

High Performance & Environmental Friendly

Investment Symposium for Energy sector in the Philippines

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



MASASHI TERAUCHI
MITSUBISHI HEAVY INDUSTRIES, LTD.
DOC. GTCC130120

October. 2013

1. Introduction

2. Feature of Mitsubishi GTCC

3. Latest GT and GTCC Technology

GT : Gas Turbine

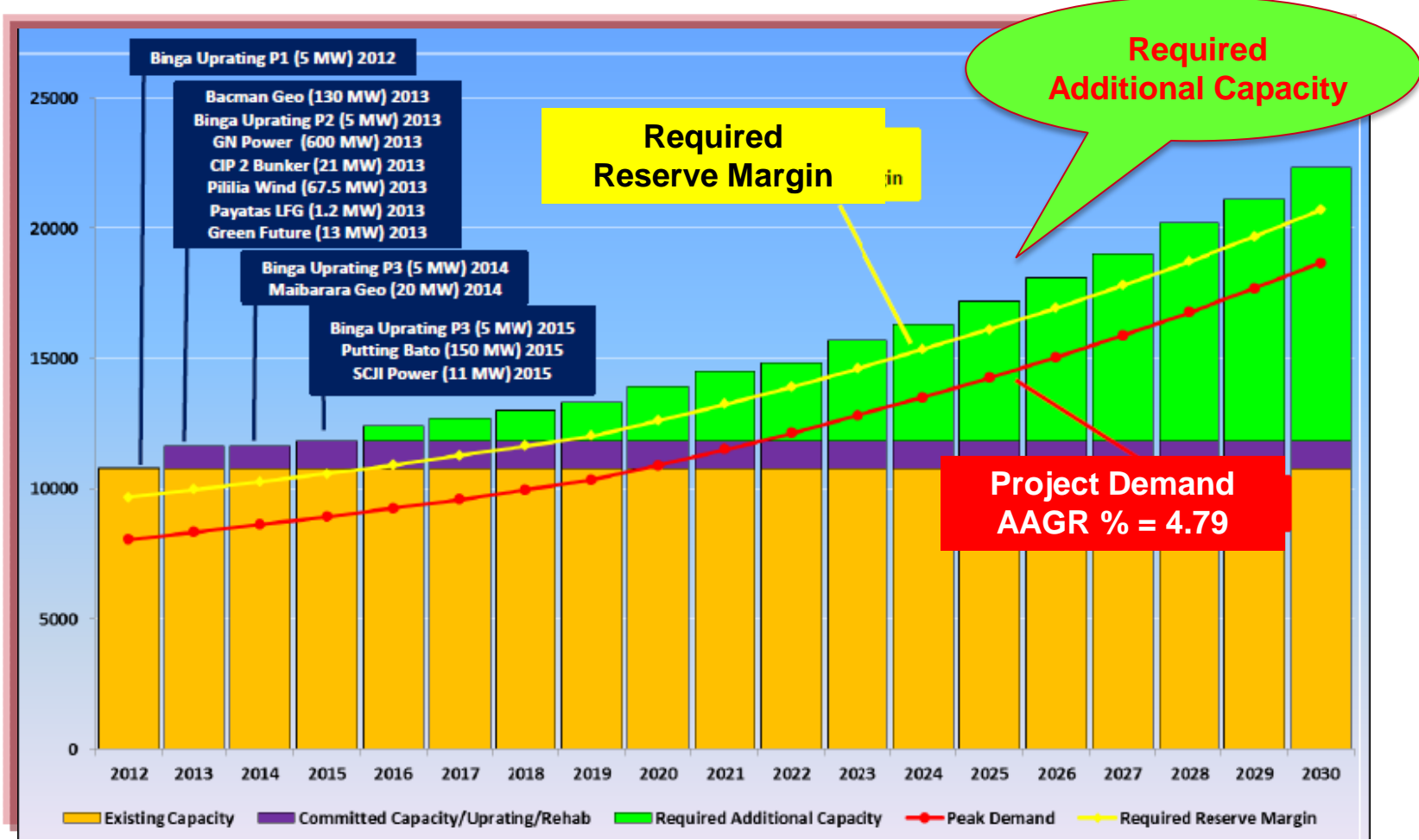
GTCC: Gas Turbine Combined Cycle

1. Introduction

MITSUBISHI HEAVY INDUSTRIES, LTD.

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

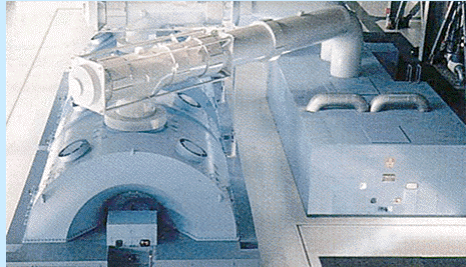


Source: DOE, Philippine Energy Plan, 2012-2030

Mitsubishi Main Products for Power Generation



Combined Cycle Power Plant



Steam Turbine



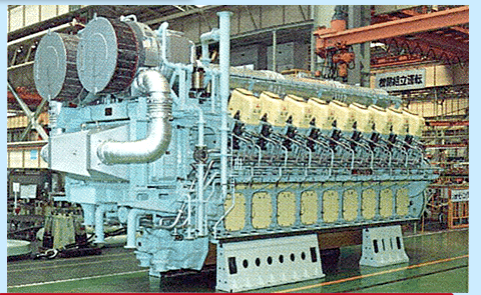
Gas Turbine



Geothermal Power Plant



Boiler



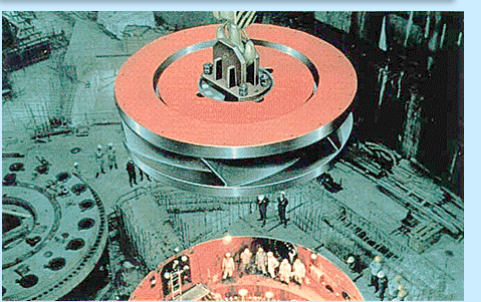
Gas /Diesel Engine Power Plant



Wind Turbine

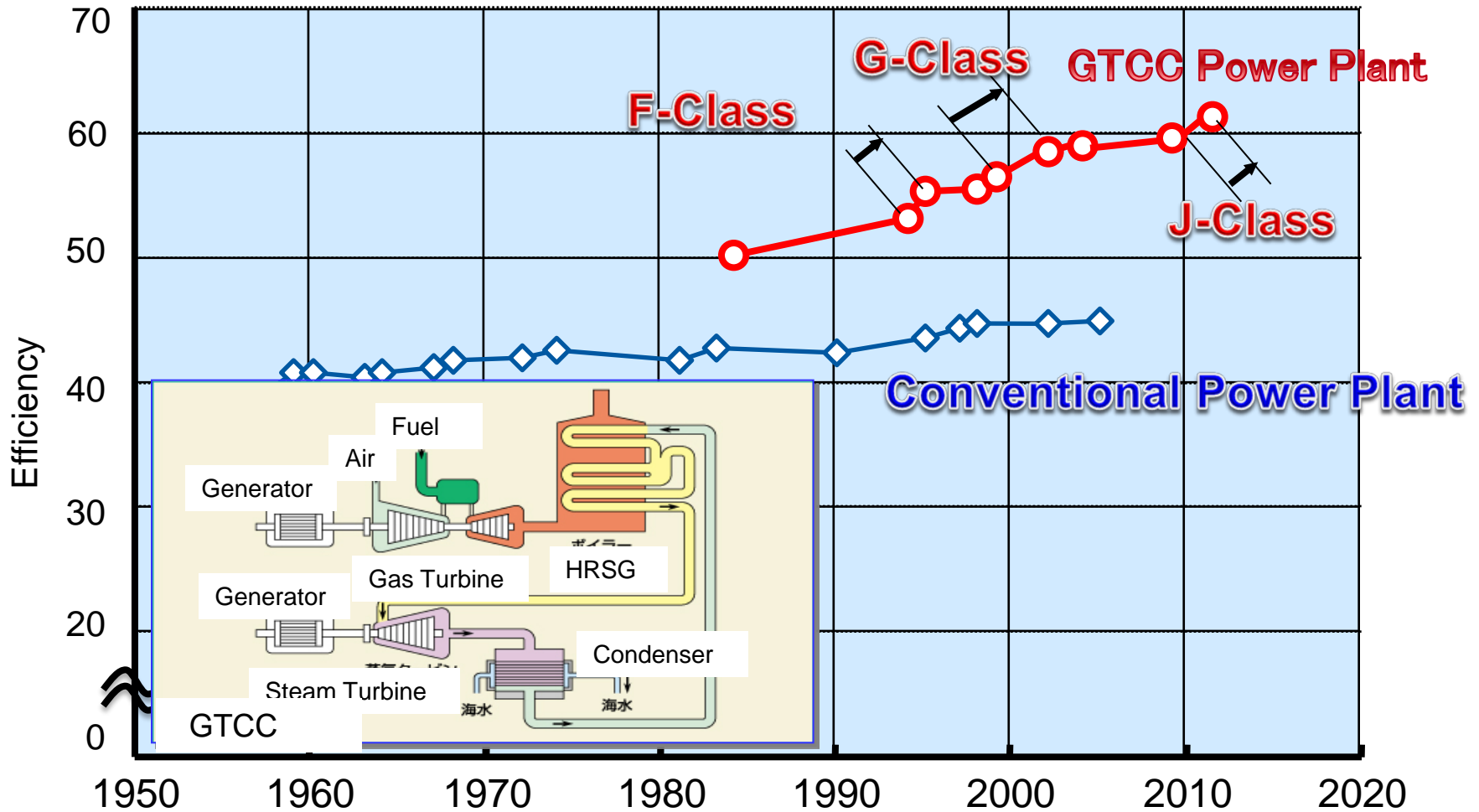


Lithium-ion Secondary Battery



Hydro Turbine

Remarkable Progress in GTCC Efficiency



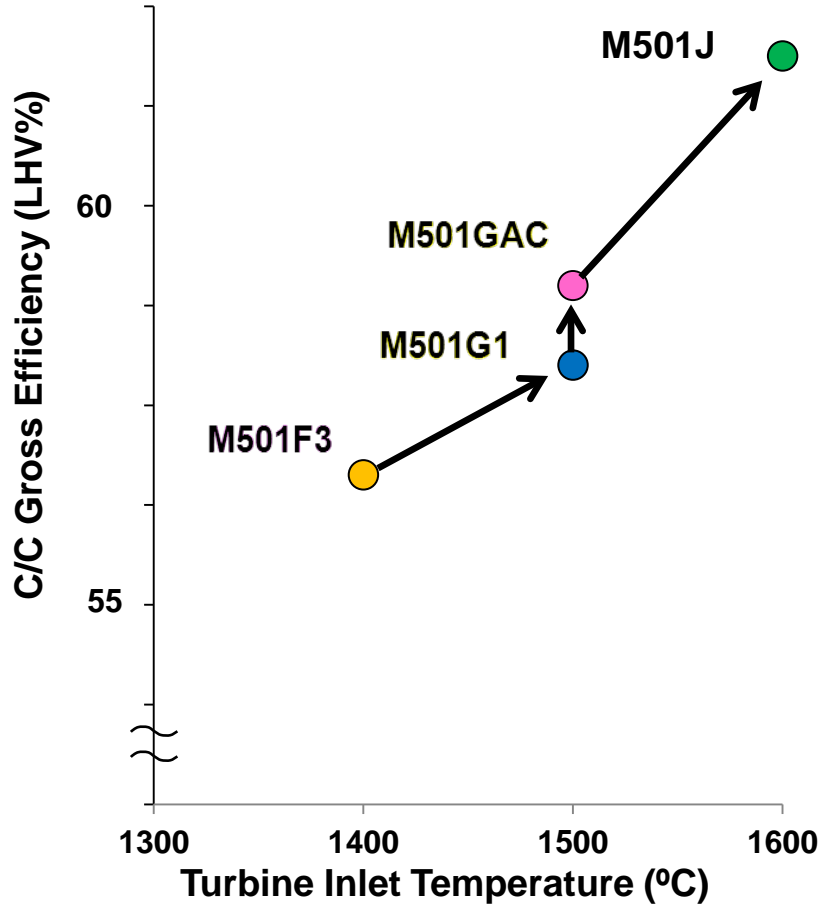
2. Feature of Mitsubishi GTCC

MITSUBISHI HEAVY INDUSTRIES, LTD.

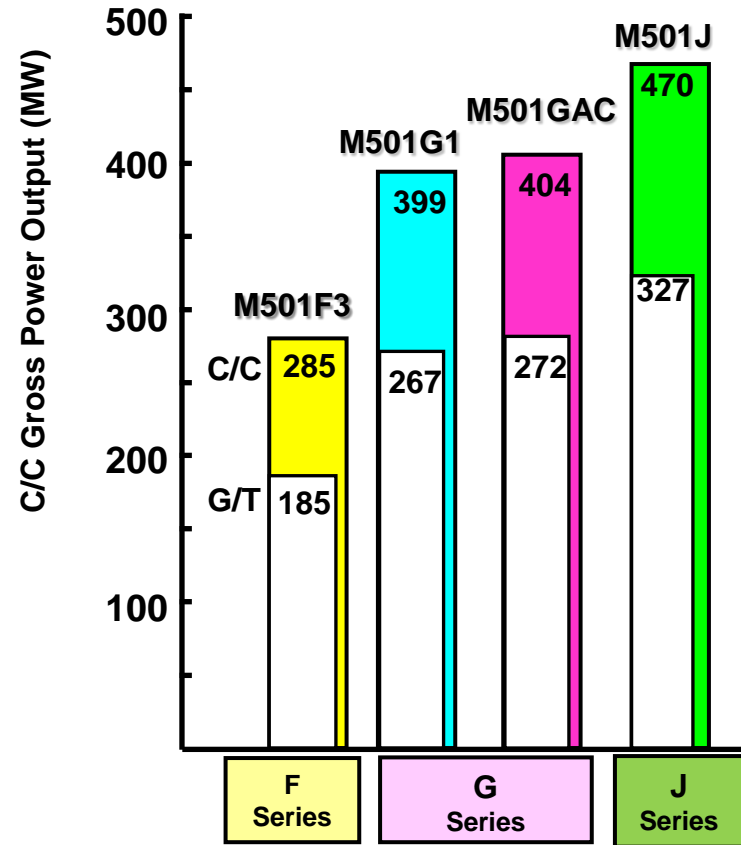
Evolution of MHI GTCC Performance (60Hz)

ISO Standard (1 on 1)

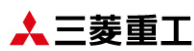
Combined Cycle Gross Efficiency



Gas Turbine and C/C Power Output



World Wide Experiences of Mitsubishi Gas Turbine



M501J × 17
M701J × 2
Total: 19 units

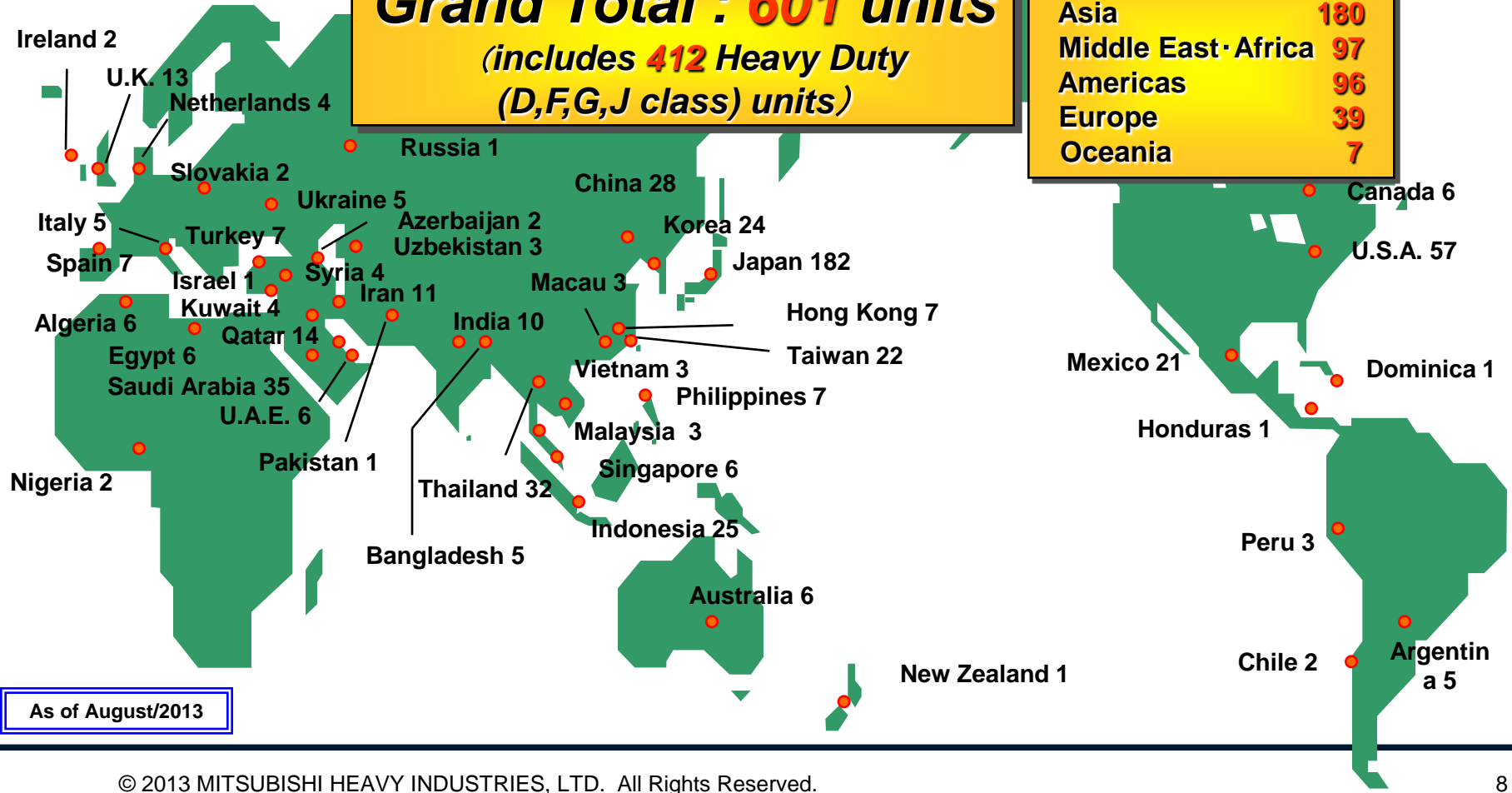
M501G × 67
M701G × 11
Total: 78 units

M501F × 73
M701F × 125
Total: 198 units

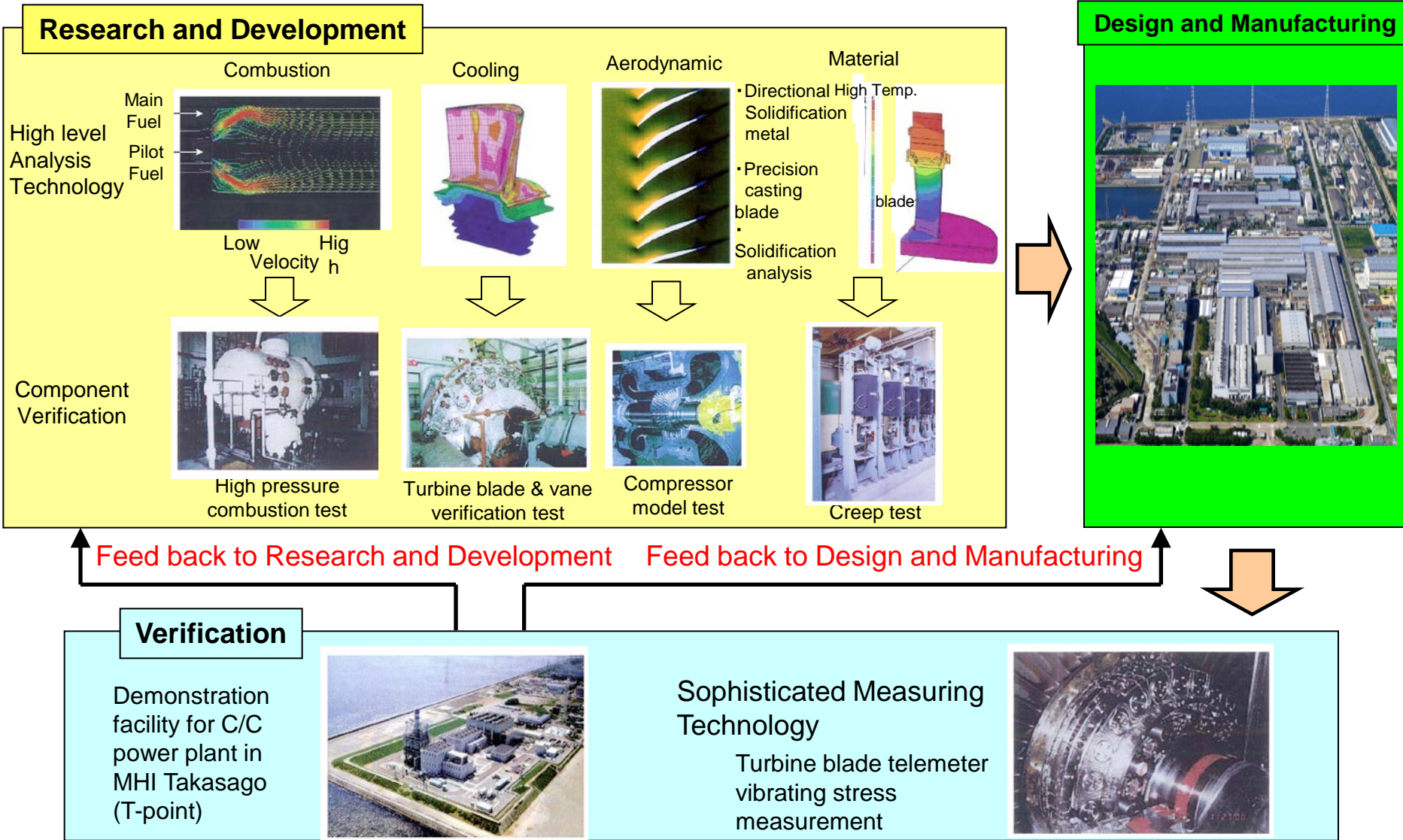
M501D × 25
M701D × 92
Total: 117 units

Grand Total : 601 units
(includes 412 Heavy Duty (D,F,G,J class) units)

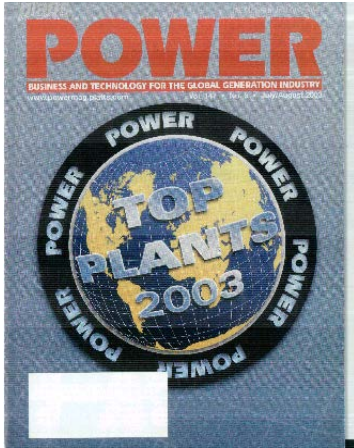
Japan	182
Asia	180
Middle East·Africa	97
Americas	96
Europe	39
Oceania	7



As of August/2013

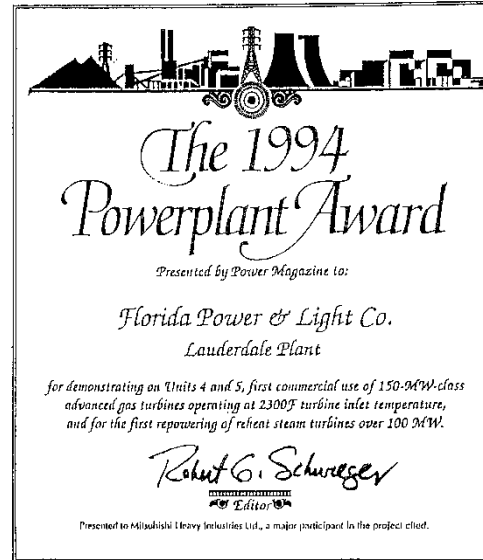


Philippine ILIJAN 1200MW M501G x 4



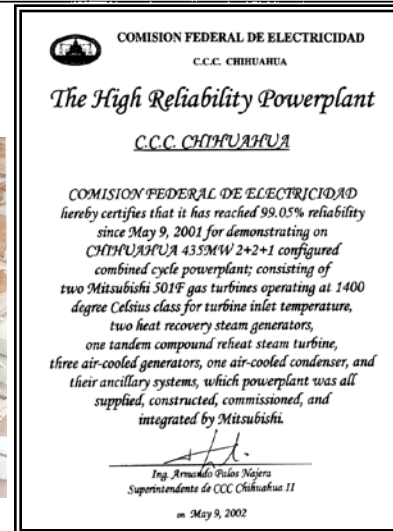
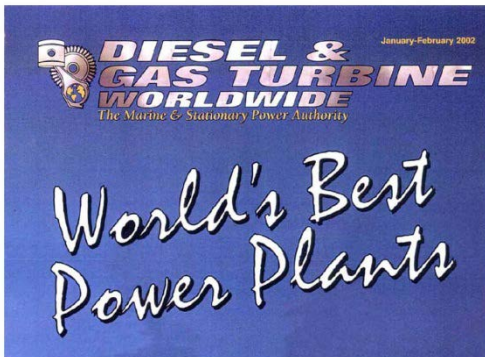
**over 96% availability.
0.48% forced outage rate.**

U.S.A FPL Lauderdale M501F x 4



**availability: 93.0%
Reliability: 99.3%**

Mexico Chihuahua M501F3 x 2



**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

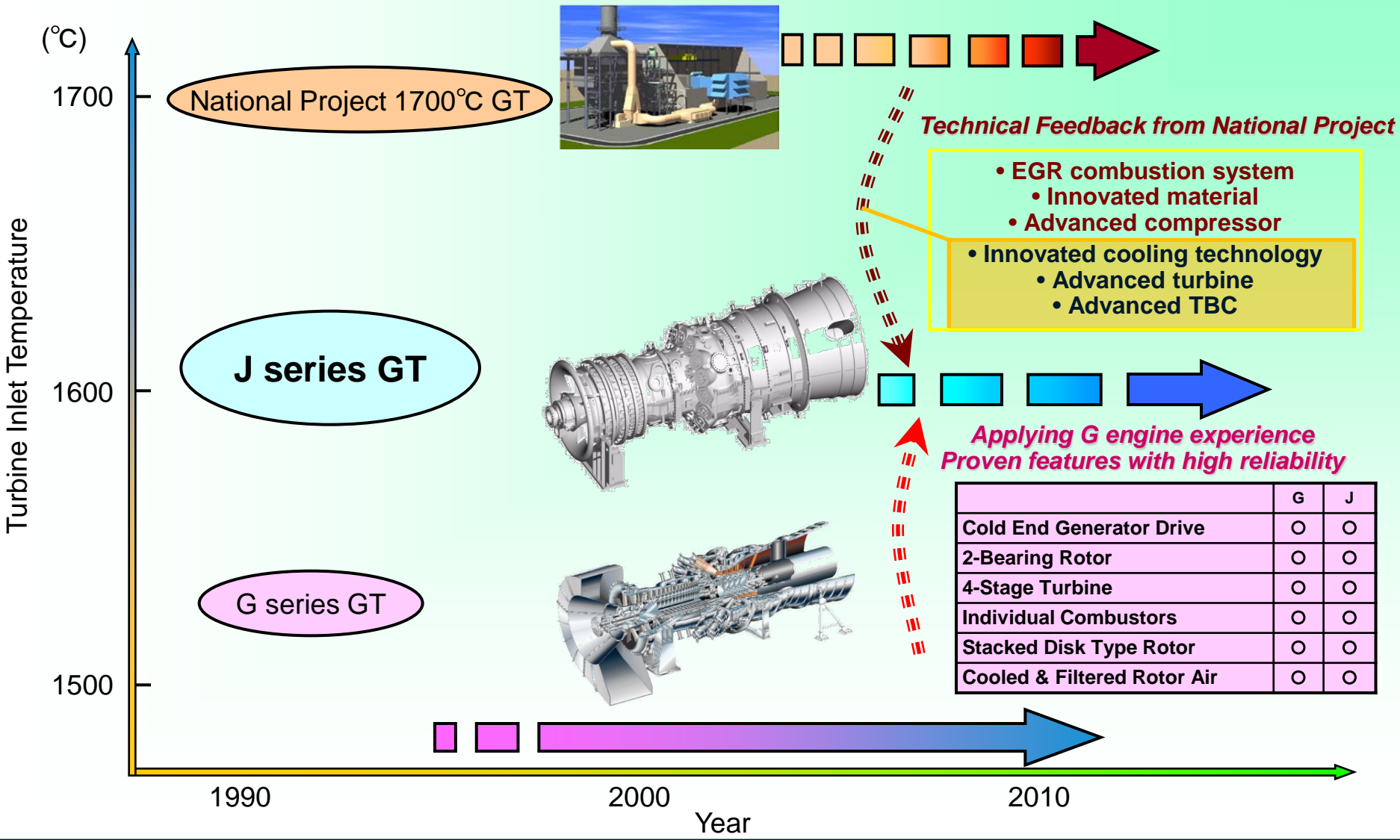
☑ **Verification Test Complete**
Successfully finished "J" class gas turbine at "T-point"

☑ **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 Ratio Compressor Experience from G Engine
- Steam Cooled Combustor Experience from G Engine
- Turbine Technologies from National Project

Combustor

Proven G Combustor

- Well experienced DLN combustor
- Steam cooled liner

Compressor

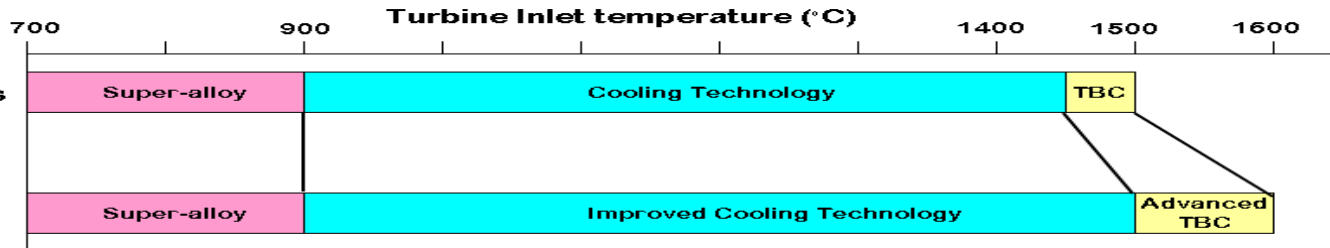
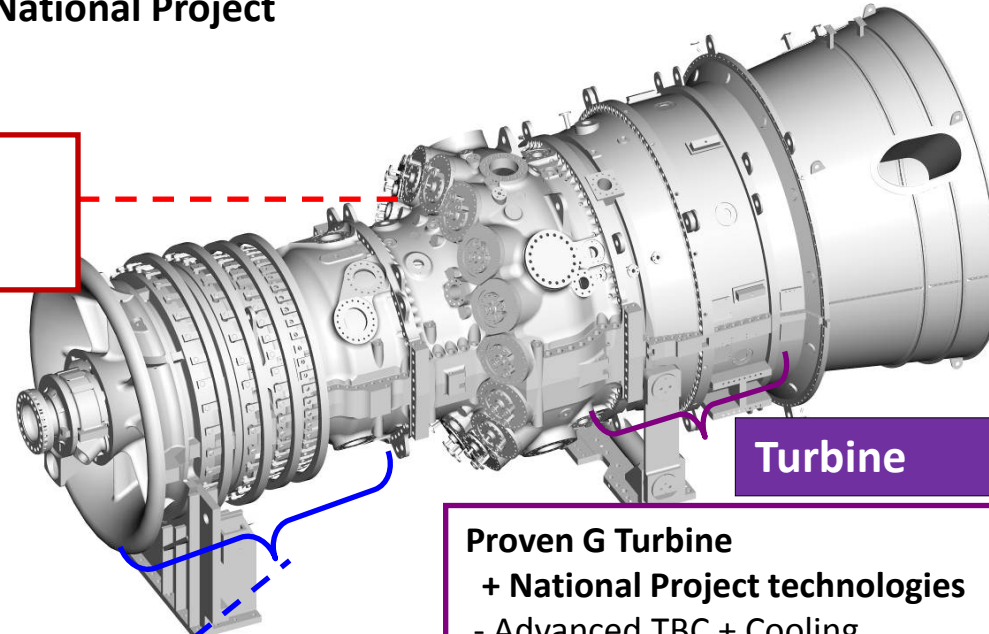
Validated G Compressor

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

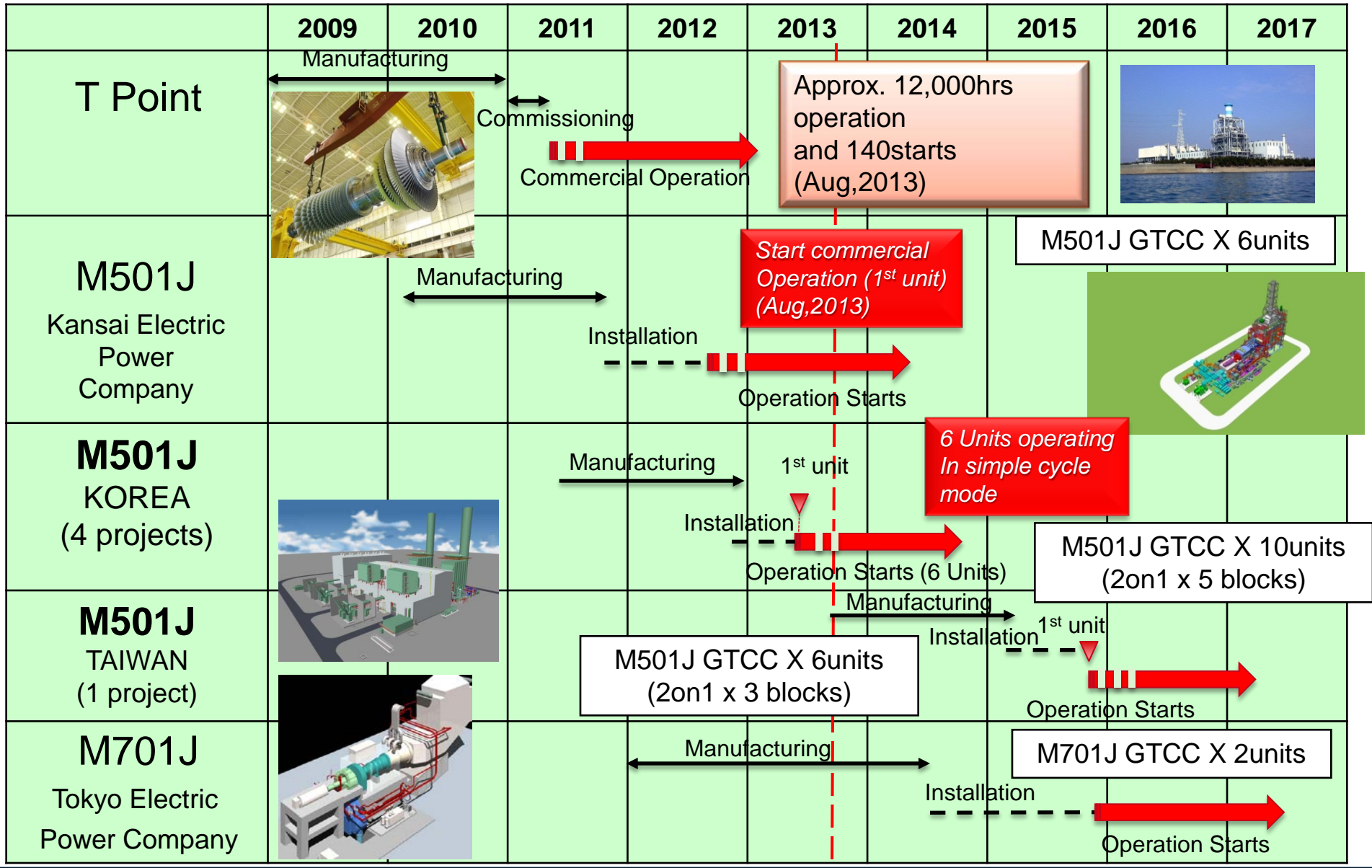
Turbine

Proven G Turbine

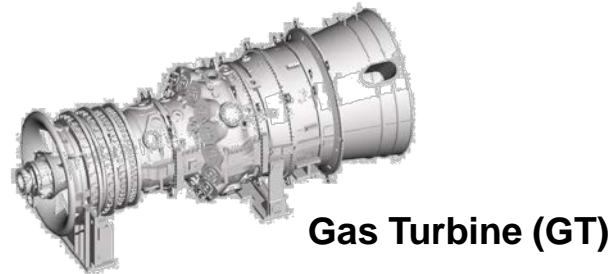
- + National Project technologies
- Advanced TBC + Cooling
- High efficient aerodynamic technology
- Cooled row4 blade



J Class Gas Turbine To the Market



Engineering work completed



HRSG

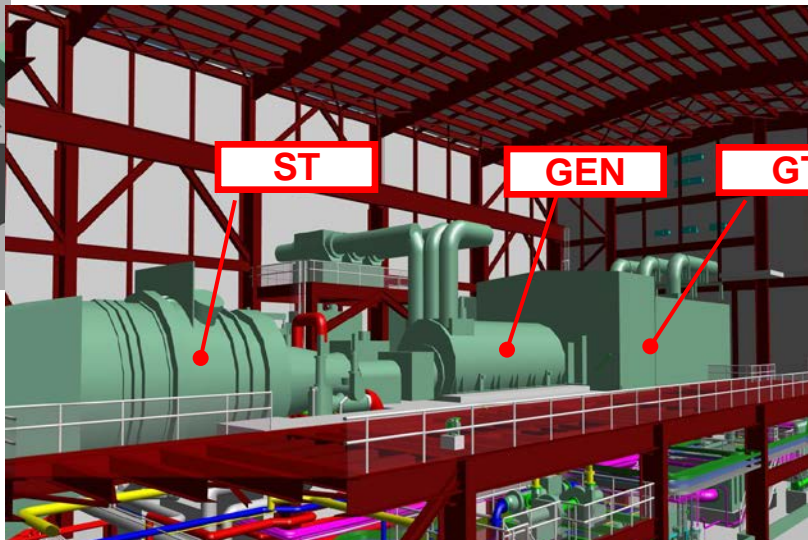
Inside Turbine Building

CONDENSER

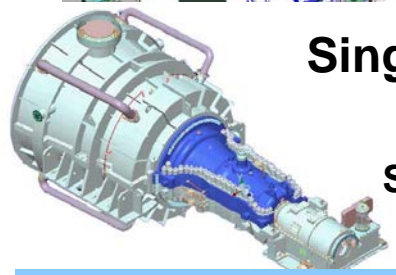
ST

GEN

GT



Single Shaft Overview



Steam Turbine (ST)

430MW class of M501J 1on1 Single Shaft GTCC

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



MITSUBISHI
HEAVY INDUSTRIES, LTD.

Our Technologies, Your Tomorrow

