



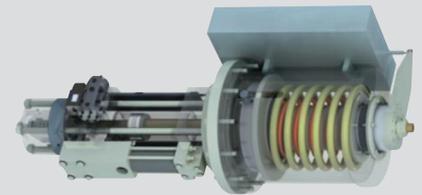
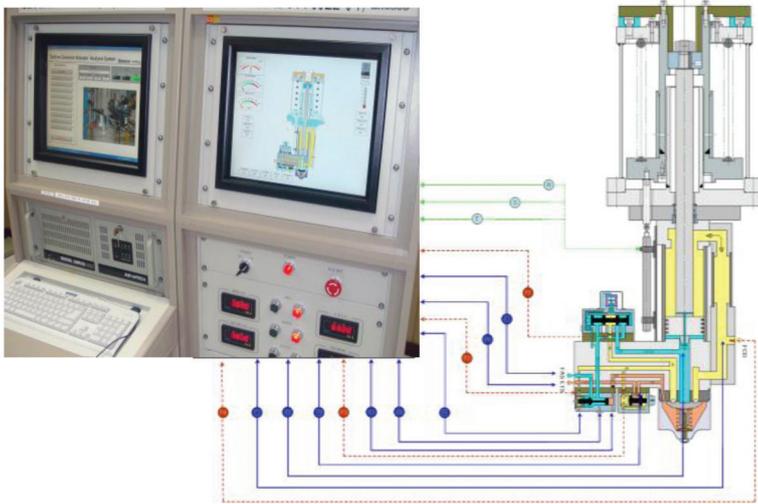
Hydraulic System Technology Division

enesG Global Energy Service Hydraulic system technology is essential to capture the reliability of hydraulic system for the operation of steam turbine valve. ENESG got certified as NET¹ holding company for reliability of hydraulic technology from MKE². Also ENESG supplies hydraulic actuator for TBN valve with more enhanced durability and reliability than existing products to nuclear, fossil & combined power plants.

Main Business

Engineering, Maintenance, Design, Manufacturing and comprehensive performance test services for Hydraulic Actuator

- Hydraulic actuator for fossil, nuclear, combined cycle power plant
- Diagnostic equipment specimens manufacture
- ETS (Emergency Trip System) test and maintenance



Patent, NET, NEP

Engineering & Modification

- Turbine Valve Hydraulic Actuator for Power Plant
- Hydraulic Actuator Cylinder Assembly
- Hydraulic Actuator Bushing
- Method of Hydraulic Actuator Anti Corrosion
- Turbine Valve Control Actuator using Internal Check Valve for Nuclear and Fossil Power Plant

Reliability & Evaluation

- Turbine Valve Hydraulic Actuator Static and Dynamic Diagnosis Technology using THASA and Buffer
- Test Block of Non-Control Type Hydraulic Actuator
- Device and Method of Hydraulic Actuator Emergency Trip Test for Power Plant
- Test Block of Control Type Hydraulic Actuator
- (Method of Hydraulic Actuator Fast Acting Solenoid Valve Test Block)
- (Device and Method of Hydraulic Actuator Test for Power Plant)



1) New Excellent Technology. ENESG's NET is the Technology of Static and Dynamic Characteristics Diagnosis for Turbine Valve Hydraulic Actuator utilizing THASA(Turbine Valve Hydraulic Actuator System Analyzer) and buffer
 2) MKE: Ministry of Knowledge Economy of Korea



Hydraulic System Technology Division

Experience of Actuator Upgrade

enesG has lots of experiences for actuator maintenance works in the not only domestic but also overseas country

Domestic Maintenance Experiences

| Description | Nuclear PP | Fossil PP | CC PP |
|--------------------|---------------|---------------|---------------|
| Hydraulic Actuator | 395 Actuators | 754 Actuators | 558 Actuators |
| Hydraulic Valve | 23 Plants | 66 Plants | 26 Plants |

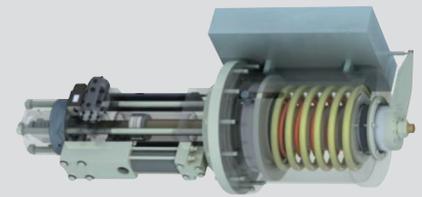
Experiences of supplying the spare Actuator

| Description | Nuclear Power | Fossil Power | CC PP |
|-------------|---------------|---------------|--------------|
| 2006 ~ 2011 | 46 Actuators | 88 Actuators | 21 Actuators |
| 2012 ~ 2017 | 28 Actuators | 21 Actuators | 16 Actuators |
| Total | 74 Actuators | 109 Actuators | 37 Actuators |

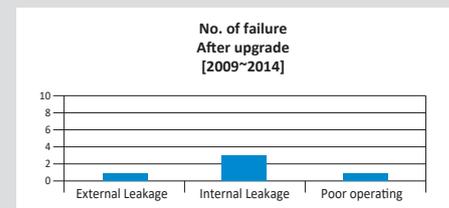
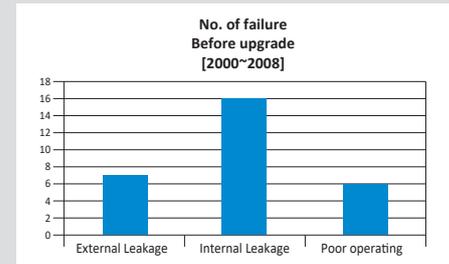
Overseas Experiences

| Description | Philippines | Japan | Thailand |
|--------------------|-----------------|--------------------------------------|-------------|
| Hydraulic Actuator | 5 Actuators | 5 Actuators | 6 Actuators |
| Hydraulic Valve | 18 Servo Valves | 5 set of Hydraulic & Solenoid Valves | - |

- Maintenance, Production of Hydraulic actuator for turbine
- Hydraulic Actuator for Steam Turbine Main Vave Modification[MHPS]
- GT Servo Actuator Overhaul(Repair of Moog Servo Actuators) [ILLIJAN COMBINED CYCLE POWER PLANT]
- Actuator Maintenance(Alstom Actuator Modification)[EGCO]



Effect of Actuator Upgrade



Fossil

| Product | Size |
|---------|---|
| CV1,2,3 | Cylinder5",10"Stroke |
| CV4 | Cylinder5",10"Stroke |
| CV1,2,3 | Cylinder6",10"Stroke |
| CV4 | Cylinder6",10"Stroke |
| CV1,2,3 | Cylinder12",10"Stroke |
| CV1,2,3 | Cylinder10",4"Stroke |
| IV 1,2 | Cylinder5",12"Stroke |
| IV 1,2 | Cylinder6",12"Stroke |
| IV 1,2 | Cylinder7",12"Stroke |
| IV 1,2 | Cylinder8",14"Stroke |
| RSV 1,2 | Cylinder10",12"Stroke(Non-Control Type) |
| RSV 1,2 | Cylinder8",8"Stroke(Non-Control Type) |
| RSV 1,2 | Cylinder7",8"Stroke(Non-Control Type) |

| Product | Size |
|---------|---|
| RSV 1,2 | Cylinder8",10"Stroke(Non-Control Type) |
| RSV 1,2 | Cylinder10",10"Stroke(Non-Control Type) |
| MSV 1 | Cylinder6",6"Stroke(Non-Control Type) |
| MSV 2 | Cylinder6",6"Stroke(Control Type) |
| MSV 1 | Cylinder8",8"Stroke(Non-Control Type) |
| MSV 2 | Cylinder8",8"Stroke(Control Type) |
| MSV 1 | Cylinder9",8"Stroke(Non-Control Type) |
| MSV 2 | Cylinder9",8"Stroke(Control Type) |
| MSV 1 | Cylinder9",9"Stroke(Non-Control Type) |
| MSV 2 | Cylinder9",9"Stroke(Control Type) |
| CRV | IV# 1~2, Cylinder5",12"Stroke |
| CRV | RSV# 1~2, Cylinder4",8"Stroke |
| LPA CV | 4-1/4"DIA.x239.9mm Stroke(Control Type) |

Nuclear

| Product | Size |
|------------|--|
| CV1,2,3 | Cylinder10",14"Stroke |
| CV4 | Cylinder10",12"Stroke |
| MSV 1,3,4 | Cylinder10",12"Stroke (Non-Control Type) |
| MSV 2 | Cylinder10",12"Stroke(Control Type) |
| IV 1,2,3 | Cylinder5",14"Stroke |
| IV 4,5,6 | Cylinder5",14"Stroke(Non-Control Type) |
| ISV 1~6 | Cylinder8",12"Stroke(Non-Control Type) |
| TV 1,2,3,4 | Cylinder8",8"Stroke |
| GV 1,2,3,4 | Cylinder7",20"Stroke |
| IV 1~6 | Cylinder6",10"Stroke |
| RV 1~6 | Cylinder6",10"Stroke |



Thermal Performance Engineering Division

Experienced over 100 power plants thermal performance testing



Thermal performance acceptance testing of the new power plant is vital engineering activity to demonstrate the contractual performance guarantee and acquire the benchmark performance Level for overall power plant and its major equipment. Thermal performance diagnostic testing allows plant engineers to evaluate the performance degradation factors, identify and recapture the recoverable energy losses. It also provides unit-specific operation and maintenance guidelines to optimize the power plant thermal efficiency.

These testing programs are designed and executed according to the internationally accredited codes and standards and require expertise on power plant thermodynamics and operation characteristic, as well as quality assurance for test instruments. enesG has been accumulating successful field experience and rewarding reputation in thermal performance engineering service in more than a decade.

Main Business

Thermal Performance Acceptance Test

Performance acceptance testing and third party performance acceptance test supervising according to international standards

- Overall Power Plant
- Fired Steam Generator
- Gas Turbine HRSGs
- Steam Turbines
- Gas Turbines
- Heat Exchangers
- Test Uncertainty Analysis
- Plant performance correction curves using thermodynamic heat balance modeling(GateCycle™)

Thermal Performance Diagnosis

- Establishment of benchmark performance
- Parameters for power plant facilities
- Diagnosis of abnormal aging, degradation
- Steam Path Audit and Performance Reevaluation
- Cycle isolation valve leakage detecting service
- Execution of heat rate improvement program

Flow Meter Calibration Facility

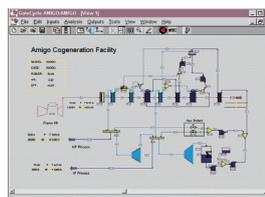
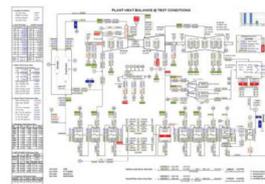
- Accredited by KOLAS
- Capacity : 100~5,400 m³/h
- Calibration process : ASME/ANSI MFC-9M-1988.
- Calibration & Measurement Capacity : ±0.18%

Thermal Performance Evaluation Tools

- Customized heat balance generating program for steam turbine cycle.
- Developing customized Excel add-in module for thermal performance evaluation
- Customized on-line performance monitoring system

Contract-related Supporting for Thermal Performance Guarantee

- Technical consulting on the performance guarantee related activities from ITB stage to the turn-over.



Recent 10 Years Experiences



1. International Code Acceptance Test (ASME PTC, IEC, DIN, ISO)

Combined Cycle Power Plant

- Korea: GS EPS Dangjin CCPP
- Korea: GS Power Anyang CHP Unit 2
- Korea: POSCO Incheon CCPP Unit 5~9
- Peru: Kallpa Generation CCPP Add-on
- Peru: Chilca Uno CCPP Add-on
- Israel: Rotem CCPP
- Saudi Arabia
 - : Qurayya IPP CCPP 6 Blocks
 - : Rabigh II IPP CCPP 3 Blocks
 - : Shoaiba II CCPP 2 Blocks
 - : ARAMCO Third Party Cogeneration x 3 Power Plants
- Ghana: Takoradi II CCPP Add-on
- Cote D'Ivoire: Ciproel CCPP Add-on
- Thailand: Bangchak Petroleum Plant
- Malaysia: Prai CCGT
- Qatar: UMM AL HOUL Water and Power 2 Blocks

Fossil Power Plant

- Thailand: Gheco-One Power Plant
- Thailand: Glow CFB Power Plant
- Turkey: Tufanbeyli CFB Power Plant x 3 Unit
- Malaysia: Manjung Unit 5 Power Plant
- Saudi Arabia: Marafiq 5 & 6 TPP
- Saudi Arabia: Yanbu II Unit 21, 22, 23

Biomass Power Plant

- Korea: (Donghae Biomass Power Plant
- Korea: (Seokmun Community Energy Power Plant
- Korea: (Poseung Biomass Cogen Power Plant
- Korea: (Kwangju-Jeonnam CHP Plant
- Fiji: Nabou Biomass Plant

2. Performance Diagnostic Testing

Nuclear Power Plant Rankin Cycle

- Kori NPP #1~4
- Hanbit #1~6
- Hanul #1~6
- Wolsong #1~4
- Shin-Kori #1,2
- Shin-Wolsong #1,2

Fossil Power Plant

- Hadong Fossil Power Plant #1~6
- Taean #1~6
- Poryong #3

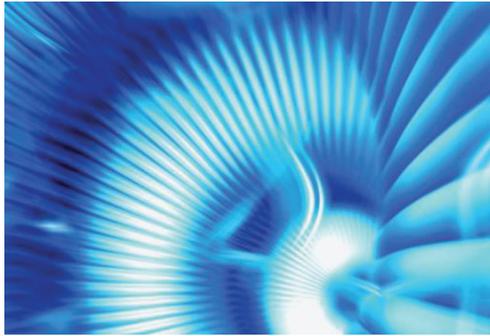
enesG is conducting periodic performance diagnostic testing program for KHNP's 24 nuclear units and Korea Standard Fossil 500MW Units

Diesel Power Plant

- Guam: Carabas Diesel Power Plant #3,4
- Papua New Guinea: Kanudi Diesel

3. On-line Performance Monitoring System

- GS EPS Dangjin Unit 1~4
- Domestic Nuclear Power Plant 24 Units
- Taean Fossil Power Plant #1~4



Power Plant Service & Engineering Division

Integrity Evaluation Engineering

enesG Integrity Evaluation Engineering Team is playing a role of Integrity Service and life assessment through the In-Service inspection about the main components of power plants, which is the major requirement of the Korea Institute Nuclear Safety.

As a project to prove and assure the reliability for the MRO(Maintenance, Repair, Operation) of main components, the purpose of this engineering service is to prevent any personal or material loss that may cause the breaking down of the major facilities.

Main Business

- FPP Rotor Bore Inspection
- FPP Rotor Disc/Blade Inspection
- NPP Rotor Bore Inspection
- NPP Rotor Disc/Blade Inspection
- Modeling, Structure & Thermal Analysis, Crack Propagation Analysis

Automated Inspection Equipment



Rotating Part Automated Inspection System



Bore Automated Inspection System

MT & Honing Machine & Equipment

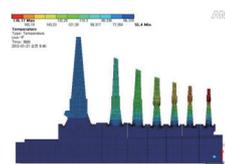


20,000Amp HWDC & FWDC MT Equipment

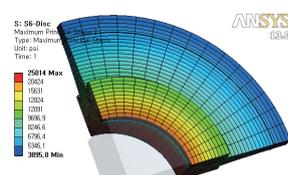


Portable Boring & Honing Machine

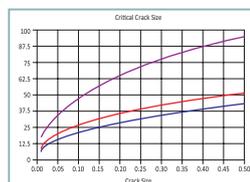
Modeling & Stress Analysis via Finite Element Method



Rotor Assy Stress Analysis



Disc Stress Analysis



Crack Propagation Analysis



Recent Experiences

- Nondestructive Testing & Integrity Evaluation for Turbine Rotor of Nuclear Power Plant (UIChin NPP HP, LP Turbine and many others)
- Nondestructive Testing & Integrity Evaluation for Turbine Rotor of Fossil Power Plant (TaeAn FPP HP, IP, LP Turbine and many others)

Patent & New Technology

- Automated Ultrasonic Inspection Technology for Integrity Evaluation of Steam Turbine Rotor of Power Plant
 - Wedge Set for Blade Root Automatic Ultrasonic Flaw Detection
 - Direct Motor Driven Type Honing Machine for Turbine Rotor Bore
 - The Water Column Wedge Unit for The Automated Ultrasonic Test on Blade Pins of Turbine in The Power Plant
 - Nondestructive Ultrasonic Detection Device for Blade Tenon of Turbine Rotor
 - Imaging Device for Visual Inspection of Turbine Rotor Bore
 - Ultrasonic Testing Scanner for Turbine Rotor
 - Integrated Inspecting Scanner for Turbine Rotor Bore
- 25 Patents & 3 Designs

Leading Technologies being developed

- Development of Automated Ultrasonic Inspection Techniques for Integrity Assessment of Nuclear Turbine Rotors
- Development of Inspection Technology for the Rotor Bore using Integrated NDE System
- Domestic Development of LP Turbine Rotor Curved axial entry wheel & bucket Inspection Technology and automatic device
- Development of Automated Ultrasonic Inspection Techniques for Integrity Assessment of Nuclear Turbine Rotors



Power Plant Service & Engineering Division

Maintenance Engineering

enesG Global Energy Service Power-plant Maintenance Engineering Team is performing maintenance and facility improvement of core equipment for NSSS and main piping system. Also enesG is providing comprehensive engineering services of manufacturing, developing special equipment for NSSS Main facilities

Main Business

Engineering Services

- Engineering Diagnosis, Trouble Shooting & Technical Services on diesel engines, pumps, valves, fans, Hydraulic Components, Reactor Coolant pumps, Chiller(Air conditioning System) etc.
- Designing Assist & Consulting services for design modification, performance improvement, an improvement in working or operating environment.
- Design & Consulting services for developments of Special tools & Equipments.
- Technical Services & Consulting services for high radiation work.
- Thermal Performance diagnosis, test & analysis



Field Services

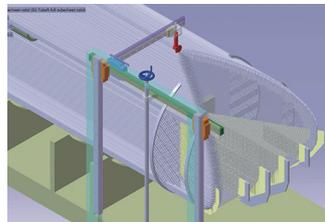
- Decommissioning, dismantling and installation services on Components, Piping & Steel structures.
- Cutting & Welding of Piping System
- Maintenance, Repair of Components and Equipments
- Various kinds of welding and machining
- Various Outage Services

Manufacturing Services

- Tools & Equipments
- Steel structures
- Hydraulic oil actuators & machines
- Test benches, machines & equipments

Research and Development

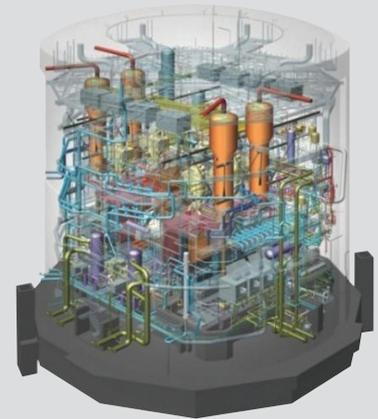
- Special tools & equipments
- Maintenance technology for Reactors & Reactor coolant system
- An Improvement technology of the safety for Nuclear Power Plants
- Hydraulic oil actuators & machines
- Test benches, machines & equipments
- Welding & Machining technology



SG out-cutting System



Small nozzle maintenance welder
 (PZR heater sleeve/RCS small nozzle)



Recent Experience

- Thermal sleeves removal (Ulchin NPP 3&4, YeongGwang NPP 3&4)
- Reactor vent nozzle repair field service (YeongGwang NPP 3&4)
- A development of movable rail type pulling device for generator rotating assembly
- Automatic lapping plate manufacturing for hydraulic oil seal face on NPPs
- A machining device (remote control type) manufacturing for CEDM nozzle & guide cone on reactors
- Degasser-Condenser nozzle welding repair
- Pressurizer full structure weld overlay repair (YeongGwang NPP)
- China AP1000 manway cover handling device
- RCS Small nozzle maintenance



Quality Assurance

enesG Quality Assurance Team has obtained some kinds of certifications, including ISO 9001/ 14001.

ISO 9001

KS Q ISO 9001 : 2015 / ISO 9001 : 2015
 Certificate No. : QMS-3431
 Valid From : Dec. 06, 2017
 Valid Until : Dec. 05, 2020

ISO 14001

KS I ISO 14001 : 2015 / ISO 14001 : 2015
 Certificate No. : EMS-0938
 Valid From : Dec. 06, 2016
 Valid Until : Dec. 05, 2019

Scope of Certification

DESIGN, DEVELOPMENT, MANUFACTURE, MAINTENANCE AND SERVICING FOR TURBINE LOAD CONTROL ACTUATOR, HYDRAULIC PROTECTION VAVLES AND DIAGNOSTIC ANALYSIS SYSTEM.
 PERFORMANCE TESTS AND ANALYSIS SERVICES FOR POWER PLANT(NUCLEAR, THERMAL, COMBINED CYCLE, DIESEL ENGINE)

CE

Product : Hydraulic Actuator
 Certificate No. : CA15P2131
 Type / Model : Cylinder Bore 5", 6", 7", 8", 9", 10"
 Issue Date : Dec. 04, 2015
 Expiry Date : Dec. 03, 2020

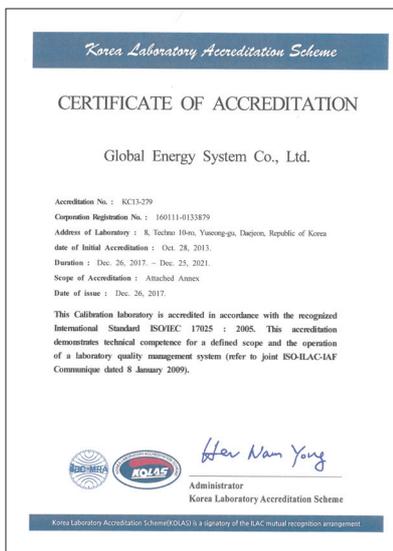
KOLAS

Scope of Certification : Fluid Flow
 Accreditation No. : KC13-279
 Duration : Dec. 26, 2017 ~ Dec. 25, 2021

ISO 9001 / 14001



CE / KOLAS





Quality Assurance

Certificate for Cooperative Company Registration



KHNP(Nuclear Power Plant)

- Valve Actuators
- TBN Valve Actuator
- Turbine Rotor NDT
- Low Pressure Turbine Bucket NDT
- Nondestructive Evaluation of Turbine Rotor(HSNP/PHWR)
- Turbine Governor Actuator / ETS system maintenance and reliability assessment techniques
- Equipment Repair(Valve/Fitting)
- Equipment Repair(Valve)
- Equipment Repair(Supplementary Equipment of Production)

* Leslie agency

Power Plants

- Korea Western Power Plant
- Korea South-East Power Plant
- Korea East-West Power Plant
- Korea Midland Power Plant
- Korea Southern Power Plant

Scope of Certification

- Axial Flow Fan
- Hydraulic Hose, Hydraulic Cylinder, Hydraulic Valve
- Relief Valve, Solenoid Valve, Servo Valve
- Hydraulic Type Actuator
- Oil Filter, Cartridge Filter

Certificate and Registration

KPS

- Repair & Production(supplementary equipment, Piping and Fitting, TBN Actuator, Valve, Hydraulic System)

KEPIC

- Mechanical

Certificate and Registration

- Certificate of Reliability(Shutoff Valve for Turbine Control)
- Performance certificate(Turbine Valve Hydraulic Actuator)
- Certificate of company affiliated Institute
- Certificate of Non Destructive Inspection
- Certificate of Electrical
- Certificate of construction industry

