

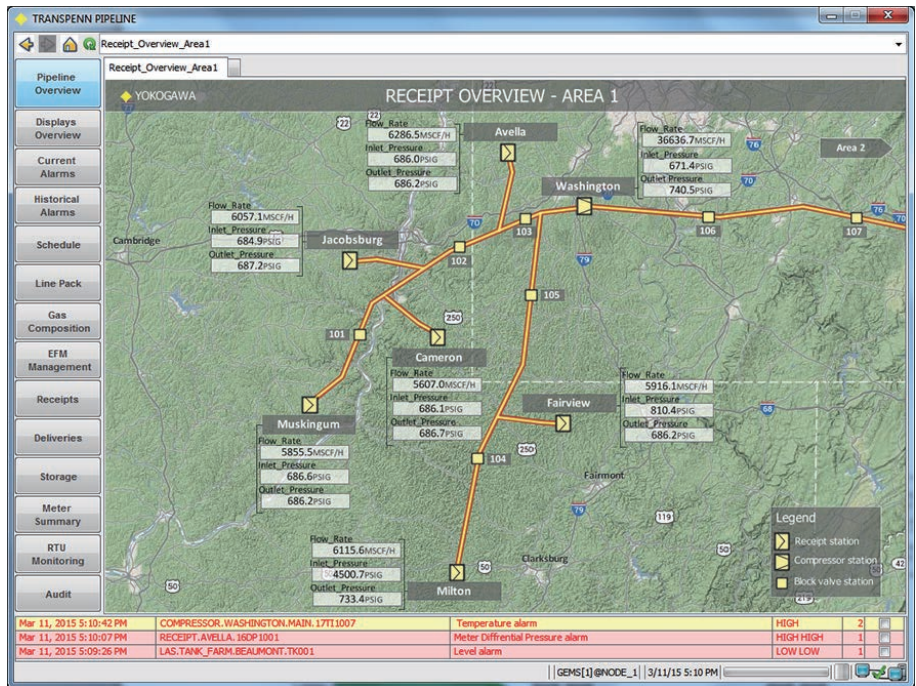
General Specifications

GS 50A01B10-01EN

Yokogawa EPMS
Enterprise Pipeline
Management - Solution
for gas and liquids

OVERVIEW

The Enterprise Pipeline Management Solution (EPMS) provides a collection of standard applications which can be seamlessly plugged into the FAST/TOOLS real-time system platform similar to SCADA monitoring and control applications to facilitate the management and operations of gas/liquids pipeline systems. EPMS consist of Gas Enterprise Management Suite (GEMS) and Liquid Enterprise Management Suite (LEMS).



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Figure Sample Pipeline Operations Image

The utilization of the EPMS package brings the following benefits to the pipeline/grid operators based on 20 years of experience in engineering medium to large complex pipeline automation jobs around the world.

- Pipeline management system implementation
 - Better, faster implementation
 - Dedicated consultants and product support
 - Knowledge centralization, retention and documentation
 - Enhanced lifecycle management
 - Reliable systems using proved functions
- Cost of integration
 - Prevent application vendor and integration technology lock-in
 - Establish a standards-based and IT/Security compliant application platform
- Reduced cost of ownership
 - Standard technology
 - Scalable, flexible, reusable
 - Lifecycle management
- Support of industry standards
 - Implement best practices from pipeline industry standards
 - Provide foundation for regulatory support and compliance
- Future proof
 - IT architecture hedges against disruptive technologies and trends
 - Increased process and data variety, volume, and velocity

■ FEATURES

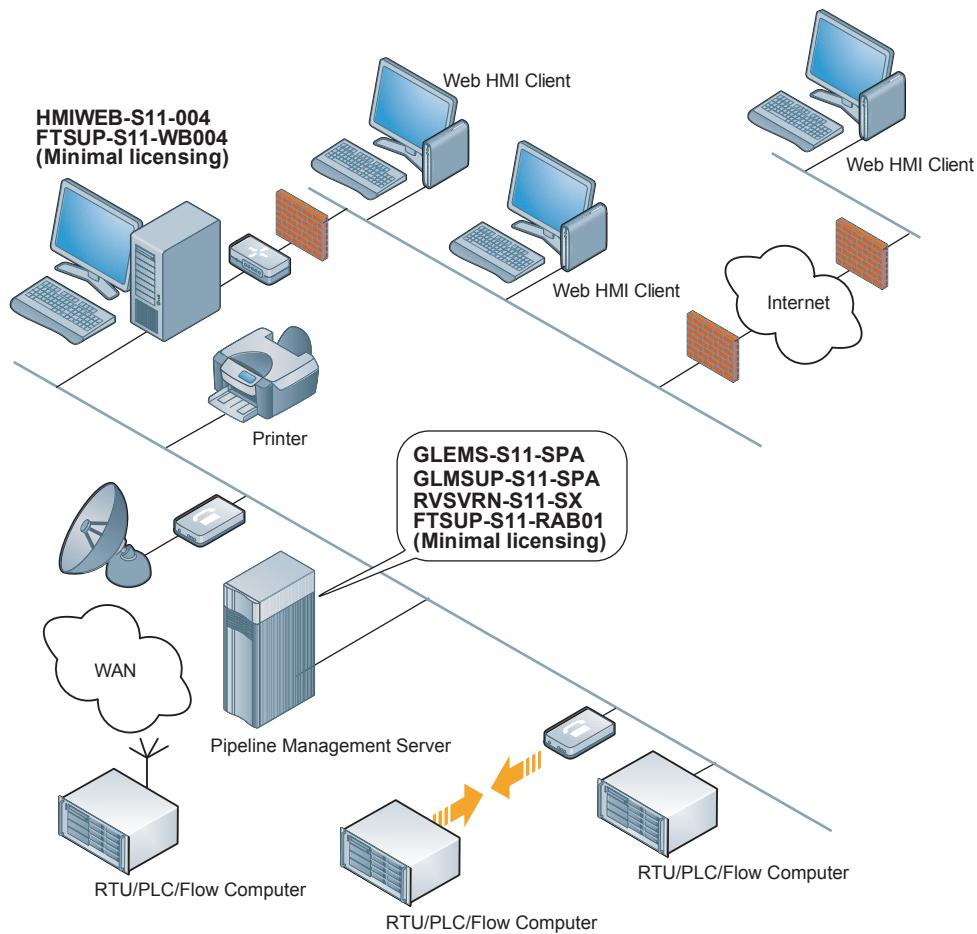
Gas Enterprise Management Suite (GEMS)

- Flexible sourcing of gas composition data from local GC (Gas Chromatograph) or via the EPMS host system from other area's or manually entered from laboratory GC's
- Support manual adjustments of gas composition data and forced upload to the flow computer
- Scheduling of gas composition and AGA parameters data exchange per flow computer
- Authorized pipeline operators can make adjustments to key measurements which are trailed and signed as history for auditing purposes while daily, weekly and monthly volumes are automatically recalculated.
- Fast application deployment due to standard display, symbol templates and functions.
- Embedded alarm functions on deviation from nomination/delivery targets for gas delivery and receipt stations.
- Embedded alarm functions on safe operation violation with respect to the Maximum Allowable Operating Pressure (MAOP) per station and segment.
- Indication of changes in line pack change over various time periods result in a drafting, packing or stable statuses per segment and pipeline.
- Storing of EFM logs in the EFM log database for long term retention and exporting the EFM logs to a cfx file to be used by other business applications.
- Update nominations within defined time limits over the course of the gas day.

Liquid Enterprise Management Suite (LEMS)

- Automatic aggregation and storage all flows into hourly, daily and monthly figures.
- Indicated flow estimation in case of lost field communication and recalculation on recovery.
- Support for remotely initiated and/or automatic meter proving with temperature and pressure compensation.
- Batch scheduling and Batch tracking.
- Ticketing
- Product compatibility checking.
- Continuous real-time updating of Estimated Time of Arrival (ETA).
- Volume corrections based on MPMS 12.1.
- Embedded alarm functions on safe operation violation with respect to the Maximum Allowable Operating Pressure (MAOP) per station and segment.
- Tank management.
- Path/Manifold management.

■ SYSTEM CONFIGURATIONS



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Figure Sample System Configuration

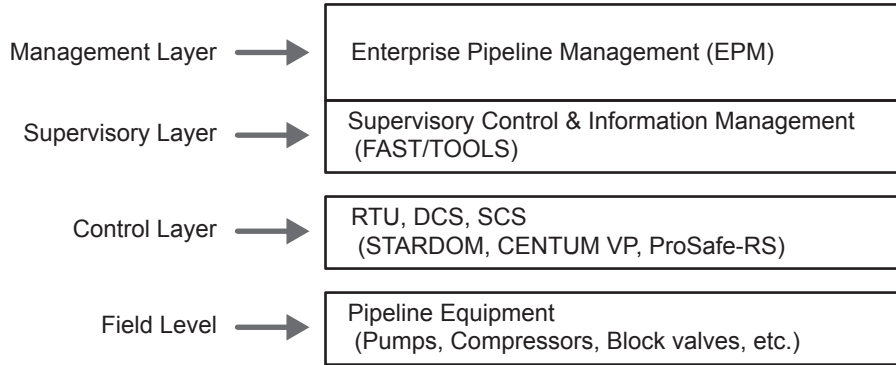
Item	Model	Quantity
Enterprise Pipeline Management Server (*1)	GLEMS-S11-SPA &	1
FAST/TOOLS Server Package	RVSVRN-S11-S□	1
Web HMI Server/Client	HMIWEB-S11-004	1
Support Contract for GLEMS	GLMSUP-S11-SPA	1
Support Contract for RVSVRN	FTSUP-S11-RAB01	1
Support Contract for HMIWEB	FTSUP-S11-WB004	1

*1: Enterprise Pipeline Management Solution (EPMS) Server contains f Gas Enterprise Management Suite (GEMS) and Liquid Enterprise Management Suite (LEMS).

- EPMS requires one (optionally redundant) FAST/TOOLS Server Package (RVSVRN-S11-SX). Multi-level systems are not supported. System size of FAST/TOOLS license depends on the system size.
- EPMS licenses require agreement between Yokogawa and customer.
- EPMS is an enterprise pipeline management solution at level 3. Level 2 control and monitoring/alarming of a pipeline is out of EPMS scope as this is provided at SCADA and (field) controller level.

■ SYSTEM ARCHITECTURE

EPMS is positioned on Management Layer

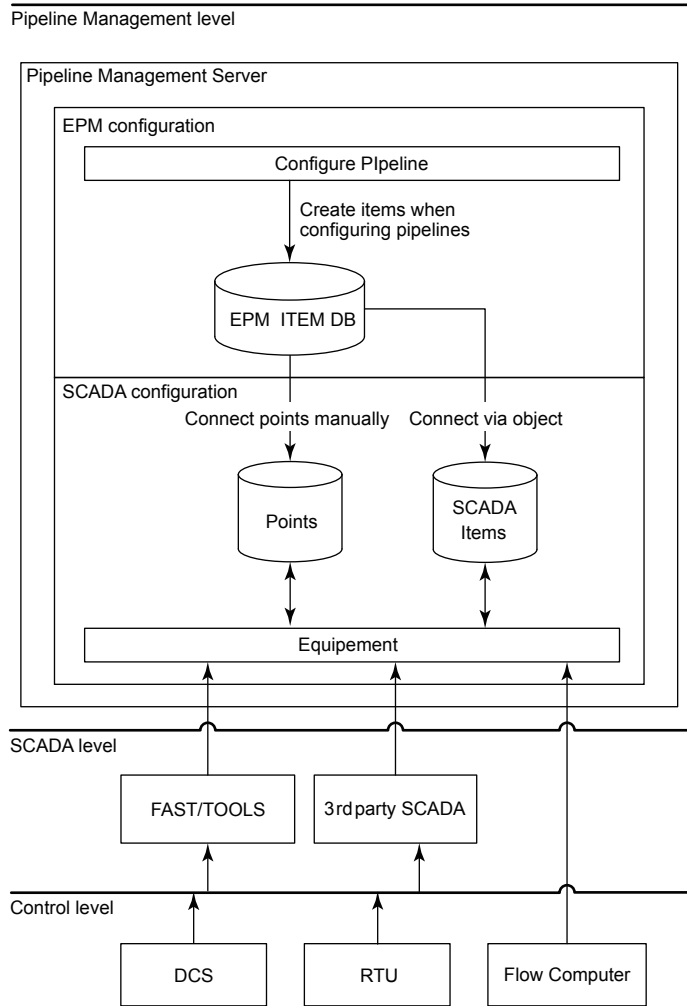


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Figure System Architecture

EPMS plugs into the same platform with FAST/TOOLS Advantages of use with FAST/TOOLS are:

- One system/user management and configuration environment
- Same layout of pipeline displays can be used for process displays
- Same user authorization can be used within the whole application
- Standard features like reporting, history and configuration are available in the same environment.



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Figure System Architecture

When utilizing FAST/TOOLS for the pipeline SCADA functions, the configuration is done in the same engineering environment. Items created by EPMS are linked to the field information. Item linking can be done by configuring the points or by linking them to other items via objects.

■ FUNCTIONAL SPECIFICATION

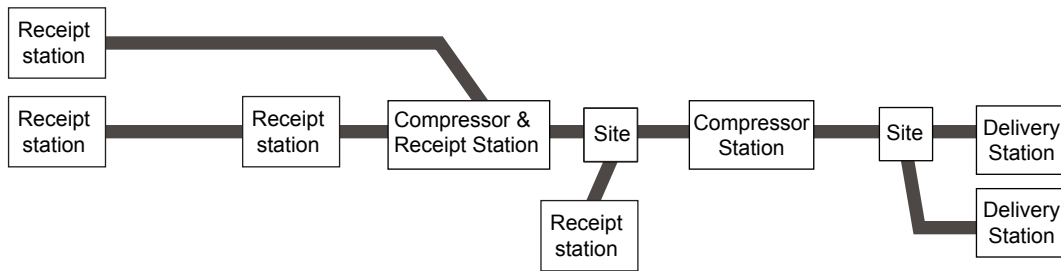
EPMS delivers the following interrelated and integrated functions.

- Processing of meter inputs for accurate measurement and flow calculations.
- Management of gas data with the device scheduler and EFM log up-loader.
- Schedule and monitor gas nominations.
- Monitor the line-pack along the pipelines and segments.
- MAOP (Maximum Allowable Operating Pressure) monitoring.
- Pipeline balance, storage and inventory calculations.
- Schedule and track batches for efficient transportation of liquid products.
- Monitor liquid pipelines for leaks, inventory and hydraulic profiling.
- Drag reducing agent management and power management on compressors and pumps.
- Controlling a manifold with the flow path manager.
- Tracking and management of anomalies like pigs/scrapers, merge/hot spots and interfaces.

EPMS is segregated into a suite with specific application functions and features for gas pipelines GEMS (Gas Enterprise Management Suite) and a suite providing the application functions that are specific to the management of liquid pipelines LEMS (Liquids Enterprise Management Suite).

■ PRODUCT LINEUP

● GAS Enterprise Management suite (GEMS)



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Figure Samples of gas pipeline topology

● **Key functionality provided by GEMS (Gas Enterprise Management Suite)**

Receipt and Delivery Station	Metering processing	Gas Flow Data Acquisition
		Meter run & RTU management
		Gas Calculation Parameter management
		Device Scheduler
		Gas Composition
		EFM/EGM
Gas Flow estimation/nomination		
Pipeline	Line Pack, Pipeline Inventory	
	Interface to 3th party leak detection system	
	Pig Launching, Receiving	
	Hydraulic Profile (Max Allowable Operating Pressure)	
Gas Storage Inventory		
Compressor station Management		
Graphic examples (Meter stations, Line Pack, Nominations, Gas Composition, Compressor stations, etc.)		

Metering processing

Depending on the measurement methodology and the level of intelligence of intermediate devices like flow computers, RTU's and instruments correctly processes the available inputs into normalized flow, volume and energy values.

Gas data management

Ensure that each flow calculation is done with the correct gas composition. This calculation can be done by GEMS or a flow computer. Gas data management also makes Electronic Flow Measurement (EFM) log data available in GEMS. The primary function of EFM is the scheduled or on demand upload of measurement data from Flow Computers or EFM log capable RTU's.

Gas nominations

Monitor the received and delivered volumes at the receipt and delivery station along the pipeline throughout the gas day. The received and delivered volumes are compared with the projected nominated volumes for each station to timely identify any nomination imbalances.

Pipeline monitoring

Provide the operator with the following insights on the real-time operational conditions to make timely and right decisions.

- Pipeline balance - to track the gas stock figures the pipeline balance function calculates the volume and energy balance for the total pipeline/grid and storage buffers.
- Line pack - calculated per segment by actual pressure and temperature as well as over the total pipeline with volume corrections in accordance with AGA 8.
- Maximum allowable operating pressure (MAOP) - provides the minimum, maximum and actual pressures of each segment of the pipeline.
- Leak Detection (3rd party).

Pipeline optimization

Calculate the efficiency and manage the overall statistics of compressors.

- Power management statistics
 - Start/stop
 - Peak hour statistics
 - Volume or period statistics
- Compressor actions or business rules

● **Liquids Enterprise Management Suite (LEMS)**

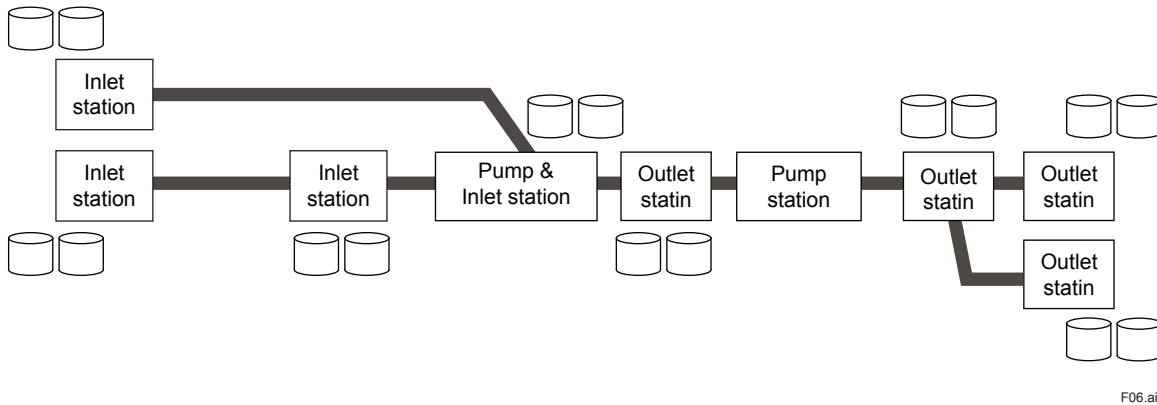


Figure Samples of liquid pipeline topology

● **Key functionality provided by LEMS (Liquids Enterprise Management Suite)**

Meter Processing		
Pipeline	Batch Scheduling	Compatible Product Check
	Batch Tracking	Anomaly Tracking
	Ticket management	
Pipeline segment	Line balance	
	Leak detection based on Mass Balance	
	Pig Launching/Receiving	
Hydraulic Profiling (Max Allowable Operating Pressure)		
Pump station Management		
Manifold Management		
Tank Management		
Drag Reducing Agent Management		
Graphic examples (Meter stations, Batch Scheduling, Batch Tracking, Ticket overviews, Pump stations, Tanks, etc)		

Metering process

Depending on the measurement methodology and the level of intelligence of intermediate devices like flow computers, RTU's and instruments correctly processes the available inputs into Gross Observed Volume (GOV) and Gross Standard Volume (GSV) volume.

Batch management

Manage transportation of multiple liquid products to multiple customers in a single pipeline. Within LEMS a batch has always only one origination and one destination. Batch management includes the following sub functions:

Scheduling:

Allows pipeline operators to schedule batches by adding them manually or by importing prepared schedule

Batch tracking:

Monitoring the position of the batches in the pipeline

Ticketing:

Create tickets for the delivered batches containing the following information; type of product, actual amount delivered, transportation origination, destination point and batch owner.

Anomaly tracking:

Provides the operator with a visual representation of one or more (non-)product entities moving through the pipeline like (inspection) pigs, scrapers, interfaces, hot spots and merge spots.

Interface management:

Calculates the amount of transfer mix generated by different adjacent product batches and how the trans mix should be managed; as a separate batch (to be reprocessed) or as product to be added to the upstream or downstream batch.

Pipeline monitoring

LEMS includes the following modules for pipeline monitoring.

ILeak detection:

Employs the Compensated Volume Balancing (CVB) methodology to detect leaks on a pipeline per segment

IPipeline Inventory:

Calculates the total inventory for the whole pipeline and intermediate tank storage depots based on MPMS 12.1

IHydraulic profiling:

Monitor at all times that the pipeline operates safe and efficient within the Maximum Allowable Operating Pressure (MAOP) boundaries. When the actual pressure at any point along the pipeline is out of range an alarm is generated. The maximum and minimum pressures per pipeline station and segment can be in the LEMS pipeline topology database.

Pipeline optimization

Calculate the real-time pump performance based on the pump performance tables from the pump suppliers. The operating point is shown in the pump performance graphical component. The following power management statistics are recorded.

- Start/stop data
- Peak hour statistics
- Efficiency at different head and flow levels
- Volume or period statistics
- Pump actions or business Rules

Business rules can be defined for instance by setting limitations on requested commands.

An additional function to optimize power consumption in the LEMS suite is the Drag Reducing Agent Management (DRAM) that optimizes fluency to reduce the energy required to pump the products through the pipeline. The amounts are optimized per product and for the specific pipelines.

Flow path manager

Manage flow path alignment for station manifolds at storage depots. Each Batch in the LEMS has a destination and sub destination. The destination is used to transport the product to the correct tank farm station and the sub destination is the tank within this tank farm station.

■ LIMITATIONS

- Liquids batch tracking operates on a per pipeline route basis in one direction.
- Gas nominations are scheduled and assigned on a gas day basis though can be adjusted during operations.
- EPMS applications operate on the (optionally redundant) host system server.

■ APPLICABLE STANDARDS

The EPMS suite follows the following standards to the extent of relevance for the delivered functionality.

Standard	Description	Remark
API RP 1165	Alarm Management	
API RP 1167	Display Standards	
API 1164	Pipeline System Security	
ISA 18.2	Alarm management	
ISA 101	HMI management	
ISA 106	Design of automated procedural operations	

Specifically for GEMS

Standard	Description	Remark
AGA 3	Orifice metering of natural gas and other related hydrocarbon gases (1992)	
AGA 5	Calculation of gross heating value and compressibility factor for natural gas mixtures	
AGA 7	Measurement of gas by turbine meters (1996)	
AGA 8	Compressibility factors of natural gas and other related hydrocarbon gases (1992)	
GPA 2172	Calculation of gross heating value, relative density and compressibility factor for natural gas mixtures (1996)	

Note: Other (regional specific) standards can be made available on request.

Specifically for LEMS

Standard	Description	Remark
API MPMS 11.1	Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined products, and Lubricating Oil	
API MPMS 12.1.1	Storage Tanks Volume Calculation	
API MPMS 1164	Pipeline System Security	
API MPMS 14.3.1	Orifice Plate	
API MPMS RP 1165	Alarm Management	
API MPMS RP 1167	Display Standards	

Note: Other (regional specific) standards can be made available on request.

■ OPERATING ENVIRONMENT

The pipeline management package is supported on the server platforms as defined below. For each platform, the required operating system is specified.

Platform	Operating System
Microsoft	Microsoft Windows 8.1 Update 2, Professional Edition Microsoft Windows 2012 R2
LINUX	Red Hat Linux x86 6.4
IBM	AIX 6.1L, 64 bit
HP	HP-UX11i v3

■ SYSTEM REQUIREMENTS

The specified hardware is a minimum recommendation for optimal software performance when installing EPMS on a SCADA host system running FAST/TOOLS. Furthermore it should be taken into account that additional non EPMS applications may require additional resources.

Application/Host Server

Items	Specifications
CPU	Microsoft Windows 8.1 X64 Intel Core i5 3 GHz or better
	Microsoft Windows 2012 X64 Intel Xeon E-series 3 GHz or better
	Red Hat Linux x86 6.4 X64 Intel Core i5 3 GHz or better (does not support HAC)
	HP-UX 11i v3 HP Integrity LX3600
RAM	At least 8 GB
Hard Disk	1 TB (7200 rpm) At least 300 Mbytes of free space is required for the software. Additional disk space is required to store configuration and historical data: add on average 2150 byte per item definition, 100 byte per history sample, 550 byte per event sample, 18 Kb per class, 2 Kb per object, 2 Kb per report and 30 Kb per display symbol.
Ethernet adapter	An Ethernet adapter that is supported by the operating system is required at installation. Please note that for HAC (High Availability Computing) a dedicated network adapter is preferred.
DVD-ROM Drive	A DVD-ROM drive that is supported by the operating system is required.

■ RELATED DOCUMENTS

GS 50A01A10-01EN FAST/TOOLS

■ MODELS AND SUFFIX CODES

Application Suite

		Description
Model	GLEMS	Gas and Liquid Enterprise Management Suite
Suffix Codes	-S	Software license
	1	Always 1
	1	Always 1
	-SPA	Single product / Single pipeline
	-SPB	Multi products / Single pipeline
	-MPA	Single products / Multiple pipelines
	-MPB	Multi products / Multiple pipelines

Annual Support Fee

		Description
Model	GLMSUP	Gas and Liquid Management Support Contract (Annually)
Suffix Codes	-S	Support License
	1	Always 1
	1	Always 1
	-SPA	Single product / Single pipeline
	-SPB	Multi products / Single pipeline
	-MPA	Single products / Multiple pipelines
	-MPB	Multi products / Multiple pipelines

Note: This support includes; Free version upgrade to latest version of the Pipeline Application Suites, Bug solving, Telephone/ email support, Availability of consultant.

■ TRADEMARKS

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