TRELLEBORG

LNG Bunkering Today and Tomorrow

A HARVEY GULF/Q-LNG CASE STUDY

Contents

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Abstract

The market for LNG as a marine fuel will grow significantly over the next few years. Fueling will have to be completed within tight time frames to meet ship sailing schedules and take account of simultaneous operations such as loading containers, vehicles or passengers. There is simply no margin for error if the operation is to be completed safely each and every time.

Fortunately, LNG bunkering companies can build upon the excellent standards set by bulk LNG shipping, which has one of the most impressive safety records in any marine transportation sector. The 50-year history of LNG cargo trade has undoubtedly proved that LNG can be transferred safely and efficiently. This outstanding record was achieved by using well-trained crews and highly effective safety technology. In particular, the bulk LNG sector makes extensive use of linked ship-shore shutdown systems, in accordance with SIGTTO recommendations.

Effective communication between the parties involved is critical to ensuring safe LNG bunkering. All those involved require a common understanding of the entire process arrangement.

The paper provides an overview of the most recent work by the Society for Gas as a Marine Fuel (SGMF) in respect of SSL and communications. The LNG bunker project of Harvey Gulf will act as a case-in-point. The company purpose-built an LNG fueling facility at Port Fourchon, Louisiana, to serve their fleet of LNG powered Offshore Support Vessels.

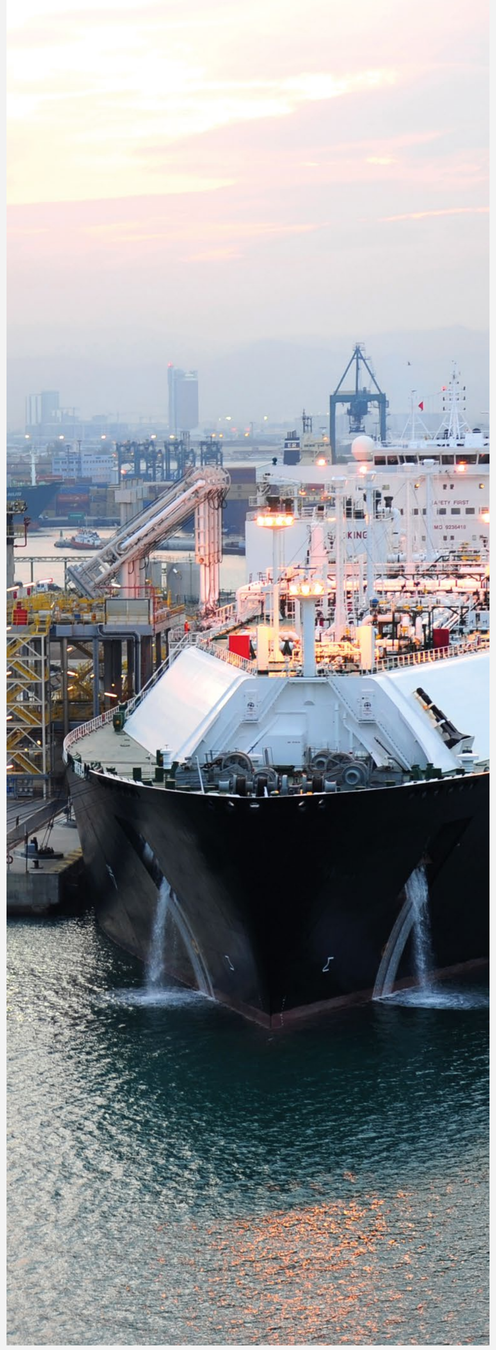
In addition, it is now building a 4,000m^3 LNG bunker articulated tug barge; this will be designed to load LNG from existing and new bulk export facilities in the U.S. Gulf Coast, and transfer it as a fuel to various LNG fueled vessels around Florida and the Caribbean.

Harvey Gulf considered loading from terminals or fueling vessels with legacy SIGTTO/IGC/ISO 28460 type Ship-Shore Links (SSL), which can permit mutual transfer of ESD, telephony and mooring load monitoring information. However, after reviewing the “lessons learned” from similar applications in projects across the globe, they selected the enhanced ISO 20519 compliant Universal Safety Link (USL). This uses a fiber optic link to give a complete real-time overview of process parameters on both sides of the operation while also integrating the emergency shutdown systems of the facility and vessel. The Trelleborg USL carries both ESD and process data signals and so the bunkering process is now a ‘silent transfer’. The bunker vessel builds on this and so will require a complete solution including ISO28460 links for bulk loading, and enhanced ISO20519 links for bunkering to LNG fueled vessels.

Trelleborg has been the leading developer and supplier of SSL for large-scale LNG since 1996 and pioneered the integrated SSL, which was a factor in expansion of LNG spot trading in the early 2000s and is in use today on almost 100% of the LNGC fleet. To date it has contracted for and supplied more than 800 SSL systems, of which over 70 are USLs for use in applications such as LNG as marine fuel.

Abbreviations

ATB	Articulated Tug and Barge
CCTV	Closed Circuit Television
CDI	Chemical Distribution Institute
CNG	Compressed Natural Gas
DCS	Distributed Control System
ESD	Emergency Shut Down
FSRU	Floating Storage and Regasification Unit
FSU	Floating Storage Unit
IAS	Integrated Automation System
IGC	International Gas-carrier Code
IMO	International Maritime Organization
ISO	International Standards Organization
LNG(C)	Liquefied Natural Gas (Carrier)
MLM	Mooring Load Monitor/ing
NGO	Non-Governmental Organization
OCIMF	Oil Companies International Marine Forum
OM	Optical Multi-mode
OSV	Offshore Support Vessel
Q-LNG	Quality LNG Transport, LLC
QRH	Quick Release Hook
RTU	Remote Terminal Unit
SGMF	The Society for Gas as a Marine Fuel
SIGTTO	The Society of International Gas Tanker and Terminal Operators
SONET	Synchronous Optical Networking
SSL	Ship-Shore Links
TCP	Transmission Control Protocol
USCG	United States Coast Guard
USL	Universal Safety Link



Background to Ship-Shore Links

The linking of emergency shutdown systems during LNG transfers has been commonplace since the earliest of LNG marine transfers when it was recognized that an ESD valve closure stopping the transfer at the receiver could cause damage to infrastructure through surge. Overfilling of cargo tanks also had to be avoided and the transfer needed to be protected in the case of excessive movement of the vessel on the berth. Various safety measures were introduced to mitigate this risk, however directly linking the shutdown systems proved the fastest and safest possible solution.

The earliest solutions involved linking the two systems via pneumatic hoses with common pressure settings such that a loss of pressure within the system would cause a trip on either side. This fulfilled the basic requirements of ESD, however as pneumatics are reliant on specific system air volumes as well as pressure settings, ESD timings are difficult to make repeatable and the system can be slow to operate, especially if multiple vessels visit the same berth. The issue of repeatability led to alternate solutions being sought. In the 1970s electrical links were implemented that as well as ESD transmission, supported telecommunication channels. Although the provision of a telecommunications path was a secondary function, it became the standard worldwide. The main trade patterns at the time were typically around Asia, for example Brunei to Japan, and also North Africa, Europe and the U.S. Although electrical linked systems were adopted worldwide, the Asian trade developed a system based on 6-pin Japanese connectors manufactured by Miyaki Denki while the western routes utilized 37-pin connectors manufactured by Pyle National.

The mid 1980s saw a SIGTTO recommendation published documenting the requirements for links, making reference to existing liner trade electrical and pneumatic link options, and finally detailed a new electrical system which became known as the SIGTTO link. This link is purely for ESD and was envisaged as an international connection that would facilitate a common connection worldwide. The system is based on intrinsically safe interposing relays which allow a single loop to be tripped by either side.

Although technically sound, the document allowed an ‘interim’ solution of a manually operated push button pendant. The fact that the widely used telecommunication function wasn’t available seems to have stifled adoption in bulk LNG transfer scenarios, although it was well adopted in the LPG industry. The pendant option however became a barrier to the system as it removed the incentive for the other party to install the counterpart to the link as they thought the pendant was sufficient. Critically, the manual operation of the pendant removed the intrinsic benefit of automatic linking of ship and shore ESD systems and therefore reduced effectiveness.

By the late 1980s fiber optic technology was being implemented in industry worldwide, and the Japanese developed a SSL using this latest technology. The fiber optic link not only supported the ESD and communications offered by the electrical solutions but added a basic data channel for transmission of jetty quick release hook tension monitor data to the LNGC, allowing the vessel to actively manage the line tensions, referring to the received Mooring Load Monitor system data[1].

The fiber optic link is based around a 6-pin ferrule butt-connector which relies on the alignment of a 50μm beam of light being accurately positioned to couple the signal into the connecting fiber system. Although reliable and with good mechanical alignment support, the optical ferrule face can be subject to contamination by dirt or, even worse, surface scratching which can degrade the integrity of the link.

Although a 6-pin connector is used, for standard LNG transfer, fiber cores one and two are used for telecommunication and fiber cores three and four solely for ESD. Fiber cores five and six, previously unused, have more recently been utilized to provide enhanced digital links enabling even greater data transfer including tank levels, pressures and temperatures.

In 2006 Trelleborg developed the digital SSL that has been used in the vast majority of FSRU and FSU applications when a jetty connection has been required. The digital link again supports the primary ESD and secondary telecoms that have become standard, however in the more complex process arrangements of these floating installations, further integration of the terminals and vessels has been required. This includes the provision of additional ESD signals in relation to the gas send out or other plant requirements. The key advancement of these systems has been the ability to transfer bulk quantities of data such as process data communication, CCTV, internet and other Ethernet type signals. The link itself is based around SONET communication protocols which make it both sustainable in the future, expandable and open for others to interface with.

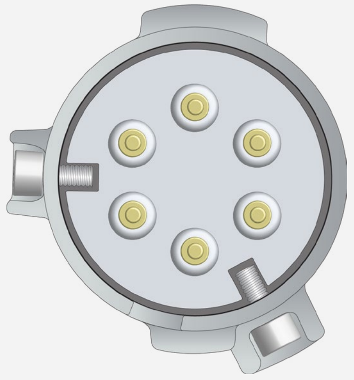


Figure 1 – Miyaki Denki 6-way connector

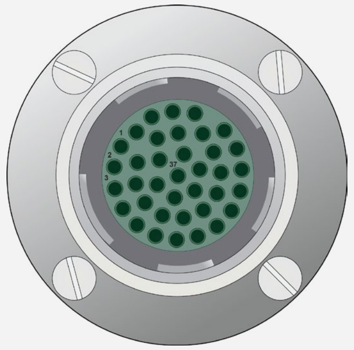


Figure 2 – Pyle National 37-way connector

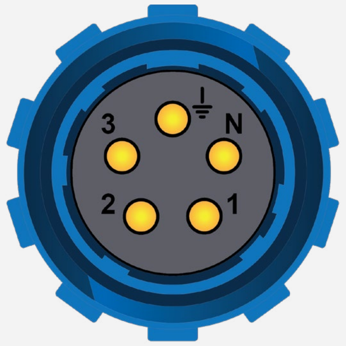


Figure 3 – SIGTTO 5-way connector

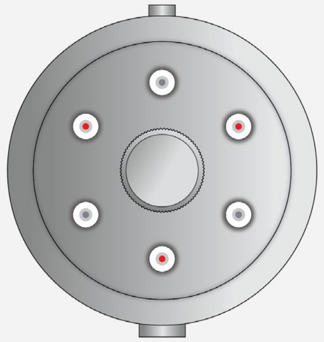


Figure 4 – Fiber Optic 6-way connector

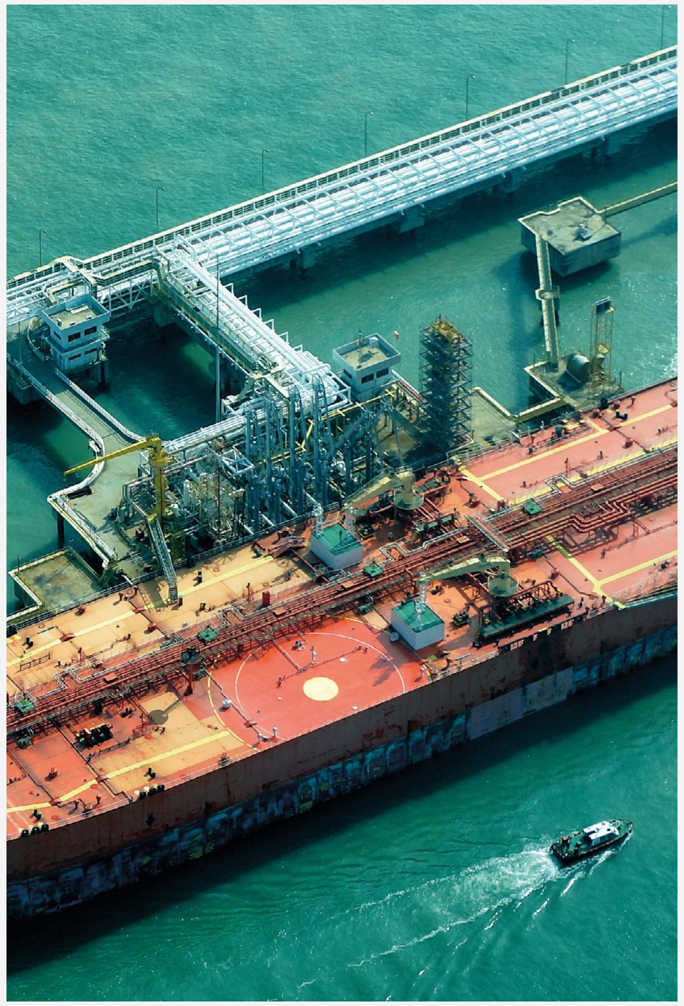
[1] This function could have been implemented in the Pyle National connector system earlier. However, there was no requirement as the Japanese did not use the Pyle National connectors. Once fiber optic links were adopted worldwide, a version of this data link was added to the Pyle National connector links

Beginnings of LNG Bunkering Regulatory Frameworks

Although LNG carriers have been using boil off gas for propulsion for a number of years, for LNG to be considered a viable fuel for non-LNG carriers, safety considerations as well as infrastructure costs play a considerable role. The safe transfer of LNG in any industrial quantity requires the highest levels of safety.

As an industry, ignoring the impeccable safety standards set in the bulk transfer sector just because the volumes are reduced in bunkering applications simply would not make sense. SIGTTO originally led a LNG fueling workgroup which quickly recognized the need to set up a new industry body. By 2012 a new NGO, SGMF, had been created with a remit to promote safety in LNG fueling applications. The work undertaken by SGMF includes the setting up of formal working groups tasked with producing peer reviewed guidelines for use in LNG bunkering applications. One of the more recent Working Groups '6' is responsible for producing guidance on 'essential working components' for which a separate sub-workgroup '6-2' was convened to look at the electronic components involved in the transfer, including ESD links.

Concurrently, various standards bodies were working on creating initial frameworks to allow safe construction and operation of gas fueled ships. IMO published the IGF code which all gas fueled ships built since January 2017 must conform to. Section 8.5.7 of the IGF code clearly states that a SSL shall be installed onboard the vessel. Unfortunately, IGF code is only applicable to the vessel board equipment and has no influence over land-based suppliers. Here ISO published the standard ISO20519:2017 which details the requirements for links and specifies functionality. The market had been reviewed for common link platforms and ISO chose as minimum ESD requirements both SIGTTO link and pneumatic[2] link options. ISO20519 however also recognized the enhancements other links offer and also states that telephony can form part of the link.



Solutions to Bunkering Links

In 2012 Trelleborg was approached to propose a cost-effective link that could be used in the LNG fueling market and which not only offered the same levels of safety present in the large-scale sector but would be priced at levels that would aid adoption of the higher-end technologies in a cost sensitive market. Unfortunately, the majority of the large-scale LNG link systems utilize a great deal of legacy technology and connectors which add substantial cost to systems and which could not be borne by the LNG fueling vessels.

The process of bunkering LNG will generally be performed on one side by a well-trained operator – who handles LNG either at a shore facility or a bunker vessel with routine LNG transfers taking place at regular intervals either during bulk loading or during bunkering offtakes – and on the other side the receiving vessels crew who are suitably trained but may not have the experience of handling LNG or cryogenic liquids. In these cases, it is absolutely key that the process is transparent and the bunker provider is able to control the transfer with as much real-time information to hand in order to achieve the safe, efficient and cost-effective transfer of liquid from one vessel to another.

FEATURE	GEN3 SSL	UNIVERSAL SAFETY LINK	SIGTTO LINK + PNEUMATIC	SIGTTO LINK	PNEUMATIC SSL
ISO 28460 Compliant	✓	✗ inc. backup	✗ inc. backup	✗	✓ as backup
ISO 20519 Compliant	✓	✓	✓	✓	✓ <150m³/h
Pneumatic Link	✓	✓	✓	✗	✓
Electric Link	✓	✓	✓	✓	✗
SIGTTO Link 5-way	✓	✓	✓	✓	✗
Pyle National 37-way	✓	✗	✗	✗	✗
Miyaki Denki 6-way	✓	✗	✗	✗	✗
Fiber Optic Link	✓	✓	✗	✗	✗
Analogue 6-way	✓	✗	✗	✗	✗
Digital 6-way	✓	✗	✗	✗	✗
Digital 2-way	✓	✓	✗	✗	✗

Table 1 – SSL system options

[2] Pneumatic link is only accepted for transfer rates below 150m³/h, in effect limiting it for truck transfer operations (ISO20519 section 5.4.5)

To meet this requirement, the digital fiber optic link was evaluated and found to not only offer the basic ESD requirement, it could also be utilized for telecommunications as well as process data transfer and other future data transfer requirements. For the first time in link technology, the system would be future-proof to allow additional functionality as required. The packaging of the digital SONET link required addressing and instead of utilizing the bespoke 6-way connector – only used in large-scale transfer – a military[3] standard battlefield proven connector was chosen, which not only could provide the robustness required for a marine connector, but actually utilized expanded beam technology that moved the link away from the previous butt joint type connection. Expanded beam connectors expand the 50μm light beam by over 100 times, eliminating the problems caused by dirt and scratching as now the light path will be bigger than any contamination. The beam is then refocused into the fiber core on the other side of the connector. There is little optical power loss penalty compared to a clean ferrule butt connector, and expanded beam connectors are far more suited to applications requiring multiple mating cycles.

Following the practices of large-scale links, where redundancy in the form of an independent backup is specified in ISO28460, it would make sense to follow these same well practiced applications, with a fiber optic primary, the SIGTTO electric link can be utilized as an ESD only backup, as the SIGTTO link system is referenced by SIGTTO, OCIMF and CDI guidelines and its functionality is currently fixed to just ESD, there may be future options to expand the system to utilize some spare connector cores for a limited system upgrade, this would require agreement of all stake-holding parties. The challenge with the SIGTTO link compatibility however is that it was historically based around a fixed 'Shore' type system with a different counterpart 'Ship' type system. For standard cargo trading this is fine, however for bunkering where ship-to-ship transfers will be commonplace, a solution was required to also enable this specific functionality.

In ship-to-ship operation, the base systems are the same on both sides of the transfer. However, the interposing relay interface is typically only installed in shore systems and had historically been carried out by specific hazardous area relay modules which were not only expensive but also not freely available in the market. The solution therefore was to redesign the output of the link circuit around the rest of the circuitry so it formed part of a single system, thereby being subject to a single hazardous area certification process[4] while allowing the relay interfaces to be switched in or out of circuit depending on the mode of operation: Master (shore or supplier type) or Slave (ship or receiver type).

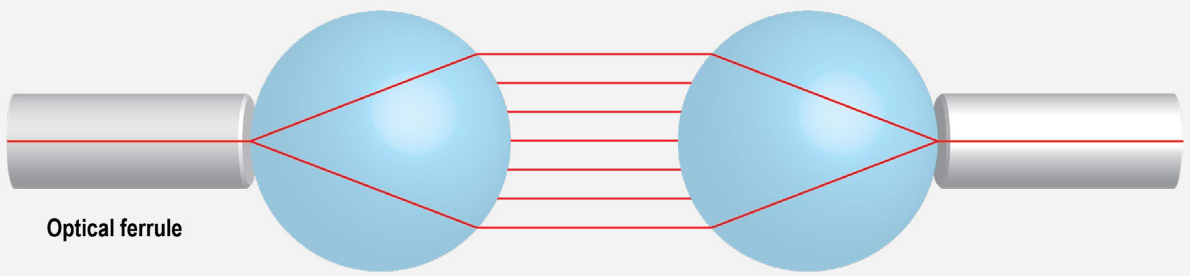


Figure 5 – Example of expanded beam connections

Pneumatic links have been identified as a solution for lower volume transfer as an 'it's better than nothing' solution. However, there are inherent issues in the pneumatics around calibrating system volumes, operating at common pressure settings both in healthy conditions and at defining a mutual trip pressure. SIGTTO goes as far as to describe pneumatic shutdown links as:

Such [pneumatic] systems are inherently slow in operation, suffer from problems caused by dirt or moisture and it is difficult, if not impossible, to achieve accurate and repeatable timing. The designer must be aware that the diameter of the pipework and dump valve can significantly influence the closing time'[5]

The pneumatic link is a very simple system comprising a hose linking the two ESD systems, each side will monitor the hose pressure via a pressure switch or transmitter to detect an ESD initiated by the connected system and will have control of a solenoid valve to allow the pressure to be released in the case of an ESD generated on the local system.

All of these link options, together with the original large-scale solutions can be packaged in numerous ways to suit a vessel's intended trading or bunkering pattern.

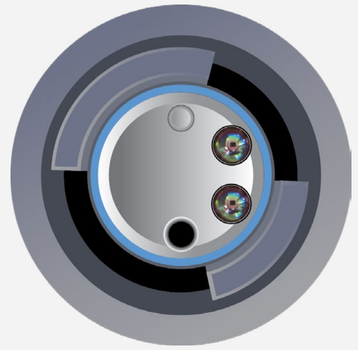


Figure 6 – MIL-DTL 83526 expanded beam fiber optic connector

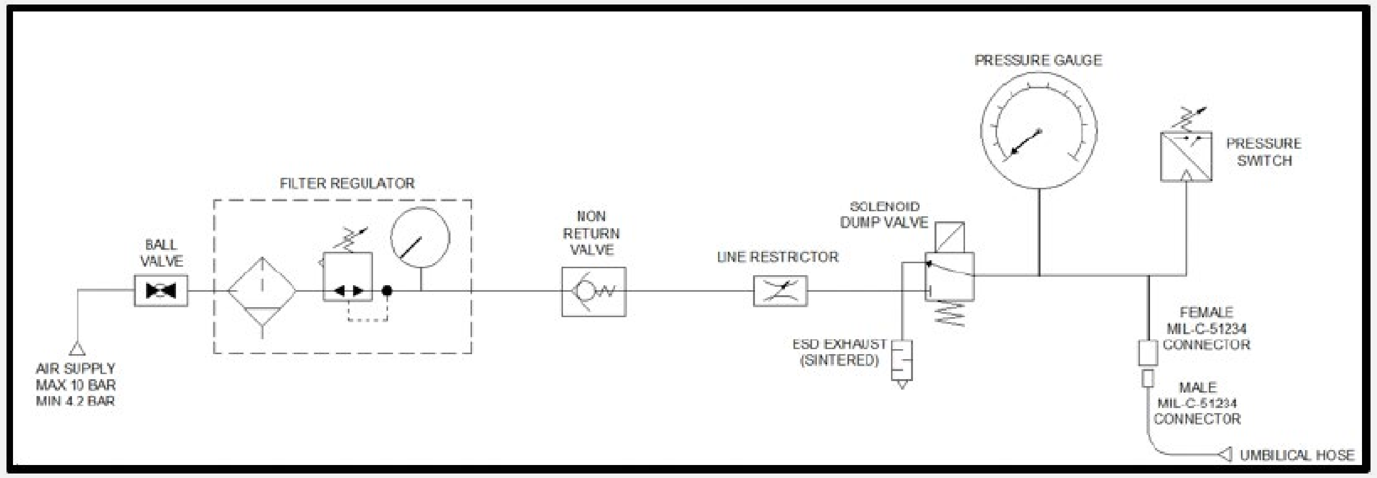


Figure 7 – Example of pneumatic link

[3] MIL-DTL-83526
[4] Multiple certificates may be required to suit jurisdiction however a single certificate covers all system components

[5] SIGTTO ESD Guidelines, Part 3 section 1

Harvey Gulf Applications

During 2011 Harvey Gulf announced a build plan for six LNG fueled vessels along with a purpose-built fueling facility. At the time there were no rules or regulations guiding the construction of such LNG fueled vessels, so plans were written in consultation with the relevant bodies including the U.S. Coast Guard ensuring the highest standards of safety were to be set. When it came to the link options, through consultation between Harvey Gulf and Trelleborg it was clear there were processes that needed considering before a solution could be chosen.

LNG trucks provided by Martin Energy were installed with an ESD valve reliant on being held healthy by a positive air pressure above 2.8bar. Without the option of providing alternate systems to the trucks, both the facility and vessels would require a compatible pneumatic link to be available.

From discussions around the required functionality during a vessel bunkering, it became clear that operator feedback of the process would be an important factor in not only maintaining safety, but in allowing the transfer to be actively managed to prevent any lost time through avoidable ESD events. At the time of installation there was no IGF code or ISO 20519 to cross-reference, however to follow the best practice of the large-scale link systems, a backup SIGTTO link system was specified which is functionally safer than being forced to use a pneumatic link as it would allow fast ESD response times in cases where it had to be used.

To date the facility has carried out:

- Truck to Facility – 881 transfers
- Truck to Vessel – 98 transfers
- Facility to Vessel – 278 transfers

Prior to the completion of their shore storage facilities, Harvey Gulf bunkered the original vessels directly from road tankers. In this arrangement, the pneumatic shutdown link which formed part of the USL was used to link the ESD valve on the truck to the onboard bunkering shutdown system.

This ensured a minimum safety level was met but also relied on constant radio communication between the truck operator, facility and vessel staff in order to ensure that the transfer was being carried out to defined operational requirements.

As the bunkering quantities exceeded the volume contained in a single road truck, multiple trucks were required to provide the required volumes which further complicated the arrangement. Lessons were learnt in these early transfers, as although the pneumatic shutdown link is well defined by SIGTTO[6], the pneumatic pressure levels originally required by the truck to keep the ESD valve open were in the higher range of the vessel systems at around 8bar. Early transfers resulted in damage to the vessel's link systems due to excessive pressure pulses. During an ESD, the truck would attempt to exhaust its entire pneumatic volume, including trailer suspension system, through the vessels 8mm nylon tube rated for 16bar which was 'blown up like a balloon'. The transfer process was soon optimized so that the truck isolated its ESD valve from the suspension system and the truck allowed the air to be provided by the vessels to open the ESD valve, the operating pressure required by the trucks has since been addressed bringing it in line with SIGTTO recommendations.

As the facility began commissioning its storage capacity, there were two separate stages of LNG transfers required to be carried out. The facility storage tanks were loaded by a number of road trucks, which then enabled the vessels to be bunkered with the required volumes directly from the facility storage tanks. The trucks utilized the pneumatic shutdown again during the loading of the storage tanks, however with the option to now use the terminal's enhanced capabilities of the USL fiber optic system and the 155Mbps digital SONET data link, the connection between the terminal facility and the vessels is now one of the most comprehensive in use at any LNG transfer facility.

The OSV delivery schedule has been staggered to meet market demand, and to date five of the six vessels are fully operational meeting the charterers needs at the platforms in the U.S. Gulf of Mexico. As each vessel is delivered, gas trials are carried out at the Fourchon facility to ensure correct operation of all onboard systems.

During one of these operations, a facility operator noticed a filling valve closing on the vessel data mimic received by the facility, in order to manage the situation the operator contacted the vessel to find out the problem before an ESD would be automatically generated, it turned out that during setup of the data interface, instead of passing the filling valve position to the USL system, the fuel gas supply system had set up a non-relevant pre-alarm into the message structure, which was easily corrected in the onboard IAS system. This interaction between terminal operators and vessel crew highlight the benefits of these linked systems and having the ability to monitor and manage the process in real-time instead of being limited to responding to an ESD event which could have been avoided. Use of the USL has streamlined operations to a point the operators now consider it to be a 'silent transfer' as all information is to hand so manual checking via radio is no longer necessary.

Fig 8 – Truck loading at Port Fourchon

Figure 9 – Bunkering OSV at Port Fourchon

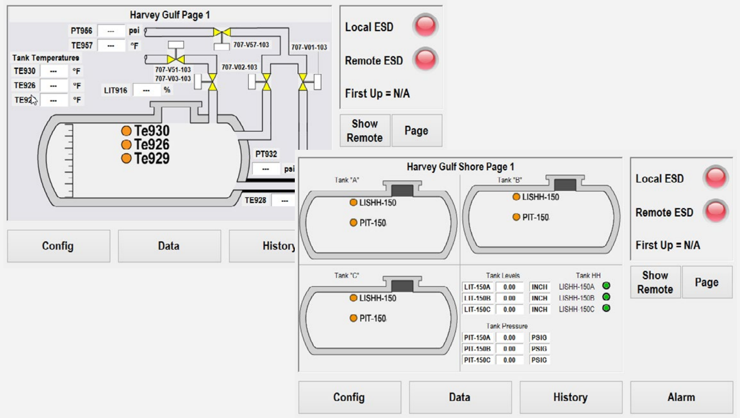


Figure 10 – Harvey Gulf USL Mimics

[6] SIGTTO ESD Guidelines, Appendix D

Bunker Vessel Considerations

When specifying LNG bunker vessels, further in-depth analysis of potential trading patterns is required to ensure that the vessel is not only capable of physically berthing at the terminals it may trade with, but also whether it will have the correct linked ESD interface to be able to not only connect to the bunkering vessels, but to also connect to the large-scale terminals it may be required to load from. The number of LNG bunker vessels is increasing rapidly, and these considerations need addressing.

Although the SIGTTO ESD guidelines[7] clearly state that the SIGTTO electric link system has not been adopted by any of the major international LNG projects and the use in the LNG sector has been limited to the Norwegian LNG costal network, this is slightly out of date as it is now expanded to be installed in a few Nordic LNG coastal terminals. Adoption at large LNG facilities has been for dual purpose facilities where both LNG and LPG are handled. In these cases, they are typically connected via separate ESD control philosophies which would exclude the use of SIGTTO link in LNG transfers.

What this unfortunately points to is bunker vessels either having to install low cost equipment purely for bunkering which limits loading to a few specialist facilities, or to install a comprehensive variety of systems to enable trouble-free connection compatibility. Figure 11 clearly illustrates the problems that need addressing. The bunker vessel is the equivalent of a small-scale LNG carrier, it just so happens to be ordered to provide bunkering services. To accommodate these cross-over type installations, in 2017 Trelleborg launched their latest GEN3 SmartPort enabled SSL which allows all known link types to be available via a single cabinet. The use of a new common electronics infrastructure means separate complete system modules are no longer

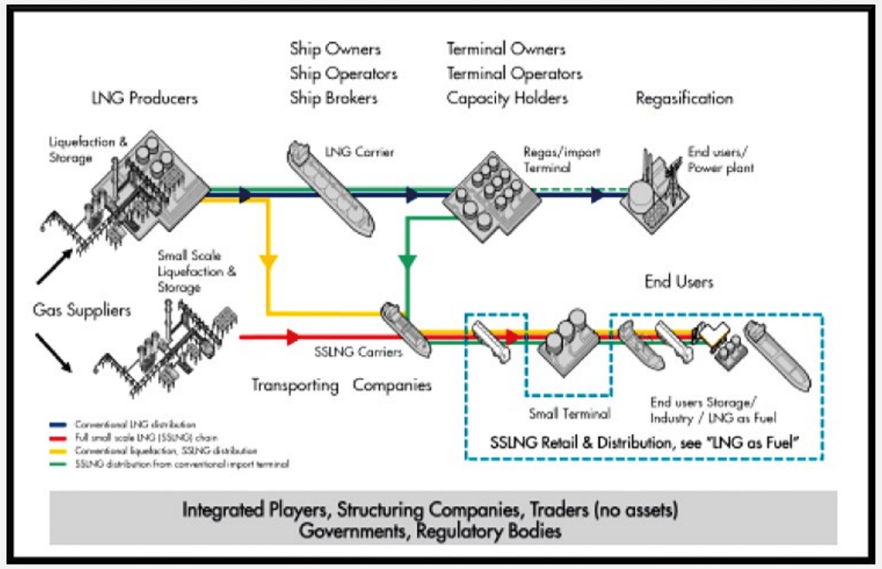


Figure 11 – LNG value chain, courtesy of Shell

[7] SIGTTO ESD Guidelines, Part 3 section 2.4

required, they have been reduced to single circuit boards per system, expandable to suit the vessels operation. This simplifies the installations required in the more complex arrangements.

Figure 12 is of a 2017 delivered bunker vessel linked shutdown system with interfaces for:

- Pyle National 37-way electric[8]
- 6-way analogue fiber optic
- Pneumatic
- USL digital fiber optic[9]
- SIGTTO link

Solutions like this are seen to be the future allowing for the most flexible trading patterns for the bunkering fleet.

In 2017 it was announced that Q-LNG (a new venture between Mr. Shane Guidry and Harvey Gulf) would build a 4000m3 ATB at VT Halter Marine construction yard to provide LNG distribution and bunkering services around Florida and the Caribbean. Trelleborg and Harvey Gulf began discussions around the barge's required links in 2015. As the project scope expanded, so did the configuration of the required links change. Originally the concept included options for loading at a dedicated refueling facility, similar to the current Harvey Gulf Port Fourchon unit. The link was simply then defined as a digital fiber optic USL onboard the barge to allow it to load from this dedicated facility and discharge to vessels requiring an LNG bunker.

As time passed and the project began to take shape in terms of the realistic operational profile of this barge, it became clear the charterers' requirements for the barge were that the barge should be able to load LNG from any of the existing LNG facilities around the Gulf, and therefore by extension any international LNG terminal. As well as the barge now having to install a second raised manifold arrangement to facilitate berthing at the large-scale terminals, the link options were re-addressed to cater for the project requirements.

The current arrangement is similar to the example given above whereby full analogue fiber optic and 37-way Pyle National electric links are available to give the required ESD, telecommunication and MLM data exchange required by the large-scale facilities, and utilizing the digital fiber optic for full USL functionality for bunkering along with associated backup systems of the electric SIGTTO link and pneumatic ESD only solutions. This solution meets not only ISO20519 for bunkering, but also ISO28460 for large-scale transfer as well as all recommendations from SIGTTO, SGMF and USCG.

Additionally, as this would be an ATB construction with barge operated via the tug, the main control station would have to be within the push tug wheel house. As networking of other systems was already specified within the barge-tug interface, the GEN3 SSL system could utilise its network extension capabilities to allow the operator full control of the SSL system, from the tug control station via a third-party hardware interface. This functionality was not even an option on other SSL implementations.

Figure 12 – Trelleborg GEN3 SmartPort SSL cabinet in bunkering configuration

[8] Miyaki 6-way electric link could also have been included but was not a customer requirement for this vessel
[9] Electronic functionality is fully included, 2-way optical connector is utilized via an adaptor from the 6-way fiber optic connector to 2-way expanded beam connector

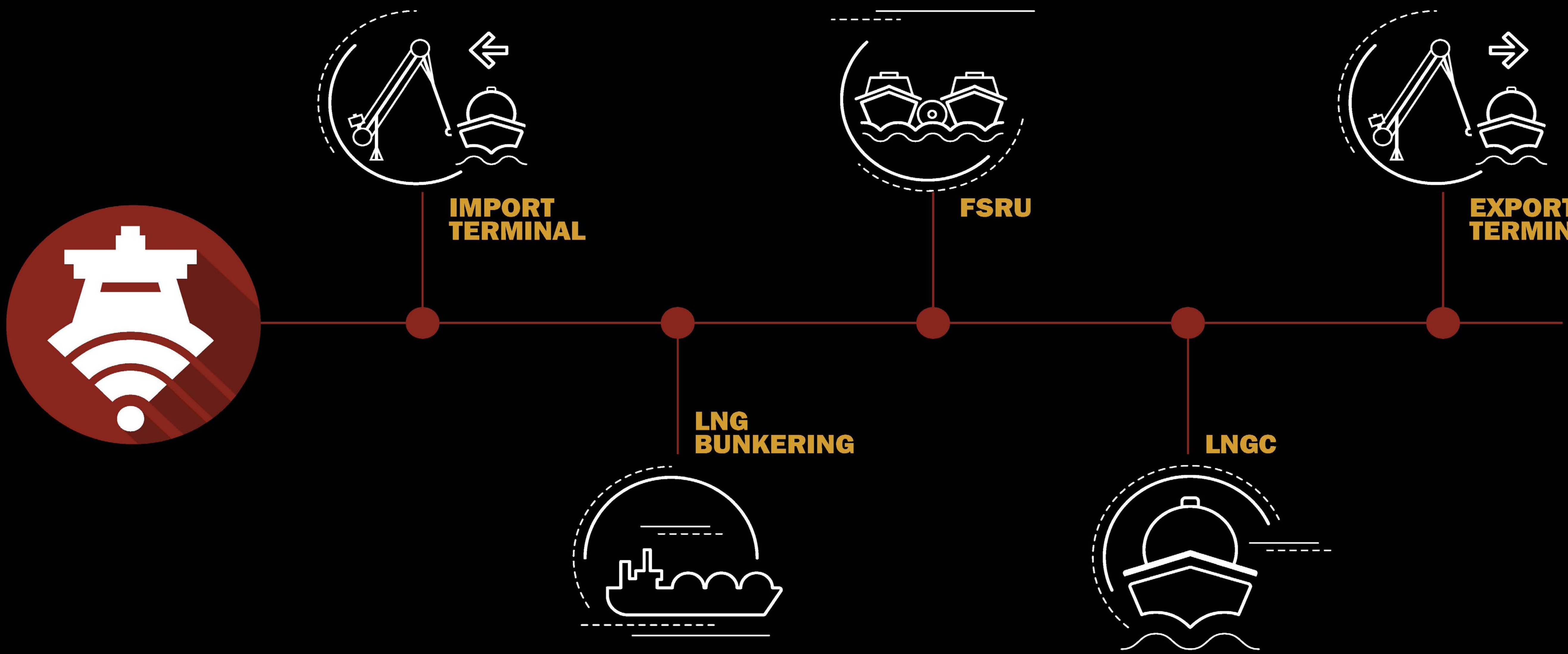
SmartPort: insight at every interface

Trelleborg expertise across the LNG supply chain

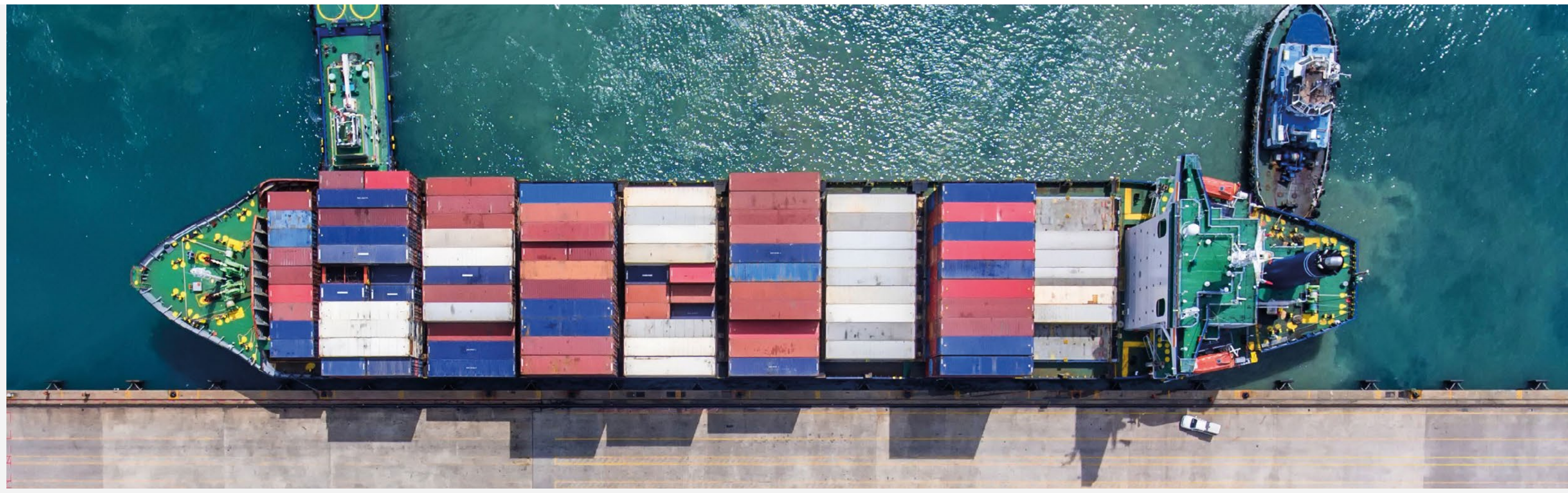
Whether your operations involve traditional terminals, bunker barges or anything in between, Trelleborg has the experience and expertise to minimize your risk.

Our unique oversight across the entire supply chain ensures compatibility, safety and efficiency in any transfer operation, for any business model.

With the SmartPort range, Trelleborg connects operations, standardizes processes and enables data-driven insights at every transfer point.



Conclusion



The LNG bunkering market is not standing still, there are already custom-built bunker vessels, converted small LNGC bunker vessels, bunker barges either pushed, towed or self-propelled, being put into operation worldwide. Ensuring compatibility of these vessels with the links not only installed on the vessels being bunkered but also with the terminals that LNG is being loaded from is critical.

Once compatibility is established, then utilizing the available functionality to maintain or even better raise the level of safety of the transfer needs to be a priority. Actively managing a transfer is more than monitoring your own system as LNG is received or pumped out, there are even thoughts of pressure matching the supply manifold to the receive manifold to see if there are leaks in the transfer system. These systems are possible when data is available and able to be used.

Learning from what we have done previously is the key to allow us to move the industry forward whilst maintaining the levels of safety attributed to marine LNG transfers. Taking feedback from operators and addressing concerns or thoughts on improvement will not only benefit the person making the request, but also others in similar situations who may not have thought about those particular problems. The levels of integration offered by the Trelleborg GEN3 SSL can only come from leveraging off operator's feedback and customers' requirements so that cost-effective solutions can be offered that do not jeopardize safety. Relying on systems described as not fit for purpose 10 years ago for new applications is not a constructive way to continue safe transfer practices. If pneumatics were superseded in the 1970s, why are they now specified for LNG bunkering? The SIGTTO electric link was not adopted by the large-scale LNG industry because more superior solutions were already available and being used, why is it now being specified for LNG bunkering when more advanced technologies and solutions replace the limited functionality on offer for similar levels of cost?

It is vital that this industry does not settle on a lowest common safety factor, but continues to push for the safest solutions not only in emergency protection via ESD, but in looking at processes that can be integrated in the future to enable more oversight, more automation and enhanced safety within the LNG transfer application space. Harvey Gulf has set a very high bar for safety when they set out on their LNG fueled vessel project which has earned them a position as thought leaders when it comes to projects in this application space. Their success has ensured that the projects that have followed, especially in the USA, have been measured against their high standards which still exceed the current industry minimum.

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