



Energy Solutions

## Pipeline Management Solutions

Germanischer Lloyd – Service/Product Description



## Commercial Systems

**Service Title:** Energy Solutions

**Lead Practice:** GL - Energy Solutions

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## Service Description and Values Generated:

Pipeline Management Solutions are a range of software products, solutions and services design for use on gas transmission and distribution systems. These solutions can be applied across the pipeline supply chain and at all stages of a pipeline life cycle.

These systems can be used for Feasibility studies, Design, Engineering, Operations, Asset Management, Training, and Optimisation of gas and liquid pipelines.

The comprehensive range of products and services provided by the GL range of Stoner software enables energy utilities and pipeline operating companies to solve almost any planning, design or operating problem involving the analysis of steady state and transient interactions of fluids and controls in gas or liquid pipelines or distribution networks. GL provides a wide range of technical services supporting its world leading software products to cover all areas of the project or asset cycle, these include

**Design:** Stoner Pipeline Simulator (SPS) is used by engineering, planning and operational divisions and construction firms to simulate pipeline model design and performance. SPS/Simulator can be used to solve operational challenges and/or design for networks transporting natural gas, dense phase gas or (batched) liquid hydrocarbons.

**Network analysis and planning:** development of simulation models of an existing or future gas distribution or transmission network, and the use of these models to evaluate design options and enable robust decisions to be made on future capital or replacement projects or current operational procedures. Models can be created by extracting facilities data from geospatial databases.

**Pipeline Operations:** Real time pipeline management systems supporting the proactive, safe, and efficient management of pipeline operations, including leak detection, capacity management, operational surveillance, scraper tracking, management, predictive simulation, survival time analysis, contingency analysis and optimisation.

**Pipeline Operator Training and Qualification Systems:** These systems allow pipeline companies to train operators in the management of pipelines in a safe, secure environment. Designed to meet the training requirements of operators, and as an integral component of on-going training to meet in-house and national legislative requirements.

**Third Party Access and Commercial Systems Management:** automate and manage all commercial processes for operators of LNG liquefaction and re-gasification facilities and gas storage facilities; enable Third Party Access (TPA) and ensure compliance with regulatory guidelines.



**Hydraulic Consulting:** professional engineering analysis services, where we combine our expert knowledge of pipeline hydraulic behavior with our advanced software tools to provide our clients with insights into the performance of their pipeline systems.

Implementation services also include the design, development, engineering, supply, training, testing, commissioning, and tuning of gas and liquid pipeline management systems based on the Stoner Software products.

**Support:** GL provide a comprehensive application support and hosting operation, ready to meet the specific operational requirements of our customers in the energy industry. A 24/7 application support operation ensures that our customers have access around the clock to our team of expert software engineers and consultants, ensuring that their business critical operations can continue to operate no matter the situation.

# DETAILED METHOD STATEMENT

Pipeline management systems are designed to meet the individual requirements of a particular pipeline company. Configured from standard software applications the pipeline management system can combine the business, operational and asset management requirements of an organisation, to provide a platform that will allow the business to improve the operation of its pipelines in a number of key areas. Utilising a combination of advanced simulation based tools and applications developed by GL a "Virtual Pipeline" can be developed. Where all aspects of a pipeline's current and future operations can be simulated, providing operators with unprecedented information on the pipelines current and future states, and a veritable "Crystal Ball" for planners, engineers, operators and managers alike. Pipeline management solutions are provided in four main areas:

## a. Network Analysis & Planning

The SynerGEE family of products is the foundation for our network analysis and planning services offerings.

### SynerGEE®

SynerGEE Gas models and analyzes closed conduit networks of pipes, regulators, valves, compressors, storage fields and production wells. SynerGEE serves as a general purpose-modelling tool for piping networks including, but not limited to natural gas, propane, steam, oxygen and air.



The following optional modules are available for SynerGEE Gas:

- **Model Builder:** Provides a seamless integration between SynerGEE Gas and geospatial information system (GIS) data.
- **Facilities Management Module:** Synchronize gas distribution network models with GIS updates without rebuilding the model.

- **Customer Management Module:** Create a link between SynerGEE and customer information system. Establish a relationship among weather, individual customer load and customer location.
- **Area Isolation Module:** Simulate the isolation of user-selected areas of a gas network for emergency planning, maintenance or other operational needs.
- **Automated Design Module:** Calculate and report the lowest possible pipe diameter capable of transporting sufficient quantities of gas to required delivery points safely and reliably.
- **Estate Design Module:** Analyses pipe size options for your model with specified loading conditions, material cost, installation cost and location. The module is particularly helpful when designing new systems with demand diversity.
- **Cost of Service Module:** Report the cost of service for gas in a distribution system based on the pipe cost, the pipe capacity and customer demand on peak day.
- **Leakage Minimisation Module:** Analyse a single lower pressure tier to reduce the set pressures at supplies so that the pressure in the pipes with the highest leakage is preferentially reduced.
- **Optimisation Module:** Fuel and cost of fuel optimization. Minimize system-wide volumetric fuel consumption or system-wide fuel cost.
- **Time Varying Module:** Perform a series of consecutive steady-state analyses to simulate the changes in network over time. Link individual steady-state simulations through time for inventory tracking and compressor maintenance scheduling.
- **Unsteady State Module:** Off-line unsteady flow condition analysis in natural gas networks. Model gas composition, heat content and specific gravity as it varies with time as system supplies change.



## b. Pipeline Operations

The Stoner Pipeline Simulator (SPS) family of products is the basis for our pipeline operations offerings. The following SPS modules are available:

### *Stoner Pipeline Simulator*

The Stoner Pipeline Simulator is an advanced transient hydraulic simulation tool that simulates dynamic flow of a single fluid, batched fluids, or mixed fluids through a pipeline using a mathematically sophisticated model. SPS can model operating characteristics of almost any proposed pipeline configuration and predict the outcome of various control strategies for operating scenarios such as pipe rupture, equipment failure, or other upset conditions. SPS performs its simulations by calculating flow, pressure, density, temperature, and other variables at numerous locations along a pipeline model over time, and reports these values in the form of printed reports and graphs. SPS simulates liquid (including column separation and slack line flow) or gas pipelines. The simulation can be run either in batch mode or in an interactive mode. The initial state of the simulation can be a zero-flow condition, a user-defined steady-state condition, or a state saved during a prior simulation.



### *SPS Statefinder*

Using real-time measurement data from a SCADA system, Statefinder maintains a constantly available picture of the current operation of the pipeline. It provides detailed information about the ongoing operation of the pipeline even when operating with degraded or limited SCADA data. Some benefits of Statefinder are:

- **Alarms:** customize alarms and categorize the alarms to aid in the detection of equipment outages, pressure violations, and other significant events.
- **Detection of equipment malfunctions:** the autocalibration process detects instrument outages, out-of-range calibration errors, fouled pipes, inefficient pump/compressor operation, valve malfunction, etc.
- **Archiving of the pipeline state:** schedule archives and/or perform archives on demand.
- **Data Estimation:** estimate non-telemetered data and the pipeline state during data outages.
- **Batch tracking:** track liquid batch movement through a piping model, and/or changes in gas composition and related qualities, and/or gas gravity.
- **Real time information:** by providing constantly available distance plots of pressure, flow, density and other parameters along the pipeline, Statefinder acts as an extension to the SCADA system. Indeed, these variables can be passed back to the SCADA system just as if they came from installed field equipment. This enables the operators to observe system performance even without installed telemetry, thus minimizing investment in telemetry equipment. For petroleum and product pipelines, Statefinder maintains a constantly available view of the location of all batch interfaces, along with their estimated time of arrival.
- **Operational surveillance:** automatically adjusts and calibrates incoming SCADA data to compensate for errors associated with meter drift or changing pipeline roughness. Alarms can be configured to alert such problems as an instrument reaching its maximum calibration limit, thus assisting in determining maintenance schedules. Statefinder also acts as an operational surveillance aid through its constant scrutiny of the pipeline for maximum and lowest allowable operating pressure (MAOP and LAOP)
- **State Estimation:** adjust SCADA data and pipeline friction within user-defined limits to calculate an overall model state that is as consistent as possible with all the data.
- **Autocalibration:** biases in the State Estimation results are fed back into the model so that the model improves over time.

# DETAILED METHOD STATEMENT

- **User-defined applications:** using the proprietary, user-friendly SPS application development language (ADL) the user can define associated variables and equations that combine any of the implicit variables associated with each of the model devices, and any explicitly defined associated variables. This enables users to create customised application environments.



A range of standard applications are available within the pipeline management system:

- Batch tracking
- Dynamic link pack
- **Applications:**
  - Capacity management
  - Scraper tracking
  - Instrument analysis
  - Gas quality tracking
  - Virtual Instrumentation

## SPS Leakfinder

Leakfinder combines Statefinder with the Leakanalyzer to form an effective leak detection system. Statefinder uses real-time SCADA data to track pipeline hydraulics and to signal measurement anomalies. The Leakanalyzer scrutinizes those anomalies looking for possible leak signatures. When a leak is detected, Leakfinder raises an alarm that shows the leak location, the onset time, the leak rate, and the total volume released. Leakfinder also assigns a confidence level to the leak. Statefinder can operate with degraded or limited SCADA measurement data.

When this occurs, as when a liquid pipeline runs slack, the Leakanalyzer automatically adjusts its leak detection thresholds (LDTs) to maintain the best possible system performance while avoiding false alarms. An LDT is a distance plot along the pipeline that represents the smallest leak that is not masked by the aggregate uncertainties in the measurement data, current operating conditions, fluid properties, elevation data, and many other factors. These LDTs are profiled graphically and provide a dynamic and constantly available measure of how well the pipeline is protected.

## Predictor

The current results from Statefinder, or a state saved from a previous simulation can be used as the starting point for the Predictor calculations. It is usually deployed in two coexisting modes:

- **Automatic Predictor:** runs "look-ahead" hydraulic simulations automatically at a specified frequency and duration using the current results from Statefinder as the starting point. Using a list of timed events (flow and pressure changes) from a Load Forecaster (for weather dependent loads) or from a batch scheduling SPS, the Automatic Predictor steps forward in time to show how the network will behave. A control schedule for planned set point or equipment changes can be used for changes in the model. Predicted alarm conditions are signalled so that pre-emptive action can be taken before the real-life conditions occur.
- **Planning Predictor:** is used to run "what-if?" cases upon request. By comparing the economic and hydraulic results of two or more forecasts, the user can select the better strategy for pipeline operation. A trial Control Schedule (typically a modified version of the schedule used by the Automatic Predictor) is used as the operating strategy for the predictive simulation. Similarly, a modified weather forecast might be used to derive a different forecast of model loads. Results from Statefinder or from the Automatic Predictor can be used as the starting point of the Planning Predictor.
- **Survival Time:** is used to monitor gas available within a pipeline following a reduction or break in supply. The survival time module will automatically calculate the time available to meet current demands in the system.

## c. Pipeline Operator Training and Qualification Systems

A training simulator assists in the education process of both new and experienced operators by providing the most realistic training experience possible. Simulators, as opposed to any other form of training, uniquely expose operations staff to realistic, normal and abnormal pipeline conditions without any effect on the actual pipeline.

Using a simulator-based training system, an operator can:

- Learn the "feel" of the pipeline's dynamic operation
- Learn to recognize the tell-tale signs of emerging problems on the pipeline
- Learn how to mitigate their effects by returning the pipeline to equilibrium

SPS/Trainer builds on the high-fidelity hydraulic simulation precision of the SPS Simulator engineering analysis tool, with control-room style graphics for the student interface. This interface can be configured as either graphics-interfaced or SCADA-interfaced and can represent either a specific existing pipeline or a generic pipeline.

For qualification purposes, the Stoner OQ add-on module provides a comprehensive administration facility for testing and record-keeping of the performance of control room staff.

A number of options are available to meet the individual needs of pipeline companies

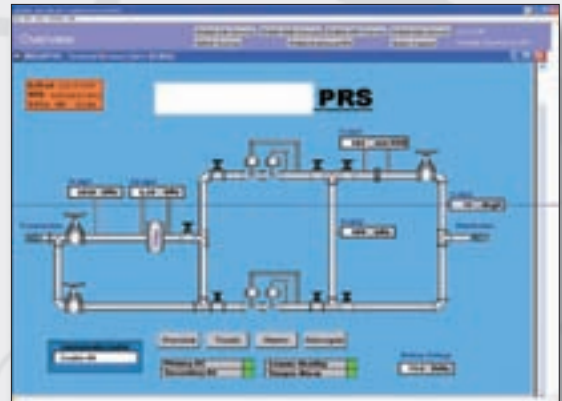
### Graphics-interfaced Trainer

A graphics-interfaced trainer is normally hosted on a PC. In this case, the user interacts with the training session through screens and dialog boxes developed using the SPS Operational Interface, based on the Iconics Genesis32® Automation Suite. These screens are usually constructed to look and behave similar to the control-room SCADA screens. Depending on the vintage of the SCADA system (or the engineering of the student interface), control-room screens may have only simple graphics, relying on text tables to present data to the student. Others may have dynamic visualization (colour change, animation) of station equipment, flow paths and more. SPS Operational Interface readily supports both these styles of interface.

### SCADA-interfaced Trainer

A SCADA-interfaced Trainer teams the Trainer host with a duplicate copy of the SCADA host system. The duplicate SCADA host system thinks it is communicating with the real pipeline, but actually, Trainer intercepts these communications and responds with data from the on-going simulation. Trainer also intercepts equipment control and set point commands to the "field" and the equivalent control is executed in the simulation. GL has combined with many different SCADA vendors to provide this style of training simulator to students of both natural gas and liquid hydrocarbon pipelines.

Properly configured, users cannot tell the difference between the training environment and the real pipeline. In fact, some pipeline students have specifically requested the SCADA vendor to change the SCADA screens to somehow distinguish a training session from the real pipeline.



### Operator testing and qualification

Through a training simulation system, operators can become proficient in a wide range of normal and abnormal pipeline operations and gain confidence in their abilities to perform these operations. Formal testing and qualification programs spread confidence through the company and to industry watchdog organizations and the public. For example, in the U.S.A., the Department of Transportation instituted the "Operator Qualification" or OQ rule in 49CFR Part 192 Subpart N (natural gas), and Part 195 Subpart G (hazardous liquids), which requires operators of gas and hazardous liquid pipelines to conduct programmes to qualify individuals who perform certain safety-related tasks on pipelines.

### Stoner OQ

Transforming a training simulation system into an effective tool for testing and qualification is a simple task, involving only the addition of a controlled administration of the formal testing process, and the ability to maintain auditable records of the individual test sessions. Taking its name from the U.S. legislation, Stoner OQ is the GL solution. It provides a comprehensive administration facility for testing and record keeping of the performance of control room staff. It is fully compatible with Trainer, which is the vehicle for the actual qualification sessions.



# DETAILED METHOD STATEMENT

## d. Third Party Access and Commercial Systems Management

Our commercial systems, based on Access Manager, increase profitability of LNG operations by managing availability and demand across multiple customers. Access Manager facilitates, automates and manages all commercial processes for operators of LNG liquefaction and re-gasification facilities and gas storage facilities, delivering improved operating efficiency and enhanced customer service. It enables Third Party Access (TPA) and ensures compliance with regulatory guidelines.

Effective commercial management of the pipeline is crucial for its success, commercial systems, applications and tools form part of the integrated pipeline management system providing information for the different parties involved in buying, selling and transporting the product in the pipeline. Historically the commercial and operational departments of a pipeline company did not interact closely resulting in the pipeline company not being able to maximise its revenue.

Developed specifically for the commercial environment of Third Party Access, Access Manager is a web-enabled system that provides a robust and reliable platform that meets the demands of today's liberalised energy markets. It is a proven end-to-end (ship to send out) terminal system. The system can be configured and customised to meet the constantly evolving market requirements.

### Key Benefits

- Cost savings through automation of the commercial processes – The system can be configured to electronically send alerts by email, fax or phone, removing the need for a 24/7 Commercial Operations team
- A proven solution that reduces risk and delivery timescales compared with a bespoke development
- Facilitates the optimisation of the Terminal through the provision of accurate and timely information to the Customers
- Security and audit features ensure confidentiality of the user parties' data and demonstrates regulatory compliance
- Low cost of ownership achieved through flexible user configurability and support, for example simple changes (such as screen appearance) can be made by system administrators
- Demonstrates regulatory compliance and supports Secondary Trading and UIOLI rules (Use It Or Lose It)
- The modular nature of the system reduces cost and risk of extending the system to other users and future project phases

- Business process automation enables internal IT staff to maintain the system without detailed knowledge of stakeholder processes
- Remote secure web based access to the system
- Multi language support enables the system to be deployed world wide

## e. Hydraulic Consulting

GL provides clients with professional engineering and analysis services. We combine our expert knowledge of pipeline hydraulic behavior with our advanced software tools to provide insights into the performance of clients' pipeline systems.

The results of these analyses are presented in the form of written reports, supplemented by the graphical outputs from the simulation case studies. Areas where we have performed such analyses include:

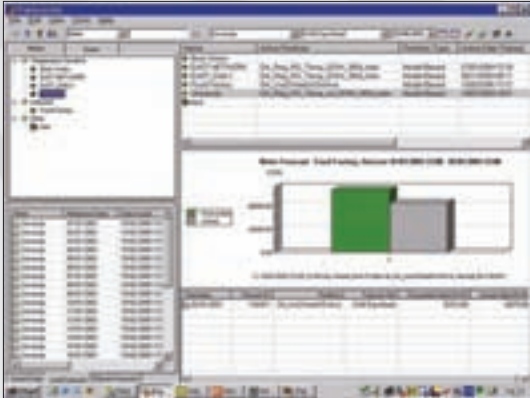
- Startup and shutdown procedures
- Operational stability
- Compressor operating schedules
- Leak sensitivity analyses
- Control system design
- Contingency analysis of equipment failures.

## f. Other Software Solutions

### Forecaster

Forecaster is a software product to predict future energy demand for Transmission, Distribution and gas supply/trading companies. Forecaster supports a wide range of modelling techniques that can be configured to generate highly accurate short, medium and longer term demand forecasts.

The models in Forecaster capture the knowledge gained from over 30 years of forecasting in the UK gas market. Forecaster, coupled with GL modelling services can significantly reduce demand forecast errors, helping to improve decision making and business profitability.

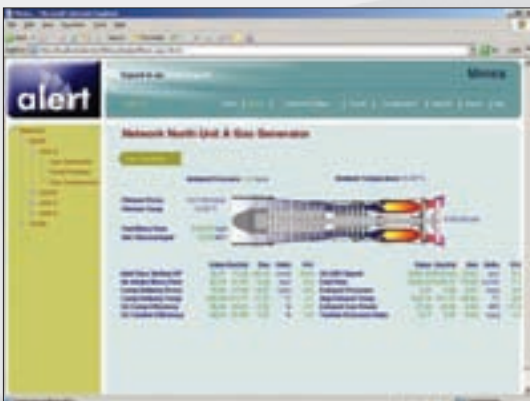


## Uptime®

Uptime is an integrated, geographic information system (GIS) based pipeline industry data management and analysis solution designed to help achieve optimum value from your assets. This value must be achieved within a framework of regulatory rulings and guidelines that determine standards for safe pipeline operations. Whether you choose a prescriptive or performance-based system management approach, Uptime's highly flexible tools and configuration options can help. Uptime enables you to implement your approach in a business process-driven data management and analysis environment that best fits and grows with your organization. Uptime provides a complete range of tools to support data management in a single integrated environment, including: Data integration and management, Process management and documentation, Risk assessment, Integrity assessment, and Performance measurement.

## alert

Alert is the GL rotating machinery asset management solution providing data and reports to assist operations, maintenance and environment engineers to manage their compressor fleet more effectively. The system is designed to cover a wide range of gas turbine and compressor models and compares actual performance to baseline figures, enabling performance condition and equipment emissions to be monitored and reported.



## g. Application Support & Hosting Services

GL recognises the importance of an effective application support and hosting service and the business benefits of a responsive, high quality service to support key business solutions in the energy industry. GL has an excellent record for quality of service and have a commitment to provide a level of responsiveness driven by customer defined service levels.

GL have been providing support services to the UK energy industry for over 20 years, ensuring that the systems operating the UK gas networks continue to function around the clock.

Call handling software is used to log, record and monitor calls against customer specific service levels.

### Support Services

- **Location and Availability**

With GL offices around the world, 1st line support services can be established in locations closest to the customer, operating in their time zone and their language. Depending on the nature of the customer's business and the business criticality of the operations, GL can offer expert support coverage right through to 24 hours a day, 7 days a week. This gives the customer access to expert software engineers and consultants, who can promptly resolve and get to the root cause of any application issue.

- **Call Management**

Each call received by the helpdesk teams is recorded in a call logging system and given a call reference number. The caller is asked to provide the following information:

- User identification and contact details
- Description of the problem
- Priority of call

GL will acknowledge the acceptance of the call within the agreed SLA timings and contact the customer for further information, if required including:

- Requests for screen shots
- Error message texts
- Confirmation of local IS problems (e.g. network or desktop failure; failed web access)
- Information on actions taken to date
- Information on steps required to reproduce the failure or circumstances under which failure occurred

# DETAILED METHOD STATEMENT

Initial problem diagnosis will be undertaken on the production system. In order to achieve the level of support required as effectively as possible, the Support Team often have controlled access to the production system so that the particular problem can be monitored and assessed.

Further investigation, when necessary, takes place on internal development systems. Additional information and diagnostic data is often made available by the user on request to help with the resolution of the problem.

In some cases, diagnosis may involve duplicating the problem to understand the issues. It may also be necessary to investigate the data and functionality of the system. The customer will often provide assistance and access in this regard.

- **Problem Resolution**

Once the problem has been identified and fixed, the issue is closed by the support team in agreement with the user.

When the correction of the problem entails the implementation of a fix, the call will be closed once a solution or an acceptable workaround has been provided.

- **Reporting and Performance Review**

GL provide customers with monthly performance reports, keeping the customer informed about the number of calls being taken, details of the calls, and the support teams performance against the agreed service levels.

Face to face meetings are also held on a regular basis to ensure that the service being provided is meeting requirements and achieving the level of system availability that the customer needs to keep their business operating at the optimum level.

- **Hosting Capabilities**

GL offer full end-to-end service delivery, support and hosting capabilities. With our expert knowledge of hardware requirements best suited to meet the demands of our applications, we work with our customer to design a hardware solution that meets their requirements with regards to performance, disaster recovery and cost. System availability right through to 99.99% availability can be provided, removing the need for companies to provide their own infrastructure and hardware support.

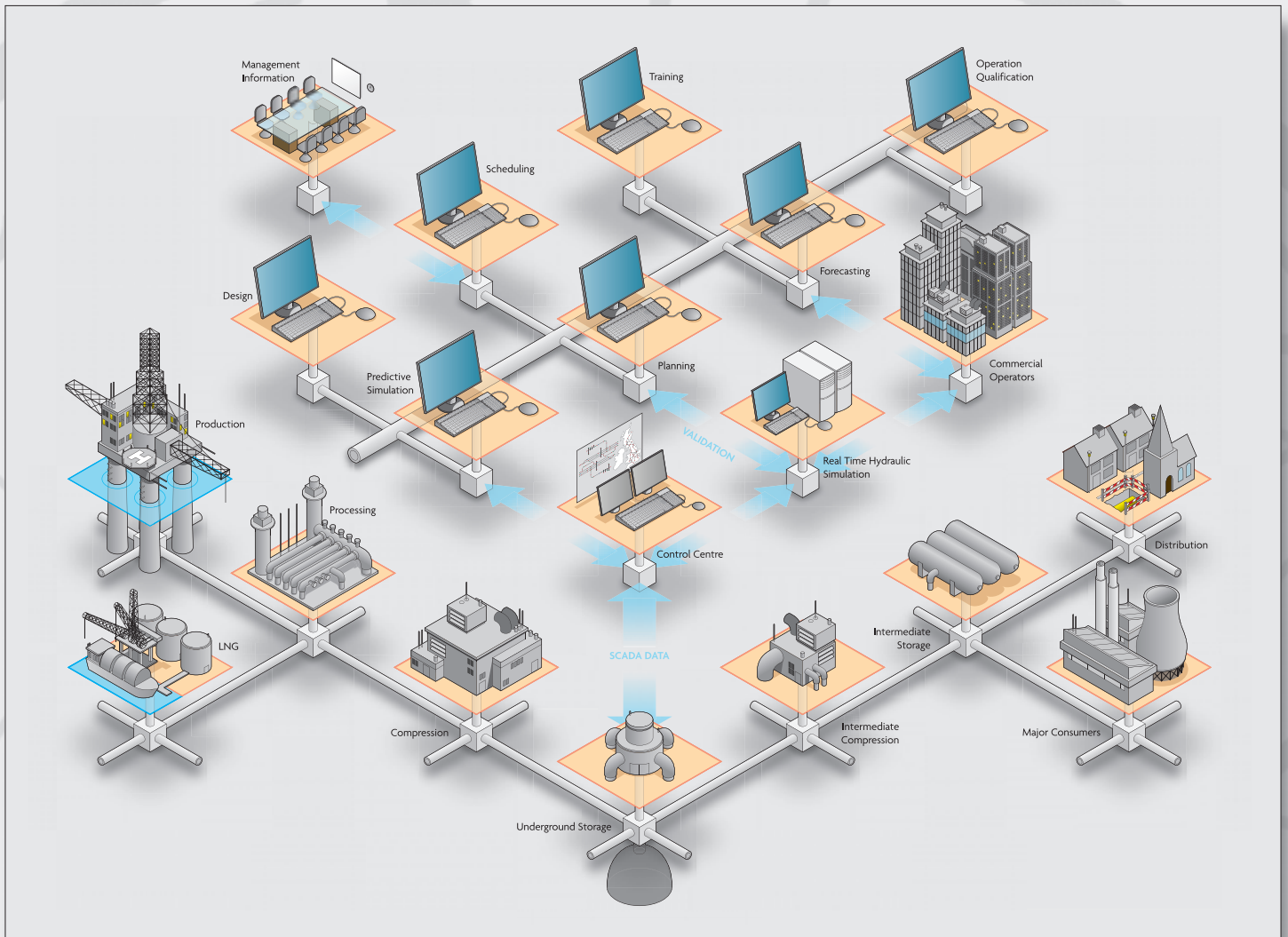
## **Benefits**

Customers gain the following benefits by adding application support and hosting services to a GL software solution:

- Assurance that problems in operating important and business critical software systems are resolved within a defined service level
- Assurance that your business processes will be supported to reduce disruption from problems
- GL experts support the system from both a software and IT domain and the commercial/engineering domain to ensure that the solution continues to meet your business objectives
- GL can support the solution from end-to-end including software and hardware
- A GL support service can easily add extra support for additional analysis and modelling using the data from supported systems
- Regular reports give you key information about the system and how it has been supported within the required service levels

In addition, GL application hosting services offer further benefits:

- Significant savings in both time and cost when implementing GL solutions
- Greater agility to respond to your business need quickly
- GL experts provide a single team to support every aspect of your system including implementation, configurations, hardware and software to keep the system running at peak efficiency.



**Integrated Pipeline Management**

An integrated pipeline management systems provides a platform that can be used to improve all parts of the organisation. All of the systems discussed in this document together with third party systems can be integrated into a single solution, providing a range of advantages for the client. Integrated commercial systems and applications provide automated mechanisms to capture the daily availability of natural gas in the pipeline. Shippers and Shipper Groups provide daily and hourly nominations, which can be combined with real time line pack and available capacity from the virtual pipeline together with forecasted future demands from the pipeline, to allow pro active pipeline management. Seamless interfaces to predictive simulation processes including the load forecasting / look ahead and the survival time modules that will be used to determine the delivery capability of the pipeline.

Integrating real time simulation data with asset management information provides tangible benefits to the maintenance and integrity management groups enabling better maintenance and greater safety in pipeline operations, as well as increasing the life cycle of the assets.

Web enabled systems are key requirements for many companies with significant pipeline distances, distributed workforces, and international customers all requiring instantaneous access to information. Putting information on the desktops of those who need it, when they need it is clearly an enabler for effective operation of any pipeline company.

GL has an excellent track record in supporting customers to implement an integrated Pipeline Management Systems and to achieve the best possible benefits from investments in individual applications.

# CASE STUDIES

## a. Enbridge

**Date:** 1978 - Present day  
**Customer:** Enbridge Pipelines  
**Savings:** Pipeline management and leak detection on over 7900 miles of gas, oil and multi product pipelines

### Issue:

Enbridge needs to safely and effectively manage multiple pipeline operations and provide a comprehensive pipeline leak detection capability on all of their pipelines within Canada and North America.

### Methodology & Results:

SPS (Stoner Pipeline Simulator) and Leak finder systems were successfully implemented by Enbridge on 19 individual gas and liquid pipelines systems.

### Savings:

Enbridge engineers implemented the systems themselves following training from GL personnel.

New pipelines are now added to the system by Enbridge staff so that all implementation is undertaken in-house.

### 3rd-Party Validation of Excellence

Enbridge were retiring a prior leak detection application from another vendor at the same time as installing our Leakfinder on their Line 21 pipeline. Enbridge ran two leak detection systems in parallel and then conducted a controlled release. Enbridge's documented results show that Leakfinder discovered the release twice as fast as the competitor software in three out of four tests. In the fourth test, the competitor software did not detect the leak that was found by Leakfinder. The competitor software was turned off, and Leakfinder today is providing 24hr/day surveillance of Enbridge's Line 21, as well as many other pipelines.



**b. Bord Gais**

**Date:** 2005  
**Customer:** Bord Gais, Ireland  
**Savings:** Pipeline management system for the Irish gas transmission network 775Km and the interconnector pipelines totalling 442 Km.

**Issue:**  
 Bord Gais wanted a solution to effectively manage pipeline operations and provide a pipeline leak detection capability on all of their pipelines within Southern Ireland and on the UK interconnector.

**Savings:**  
 The systems included a number of advanced applications allowing Bord Gais to meet its legislative compliance and improve its operations of the pipeline network. These applications include, leak detection, capacity management, gas quality tracking, scraper tracking.

**Methodology & Results:**

Real time pipeline management systems using SPS (Stoner Pipeline Simulator) and associated applications were implemented by GL for the complete network within Ireland together with the UK interconnector.



## CASE STUDIES

### c. European Network Model - Gas Flow Modelling

**Date:** 2006 - Present day  
**Customer:** Confidential: European Energy Company  
**Benefits:** European Gas transmission network model across 5 countries

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#### **Issue:**

To understand how gas moves across Europe and what identify what physical bottlenecks could affect the potential flows of gas under different supply/demand/storage scenarios

#### **Methodology & Results:**

The SynerGEE network modelling tool was successfully used to develop an integrated model of 5 European countries gas networks using proprietary and public domain data.

#### **Benefits:**

Several scenarios were investigated by the client with the intention of using the network model in conjunction with in-house economic modelling tools to support strategic decision making. The model allowed the user to assess whether capacity existed for transit of gas across Europe and whether there were any physical barriers to gas transportation. This information when added to commercial pricing information allowed the client to develop a deeper insight into third party transportation, storage and shipper statements.

#### d. Hydraulic Study of the Master Gas System Expansion

**Date:** 2007  
**Customer:** Saudi Aramco  
**Savings:** Increase Capacity of the Master Gas Pipeline System



#### Issue:

GL conducted a hydraulic analysis study on the expanded Master Gas pipeline System (MGS). The expanded MGS should deliver the increased contracted flow rates of sales gas to Saudi Aramco customers in Business Plan 2007-2013. In addition, the MGS must sustain delivery pressures and flow rates for 8 hours of survival time, after the shutdown of Hawiyah Gas Plant (HGP).

#### Methodology & Results:

Stoner Pipeline Simulator (SPS) was used to perform the hydraulic and transient analysis. The study identified bottle necks, added mainline pipes, upgraded control valves, and sized metering and filtration equipments to increase the capacity of the pipeline system. Transient analysis was conducted for survival time calculations. Temperature sensitivity cases were conducted for 70 °F (winter), 90 °F, and 100 °F.

#### Savings:

The hydraulic analysis identified the optimum pipelines sizes, and added pipeline loops to avoid bottlenecks. The study provided the optimum control equipment size, and provided basis for filtration and metering stations design.

## Energy Solutions

Asset Integrity Systems

Commercial Gas Management Solutions

- **Pipeline Management Solutions**

Network Development Services

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