



KGS, since its incorporation in 1974, has been working around the clock to keep the lives and property of the people safe from the dangers of gas accidents.

KGS is a public organization and the only one in the world with superior capabilities in all related sectors including safety diagnosis for large-scale petrochemical facilities, inspection, examination, certification of gas appliances, accident investigation, education, public relations, and research and development for gases.

KGS has been playing a key role to raise the competitiveness of the domestic gas industry and support companies for expansion into the global arena. This brochure is published to provide related information for the gas industry.

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01

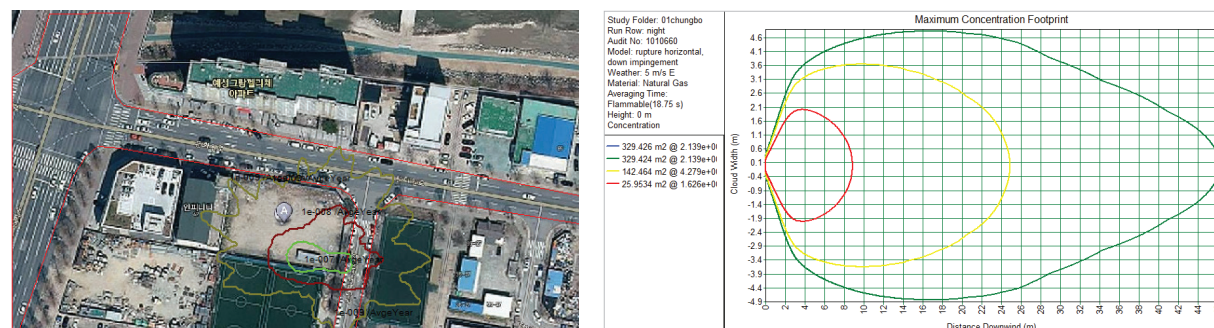
Safety System Assessment

KGS provides petrochemical, refinery and gas industries with the ultimate solutions to operate safely and to reduce risk via state of the art safety diagnostic technology. Furthermore, KGS's Safety System Diagnosis contributes to improving overall safety management systems in related businesses effectively by offering best safety practices and recommendations.

Risk Assessment Consulting

Risk Assessment (RA) is a method of quantifying risk by identifying major hazards that result in accidents in a process or a facility sites and calculating the degree of the risk mathematically. RA would show risk levels and compare each risk level on the site. It helps to make a systematic evaluation of risk and implement a rational evaluation of each risk's significance in order to aid the decision-making process.

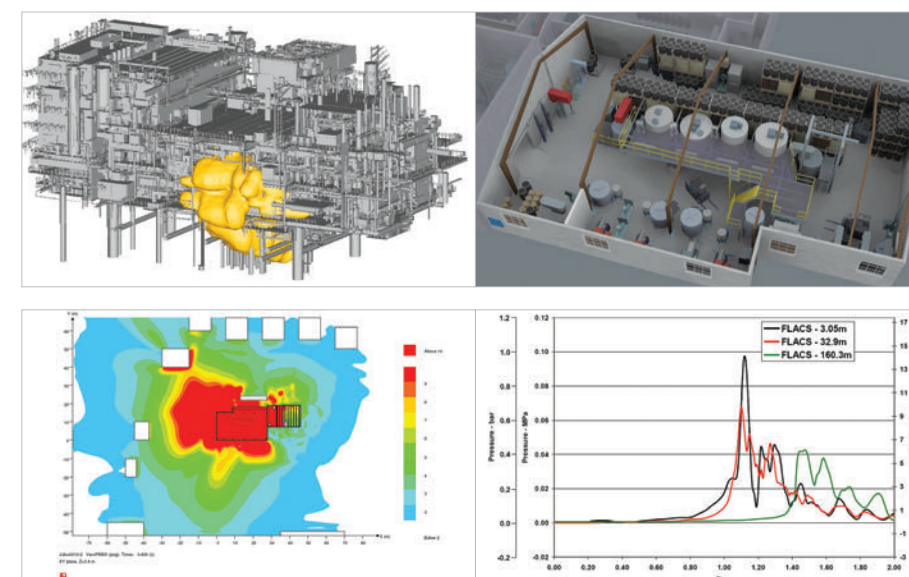
Scope	LPG/City Gas Facilities and Petro-Chemical/Petroleum Refinery Plants
Key Technology	- Pre-Risk Assessment : What-if, HAZOP, FMEA, LOPA etc. - Accident Frequency Analysis : FTA, ETA, Human Error Analysis etc. - Consequence Analysis : Leak, Fire, Explosion, VCE Simulation, Human Effect Calculation - Risk Analysis : Indicating the Degree of Individual Risk and Societal Risk - Providing Comprehensive Information About Accidents, Safety Know-How
Software	DNV Phast-Risk v6.7
Strengths	- Deducing the series of possible accident scenarios and related prevention measures - Identifying the risk level at facilities - Deducing the increase and decrease of risk level after process improvement - Deducing the area of potential damage by accident and emergency response planning
Experience	- Posco Gwangyang Steel Mill - Samchully - KOREA Hydro & Nuclear Power Co. - E1 - KOGAS - KDGAS - Samsung Total Co. - SKGAS



Computational Fluid Dynamic-Based Safety Consulting

Computational Fluid Dynamics (CFD) technology helps to predict real gas (fluid) flow and diffusion combustion, explosion phenomena by a three-dimensional computer-simulation. The cause and process of accidents can be estimated by visualization of the blast overpressure and heat radiation damage caused by runaway reaction, explosion in large-scale petrochemical and gas facilities.

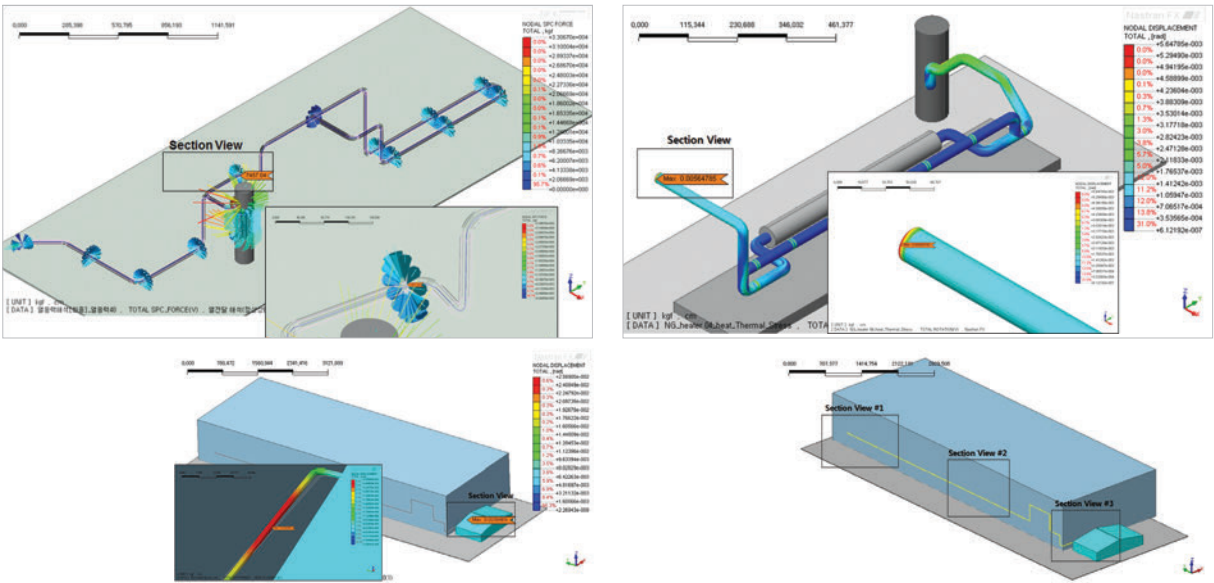
Scope	- Phenomenon of toxic and flammable gas explosion and diffusion in shipbuilding, semiconductor and petrochemical industries - Leak and fire phenomenon at liquid pools around LNG storage tanks and vessels - In-building gas diffusion and explosion, relief system validation
Software	Gexcon FLACS v9.2
Strengths	- Various possible accident scenarios that may occur due to fire or explosion and determine the impact damage in facility - Safety designs and actual emergency measures to improve the safety of the facility can be reflected by more realistic results using 3D.
Experience	- Tech-Ross Co., ballast water disinfection facility safety assessment for hydrogen gas - Korea Gas Safety Corporation, accident investigations, etc.



Compute-Based Stress Analysis

Stress analysis provides an approximate prediction of stiffness , stress distribution and deformation by linear or non-linear numerical computation when structures such as storage tanks or piping are subject to external forces. The simulation results are presented by 3D modeling, so weak points are found easily and quickly. Whenever a structure is reinforced or changed, the effect of safety improvements can be compared numerically.

- Scope
- Piping and facilities safety assessment because of settlement and earth pressure
 - Work on protection measures due to pipe stress analysis
- Software
- Structural Analysis Software: Midas Nastran FX
- Key Technology
- Linear Static Analysis
 - Free Vibration Analysis
 - Linear Buckling Analysis
 - Analysis of Heat Transfer
 - Nonlinear Analysis
 - Contact Analysis
- Experiences
- STX Offshore & Shipbuilding Co., Ltd.
 - Samsung Electro-Mechanics Co., Ltd.
 - Korea East-West Power Co., Ltd.
 - Korea National Oil Corporation / Praxair Korea



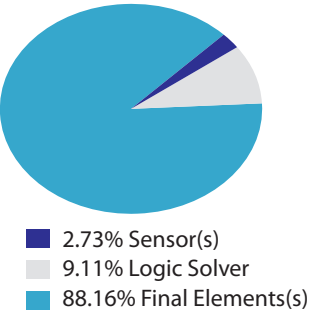
SIL (Safety Integrity Level) Consulting

SIL consulting is a technique to evaluate the current safety level of control systems quantitatively, so that it assists in selecting control systems and improves safety. SIL presents a rating and the probability to satisfactorily perform safety management functions that are required within a period of time. A higher SIL level means that the more management functions are performed.

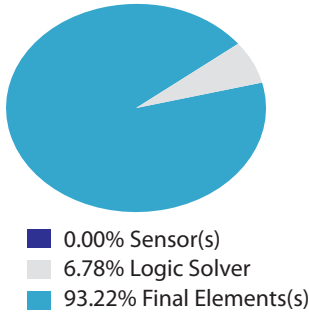
- Scope
- Petrochemical, oil refining process and storage facilities
 - LPG station, Gas manufacturing / storage / use facilities, Refrigeration facilities, Toxic gas processing facility and Facilities where risks exist
- Software
- PHA-Pro V8
- Strengths
- Reliability evaluation through analysis of instrumentation system
 - Reassess risks after process improvement
- Experiences
- Yeochun NCC Co. #3 Plants
 - LG Chem Co. , Daesan
 - Honam Petrochemical Co., S-OIL Co. #1 · #3 Plants
 - Samsung Total, etc.

SIL	PFD	1/PFD
Safety Integrity Level	Probability of Failure on Demand per year (Demand mode of operation)	Risk Reduction Factor
SIL 4	$\geq 10^{-5}$ to $< 10^{-4}$	100,000 to 10,000
SIL 3	$\geq 10^{-4}$ to $< 10^{-3}$	10,000 to 1,000
SIL 2	$\geq 10^{-3}$ to $< 10^{-2}$	1,000 to 100
SIL 1	$\geq 10^{-2}$ to $< 10^{-1}$	100 to 10

PFDavg Contribution



MTTFS Contribution

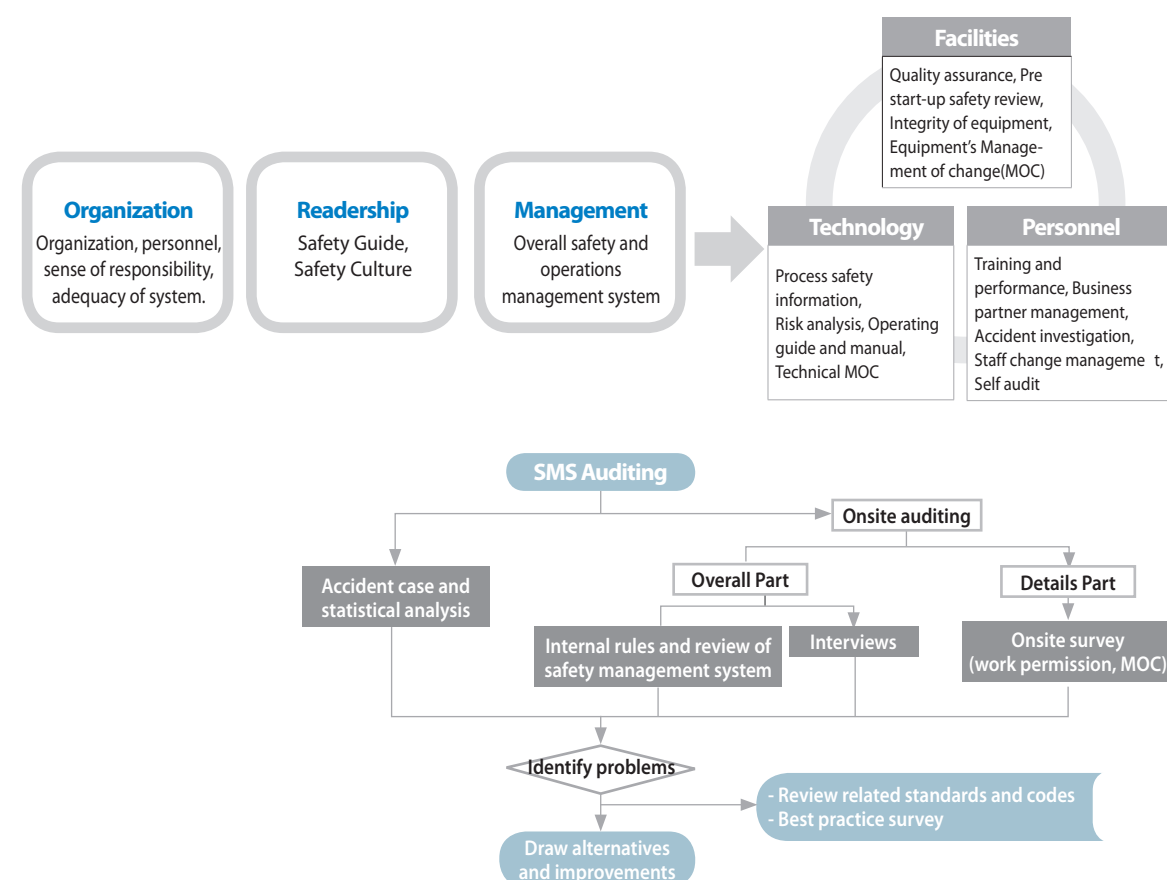


SMS (Safety Management System) Auditing

SMS auditing ensures comprehensive workplace safety through the auditing of each component of the safety management system such as management of change, facilities management, supplier management, education and training and so on.

It provides the necessary information to improve management direction by recommending improvement measures.

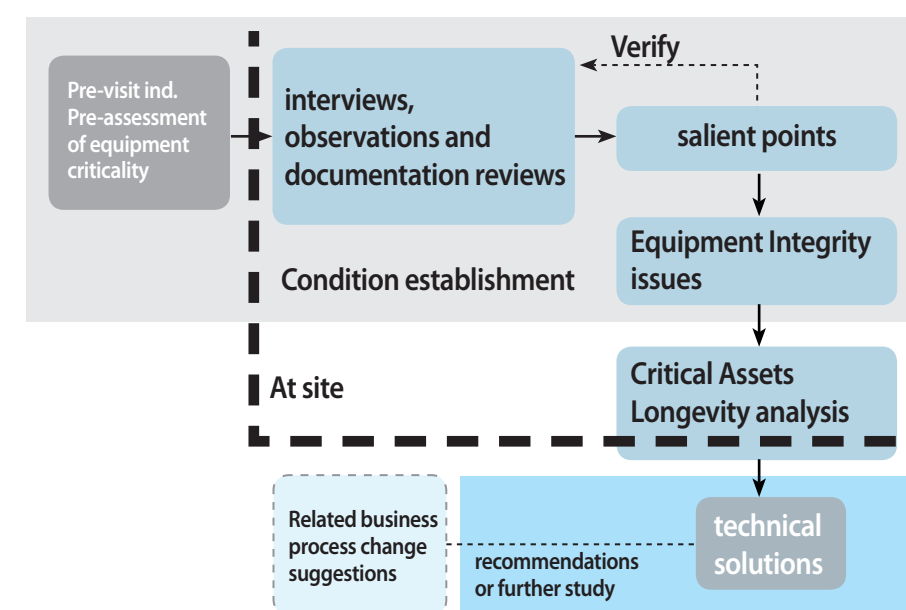
Scope	- Oil refinery, Petrochemical plants, Iron and steel industry. - Fertilizer production facility, City gas providers and Large liquefied gas plant managed and operated by SMS/PSM
Strengths	- To identify current level compared with similar domestic companies - To provide improvements item by item with best domestic company examples in current business
Experience	- GS Caltex Co. - LG Chem Co. NCC - SK Energy Co. - LG MMA Co. - Honam Petrochemical Co. - S-OIL Co., etc.



Asset Integrity Review System

AIR is an auditing technique that assesses the overall integrity of core equipment so that recommendations are provided for improvement of the asset integrity system's strengths & weaknesses and identify critical equipment.

Scope	Petrochemical, oil refinery
Strengths	- Provides intensive and in-depth review of asset management system - Suggests priorities for equipment that need to be improved and monitored - Provides rationale for necessary resources and activities for process improvement, replacement or major maintenance
Experience	GS Caltex Co.



ECDA (External Corrosion Direct Assessment)

ECDA is a comprehensive inspection for integrity confirmation of external corrosion in coated underground pipelines. This method can identify a latent risk and assess external coating conditions / retained strength. Finally, it can avert accidents and ensure the integrity of cathodic-protected pipelines.

Scope	Defective coating of underground pipelines with dis-functional CP facilities
Key Technology	- Underground pipeline diagnosis through Close Interval Potential Survey (CIPS), etc. - Corrosive environment assessment and detection of coating pin-hole - External coating analysis and thickness survey - External Corrosion Direct Assessment (ECDA) to determine which indirect inspection indications are most severe and collect data to assess corrosion activity. - Procedure : Pre-Assessment ⇒ Indirect Inspection ⇒ Direct-Examination ⇒ Post-Assessment
Equipment	Coating thickness measuring device, Pin-hole detector, Soil resistivity measuring instrument, Ultrasonic thickness measuring device, Corrosion rate measuring device, pH measuring electrode and so on.
Strengths	- Actual repair of pipelines and reduction of repair cost - Selection of priorities for excavation and repair via DCVG and CIPS
Experience	- Korea West Power Co., Ltd. - KP Chemical - Army Consolidated Logistics School, etc.



Step-by-Step Plant Assessment

For the safe operation of the plant during new construction work and maintenance or change of existing facilities in operation, the inspection team that consists of specialists in each field, such as process, electrical-instrumentation and mechanical-equipment, conducts a safety verification and provides direction for improvement regarding potential risks before operation.

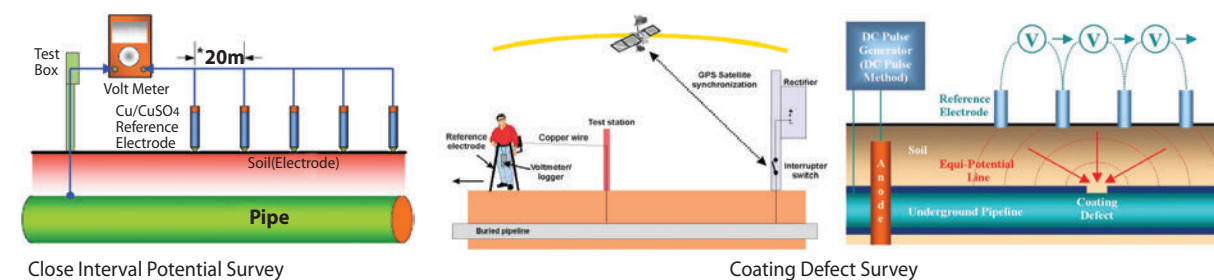
Scope	- Petrochemical, petroleum refining facility - Facilities for manufacture and storage of gas where risks exist
Key Technology	Design review field - Provide and review technical details that consider safety in design. - Coverage : Flare Load, Safety Valve, Earthquake-resistant design, HAZOP, etc. Assessment under construction - Inspect construction compliance concerning facilities, equipments, piping etc. - Coverage : Fire-proofing, Construction status of piping and explosion proof equipment Assessment before operation - Before plant start-up, finally check safety of related facilities and safety systems - Coverage : Process safety, Electrical & instrumentation, Mechanical, Fire protection
Strengths	- Presenting correct design direction and contributing to safety and timely start-up - Improving unsafe elements rapidly on site and cutting construction costs
Experience	- LG Chemical Co., Ltd. - GS Caltex Co., Ltd. - Samsung Total Co., Ltd. etc.



Underground Pipeline Assessment

Comprehensive diagnosis for integrity confirmation of Cathodic Protection (CP) system, detection of interference current and coating conditions. Through reliable methods including location probing, CP facilities assessment, potential survey and relative size of coating defect, CP integrity of underground pipelines is identified.

Scope	- Coating defect underground pipeline with dis-functional CP facilities - Underground pipelines with inadequate structure-to-soil potential
Key Technology	- Installation inspection and CP system examination - Location probing of underground pipeline using a MPL (Magnetic Probing Locator) - Integrity assessment by Close Interval Potential Survey (CIPS) - Coating Defect Survey by DCVG (Direct Current Voltage Gradient) - Administration of underground pipeline locations by DGPS location survey - Evaluation of retained strength and probable life by ECDA
Equipment	CIPS survey data logger, DCVG equipment, ACVG equipment, GPS synchronized current interrupter, Magnetic pipe locator, Insulation measuring instrument, Cathodic protection measuring instrument, Differential GPS equipment and so on
Strengths	- Survey without shutdown, identify coating defects without excavation work - Retain the integrity of pipelines and prevent accidents through a selective repair of corrosive region
Experience	- GS Caltex Co. - S-Oil - BASF Korea - SK Energy, etc.



Facility Safety Assessment

Derive potential harmful factors through a comprehensive precise safety inspection of high risk facilities such as specific manufacturing facilities and manufacture, storage, sale and use facilities of LPG, city gas and high-pressure gas and propose ways to improve safety management that are most appropriate for the plants.

Scope	- Petrochemical & refining industry, Gas storage & use facilities - LPG / city gas storage and use facilities
Key Technology	Process Safety - Risk and operability analysis and check of safety devices / interlock system - Evaluation of safety management conditions in operation manual, safety measures Electrical & Instrumentation - Evaluation of adequacy of the explosion-proof facilities - Check measuring instruments and inspect gas leakage alarm device Mechanical & Equipment - Gas leak inspection and checking the installation status of equipment - Thickness / hardness measurement and non-destructive testing - Analyze composition of the pipe using PMI (Positive Material Identification) Fire Protection - Check and review domestic and international laws and codes (ANSI, CCPS, API, ASME, NFPA, etc.) related to fire protection in petrochemical plants and facilities
Equipment	- Electrostatic measuring instrument, Digital multimeter, Clamp meter, Earth resistance meter, Multi-gas detector, Piping thickness gauge, Hardness tester - Infrared thermal imaging camera, Gas detection, RMLD, Ultrasonic thickness gauge
Experiences	- GS Caltex - Honam Petrochemical - Hyundai Steel, etc. - Samsung Everland - Korea Midland Power - SK Energy - LG Chemical - Samsung Electronics - Korea Hydro & Nuclear Power



02

Equipment Assessment

We provide trusted equipment assessment for large petrochemical plants, heat exchangers, steam generators, LPG/LNG storage facilities and other equipment with the most advanced technologies and support the industry to ensure safety and product quality with reliable technologies.

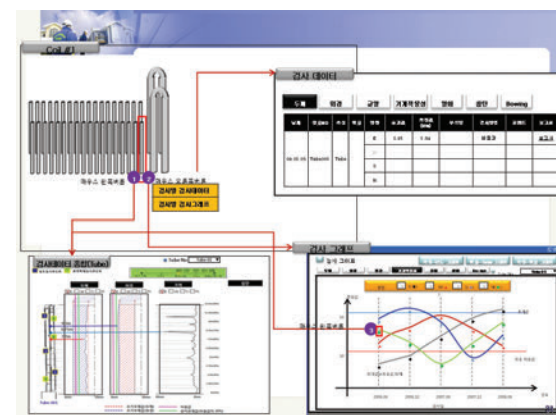
Automatic Crawler & CMMS (Computerized Management Maintenance System)

We offer automatic safety assessment with life / damage analysis using Automatic Crawler Robot for reformer & heater tubes in a severe environment process with high temperature & high pressure. Furthermore, we can establish CMMS (Computerized Management Maintenance System) with data collected by the Crawler.

Scope	• Heater & reformer tubes of refineries, petrochemical plants
Equipment	• Auto Crawler : Auto moving system embedded with outer diameter inspection equipment, and ECT equipment - O.D. measurement : non-contact laser sensors detect changes in outer diameter resulting from damage by heat - Eddy current testing : Detects cracks and damages by using multi-channels • CMMS : Efficient management system of the new or old high temperature facilities. - Composed of inspection drawing system, equipment management system and document management system - Possible to establish independent or network linkage systems - Possible to establish customized system reflecting user requirements
Strengths	• Productivity : Fast and accurate inspection reduces shut-down time • Accident Prevention : Tool for effective equipment management • Cost Reduction : Optimum replacement period of tubes by life-time assessment. • Economy & Safety : Reduce accessory costs like scaffolds, etc and prevents fall accidents
Experience	• GS Caltex Reformer Safety Assessment • LG Chemical Heater Safety Assessment • YNCC Heater Safety Assessment • Hanwha Chemical Heater Safety Assessment • Honam Petrochemical Heater Safety Assessment



Auto Crawler



CMMS

AE (Acoustic Emission)

A new and novel NDE technique to evaluate fitness of storage and tanks in plants by attaching sensors on the surface of the tank, and analyze / evaluate received signals from sensors.

※ AE (Acoustic Emission) : Elastic wave generated when tanks and storage are pressurized.

Scope	• Safety assessment of storage and pressure vessels when on-stream • Safety assessment of bottom of above-ground storage tanks • Safety assessment of internal leak in closing-valve, safety valve, etc.
Equipment	• SAMOS 112CH : For Assessment of Large Structures and Equipment (PAC, USA) • DISP 56CH : For Assessment of Spherical Storage Tanks (PAC, USA) • SAMOS 32CH : For Assessment of Pressure Vessels and Bottom Corrosion in Above-Ground Storage Tanks (PAC, USA) • AMSY-6 12CH : For Assessment of Bottom Corrosion in Above-Ground Storage Tanks • Sensor Highway II 8CH : For Assessment of On-Line Monitoring (PAC, USA) • V-5131 : For Assessment of Internal Leaks in Closing-Valve, Safety Valve (PAC, USA)
Strengths	• On-Stream Inspection is Available • Can be Alternative way instead of Open-Inspection • No Need to Remove Insulation; Environment Friendly • 1 test covers whole volume of storage tank → Reduced Inspection Cost (Less than of 1/3 of Open Inspection) → Reduced Inspection Period (Less than of 1/4 of Open Inspection)
Experience	• Safety Assessment of pressure vessels, storage tanks and tube trailers in about 40 domestic companies ※ From 1999~Present : Pressure vessels and storage tanks (about 230 items), Tube trailers (about 160 items)



ACFM (Alternating Current Field Measurement)

ACFM makes electric field at the surface of a subject to find crack and has a feature that ACFM finds defects between ferrous and non-ferrous metal without calibration.

Scope

- Pressure Vessels, Drum, Reactor, Tower, Storage Tanks
- Piping, Support
- Bridge, Crane
- Turbine, Piping etc in Power Plants
- Ship, Amusement Facilities etc.

Equipment

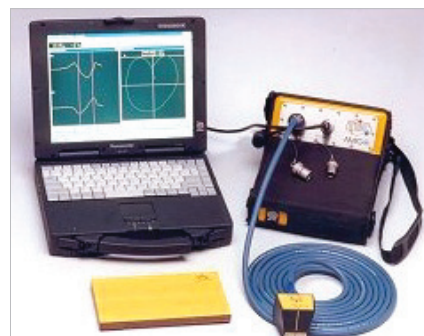
- Hardware : AMIGO ACFM instrument (Main Equipment)
- Software : ASSISTant Software (Analysis Software)
- Manufacturer : TSC, UK

Strengths

- Applicable for Both Ferric and Non-Ferric
- No Need to Remove Paint
- Sizing Defects (Width, Depth, Location)
- On-Stream Inspection of Pressure Vessels, Storage Tanks, Pipings
- Record All Inspection Data in Computer, an Operator Can Review the Inspection Result

Experience

- Korea Gas Corporation : LNG Procurement Department (In-Cheon, Pyeong-Taek, Tong-Young) Safety Assessment
- SK Energy : Pressure Vessels in Ulsan and In-Cheon Plant Safety Assessment
- GS Caltex : Piping Safety Assessment
- LG Chemical : Pressure Vessels and Storage Tanks Safety Assessment
- Samsung Total : Pressure Vessels Safety Assessment etc.
- Honam Petrochemical Corporation : Pressure Vessels Safety
- Yeochun NCC Corporation : Pressure Vessels Safety Assessment



Real Time – RT

By Using Radioisotope (Gd-153), RT-Profiler can conduct real-time inspection of thickness thinning and measure thickness of piping or accumulated sludge without removing insulation, so it is relatively temperature-dependant, can perform on-stream inspection.

Scope

- Pressure Vessel, Drum, Reactor, Tower, Nozzle of Storage tank
- Piping, Support etc.

Equipment

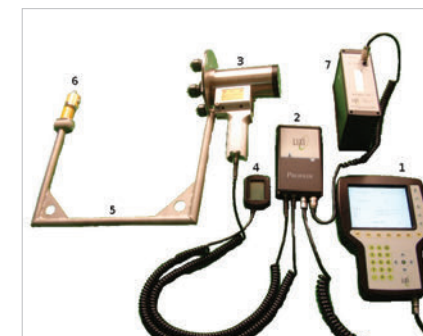
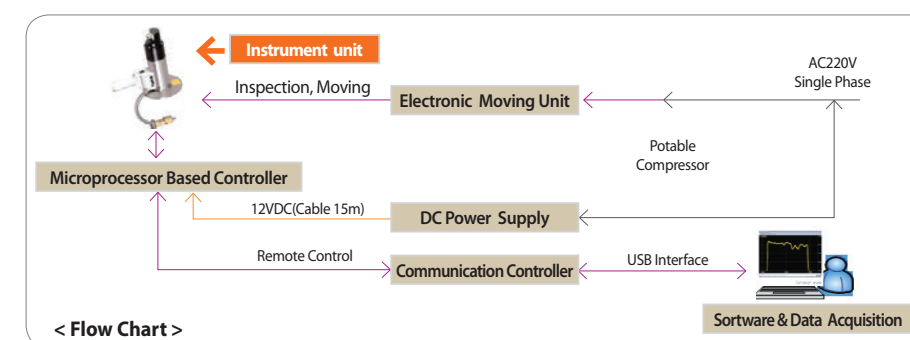
- RT-Profile (or LIXI- rofiler) (LIXI. nc., USA)

Strengths

- Detect internal/external corrosion of insulated piping and size thickness of pipe
- Detect foreign objects such as ice, water between piping and insulation
- On-stream inspection of pressure vessel, storage tank, and piping
- Records all inspection data in computer, so operator can review the inspection result
- Applicable to any material pipes like steel pipe, PVC pipe, etc.

Experience

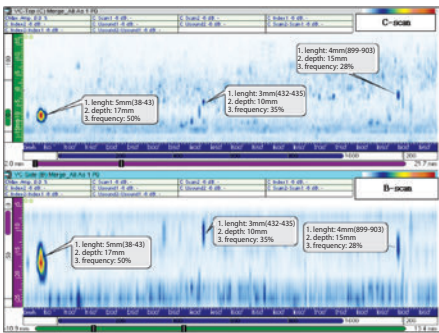
- Honam Petrochemical : Piping CUI Safety Assessment
- GS Caltex : Piping CUI Safety Assessment



Phased Array Ultrasonic

Ultrasonic phased arrays are a novel technique for generating and receiving ultrasound. Instead of a single transducer and beam, phased arrays use multiple ultrasonic elements and electronic time delays to create beams by constructive and destructive interference.

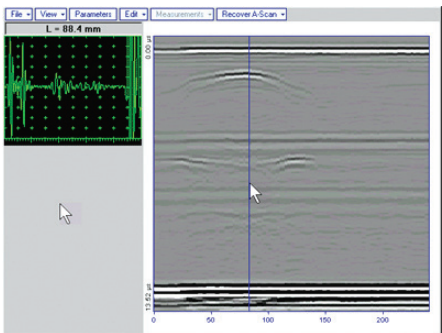
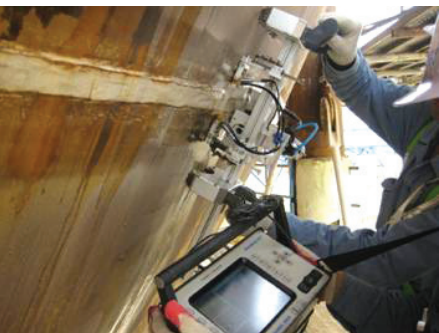
Scope	• Safety Assessment of Welds in Pressure Vessels, Pipings, Steel Structures, etc. • Corrosion Mapping • On-Stream Detection of Fatigue Cracks in Welds
Equipment	• Omniscan MX 16:128 1 Set (Olympus, Canada)
Strengths	• Save Inspection Result in Image File • High Sensitivity and High Resolution • Can Inspect Complex Objects • Obtain Volumetric Image Without Moving Probe ※Benefits of phased array technology over conventional UT - Ability to use multiple elements to steer, focus and scan beams with a single transducer assembly - Beam steering, commonly referred to as sectorial scanning, can be used for mapping components at appropriate angles. This can greatly simplify the inspection of components with complex geometry. The ability to test welds with multiple angles from a single probe greatly increases the probability of detection of anomalies - Electronic focusing permits optimizing the beam shape and size at the expected defect location, as well as further optimizing probability of detection The ability to focus at multiple depths also improves the ability for sizing critical defects for volumetric inspections
Experience	• Korea Gas Corporation, Samnam Petrochemical Pressure Vessels Safety Assessment, etc.



TOFD (Time of Flight Diffraction)

TOFD is a novel NDE and advanced UT-based technique. Embedded with automated computer imaging system, by analyzing the time of diff acted ultrasonic signal, TOFD can detect internal defects in welds at back plate more than 15mm thick, and size and locate defects precisely.

Scope	• Safety Assessment of Welds in Pressure Vessels, Pipings, Steel Structures etc.
Equipment	• ISONIC 2005 (SONOTRON, ISRAEL)
Strengths	• Offers highly reliabe data for FFS (Fitness For Service) due to its high precision (error less than 1mm) in measuring crack`s depth and height. • Result is shown in images and can be stored in computer • Inspection result can be checked immediately and on-stream inspection is possible when operating temperature is less than 150°C • In case of plate thicker than 25mm, it is economic due to speed of inspection with respect to RT • TOFD defect detection does not depend on defect orientation • Defect height can be precisely determined • Higher POD improves risk reduction and calculation
Experience	• Samsung Total Storage Tank Safety Assessment • HYUNDAI STEEL Pressure Vessel Safety Assessment • SK Energy, POSCO • Honam Petrochemical • Yeochun NCC



Long Range Guided Wave UT

The technique, analyzing guided waves which can propagate a long distance (typically 50m) of piping and may be reflected from defects, is designed for the rapid screening of long lengths of piping.

It detects corrosion defects, such as corrosion under insulation and internal corrosion due to corrosion, erosion and erosion-corrosion, removing.

Scope	• Overhead piping • Insulated piping • Road Crossing pipe and Culvert • Buried piping • Heater Tube, etc.
Equipment	• Hardware : G3 (GUL, UK) • Solid Ring • Inflatable Ring • T-scan • Software : Wavepro G3 (GUL, UK)
Strengths	• Minimizing the removal (300mm in length) of insulation and testing long distance of piping (Max. 200m in length) • Inspecting the area hard to approach • On-Stream inspection
Experience	• On-stream piping : Fuel piping of 5 companies including SK Energy • Underground piping : City gas piping of 2 companies including Ultra Construction co. • Heater tube • Road Crossing pipe and Culvert : S-OIL



Overhead pipe



Insulated pipe



Piping through the wall



Sleeved pipe

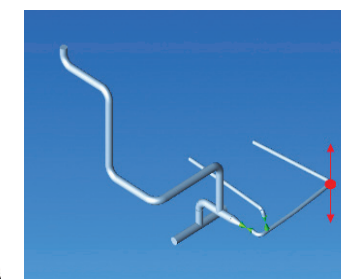
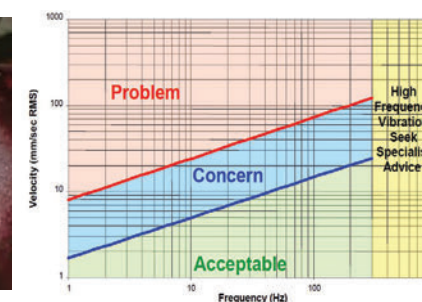
Piping Vibration Analysis

The technique is used to find the causes of piping vibration, including compressor or pump induced pressure pulsations, flow turbulence, vortex shedding, resonance, etc.

To decide the condition of piping system, it determines the piping system vibration amplitudes, frequencies, nodal points, and the pipe modal shape.

And also it can identify defective supports, incorrectly placed supports, and the locations of maximum deflection requiring additional supports.

Scope	• Analysing the cause of piping system vibration and noise
Equipment	• Hardware : OR36 (OROS) 16ch. • Software : NVIGate (OROS)
Strengths	• Having the state-of-the-art equipment and software to collect and analyse the measured data • Providing the vibration assessment of piping system, according to the guideline of ASME OM-3, Energy Institute, etc. • Predicting the vibration behavior by FSI (Fluid Structural Interaction) when operating conditions will be changed
Experience	• The metering piping system of LNG plant : Korea Gas Corporation : • The process piping system of refinery and Petrochemical plant :Hanhwa Chemical, GS-Caltex, Samsung Petrochemical, etc.

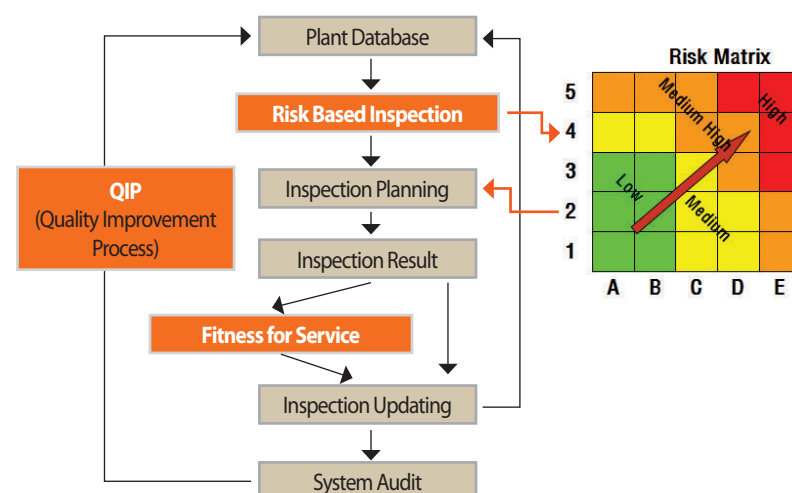


RBI (Risk Based Inspection)

RBI is a risk based approach to prioritizing and planning inspection used in engineering industries, and predominant in the oil and gas industries. This type of inspection planning analyses the probability (or likelihood) and consequence of failure of an asset to calculate its risk of failure. The level of risk is used to develop a prioritised inspection plan for the asset.

RBI will assist a company to select cost effective and appropriate maintenance and inspection tasks and techniques, to optimize such efforts and cost, to shift from a reactive to a proactive maintenance regime, to produce an auditable system, to give an agreed "operating window", and to implement a risk management tool.

Scope	- Oil & Gas Separation Plant - Refinery Plant - Petro-chemical Plant
Softwares	- KGS-RBI ver. 3.1 - Database : MS SQL Server 2008 - Type : Web & Stand Alone Base - Language : ASP.net
Strengths	- To extend the inspection interval from time based inspection often governed by minimum compliance with rules, regulations and standards for inspection - Apply a strategy of doing what is needed for safeguarding integrity and improving reliability and availability of the asset by planning and executing those inspections that are needed - Provide economic benefits such as fewer inspections, fewer or shorter shutdowns and longer run length - Reduce inspection and maintenance costs without compromising safety or reliability - Provide a flexible technique able to continuously improve and adopt to change risk environment - Ensure Inspection techniques and methods are clearly defined based on thorough understanding of potential failure modes
Experience	- Domestic Project - Plenty of refinery and petrochemical plant - Oversea Project - Gas and oil separation plant, Oman - Cracker #1 of Titan chemical, Malaysia

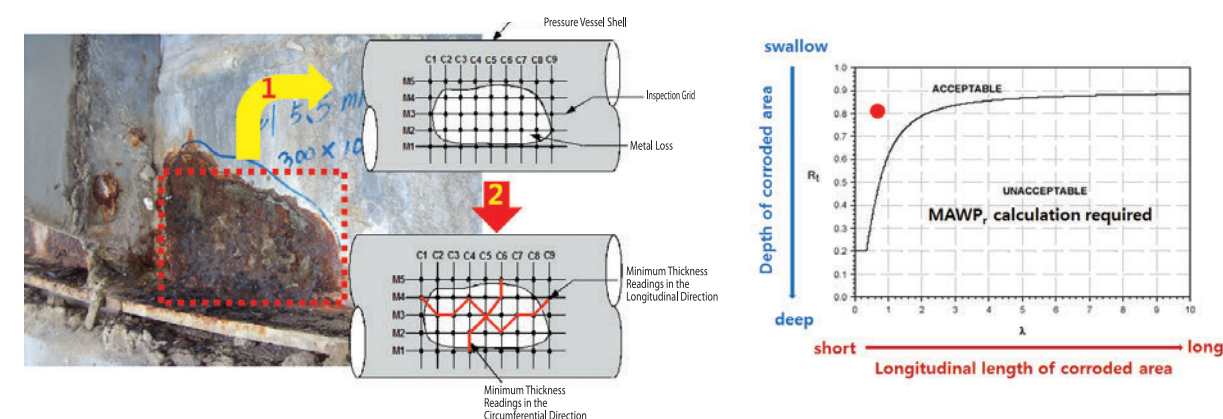


FFS (Fitness-For-Service)

Fitness for service assessment is performed to confirm that the degraded process plant equipment will operate safely and reliably for some desired future period by evaluating the remaining strength of the equipment based on API Recommended Practice 579.

The evaluated common degradation mechanism include corrosion, localized corrosion, pitting and crevice corrosion, hydrogen attack, embrittlement, fatigue, high-temperature creep, fibre damage, and mechanical distortion.

Scope	Pressure vessels, Reactor, Heat Exchanger, Piping, and Tanks
Softwares	- Signal FFS Software (Quest Integrity Group, USA) - FractureGraphics Software (Structural Reliability Technology, USA)
Strengths	- Maintaining the safety of plant personnel and the public - Protecting the environment for accidental releases of damaging substances - Reliably operating aging facilities - Maintaining safe and reliable operations with increased run lengths and decreased shutdown periods - Determining the feasibility of increasing the severity of operations
Experience	- Samsung Total : Corrosion Under Insulation on Pressure Vessels - Green Air : Crack in Storage Tank - Cheil Industries : Crack in pressure vessels - Samsung Fine Chemicals : Life assessment of reformer tube



03

Product Certification

KGS is providing certification services for products of gas, electric explosion-proof and CBR protective equipment. Our quality system is accredited by KOLAS. We provide our product certification services in accordance with both Korean domestic and international regulations, such as KGS Code, KS, IEC, EN etc.



IECEX and ATEX Certification

As an IECEx Certification body (ExCB) and an IECEx Testing laboratory (ExTL), KGS tests the explosive-proof equipment intended for use in explosive environments, conducts a factory audit and issues the IECEx certificate.

For customers who want to expand markets to Europe, Middle East and China, we help to obtain the ATEX Certificate and the NEPSI Certificate.

Applicable products

- Motors, Luminaires, Measuring instruments
- Junction Boxes, Control & Distribution Panels
- New-type of explosive-proof equipment, etc.

Scope

- Flameproof Enclosure “d”, Pressurized enclosure “p”
- Increased safety “e”, Intrinsic Safety “i”
- Type of protection “n”, Encapsulation “m”
- Oil immersion “o”, Dust-protection by enclosure “tD”

Advantages

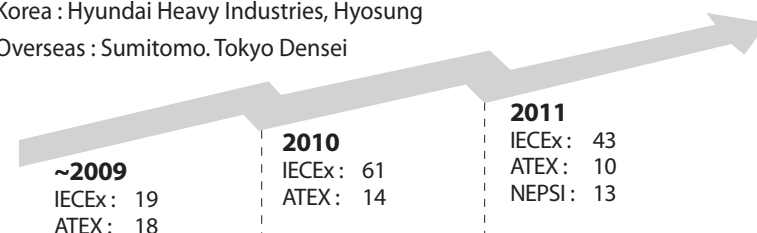
- **New and Global Markets** : You can access to new and global markets with the IECEx certificate from KGS. Over 30 countries all over the world are already joined IECEx member countries
- **Technical Supporting** : We have over ten year's accumulated experience in this field. We always work to provide improved safety to manufacturers according to strict international standards. You can have the best explosive-proof equipment in the world with KGS
- **Various Conversions** : With KGS IECEx certificate, you can obtain various certificates like ATEX certificate for European markets and NEPSI certificate for the China market. Also we can issue National Safety Certificate with KGS IECEx certificate



- **Economical Efficiency** : We provide manufacturers obtaining IECEx and ATEX certificates with economy of time and cheaper cost than other organizations around the world

Experiences

- Korea : Hyundai Heavy Industries, Hyosung
- Overseas : Sumitomo, Tokyo Denso



National Safety Certification

KGS is one of the organizations entrusted with mandatory certification work by the Ministry of Employment and Labor. To obtain National Safety Certification, manufacturers should prepare applications and submit samples of the equipment tested by KGS. A factory inspection will be organized by KGS.

To ensure that the stringent standards are being maintained by manufacturers, KGS conducts on-going periodic audits (including factory inspections).

Applicable products

- Facility for reference and non-transmission test
- Facility for overpressure test
- Power supplier and temperature recorder for thermal test

Scope

- Flameproof enclosures (Ex d)
- Increased safety (Ex e)
- Intrinsic safety (Ex ia or ib)
- Encapsulation (Ex ma or mb)
- Non-sparking (Ex nA, nC, nL, or nR)
- Oil immersion (Ex o)
- Pressurized enclosures (Ex px, py or pz)
- Powder filling (Ex q)
- Dust-Protection by enclosures (Ex tD)



Flameproof enclosures (Ex d)



Intrinsic safety (Ex ia or ib)



Encapsulation (Ex ma or mb)

Advantages

- Protection for domestic industries against explosive hazard
- Assisting and protection of domestic explosion-proof industries against overseas competition
- Contribution to R&D of domestic explosion-proof industries for certification according to IECEx system

Experiences

- Domestic : HYOSUNG, HYUNDAI, DAEYANG etc.
- Overseas : TOKYO DENSAI, TEIKOKU, SUMITOMO etc.

IECEX Certification for Service Facilities

This IECEX Scheme is an International Certification Scheme that covers the assessment and on-site audit of organizations that provide services such as repair and overhaul to the Ex industry.

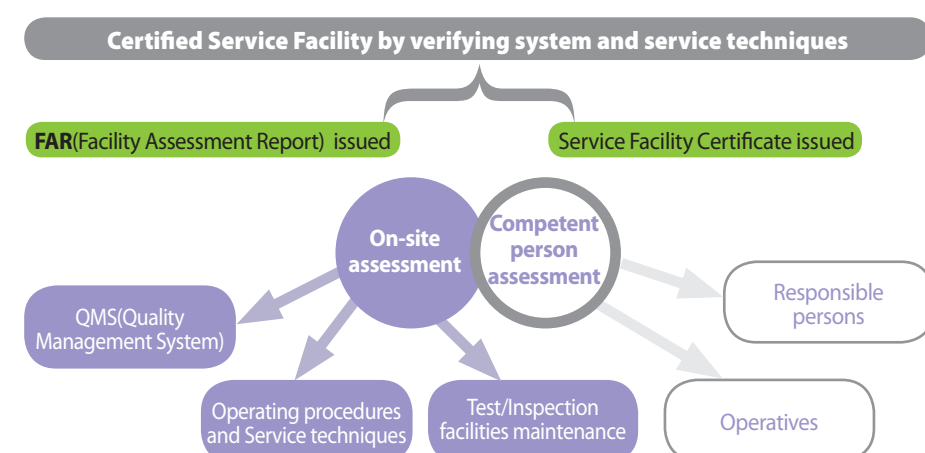
Applicable item

- All organizations providing repair and overhaul services to the Ex industry

Scope

- All Ex equipment used in the area of Hazardous Locations such as oil refineries, rigs and processing plants

Procedure



Advantages

- **A/S for Ex certified equipment :** Assurance for the character of Explosion proof, in reference to a report issued by the company certified in accordance with the IECEX Service Facilities scheme
- **Economical efficiency :** Due to the very high capital investment made by industry in most Ex equipment, it is much more economical to repair and overhaul equipment rather than to replace it. This also has obvious environmental benefit

Experiences

- HYOSUNG • DAEYANG etc.



National Certification for CBR (Chemical, Biological and Radiological) Protection Facility

For protect OUR Lives and Properties by terror bombing, KGS provide the service which certifies CBR protective facility certification body in KOREA(KOLAS, KAS), securing the quality reliability and safety of CBR protective facility.

Applicable Products

- Blast door, Gastight door, Blast valve series, Backward prevention valve, Gastight closing valve, Gastight connection Tube, Chemical filter etc.

Test equipment we have

- **Performance test**
Blast Wave Durability Test Apparatus, Explosion resistance Test Apparatus, Leakage Test Apparatus, Tightness Test Apparatus, Flowing test Apparatus, Shut-off pressure test Apparatus, Thermal resistivity test Apparatus
- **Certification**
Material performance test Apparatus, Shock wave test Apparatus, A salt-water mist test Apparatus, Aging test Apparatus, Hardness test Apparatus, etc.



Blast Wave Durability Test Apparatus



Explosion resistance Test Apparatus



Leakage Test Apparatus



Flowing test Apparatus

Expected Effectiveness

- Offering efficient performance tests & certification services for Components of the CBR Protection Facility
- Supporting essential techniques to improve good performance products
- Ensuring national safety from fatal explosion pressure and toxic gas
- Supporting technical advance and development to related industries

Factory Registration

Foreign manufacturers of gas products who intend to export them to Korea shall register with the Ministry of Knowledge Economy in accordance with Article 5-2 of the High-Pressure Gas Safety Control Act or Article 6-2 of the Safety Control and Business of Liquefied Petroleum Gas Act. The Korea Gas Safety Corporation conducts the technical review and factory audit to verify quality of gas products.

Major Objects of Factory Registration

Section	The High-Pressure Gas Safety Control Act	The Safety Control and Business of Liquefied Petroleum Gas Act
Objects	- Cylinder and Cylinder's Accessories - Storage Tank and Pressure Vessel - Specified Equipment for Refrigeration - Safety Valves, Emergency Cut-Off Device, Etc.	- Gas Appliances - Burning Appliances such as Ranges, Ovens, Etc. - Safety Appliances such as Pressure Regulators, Hoses, Etc.

Factory Registration Process Flow

Technical Review	Reception : Korea Gas Safety Corporation (Factory Auditing Department) Required Document : Company Profile, Manufacturing Facilities & Inspection Equipment List, Quality Control Procedure, Drawing and Strength Calculation	The technical review consists of a document review of the general present status, standards for manufacturing and testing facilities of the manufacturer, and its subcontractor's quality control
Factory Audit	Reception : Korea Gas Safety Corporation (Factory Auditing Department)	The factory audit is the procedure for conducting field inspection of matters related to technical review and quality control regulation, and consists of checks on manufacturing and testing facilities, quality control by processes, subcontractor's quality control and quality control regulations.
Factory Registration	Reception : The Ministry of Knowledge Economy Required Documents : Company Profile and Brochure, Result of Technical Review and Factory Audit.	The Ministry of Knowledge Economy verifies that the company profile and result of the technical and on-site audit conducted by the Korea Gas Safety Corporation is suitable against the registration criteria

2011.12.31

Record of Factory Registration

Objects	Pressure Vessel	Cylinder	Cylinder Accessories	Safety Valves	Specified Equipment for Refrigeration	Toxic Valve	Emergency Cut-Off Device	Total
Registered company	108	39	11	8	4	3	2	179

Further Details

How to Access	Contact Point
KGS SERVICES : Manufacture Registration (http://www.kgs.or.kr/kgsmain_eng/kgs_services/manufactural_sys.jsp)	Sang-Wha Lee : jjeech@kgs.or.kr, Tel : 031-310-1602 Young-Hoon Lee : kamf2000@kgs.or.kr, Tel : 031-310-1486

※ Factory Registration Manual can be downloaded at KGS Web page. (www.kgs.or.kr)

KAS Certification (V-check Mark) Service for Gas Products

- Gas products which meet certain qualification requirements or specifications stipulated in ANSI, EN, IEC and KGS Code can obtain KAS Certification (V-check Mark).
- KGS, as one of KAS (Korea Accreditation System) - accredited Product Certification Bodies, provides V-check certification service based on a product certification system that complies with ISO / ICE Guide65.

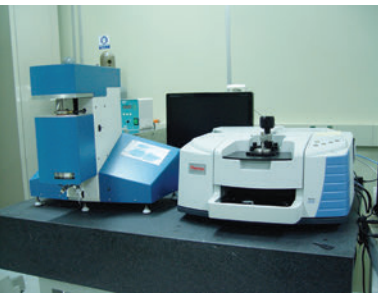
Scope

- Gas products (gas appliances, connectors, valves, safety devices etc.)
- Explosion-proof electrical devices
- Other gas-related components

Advantages

- Designation as a good public procurement product
- Purchase preference given by DAPA (Defense Acquisition Program Administration)
- Improvement of product export competitiveness through PAC (Pacific Accreditation Cooperation) MLA (Multilateral Recognition Arrangement)
- Marketing advantage by the formation of good quality product image

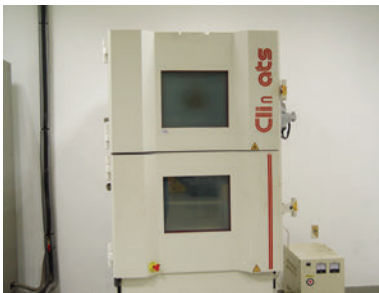
Equipment



FT-IR, TGA



3D Vibration Tester



Thermo-impact Tester

E-Mark Testing Service for Automotive Components

- KGS provides E-Mark testing and consulting services for LPG, CNG and hydrogen vehicle components to be exported to European and non-European countries in accordance with ECE Regulations.
- Vehicle Certification Agency in the UK and TUV-SUD in Germany have been working with KGS as MOU partners and KGS is also cooperating with KIWA in the Netherlands.

Scope

- Vehicle Regulator, Filter, Injector, Solenoid Valve, Hose, etc.

	LPG vehicle components	CNG vehicle components	Hydrogen vehicle components
Standards	R67	R110	R79, R406

Equipment



Multi-Valve Performance Tester



Part of CNG Vehicle
Performance Tester



Part of Hydrogen Vehicle
Performance Tester

Advantages

KGS can help automotive component manufacturers who wish to access to global market

- Helping them save time, money and effort
- Providing information regarding E-Mark
- Providing pre-performance assessment service before they actually apply for E-Mark

Gas Appliance Certification Service for Global Market Access

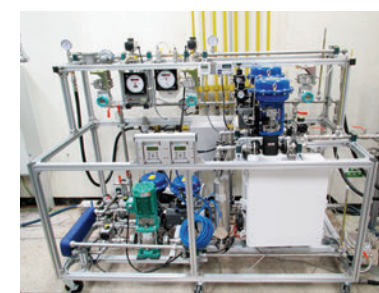
- KGS provides safety testing and consulting services for gas appliances to be exported to the global market, mostly to Europe, North America and Oceania
- BSI (UK), KIWA (the Netherlands), Intertek (USA), and AGA (Australia) have been working with KGS to help manufacturers obtain CE, ETL, AGA etc. for their products.

Scope

- CE : Gas boiler, gas water heater, gas range
- AGA : Gas boiler, gas water heater, gas range
- ETL : Gas boiler, gas water heater

Equipment

- Product Performance Tester, Leakage and Internal Pressure Tester, Electromagnetic Compatibility (EMC) Tester, Combustion Gas Analyzer, Electrical Insulation Tester, etc.



Performance Tester



EMC Tester



Combustion Gas Analyzer

Advantages

KGS can help gas appliance manufacturers who wish to access the global market

- Helping them save time, money and effort
- Providing information regarding overseas regional product certifications



04

System Certification

We provide greenhouse gas emission verification services of the best credibility and expertise. KGS certification services - GMS (Green Management System), ISO 9001 (Quality Management System), ISO 14001 (environmental management system), OHSAS 18001 (Occupational Health and Safety Management System) - strengthen the competitiveness of enterprises.

ISO Certification

ISO 9001 and ISO 14001 have become international references from the International Standard Organization (ISO), and OHSAS 18001 has become the accreditation reference by the International Accreditation Forum (IAF). KGS-QA has been carrying out ISO 9000 certification services since 1999, providing quality, environment, health and safety certification services for customers.

* Quality Management System certification (KAB-QC-22, Mar. 1999, Korea Accreditation Board),
Environment Management System certification (KAB-EC-15, Nov. 2001, Korea Accreditation Board)

ISO 9001 Quality Management System

Throughout the entire process of product design and development, QMS is a management system for improving the quality of the product, preventing defects, maximizing customer satisfaction, and strengthening corporate competitiveness.

Incentives

- Cost reduction and strengthen corporate competitiveness
- Technology accumulation and defect prevention
- Improved quality awareness

ISO 14001 Environment Management System

Throughout the entire process of raw material procurement, manufacturing, distribution, sales, and disposal, EMS is a management system for minimizing the environmental impact of a product or service, encompassing resource consumption, air and water quality, noise, vibration, waste disposal, etc.

Incentives

- Minimizing energy consumption and waste, improving process efficiency and reducing costs
- Increasing awareness for eco-friendly businesses among customers, partners, investors and communities
- Enhancing international credibility, improving corporate image

OHSAS 18001 Occupational Health and Safety Management System

OHSAS 18001 is a management system for occupational health and safety, which enables an organization to control its risks and improve its performance. The standard provides a systematic approach to identifying hazards, and then either eliminates or reduces the risks of the hazards.

Incentives

- To prevent health and safety accidents, reduce disaster compensation and increase productivity
- To evaluate workplace risks, drive safety and health management efficiently
- Self-building of efficient workplace with safety and health management system

GMS (Green Management System)

GMS is a management system for using energy and resources efficiently, minimizing pollution and greenhouse gas emissions, performing ethical responsibilities.

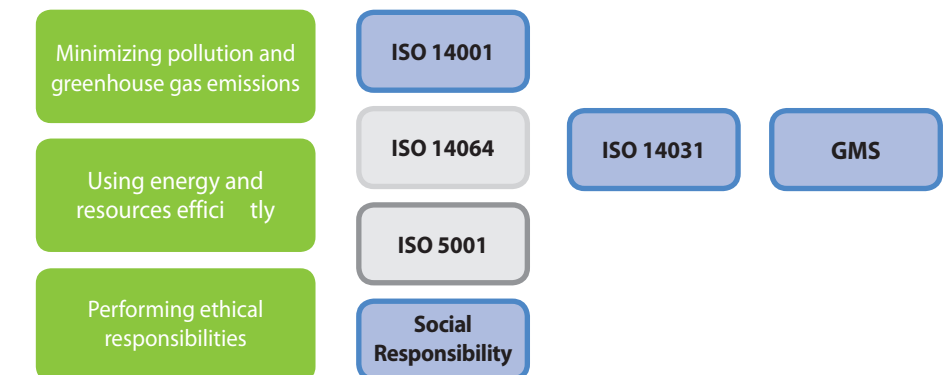
* Green Management System certification (KAB-GC-11, June 2012, Korea Accreditation Board)

Need for GMS

- Lack of resources and energy reserves, rising costs
- Strengthen greenhouse gas emission regulations
- Increase social roles of eco-friendly companies

GMS Components

- GMS has four management system elements (environment, energy, greenhouse gases and social responsibility) added to the concept of green management performance evaluation



Incentives

- **Design stage** : Eco-friendly products and system design
- **Production stage** : Clean production and process innovation
- **Use stage** : Using green products and reducing energy consumption
- **Disposal stage** : Resource recycling and reuse

Greenhouse Gas · Energy Target Management Scheme Verification

The greenhouse gas and energy target management scheme was introduced in April 2010 by the Ministry of Environment. Target companies who are emitting greenhouse gases of at a certain volume must report their GHG inventory, implementation plan, and performance toward achieving the national greenhouse gas goals. Target companies must have their GHG emissions verified by a verification agency in order to improve reliability.

* Greenhouse gas and energy verification agency (2011-16, June 2011, Ministry of Environment)

Target

	Company Standards	Workplace Standards
Greenhouse gas emissions	Emissions of more than 87,500 tCO ₂ (2014 at least 50,000 tCO ₂)	Emissions of more than 20,000 tCO ₂ (2014 at least 15,000 tCO ₂)
Energy consumption	Consumption of more than 350 TJ (More than 200 TJ in 2014)	Consumption of more than 90 TJ (More than 80 TJ in 2014)

Description

- By March of each year, target companies have to identify the previous year's greenhouse gas emissions and energy consumption, and then be verified by a verification agency with the results submitted to the government
- **Verification**
 - Annual greenhouse gas emissions
 - Annual energy consumption
 - Annual greenhouse gas emission reduction
- **Verification Scope**
 - Chemical, electrical-electronics, steel-metal, industrial minerals and waste sectors

Incentives

- Reduced energy consumption, reduced costs
- Applying reduction techniques, enhanced competitiveness
- Through greenhouse gas measuring and reporting mission, acquire trained experts

Korea Voluntary Emission Reduction (KVER) Verification

KVER (Korea Voluntary Emission Reduction) was introduced in April 2010 by the Ministry of Knowledge Economy. It provides for greenhouse gas emission reduction projects for recognizing and supporting participants' efforts to reduce greenhouse gas emissions through a government-registered certification system

* Greenhouse Gas Emissions Verification Agency (2011-02, July 2011, the Ministry of Knowledge Economy)

Targets

- Non-target scheme companies with annual reductions more than 100 tCO₂

Project Requirements

- 1 GHG reduction projects through improvement of energy efficiency
- 2 Renewable energy projects
- 3 Other GHG emission reduction projects approved by the government

Except Registered Businesses

- 1 Production change (load change), simple maintenance, cleaning
- 2 Mandatory compliance with national policies and regulations
- 3 Unclear ownership or business boundaries

Description

- Companies have to submit a business plan and have reductions assessed to register projects. Subsequently, they should submit monitoring reports on the amount of greenhouse gas reductions during the previous year (1 year). The reports should be verified by a verification agency before being submitted to the government (Ministry of Knowledge Economy Notice No. 2011-71)

Verification Items

- Assessment of reduction project plan
- Annual greenhouse gas reductions
- Confirmation of linkage of greenhouse gas reductions to reported business plan

Incentives

- Using external reductions, companies can achieve reduction targets
- Government support for project development costs

History of KGS

- Dec. 1962 Enactment and promulgation of the "Compressed Gas Control Law
- Feb. 1973 Enactment and promulgation of the "High Pressure Gas Safety Control Law
- Jan. 1974 Establishment of the High Pressure Gas Safety Institute
- Jan. 1978 Became affiliated with the Ministry of Energy and Resources
- Dec. 1978 Revision of the High Pressure Gas Safety Control Law
Enactment and promulgation of City Gas Business Law
- Feb. 1979 Reorganized as Korea Gas Safety Corporation
- Feb. 1989 Construction of KGS headquarters building
- Dec. 1994 Became affiliated with the Ministry of Trade, Industry and Energy
- Aug. 1995 Reconstituted and enlarged to improve the national safety management system
- Aug. 1995 Establishment of the Institute of Gas Safety Technology as an affiliated research center
- Mar. 1996 Designated as nationally notified inspection body
- Jul. 1997 Declaration of 2nd foundation
- Feb. 1997 Designated as national calibration and inspection body
- Oct. 1998 Became affiliated with the Ministry of Commerce, Industry and Energy
- Mar. 1999 Designated as certification body for electrical explosion-proof performance Designated as ISO 9000 series certification body

- Mar. 2000 Won meritorious organization citation by the President for outstanding accomplishments in safety management
- Mar. 2000 Designated as "Assistance Agency for Internationally Recognized Standards Certification"
- Aug. 2000 Established KGS 18000 Certification standard and began assessment of businesses.
- Nov. 2000 Designated as ISO 14000 Series Certification Body
- May 2001 Designated as "National Research Laboratory"
- Nov. 2002 Selected as testing entity for CE marking of gas appliances
- Dec. 2002 Recognized as internationally authorized inspection organization for Korea Laboratory Accreditation Scheme (KOLAS)
- June 2003 Additional recognition as internationally authorized inspection organization (for gas appliances & electronic explosion-proof appliances)
- Oct. 2003 Approved as and IECEx (Ex Certification body) and ExTL (Ex Test Laboratory)
- Dec 2003 Recognized as KOLAS Accreditation body
- Jan. 2004 Designated as KS audit body
- Dec. 2004 Accredited as a National Product Certification Body for gas appliances by KATS
- June 2005 Won top honor in the Government's Management Assessment
- Oct. 2005 Designated as KOLAS Accredited testing body in LNG sector
- May 2006 Won meritorious organization citation by the President for outstanding accomplishments in disaster relief
- June 2006 Recognized as inspection body for KOLAS in Standard Substance Production organization sector
- Feb. 2007 Declaration of Vision 2015
- Apr. 2007 Raised to the status of government-funded organization
- Sept. 2007 Won excellent Prize for ' Labor-Management Culture'
- Nov. 2007 Designated as GHG Reduction Result Verification Body
- June 2008 Won top honor in the Government's Management Assessment
- Feb. 2009 Designated as Auto-fuel (CNG) test body (by National Institute of Environmental Research)
- Nov. 2009 Won "Family-Friendly Company Award" Excellent Prize
- Jan. 2010 Designated as CSA testing laboratory
- June 2011 Designated as GHG Energy Target Management System verification body
- June 2011 Designated as ISO 9001 auditor training facility