High Performance & Environmental Friendly

Investment Symposium for Energy sector in the Philippines

Gas-fired power generation -Mitsubishi Gas fired GTCC Power Plant-



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1. Introduction

2. Feature of Mitsubishi GTCC

3. Latest GT and GTCC Technology

GT : <u>G</u>as <u>T</u>urbine

GTCC: Gas Turbine Combined Cycle

1. Introduction

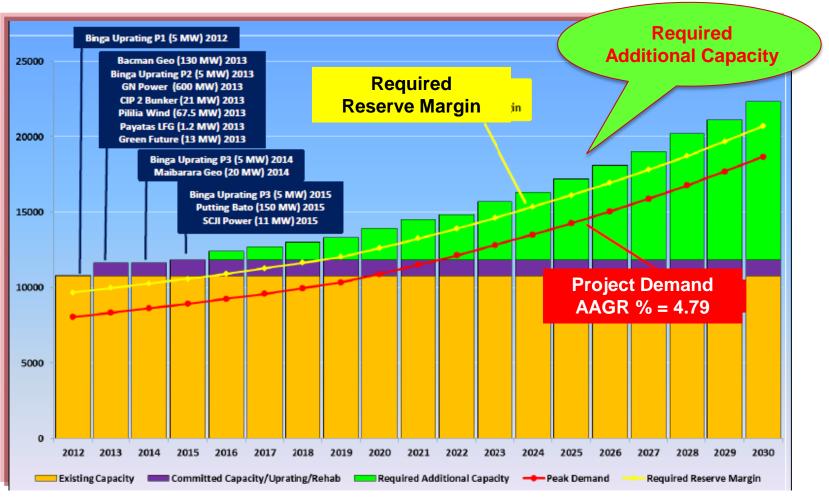
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Power Supply and Demand Outlook



Luzon Grid needs a TOTAL ADDITIONAL CAPACITY of 10,500 MW through 2030 to meet the demand and required reserve



Source: DOE, Philippine Energy Plan, 2012-2030

Mitsubishi Main Products for Power Generation











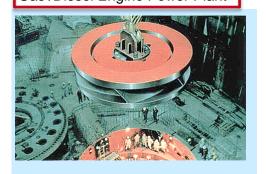
Boiler



Lithium-ion Secondary Battery



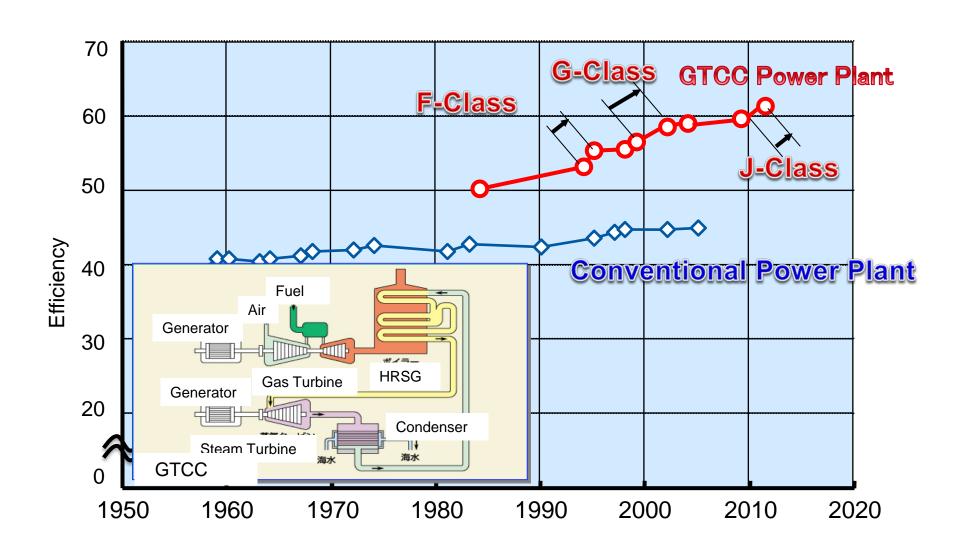




Hydro Turbine

Remarkable Progress in GTCC Efficiency



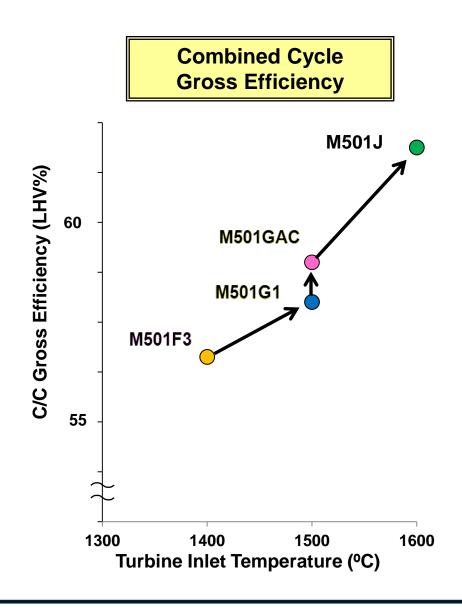


2. Feature of Mitsubishi GTCC

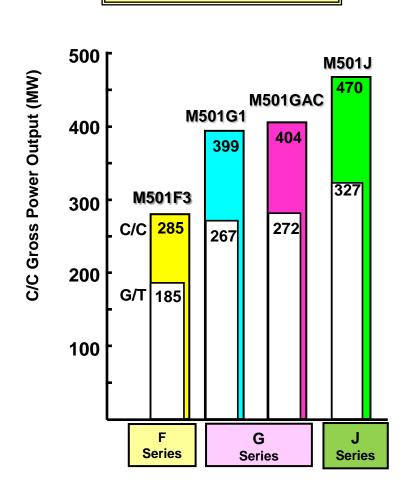
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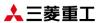
ISO Standard (1 on 1)



Gas Turbine and C/C
Power Output



World Wide Experiences of Mitsubishi Gas Turbine

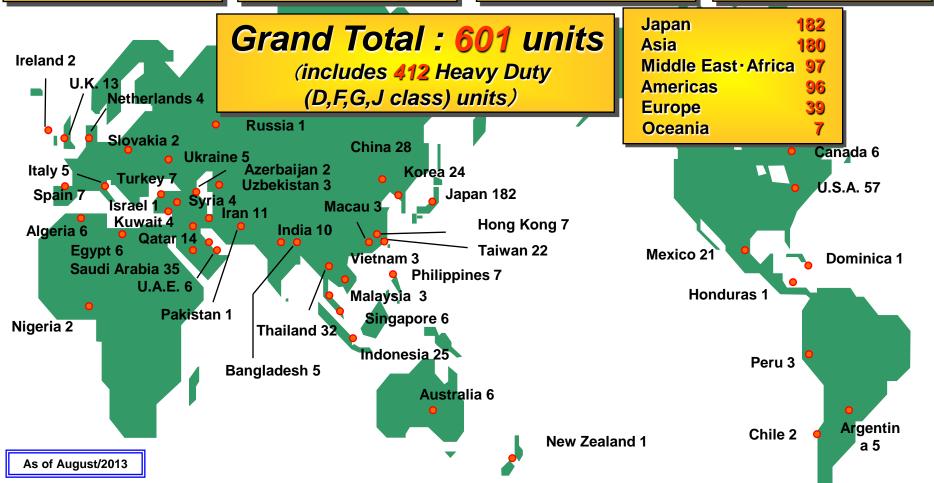


M501J×17 M701J×2 Total: Total:

M501G × 67 M701G × 11 Total: 78 *units*

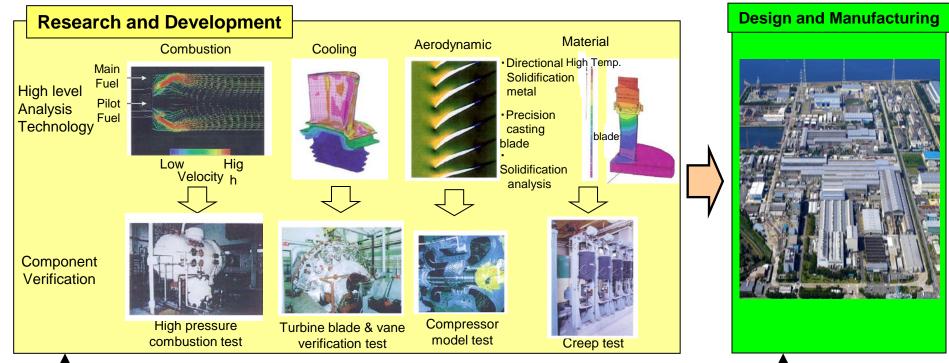
M501F × 73 M701F × 125 Total: Total:

M501D × 25 M701D × 92 Total:117units



MHI Advanced Technology and High Reliability





Feed back to Research and Development

Feed back to Design and Manufacturing



Verification

Demonstration facility for C/C power plant in MHI Takasago (T-point)



Sophisticated Measuring Technology

Turbine blade telemeter vibrating stress measurement



Award Winners



Philippine ILIJAN 1200MW M501G x 4

POSSER CHARLES OF THE GOAL CHARLES HOUSE FOWER FORE FORE



over 96% availability.
0.48% forced outage rate.

U.S.A FPL Lauderdale M501F x 4



Florida Power & Light Co. Lauderdale Plant

for demonstrating on Units 4 and 5, first commercial use of 150-MW-class advanced gas turbines operating at 2300F turbine inlet temperature, and for the first repowering of reheat steam turbines over 100 MW.



Presented to Milsuhishi Lleavy Industries Ltd., a major porticipant in the project clied.



availability: 93.0% Reliability: 99.3%

Mexico Chihuahua M501F3 x 2





comision federal de electricidad

c.c.c. chihuahua

Hiah Reliability Powerplan

The High Reliability Powerplant

C.C.C. CHIHUAHUA

COMISION FEDERAL DE ELECTRICIDAD hereby certifies that it has reached 99.05% reliability since May 9, 2001 for demonstrating on CHIFUAHUA 435MW 2+2+1 configured combined cycle powerplant; consisting of two Mitsubishi 501F gas turbines operating at 1400 degree Celsius class for turbine inlet temperature, two heat recovery steam generators, one tandem compound reheat steam turbine, three air-cooled generators, one air-cooled condenser, and their ancillary systems, which powerplant was all supplied, constructed, commissioned, and integrated by Mitsubishi.

Ing. Armando Palos Najera Superintendente de CCC Chihuahua II

on May 9, 2002

Plant Reliability: 99.05% (Gas Turbine: 100%)



< First G Type Gas Turbine in Philippines >



Power Output

Gas Turbine 198.6 MW x 4
Steam Turbine 241.7 MW x 2
Total 638.9 MW x 2

Configuration

Multi-Shaft Configuration (2 GT + 2 HRSG + 1 ST) x 2

Commercial Operation 2002 ~

3. Latest GT and GTCC Technology

MITSUBISHI HEAVY INDUSTRIES, LTD.





"J" class GTCC Delivery Started

✓ Verification Test Complete
Successfully finished "J" class gas turbine
at "T-point"



✓ Delivery Started in 2011

Delivery for 2,900MW (M501J×6units)

Kansai Electric Power Company

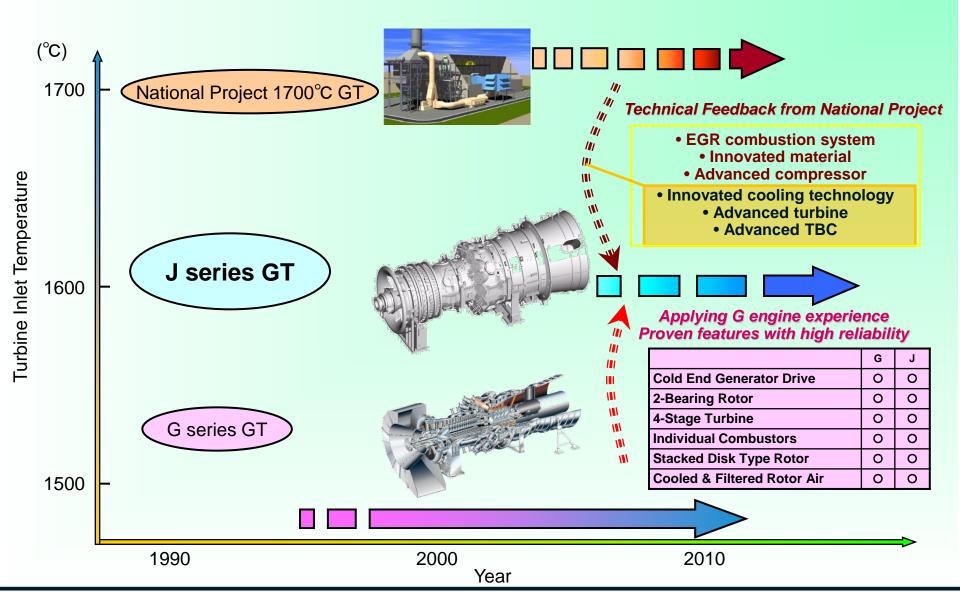




- put in commercial operation in August 2013 -

J Series Gas Turbine





Key Technology for High Performance



"J" Target: C/C efficiency > 61% (M501J:470MW / M701J:680MW)

- High Pressure Raito Compressor Experience from G Engine
- Steam Cooled Combustor Experience from G Engine



Combustor

Proven G Combustor

- Well experienced DLN combustor
- Steam cooled liner

Compressor

Validated G Compressor

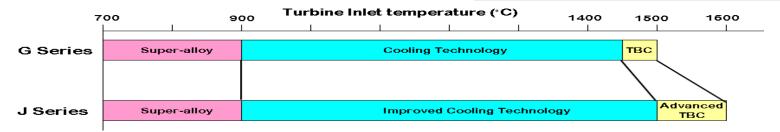
- 23:1 pressure ratio
- 3D profile
- Improved inlet duct

Proven G Turbine

- + National Project technologies
- Advanced TBC + Cooling
- High efficient aerodynamic technology

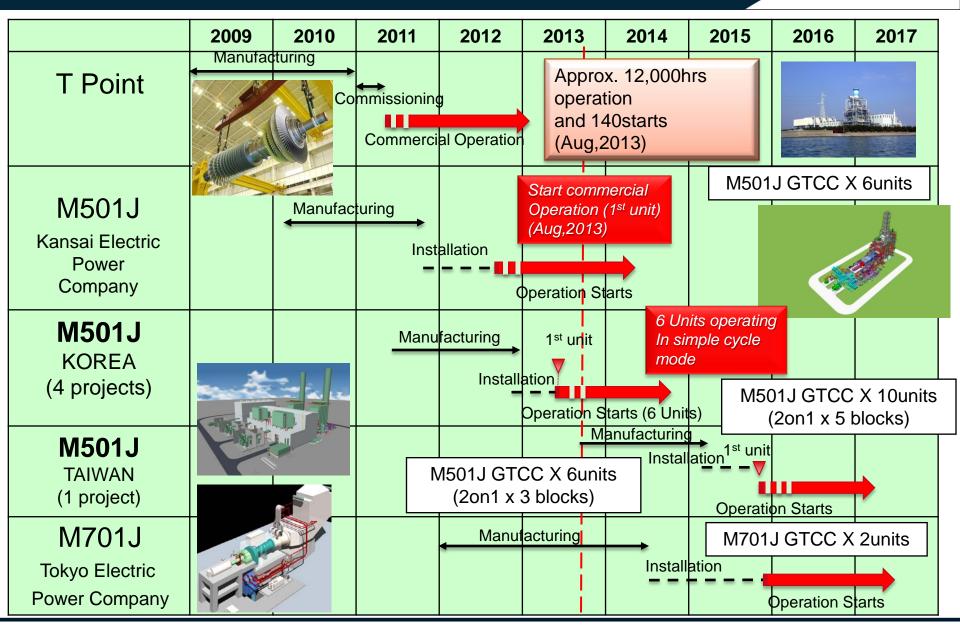
Turbine

- Cooled row4 blade



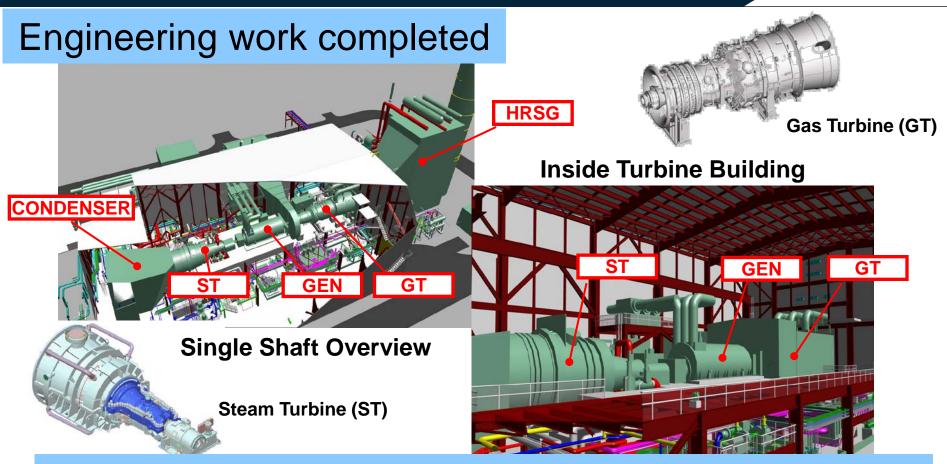
J Class Gas Turbine To the Market





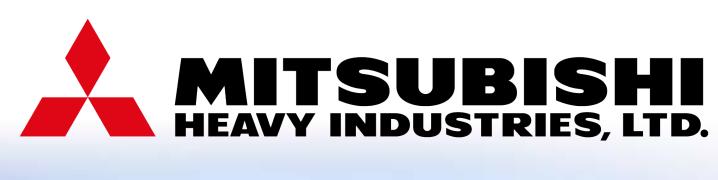
Ready to deliver Most Advanced M501J GTCC





430MW class of M501J 1on1 Single Shaft GTCC

MHI's reliable & high efficiency GTCC matches the infrastructure of the Philippines.



Our Technologies, Your Tomorrow

