Q. Provide Hydro's list of outage-cause codes and indicate how troublemen are managed and trained to properly use the codes. Explain the method used to report outage causes.

A. Hydro maintains outages codes for use on the transmission system (> 46 kV) and the distribution system. The following explains each system.

Transmission System

Hydro follows the Canadian Electricity Association (CEA) approved outage cause codes for reporting outages on the transmission system for both Bulk Electric System delivery points and transmission equipment outages. These codes are used by the Energy Control Centre (ECC) Operators to enter the information into Hydro's Reliability Reporting System database after a disturbance event occurs. The Senior System Operations Engineer – Reliability (SSOE-R) reviews the record entry, completes an initial investigation into the cause of the outage, trains the ECC operators on the use of the cause codes and updates the cause code as required. For unknown outage causes, the ECC Operator will use *undetermined* as the cause code. This code is updated by the SSOE-R following the investigation into the disturbance event, which will include discussions with field staff as necessary. The SSOE-R participates in CEA workshops where the proper use of codes is discussed among participating utilities. In addition, the CEA has published manuals which are referenced for reporting purposes. The outage cause codes are as follows:

Transmission Cause Code Definitions

The following describes the cause codes used in the Reliability Reporting System. The reporting code to be used is the root cause (primary cause) of the outage.

Code 100 - Defective Equipment

There are five sub codes used to break down the defective equipment cause code. These codes are as follows:

101 - Deterioration due to age – Equipment failure caused by the age of equipment.

102 - Incorrect Manufacturing Design – Equipment that has a manufacturing design flaw.

103 - Incorrect Manufacturing Materials – Equipment manufactured with incorrect materials

104 - Incorrect Manufacturing Assembly – Equipment was assembled incorrectly by the manufacturer.

105 - Lack of Maintenance – Equipment failure caused by incorrect maintenance procedures or no maintenance done on the equipment.

106 - Other – Defective Equipment – Equipment failure which does not fall in any of the sub codes listed above.

Code 200 – Adverse Weather

There are 11 sub codes used to describe Adverse Weather. The best code to describe the condition that existed at the time of the outage to the equipment is used. Environment Canada or any other weather service provider is used to confirm the weather condition at the time of the outage.

201 - Lightning – Outage was caused by a confirmed lightning storm.

202 - Rain – Outage was caused by heavy rains.

203 - Freezing Rain – Outage was caused by freezing rain.

204 - Ice – Outage was caused by an ice accumulation.

205 - Snow – Outage was caused by a snow storm.

206 - Wind – Outage was caused by a wind storm.

207 - High Ambient Temperatures – Abnormal temperatures above the operating range of equipment.

208 - Low Ambient Temperatures – Abnormal temperatures below the operating range of equipment.

209 - Freezing Fog or Frost – Outage was caused by a freezing fog or frost.

210 - Tornadoes – Outage was caused by a confirmed tornado.

211 - Hail – Outage was caused by a hail storm.

212 - Galloping – Outage caused by galloping conductors.

Code 300 – Adverse Environment

There are eight sub codes used to describe Adverse Environment. The best code to describe the condition that existed at the time of the outage to the equipment is used. These sub codes, where possible, are determined by field personnel at the location of the equipment which resulted in the outage.

301 - Salt Spray – Outage due to salt contamination.

302 - Industrial Pollution – Outage due to any type of industrial pollution. Not caused by birds.

303 - Humidity – Outage due to a humidity problem.

304 - Corrosion – Outage due to corrosion on the equipment that caused the outage.

305 - Vibration – Outage due to vibration on the equipment that caused the outage.

306 - Fire – Outage due to a fire on or near the equipment that caused the outage. This could be a forest, building or any type of fire. Also includes smoke from the fire.

307 - Flooding – Outage due to flooding or damage from flooding to the equipment that caused the outage.

308 - Flying Debris – Outage due to any type of flying debris that hit on the equipment that caused the outage.

Code 400 – System Conditions

There are seven sub codes used to describe System Conditions. These sub codes are determined by SSOE-R, who investigates the power system conditions at the time of the outage.

401 - Over-Voltage.

402 - Under Voltage.

403 - Switching Transient.

404 – Overload.

405 - Over-Frequency.

406 - Under-Frequency.

407 - Operation Related – System Configuration.

Code 500 – Human Element

There are ten sub codes used to describe Human Element related outages. These sub codes are determined by SSOE-R who reviews the outage.

501 - Incorrect System Records or Diagrams – Equipment information or drawing was incorrect which resulted in a human tripping the equipment.

502 - Incorrect Use of Equipment – Equipment tripped due to a human(s) using that equipment incorrectly.

503 - Incorrect Construction, Installation or Maintenance – Equipment was constructed, installed or maintained incorrectly.

504 - Incorrect Protection setting – Protection had the wrong setting applied or the protection was calculated in error.

505 - Switching Error – Personnel performing the switching caused the trip.

506 - Testing – Equipment tripped during testing due to human interaction.

507 - Incorrect Circuit Labeling – Equipment was labeled incorrect.

508 - Contact (resulting in no damage) by Employees or Utility Contractors

509 - Deliberate Damage by Employees or Utility Contractors

510 - Accidental Damage by Employees or Utility Contractors

Code 600 - Foreign Inference

There are 12 sub codes used to describe Foreign Inference. These sub codes are determined by SSOE-R who reviews the outage.

601 - Contact (resulting in no damage) by Persons other than Employees or Utility Contractors.

602 - Deliberate Damage by Persons Other Than Employees or Utility Contractors – Vandalism, Terrorism, or other Malicious Acts (Hunters).

603 - Accidental Damage by Persons Other Than Employees or Utility Contractors.

604 - Contact by Vehicles – Equipment tripped after it was hit by a vehicle (on-road or off-road type).

605 - Contact by Animals – Equipment tripped after it was contacted by an animal (not human).

606 - Contact by Trees – Equipment tripped after it was hit by a tree, broken tree branch, tree growing up in the line, falling tree, or tree damage due to storm.

607 - Solar Magnetic Induction – Equipment tripped after a confirmed Solar Magnetic Storm.

608 - Birds – Equipment tripped after a bird hit the equipment.

609 - Crane – Equipment tripped after it was hit by a crane (not a vehicle).

610 - Kite – Equipment tripped after it was hit by a kite.

611 - Plane – Equipment tripped after it was hit by an aircraft.

612 - Vegetation – Equipment tripped after it was contacted by vegetation (not considered a tree).

Code 700 – Loss of Generation

Used for delivery point interruptions only, caused by the loss of generation in the system that was supplying the delivery point at the time of the trip.

Code U – Unknown

The cause of the outage could not be determined. To be used only after the investigation could not determine the root cause.

Distribution System

The Distribution System includes all equipment rated at 46 kV and below. Reporting occurs for only equipment problems which result in customer interruptions. The distribution system reporting is based on the CEA approved outage codes. Hydro uses a further breakdown to some of the cause codes. These additional codes are used by Hydro to identify certain areas of concern. Line crews are trained to complete the attached form (PUB-NLH-185 Attachment 1) for each trouble call affecting one customer or the entire distribution feeder. The Asset Specialist – Distribution will complete the form for total distribution system outages. New personnel are trained by senior members of the line crews or by Line Supervisors. The completed forms are forwarded to office clerks for input into the Distribution Outage Reporting System database. The Asset Specialist – Distribution reviews and verifies all reports. The Asset Specialist is a senior person who is familiar with the reporting system. These reports are monitored for each distribution feeder to identify any trends that may be developing in substandard

materials or in work practices that need to be improved upon. In addition, any work identified by the line crew or by the Asset Specialist that requires immediate attention is addressed by the line crew at the time and if it can wait to be scheduled, it is provided to the distribution planner to schedule a work crew to address.

Distribution Cause Codes Definitions

A customer interruption cause is defined in terms of the primary cause of the interruption. These causes are assigned the following codes:

0. Unknown/Other

Customer interruptions with no apparent cause or reason which could have contributed to the outage.

1. Scheduled Outage – Planned

Customer interruptions due to the disconnection at a selected time for the purpose of construction or preventive maintenance.

2. Loss of Supply

Customer interruptions due to a trip or problems in the bulk electricity supply system such as underfrequency load shedding, transmission system transients, or system frequency excursions. Also includes the trip of the diesel plant on isolated systems.

3. Tree Contacts

Customer interruptions caused by faults due to trees or tree limbs contacting energized circuits.

4. Lightning

Customer interruptions caused by faults due to lightning striking the Distribution System, resulting in an insulation breakdown and/or flashover.

5. Defective Equipment

a. Defective Equipment – Flashover (Further breakdown for Hydro use).

b. Defective Equipment – Overload (Further breakdown for Hydro use).

Customer interruptions resulting from equipment failures due to deterioration from age, incorrect maintenance, or imminent failures detected by maintenance.

6. Adverse Weather

a. Adverse Weather – Gallop Conductor (Further breakdown for Hydro use).

Customer interruptions resulting from rain, ice storms, snow winds, extreme ambient temperatures, freezing fog, or frost and other extreme conditions.

7. Adverse Environment

a. Environment – Corrosion (Further breakdown for Hydro use).

b. Environment – Salt Spray (Further breakdown for Hydro use).

Customer interruptions due to equipment being subjected to abnormal environment such as salt spray, industrial contamination, humidity, corrosion, vibration, fire or flooding.

8. Human Element (Human Error)

Customer interruptions due to the interface of the utility staff with the system such as incorrect records, incorrect use of equipment, incorrect construction or installation, incorrect protection settings, switching errors, commissioning errors, deliberate damage, or sabotage.

9. Foreign Interference

a. Foreign Interference – Blasting (Further breakdown for Hydro use).

b. Foreign Interference – Object (Further breakdown for Hydro use).

c. Foreign Interference – Vehicle (Further breakdown for Hydro use).

Customer interruptions beyond the control of the utility such as birds, animals, vehicles, dig-ins, vandalism, sabotage and foreign objects.

10. Customer Request

Customer requested a disconnection at a selected time for the purpose of changes on customer owned equipment.

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TRO DISTRIBUTION TROUBLE REPORT

CUSTOMER INFORMATION	NAME:	JDE WORK ORDER NO.	
	LOCATION:	SYSTEM NO.	
NATURE OF TROUBLE:		FEEDER(S) AFFECTED :	
		REPORTED BY:	
		RECEIVED BY:	
		WORK DONE BY:	
		DATE: TIME: HRS.	
		TRANSFORMER	
		T #:	
		KVA:	
POTENTIAL DAMAGE CLAIM? YES ☐ NO ☐	THIRD PARTY CONTACT (IF APPLICABLE):	LOAD (AMPS):	
		SEC VOLT:	

INTERRUPTION DEVICE	DATE				LINE #	NO. CUSTOMERS INTERRUPTED	DURATION HRS : MINS
	MONTH	DAY	YEAR	TIME (24 HR)			
INTERRUPTION							:
RESTORATION							:
RESTORATION							:
RESTORATION							:

FAILURE DATA - CHECK ONE ITEM ONLY IN EACH CATEGORY

PRECIPITATION	☐ NONE	☐ RAIN	☐ FREEZING RAIN	☐ SLEET	☐ SNOW	☐ FOG	☐ LIGHTNING
WIND	☐ NORMAL	☐ HIGH (TO 50 KMH)	☐ EXCEPTIONALLY HIGH (OVER 50 KMH)				
LOSS OF SUPPLY	☐ 230 KV	☐ 138 KV	☐ 66 KV	☐ GENERATION	☐ N/A		
DIST VOLTAGE AFFECTED	☐ 46 kV	☐ 25 / 14.4 kV	☐ 12.5 / 7.2 kV	☐ 4.16 / 2.4 kV	☐ SECONDARY		
INTERRUPTING DEVICE	☐ H V FUSE	☐ RECLOSER	☐ LINE SECTIONALIZER	☐ BREAKER	☐ TRANSFORMER FUSE	☐ DISCONNECT SWITCH	☐ OTHER
RESTORED BY	☐ REPAIR	☐ RECLOSING DEVICE	☐ REPLACEMENT	☐ SECTIONALIZING	☐ LOAD TRANSFERS	☐ OTHER/ UKNOWN	
CAUSE	☐ PLANNED	☐ CORROSION	☐ FLASHOVER	☐ SALT SPRAY	☐ GALLOPING CONDUCTOR	☐ DEFECTIVE EQUIPMENT	☐ TREES
	☐ VEHICLE	☐ BLASTING	☐ FOREIGN OBJECT	☐ OVERLOAD	☐ HUMAN ERROR	☐ CUSTOMER REQ./PROBLEM	☐ OTHER/ UKNOWN
	☐ LOSS OF SUPPLY	☐ LIGHTNING	☐ WEATHER	☐ ADVERSE ENVIRONMENT			
FAULT ANALYSIS	☐ 3 PH	☐ PH - PH	☐ PH - N	☐ PH - SEC	☐ PH- PH- SEC	☐ PH - FOREIGN OBJECT	☐ NO FAULT

COMPONENT RESPONSIBLE FOR FAULT OR OUTAGE - CHECK ONE ITEM ONLY

OVERHEAD CIRCUIT	☐ SPLICE	☐ PRIMARY CONDUCTOR	☐ SECONDARY CONDUCTOR	☐ SERVICE DROP	☐ SERVICE CLAMP	☐ TRANSFORMER	☐ TRANSFORMER FUSE
	☐ CONNECTOR	☐ JUMPER	☐ INSULATOR	☐ PIN	☐ TIE	☐ SECTIONALIZER	☐ LIGHTNING ARRESTER
	☐ POLE	☐ ARM	☐ BRACE	☐ ANCHOR AND ROD	☐ GUY ASSEMBLY	☐ REGULATOR	☐ BY-PASS SWITCH
	☐ RECLOSER	☐ DISCONNECT SWITCH	☐ METERING TANK	☐ P.T.	☐ OTHER/ UKNOWN		
SUBSTATION	☐ BUS	☐ RECLOSER	☐ REGULATOR	☐ BY-PASS SWITCH	☐ INSULATOR	☐ LV LIGHTNING ARRESTOR	☐ LV CONNECTOR
	☐ LV FUSE	☐ HV FUSE	☐ BREAKER	☐ DISCONNECT SWITCH	☐ METERING TANK	☐ HV LIGHTNING ARRESTOR	☐ HV CONNECTOR
	☐ C.T.	☐ P.T.	☐ POWER TRANSFORMER	☐ TERMINATION	☐ OTHER/ UKNOWN		
CUSTOMER EQUIPMENT	☐ FUSE	☐ METER	☐ METER SOCKET	☐ CUSTOMER BREAKER	☐ STREET LIGHT	☐ OTHER/ UKNOWN	

EXPLAIN PROBABLE CAUSE & ACTION TAKEN: _____

REPLACED TRANSFORMER #: _____ KVA: _____ VOLTAGE: _____ POLE #: _____

NATURE OF REPAIR			
☐	PERMANENT	☐	TEMPORARY

☐ REPORT ATTACHED

FIELD SIGNATURE: _____

FRONT LINE SIGNATURE: _____

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