

## Appendix B9 Geothermal Unit Cause Codes

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(Unit Codes 800–899)

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## **BOILER**

### **Boiler Piping System**

#### **Main Steam**

- 0500 Main steam piping up to turbine stop valves
- 0510 Main steam relief/safety valves off superheater
- 0520 Other main steam valves (including vent and drain valves but not including the turbine stop valves)
- 0530 Other main steam system problems

#### **Desuperheaters/Attemperators**

- 0580 Desuperheater/attemperator piping
- 0590 Desuperheater/attemperator valves
- 0600 Desuperheater/attemperator spray nozzles
- 0610 Desuperheater/attemperator drums
- 0620 Other desuperheater/attemperator problems

## BALANCE OF PLANT

### Condensing System

#### Condenser Tubes and Support Equipment

- 3110 Condenser tube leaks
- 3111 Condenser tube fouling shell side
- 3112 Condenser tube fouling tube side
- 3113 Condenser tube and water box cleaning (including circulating water flow reversal)
- 3114 Air-cooled condenser tubes
- 3115 Air-cooled condenser pumps
- 3116 Air-cooled condenser fans
- 3117 Air-cooled condenser fan motors
- 3118 Other Air-cooled condenser problems
- 3119 Other condenser tube casing or shell and internal problems

#### Condenser Casing or Shell and Internals

- 3120 Tube sheets
- 3121 Expansion joint
- 3122 Gaskets and seals
- 3123 Hot well
- 3124 Tube sheet fouling
- 3129 Other condenser casing or shell and internal problems

#### Vacuum Equipment

- 3130 Air ejectors
- 3131 Air ejector piping and valves
- 3132 Inter and after condensers
- 3133 Vacuum pumps
- 3134 Vacuum pump piping and valves
- 3135 Vacuum pump motor and auxiliaries
- 3139 Other air extraction system problems - general
- 3149 Loss of vacuum not attributable to a particular component such as air ejectors or valves; or, high back pressure not attributable to high circulating water temperature, or vacuum losses from a known cause.

#### Condenser Controls

- 3150 Hot well level controls
- 3151 Vacuum pump and air ejector controls
- 3152 Air-cooled condenser controls
- 3159 Other condensing system controls and instruments

#### Miscellaneous (Condensing System)

- 3170 Condenser inspection (use code 3110 to report looking for tube leaks)
- 3171 Air-cooled condenser inspections

- 3180 Major condenser overhaul
- 3185 Water side cathodic protection
- 3190 Air leakage (for losses not attributable to previously noted equipment related codes)
- 3199 Other miscellaneous condensing system problems

### **Circulating Water Systems**

- 3210 Circulating water pumps
- 3211 Circulating water pump motors
- 3220 Circulating water piping
- 3221 Circulating water piping fouling
- 3230 Circulating water valves
- 3231 Waterbox
- 3232 Condenser tube cleaning system including debris filter
- 3233 Circulating water priming system
- 3235 Cooling tower booster pump
- 3236 Cooling tower booster motor
- 3247 Cooling tower instrumentation
- 3238 Cooling tower fan motors
- 3239 Cooling tower fan motors - variable speed
- 3240 Cooling tower fans
- 3241 Cooling tower efficiency below design
- 3242 Cooling tower fill damage
- 3243 Cooling tower icing
- 3244 Cooling tower fires
- 3245 Other cooling tower problems
- 3246 Cooling tower fouling
- 3247 Cooling tower instrumentation
- 3250 Circulating water system instruments and controls
- 3260 Traveling screens
- 3261 Traveling screen fouling
- 3269 Circulating water biological conditions (ie, zebra mussels)
- 3270 Intake system problems other than traveling screens
- 3271 Intake grating fouling
- 3272 Circulating water screenwash system
- 3280 High circulating water temperature (not due to season, tower efficiency below design, or other listed equipment problem)
- 3281 Circulating water tempering system
- 3282 Circulating water cooling ponds
- 3285 Circulating water chemistry

### **Waste Water (zero discharge) Systems**

- 3290 Waste water (zero discharge) tanks, pumps and motors
- 3291 Waste water (zero discharge) system fouling
- 3292 Waste water (zero discharge) piping
- 3293 Waste water (zero discharge) valves

- 3294 Waste water (zero discharge) controls and instrumentation
- 3295 Other waste water (zero discharge) problems
- 3299 Other circulating water system problems

### **Condensate System**

#### **Pumps, Piping, and Valves**

- 3300 Condensate water pre-treatment
- 3310 Condensate/hotwell pumps
- 3311 Condensate/hotwell pump motor
- 3312 Condensate booster pump
- 3313 Condensate booster pump motor
- 3314 Condensate booster pump motor - variable speed
- 3315 Condensate booster pump drive (other than 3313 and 3314)
- 3320 Condensate piping
- 3330 Condensate valves

#### **Miscellaneous (Condensate System)**

- 3360 Condensate makeup and return (including storage tanks)
- 3370 Condensate system controls and instrumentation (not hotwell level, heater level, or deaerator level controls: see codes 3150-3159, 3344, 3502).
- 3380 Condensate coolers
- 3399 Other miscellaneous condensate system problems

### **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
- 3629 Other switchyard or high voltage system problems - external
- 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**

#### **Open Cooling Water System**

- 3800 Open cooling water pumps and motors
- 3801 Open cooling water piping
- 3802 Open cooling water valves
- 3803 Open cooling water heat exchangers
- 3804 Open cooling water system fouling
- 3805 Open cooling water system instrumentation
- 3806 Open cooling water strainer
- 3809 Other open cooling water problems

### 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
- 3815 Service water strainer
- 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
- 3825 Closed cooling water instrumentation
- 3826 Closed cooling water strainer
- 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
- 3835 Auxiliary boiler burner management system
- 3839 Other auxiliary steam problems (also see extraction steam codes 3520 to 3529; startup bypass codes 0630 to 0660; and soot blower steam code 0870)

### Service Air

- 3840 Service air compressors
- 3841 Service air piping
- 3842 Service air valves
- 3843 Service air dryers
- 3844 Soot blowing air compressor and system
- 3849 Other service air problems

### Instrument Air

- 3850 Instrument air compressors
- 3851 Instrument air piping
- 3852 Instrument air valves
- 3853 Instrument air dryers

- 3854 N<sub>2</sub> 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 instruments and controls
- 3869 Other fire protection system problems

**Seal Air Fans**

- 3880 Seal air fan
- 3881 Seal air fan drive - motor
- 3882 Seal air control dampers and drives
- 3883 Seal air filters
- 3889 Other seal air problems

**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



## STEAM TURBINE

Besides the turbine, this set includes the steam stop/control valves, turbine control system, and the turbine auxiliaries. The extraction steam codes are contained in the Balance of Plant set.

### Low Pressure Turbine

4200	Outer casing
4201	Inner casing
4209	Nozzle bolting
4210	Nozzles and nozzle blocks
4211	Diaphragms
4212	Buckets or blades
4213	Bucket or blade fouling
4215	Wheels or spindles
4220	Shaft seals
4221	Dummy rings
4222	Gland rings
4230	Rotor shaft
4240	Bearings
4241	Thrust bearings
4250	Other low pressure turbine problems

### Valves

4260	Main stop valves
4261	Control valves
4262	Intercept valves
4263	Reheat stop valves
4264	Combined intercept valves
4265	Miscellaneous drain and vent valves
4266	Main stop valve testing
4267	Control valve testing
4268	Reheat/intercept valve testing
4269	Other turbine valves

### Piping

4270	Crossover or under piping
4279	Miscellaneous turbine piping

### Lube Oil

(do not include bearing failures due to lube oil)

4280	Lube oil pumps
4281	Lube oil coolers

- 4282 Lube oil conditioners
- 4283 Lube oil system valves and piping
- 4284 Lube oil pump drive
- 4289 Other lube oil system problems

### **Controls**

- 4290 Hydraulic system pumps
- 4291 Hydraulic system coolers
- 4292 Hydraulic system filters
- 4293 Hydraulic system pipes and valves
- 4299 Other hydraulic system problems
- 4300 Turbine supervisory system (use codes 4290 to 4299 for hydraulic oil)
- 4301 Turbine governing system
- 4302 Turbine trip devices (including instruments)
- 4303 Exhaust hood and spray controls
- 4304 Automatic turbine control systems - mechanical
- 4305 Automatic turbine control systems - mechanical - hydraulic
- 4306 Automatic turbine control systems - electro-hydraulic - analog
- 4307 Automatic turbine control systems - electro-hydraulic - digital
- 4308 Automatic turbine control systems - digital control and monitoring
- 4309 Other turbine instrument and control problems
- 4310 Steam Turbine Control System - data highway
- 4311 Steam Turbine Control System - hardware problems (including card failure)
- 4312 Steam Turbine Control System - internal and termination wiring
- 4313 Steam Turbine Control System - logic problems
- 4314 Steam Turbine Control System – upgrades

### **Miscellaneous (Steam Turbine)**

- 4400 Major turbine overhaul (720 hours or longer) (use for non-specific overhaul only; see page B-FS-2)
- 4401 Inspection
- 4402 Minor turbine overhaul (less than 720 hours) (use for non-specific overhaul only; see page B-FS-2)
- 4410 Turning gear and motor
- 4411 Steam turbine gear box (single shaft configuration)
- 4412 Steam turbine clutch (single shaft configuration)
- 4415 Shaft coupling mechanism
- 4420 Vibration of the turbine generator unit that cannot be attributed to a specific cause such as bearings or blades (use this code for balance moves)
- 4430 Gland seal system
- 4450 Water induction
- 4460 Turbine overspeed trip test
- 4470 Differential expansion
- 4490 Turbine performance testing (use code 9999 for total unit performance testing)
- 4499 Other miscellaneous steam turbine 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

### 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 generator overhaul (720 hours or longer) (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
- 4850 Core monitor alarm
- 4860 Generator neutral grounding equipment
- 4899 Other miscellaneous generator problems

## **MISCELLANEOUS - GEOTHERMAL**

### **Plant and Auxiliaries**

- 6410 Steam wells/steam field piping problems
- 6415 Low steam pressure
- 6420 Condensate reinjection system
- 6430 Unit H<sub>2</sub>S emission limitations - regulatory
- 6435 Steam field H<sub>2</sub>S emission limitations - regulatory
- 6440 H<sub>2</sub>S abatement system problems - general
- 6450 Heat exchanger problems due to H<sub>2</sub>S abatement system
- 6460 Condenser problems due to H<sub>2</sub>S abatement system
- 6470 Cooling tower problems due to H<sub>2</sub>S abatement system
- 6480 Steam strainer plugging - mineral deposits
- 6490 Turbine plugging - mineral deposits
- 6499 Geothermal

## **POLLUTION CONTROL EQUIPMENT \***

Use this set of codes to report problems with flue gas desulphurization equipment and stack gas particulate removal equipment. If outages or deratings occur due to reasons other than equipment problems, use the set of codes for Regulatory, Safety, Environmental stack emission limits.

### **Wet Scrubbers**

#### **Chemical Supply**

- 8000 Chemical feed storage, mill feeders, and conveyors
- 8002 Screw conveyors
- 8003 Bucket elevators
- 8006 Weigh feeders

- 8010 Crushers/mills
- 8020 Mill slurry tanks supply problems
- 8030 Classifiers
- 8040 Slurry transfer pumps and motors
- 8050 Chemical unavailability
- 8099 Other chemical supply problems

**Wet Scrubber**

- 8100 Scrubber/absorber tower or module
- 8110 Spray nozzles
- 8115 Disc scrubber throats
- 8120 Spray pumps and motors
- 8125 Scrubber recycle (liquid) pumps
- 8127 Scrubber recycle (liquid) pump motors
- 8130 Recirculation tanks including agitators
- 8140 Reaction tanks including agitators
- 8150 Tubes
- 8160 Mist eliminators/demisters and washdown
- 8199 Other scrubber problems

**Piping, Ducting, Dampers, and Fans**

- 8200 Piping
- 8210 Valves
- 8220 Strainers or filters
- 8225 Drain pots
- 8230 Ducting
- 8235 Demister
- 8240 Bypass dampers
- 8250 Dampers other than bypass
- 8260 Scrubber booster I.D. fan (fan specific to the scrubber)
- 8261 Scrubber booster I.D. fan drive

*\*Use code 9510 for outages or deratings required to install pollution control equipment. Use codes 9600 to 9650 only when the pollution control equipment problems are not responsible for exceeding emission limits.*

- 8262 Scrubber booster I.D. fan vibration (fan specific to the scrubber)
- 8264 Scrubber booster I.D. fan blades (fan specific to the scrubber)
- 8270 Scrubber booster F.D. fan (fan specific to the scrubber)
- 8271 Scrubber booster F.D. fan drive
- 8272 Scrubber booster F.D. fan vibration (fan specific to the scrubber)
- 8274 Scrubber booster F.D. fan blades (fan specific to the scrubber)
- 8280 Reagent feed piping
- 8290 Demister wash piping assembly
- 8299 Other piping, ducting, damper, and fan problems

**Miscellaneous (Wet Scrubber)**

8400	Scrubber gas discharge reheaters - general
8402	Scrubber gas discharge reheaters - vibration
8404	Scrubber gas discharge reheaters - tube leaks
8406	Scrubber gas discharge reheaters - ducts
8410	Scrubber instruments and controls
8415	Liquid level controls
8420	Heat tracer
8425	Miscellaneous mechanical failures
8426	Miscellaneous electrical failures
8430	Stack damage related to scrubber system
8440	Major overhaul
8450	Inspection
8460	Testing
8470	SO <sub>2</sub> monitor
8499	Other miscellaneous wet scrubber problems

### **Continuous Emissions Monitoring Systems (CEMS)**

8700	CEMS Certification and Recertification
8710	SO <sub>2</sub> analyzer problems
8720	NO <sub>x</sub> analyzer problems
8730	CO analyzer problems
8740	CO <sub>2</sub> analyzer problems
8750	O <sub>2</sub> analyzer problems
8760	Opacity monitor problems
8770	Flow monitor problems
8780	Data acquisition system problems
8790	Miscellaneous CEMS 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 <i>including wildfires</i> , 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
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- 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 that are 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)

**Miscellaneous (External)**

- 9300 Transmission system problems other than catastrophes (do not include switchyard problems in this category; see codes 3600 to 3629, 3720 to 3730)
- 9305 Ash disposal problem
- 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 - intervener 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)

### 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

## 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)