G-Sim
Liquid Gas Handling Simulator

Main Details

- Designed specifically for simulating the operations conducted with LNG and Liquid Gases
- Uses standard PC hardware
- Simple to set up and use
- Can be configured to support any type of training activity
- 16 different configurations of LNG Carrier based on size, containment and propulsion systems currently available
- Different configurations of LNG as a Fuel supply vessel and Fuel Gas Handling Systems
- Can be used for training, research and operation planning

Contents

Introduction

G-Sim, Liquid Gas Handling Simulator developed by GTT Training Ltd., is a highly detailed simulation platform that allows operators to be trained in all aspects of handling Liquid Gas Cargoes on board ship and ashore, in a safe environment. The accuracy and realism of the simulator also allows it to be used for research and operation pre planning purposes.

Using high fidelity mathematical models the system provides very realistic simulation of all the flow and control processes together with the appropriate equipment for the respective liquid gas system(s). These include the selection of cargo, cargo containment and propulsion systems. Sixteen possible configurations of LNG Carrier are currently available. Each model includes all the components of a vessel or system that need to be considered in the management of a vessel or shore installation and hence allow any operation that may be undertaken on the real system to be replicated. Consequently the models allow the full scope of training to be conducted from basic system familiarisation through to detailed problem solving and implementing emergency procedures.

The simulator has been designed for use on standard PC's and hence can be installed and used on hardware equipped with MS Windows operating systems (including tablets). The user interface has been designed to replicate real control systems used on board, whilst allowing simple operation by operators not familiar with the system. G-Sim provides maximum flexibility in tailoring the system configuration to suit the requirements of an organization, instructor or individual, both initially at the initial purchase stage, and at the time of running individual courses or exercises.

The control software for the simulators provides the instructor with all the tools that are required to set up the required configuration, monitor all aspects of the student's behaviour and provide material for use in evaluation and feedback. The software incorporated into the various models enables all cargo related activities to be conducted with a very high fidelity.

The system can be used very effectively in all the following areas:

- Training
  - The flexibility of the system allows it to be used to deliver training across the full range including-
    - Introduction of basic concepts to those with little knowledge
    - Practical experience to those with little 'hands on' experience
    - Enhanced skills involving fault diagnosis, problem solving and emergency situations for experienced personnel
- Performance Assessment
  - Can be used to provide a detailed assessment of the performance of multiple personnel whilst involved in operations, and produce hardcopy supporting evidence
- Research
  - Pre-running of unusual load patterns
  - Development and verification of operating procedures
  - Research into areas such as the effects of changing individual parameters of equipment, or the changing of an overall system design, and pre running of unusual load patterns.

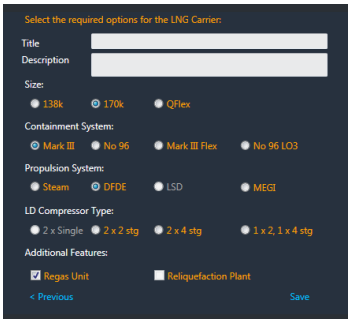
Model Library

LNG Carrier

Available immediately

Available for use in sixteen (16) different configurations, the LNG Carrier model is based on a modern membrane type vessel. The operator can currently select the configuration to be used from the following items:

- Ship size (138k or 170k m^3)
- Type of containment system (GTT MkIII or GTT NO96 and variations)
- Type of propulsion system (Steam, DFDE or MEGI)



The configuration of the model can be made by the operator in advance, allowing suitable scenarios to be generated, or immediately after the simulator is started with the configuration change being applied immediately the stations are loaded.

The basic configuration of the 138k and 170k vessels comprise of four cargo tanks each containing two cargo pumps, a single spray pump, emergency cargo pump, load lines and spray rails. The modelling of the inter-barrier insulation spaces around the tanks has been carefully considered to allow both the accurate monitoring of the various temperature gradients within the system but also the effects of a leakage of cargo into the respective spaces. In addition each model includes:

- Complete cargo piping system
- LNG and forcing vaporizers
- High duty compressors
- Low duty compressors appropriate to the propulsion system selected
- Cargo heaters appropriate to the propulsion system selected
- Fuel gas supply system
- Inert gas/dry air supply and distribution system

- Nitrogen supply, distribution and inter-barrier space pressurization system
- Cofferdam heating system
- Steam, Glycol & Lub oil systems as appropriate
- Segregated ballast system
- Fixed gas detection systems
- Portable gas detection for Oxygen, %LEL, %Vol H/c, Carbon Dioxide and Dewpoint
- Emergency shutdown system
- Automatic control systems
- Temperature monitoring system

All of the models incorporate the equipment control logic, interlocks and alarms as installed on the real vessels. For more detail regarding the contents of each model see the full description in the 'Models' section below.

Available soon

For the LNG Carrier the choices available for selection by the operator will be expanded to include:

- XDF propulsion systems
- Regas unit
- Reliquefaction

These will be introduced as they become available.

LNG Bunkering & Fuel Gas Handling Systems

Designed to support the requirements of the developing 'use of LNG as a fuel' in commercial vessels the LNG Bunkering & Fuel Gas Handling Systems model includes:

- LNG Bunker barge
  A fully operation bunker vessel model that can be used for the simulation of all the operations that may be required to be conducted on board such a vessel in the provision of LNG Bunkers. The model can also be adapted to allow the simulation of transferring between any type of containment system (pressurised or atmospheric).
- LNG Fuel Gas Handling Systems
  The module also includes various designs of LNG fuel storage and gas handling systems as currently being installed on board real vessels to enable training to be conducted in all aspects of bunkering, fuel storage and the supply of gas as a fuel. The design of the systems and equipment they comprise being dependent upon the type of fuel storage tanks and the type of consumers that are fitted on the vessels concerned.

  Currently the module includes the following systems:
  - Atmospheric Tanks to XDF primary and medium speed secondary consumers
  - Pressurised tanks to medium speed consumers will be available later in 2019

All the models are designed so that they may used to support the training requirements as defined by STCW and organisations such as SIGTTO and SGMF.

See 'Models' section for more details.

Applicable Legislation, Rules & Regulations

As per the vessels upon which they are based all the models within G-Sim are designed and constructed taking into account and incorporating the requirements where specified of the following rules and regulations as appropriate:

- Current Legislation
- Rules and Regulations of Government Departments
- Rules and Regulations of Classification Societies.
- SOLAS (Safety of Life at Sea)
- STCW (Standards of Training and Certification of Watch keepers) (All editions)
- MARPOL
- International Gas Carrier Code (IGC)
- IGF Code

Hardware Components

G-Sim can be installed and operated on any 'off the shelf' PC hardware equipped with the Microsoft Windows operating system.

This provides the following advantages:

a) It allows clients to purchase the hardware directly via their usual IT equipment suppliers minimising set up costs
b) Maintenance contracts can be agreed with local suppliers ensuring rapid support in the event of an equipment failure.
c) Existing PC hardware can be used, as long as the basic minimum requirements are met.

The basic equipment required comprises of the following:

PC Workstations

Standard 'off the shelf' PC's running Microsoft Windows 7 (32bit & 64bit), Windows 8 & 8.1 (32bit and 64bit) and associated variants are required. The installation of G-Sim results in minimal changes on the operating system and requires very few resources when in operation. This allows the PC's to be used for other applications, in addition to the simulator, if so required.

High-Resolution Monitors

G-Sim has been designed to take full advantage of modern, multi-screen display arrangements when available (minimum of two displays per station is recommended), with widescreen formats being preferred. G-Sim will automatically scale to suit any resolution above the minimum specified and the software has been optimised for full touch capability.

Network

When used in a multi-student training environment each PC should be linked using an Ethernet network (100Mbs or above) comprising the cabling and a network hub suitable for the total number of stations to be installed.

Software Description

Operating Modes

The G-Sim software supports the running of the simulator in either a single PC or multi station environment.

For the training of groups the use of multiple stations, comprising of a number of student workstations connected to an instructor workstation, is recommended. Whilst there is not a limit imposed on the number of student workstations that can be installed or supported by the software, the recommended configuration comprises up to six students per instructor.

System Description

The design is based on the distributed processing model using networked PC's. The same software is installed on each PC, hence any of the PC's can all be run in either 'Instructor' or 'Student' mode.

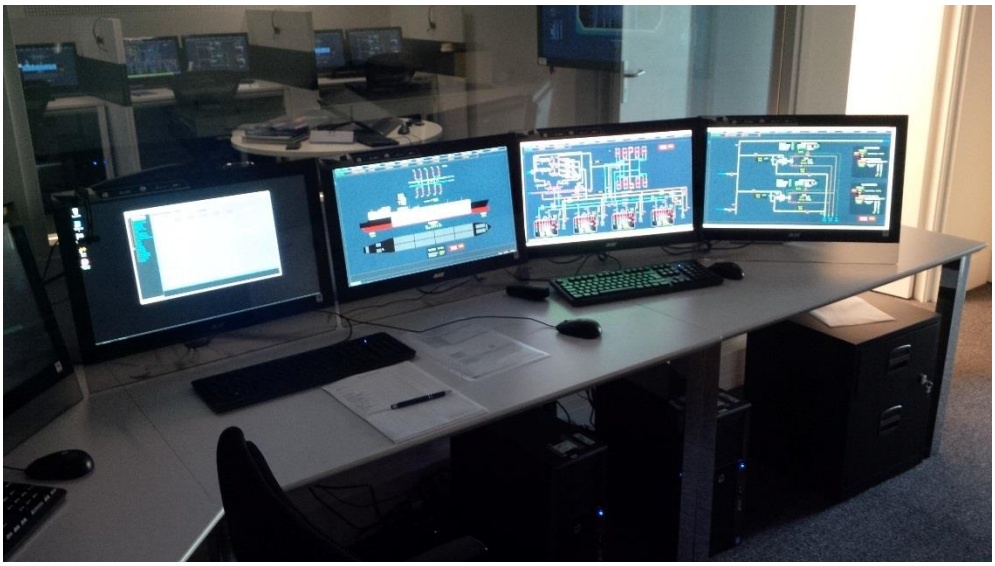
The advantages of this type of processing model are:

- It is easy to reconfigure the overall simulator to an arrangement suitable for the training to be delivered from within the software (ie no changes to the hardware are required). Each station can be configured to run exercises independently, linked together to form a ship to ship, or ship to shore combination, or combined to allow all the linked stations to be used to control a single model hence allowing group exercises to be undertaken.
- Each station performs its own modelling, display, and input processing. This allows the number of stations to be increased or decreased at any time after the initial installation with minimal effort.
- Any station can be configured as either an instructor or student station. Within the overall group of stations multiple subgroups of instructor and student stations can be configured if required.
- In the unlikely event of a hardware failure on the normal instructor PC, any of the students PC's can immediately be used in instructor mode minimizing any disruption that may result.
- The system enables all models to run in all possible combinations, either independently or concurrently.
- The need to back up the software is not required as a copy is maintained on each of the stations within the network.

As indicated the software can be operated in two modes:

Instructor Mode

When in instructor station mode the functionality is provided to allow the instructor to start /stop and set up the simulator for the training exercises, selection of the stations to be monitored and the facilities to record student actions and display them in various formats for later analysis. The instructor station is usually equipped with between 2 and 5 monitors depending on the arrangement selected.



The Instructor Station provides all the facilities to enable an instructor to:

- Select the configuration of the models to be used in the simulation
- Define simulator configuration, to suit a variety of training needs.
    - Independent - allowing individual tuition
    - Pairs of stations linked together - for direct ship/ship or ship/terminal operations
    - One model spread over a number of stations - to allow team training in a control room atmosphere
- Create and run exercise scenarios
- Enable recording / logging of all student actions
- Interact with individual students by adjusting model condition such as flow rates
- Monitor individual student activities
- Trend defined variables for each student
- Inject malfunctions in real time
- Interactive exercise replay
- Remotely monitor individual student performance, both visually and by using the optional Competence Assessment System
- Produce hardcopy de-brief / assessment material
- Communicate with each student individually both for instructive and role play purposes

The displays on the instructor station can also be linked directly to a projector or 'SMART' board to allow for demonstrations and feedback to be provided directly to the students.

Student Mode

In student mode, each station performs the necessary math modelling to support the simulation exercises, and display the results.

Each student station is equipped with one or multiple monitors and is designed to allow the simulator to be operated by a single mouse, or by touch, with only minimal keyboard input required, minimizing the learning time required for a student to become familiar with its operation.

To the student, the ship or plant model is visible as a set of mimic diagram 'pages' displayed on the monitors. All monitoring and control of the system by the student is undertaken via these 'pages' replicating the control method used on modern ships and terminals, enhancing the transfer of knowledge to the real life environment. The provision of multiple displays provides the ability for the student to monitor different areas of a system at the same time, again enhancing the learning experience.

As well as being able to control every aspect of the vessel, the student also has access to the following facilities:

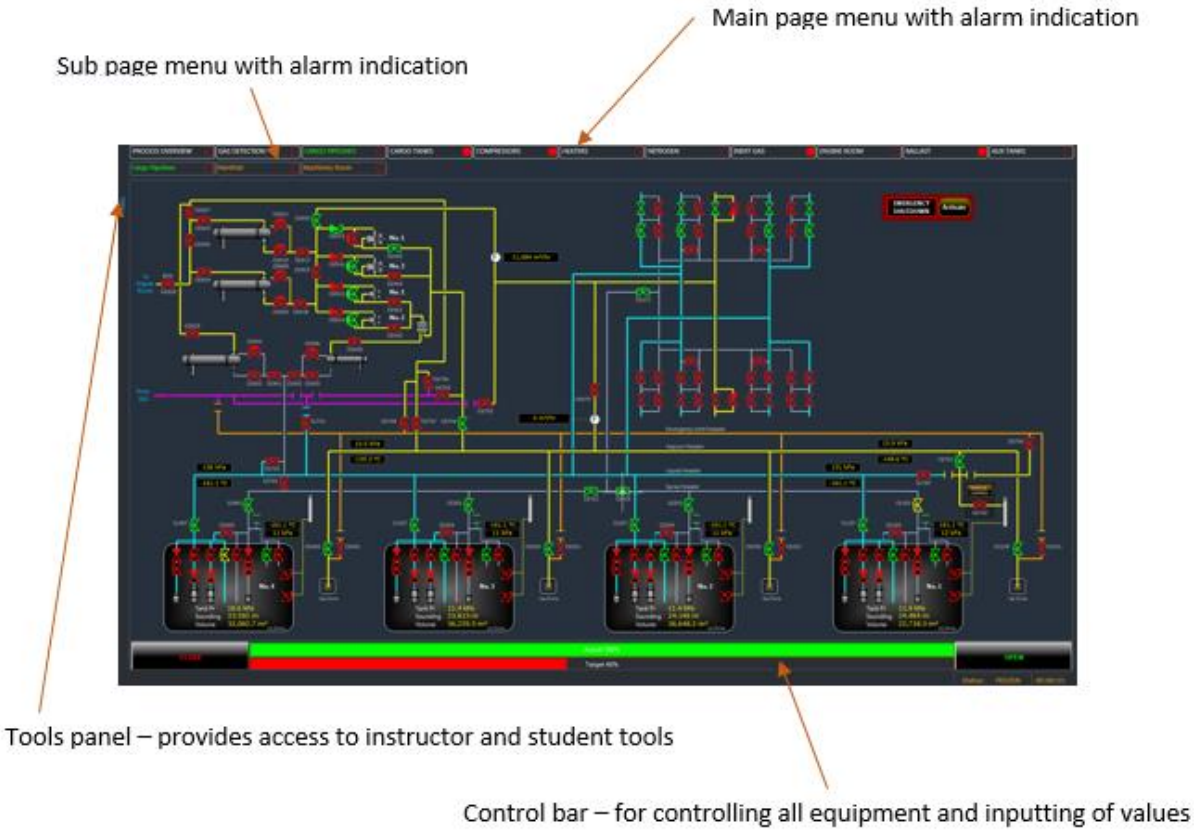
- Alarm logging and summary display
- Online/offline 'Cargomax stress and stability module
- Trending of specific variables

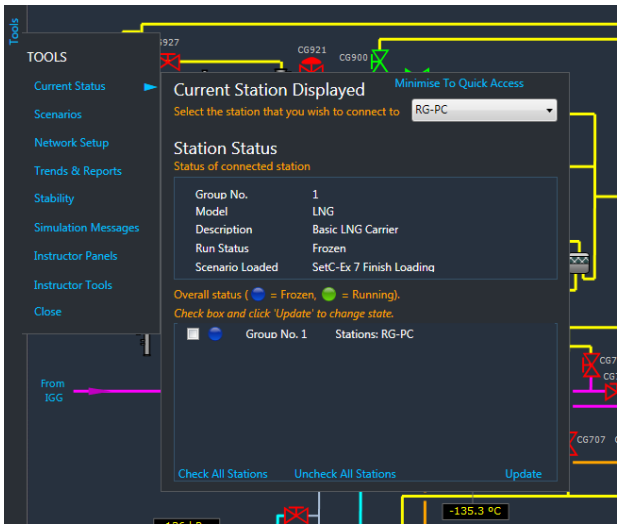
User Interface

Main display

The user interface has been designed taking into account best practice within the control system industry whilst maintaining ease of operation for both student and instructor.

The basic design of the system mimic pages incorporate the following:





Example of tools menu selected

The user can access all the controls required directly via the mimic display. Floating windows have been avoided due to the hiding of the main display. Instead to operate or change any item, the operator just selects the item and the appropriate settings are displayed in the control bar which can them be changed accordingly. The same process is used for all items making learning of the system easy to achieve.

Instructor displays

In addition to the main displays the instructor has access to a number of 'instructor displays' which provide him/her with detailed information about each of the models running and the ability to interact and control the student models (ie changing flow rates, tank filling levels) as requested by the student.

Malfunctions

The instructor can also apply malfunctions to many items within the model. The malfunctions can be activated either via the instructor displays or by selecting the item to be malfunctioned directly on the mimic display. Some of the malfunctions available include:

- Valves
  - Sticking of valves
  - False indication
  - Movement of valves when not controlled
  - Freezing of valves
- Alarms
  - False indication
  - Incorrect set points
- Leaks
  - Leaks at manifolds
  - Leak from cargo tanks into barrier spaces
  - Ballast leaks
- Inert gas / Nitrogen
  - Temperatures increasing over time
  - O2 , CO2 or dewpoints changing over time
- Equipment failures

Models

Techniques

To allow the very complex operations to be conducted as required, all the models incorporate:

- Fluid dynamics
  - Incorporating all aspects relating to the control of flows within a system including specific features such as pump cavitation and heating by adiabatic compression
- Thermodynamics
  - Address both equilibrium and non-equilibrium aspects
  - Based on vapour/liquid equilibrium for a multi-component, multi-phase system
  - Heat exchange through tank walls and heat exchangers

G-Sim is designed as a Liquid Gas Operations Simulator. Currently the components / cargoes that may be modelled include:

- LNG - composition adjustable to suit
- Ethane
- Propane
- Butane
- Nitrogen
- Inert Gas
- CO2
- O2

Verification

The mathematical models within G-Sim are derived from a rigorous analysis of the physical characteristics of the simulated plant and the behaviour of liquids and vapours within closed systems. As well using the design data provided by relevant machinery manufacturers the models incorporate the extensive knowledge and expertise of the behaviour of LNG in its various phases that GTT have acquired during its 50 year history. Such characteristics include the mechanical, thermodynamic, electrical and chemical properties and reactions and the modelling of Pressures, Flows, Levels and Temperatures according to operational conditions. Each of the models a carefully checked against the design parameters of the individual items of equipment involved.

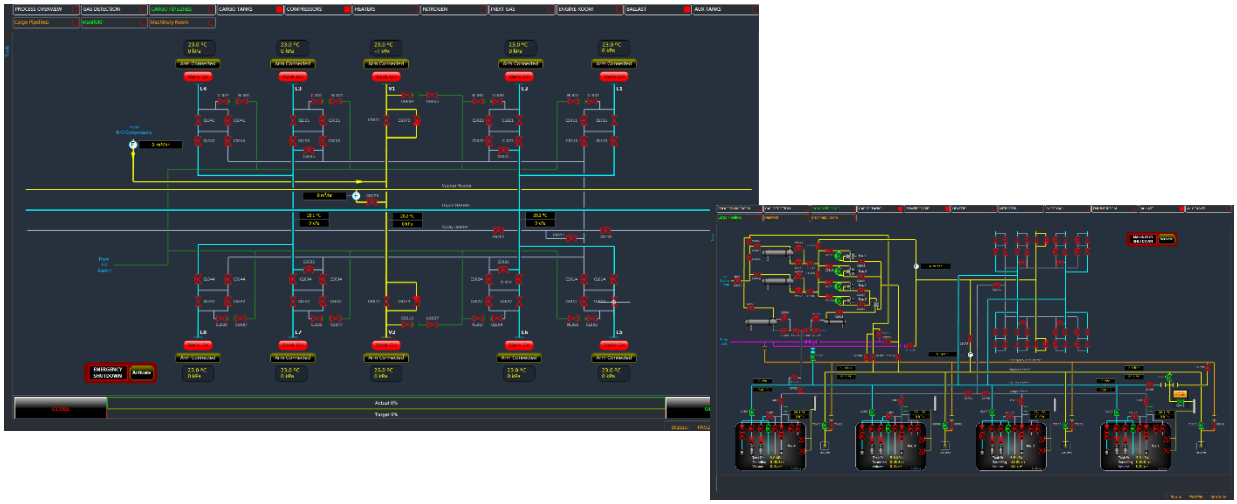
Once initial development is completed the results are then checked again against real data obtained from the ship that has been modelled to ensure the parameters are adjusted to take into account real life operations. Due to the validity of the modelling they are capable of been used in undertaking research into the effects of changing working procedures, maximizing operational efficiency of actual vessels and use in the design phase of new facilities to determine the requirement for new equipment.

In summary, every system is fully modelled using the appropriate mathematical method – thermodynamic, electrical, chemical, mechanical etc. Individual components such as sensors, controllers, actuators, valves etc are also modelled in sufficient detail to ensure that the simulator behaves naturally and realistically in response to any input – whether correct or incorrect.

Detailed description (LNG Carriers)

Cargo System

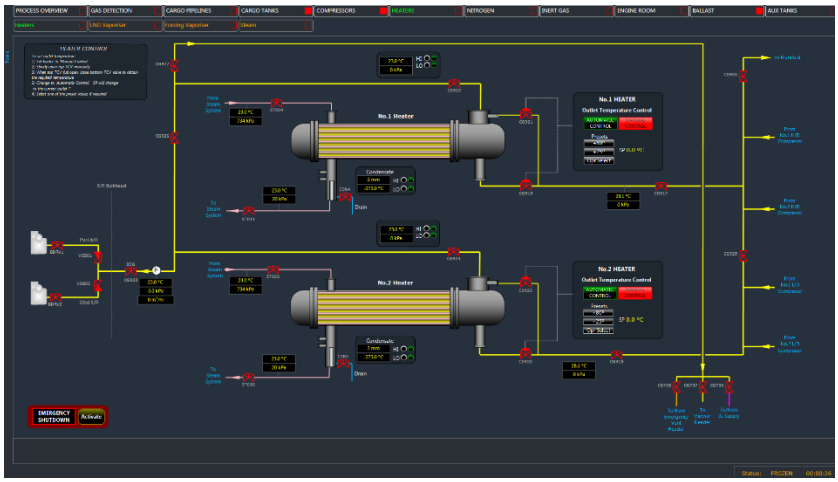
The cargo system includes all the relevant pipelines for the movement of liquid and vapour around the vessel, together with connections into supplementary systems allowing all required operations to be conducted. The operator is provided with complete control over the line-up used. Restrictions on the movement of spool pieces or valves are applied as would be in real life. The cargo manifold arrangement allows the operator to decide which manifolds should be used and connected to shore or atmosphere to allow full loading / discharge operations or line purging operations to be conducted.



Vaporisers & Heaters

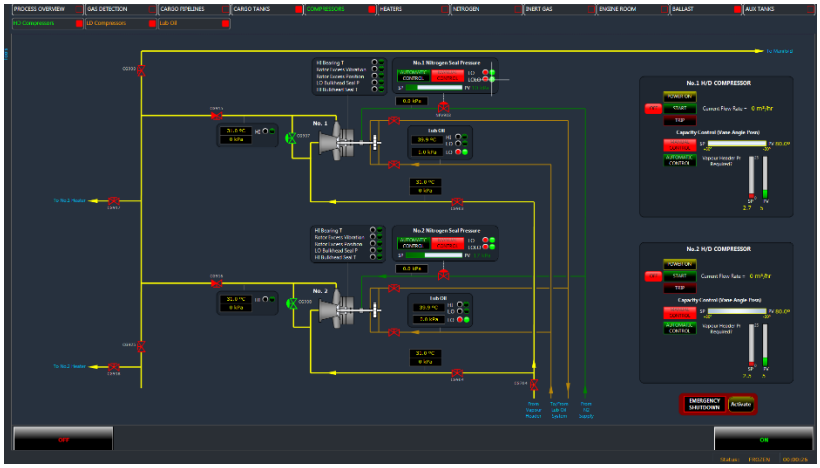
Two vaporisers are incorporated, one for the supply of LNG vapour for 'gassing up' and discharging purposes and the other for the supply of gas to the vessels propulsion system. Heaters are provided, which can be used for circulating LNG vapour and for supply to the propulsion system, in accordance with the propulsion system selected. Manual and automatic controls are provided to allow the system to be set up to deliver the correct temperature and pressure of boil off gas to the vessels engine room in combination with the low duty compressors.

The operator is provided with all the necessary controls including automatic systems for the operation of the vaporisers and heaters. All interlocks and alarms are provided as per the real vessel.



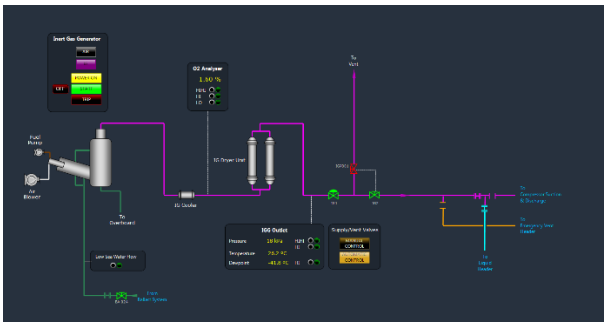
Compressors

Two high duty compressors are provided for the removal and circulation of LNG Vapour, along with two low duty compressors for the supply of boil off gas to the engine room. The type of compressors displayed is dependent upon the propulsion system selected. Full control mechanisms for the compressors are provided including automatic capacity control by adjustment of the inlet vane angle. Monitoring information includes the inlet and outlet pressures and temperatures together with flow.



Inert Gas / Nitrogen Systems

The vessels are equipped with an Inert Gas generator together with a drying system. The quality of the inert gas can be decided by the operator, with connections provided into the cargo lines or directly into the hold spaces surrounding the cargo tanks. Two Nitrogen generators of the membrane type are also included for the supply of Nitrogen to the compressors, Engine Room and purging of the inter-barrier space around the cargo tanks. The purging system incorporates all the flow and pressure controls as per the real vessel. In a similar way to the IG the quality of the Nitrogen can be adjusted by the operator.



Facilities allow all procedures to be conducted in preparing for the supply of gas to the engine room and to provide the correct quantity and temperature of gas to the boiler in the different service modes.

In the event of a gas leakage into the barrier spaces the models allow all the procedures to be conducted to remove or control the gas leakage as appropriate to the system modelled.

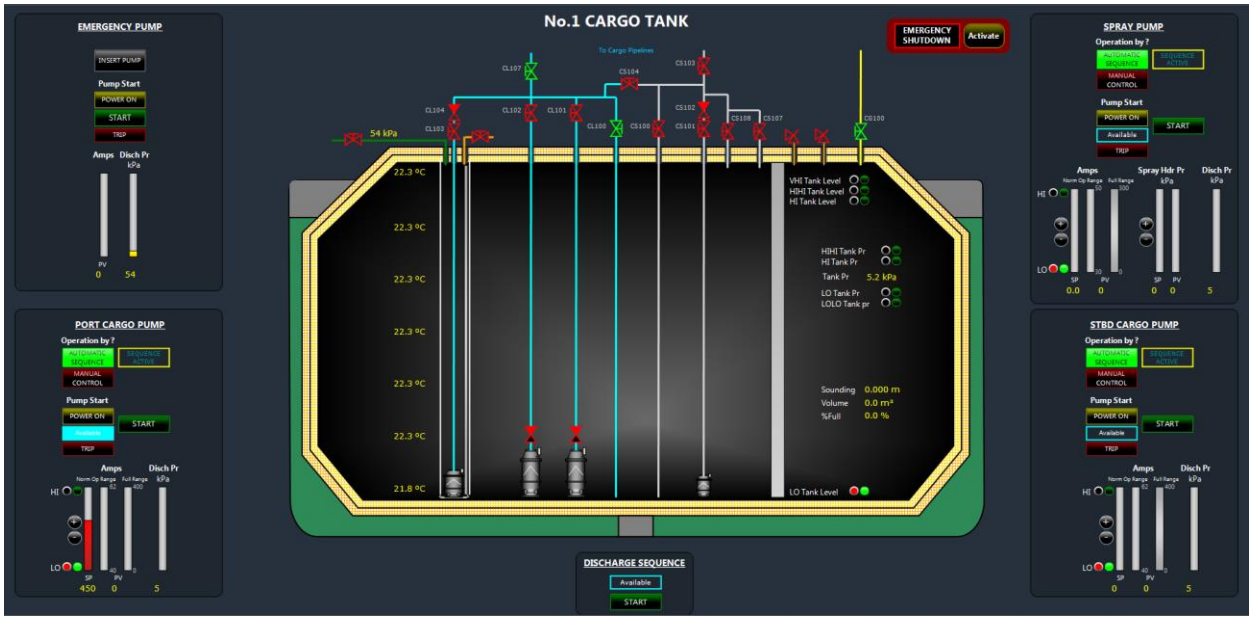
Gas Detection Systems

Both fixed, sequential and portable gas detection systems are provided. The two sequential systems continuously monitor the spaces around the cargo areas for leakages with appropriate alarms and shutdowns implemented if gas is detected. The portable system allows the operator to select the type of instrument to be used for the detection of oxygen, %LEL or %Vol. The sample location points, located

in the same location as per the actual vessel, can then be selected including cargo equipment and manifold connections, allowing the operator to check if operations are progressing correctly and safely.

Cargo Pumps & Controls

Automatic pump controls are provided which mimic the behaviour of the systems used on board the real vessels. Full pump start and appropriate valve opening sequencing is included. Spray pump controls are provided with an additional controller to allow the required pressure to be maintained within the spray header to be set, and maintained for use when tank cooling or providing a supply to the Forcing vaporiser. An Emergency Pump is also provided in each tank together with the appropriate equipment to allow the full installation procedures to be conducted.

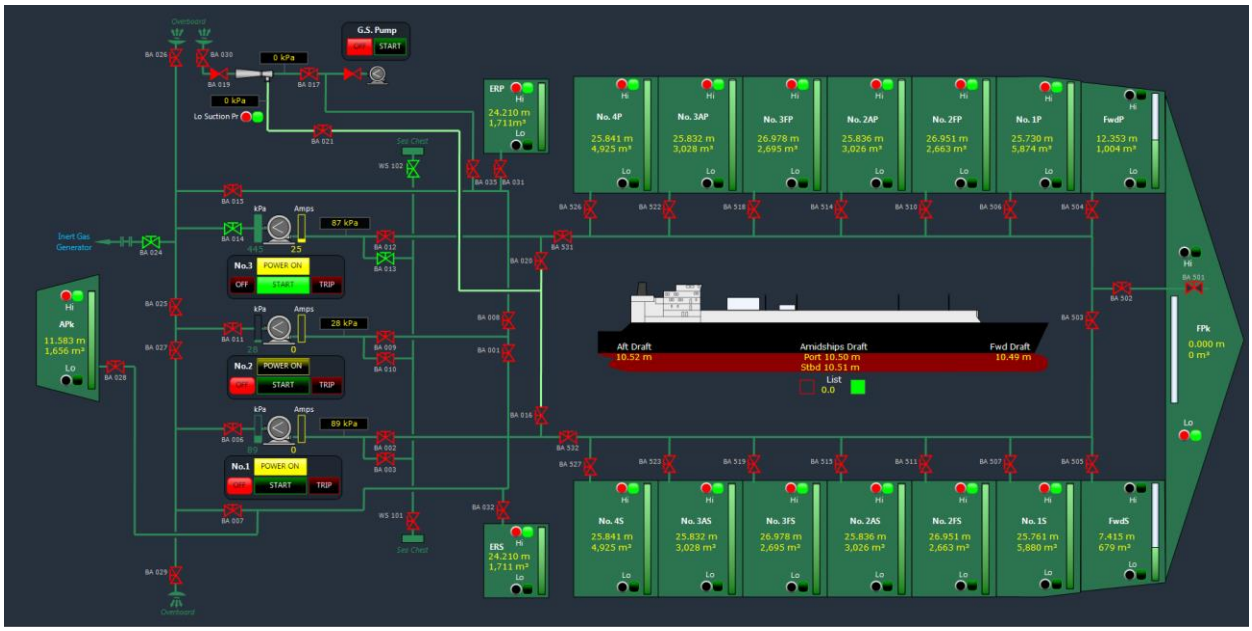


Glycol & Temperature Monitoring Systems

The full glycol circulation system is included to allow the operator to monitor and take appropriate steps to maintain the bulkhead temperatures fore and aft of the cargo tanks

Ballast & Auxiliary Systems

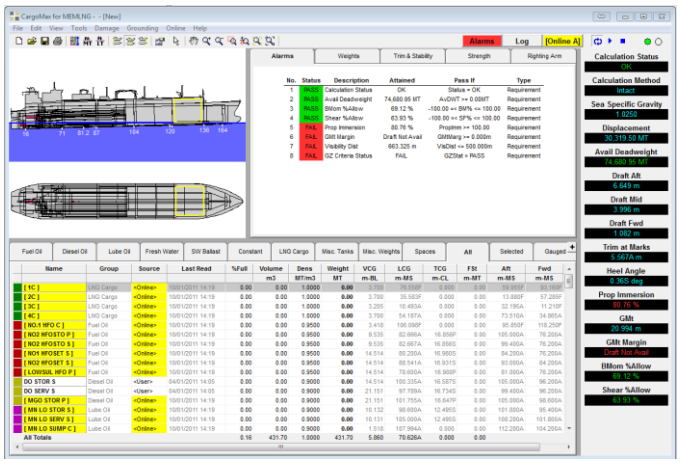
The ballast system comprises of two or three electric pumps for the supply and discharge of sea water ballast. A separate pump provides the supply to the stripping eductor. Appropriate connections are provided, for example to provide a supply to the Inert Gas Generator and to allow the emptying of interbarrier spaces. The operator is also provided with displays indicating the status of the lubricating oil supply for the compressors and the steam supply to the cargo heaters and vaporisers. Status of all fuel and water tanks is also shown to enable the correct assessment of trim and stability conditions.



The Emergency Shutdown System provides different links into shore based systems and provides indication of the cause of operation.

CargoMax Stress and Stability Program

Facilities are provided for each model (where appropriate) to enable the student to undertake a full assessment of the vessels stress and stability at any time both during planning and real time monitoring. These facilities are provided using the latest version of 'Cargomax'



'CargoMax' is a commercial, fully class approved, stress and stability program for vessels supplied by Herbert –ABS. **CargoMax** displays all the information likely to be required regarding the draughts, trim, list, shear forces, bending moments and damage stability for a particular vessel. The information is displayed using a 'Windows' format using both analogue tables and graphical indicators.

A version of '**CargoMax'** has been developed for each of the ship models within the simulator library. The program is fully integrated into the simulator allowing it to be used as a 'standalone' planning tool or to provide 'on line' information as exercises are conducted on the simulated model. Once the Cargomax program has been started the interface appears as a normal simulator graphics display and is accessed via the simulator 'page menu'.

The basic functions included within CargoMax are as follows:

Intact Stability calculation according to international requirements, including

- Calculation of GZ curve and comparison with IMO criteria
- Comparison of GMt / KGvirtual with Required GMt / Max. KG curves
- Warning and check of various loading restrictions such as draft limits, visibility requirements, and custom tank filling restrictions
- Longitudinal Strength (Bending Moment and Shear Force) if required by approved Loading Manual
- Comparison to class allowable at the required frames
- Comparison for both in Harbour & At Sea allowable
- User input of tank data by sounding, ullage, volume, weight or percent full and density (or specific gravity). Automatic conversion of the other input types.
- Damage Stability
- Online interface to simulated model to automatically read in tank levels and cargo characteristics (such as density, temperature), CargoMax can be set to continuously monitor the gauging system at a user defined interval.

Detailed Description (LNG Bunkering & Fuel Gas Handling Systems)

The LNG as a Fuel and Bunkering model comprises a LNG Supply vessel together with the various shore supply and LNG receiving facilities, and the storage and fuel gas handling systems representing those installed on vessels that are using LNG as a fuel. The model enables all the operations that may be conducted on an LNG supply vessel or onboard a vessel that uses LNG as a fuel to be conducted.

The full model comprises of two main configurations:

- LNG Supply Vessel
- Storage & Fuel Gas Handling Systems

LNG Supply Vessel

The LNG Supply vessel is based on the 2200m^3 capacity LNG Barge that is currently in service in the USA and includes:

- LNG tank and associated systems
- Complete cargo piping system on board the vessel
- Pressure management systems
- Compressors
- Vaporizers
- Reliquefaction system
- GCU
- Nitrogen supply and distribution system
- Cofferdam heating system
- Steam & Lub oil systems
- Segregated ballast system
- Fixed and potable gas detection systems
- Load and LNG transfer facilities
- Emergency shutdown system
- Automatic control systems

To facilitate the simulation of all the various types of transfer operation in which the supply vessel may be engaged the model also includes the following:

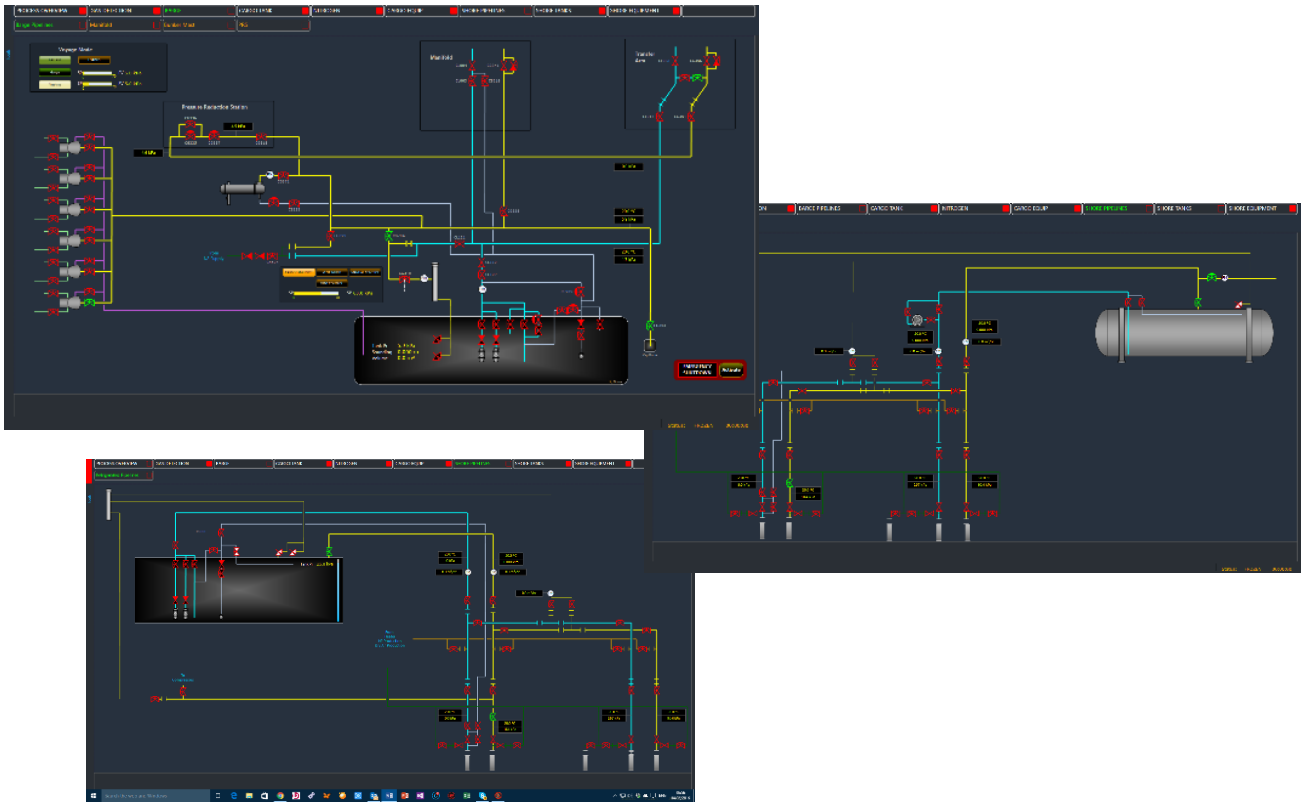
- Pressurised and refrigerated LNG receiving tanks with associated systems
- Pressurised and refrigerated shore LNG supply tanks and associated shore based systems and equipment
- Ability to change the barge containment between refrigerated and pressurised storage

The model allows the operator to change the liquid composition, liquid level and liquid temperature within any of the tanks with the subsequent results displayed accordingly.

Cargo System

The cargo system includes all the relevant pipelines for the movement of liquid and vapour both onboard the supply vessel and to the respective storage facilities (atmospheric and pressurised) on the shore/receiving vessel, and the connections into supplementary systems allowing all required operations to be conducted.

The operator is provided with complete control over the line-up used. Restrictions on the movement of spool pieces or valves are applied as would be in real life. The system includes both a standard and transfer cargo manifold arrangements allowing the operator to decide which manifolds should be used and connected to shore or atmosphere to allow full loading / discharge operations or line purging operations to be conducted.

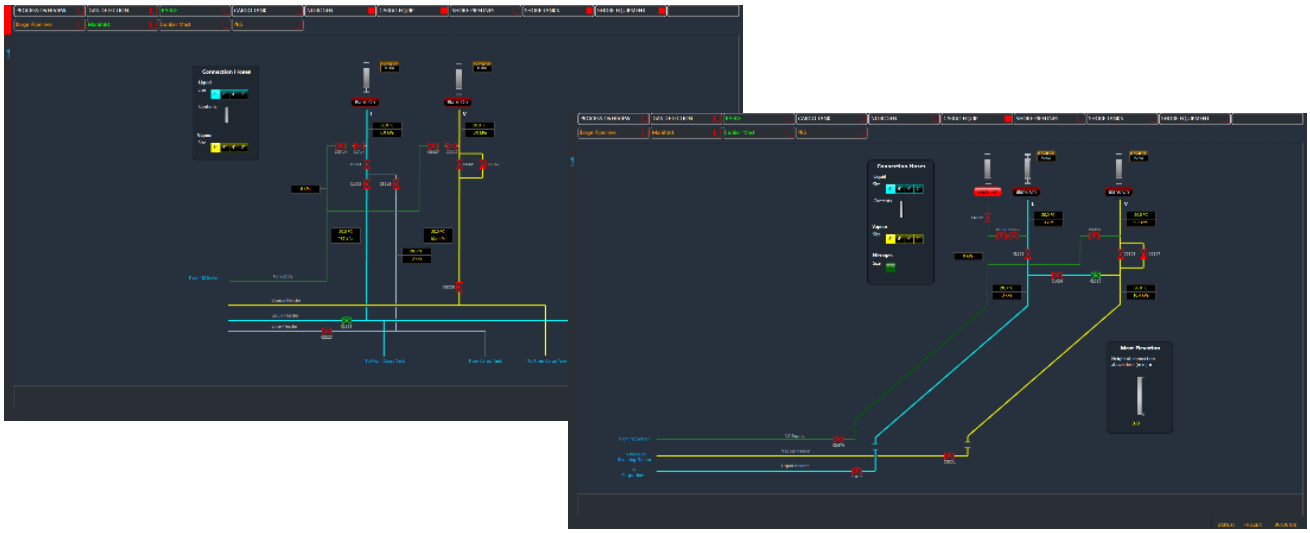


Vessel Arrangement

The supply vessel arrangement comprises of one tank (atmospheric or pressurise) equipped with two cargo pumps and a spray pump. In addition the vessel is equipped with a reliquefication plant comprising of six Cryo Coolers and a Vaporiser.

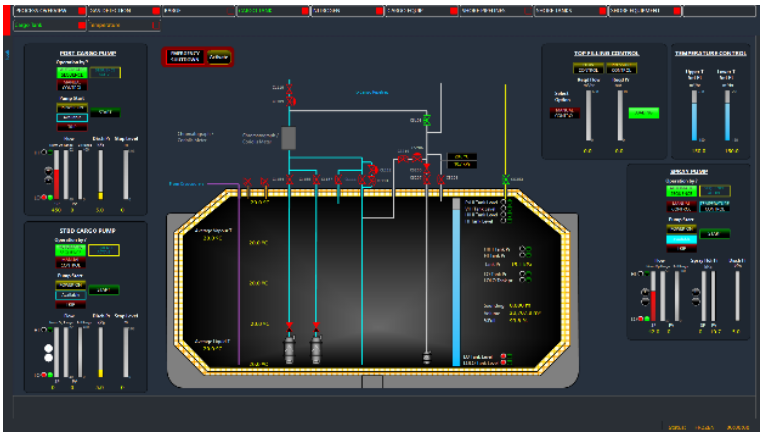
Manifold & Transfer Arms

A standard manifold for loading of the vessel and a transfer arm for the bunkering of LNG fuelled vessels are provided. For both the operator may select the hose sizes to be used, and for the transfer arm, the altitude of the actual connection. Both include facilities to allow the operator to purge the connectors with dry air/N2 prior to connection.



Cargo Pumps & Controls

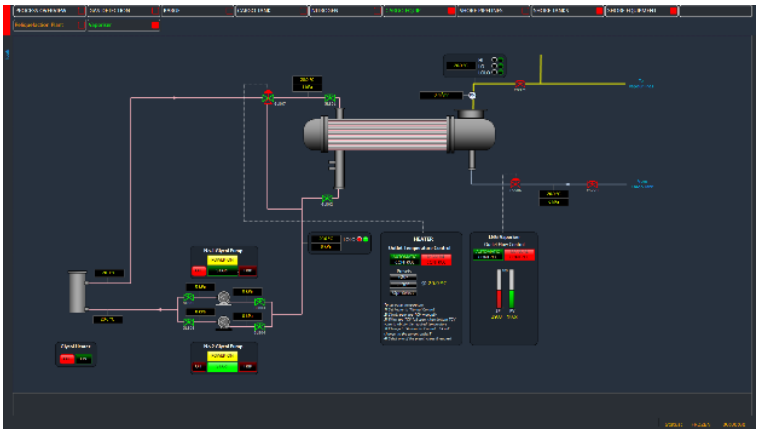
Automatic pump controls are provided which mimic the behaviour of the systems used on board the real vessel. Full pump start and appropriate valve opening sequencing is included. Spray pump controls are provided with an additional controller to allow the required pressure to be maintained within the spray header to be set, and maintained for use when tank cooling. The pumps use VFD controllers together with a required flow controller that adjust the position of the main tank liquid valve to achieve the required flow rate.



Vaporiser

One vaporisers is provided for the supply of LNG vapour for ‘gassing up’ and discharging purposes. Manual and automatic controls are provided to allow the system to be set up to deliver the correct temperature and pressure of boil off gas to the vessels engine room in combination with the low duty compressors.

The operator is provided with all the necessary controls including automatic systems for the operation of the vaporisers and heaters. All interlocks and alarms are provided as per the real vessel.

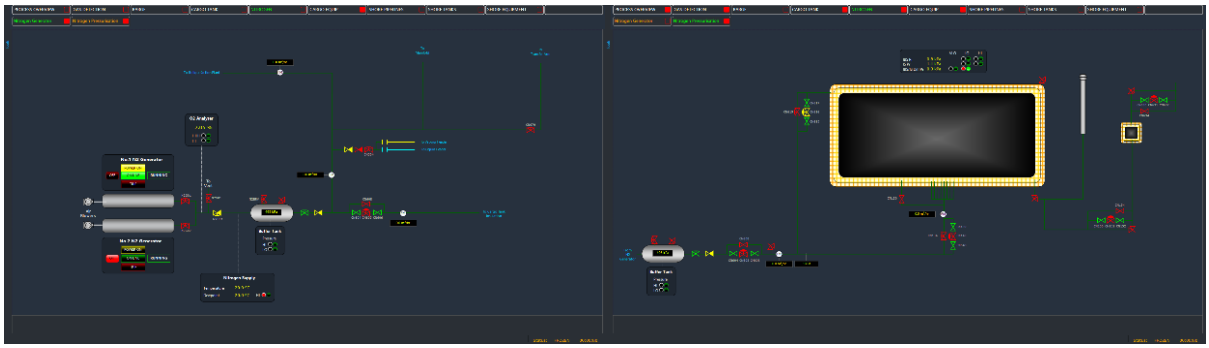


Reliquefaction Plant

Six Cryo Cooler compressors are provided for the reliquefaction of LNG Vapour. Full control mechanisms for the compressors are provided including automatic capacity control by adjustment of required vapor header pressure Monitoring information includes the inlet and outlet pressures and temperatures together with flow.

Inert Gas / Nitrogen Systems

The vessels are equipped with a Nitrogen Generator together with a drying system. The quality of the N2 can be decided by the operator, with connections provided into the cargo lines or directly into the hold spaces surrounding the cargo tanks. The purging system incorporates all the flow and pressure controls as per the real vessel.



In the event of a gas leakage into the barrier spaces the models allow all the procedures to be conducted to remove or control the gas leakage as appropriate to the system modelled.

Gas Detection Systems

Both fixed, sequential and portable gas detection systems are provided. The two sequential systems continuously monitor the spaces around the cargo areas for leakages with appropriate alarms and shutdowns implemented if gas is detected. The portable system allows the operator to select the type of instrument to be used for the detection of oxygen, %LEL or %Vol. The sample location points, located in the same location as per the actual vessel, can then be selected including cargo equipment and manifold connections, allowing the operator to check if operations are progressing correctly and safely.

Trim System

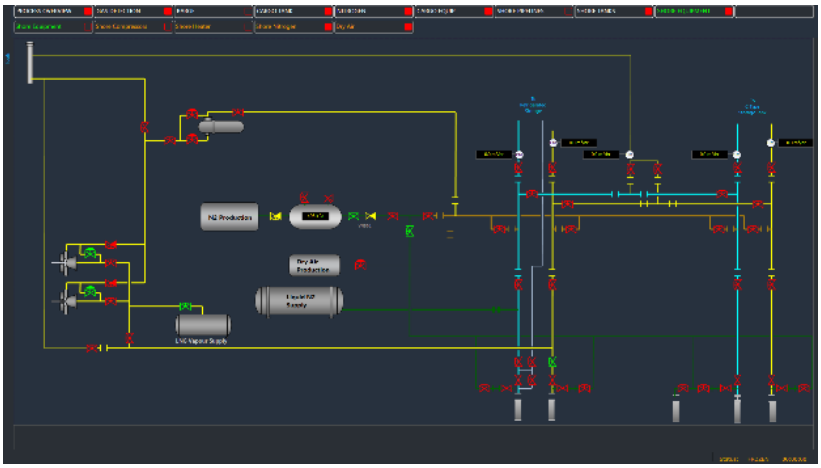
The ballast system comprises of two electric pumps for the control of the trimming ballast water.

Shore/Receiver Arrangement

The model incorporates the pipelines and connections to allow the operator change between the various types of storage that may be encountered to either load from, or discharge to. In addition, the supply vessel is not equipped with all the equipment that may be necessary to complete operations such as gas freeing. Instead these are positioned on the shore and would usually be supplied on portable skids. Such equipment provided includes:

- Compressors for the handling of Boil Off
- Nitrogen & Dry Air Supplies
- Heater
- LNG Liquid & Vapour supplies (not from the tanks)

Using the above the model provides the operator with the ability to simulator any of the likely scenarios that will be encountered by a typical LNG Bunker supply vessel



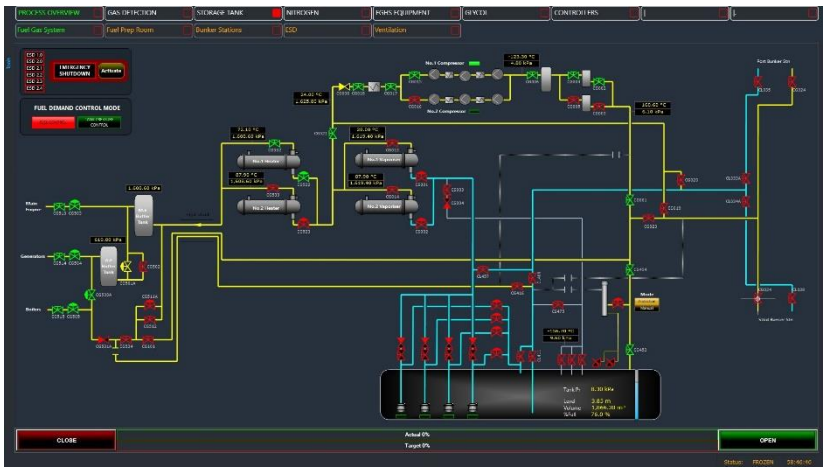
LNG Storage and Fuel Gas Handling Systems

The model will incorporate a number of different configurations of storage and fuel gas handling systems (fghs) that may be found on vessels using LNG as a fuel. The design of the systems and equipment they therefore comprise being primarily dependent upon the type of fuel storage tanks and the type of consumers that are fitted on the vessels concerned. The following describes the main features of each of the types of system currently available.

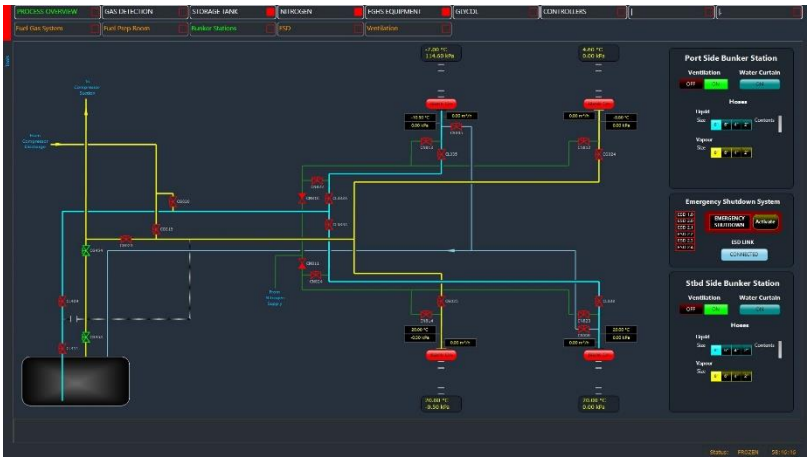
Atmospheric Tanks to XDF primary and medium speed secondary consumers

Fuel Gas Handling System

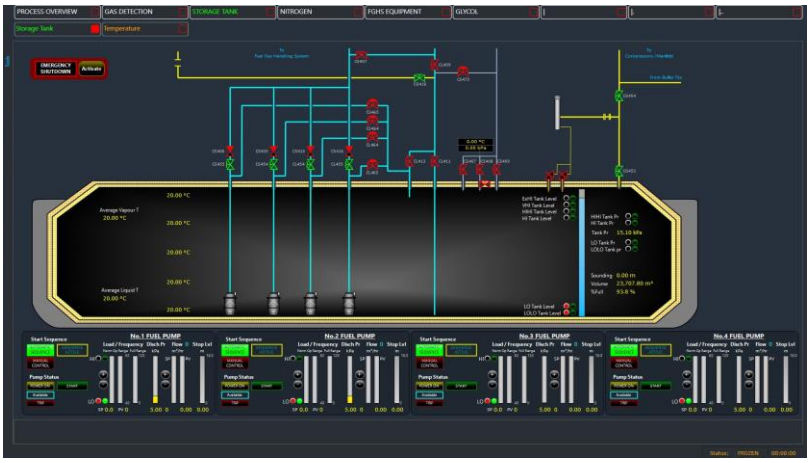
The fuel gas handling system includes all the relevant equipment and pipeline arrangements to retain the LNG within the storage tanks and then provide the gas to the various consumers in the appropriate quantities. The operator is provided with complete control over the line-up used. Restrictions on the movement of spool pieces or valves are applied as would be in real life. The bunker station



arrangements allow the operator to decide which manifolds should be used and connected to LNG bunker supplier to allow the operations to be undertaken as part of the full transfer to be conducted including setting the size of the hose to be used for the transfer and monitoring of the liquid content within the transfer hose.

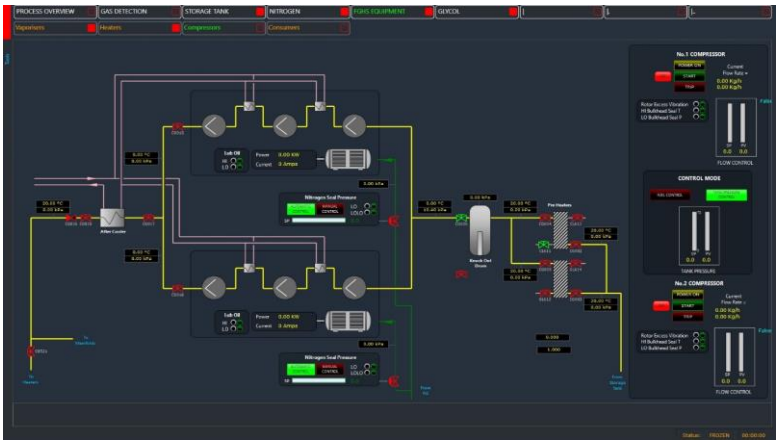


Fuel Storage Tank



The system comprises of a single atmospheric storage tank (Membrane type) which is fitted with four independent fuel supply pumps. The fuel supply pumps can also be used to maintain the condition in the tank. Full pump start and appropriate valve opening sequencing is included together with the automated control of the pump capacity to enable to appropriate amount of gas to be supplied to the consumers.

Compressors

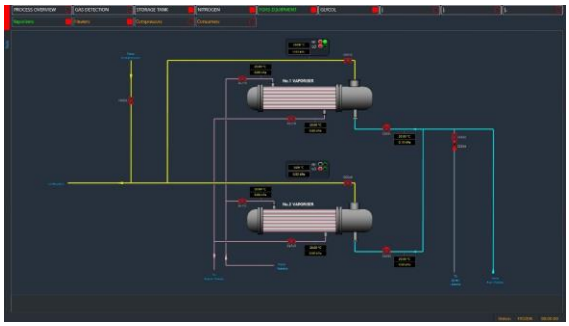


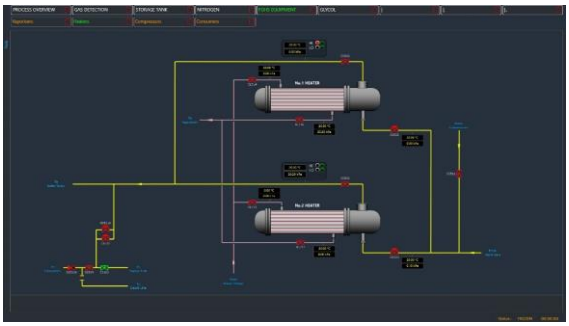
The system includes two, 3-stage compressors which are used to provide gas directly from the storage tank to the consumers via the heaters. The cooling glycol circuit is also included together with the Nitrogen sealing arrangements. As with the other items of equipment all the start permissives and start / stop sequences are implemented as per the actual vessel together with the manual and automatic control functionality of the capacity of the compressor.

Vaporisers & Heaters

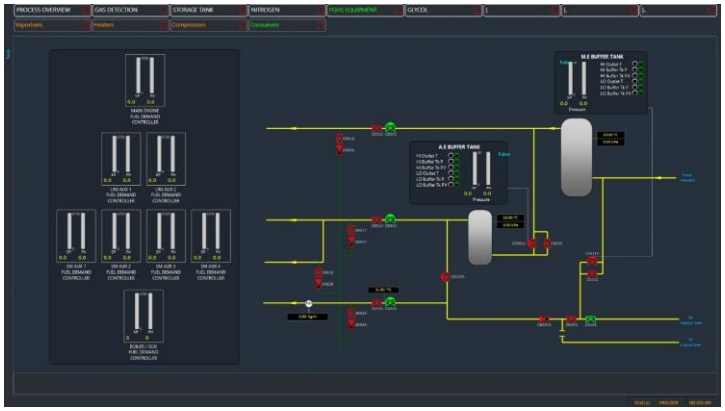
Two vaporisers and two heaters are included, to enable the gas to be supplied to the consumers at the appropriate temperature. one of each in use, whilst the others are standby units. The heating medium for both the vaporisers and heaters is a warm glycol system. Manual and automatic controls are provided to allow the system to be set up to deliver the correct temperature and pressure of boil off gas to the vessels engine room in combination with either one of the compressors or one of the fuel pumps.

The operator is provided with all the necessary controls including automatic systems for the operation of the vaporisers, heaters and the associated glycol system. All interlocks and alarms are provided as per the real vessel.





Consumers

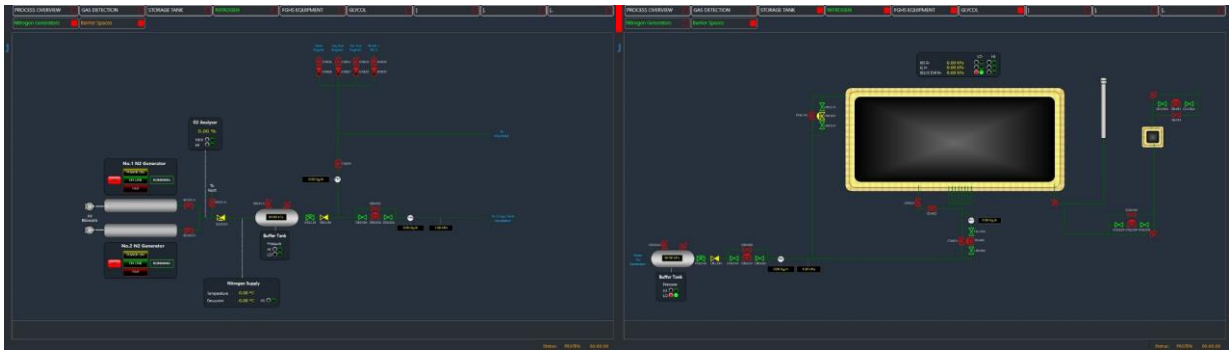


The model allows the operator to control all the functions required from the storage tank through to the main gas valve unit of each consumer. The operator is able to set the required fuel demand on each consumer, which then adjusts to total fuel demand set point used by the automatic control system to adjust the capacity of the compressors or pump. The full control system is implemented and can be adjusted / controlled by the operator.

Nitrogen Systems

Aa Nitrogen Generator together with a drying system is incorporated. The Nitrogen is used for purging of the tank barrier spaces, compressor sealing arrangements and for inerting various parts of the pipeline system when required. The quality of the N2 can be decided by the operator, with connections

provided into the barrier spaces around the storage tank. The purging system incorporates all the flow and pressure controls as per the real vessel.



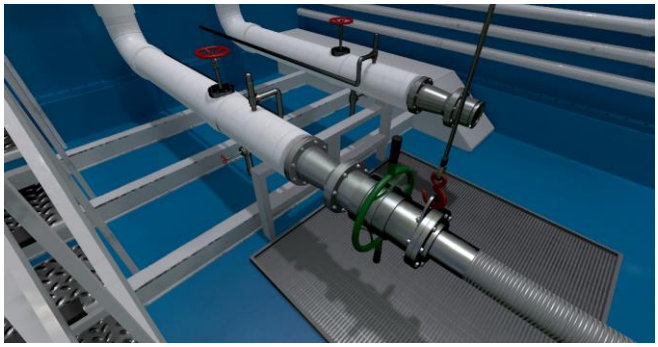
In the event of a gas leakage into the barrier spaces the models allow all the procedures to be conducted to remove or control the gas leakage as appropriate to the system modelled.

Gas Detection Systems

Both fixed and portable gas detection systems are provided. The portable system allows the operator to select the type of instrument to be used for the detection of oxygen, %LEL or %Vol. The sample location points, located in the same location as per the actual vessel, can then be selected including cargo equipment and manifold connections, allowing the operator to check if operations are progressing correctly and safely.

Bunker Station CCTV

A dynamic 'CCTV' visualisation of the bunker station can also be included if required. The visualisation provides a view of the bunker station that is linked to the actions conducted by the operator and provides a visual representation of the actions conducted at the bunker station including connection/disconnection of the hoses, cooling down and purging etc.



Pressurised storage (Type C) to medium speed consumers

Details available upon request.

International Compliance

G-Sim provides a simulation of a realistic environment as required by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) and allows training to be conducted in accordance with STCW section A-II/1, A-II/2, A-!1/3, A-III/2, A-V/1 and B-1/12.

G-Sim also meets the requirements for a 'Class A' simulator as defined by DNV – Standard for Certification of Maritime Simulators, Section 6, 2019, and for the training and assessment of seafarers in accordance with the requirements of the SIGTTO - LNG Shipping Suggested Competency Standards, the Training & Competence Guidelines for LNG Bunkering issued by SGMF, and the DNV SeaSkill Standard for Certification of the Competence of Shipboard LNG Cargo Operators.

Contact Details

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