

Appendix B7 Jet Engine 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 720hours) (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 doble testing
- 4842 Reactive and capability testing
- 4850 Core monitor alarm
- 4860 Generator neutral grounding equipment
- 4899 Other miscellaneous generator problems

JET ENGINE

Inlet Air System and Compressors

(use HP compressor if only one)

Ducts and Filters

- 5400 Inlet air ducts
- 5401 Inlet air vanes/nozzles
- 5402 Inlet air filters
- 5403 Inlet and exhaust cones
- 5404 Inlet air chillers
- 5405 Inlet air evaporative coolers
- 5406 Inlet air foggers
- 5409 Other inlet air problems

Compressors

- 5410 High pressure shaft
- 5411 High pressure bearings
- 5412 High pressure blades/buckets
- 5413 Other high pressure problems
- 5414 Compressor diaphragms/vanes
- 5420 Low pressure shaft
- 5421 Low pressure bearings
- 5422 Low pressure blades/buckets
- 5429 Other low pressure problems
- 5430 Supercharging fans
- 5435 Compressor washing
- 5436 Compressor shaft and bearings for two-shaft machines
- 5439 Other compressor problems

Fuel, Ignition, and Combustion Systems

- 5440 Fuel tanks
- 5441 Fuel piping and valves
- 5442 Fuel nozzles/vanes
- 5443 Fuel filters
- 5444 Liquid fuel oil pump
- 5445 Liquid fuel oil transfer/forwarding pump
- 5446 Liquid fuel purge system
- 5447 Gas fuel system including controls and instrumentation
- 5449 Other fuel system problems
- 5450 Ignition system
- 5451 Pilot fuel piping and valves
- 5452 Pilot fuel nozzles/vanes
- 5453 Pilot fuel filters
- 5454 Water injection system
- 5455 Fuel nozzle/vane cooling air system

- 5460 Atomizing air system
- 5470 Combustor casing
- 5471 Combustor liner
- 5472 Combustor caps
- 5473 Flame scanners
- 5474 Flashback (including instrumentation)
- 5475 Blade path temperature spread
- 5479 Other combustor problems

Turbine

(use HP if only one)

- 5480 High pressure shaft
- 5481 High pressure bearings
- 5482 High pressure blades/buckets
- 5483 High pressure nozzles/vanes
- 5484 High pressure casing/expansion joint
- 5485 Interstage gas passages
- 5486 High pressure shaft seals
- 5487 Thrust Bearing
- 5489 Other high pressure problems
- 5490 Low pressure shaft
- 5491 Low pressure bearings
- 5492 Low pressure blades/buckets
- 5493 Low pressure nozzles/vanes
- 5494 Low pressure casing/expansion joints
- 5497 Other low pressure problems
- 5498 Expansion joints
- 5499 Shaft seals

Exhaust Systems

- 5500 Chamber
- 5501 Hoods
- 5502 Vanes/nozzles
- 5503 Silencer
- 5504 Cones
- 5505 Diverter Dampers
- 5508 High engine exhaust temperature
- 5509 Other exhaust problems (including high exhaust temperature not attributable to a specific problem)

Auxiliary Systems

- 5510 Lube oil system
- 5516 Power Augmentation System Equipment
- 5520 Hydraulic oil system
- 5530 Starting system (including motor)
- 5540 Battery and charger system
- 5550 Turning gear and motor
- 5551 Load gear compartment

- 5560 Cooling and seal air system
- 5570 Cooling water system
- 5580 Anti-icing system
- 5590 Other auxiliary system problems

Miscellaneous (Jet Engine)

- 5600 Reduction gear
- 5601 Load shaft and bearings
- 5605 Main coupling between the turbine and generator
- 5606 Clutch
- 5610 Intercoolers
- 5620 Regenerators
- 5630 Heat shields
- 5640 Fire detection and extinguishing system
- 5641 Fire in unit
- 5645 Jet Engine Control System - data highway
- 5646 Jet Engine Control System - hardware problems (including card failure)
- 5647 Jet Engine Control System - internal and termination wiring
- 5648 Jet Engine Control System - logic problems
- 5649 Jet Engine Control System - upgrades
- 5650 Other Controls and instrumentation Problems
- 5660 Major overhaul (use for non-specific overhaul only; see page B-FS-2)
- 5661 Engine/compressor washing
- 5662 Engine exchange
- 5665 Engine shafts and bearings
- 5670 Hot end inspection
- 5672 Boroscope inspection
- 5674 General unit inspection
- 5680 Vibration (not engine) in unit not attributable to bearings or other components
- 5685 Engine vibration
- 5686 Jet engine lockout
- 5690 Engine performance testing - individual engines (use code 9999 for total unit performance testing)
- 5695 Synchronous condenser equipment
- 5699 Other miscellaneous jet engine 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
- 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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- 9198 Economic (for internal use at plants only)
- 9199 Economic (for internal use at plants only)

Fuel Quality

(Use code 9604 to 9654 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 outages or deratings 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 X 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)

- 9604 SO₂ stack emissions – Jet engines
- 9614 NO_x stack emissions – Jet engines
- 9624 Particulate stack emissions – Jet engines
- 9634 Opacity – jet engines
- 9654 Other stack or exhaust emissions – Jet engines
(use codes 9200 to 9290 if fuel quality causes pollution control equipment problems that result in excess stack emissions)
- 9658 Other stack or exhaust emissions testing - Jet engines

Other Operating Environmental Limitations

- 9664 Thermal discharge limits – jet engines
- 9674 Noise limits (not for personnel safety) – Jet engines
- 9684 Fish kill – jet engines
- 9694 Other miscellaneous operational environmental limits – Jet engines

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)