

Gas Turbines: Frame 7FA/60Hz/171MW

PG7241
171 MW
Low Nox
60 Hz



Equipment Overview

Gas Turbine

Feature Specification
Primary Fuel Natural Gas
Starting Means Static Start
Air Filtration Two Stage Static
Exhaust System Axial Exhaust
Emissions Control Gas-Dry Low NOx
Outdoor Enclosure Turbine and Accessory Compartments
Off-Base Acoustic Enclosure Turbine and Accessory Compartments
Off-Base Acoustic Enclosure Turbine Compartment

Generator

Feature Specification
Model 7FH2
Cooling Hydrogen
Frequency 60 Hz
Power Factor (PF) 0.85 Lagging
Power Factor (PF) Capability to .90 Leading @ ISO
Conditions
Terminal Voltage 18.0 kV
Generator Excitation EX2000P-Static Bus Fed
Outdoor Enclosure Load Compartment
On-Base Lagging Accessory Base

Control Systems

Feature Specification
Turbine-Generator SPEEDTRONIC mark VI

G.E. SCOPE OF SUPPLY

1. Gas Turbine Systems
2. Generator
3. Gas Turbine-Generator Controls & Electric Auxiliaries
4. Services

1. GAS TURBINE SYSTEMS

GAS TURBINE

Base Mounted PG7241 (FA) 60 Hz gas turbine including:

- Modulating IGV

COMBUSTION SYSTEM

- Dry Low NOx combustion system -With inlet heating
- Compressor inlet humidity sensor
- Compressor inlet temperature thermocouple

FUEL SYSTEMS

GAS FUEL SYSTEM

- Natural gas only
- Stainless steel gas piping
- Orifice type gas flow measurement system
- Single gas strainer
- Gas fuel valves on accessory base
- Gas fuel temperature supplied per GEI-41040F-Heater by Owner
- Gas Fuel cleaning equipment (fuel gas scrubber) (duplex)

LUBRICATING and HYDRAULIC SYSTEMS PUMPS

- AC Motor driven dual oil pumps
- AC Motor driven dual hydraulic pumps
- DC Motor driven, emergency lube oil pump
- AC/DC Motor driven auxiliary generator seal oil pump
- Dual pump for pressure lift journal bearings in:

Turbine

Generator

Generator seal oil pump

FILTERS and COOLERS

- Dual lube oil system filters
- Dual hydraulic oil filters
- Dual lube oil coolers

Plate/Frame type with stainless steel plates

- ASME code stamp

Lube oil coolers

Lube oil filters

LUBE OIL PIPING

- 304L stainless steel lube oil feed pipe
- Carbon steel lube oil drain pipe
- Lube system valve stainless steel trim

MIST ELIMINATION

- Lube vent demister

OIL RESERVOIR

- With heater for -20 deg. F

INSTRUMENTATION

- Pressure switches for lubrication and hydraulic oil filters

INLET SYSTEM

- Inlet system arrangement

Up and Forward inlet system arrangement

Inlet compartment supports straddle ductline

- Inlet Filtration

Two-stage static filter, prefilter and high efficiency filter

Standard filter media (low humidity, non-corrosive environments)

Weather protection on inlet filter compartment

Inlet system differential pressure indicator

Inlet system differential pressure alarm

Inlet filter compartment support steel (Seismic Zone 4A= 120 mph wind speed)

- Inlet system atmospheric Protection

Zinc rich paint inside and outside of the inlet filter compartment
Zinc rich paint on inlet filter compartment support steel
Zinc rich paint inside and outside of inlet ducting with epoxy topcoat inside ducting
Galvanized inlet silencing perforated sheet
Zinc rich paint on inlet ducting support steel

EXHAUST SYSTEM

ARRANGEMENT

- Exhaust diffuser with an axial exit
- Exhaust expansion joint
- Exhaust stack, if required, by Customer

COUPLINGS

- Rigid load coupling
- Load coupling guard

GAS TURBINE PACKAGING

- Lagging and enclosures
- On-base accessory compartment lagging
Turbine and accessory compartment lagging
Load coupling compartment lagging
Off-base acoustic enclosure for turbine only
Off-base acoustic enclosure for turbine, accessory compartment and exhaust diffuser for 85A dBA
- Compartment ventilation, pressurization and beating
- Dual turbine compartment vent fans
Dual accessory compartment lagging
Dual load compartment fan
Heated turbine and accessory compartments for humidity control
Dual vent fans for diffuser/exhaust area
- Plant Arrangement
- Turbine designed for installation outdoors
Right hand accessory module
Unit walkways by customers, mounting pads by GE
- Turbine and accessory base painting
- Standard primer
- UBC seismic zone #4
 - Hazardous area classification
- NEC Class 1, Group D, Division 2
Turbine compartment
Gas fuel compartment
- Special features
- Dual (metric-English) indicators and gauges

FIRE PROTECTION SYSTEM

- Fire detection system
- Turbine and accessory compartment
- Smoke detection system
- Control cab/PEECC
- Compartment warning signs
 - CO2 supply system
- One low pressure CO2 tank per unit
Tank suitable for 0-120 deg. F (-18 to 49 deg. C)
- Fire protecting piping
 - Hazardous atmosphere detectors in turbine and gas fuel compartments
 - Hazardous atmosphere detector readout

STARTING SYSTEMS

- Static Start

Generator start with inverter/regulator

Static start isolation transformer

Oil filled

- Shared hardware for two units

Isolation transformer fed from auxiliary bus

Shared hardware across power blocks using cross ties

PLC based changeover panel

12- pulse, water-cooled LCI

Single dc link reactor

Water to water heat exchanger, shipped loose

- Rotor turning systems

Turning gear and motor for rotor cool-down

Rotor indexing (borescope inspection)

MISCELLANEOUS SYSTEMS

SPECIAL SYSTEMS

- Exhaust frame blowers on turbine compartment roof

2. GENERATOR

GENERAL INFORMATION

- Hydrogen cooled generator with conventionally cooled armature
- Outdoor Installation
- 60 Hz generator frequency
- Generator voltage 18.0 kV
- 0.85 power factor (lagging)
- Capability to .90 power factor (leading) @ ISO conditions
- Class "F" armature and rotor insulation
- Class "B" temperature rise, armature and rotor winding
- Generator Bearings

End shield bearing support

Elliptical journal bearings

Rollout bearing capability without removing rotor

Insulated collector end bearing

Online bearing insulation check

Offline bearing insulation check with isolated rotor

- Monitoring Devices

Two BN3300 probes per bearing at 45 deg. Angle with monitors

Two (2) velocity vibration probes at turbine end, one (1) at collector end

Provisions for key phaser-generator

Provisions for permanent flux probe

Proximity vibration sensors

- Generator Field

Direct cooled field

Two-pole field

Finger type amortisseurs

Full-length coil slot amortisseurs

GENERATOR GAS COOLERS

- Coolers shipped installed
- Generator gas cooler configuration

Five (5) horizontally mounted simplex coolers
Cooler piping connections on the left side as viewed from collector end
ASME code stamp
Single wall cooler tubes
Victaulic cooler couplings
Plate fins
Cooling water manifold and isolation valves
• Generator gas cooling system characteristics
Coolant temperature
-20 deg. F
TEMA Class C coolers
Generator capacity with one section out of service 80% with Class "F" rise
Maximum cooler pressure capability -125 psi
Fouling factor:.002

- Generator gas cooler construction materials
90-10 copper-nickel tubes
Carbon steel tube sheets
Carbon steel waterbox and coupling flanges with epoxy coating
Aluminum cooler tube fins

GENERATOR LUBE OIL SYSTEMS AND EQUIPMENT

- Bearing lube oil system
Generator lube oil system integral with turbine
Sight flow indicator
- Bearing lift oil system
Stainless steel lift oil piping and tubing
Lift oil supplied from turbine oil system
- Lube oil system piping materials
Stainless steel lube oil feed pipe
Carbon steel lube oil feed pipe
Welded oil piping
Flexible pipe as permitted by ANSI 31.3

GENERATOR GROUNDING EQUIPMENT

- Neutral grounding equipment
Neutral ground transformer and secondary resistor
Mounted in terminal enclosure
Motor operated neutral disconnected switch

GENERATION TEMPERATURE DEVICES

- Stator winding temperature devices
100 ohm platinum RTD's (resistance temperature detector)
Single element temperature sensors
Four (4) cold gas
Two (2) hot gas
GTG-2 (common cold gas)
- Bearing temperature devices
Chromel alumel (type K) thermocouples
Dual element temperature sensors
Two (2) bearing metal temperature sensors per bearing
- Collector temperature devices
100 ohm platinum RTD's
Single element temperature sensors
Collector air inlet temperature sensors
Collector air outlet temperature sensor
- Lube oil system temperature devices
Chromel alumel (K) thermocouples

Dual element temperature sensors
One (1) bearing drain temperature sensor per drain

PACKAGING, ENCLOSURES AND COMPARTMENT

- Paint and preservation
Standard alkyd beige primer
- Generator terminal enclosure (GTE)
- Line-side terminal enclosure
Terminal enclosure shipped separate
High voltage bushings shipped installed
Six (6) ambient air-cooled, high voltage bushings
Isolated phase bus duct connection
Phase sequence R-C-L when looking at enclosure terminals
Outgoing power connection on right side when viewed from collector end
Lighting arrestors
Voltage transformers, fixed
- Current Transformers
Relaying Class C800
Metering Class- 0.3B- 1.8 (ANSI C57.13)
CT Ratio-800: 5A
Line CT's
CT16, CT17, CT18
CT19 for extension
CT19A and CT19C for EX2000

- Neutral Terminal enclosure
Integral with lines side terminal enclosure
Neutral tie
Neutral CT's
CT1, CT2, CT3
CT4, CT5, CT6
CT7, CT8, CT9
Top mounted
Forced ventilation
- Collector Compartment
Collector Compartment shipped separately
Outdoor
- Compartment Lighting and Outlets
AC Lighting
Collector Compartment
- Fountain Hardware
Generator Shims
Generator Alignment Key(s) – collector end
Generator Alignment Key(s) – turbine end
Generator Alignment Key(s) – axial

HYDROGEN SYSTEMS AND ACCESSORIES

- Hydrogen Control Cabinet
NEMA 1 cabinet in collector compartment

Hydrogen Gas Manifolds
Auto purge gas purge control manifold
Hydrogen/CO2 control manifold in collector compartment

- Seal Oil System
Control unit mounted in collector compartment
Stainless steel seal oil feed pipe
Carbon steel seal oil drainpipe

ELECTRICAL EQUIPMENT

- Motors

TEFC Motors

Coated with antifungal material for protection in tropical areas

High Ambient motor installation

Motor Heaters connected to AC power

Extra severe duty motors

Cast iron motor housing

- Heaters

Generator Stator Heaters

Generator Collector Heaters

Generator Terminal Enclosure Heaters

GENERATOR EXCITATION SYSTEMS, STATIC COMPONENTS

- Static excitation with dual hot backup bridge

EXCITATION MODULE FEATURES

- Control/ Monitor/Display through TCP
- Power Factor controller in turbine control system
- Var controller in turbine control system
- Selection of automatic or manual regulator
- Voltage matching in turbine control system
- Raise-lower of the active regulator setpoint
- Enter setpoint command
- Display field amps
- Display field volts
- Display transfer volts
- Display field temperature
- Built-in diagnostic display panel
- Automatic voltage regulator (AVR)
- Manual voltage regulator (FVR)
- Automatic and Manual bi-directional tracking
- Reactive current compensation (RCC)
- Volts per hertz limiter (V/Hz LIM)
- Volts per Hertz protection (24EX) (backup to 24G)
- Over excitation limiter (OEL)
- Offline/online over excitation protection (76EX)
- Loss of excitation protection (40EX)
- Bridge ac phase unbalance protection (47EX)

Under excitation limiter (UEL)

Generator over voltage protection (59EX)

Generator field ground detector (64F)

VT failure detector (VTFD) (60EX)

- Dual source internal bulk power supply
- Millivolt shunt for field
- Surge protection

VT disconnect and CT shorting switches

Two phase current sensing (CT's A, C)

Three phase voltage sensing

Single pole dc field contact/bridge

- Thyristor bridge circuit filtering
 - Shaft voltage suppressor circuit (mounted in panel)
- Field de-excitation circuit (with field discharge inductor)
- 125 Vdc field flashing circuit (when required)

Bridge disconnect: ac no load

- Power system stabilizer

PERFORMANCE

- 2.0 Response and 160% VFFL (100 degree C) ceiling@ VT=1.0pu

EX2000 ENCLOSURE LOCATION

- Installed in LCI/EX

LCI FEATURES

- LCI located in LCI/EX compartment
- LCI output isolation switch (89MD)

Located in LCI compartment

- LCI disconnect switch (89SS)

Located in generator terminal enclosure

- LCI fuse

Located in compartment with LCI

PPT FEATURES

- Freestanding oil filled PPT
- PPT fed from auxiliary bus

3. GAS TURBINE-GENERATOR CONTROLS & ELECTRIC AUXILIARIES

CONTROL CAB/PACKAGED ELECTRIC AND ELECTRONIC CONTROL COMPARTMENT (PEECC)

- Control panels mounted on a common skid
- Weatherproof, climate control, base mounted enclosure
- Supplemental wall mounted air conditioner by General Electric
- Interconnection cables (hard wire) within enclosures by G. E.
- Interconnection cables (hard wire) between packages by Customer

GAS TURBINE CONTROL SYSTEM PANEL FEATURES

- Triple modular redundant (TMR)
- Skid mounted control panels
- Auto/Manual synchronizing module with synchronizing check function
- Generator stator overtemperature alarm (49)
- Droop control
- Load limiter
- Purges cycle
- Customer alarm/trip contact for CRT display
- Additional customer input contacts
- Additional customer output to customer
- Provision for 8 selectable analog inputs from customer
- Provision for 8 selectable analog output from customer
- Wet low NOx data for EPA compliance
- Vibration alarm readout and trip
- Electrical overspeed protection
- Constant settable droop
- Power factor calculation and display
- Power factor control
- VAR Control
- Manual set point pre-selected load
- Mounted in PEECC

LOCAL OPERATOR STATION

- Commercial grade personal computer
- Color Monitor

Tabletop

15-inch screen

- Mouse cursor control
- Table top AT 101 keyboard
- Printer

24 pin dot matrix

- Display in English Language
- 50 foot of Arcnet cable between gas turbine control system panel and local operator interface <I> for indoor use
- RS232C two way serial link (MODBUS) via local <I>

Power 120V ac 60 Hz

- Mounted in PEECC

ROTOR, BEARING and PERFORMANCE MONITORING SYSTEMS BENTLEY NEVADA 3500

- Performance monitoring systems

Performance monitoring sensors wired to gas turbine control system

- Vibration Sensors

Velocity vibration sensors

Proximity vibration sensors

- Bentley Nevada 3500 Monitor

Relay outputs wired to gas turbine control panel

- Bearing Thermocouples

Bearing Drain thermocouples

Bearing metal thermocouples

- Borescope access holes

GENERATOR CONTROL PANEL

GENERATOR CONTROL PANEL HARDWARE

- Mounted in PEECC
- Skid mounted with turbine panel
- DGP with test plugs
- DGP without Modbus communication interface
- DGP with communication interface
- DGP with oscillography capture
- DGP with printer port
- DGP with redundant internal power supply
- Generator breaker trip switch (52S/CS)
- Humidity sensor readout
- Bentley Nevada vibration monitor(s)

DITIGAL GENERATOR PROTECTION SYSTEM (DGP)

- Generator overexcitation (24)
- Generator under voltage (27G)
- Reverse power/ anti-motoring (32-1)
- Loss of excitation (40-1,2)
- Current unbalance/negative phase sequence (46)
- System phase fault (51V)
- Generator overvoltage (59)
- Stator ground detection (64G1)/(59GN)
- Generator over frequency (810-1,2)
- Generator under frequency (81U-1,2)
- Generator differential (87G)
- Voltage transformer fuse failure (VTFF)

GENERATOR PROTECTION DISCRETE RELAYS

- Synchronizing undervoltage relay (27BS-1,2)
- Voltage balance relay (60)
- Breaker or lockout trip coil monitor relay (74)
- DC tripping bus, blown fuse protection relay (74-2)
- Generator differential lockout relay

MAIN TRANSFORMER DIGITAL PROTECTION

- SR 745 relay with two restraint windings (86T/87T)

MAIN TRANSFORMER DISCRETE RELAYS

- Main transformer lockout relay (86T-1)

FEATURES INTEGRATED INTO GAS TURBINE CONTROL SYSTEM

- Gas turbine control system with speed matching, synchronization and check
- Manual synchronization displayed on gas turbine control system
- Auto/manual synchronizing module displayed on gas turbine system <1>
- Load control in gas turbine control system
- Temperature indication for generator RTD's

GENERATOR CONTROL PANEL METERING

- Generator digital multimeter
- ~ VM - Generator volts
- ~ AM - Generator Amps: Phase 1,2,3 and Neutral
- ~ MW - Generator Mega watts
- ~ MVAR - Generator Mega VAR's
- ~ FM - Generator frequency
- ~ MVA - Generator MVA
- ~ PF - Generator Power factor
- ~ MWH - Generator Megawatt Hours
- ~ MVAH - Generator MVA Hours

GENERATOR CONTROL PANEL TRANSDUCERS

- Generator watt/VAR transducer 4-20 mA output for input to TCP (96GG1)
- Generator TCP/droop control transducer 4-20 mA output (96GW-1)
- Generator power factor transducer 4-20 mA output for customer (96GP-1)
- Generator VAR transducer 4-20 mA output for customer (96GR-1)

GENERATOR PROTECTION

- Generator electrical protection equipment

Ground brush rigging

BATTERIES and ACCESSORIES

- Lead Acid Battery
- Single phase battery charger
- Battery and Charger mounted in the PEECC

MOTOR CONTROL CENTER

- MCC mounted in control cab/PEECC
- Tin-plated copper bus-work
- 42 kA bracing
- 480V 60 Hz auxiliary power

MOTOR FEATURES

- TEFC motors (200hp)
- Coated with anti-fungal material for protection in tropical areas
- High ambient motor insulation
- Energy saver motors
- Extra severe duty motors
- Cast iron motor housing
- All redundant motors to be lead/lag
- Motor heaters

Rated 110/120 volts, 50/60 hertz

- WP motors > 200 hp

Trunions for generator

On loan basis only

Jacking bolts for generator

Foundation/installation washer and shim packs

- Power Systems Studies

Provided by customer

MS7001(FA) Gas Turbine Packaging (Typical)

