Heat Recovery Steam Generators
connected excellence in all we do
An Amec Foster Wheeler HRSG producing 70 MWe of power at the La Rábida refinery since 2009
A long history with Heat Recovery Steam Generators

Since we supplied our first HRSG to the Rio Pecos combined cycle plant (Texas, USA) in 1958, we have advanced HRSG technology to a new level of thermal and mechanical performance, reliability and ease of maintenance.

With over 450 Foster Wheeler HRSGs in the field today with millions of operational hours, Amec Foster Wheeler HRSGs have developed a track record of reliable operation and high customer satisfaction for a wide range of combustion turbines.

We offer HRSGs for all applications ranging from large utility combined cycle power plants to small co-generation and industrial facilities.

Our client support doesn’t stop once an Amec Foster Wheeler HRSG is operational. We provide a broad range of after-market services to solve problems and improve performance and reliability of your HRSG. This applies to not only Amec Foster Wheeler HRSGs, but to all HRSGs, no matter the OEM.

Gas turbine experience

- Alstom/ABB
- GT-8C, 10, 35
- General Electric
- PG 6531, 6581, 7121, 9171
- LM 1600, 2500, 6000
- Frame 6, 6B, 6F, 6FA, 7B, 7E, 7F, 7FA, 9, 9E, 9F, 9FA, 9FB
- Mitsubishi
- M501F, FD, SDA
- Solar
- Cemtaur, H
- Mars
- Siemens
- SGT, 600, 800
- SGT5 - 4000F
- SFT6 - 5000F
- V64.3, .4
- V94.2, .3A
- Rolls Royce
- RB211
- Westinghouse
- 501D5A
- 501F
- 251 B6
Amec Foster Wheeler HRSGs are designed for reliability and long life

- Horizontal and vertical designs available for both utility and industrial applications
- Steam temperatures up to 600°C (1115°F)
- One, two or three pressure levels to suit any application
- Unfired, co-fired and fresh air fired for guaranteed steam production even without gas turbine operation

**Positive casing seal**
**SCR available on all designs**
**Flex tube assembly**
**Upflow/downflow economizers circuitry**
**Full penetration tube to header welds**

### RECENT PROJECTS

**Algeria**
- Location: Mostaghanem, Algeria
- Customer: Samsung C&T Corp.
- Start-Up Year: 2019
- HRSG Capacity: 4 x 123 MWe
- GT Model: GE 9FA
- Fuel: Natural Gas

**York**
- Location: Pennsylvania, USA
- Customer: Undisclosed
- Start-Up Year: 2017
- HRSG Capacity: 2 x 182 MWe
- GT Model: 7FA
- Fuel: Natural Gas

**Kimberly Clark de Mexico Ramos Arizpe Facility**
- Location: Coahuila, Mexico
- Customer: Iberdola
- Start-Up Year: 2016
- HRSG Capacity: 44 MWe
- GT Model: LM6000
- Fuel: Natural Gas
- Top supported coils for thermal mechanical flexibility
- Harps, C Sections or modular fabrication for delivery and field erection flexibility
- Large sized drain system to reduce fatigue stress during rapid start-up and shut-down
- Extra strength full penetration welds to handle fast transients and thermal shocks

**RECENT PROJECTS**

**Hail Power Plant**
- Location: Hail, Saudi Arabia
- Customer: Saudi Electricity Company
- Start-Up Year: 2016
- HRSG Capacity: 4 x 37 MWe
- GT Model: Siemens SGT-2000
- Fuel: Arabian Light Oil

**Rabigh II**
- Location: Rabigh, Saudi Arabia
- Customer: SCT
- Start-Up Year: 2016
- HRSG Capacity: 6 x 118 MWe
- GT Model: SGT6-5000F
- Fuel: Natural Gas & Distillate Oil

**Pocheon**
- Location: Pocheon, South Korea
- Customer: Daewoo Engineering & Construction
- Start-Up Year: 2016
- HRSG Capacity: 2 x 148 MWe
- GT Model: M50LI
- Fuel: Natural Gas
Not all HRSG designs are the same

- Superheaters designed with oversized headers, downcomers, feeders and drain systems to reduce fatigue stress during rapid start and shut down

- Full radial penetration welds are used for each transfer tube to header weld so unit can tolerate fast transients and thermal shocks with less risk of weld cracks and tears associated with lower quality welds

- SCR\s are available on all FW HRSGs to achieve very low NOx emissions

- Designs allow for future addition of SCR components when requested

**RECENT PROJECTS**

<table>
<thead>
<tr>
<th>Location</th>
<th>Customer</th>
<th>Start-Up Year</th>
<th>HRSG Capacity</th>
<th>GT Model</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khanom</td>
<td>Amphoe Khanom, Thailand</td>
<td>2016</td>
<td>2 x 158 MWe</td>
<td>M701F</td>
<td>Natural Gas &amp; Distillate Oil</td>
</tr>
<tr>
<td>Bugok 3</td>
<td>Chungbuk, South Korea</td>
<td>2015</td>
<td>133 MWe</td>
<td>Siemens SGT6-8000H</td>
<td>Liquefied Natural Gas</td>
</tr>
<tr>
<td>Stalowa Wola</td>
<td>Stalowa Wola, Poland</td>
<td>2014</td>
<td>160 MWe</td>
<td>GE 9FB</td>
<td>Natural Gas</td>
</tr>
</tbody>
</table>

*Heat Recovery Steam Generators*
Heat Recovery Steam Generators

Flex tube design provides inherent mechanical flexibility ensuring long HRSG life while enduring fast start-ups, upsets and transients.

- Every heat transfer tube in every section has at least one tube bend.
- Optimally placed anti vibration grid plates to minimize noise and vibration induced by perpendicular gas flow to tube bundles.
- Flexible bellow casing seal ensures leak-tight connection while allowing free thermal expansion through all operating conditions.
- Flow accelerated corrosion eliminated by use of high chrome tube materials in critical areas.

**RECENT PROJECTS**

**Emal**
- Location: Abu Dhabi, UAE
- Customer: Samsung C&T Corp.
- Start-Up Year: 2014
- HRSG Capacity: 4 x 133 MWe
- GT Model: GE 9FA
- Fuel: Natural Gas

**Qurayyah**
- Location: Saudi Arabia
- Customer: Samsung C&T Corp.
- Start-Up Year: 2014
- HRSG Capacity: 12 x 117 MWe
- GT Model: Siemens SGT6-5000F
- Fuel: Natural Gas & Diesel Oil

**HRSG modules hung**
- from risers manifold with simplified top supported design to reduce space, erection time and manpower.
Our capability to supply our HRSGs in different configurations provides the most flexibility to our clients, allowing them to minimize site erection work and the ultimate installed cost of their HRSGs.

Our global network of manufacturing facilities and engineering centers, allows us to provide a quality product at very competitive cost levels and delivery times, no matter where the project is located.

We have world-wide design and fabrication capability and specialists in systems, instrumentation, metallurgy and welding support to our clients.

**Recent Projects**

**Dongducheon**
- Location: Kyung-gi-do, Republic of Korea
- Customer: Samsung C&T Corp.
- Start-Up Year: 2014
- HRSG Capacity: 4 x 150 MWe
- GT Model: MHI M501J
- Fuel: Liquefied Natural Gas

**Tereftalatos Mexicanos S.A. DE C.V. Top 1002**
- Cogeneration Project
- Location: Veracruz, Mexico
- Customer: SCS Proyectos, S.A.P.I. de C.V.
- Start-Up Year: 2013
- HRSG Capacity: 2 x 49 MWe
- GT Model: GE LM6000
- Fuel: Natural Gas

**Pocheon**
- Location: Kyung-gi-do, South Korea
- Customer: DAELIM Industrial Co., Ltd
- Start-Up Year: 2013
- HRSG Capacity: 4 x 133 MWe
- GT Model: MHI M501G
- Fuel: Natural Gas
Heat Recovery Steam Generators

**Harps**
- Individual tube bundles without casings or roof
- Most cost effective for small HRSGs

**O-Sections**
- Fully cased tube bundle for modular assembly
- Most cost effective for units one module wide

**C-Sections**
- Partially cased tube bundles
- Most cost effective for HRSGs that are two modules wide

**Modules**
- Individual tube bundles without casing but with roof
- Most common option for large combined cycle HRSGs

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**RECENT PROJECTS**

**Manifa Cogeneration**
- Location: Manifa, Saudi Arabia
- Customer: Tecnicas Reunidas Power
- Start-Up Year: 2012
- HRSG Capacity: 2 x 62 MWe
- GT Model: Mitsubishi M501F
- Fuel: Natural Gas

**Norte II**
- Location: Chihuahua, Mexico
- Customer: Samsung Engineering Co., Ltd
- Start-Up Year: 2012
- HRSG Capacity: 2 x 72 MWe
- GT Model: GE Frame 7FA
- Fuel: Natural Gas

**Cartagena**
- Location: Murcia, Spain
- Customer: Repsol Petroleo S.A.
- Start-Up Year: 2011
- HRSG Capacity: 1 x 15 MWe
- GT Model: GE PG6581
- Fuel: Natural Gas

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Heat Recovery Steam Generators
With more than a century of designing, fabricating, erecting and starting our own equipment, we have the experience and capability to assess your HRSG, recommend improvements, and predict the impact on performance, reliability and operation before any fieldwork is started.

Service is an integral part of our business. Preventive condition monitoring, expert maintenance, rapid response repair work, and replacement part deliveries are key factors in achieving maximum plant reliability and cost effective performance year after year.

Through our service agreements, we provide comprehensive and cost effective maintenance programs, ranging from HRSG inspections to the supply of parts, equipment and construction services.

Our service is backed by a global network of manufacturing, engineering and customer service centers that can meet tight schedules while achieving the most competitive pricing.
Heat Recovery Steam Generators

Thermal Performance Modeling
- To identify causes of performance shortfalls
- To evaluate benefit of design improvements
- Modeling is done using Amec Foster Wheeler’s expert performance design software which is continually updated and validated with field data

Feasibility and Engineering Studies to Evaluate the Thermal and Mechanical Impact of
- Addition of in-duct burners
- Turbine changes
- Capacity increases
- SCR additions

Site Services
- Performance, efficiency benchmarking
- Assessment of water quality issues
- Investigation of casing issues, hot spots, leaks
- Burner tuning
- Investigation of tube corrosion issues
- Condition, remaining life assessments

Metallurgical Analysis
- UT testing to determine cracking and tube wall thinning
- To determine causes of tube failures and develop solutions

Vibration Analysis
- To address vibration-related failures in tube assemblies, baffle plates, liner plates

Dynamic Analysis
- To investigate tube, header, nozzle temperature differentials and flexibility during start-up, shut-down, and steady-state operation
- To evaluate life cycle fatigue

HRSG upgrade
Unit & Location: Saica 3, Zaragoza, Spain
Customer: Saica Paper
Work Completed: 2010
HRSG Capacity: 12 MWe
GT Model: PG 6581
HRSG OEM: Deutsche Babcock

FW scope:
- Engineering study
- Recommended design and operational improvements
- Supply and erection and new duct, primary and secondary superheaters, attemperator, BMS and safety PLC

Benefits to customer:
- Improved HRSG and plant availability, operational flexibility and plant performance
- New Human Machine Interface system for easier plant operation and diagnostics
- Lowered HRSG gas leakage

HRSG steam drum replacement
Unit & Location: Unit 3, Barcelona, Spain
Customer: ENDESA GENERACION
Work Completed: 2011
HRSG Capacity: 140 MWe
GT Model: GT-26
HRSG OEM: CMI for Alstom

FW scope:
- Replacement of high pressure steam drum and auxiliary equipment including engineering, design, supply and erection

Benefits to customer:
- Improved HRSG and plant availability
- New high pressure drum designed to eliminate cracking in both circumferential and nozzle-to-drum welds
- Project engineered to minimize HRSG modification, site labor and plant down time
Amec Foster Wheeler’s Global Power Group offers a full range of steam generator equipment, clean air technologies, aftermarket products and services to the power, industrial, and waste-to-energy sectors. GPG’s global engineering, manufacturing, and procurement network delivers high-quality, cutting-edge products and services cost competitively, no matter where the project is located.

### PRODUCTS AND SERVICES

#### Steam Generators
- Circulating Fluid Bed
- Pulverized Coal
- Oil & Gas
- Solar
- Bubbling Fluid Bed
- Package
- Grate and MSW
- Waste Heat
- HRSG

#### Environmental Products
- Wet FGD systems
- CFB scrubbers
- Dry Sorbent Injection
- Spray Dry Absorbers
- Wet and dry ESPs
- Fabric filters
- Cartridge collectors
- Low NOx combustion and SCR retrofits

#### Aftermarket Services
- Engineered pressure parts
- Replacement parts
- Weld overlays
- Refractory upgrades
- Coal mill service and upgrades
- Construction Services
- Performance upgrades
- Boiler retrofits

#### Auxiliary Equipment
- Condensers
- Feedwater heaters
- Biomass gasifiers

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