

# Appendix B5 Hydro Pumped Storage Unit Cause Codes

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## HYDRO/PUMPED STORAGE UNITS INDEX TO SYSTEM/COMPONENT CAUSE CODES

(Unit Codes 500–599 and 900–999)

<b>BALANCE OF PLANT</b>	<b>Cause Code Ranges</b>	<b>Page No.</b>
Electrical	3600-3690	B-HY-2
Power Station Switchyard	3700-3730	B-HY-3
Auxiliary Systems	3810-3899	B-HY-3
Miscellaneous (Balance of Plant)	3950-3999	B-HY-4
<b>GENERATOR</b>		
Generator	4500-4590	B-HY-5
Exciter	4600-4609	B-HY-5
Cooling System	4610-4650	B-HY-5
Controls	4700-4750	B-HY-6
Miscellaneous (Generator)	4800-4899	B-HY-6
<b>HYDRO TURBINE/PUMP</b>		
Turbine	7000-7099	B-HY-6
Water Supply/Discharge	7100-7199	B-HY-7
Miscellaneous (Hydro Turbine/Pump)	7200-7300	B-HY-7
<b>EXTERNAL</b>		
Catastrophe	9000-9040	B-HY-8
Economic	0000, 9135-9160	B-HY-8
Economic (for internal use at plants only)	9180-9199	B-HY-8
Miscellaneous (External)	9300-9350	B-HY-9
<b>REGULATORY, SAFETY, ENVIRONMENTAL</b>		
Regulatory	9504-9590	B-HY-9
Other Operating Environmental Limitations	9676-9696	B-HY-9
Safety	9700-9720	B-HY-9
<b>PERSONNEL OR PROCEDURE ERRORS</b>	9900-9960	B-HY-10
<b>INACTIVE STATE</b>	0002, 9990-9991	B-HY-10
<b>PERFORMANCE</b>	9997-9999	B-HY-10

## 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 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
- 3869 Other fire protection system 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
- 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
- 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 (including damper windings and fan blades on hydro units)
- 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 (including thrust bearings on hydro units)
- 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 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
- 4842 Reactive and capability testing
- 4850 Core monitor alarm
- 4860 Generator neutral grounding equipment
- 4899 Other miscellaneous generator problems

## **HYDRO TURBINE/PUMP**

### Turbine

- 7000 Shaft
- 7001 Shaft packing
- 7003 Lube oil system (use code 7007 to report bearing failures due to lube oil problems)
- 7007 Bearings
- 7008 Bearing cooling system
- 7009 Bearing oil system
- 7010 Runner cavitation damage
- 7011 Other runner problems
- 7012 Casing, wear ring, or liner cavitation damage
- 7014 Blade or bucket cracking
- 7020 Nozzle assembly
- 7030 Vibration (Only for unbalance, report bearing failure, etc., in appropriate category)
- 7040 Turbine overhaul
- 7050 Turbine governor
- 7052 Other turbine control problems (Report specific wicket gate controls, etc., using the code for the appropriate equipment item.)
- 7053 Governor oil system
- 7070 Speed Increaser
- 7099 Other turbine problems

### Water Supply/Discharge

- 7100 Upper reservoir dams and dikes
- 7101 Lower reservoir dams and dikes
- 7102 Auxiliary reservoir dams and dikes
- 7110 Intake channel or flume (including trash racks)
- 7111 Intake tunnel
- 7112 Ice blockages at intake structures including frazil ice, sheets, blocks of ice, etc.
- 7120 Headgates
- 7121 Shutoff valves
- 7123 Shutoff valve bypass line and valve
- 7124 Penstock
- 7130 Spiral case
- 7140 Wicket gate assembly
- 7141 Wicket gate operating mechanism or positioner
- 7142 Wicket gate shear pin
- 7150 Stay vanes
- 7160 Pressure regulating valve
- 7161 Pressure regulating valve operator or positioner
- 7162 Relief valve and vacuum breakers
- 7170 Draft tube
- 7180 Tailrace
- 7181 Tail water depressing equipment
- 7190 Dewatering and rewatering equipment
- 7191 Equalizing line
- 7199 Other water supply/discharge problems (use for equipment related problems; use codes 9135 or 9320 for lack of water or discharge limit related problems)

### Miscellaneous (Hydro Turbine/Pump)

- 7200 Major overhaul (use for non-specific overhaul only; see page B-FS-2)
- 7201 Inspection
- 7210 Canals (including siphons, radial gates, and spills)
- 7220 Unit out of service due to common penstock with unit under repair
- 7230 Pony motor (pumped storage units only)
- 7240 Powerhouse substructure
- 7299 Other miscellaneous hydro turbine/pump problems (use generator codes and balance of plant electrical and auxiliary codes as appropriate)
- 7300 Routine Hydro Planned Outage (reoccurring schedule) (Use 4840 or 7201 for specific inspections.)

## **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
9135	Lack of water
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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9197	Economic (for internal use at plants only)
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)
- 9310 Operator training
- 9320 Other miscellaneous external problems
- 9340 Synchronous Condenser Operation
- 9345 Pumping Operations
- 9350 Public Safety (water hazard or river rescue)

**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)

**Other Operating Environmental Limitations**

- 9676 Noise limits (not for personnel safety) – hydro and pumped storage
- 9686 Fish kill – hydro and pumped storage
- 9696 Other miscellaneous operational environmental limits – hydro and pumped storage

**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)