SMART POWER GENERATION

Wärtsilä North America

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Dan Shelledy Business Development Manager, Power Plants



About Wärtsilä



Power Plants

Marine

Service

Wärtsilä provides complete **lifecycle power solutions** for the marine and energy markets. In 2012, Wärtsilä's net sales totaled **US\$ 6.5 billion** with approx. 18,900 employees. The company is based **Finland** and has operations **70 countries**. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.



About Wärtsilä



Marine: We cover all key shipping segments



• 1 out of every 3 ships in the world have Wärtsilä engines



Wärtsilä Lifecycle support around the world



→ 70 countries → 160 locations → 11,000 people → 7,500 field service forces We are the only player in the market able to offer our clients 24/7 support, globally, in the fields of logistics, technical support and field service from a single source.





Wärtsilä Power Plants Worldwide *



Wärtsilä North America, Inc. - Flexible Power Plants

(link to video in YouTube)

Wärtsilä US Flexible Power Plants (Video)



Global expansion of renewable energy – wind, solar, biomass

- reduced emissions
- high operating variability

Smart Power Generation is now critical for reliable, affordable and sustainable operation

- fast start, quick response natural gas-fired generators supplied by pipelines or LNG systems
- distributed generation model to minimize electric transmission upgrades
- selected use of combined heat and power (CHP) or trigeneration at up to 90% efficiency



A word about our nomenclature...

Typical Wartsila engine name: Wartsila 20V34SG

How many Cylinders
(4,6,8,9,12,16,18, 20)Cylinder
Cylinder
configuration
in cm
V or L (R)Cylinder bore
in cm
in cm
DF = Dual Fuel

GD = Gas Diesel

(nothing = liquid fuel)



Generator Set Portfolio



Wärtsilä Gas Engines

	20V34SG-D	18V50SG
Output	9,341 kWe	18,759 kWe
Heat Rate* (LHV) (HHV)	7,461 Btu/kWh 8,271 Btu/kWh	7,375 Btu/kWh 8,176 Btu/kWh
Speed	720 rpm	514 rpm
Dimensions (L/WH)	42' x 11' x 15' 143 US tons	63' x 18' x 21' 391 US tons

* At generator terminals (pf 0.8, 0% tolerance)



Wärtsilä Duel Fuel Engines

	20V34DF	18V50DF	
Output	8,439 kWe	17,076 kWe	
Heat Rate* (LHV) (HHV)	7,993 Btu/kWh 8,439 Btu/kWh	7,460 Btu/kWh 8,271 Btu/kWh	
Speed	720 rpm	514 rpm	
Dimensions (L/WH)	42' x 11' x 15' 143 US tons	63' x 18' x 21' 391 US tons	

* At generator terminals (pf 0.8, 0% tolerance) when operating on natural gas with 1% liquid pilot fuel



Wärtsilä liquid fuel engines

	20V32	18V46	
Output	8.7 MWe	17.1 MWe	
Heat Rate (HHV)*	8,300 Btu/kWh	8,183 Btu/kWh	
Speed	720 rpm	514 rpm	
Dimensions (L/WH)	42' x 11' x 15' 143 US tons	63' x 18' x 21' 391 US tons	
* At generator termi	nals (0% tolerance)		A TOKO



Our energy solutions offer a unique combination of:

ENERGY EFFICIENCY

Best simple cycle efficiency available in the market. Excellent Partial load efficiency

OPERATIONAL FLEXIBILITY

High operational flexibility with multi-engine solution. Quick start and multiple starts/stops with no cost



Solutions for liquid and gas, fossil and renewable fuels



We offer the **best simple cycle efficiency** available in the market at >46%. Typical **net** plant heat rate of <8400 Btu/kWh HHV at 95 °F

Our power plants achieve high efficiency in a **wide range of ambient conditions**



Multi-engine advantage

Multi-engine solution allows for a good partial load efficiency with a plant turn down ratio of 30%



No start penalties & No start-up costs

Unlimited starts & stops with no impact on cost or maintenance schedule.

This is unique, no other competing technology offers the same.



Dispatcher's dream plant Plains End 227 MW Colorado



Case Colorado, USA – Grid Stability

Total wind generation drops (green curve) from 700 MW to 350 MW during 1 hour



Screen shot from Colorado Dispatch Center, Xcel Energy, USA



PLAINS END GENERATING FACILITY, COLORADO, USA

Туре:	Grid stability				
Engines:	20 x Wärtsilä 18V34SG				
	14 x Wärtsilä 20V34SG				
Total output: 227 MW					
Fuel:	Natural gas				
Installed:	2002 and 2008				

Remote controlled from Colorado Dispatch Center

Grid stability Power Plants based on gas fired combustion engine gensets are started, providing fast reaction to the change (red and white curves)



W34SG, fast start up and loading





W50SG, fast start up and loading





Quick Start

Start up and loading of a Gas Engine power plant compared to a GTCC





Dispatch flexibility



22 x 20V34SG

Plant Net Output



Wärtsilä Flexicycle[™]

24 x 18V50SG

Additional Equipment for Combined Cycle

- 1 Exhaust gas boilers
- **(2)** Steam turbine + condenser + auxiliaries
- **(3)** Cooling towers + cooling water pumps



Simple Cycle450 MWCombined Cycle493 MW

Minimum Area 680' X 700' Minimum Area 700' X 750' (Excluding Switchyard)



Wärtsilä Flexicycle[™]

100...500 MW combined cycle power plant based on **18.7MW** natural gas engine **18V50SG**

Simple cycle mode – for flexible power

- » 7 minutes to full load, 1 minute to stop
- » 48.6% plant efficiency
- » Unlimited starting and stopping

Combined cycle mode – for competitive base load power

- » **52.1%** plant efficiency
- » 60 minutes to full efficiency
- » Switch back to simple cycle on the run



Flexicycle™ Combined cycle



(2)

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6 x 18V50SG + ST

- 1. Heat Recovery Steam Generator (HRSG)
- 2. Feed Water Tank
- 3. Steam Turbine
- 4. Condenser
- 5. Condensate preheater
- 6. Auxiliary Boiler
- 7. Cooling Tower
- 8. Engine preheater



Exhaust gas boiler, working principle



for a 18V50SG combined cycle

WAR

Wärtsilä Flexicycle™

240 MW Flexicycle™ indicative performance



Combined cycle \rightarrow

+ 9% in plant output

WARTS

10.

Output at ISO 3046 conditions, cooling towers for combined cycle system

Availability





Typical reliability data for Wärtsilä gas engines:

- Excellent unit availability ٠
- Excellent unit reliability ٠
- Excellent unit starting reliability ٠



Multi-fuel solutions

We offer solutions for liquid, gas and renewable fuels





Multi-fuel solutions which can flexibly change between fuels (liquid and gas) on-line

Hedge for future, solutions that can easily be upgraded from liquid to gas





- » Nox Nitrogen oxides: 5 ppm (0.064 g/kWh) (as NO2) (dry, at 15 vol-% O2) - with SCR
- » CO Carbon monoxide: 15 ppm (0.12 g/kWh)
 (dry, at 15 vol-% O2) with CO catalyst
- » VOC 25 ppm (0.12 g/kWh) (dry, at 15 vol-% O2)
- » Particulates (total) (0.12 g/kWh) (at 15 vol-% O2)



Noise levels

65 dBA @ 600 ft

Engine noise at 1 meter: ~ 115 dBA Power House interior: ~ 110 dBA Outside: typical design is 65 dBA @ 600 ft



Wärtsilä' solutions minimize not only fuel but also water consumption thereby providing major environmental benefits. Our power plants use a **closed loop cooling system** that **requires minimum water**

Simple Cycle water consumption = **1** gal/engine/week

Combined Cycle water consumption is 1/3 of GTCC Plant



Low pressure gas



Wärtsilä power plants use **low pressure** natural gas **(75 psig)**. No need for aux. gas compressor or high pressure gas line



Modularity

Our modular design allows for **easy capacity additions** and makes it simple for our customers to construct an optimally sized plant







Engine auxiliary systems





Light industrial look to the plant

Wärtsilä design makes the project look like a warehouse. No visible smoke, fumes or steam release



Wärtsilä Smart Power Generation - Texas

34SG



3 x 20V34SG 25 MW – GEUS – Greenville, TX

18 x 20V34SG 170 MW – GSEC - Abernathy, TX

24 x 20V34SG 203 MW – STEC - Pearsall, TX



GEUS – Greenville, Texas

3 x 20V34SG 25 MW



STEC – Pearsall, Texas

34SG



24 x 20V34SG 203 MW

The South Texas Electric Cooperative (STEC) Pearsall Power Plant in addition to serving load at member cooperatives, participates in the ERCOT Ancillary Services Market providing quick start reserves, spinning reserves, regulation and other high value products.



Recent Wärtsilä US Flexible Power





- Plains End I / II, Colorado, 227 MW
- Barrick, Nevada, 116 MW
- Midwest Energy, Kansas, 76 MW
- STEC Texas 203 MW
- Greenville, Texas, 25 MW
- Modesto, California, 50 MW
- Golden Spread Texas 170 MW
- Lea County Coop 43 MW



34SG

Wärtsilä Smart Power Generation - Texas





Simple Cycle 221 MW *

Future Combined Cycle 239 MW *

The South Texas Electric Cooperative (STEC) Red Gate Power Project is one Wärtsilä's new flexible power plants with fast start, fast ramping, high efficiency at full and part load with minimal water use. The Equipment Supply Contract was signed in December 2012. Commercial operation is planned for Summer 2014. The plant layout will accommodate future expansion to Flexicycle[™] (combined cycle).

NEW STEC Red Gate Project

50SG

12 x 18V50SG

225 MW – Edinburg, TX

* Net Output at 95 F



Wärtsilä Smart Power Generation - Azerbaijan



21 x 18V50SG 384 MW Boyuk Shor – Baku, Azerbaijan



50SG

Wärtsilä Smart Power Generation - California

50DF



Pacific Gas & Electric, Humboldt - Eureka, California **10 x 18V50DF - 162 MW**



Wärtsilä Flexicycle[™] – Dominican Republic



Dimensions	(Feet)	
Length	342	
Width	105	
Roof Height	52	
Stack Height	95	
Draught	13	

US based Seaboard Corporation 110 MW 6 x 18V50DF Flexicycle[™]

Heat Rate (LHV / HHV) 7,139 / 7,916

The combined cycle output and performance at 95° F on natural gas. The configuration utilizes once-through cooling



50DF

Wärtsilä Flexicycle[™] – Dominican Republic

24 x 18V50DF - 430 MW Flexicycle[™]



Barrick Gold of North America Inc. Quisqueya I - 12 x 18V50DF Flexicycle[™]

Now under construction – Fast Track -Simple cycle in 12 months (8 engines) -Full combined cycle in 16 months (12 engines)

EGA Haina of Dominican Republic Quisqueya II - 12 x 18V50DF Flexicycle™

Now under construction NTP Jan 2012 -Full combined cycle in 24 months (12 engines)



50DF

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Wärtsilä Smart Power Generation – Jordan

IPP4 18 x 18V50DF-> 300 MW US based AES Corporation





<- IPP3 - 38 x 18V50DF 632 MW

50DF

Amman Asia Electric Power, is a special purpose independent power producer, in which Wärtsilä has a minority interest. The other owners of the company are Korea Electric Power Corporation of South Korea (KEPCO) and Mitsubishi Corporation of Japan. The project company will supply electricity to the National Electric Power Company of Jordan (NEPCO).



THANK YOU!

Smart Power Generation

Dan Shelledy Business Development Manager, Power Plants Houston, TX (281) 233-6216 dan.shelledy@wartsila.com



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