfer operations are taking place. If SIMOPS are to occur during LNG fuel transfer operations, a formal risk assessment should be conducted by the facility owner to address the added hazards and evaluate the potential risks.

The risk assessment should be conducted in accordance with a recognized standard and include

stakeholders, regulators, and local organizations in addition to being coordinated by a facilitator. The facilitator should be a qualified individual and have experience with conducting risk assessments, a knowledge of LNG hazards, an understanding of the facility's operations, and an understanding of vessel operations for the type of vessel that the transfer will occur. There are several resources that give examples of risk assessments that can be used. They include the U.S. Coast Guard's Risk Based Decision Making (RBDM) Guide, and guidance published by the American Petroleum Institute (API), American Bureau of Shipping (ABS) or other Classification Societies, International Safety Guide for Oil Tankers and Terminals (ISGOTT), Society of International Gas Tankers Terminal Operators (SIGTTO) and the International Gas Carriers (IGC).

Risk assessments should be quantitative or qualitative in nature. Quantitative analysis may be assisted by existing data related to failure rates of equipment or mechanical systems in close proximity of the transfer. Qualitative analysis may be best used when looking at items that may not have had a clear history of performance. The human factor of a LNG transfer may be one of the items that are better analyzed by a qualitative risk.

Completed risk assessments should be reviewed if the mode of transfer, the facility transfer operations, or vessel transfer operations are altered in a way that may cause a change in the risk associated with the operation.

A. Information to be considered prior to conducting a risk assessment.

Before conducting a risk assessment, information regarding the vessel, the facility, the transfer operation, and response capabilities should be collected.

1. Vessel particulars (vessel to be bunkered*)

Vessel particulars should include

(a) An understanding of operations for the ship while in port including

1. Amount of time that vessel is expected to be in port
2. How cargo is loaded onto ships (overhead crane, conveyor/ auger, driven-on etc.)
3. How passengers embark/disembark
4. How luggage is loaded/unloaded
5. How ship stores are loaded
6. Other services (crew changes, maintenance, garbage, etc.)

(b) A general layout of vessel fuel gas system including

1. Fuel tank(s): type, location, and capacities
2. General Arrangement
3. Hazardous Area or Hazardous Zone Plan
4. Vent mast and ventilation system arrangements
5. Fuel gas supply system arrangements (Piping and Instrumentation Diagram (P&ID))
6. Fuel bunkering station arrangement (P&ID)
7. Safety Equipment that can include
    i. Emergency Shut-Down Device
    ii. Gas Monitoring
    iii. Drip Pan/Water Curtain
    iv. Communications
    v. Automatic Vapor Pressure Release Locations
    vi. Exclusion Zones
    vii. Ship to shore communications
    viii. Grounding/Static Electricity protection
    ix. Gangway location and access

(c) Transfer procedures

(d) Emergency procedure

(e) LNG Fuel Transfer System Operations Manual

(f) Training

(g) Position of the Vessel LNG Manifold: Depending on the vessel, LNG loading manifolds can be located on stern, waterside, or port-to

areas. When evaluating SIMOPS, the location of the manifold is an important factor that needs consideration.

1. **Port-to**: This location will have the closest proximity to persons on the facility. Depending on weather conditions, a LNG release can involve larger areas of the facility.
2. **Stern**: Loading to a stern manifold can still have significant impact on the facility, depending on the position of the manifold and the source of the LNG. This position also can cause dispersion of gas to areas under the pier which could collect to unsafe levels or be funneled to areas on the facility that are outside the designated exclusion zone(s) for LNG transfers.
3. **Waterside**: A release on the waterside may have the least impact on the facility operations although there may be some impact dependent on the size of the vessel, the position of the manifold, and weather conditions. Though the facility may not be impacted the navigation channel, vessels using the channel and other facilities may be impacted by an incident or release.

(h) Hazardous Zones: Distances around LNG fuel manifolds are established to maintain safety and reduce risk of igniting LNG if released. Though these zones allow operations to be conducted within their perimeter, ignition sources, accommodation openings, and ventilation air inlets should be prohibited. Examples of these zone distances in international codes include the IGF Code limits the Electrical Hazardous Zones to 4.5m from source as per IGF Code Section 12.5. It also adds another 1.5m buffer distance for ventilation air inlets as per IGF Code Section 13.3. Therefore the distance for air inlets from a hazardous zone source may be 6m. In addition to the Electrical Hazardous Zones, a distance of 10m from pressure relief valve vents is addressed by 6.7.2.8 - 6.7.2.9. Coast Guard Guidance from OES 1-17 and the LGC NCOE Field Notice (01-2017) defines these zones.

(i) Multiple Openings into the Hull: Many vessels have multiple hull doors that are open to receive stores, utilities, cargo, or transfer garbage to the facility. These openings should be evaluated with relationship to

1. how far they are from the transfer location
2. are they essential to SIMOPS or can others openings further away from the transfer location be substituted
3. how fast they can be secured in an emergency.

(j) Response capabilities including fire and medical

***If a bunker barge/vessel is used in the transfer, the same type of information should be gathered for that vessel.**

2. Facility Particulars

Facility particulars should include:

(a) An understanding of operations in the vicinity of the LNG fueling operation which would include:

1. Amount of time that vessel is expected to be in port
2. How cargo is loaded onto ships (overhead crane, conveyor/auger, driven-on etc.)
3. Other vehicles/conveniences used to deliver cargo to dock area
4. How Passengers embark/disembark
5. How luggage is loaded/unloaded
6. How ship stores are loaded
7. Other services (crew changes, maintenance, etc.)
8. Location of other berths and vessel operations on the facility
9. Other fueling operations
10. Egress routes on the facility
11. Locations of shelters in place
12. Other activities (traffic) on the facility w/location
13. Possible ignition sources in the vicinity

(b) A general layout of fuel system including:

1. Source of fuel (truck, fixed tank, portable tank, bunker vessel, etc.) which includes location and capacities
2. Transfer mode (fixed pipe to manifold, loading arm, quick connect, hoses, above ground, below ground, under dock, etc.)
3. Safety/Release Mitigation Equipment that can include
    i. Emergency Shut-Down Device
    ii. Gas Monitoring
    iii. Drip Pan
    iv. Communications
    v. Automatic Vapor Pressure Release Locations
    vi. Vapor recovery
    vii. Emptying hose/pipe

(c) Other Structures in Proximity of Loading: Warehouses and passenger terminals should be evaluated. Dispersion of a LNG release can enter openings in these structures and in some instances accumulate to unsafe levels. All structures near or in vicinity of the LNG transfer should be evaluated with relationship to

1. how far they are from the transfer location
2. are all openings to the structures necessary during loading operations or can some be secured

3. how fast they can be secured in an emergency
4. can persons inside these structures be safely evacuated or can the structure serve as a shelter in place

(d) Pier/bulkhead construction considerations (important for evaluating fracturing due to contact with cryogenic liquids

(e) Lighting type and other electrical equipment on the pier

(f) Drainage on pier (sewer system, sump, etc.)

(g) Transfer procedures including DOI

(h) Emergency procedure

(i) Training

(j) Response capabilities including fire and medical

3. Transfer Operations

(a) Information regarding the transfer operations should include

i. Amount of LNG to be transferred
ii. Compatibility of bunker and residual fuel (temperature and density)
iii. Transfer rate and pressure
iv. Time for hook-up transfer and disconnect
v. Number of hook-ups/disconnects per fueling (if multiple trucks/ portable tanks are used)
vi. Loading arm, hose, quick connect, dry break-away coupling information

B. Risk Assessment Method

The SIMOPS risk assessment approach should consider risk as the combination of an undesired event occurring and the consequences if the event does occur. Fundamentally, this means asking: “What can go wrong?”, “What is the likelihood that this will occur?”, and “How severe can the consequences be?” By answering these three questions, the facility, in cooperation with the vessel and local stakeholders, can effectively characterize the risk and recommend strategies to reduce the identified risk.

1. Assessment Plan

A written plan should be prepared for the SIMOPS risk assessment to provide scope and direction and should be submitted to the Coast Guard and any other entity that will regulate operations on the facility or vessel. The plan should contain the following information:

(a) Description of operations covered by the assessment (vessel, facility operations, SIMOPS and bunkering operation);

(b) Scope and objectives of the assessment;

(c) Point of contact for the assessment and qualification of key persons conducting/facilitating the assessment.

(d) Key stakeholders to be involved in assessment (e.g. vessel and facility reps, fueling operator, venders, responders)

(e) Relevant information and available data (e.g. vessel/facility layout, bunkering procedures;

(f) Description of methodologies to be used when performing the assessment;

(g) Risk metrics that will be used to evaluate the risk level of hazards and/or scenarios;

(h) Resume of qualified individual(s) coordinating or facilitating the assessment

2. Scenarios

Scenarios developed for the risk assessment should take into account the transfer system of the LNG and facility and vessel operational particulars. Scenarios should include:

(a) Failure of transfer pipe or hose

(b) Failure at connection

(c) ESD Failure

(d) Overfilling tank

(e) Liquid trapped/blocked in the transfer line

(f) Venting close to ignition source

(g) Insufficient pre cooling of lines and equipment

(h) Vapor recovery failure – venting/release

(i) LNG left in the line when disconnecting

(j) Fire on Board Vessel and/or Facility

(k) Weather related

(l) Mooring failure

(m) Vessel movement

3. Risk Management Strategies

Risk management is a process in which the applicant identifies ways to prevent an identified accident from occurring and develops measures to mitigate the consequences should a release of LNG occur. Use the information in Section 4 of this document to assist in

identifying possible risk management strategies for areas identified by the risk assessments discussed above, and determine which risk management strategies are appropriate.

4. Possible Risk Mitigation Strategies

The following actions should be considered to reduce the risk of LNG releases or its consequences during bunkering operations where SIMOPS are being conducted. These actions are not exhaustive and further actions should be considered.

(a) Establishing Exclusion Zones: The facility should establish exclusion zones around the LNG transfer manifold. The size of the zones will be dependent on factors associated with the transfer operation and the type of operations conducted at the facility. These factors are important when establishing the exclusion zones because it indicates the hardness of the transfer system, the safeguards established for each system, and the most probable release from each system. See Coast Guard Guidance from OES 1-17 and the LGC NCOE Field Notice (01-2017) for more information on defining these zones.

1) Factors associated with the transfer operation include:

i. Is the LNG transfer conducted from a truck, barge, portable tanks, or fixed tank
ii. Is the LNG transfer conducted using pipe/loading arm or hose assembly (fixed connection or quick-connect)
iii. Is there an emergency disconnect device

2) Factors associated with the facility operations include, but are not limited to:

i. how is cargo handled at the facility (crane, conveyer belt, vehicle, auger, etc.)
ii. what facility equipment and structures are essential to operations, safety, and security of the facility and its workers
iii. does the vessel handle passengers
iv. if handling passengers, is the facility a destination or embark/disembark port
v. what type of emergency communication is used on the facility

(b) The Coast Guard recommends that three exclusion zones are established. The first exclusion zone should be established around the manifold. Operations, other than those essential to the transfer of LNG within this zone, should be prohibited or at least kept to a minimum because it is probable that the LNG vapor dispersion of a release would make the area unsafe. The second exclusion zone should be established outside the first zone and take factors into account such as prominent wind direction to determine the possible direction that LNG vapor dispersion may take when released.

Operations within this second exclusion zone should be limited to only approved SIMOPS, which could include cargo/passenger operations, the delivery of stores, loading water, or offloading garbage etc. The third zone would have less restrictions than the second although it may have effects from a LNG release within its boundaries.

When establishing a facility exclusion zones, the vessel's established hazardous zones should be taken into account.

1) Overhead Cargo Loading

i. Loading cargo over the manifold area while transferring LNG should be prohibited. Loading cargo over above ground LNG piping or hoses should be prohibited.

ii. Loading cargo over buried/trenched LNG piping or LNG piping under docks or pavements should be assessed and limited to cargo; that if dropped, will not affect the pipe integrity.

2) Vehicle Traffic

i. Vehicle traffic or equipment within the transfer probable exclusion zone (1) should be prohibited.

ii. Vehicle traffic within the possible exclusion zone (2) should be limited to vehicles or equipment essential to vessel operations.

iii. Movement of multiple LNG fuel trucks to conduct single bunkering should be regulated within the exclusion zones to limit movements.

iv. LNG fuel trucks should not enter the exclusion zones for "change out" during multiple truck fueling while connection or disconnection operations are being conducted.

3) Communication within the exclusion zones during a LNG transfer must be rated as intrinsically safe. It is recommended that all communications outside the exclusion zones used outdoors on the facility during a LNG transfer be rated as intrinsically safe. This includes visitors or vendors on the facility that are involved with SIMOPS. A common frequency must be used by both the vessel and facility PIC. This frequency must also be monitored by personnel who control alarms and emergency notifications for the facility.

4) Person In Charge

i. The PIC for the vessel and facility must be trained and designated for LNG transfers.

ii. The PIC for the vessel or the facility should have no other duties or responsibilities while conducting a LNG transfer.

5) Personal Protection Equipment (PPE)

i. PPE must be worn/used by all personnel within exclusion Zone 1.

ii. PPE must be issued for all personnel working in exclusion Zone 2.

6) Emergency Shut Down (ESD). SIMOPS should not be allowed if

ESD cannot be achieved by an automatic monitoring system or by the vessel and facility PIC.

7) Shelter-In-Place and Evacuation Plans. The vessel and facility must have a shelter-in-place plan for all personnel. In addition, the facility must have an evacuation plan for all personnel. SIMOPS should not be conducted if these plans do not exist.

8) Response Capabilities. The facility must have a list of resources within the area that will respond if a release of LNG occurs. At minimum, the list should include, medical, fire, law enforcement and environmental agencies. SIMOPS should not be conducted, if this list does not exist.

9) Placement of gas detection devices

i. Gas detection devices should be placed near the manifold and each connection of the fueling system.
ii. The PIC should have a gas detection device for personal use and to use to periodically check the system.
iii. Gas detection devices should be placed in structures and vehicles that may be affected by a LNG release.
iv. Temperature sensors should be placed in the bunker system drip trays.

10) Fire Suppression Systems

Any structure or vehicle that may be affected by a LNG release should have appropriate fire suppression systems assigned to them.

11) Declaration of Inspection (DOI)

i. As part of the DOI, the facility must insure that the vessel agrees that SIMOPS can occur while transferring LNG. If the vessel has not previously done a risk assessment for SIMOPS, it should not be allowed.
ii. For vessels that have not conducted a previous SIMOPS risk assessment and wish to conduct SIMOPS
    a. SIMOPS risk assessment can be conducted if the facility and third parties involved in SIMOPS participate, and all recommendations are implemented prior to signing the DOI
    b. the COTP must be notified that a risk assessment has been conducted and must approve SIMOPS
iii. The DOI must indicate each type of SIMOPS that will take place (stores, cargo, passenger operations etc.) while the transfer is occurring and the vessel and facility PIC must agree on each type.

12) Training

i. All personnel involved with SIMOPS must be trained; this includes all vendors, facility workers and vessel crew. Training should include the hazards of LNG and what should be done at the facility, if a

release occurs while transferring LNG.

ii. Facilities are encouraged to include local response personal (EMS, fire, medical, law enforcement) in their training sessions.

5. Evaluating the SIMOPS Risk Assessment Report:

The tables in Attachment A can be used to evaluate the SIMOPS risk assessment report for meeting the expectations of the risk assessment. The tables in Attachment B can be used as a quick reference risk tool for different types of vessels, facilities conducting LNG bunkering operations, and the mode which the transfer is being conducted.

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Attachment A
Evaluating the SIMOPS risk assessment report

SCOPE OF ASSESSMENT AND GENERAL CONTENT REVIEW				
	Yes	No	N/A	
1				Did the SIMOPS risk assessment follow the submitted risk assessment plan?
2				Does the SIMOPS risk assessment identify the professional competencies of those selected to conduct an assessment?
3				Does the SIMOPS risk assessment include vessel specific information?
4				Does the SIMOPS risk assessment include facility specific information?
5				Does the SIMOPS risk assessment include LNG bunkering specific information for this facility?
6				Does the SIMOPS risk assessment address safety issues?
Comments:				

A. VESSEL CHARACTERIZATION:				
	Yes	No	N/A	
1				Does the SIMOPS risk assessment describe the operations of the ship while in port?
2				Does the SIMOPS risk assessment describe a general layout of fuel system including the manifold location?
3				Does the SIMOPS risk assessment describe LNG bunkering procedures?
4				Does the SIMOPS risk assessment describe the vessel emergency procedure?
5				Does the SIMOPS risk assessment describe LNG training of vessel personnel?
6				Does the SIMOPS risk assessment describe the vessel's hazardous zones around the manifold?
7				Does the SIMOPS risk assessment describe the vessel's response capabilities including fire and medical?
Comments:				

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B. FACILITY CHARACTERIZATION:				
	Yes	No	N/A	
1				Does the SIMOPS risk assessment describe facility operations in the vicinity of the LNG bunkering?
2				Does the SIMOPS risk assessment describe a general layout of fuel system (mode) used for bunkering?
3				Does the SIMOPS risk assessment describe other structures in proximity of bunkering?
				Does the SIMOPS risk assessment give particular information on the bunkering operation including flow rates, mode of transfer, duration etc.?
4				Does the SIMOPS risk assessment describe transfer procedures including DOI?
5				Does the SIMOPS risk assessment describe emergency procedure?
6				Does the SIMOPS risk assessment describe LNG training of facility personnel?
7				Does the SIMOPS risk assessment describe response capabilities including fire and medical?
Comments:				

C. RISK ASSESSMENT:				
	Yes	No	N/A	
1				Does the SIMOPS risk assessment use a specific industry or government accepted risk assessment methodology? If not, is the methodology used adequate?
2				Does the SIMOPS risk assessment clearly identify the key assumptions that were made in performing the analysis?
3				Does the SIMOPS risk assessment identify all of the potential scenarios for accidental release of LNG?
4				Does the SIMOPS risk assessment adequately address the consequences of an accidental release of LNG?
5				Does SIMOPS risk assessment lead to a distinct set of issues which can be addressed with risk management strategies?
Comments:				

D. RISK MANAGEMENT STRATEGIES:				
	Yes	No	N/A	
1				Does the SIMOPS risk assessment adequately use the Section 4 and/or other sources to identify possible risk management strategies to consider for identified areas of risk and determine which risk management strategies are appropriate for each?
2				Does the SIMOPS risk assessment identify or propose additional risk management strategies that are locally available or that might be made available?
3				Does the SIMOPS risk assessment identify and apply risk management strategies that are appropriate for the given issues?
Comments:				

Attachment (B) QUICK REFERENCE; SIMOPS SAFETY HAZARDS AND RISKS ASSOCIATED WITH FACILITY TYPES CONDUCTING LNG BUNKERING

HAZARDS/ RISKS	TYPE OF FACILITY							
	Container	Break Bulk	Chemical	Cruise Ship	Ferry	Tug/Tow	RO-RO	OSV
Overhead	Container cranes on the facility or on the vessel; RO-RO ramps; gangways	Cranes (clamshell or other); augers; conveyor belts; gangways	Pipe racks; manifolds	Passenger/Crew gangways; paint scaffolding; cleaning decks and stateroom balconies	Passenger/Crew gangways; vehicle ramps	Small crane moving cargo onto deck	Small crane moving cargo onto deck	Small crane moving cargo onto deck
Vehicles	Container movers, including cranes, trucks, small movers; stores delivery; trash movers; crew vans; facility people mass transport; security vehicles; forklifts	Cranes, trucks, small movers; stores delivery; trash movers; crew vans; facility personnel mass transport; security vehicles; forklifts; train cars	Stores delivery; trash movers; crew vans facility personnel mass transport; security vehicles;	Stores delivery; trash movers; crew vans; facility personnel mass transport; security vehicles; taxis; luggage movers; passenger excursion vehicles; forklifts	Stores delivery; trash/waste oil movers; crew vans; facility personnel mass transport; security vehicles; taxis; luggage movers; passenger cars; other fuel trucks	stores delivery; trash movers; crew vans; facility people mass transport; security vehicles; forklifts	Container trailers, trailer movers, vehicle cargo (car carrier) stores delivery; trash movers; crew vans; facility people mass transport; security vehicles; forklifts	stores delivery; trash movers; crew vans; facility people mass transport; security vehicles; forklifts
Other Hazmat	Containerized HAZMAT on facility and vessel	Packaged HAZMAT on facility and vessel	Other HAZMAT being loaded in bulk		Carriage of HAZMAT vehicles moving on ferry			Packaged for oil field use
Cargo Equipment	Container moving vehicles, including cranes, trucks, small movers; trains	Cranes; augers; conveyers, trucks; trains; forklifts	Pipelines;		Trucks	Small cranes	Trailer movers	Small crane moving cargo onto deck
Enclosed Spaces	Ware houses; guard shacks; operation center; large crane control centers; container stuffing centers	Ware houses; guard shacks; operation center; large crane control centers;	guard shacks; operation center;	Passenger waiting areas; warehouses; guard shacks; control center	Passenger waiting areas; warehouses; guard shacks	Operation center	Guard shacks; operation center	Operation center
Labor Intensive	High. Limited to vehicle/cargo handling equipment	Medium/low. Limited to vehicle/cargo handling equipment	Low. Limited to loading	High/Medium (depending if port is turn-a-round or destination)	Medium/Low	Medium/Low	High. Limited to vehicle/cargo handling equipment	Medium/Low
Multiple Berths	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible	Multiple berths; possibility of more than one vessel present; distance between multiple berths & multiple SIMOPS involving several ships is possible

Note: List is not exhaustive

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Attachment (B): QUICK REFERENCE; SIMOPS SAFETY HAZARDS AND RISKS ASSOCIATED WITH TRANSFER MODE TYPES CONDUCTING LNG BUNKERING

HAZARDS/ RISKS	TRANSFER MODE					
	Truck	Fixed Tank	Portable Tank (ISO)	Vessel	Rail Car	Transfer between two land based Modes **
Hose	Distance; strength; wear; connections; manufactured for use; bursting; physically moving	Distance; strength; wear; connections; manufactured for use; bursting; physically moving	strength; wear; connections; manufactured for use; bursting; physically moving	Mooring strength; sea-state; wear; connections; manufactured for use; bursting;	Distance; strength; wear; connections; manufactured for use; bursting; physically moving	Distance; strength; wear; connections; manufactured for use; bursting; physically moving
Piping and Loading Arm	Distance; strength; wear; connections; manufactured for use; elbows; bursting;	Distance; strength; wear; connections; manufactured for use; elbows; bursting;	Distance; strength; wear; connections; manufactured for use; elbows; bursting;	Distance; strength; wear; connections; manufactured for use; elbows; bursting;	Distance; strength; wear; connections; manufactured for use; elbows; bursting;	Distance; strength; wear; connections; manufactured for use; elbows; bursting;
Vapor Control	Usually not available or mode does not have capability to accept vapors		Usually not available or mode does not have capability to accept vapors		Usually not available or mode does not have capability to accept vapors	May not be available or mode does not have capability to accept vapors
Duration of Transfer	Short duration because of capacity of mode, but multiple trucks used meaning multiple connecting and disconnecting;	Duration dependent of flow rate and size of vessel tanks	Short duration because of capacity of mode, but multiple tanks used would mean multiple connecting and disconnecting;	Duration dependent of flow rate and size of vessel tanks	Short duration because of capacity of mode, but multiple rail cars used would multiple connecting and disconnecting;	Duration dependent of flow rate and size of tanks
Proximity to Workers	Dependent on vessel manifold location; usually close to operations performed on ship and facility	regarding ship services, mode is usually located away from facility berth operations	Dependent on vessel manifold location; usually close to operations performed on ship and facility	Outboard or astern of vessel receiving; located away from facility berth operations	Dependent on vessel manifold location; usually close to operations performed on ship and facility	Transfer can be done away from workers
Draining Residual	Usually mode does not have capability to accept residual		Usually mode does not have capability to accept residual		Usually mode does not have capability to accept residual	

Note: List is not exhaustive

Attachment (B): QUICK REFERENCE; SIMOPS RISKS ASSESSMENT SCENARIOS ASSOCIATED WITH FACILITY TYPES CONDUCTING LNG BUNKERING

TYPE OF SAFETY SCENARIOS TO CONSIDER	TYPE OF FACILITY								
	Container	Break Bulk	Chemical	Cruise Ship	Ferry	Tug/Tow	Ro-Ro	OSV	Transfer between two land based Modes **
Hose/Pipe rupture	X	X	X	X	X	X	X	X	X
Failure of loading arm leading to leakage/spill	X	X	X	X	X	X	X	X	
Disconnecting hose - spill	X	X	X	X	X	X	X	X	X
Damage to mode tank during transfer	X	X	X	X	X	X	X	X	X
Venting close to ignition source	X	X	X	X	X	X	X	X	X
Liquid trapped/blocked in the transfer line	X	X	X	X	X	X	X	X	X
Overfilling tank	X	X	X	X	X	X	X	X	X
Structural damage to vessel bunkering manifold	X	X	X	X	X	X	X	X	
Vapor recovery failure – venting/release	X	X	X	X	X	X	X	X	X
Insufficient pre cooling of lines and equipment	X	X	X	X	X	X	X	X	X
Vessel allided with while bunkering	X	X	X	X	X	X	X	X	
Evacuation of area/shelter in place	X	X	X	X	X	X	X	X	X
Weather related	X	X	X	X	X	X	X	X	X
Note; Security scenarios should be developed as part of the MTSA facility security assessment									
** Includes tank truck or rail car transferring to fixed tank or fixed tank transferring to portable tank etc.									

Attachment (B): QUICK REFERENCE; SIMOPS RISKS ASSESSMENT SCENARIOS ASSOCIATED WITH TRANSFER MODE CONDUCTING LNG BUNKERING

TYPE OF SAFETY SCENARIOS TO CONSIDER	TRANSFER MODE					
	FIXED TANK	RAIL	PORTABLE TANK	TRUCK	VESSEL	Transfer between two land based Modes **
Hose/Pipe rupture	X	X	X	X	X	X
Failure of loading arm leading to leakage/spill	X				X	
Disconnecting hose/loading arm - spill	X	X	X	X	X	X
Damage to mode tank during transfer		X	X	X		X
Venting close to ignition source	X	X	X		X	
Liquid trapped/blocked in the transfer line	X	X	X	X	X	X
Overfilling tank					X	
Structural damage to vessel bunkering manifold					X	
Vapor recovery failure – venting/release	X				X	
Insufficient pre cooling of lines and equipment	X	X	X	X	X	X
Vessel allided with while bunkering	X	X	X	X	X	
Evacuation of area/shelter in place	X	X	X	X		X
Weather related	X	X	X	X	X	
Note; Security scenarios should be developed as part of the MTSA facility security assessment						
** Includes tank truck or rail car transferring to fixed tank or fixed tank transferring to portable tank etc.						

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