

Appendix B6 Gas Turbine Unit 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 double 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
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Continuous Emissions Monitoring Systems (CEMS)

- 8700 CEMS Certification and Recertification
- 8710 SO₂ analyzer problems
- 8720 NO_x analyzer problems
- 8730 CO analyzer problems
- 8740 CO₂ analyzer problems
- 8750 O₂ 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)
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- 9196 Economic (for internal use at plants only)
- 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 SO₂ 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)