

Appendix B6 Gas Turbine Unit Cause Codes

GAS TURBINE UNITS INDEX TO SYSTEM/COMPONENT CAUSE CODES

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BALANCE OF PLANT

Electrical

| | |
|------|---|
| 3600 | Switchyard transformers and associated cooling systems – external (OMC) |
| 3601 | Switchyard transformers and associated cooling systems – external (not OMC) |
| 3610 | Switchyard circuit breakers – external (not OMC) |
| 3611 | Switchyard circuit breakers – external (OMC) |
| 3612 | Switchyard system protection devices – external (OMC) |
| 3613 | Switchyard system protection devices – external (not OMC) |
| 3618 | Other switchyard equipment – external (not OMC) |
| 3619 | Other switchyard equipment – external (OMC) |
| 3620 | Main transformer |
| 3621 | Unit auxiliaries transformer |
| 3622 | Station service startup transformer |
| 3623 | Auxiliary generators |
| 3624 | Auxiliary generator voltage supply system |
| 3629 | Other switchyard or high voltage system problems |
| 3630 | 400-700-volt transformers |
| 3631 | 400-700-volt circuit breakers |
| 3632 | 400-700-volt conductors and buses |
| 3633 | 400-700-volt insulators |
| 3634 | 400-700-volt protection devices |
| 3639 | Other 400-700-volt problems |
| 3640 | AC instrument power transformers |
| 3641 | AC Circuit breakers |
| 3642 | AC Conductors and buses |
| 3643 | AC Inverters |
| 3644 | AC Protection devices |
| 3649 | Other AC instrument power problems |
| 3650 | DC instrument power battery chargers |
| 3651 | DC circuit breakers |
| 3652 | DC conductors and buses |
| 3653 | DC protection devices |

- 3659 Other DC power problems
- 3660 4000-7000-volt transformers
- 3661 4000-7000-volt circuit breakers
- 3662 4000-7000-volt conductors and buses
- 3663 4000-7000-volt insulators
- 3664 4000-7000-volt protection devices
- 3669 Other 4000-7000-volt problems
- 3670 12-15kV transformers
- 3671 12-15kV circuit breakers
- 3672 12-15kV conductors and buses
- 3673 12-15kV insulators
- 3674 12-15kV protection devices
- 3679 Other 12-15kV problems
- 3680 Other voltage transformers
- 3681 Other voltage circuit breakers
- 3682 Other voltage conductors and buses
- 3683 Other voltage insulators
- 3684 Other voltage protection devices
- 3689 Other voltage problems
- 3690 Station Service Power Distribution System, General

Power Station Switchyard

- 3700 Power Station switchyard (non generating unit equipment)
- 3710 Transmission line (connected to powerhouse switchyard to 1st Substation)
- 3720 Transmission equipment at the 1st substation) (see code 9300 if applicable)
- 3730 Transmission equipment beyond the 1st substation (see code 9300 if applicable)

Auxiliary Systems

Service Water (Open System)

- 3810 Service water pumps and motors
- 3811 Service water piping
- 3812 Service water valves
- 3813 Service water heat exchangers
- 3814 Service water system fouling
- 3819 Other service water problems

Closed Cooling Water Systems

- 3820 Closed cooling water pumps
- 3821 Closed cooling water piping
- 3822 Closed cooling water valves
- 3823 Closed cooling water heat exchangers
- 3824 Closed cooling water system fouling
- 3829 Other closed cooling water system problems

Auxiliary Steam

- 3830 Auxiliary boiler
- 3831 Auxiliary steam piping
- 3832 Auxiliary steam valves
- 3833 Auxiliary steam controls and instruments
- 3834 Auxiliary boiler tube leaks
- 3839 Other auxiliary steam problems

Service Air

- 3840 Service air compressors
- 3841 Service air piping
- 3842 Service air valves
- 3843 Service air dryers
- 3849 Other service air problems

Instrument Air

- 3850 Instrument air compressors
- 3851 Instrument air piping
- 3852 Instrument air valves
- 3853 Instrument air dryers
- 3854 N₂ backup to instrument air
- 3859 Other instrument air problems

Fire Protection System

- 3860 Fire protection system pumps
- 3861 Fire protection system piping
- 3862 Fire protection system valves
- 3863 Fire protection system fouling
- 3864 Fire protection system instrumentation and controls
- 3869 Other fire protection system problems

Low-pressure Gas Compression System

- 3870 Fuel Gas Compressor and Motors
- 3871 Fuel Gas Compressor Piping
- 3872 Fuel Gas Compressor Valves
- 3873 Fuel Gas Compressor Heat Exchangers
- 3874 Fuel Gas Compressor Controls and Instrumentation
- 3875 Fuel Gas Compressor Filters
- 3876 Fuel Gas Compressor Fire System
- 3879 Fuel Gas Compressor – Other

Miscellaneous (Auxiliary Systems)

- 3898 Miscellaneous plant auxiliary process and services instrumentation and controls
- 3899 Other miscellaneous auxiliary system problems

Miscellaneous (Balance of Plant)

| | |
|------|---|
| 3950 | Process computer |
| 3960 | Thermal derating (thermal efficiency losses in balance of plant when specific cause(s) unknown) |
| 3970 | Distributive Control System (DCS) – process computer |
| 3971 | DCS – data highway |
| 3972 | DCS – hardware problems (including card failure) |
| 3973 | DCS – internal and termination wiring |
| 3974 | DCS – logic problems |
| 3975 | DCS – upgrades |
| 3979 | Other DCS problems |
| 3980 | Programmable Logic Controller (PLC) |
| 3981 | PLC – data highway |
| 3982 | PLC – hardware problems (including card failure) |
| 3983 | PLC – internal and termination wiring |
| 3984 | PLC – logic problems |
| 3985 | PLC – upgrades |
| 3989 | Other PLC problems |
| 3995 | Powerhouse heating and ventilating systems |
| 3996 | Air conditioning systems – rooms and areas |
| 3998 | Balance of plant overhaul/outage |
| 3999 | Other miscellaneous balance of plant problems |

GENERATOR

This set of codes contains the generator, exciter, generator cooling systems, and generator controls. Note the main leads up to and includes the generator output breaker in this set of codes.

Generator

| | |
|------|--|
| 4500 | Rotor windings |
| 4510 | Rotor collector rings |
| 4511 | Rotor, General |
| 4512 | Retaining Rings |
| 4520 | Stator windings, bushings, and terminals |
| 4530 | Stator core iron |
| 4535 | Stator, General |
| 4536 | Generator heaters |
| 4540 | Brushes and brush rigging |
| 4550 | Generator bearings and lube oil system |
| 4551 | Generator bearings |
| 4552 | Generator lube oil system |
| 4555 | Bearing cooling system |
| 4560 | Generator vibration (excluding vibration due to failed bearing and other components) |
| 4570 | Generator casing |
| 4580 | Generator end bells and bolting |
| 4590 | Generator brakes |

Exciter

- 4600 Exciter drive - motor
- 4601 Exciter field rheostat
- 4602 Exciter commutator and brushes
- 4603 Solid state exciter element
- 4604 Exciter drive - shaft
- 4605 Exciter transformer
- 4609 Other exciter problems

Cooling System

(report failures caused by water leaks into generator as codes 4500, 4510, etc.)

- 4610 Hydrogen cooling system piping and valves
- 4611 Hydrogen coolers
- 4612 Hydrogen storage system
- 4613 Hydrogen seals
- 4619 Other hydrogen system problems
- 4620 Air cooling system
- 4630 Liquid cooling system
- 4640 Seal oil system and seals
- 4650 Other cooling system problems

Controls

- 4700 Generator voltage control
- 4710 Generator metering devices
- 4720 Generator synchronization equipment
- 4730 Generator current and potential transformers
- 4740 Emergency generator trip devices
- 4750 Other generator controls and metering problems

Miscellaneous (Generator)

- 4800 Generator main leads
- 4805 Generator Bus Duct Cooling System
- 4810 Generator output breaker
- 4830 Major overhaul (more than 720 hours) (use for non-specific overhaul only; see page B-FS-2)
- 4831 Minor generator overhaul (less than 720 hours) (use for non-specific overhaul only; see page B-FS-2)
- 4840 Inspection
- 4841 Generator dole testing
- 4842 Reactive and capability testing
- 4850 Core monitor alarm
- 4860 Generator neutral grounding equipment
- 4899 Other miscellaneous generator problems

GAS TURBINE

Inlet Air System and Compressors

(use HP compressor if only one)

Ducts and Filters

- 5000 Inlet air ducts
- 5001 Inlet air vanes / nozzles
- 5002 Inlet air filters
- 5003 Inlet cone
- 5004 Inlet air chillers
- 5005 Inlet air evaporative coolers
- 5006 Inlet air foggers
- 5009 Other inlet air problems

Compressors

- 5010 High pressure shaft
- 5011 High pressure bearings
- 5012 High pressure blades/buckets
- 5013 Compressor casing and bolts
- 5014 Compressor diaphragms
- 5015 Compressor seals
- 5016 High pressure compressor bleed valves
- 5017 Low pressure compressor bleed valves
- 5019 Other high pressure problems
- 5020 Low pressure shaft
- 5021 Low pressure bearings
- 5022 Low pressure blades/buckets
- 5029 Other low pressure problems
- 5030 Supercharging fans
- 5035 Compressor washing
- 5036 Compressor shaft and bearings for two-shaft machines
- 5037 Inlet Bleed Heat Valve
- 5039 Other compressor problems

Fuel, Ignition, and Combustion Systems

- 5040 Fuel tanks
- 5041 Fuel piping and valves
- 5042 Fuel nozzles/vanes
- 5043 Fuel filters
- 5044 Liquid fuel oil pump
- 5046 Liquid fuel oil transfer/forwarding pump
- 5047 Liquid fuel purge system
- 5048 Gas fuel system including controls and instrumentation
- 5049 Other fuel system problems
- 5050 Ignition system
- 5051 Pilot fuel piping and valves
- 5052 Pilot fuel nozzles/vanes
- 5053 Pilot fuel filters
- 5054 Water injection system
- 5060 Atomizing air system
- 5065 NOx water injection system including pump

- 5066 NOx Steam Injection system
- 5070 Combustor casing
- 5071 Combustor liner
- 5072 Combustor caps
- 5073 Flame scanners
- 5074 Flashback including instrumentation
- 5075 Blade path temperature spread
- 5079 Other combustor problems

Turbine
(use HP if only one)

- 5080 High pressure shaft
- 5081 High pressure bearings
- 5082 High pressure blades/buckets
- 5083 High pressure nozzles/vanes
- 5084 High pressure casing/expansion joints
- 5085 Interstage gas passages - HP
- 5086 High pressure shaft seals
- 5087 Thrust Bearing
- 5088 Gas turbine cooling system
- 5089 Other high pressure problems
- 5090 Low pressure shaft
- 5091 Low pressure bearings
- 5092 Low pressure blades/buckets
- 5093 Low pressure nozzles/vanes
- 5094 Low pressure casing/expansion joints
- 5095 Interstage gas passages - LP
- 5096 Low pressure shaft seals
- 5097 Other low pressure problems
- 5098 Expansion joints
- 5099 HP to LP coupling

Exhaust Systems

- 5100 Chamber
- 5101 Hoods
- 5102 Vanes/nozzles
- 5103 Silencer
- 5104 Cones
- 5105 Diverter Dampers
- 5106 Exhaust Stack
- 5108 High engine exhaust temperature
- 5109 Other exhaust problems (including high exhaust system temperature not attributable to a specific problem)

Auxiliary Systems

- 5110 Lube oil system - general

- 5111 Lube oil pumps
- 5112 Lube oil coolers
- 5113 Lube oil valves/piping
- 5115 Oil vapor extractor
- 5116 Power Augmentation System Equipment
- 5117 Power augmentation piping
- 5118 Power augmentation valves
- 5119 Power augmentation controls
- 5120 Hydraulic oil system
- 5121 Hydraulic oil system pumps
- 5122 Hydraulic oil system piping/valves
- 5130 Starting system (including motor)
- 5140 Battery and charger system
- 5150 Turning gear and motor
- 5151 Load gear compartment
- 5160 Cooling and seal air system
- 5170 Cooling water system
- 5180 Anti-icing system
- 5190 Other auxiliary system problems

Miscellaneous (Gas Turbine)

- 5200 Reduction gear
- 5201 Load shaft and bearings
- 5205 Main coupling between the turbine and generator
- 5206 Clutch
- 5210 Intercoolers
- 5220 Regenerators
- 5230 Heat shields
- 5240 Fire detection and extinguishing system (including hazardous gas detection system)
- 5241 Fire in unit
- 5245 Gas Turbine Control System - data highway
- 5246 Gas Turbine Control System - hardware problems (including card failure)
- 5247 Gas Turbine Control System - internal and termination wiring
- 5248 Gas Turbine Control System - logic problems
- 5249 Gas Turbine Control System - upgrades
- 5250 Other Controls and instrumentation Problems
- 5255 Computer
- 5260 Major overhaul (use for non-specific overhaul only; see page B-FS-2)
- 5261 Gas turbine/compressor washing
- 5262 Gas turbine exchange
- 5269 Combustion Inspection (CI)
- 5270 Hot end inspection
- 5272 Boroscope inspection
- 5274 General unit inspection
- 5280 Vibration (not engine) in unit not attributable to bearings or other components
- 5285 Gas turbine vibration
- 5286 Gas Turbine lockout
- 5290 Gas turbine performance testing - individual engines (use code 9999 for total unit performance testing)

| | |
|------|--|
| 5295 | Synchronous condenser equipment |
| 5298 | Main gas filter |
| 5299 | Other miscellaneous gas turbine problems |
| 4805 | Generator Bus Duct Cooling System |
| 4810 | Generator output breaker |
| 4830 | Major overhaul (more than 720 hours) (use for non-specific overhaul only; see page B-FS-2) |
| 4831 | Minor generator overhaul (less than 720 hours) (use for non-specific overhaul only; see page B-FS-2) |
| 4840 | Inspection |
| 4841 | Generator dole testing |
| 4842 | Reactive and capability testing |
| 4850 | Core monitor alarm |
| 4860 | Generator neutral grounding equipment |
| 4899 | Other miscellaneous generator problems |

EXPANDER TURBINE

| | |
|------|---------------------------------|
| 7800 | Couplings |
| 7810 | Shaft |
| 7820 | Bearings |
| 7830 | Blades |
| 7840 | Discs |
| 7850 | Spacers |
| 7860 | Nozzles/vanes |
| 7870 | Heat shields |
| 7880 | Exhaust diffusers |
| 7890 | Seal oil system and seals |
| 7900 | Inner casing |
| 7910 | Outer exhaust casing |
| 7920 | Lube oil system |
| 7930 | Controls and instrumentation |
| 7940 | Evactor |
| 7950 | Major overhaul |
| 7960 | Other expander turbine problems |

POLLUTION CONTROL EQUIPMENT

Miscellaneous (Pollution Control Equipment)

| | |
|------|------------------------------|
| 8656 | Controls and instrumentation |
|------|------------------------------|

Continuous Emissions Monitoring Systems (CEMS)

| | |
|------|--|
| 8700 | CEMS Certification and Recertification |
| 8720 | NO _x analyzer problems |
| 8730 | CO analyzer problems |
| 8740 | CO ₂ analyzer problems |
| 8750 | O ₂ analyzer problems |
| 8770 | Flow monitor problems |

- 8780 Data acquisition system problems
- 8790 Miscellaneous CEMS problems

NO_x Reduction Systems

Selective Non-Catalytic Reduction Systems

- 8800 Reagent
- 8801 Carrier gas
- 8802 Control system
- 8803 SNCR Performance testing
- 8809 Other SNCR problems

Selective Catalytic Reduction Systems

- 8810 Reactor
- 8811 Reagent
- 8812 Catalyst
- 8813 Injection grid piping/valves
- 8814 Catalyst support material
- 8815 Soot blowers
- 8816 Plugging
- 8817 Control system
- 8820 SCR NO_x Ammonia injection grid piping/valves
- 8821 SCR NO_x Ammonia tanks, piping and valves (not injection)
- 8822 SCR NO_x Ammonia air blowers
- 8823 SCR NO_x Other ammonia system problems
- 8825 Other SCR problems

Catalytic Air Heaters

- 8830 Active catalyst
- 8831 Support materials
- 8832 Plugging
- 8835 Other CAH problems

CO Reduction

- 8840 Active catalyst
- 8841 Support materials
- 8842 Plugging
- 8845 Other CO reduction problems

EXTERNAL

Use this set of codes to report events caused by external factors (flood, lightning, etc); economic factors (lack of fuel, labor strikes, etc.); operator training; and transmission system problems external to the plant.

Catastrophe

- 9000 Flood
- 9001 Drought
- 9010 Fire **including wildfires**, not related to a specific component
- 9020 Lightning
- 9025 Geomagnetic disturbance
- 9030 Earthquake
- 9031 Tornado
- 9035 Hurricane
- 9036 Storms (ice, snow, etc)
- 9040 Other catastrophe

Economic

- 0000 Reserve shutdown
- 9130 Lack of fuel (water from rivers or lakes, coal mines, gas lines, etc) where the operator is not in control of contracts, supply lines, or delivery of fuels
- 9131 Lack of fuel (interruptible supply of fuel part of fuel contract)
- 9134 Fuel conservation
- 9136 Problems with Primary Fuel for Units with Secondary Fuel Operation
- 9137 Ground water or other water supply problems.
- 9140 Plant modifications to burn different fuel (not regulatory mandated)
- 9150 Labor strikes company-wide problems or strikes outside the company's jurisdiction such as manufacturers (delaying repairs) or transportation (fuel supply) problems.
- 9151 Labor strikes direct plant management grievances that result in a walkout or strike are under plant management control.
- 9160 Other economic problems
- 9180 Economic (for internal use at plants only)
- 9181 Economic (for internal use at plants only)
- 9182 Economic (for internal use at plants only)
- 9183 Economic (for internal use at plants only)
- 9184 Economic (for internal use at plants only)
- 9185 Economic (for internal use at plants only)
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- 9197 Economic (for internal use at plants only)
- 9198 Economic (for internal use at plants only)
- 9199 Economic (for internal use at plants only)

Fuel Quality

(Use code 9603 to 9653 if the fuel quality results in excess stack emissions through no fault in the pollution control equipment. Use the appropriate equipment code to report fouling and slagging.)

| | |
|------|---|
| 9200 | High ash content (OMC) |
| 9201 | High ash content (not OMC) |
| 9205 | Poor quality natural gas fuel, low heat content |
| 9220 | High sulfur content (OMC) |
| 9221 | High sulfur content (not OMC) |
| 9230 | High vanadium content (OMC) |
| 9231 | High vanadium content (not OMC) |
| 9240 | High sodium content (OMC) |
| 9241 | High sodium content (not OMC) |
| 9260 | Low BTU oil (OMC) |
| 9261 | Low BTU oil (not OMC) |
| 9290 | Other fuel quality problems (OMC) |
| 9291 | Other fuel quality problems (not OMC) |

Miscellaneous (External)

| | |
|------|--|
| 9300 | Transmission system problems other than catastrophes (do not include switchyard problems in this category; see codes 3600 to 3629) |
| 9310 | Operator training |
| 9320 | Other miscellaneous external problems |
| 9340 | Synchronous Condenser Operation |

REGULATORY, SAFETY, ENVIRONMENTAL

Use these codes only for events not directly attributable to equipment failures. Inspections or testing of certain equipment due to regulation are reported using the appropriate equipment cause codes and the fact that it was a regulatory requirement noted in the verbal description section.

Regulatory

| | |
|------|--|
| 9504 | Regulatory (environmental) proceedings and hearings - regulatory agency initiated |
| 9506 | Regulatory (environmental) proceedings and hearings - intervenor initiated |
| 9510 | Plant modifications strictly for compliance with new or changed regulatory requirements (scrubbers, cooling towers, etc.) |
| 9520 | Oil spill in Gulf of Mexico (OMC) |
| 9590 | Miscellaneous regulatory (this code is primarily intended for use with event contribution code 2 to indicate that a regulatory-related factor contributed to the primary cause of the event) |

Stack Emission

(include exhaust emissions)

| | |
|------|---|
| 9603 | SO ₂ stack emissions – gas turbines |
| 9613 | NO _x stack emissions – gas turbines |
| 9623 | Particulate stack emissions – gas turbines |
| 9633 | Opacity – gas turbines |
| 9653 | Other stack or exhaust emissions – gas turbines |

(use codes 9200 to 9290 if fuel quality causes pollution control equipment problems that result in excess stack emissions)

9657 Other stack or exhaust emissions testing - gas turbines

Other Operating Environmental Limitations

9663 Thermal discharge limits – gas turbines

9673 Noise limits (not for personnel safety) – gas turbines

9683 Fish kill – gas turbines

9693 Other miscellaneous operational environmental limits – gas turbines

Safety

9700 OSHA-related retrofit or inspection

9720 Other safety problems

PERSONNEL OR PROCEDURE ERRORS

9900 Operator error

9910 Maintenance personnel error

9920 Contractor error

9930 Operating procedure error

9940 Maintenance procedure error

9950 Contractor procedure error

9960 Staff shortage

INACTIVE STATES

0002 Inactive Reserve Shutdown

9990 Retired unit

9991 Mothballed unit

PERFORMANCE

9997 NERC Reliability Standard Requirement

9998 Black start testing

9999 Total unit performance testing (use appropriate codes for individual component testing)