



Province of
British Columbia
Ministry of
Transportation
and Highways

Highway Engineering Branch
Electrical Section

Cassiar Tunnel

Preventive Maintenance

Check List

Version 1.2

March 1995

PREVENTIVE MAINTENANCE FOR THE

This is file: E4C0001M.DOC

Procedure for printing preventive maintenance check lists:

FILE

FIND FILE

ADVANCED SEARCH

- select the sub-directory where the check lists reside
- **ADD** this directory to the **Search in:** box
- remove any other directories from this box.
- enter *.DOC in the **File name:** box
- click **OK**

OK

- select the files to be printed by highlighting - use the shift or control keys for multiple selections.

COMMANDS

PRINT

OK

(see page 2)

PREVENTIVE MAINTENANCE FOR THE

Procedure for creating preventive maintenance check lists from the maintenance standards:

The HEADER and FOOTER of this file are used when generating a checklist from the Cassiar Standards Manual.

The following table row is the second row for use when generating a checklist:

Item:	<input checked="" type="checkbox"/>
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OPEN A NEW OR EXISTING CHECKLIST FILE

OPEN THIS FILE E4C0001M.DOC

OPEN THE STANDARD FILE CONTAINING THE CHECKLIST

SELECT THE CHECKLIST IN THE STANDARD AND COPY IT TO THE NEW OR EXISTING CHECKLIST FILE.

SELECT THE PORTION(S) OF THE COPIED CHECKLIST WHICH REQUIRE A CHECK COLUMN AND PRESS ALT + X (MACRO) TO ADD A COLUMN TO THE TABLE.

SELECT THE ADDED COLUMN AND PRESS ALT+W (MACRO) TO FORMAT THE CHECK COLUMN

DELETE THE "TABLE 999.09" HEADING ROW FROM THE CHECKLIST TABLE

COPY THE "ITEM" ROW FROM THIS FILE TO THE SECOND LINE OF THE CHECKLIST TABLE.

ADD CHECK BOXES WHERE APPROPRIATE USING ALT+Z

PAGE THE CHECKLIST BY INSERTING PAGE BREAKS AND ADDING BORDERS WHERE REQUIRED. USE ALT+P IF YOU ARE BRAVE.

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done once a month.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This maintenance shall be done during a week day when expert help and parts may be available.
.4	PM maintenance shall not be performed during rush hours or emergencies.
.5	Check with the tunnel operator and facility log book for problems relating to this equipment.
2 Cautions:	
.1	Do not use a vacuum cleaner in the immediate vicinity of any computer printed circuit boards. The high velocity air movement may create a high static electrical charge which may damage the equipment.
3 General Lock-out:	
.1	Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.
4 Equipment:	
.1	Honeywell (DDC) panels 1, 2, 3, 4, and 5 - located in substation.
.2	Fail Safe Panel - located in substation adjacent to DDC panels.
.3	Fire-fighters' Control Panel - located in operators' control room.
.4	Emergency Backup Panel - located in operators' control room.
.5	PC Computer, Monitor and Printer - located in operators' control room.
.6	Tunnel Fan MCC - DDC relay control sections - located in 3 substation MCC cabinets adjacent to tunnel fan MCCs.

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

5 Honeywell (DDC) panels 1, 2, 3, 4, and 5:

- .1 Check the six LEDs located on the bottom of the processor board:
 - .1 The three on the right column of should be "off".
 - .2 The three on the left column should be:
 - .1 - DIAG "on"
 - .2 - TRANS "blinks constantly"
 - .3 - REC "on"

panel	left column leds			right column leds		
	DIAG	TRANS	REC	off	off	off
1						
2						
3						
4						
5						

- .3 If these do not flash as noted above check the transformer and fuse then notify Honeywell.
- .4 Visually inspect and clean the panels.
- .5 Close and lock the panel doors.

6 Fail Safe Panel:

- .1 Caution: Do not operate the toggle switch. This switch should be left in the centre position. This is a very "sensitive" switch to set.
- .2 Visually inspect and clean the panel.
- .3 Close and lock the panel door.

7 Tunnel Fan T/D relays control sections:

- .1 Visually inspect and clean the equipment.
- .2 Caution: Do not adjust the delay time settings on these relays as they sequence the starting to prevent overload conditions on start-up.

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

8 Emergency Backup Panel:

- .1 Unlock and open panel door. This will disable all other control of the tunnel fans, stop the fans and give control to this panel.
- .2 Visually inspect and clean the panel.
- .3 Check that the Tunnel Fans MCC starter switches are in the "auto" position and the indicator lamps show "off" green.
- .4 Press the panel buttons to forward each fan pair.
- .5 Check and record the appropriate indicator lamps on the Emergency Backup Panel (**EBP**) Tunnel Fans **MCCs** and the Honeywell Computer Monitor (**HCM**).
- .6 Press the panel buttons to stop each fan pair.
- .7 Check and record the appropriate indicator lamps on the Emergency Backup Panel (**EBP**) Tunnel Fans **MCCs** and the Honeywell Computer Monitor (**HCM**).
- .8 Press the panel buttons to reverse each fan pair.
- .9 Check and record the appropriate indicator lamps on the Emergency Backup Panel (**EBP**) Tunnel Fans **MCCs** and the Honeywell Computer Monitor (**HCM**).

Fan↓	Forward indications			Stop indications			Reverse indications		
	M	E	H	M	E	H	M	E	H
	C	B	C	C	B	C	C	B	C
	C	P	M	C	P	M	C	P	M
FF-S-8A									
FF-S-8B									
FF-S-7A									
FF-S-7B									
FF-S-6A									
FF-S-6B									
FF-S-5A									
FF-S-5B									
FF-S-4A									
FF-S-4B									
FF-S-3A									
FF-S-3B									
FF-S-2A									
FF-S-2B									
FF-S-1A									
FF-S-1B									

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

Fan↓	Forward indications			Stop indications			Reverse indications		
	M	E	H	M	E	H	M	E	H
	C	B	C	C	B	C	C	B	C
	C	P	M	C	P	M	C	P	M
FF-N-8A									
FF-N-8B									
FF-N-7A									
FF-N-7B									
FF-N-6A									
FF-N-6B									
FF-N-5A									
FF-N-5B									
FF-N-4A									
FF-N-4B									
FF-N-3A									
FF-N-3B									
FF-N-2A									
FF-N-2B									
FF-N-1A									
FF-N-1B									

- .10 Close and lock panel door. This will stop any fans and return control of the tunnel fans to the Honeywell.
- .11 Return the key to the "red" box.

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

9 Fire-fighters' Control Panel:

- .1 Visually inspect and clean the exterior of the panel.
- .2 Insert and turn the key to activate the panel.
- .3 The "General Fire" lamp should be "off"
- .4 The "Hydro Failure" lamp should be "off"
- .5 The "Controller Failure" lamp should be "off"
- .6 The "Normal" lamp should be "on"
- .7 The "Fire S.B. Tube" lamp should be "off"
- .8 The "Fire N.B. Tube" lamp should be "off"
- .9 Press "Lamp Test" button to test lamps - all lamps should light.
- .10 Ensure that the Emergency Backup Panel door is closed.
- .11 Press buttons to activate each selection in turn. Check and record indication of each fan on the Firefighters' Control Panel and the Emergency Backup Panel:

Selection	Lamps	
	Emergency Backup Panel	Firefighters' Control Panel
S.B. Tube - Fan Forward		
S.B. Tube - Fan Stop		
S.B. Tube - Fan Reverse		
N.B. Tube - Fan Forward		
N.B. Tube - Fan Stop		
N.B. Tube - Fan Reverse		

- .12 Turn "off" key and return to "red" box.
- .13 Press "Reset to Auto" button.
- .14 Visually check that Firefighters' Control Panel has returned to normal.
- .15 Check that Honeywell alarms have been restored to normal.

10 PC Computer, Monitor and Printer

- .1 Visually inspect for damage.
- .2 Clean equipment and surrounding area.
- .3 Check monitor for "burn in" which impairs the visual clarity.
- .4 Check keyboard and printer operation with tunnel operator.

11 Final Checks:

- .1 Return all switches to automatic operation.
- .2 Ensure that Honeywell alarms are not present.

MONTHLY PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

TRI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The tri-annual preventive maintenance shall be done once every three years in conjunction with a monthly preventive maintenance.	
.2 The simulation of alarms shall be done by personnel or contractors trained and familiar with the equipment being tested.	
2 Fail Safe Panel:	
.1 Check operation of the Fail Safe Panel, various annunciators and alarms by sequentially removing the 5 amp power supply fuse located inside each of the Honeywell (DDC) panels 1, 2 and 3:	
.1 Remove the fuse from Honeywell Panel DDC-1	<input type="checkbox"/>
.2 North Bound Fans start forward after a 3 minute time delay (check MCCs indicator lamps).	<input type="checkbox"/>
.3 Check Firefighters' Panel "Controller Failure" lamp "on" . The Firefighters' Panel key must be turned on.	<input type="checkbox"/>
.4 Check Honeywell PC and printer for failure alarm.	<input type="checkbox"/>
.5 Replace the fuse from Honeywell Panel DDC-1	<input type="checkbox"/>
.6 North Bound Fans stop after time delay.	<input type="checkbox"/>
.7 Check Firefighters' Panel "Controller Failure" lamp "off".	<input type="checkbox"/>
.8 Check Honeywell PC and printer for failure alarm reset.	<input type="checkbox"/>
.9 Remove the fuse from Honeywell Panel DDC-2	<input type="checkbox"/>
.10 South Bound Fans start forward after a 3 minute time delay (check MCCs indicator lamps).	<input type="checkbox"/>
.11 Check Firefighters' Panel "Controller Failure" lamp "on"	<input type="checkbox"/>
.12 Check Honeywell PC and printer for failure alarm.	<input type="checkbox"/>
.13 Replace the fuse from Honeywell Panel DDC-2	<input type="checkbox"/>
.14 South Bound Fans stop after time delay.	<input type="checkbox"/>
.15 Check Firefighters' Panel "Controller Failure" lamp "off".	<input type="checkbox"/>
.16 Check Honeywell PC and printer for failure alarm reset.	<input type="checkbox"/>
.17 Remove the fuse from Honeywell Panel DDC-3	<input type="checkbox"/>
.18 Check Firefighters' Panel "Controller Failure" lamp "on"	<input type="checkbox"/>
.19 Check Honeywell PC and printer for failure alarm.	<input type="checkbox"/>
.20 Replace the fuse from Honeywell Panel DDC-3	<input type="checkbox"/>
.21 Check Firefighters' Panel "Controller Failure" lamp "off".	<input type="checkbox"/>
.22 Check Honeywell PC and printer for failure alarm reset.	<input type="checkbox"/>

TRI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HONEYWELL DDC CONTROL SYSTEM

.2	Simulate a Hydro failure:	
.1	Turn off the circuit breaker feeding Hydro to the Fail Safe Panel input sensing relay. This breaker is in an electrical distribution panel K located 40 feet to the right (East) of the Honeywell panels on the same wall. The breaker is labelled "Honeywell" circuit #18.	<input type="checkbox"/>
.2	Check Honeywell alarm - "Hydro status".	<input type="checkbox"/>
.3	Remove the fuse from Honeywell Panel DDC-1	<input type="checkbox"/>
.4	Half North Bound Fans start forward after a time delay (check MCCs).	<input type="checkbox"/>
.5	Replace the fuse from Honeywell Panel DDC-1	<input type="checkbox"/>
.6	North Bound Fans stop after time delay.	<input type="checkbox"/>
.7	Remove the fuse from Honeywell Panel DDC-2	<input type="checkbox"/>
.8	Half South Bound Fans start forward after a time delay (check MCCs).	<input type="checkbox"/>
.9	Replace the fuse from Honeywell Panel DDC-2	<input type="checkbox"/>
.10	South Bound Fans stop after time delay.	<input type="checkbox"/>
.11	Turn on the circuit breaker feeding Hydro to the Fail Safe Panel.	<input type="checkbox"/>
3	Final Checks:	
.1	Close and lock Honeywell Panel doors.	<input type="checkbox"/>
.2	Check that system operates normally by asking the operator to start/stop a fan pair using the Honeywell PC.	<input type="checkbox"/>
.3	Check that Honeywell alarms have been restored to normal.	<input type="checkbox"/>

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once every two years in conjunction with the secondary Main Breaker and Main Power Transformer PM service.	
.1 Note: Only one of the two sets of B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Disconnect and Load Interrupter Switches on the dual radial will be serviced during a given PM. This means there will be a four year interval between PM service on these switches.	
.2 This maintenance shall not be performed during rush hours or emergencies.	
.3 This maintenance shall not be performed during the PNE annual exhibition.	
.4 Arrange for de-energization of the active radial feed with BC Hydro at least two weeks prior to the PM service.	<input type="checkbox"/>
.5 Notify tunnel operator 48 hours prior to maintenance.	
.6 Notify the cellular telephone utility if any service interruptions are anticipated. The cellular service is not on the UPS and is interrupted whenever normal hydro is switched.	
.7 PM service of the High and Low Voltage Switch Gear within one day (shut-down) is not practical as each system will require a day to complete.	
.8 This maintenance shall be done by the equipment supplier's representative or a qualified electrician with specific service training for this equipment. Some of the following tests require specialized equipment and expert interpretation of the results.	

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

2 Equipment:

- .1 The four cabinets (cells) housing this switch gear are located on the west end of the centre isle of the substation.

Cabinet (cell) 1	Cabinet (cell) 2	Cabinet (cell) 3	Cabinet (cell) 4
Orange	Orange	Orange	Orange
B.C. HYDRO 12.47 KV NORMAL SUPPLY FEEDER HIGH VOLTAGE DISCONNECT SWITCH	B.C. HYDRO 12.47 KV NORMAL SUPPLY FEEDER HIGH VOLTAGE DISCONNECT SWITCH	12.47 KV HIGH VOLTAGE LOAD INTERRUPTER SWITCH	CONTROL INSTRUMENTS
B.C. HYDRO 12.47 KV NORMAL SUPPLY FEEDER HIGH VOLTAGE LOAD INTERRUPTER SWITCH	B.C. HYDRO 12.47 KV NORMAL SUPPLY FEEDER HIGH VOLTAGE LOAD INTERRUPTER SWITCH		12.47 KV HIGH VOLTAGE VACUUM BREAKER SWITCH

3 Warnings and Cautions:

- .1 Workers shall:
- .1 Observe all posted warnings.
 - .2 Review lock-out procedure(s) prior to commencing service.
 - .3 Use only test equipment, materials and methods approved for this service and voltage.

4 B.C. Hydro to Emergency Generator Switching:

- .1 Open the Emergency Backup Panel door in the operators' control room. Ensure that the fans are stopped.
- .2 Ensure that the generator room and equipment are clean and free of loose objects.
- .3 Ensure that ventilation intake louvers and plenum are clean and clear of loose objects.
- .4 Inspect for leaks:
 - .1 coolant
 - .2 lubricating oil
 - .3 fuel oil

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

.5	Check fluid levels:	
	.1 battery	<input type="checkbox"/>
	.2 engine oil dipstick	<input type="checkbox"/>
	.3 engine coolant - visual check through filler cap	<input type="checkbox"/>
	.4 fuel day tank - visual check through pipe cap	<input type="checkbox"/>
	.5 fuel main tank - Use calibrated dip stick and chart on side of day tank. Record level in generator log book.	<input type="checkbox"/>
.6	Record date and engine hours in generator log book	<input type="checkbox"/>
.7	Check the status of the disconnect, bypass and transfer switches:	<input type="checkbox"/>
	.1 generator room electrical panel (dark blue): main breaker 'charged' and 'closed'	<input type="checkbox"/>
	.2 sub-station secondary main breaker (light blue) : 'charged' and 'closed'	<input type="checkbox"/>
	.3 emergency bypass (dark blue): 'open', 'locked' and 'charged'	<input type="checkbox"/>
	.4 emergency transfer (dark blue): 'open', 'unlocked' and 'charged'	<input type="checkbox"/>
	.5 normal transfer (dark blue): 'closed', 'unlocked' and 'charged',	<input type="checkbox"/>
	.6 normal bypass (dark blue): 'open', 'locked' and 'charged'	<input type="checkbox"/>
.8	Check UPS:	
	.1 main switch is in the normal, on-line position	<input type="checkbox"/>
	.2 DC disconnect is "closed"	<input type="checkbox"/>
	.3 no alarms present on local UPS panel	<input type="checkbox"/>
.9	Check that the emergency stop flaps on the generator air intake are latched open (normal position).	<input type="checkbox"/>
.10	Open the secondary main breaker switch located on the (light blue) control panel in the sub-station using the remote switch located on the panel above the breaker. This will open the normal Hydro low voltage supply and transfer load to the generator.	<input type="checkbox"/>
.11	Check for alarms on the detached generator panel.	<input type="checkbox"/>
.12	Close the Emergency Backup Panel door in the operators' control room. This will return the fans to computer control.	<input type="checkbox"/>
5 Isolation and Lock-out:		
.1	Refer to the LOCK-OUT STANDARD section of the Cassiar Connector Electrical Maintenance Standards manual.	
.2	BC Hydro will switch the feed from the active radial circuit to the standby radial circuit. This will only be necessary when the active radial is being serviced.	<input type="checkbox"/>
.3	BC Hydro will remove its locks from the radial feeds.	<input type="checkbox"/>
.4	BC Hydro will leave the energized radial circuit "open".	<input type="checkbox"/>
.5	Workers shall place their personal locks on the "open" energized radial circuit which BC Hydro has placed in service.	<input type="checkbox"/>

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

.6	Workers shall place their personal locks on both the "open" normal bypass breaker and the normal breaker.	<input type="checkbox"/>
.7	Remove the two Keys from the B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Disconnect and Load Interrupter Switches on the dual radial being serviced. Insert these keys in the 12.47 KV High Voltage Vacuum Breaker Switch; then remove the single key from the 12.47 KV High Voltage Vacuum Breaker Switch and insert it in the 12.47 KV High Voltage Load Interrupter Switch to enable service access.	<input type="checkbox"/>
.8	Circuits shall be tested with a voltmeter to ensure that all sources of power have been isolated. Check that the meter is working and is on the correct scale and function prior to using.	<input type="checkbox"/>
.9	Ground equipment using ground straps. The BC Hydro incoming dual radial circuit feed being serviced shall be grounded at the service entry point.	<input type="checkbox"/>
6	Busses and connections:	
.1	Megger and record resistance prior to cleaning and disassembly.	<input type="checkbox"/>
.2	Remove dust from busses, connectors, supports and enclosure surfaces. A vacuum cleaner may be used. Dry compressed air or nitrogen at less than 25 psi may be used. Wipe clean with a warm soap water solution and wipe dry.	<input type="checkbox"/>
.3	Check and tighten electrical connections.	<input type="checkbox"/>
.4	Inspect for signs of weakened, damaged or overheated components.	<input type="checkbox"/>
.5	Megger(1000 Volt) and record resistance after cleaning.	<input type="checkbox"/>
7	Breakers and Switches:	
.1	Check the physical condition, operation and functionality of the breakers, switches and component parts.	
.2	Wipe components clean with a lint free cloth moistened with a non-flammable solvent. A vacuum cleaner may be used. Dry compressed air or nitrogen at less than 25 psi may be used.	
.3	Crocus cloth may be used to clean light corrosion from breaker contacts. A burnishing tool shall be used to clean soft silver contacts. Emery cloth or metallic cleaners shall not be used.	
.4	Pitted contacts shall be replaced.	
.5	Check and tighten electrical connections.	
.6	Visually inspect for physical damage, moisture, overheating and cleanliness.	
.7	Operating mechanisms may be sparingly lubricated with a light machine oil.	

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR



BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

.2 B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Disconnect Switch:

- .1 Key interlock
- .2 Door interlock
- .3 Cabinet - check finish inside and out
- .4 Screen and window
- .5 Warning and danger signs
- .6 Insulators and barriers
- .7 Blade and jaw
- .8 Blade operating arms
- .9 Operating mechanism
- .10 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
- .11 Insulation resistance in megohms at 1000 volts from each phase to ground:

Phase:	A	B	C
Line:			
Load:			
Switch:			

.3 B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Load Interrupter Switch:

- .1 Key interlock
- .2 Door interlock
- .3 Cabinet - check finish inside and out
- .4 Screen and window
- .5 Warning and danger signs
- .6 Insulators and barriers
- .7 Blade and jaw
- .8 Blade operating arms
- .9 Operating mechanism
- .10 Arcing blade and chute
- .11 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
- .12 Insulation resistance in megohms at 1000 volts from each phase to ground:

Phase:	A	B	C
Line:			
Load:			
Switch:			

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

.4 12.47 KV High Voltage Load Interrupter Switch components:

- .1 Key interlock
- .2 Door interlock
- .3 Cabinet - check finish inside and out
- .4 Screen and window
- .5 Warning and danger signs
- .6 Insulators and barriers
- .7 Blade and jaw
- .8 Blade operating arms
- .9 Operating mechanism
- .10 Arcing blade and chute
- .11 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
- .12 Insulation resistance in megohms at 1000 volts from phase to ground:

Phase:	A	B	C
Line:			
Load:			
Switch:			

.5 12.47 KV High Voltage Vacuum Breaker Switch components:

- .1 Operation counter - opening value: _____
- .2 Close trip indicator
- .3 Cut-off switch
- .4 Mechanical interlock
- .5 Auxiliary switch
- .6 Latch check switch
- .7 Cabinet - check finish inside and out
- .8 Warning and danger signs
- .9 Manual trip
- .10 Protective trip - test via injecting primary current through
200/5 current transformers.
- .11 Insulators and barriers
- .12 Contact erosion indication
- .13 Wipe indication
- .14 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
- .15 Insulation resistance in megohms at 1000 volts:

Phase to ground:	A:	B:	C:
Line to load :	A:	B:	C:
Phase to phase:	A-B:	B-C:	C-A:

- .16 Vacuum integrity test at 40,000 VDC _____ micro amps.
- .17 Operation counter - closing value: _____

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

.6 Secondary Main Breaker Switch components:

- .1 Cabinet - check finish inside and out
- .2 Cabinet door hinge and latch
- .3 Insulation and barriers
- .4 Contacts
- .5 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
- .6 Arc chutes
- .7 Operating mechanism
- .8 Manual charge (handle)
- .9 Electrical charge (push to charge)
- .10 Manual close (push to close)
- .11 Manual open (push to open)
- .12 Racking mechanism
- .13 Bus connection
- .14 Insulation resistance in megohms at 1000 VDC: **Note:**
 Open PT disconnect prior to test.

Phase to ground:	A: _____	B: _____	C: _____
Phase to phase:	A-B: _____	B-C: _____	C-A: _____

- .15 Battery (press battery test. green LED on if OK)
- .16 Protection trip with test unit:

Trip Unit Tests:	Setting:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		
Ground Pick-Up	D		
Ground Time	0.5		
Ground LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

8 Control Instrumentation:

- .1 Check operation of open/closed control switch and respective indicator lights.
- .2 Check operation of AC voltmeter and respective 7-position switch.
- .3 Clean enclosure.
- .4 Check condition of wiring and termination.
- .5 Check settings and operation of the two overcurrent protection relays:

Test calibration on time dial 6.		
Settings:	Phase:	Ground:
Pick-up:	8	2.5
Time:	2	2
Instantaneous:	50	16
Target Amps:	0.2	0.2

Phase Relay Test Results:					Phase A		Phase C	
	Test Amps	Test Time	Lower Limit	Upper Limit	As Found	As Left	As Found	As Left
Pick-up: $\pm 3\%$	8.00		7.76	8.24				
Time $\pm 5\%$:								
- 2 X Tap:	16.00	8.87	8.43	9.31				
- 5 X Tap:	40.00	1.50	1.43	1.58				
Instant. $\pm 5\%$:	50.0		47.5	52.5				
Target Amps:								
Insulation resistance (Megohms):								

Ground Relay Test Results:					Neutral	
	Test Amps	Test Time	Lower Limit	Upper Limit	As Found	As Left
Pick-up: $\pm 3\%$	2.50		2.43	2.58		
Time $\pm 5\%$:						
- 2 X Tap:	5.00	8.87	8.43	9.31		
- 5 X Tap:	12.50	1.50	1.43	1.58		
Instant. $\pm 5\%$:	16.0		15.2	16.8		
Target Amps:						
Insulation resistance (Megohms):						

9 Main Power Transformer and Temperature Controller:

- .1 Refer to the separate standard in the manual for these items. They shall be serviced with this equipment.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR THE HIGH VOLTAGE SWITCH GEAR

10 Final checks:

- .1 Check that all grounding straps and tools have been removed.
- .2 Secure equipment and ensure that all personnel are finished work and are clear of the equipment.
- .3 Remove personal locks.
- .4 Return interlock keys to their normal locks.
- .5 Check the status of the disconnect and load break switches:
 - .1 Sub-station secondary main breaker (light blue) : 'charged' and 'closed'.
 - .2 12.47 KV High Voltage Vacuum Breaker Switch: 'open'.
 - .3 All four (4) B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Disconnect and Load Interrupter Switches: 'open'.
 - .4 12.47 KV High Voltage Load Interrupter Switch: 'open'.
- .6 Close the B.C. Hydro 12.47 KV Normal Supply Feeder High Voltage Disconnect and Load Interrupter Switches on the energized radial feed.
- .7 Close the 12.47 KV High Voltage Load Interrupter Switch.
- .8 Close the 12.47 KV High Voltage Vacuum Breaker Switch. This will energize the Main Power Transformer and the secondary main breaker. The load will be transferred from the generator to Hydro.
- .9 Notify B.C. Hydro to switch the dual radial feed to the active circuit (if necessary) and to replace their padlocks.
- .10 The emergency generator will stop after a cool down cycle.
- .11 Check the status of the disconnect, bypass and transfer switches:
 - .1 generator electrical breaker (dark blue): main breaker 'charged' and 'closed'
 - .2 sub-station secondary main breaker (light blue) : 'charged' and 'closed'
 - .3 emergency bypass (dark blue): 'open' and 'locked'
 - .4 emergency breaker (dark blue): 'open', 'unlocked' and 'charged'
 - .5 normal breaker (dark blue): 'closed', 'unlocked' and 'charged',
 - .6 normal bypass (dark blue): 'open' and 'locked'
- .12 Check fuel level in day tank - visual check through pipe cap
- .13 Check status of generator alarm indication lights on detached panel.
- .14 Record engine hours in generator log book.
- .15 Check UPS: no alarms present on local UPS panel
- .16 Lock doors and return key
- .17 Check with tunnel operator and ensure that no alarms are present on the Honeywell computer.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR MAIN POWER TRANSFORMER

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once every other year in conjunction the High Voltage Switch Gear and the secondary Main Breaker PM service.	
2 Equipment:	
.1 The Main Power Transformer is housed in a painted orange cabinet (cell #5) located in the centre isle of the substation.	
.2 The Temperature Monitor is front panel mounted in the same cabinet as the Main Power Transformer.	
3 Main Power Transformer:	
.1 Inspect and remove dust from busses, connectors, supports and enclosure surfaces. A vacuum cleaner or dry compressed air or nitrogen at less than 25 psi may be used.	<input type="checkbox"/>
.2 Inspect and clean insulators.	<input type="checkbox"/>
.3 Inspect and clean iron core and coils.	<input type="checkbox"/>
.4 Check and tighten electrical connections.	<input type="checkbox"/>
.5 Inspect for signs of weakened, damaged or overheated insulation, tracking or carbonization and moisture.	<input type="checkbox"/>
.6 Inspect arresters.	<input type="checkbox"/>
.7 Test Insulation resistance after cleaning. Megger(1000 Volt) and record :	
.1 Primary to ground _____ Megohms.	
.2 Secondary to ground _____ Megohms.	
.3 Secondary to primary _____ Megohms.	
4 Temperature Controller:	
.1 Check the temperature reading for reasonableness. _____ °c.	

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done once every other year.
.2	This maintenance requires the use of UPS battery power for approximately one hour.
.3	This maintenance shall not be done during rush hours or emergencies.
.4	Notify tunnel operator 48 hours prior to maintenance.
.5	Notify the cellular telephone utility if any service interruptions are anticipated. The cellular service is not on the UPS and is interrupted whenever normal hydro is switched.
.6	This maintenance shall be done by the equipment supplier's representative or a qualified electrician with specific service training for this equipment. Some of the following tests require specialized equipment and expert interpretation of the results.
.7	The PM service of the secondary Main Breaker should be done with the Main Power Transformer and the High Voltage Switch Gear maintenance.
.8	The PM service of the Panel Boards should be done in conjunction with the MCC Switch Gear and Panel Boards.
.9	The PM service of the Emergency Generator power supply breaker should be done in conjunction with this equipment.
.10	The PM service of the UPS 30 KVA 600/206/120 Transformer should be done in conjunction with this equipment.
.11	PM service of the High and Low Voltage Switch Gear within a one day shut-down is not practical.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

2 Equipment:

- .1 The four cabinets (cells) housing this switch gear are located in the centre of the centre isle in the substation.

Cabinet (cell) F1	Cabinet (cell) F2	Cabinet (cell) F3	Cabinet (cell) F4	
Light Blue	Dark Blue	Dark Blue	Gray	
Normal Power Supply 347-600 V.	Maintained Power Supply 347-600 V.	Maintained Power Supply 347-600 V.	Maintained Power Supply 120-208 V.	
IQ Data (Hydro supply monitor) Transfer switch controls	Emergency Bypass	Bus Duct-MCC 1 Bus Duct-MCC 2 (inside)	Panel J	
secondary Main Breaker	Emergency Breaker	Frame Mounted Circuit Breakers	Panel ED (347/600 at rear) IQ Data (Emergency supply monitor at rear)	
utility cabinet (inside)	Normal Breaker		Panel EB	Panel H
Bus to lighting MCC cabinets (inside)	Normal Bypass	75 KVA 600/120/208 Transformer (inside)	75 KVA 600/120/208 Transformer (inside)	

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

3 Warnings and Cautions:

- .1 Workers shall:
 - .1 Observe all posted warnings.
 - .2 Review lock-out procedure(s) prior to commencing service.
 - .3 Restrict parallel use of the Emergency Breaker with the Emergency Bypass or parallel use of the Normal Breaker with the Normal Bypass as this will diminish the normal overcurrent protection.
 - .4 Disconnect B.C. Hydro metering equipment if a megger is used to test the secondary bus.
 - .5 Utilize rear panel access with the equipment de-energized, isolated and locked-out. This area contains an open bus network.

4 Lock-out and Isolation:

- .1 Refer to the **LOCK-OUT STANDARD** section of the Cassiar Connector Electrical Maintenance Standards manual.
- .2 Circuits shall be tested to ensure that all sources of power have been isolated
- .3 Ground equipment using ground straps. The BC Hydro incoming dual radial circuit feed being serviced shall be grounded at the service entry point.

5 Breakers and Switches:

- .1 Check the physical condition, operation and functionality of the each breaker switch and component parts.
 - .1 Wipe components clean with a lint free cloth moistened with a non-flammable solvent. A vacuum cleaner may be used. Dry compressed air or nitrogen at less than 25 psi may be used.
 - .2 Crocus cloth may be used to clean light corrosion from breaker contacts. A burnishing tool shall be used to clean soft silver contacts. Emery cloth or other metallic cleaners shall not be used.
 - .3 Pitted contacts shall be replaced.
 - .4 Check and tighten electrical connections.
 - .5 Visually inspect for physical damage, moisture, overheating and cleanliness.
 - .6 Operating mechanisms may be sparingly lubricated with a light machine oil.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

6 Secondary Main Breaker:

- .1 The PM of the secondary Main Breaker shall be done in conjunction the High Voltage Switch Gear PM service. Refer to the Preventive Maintenance Table (**including lock-out**) for the High Voltage Switch Gear.
- .2 Switch components:
 - .1 Cabinet - check finish inside and out
 - .2 Cabinet door hinge and latch
 - .3 Insulation and barriers
 - .4 Contacts
 - .5 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
 - .6 Arc chutes
 - .7 Operating mechanism
 - .8 Manual charge (handle)
 - .9 Electrical charge (push to charge)
 - .10 Manual close (push to close)
 - .11 Manual open (push to open)
 - .12 Racking mechanism
 - .13 Bus connection
 - .14 Insulation resistance in megohms at 1000 VDC: Note:
 Open PT disconnect prior to test.

Phase to ground:	A: _____	B: _____	C: _____
Phase to phase:	A-B: _____	B-C: _____	C-A: _____

- .15 Battery (press battery test. green LED on if OK)
- .16 Protection trip with test unit:

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		
Ground Pick-Up	D		
Ground Time	0.5		
Ground LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

7 Emergency Generator power supply breaker:

- .1 Isolation and lock-out:
 - .1 Workers shall open and place their personal locks on the maintenance lock-out provided on the local attached control panel of the Emergency Generator. This will prevent the Emergency Generator from operating.
 - .2 Workers shall open and place their personal locks on the Emergency Bypass and Emergency Breaker switches.
- .2 Switch components:
 - .1 Cabinet - check finish inside and out
 - .2 Insulation and barriers
 - .3 Contacts
 - .4 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____
 - .5 Arc chutes
 - .6 Operating mechanism
 - .7 Manual charge (handle)
 - .8 Electrical charge (push to charge)
 - .9 Manual close (push to close)
 - .10 Manual open (push to open)
 - .11 Racking mechanism
 - .12 Bus connection
 - .13 Insulation resistance in megohms at 1000 VDC: Note:
 Open PT disconnect prior to test.

Phase to ground:	A:	B:	C:
Phase to phase:	A-B:	B-C:	C-A:

- .14 Battery (press battery test. green LED on if OK)
- .15 Protection trip with test unit

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

8 Emergency Bypass:

.1 **Warning:** This breaker switch will be serviced while the secondary bus is hot. Do not service the connection to the bus at this time.

.2 Isolation and lock-out:

.1 Rack breaker out to the "withdrawn" position.

.3 Switch components:

.1 Cabinet - check finish inside and out

.2 Insulation and barriers

.3 Contacts

.4 Contact resistance (micro-ohms):
 A: _____ B: _____ C: _____

.5 Arc chutes

.6 Operating mechanism

.7 Manual charge (handle)

.8 Electrical charge (push to charge)

.9 Manual close (push to close)

.10 Manual open (push to open)

.11 Racking mechanism

.12 Insulation resistance in megohms at 1000 VDC: **Note:**
 Open PT disconnect prior to test.

Phase to ground:	A: _____	B: _____	C: _____
Phase to phase:	A-B: _____	B-C: _____	C-A: _____

.13 Battery (press battery test. green LED on if OK)

.14 Protection trip with test unit

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

9 Emergency Breaker:

- .1 **Warning:** This breaker switch will be serviced while the secondary bus is hot. Do not service the connection to the bus at this time.
- .2 Isolation and lock-out:
 - .1 Rack breaker out to the "withdrawn" position.
- .3 Switch components:
 - .1 Cabinet - check finish inside and out
 - .2 Insulation and barriers
 - .3 Contacts
 - .4 Contact resistance (micro-ohms):
 - A: _____ B: _____ C: _____
 - .5 Arc chutes
 - .6 Operating mechanism
 - .7 Manual charge (handle)
 - .8 Electrical charge (push to charge)
 - .9 Manual close (push to close)
 - .10 Manual open (push to open)
 - .11 Racking mechanism
 - .12 Insulation resistance in megohms at 1000 VDC: **Note:**
Open PT disconnect prior to test.

Phase to ground:	A:	B:	C:
Phase to phase:	A-B:	B-C:	C-A:

- .13 Battery (press battery test. green LED on if OK)
- .14 Protection trip with test unit

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

10	Switch power from B.C. Hydro to Emergency Generator:	
.1	Open the Emergency Backup Panel door in the operators' control room. Ensure that the fans are stopped. Tag and Instruct the operator to leave the door open and not to start any fans.	<input type="checkbox"/>
.2	Ensure that the generator room and equipment are clean and free of loose objects.	<input type="checkbox"/>
.3	Ensure that ventilation intake louvers and plenum are clean and clear of loose objects.	<input type="checkbox"/>
.4	Inspect for leaks:	
.1	coolant	<input type="checkbox"/>
.2	lubricating oil	<input type="checkbox"/>
.3	fuel oil	<input type="checkbox"/>
.5	Check fluid levels:	
.1	battery	<input type="checkbox"/>
.2	engine oil dipstick	<input type="checkbox"/>
.3	engine coolant - visual check through filler cap	<input type="checkbox"/>
.4	fuel day tank - visual check through pipe cap	<input type="checkbox"/>
.5	fuel main tank - Use calibrated dip stick and chart on side of day tank. Record level in generator log book.	<input type="checkbox"/>
.6	Record date and engine hours in generator log book	<input type="checkbox"/>
.7	Check the status of the disconnect and transfer switches:	
.1	generator room electrical panel (dark blue): main breaker 'charged' and 'closed'	<input type="checkbox"/>
.2	sub-station secondary main breaker (light blue) : 'charged' and 'closed'	<input type="checkbox"/>
.3	emergency bypass breaker (dark blue): 'open' and 'locked'	<input type="checkbox"/>
.4	emergency breaker (dark blue): 'open', 'unlocked' and 'charged'	<input type="checkbox"/>
.5	normal breaker (dark blue): 'closed', 'unlocked' and 'charged',	<input type="checkbox"/>
.6	normal bypass breaker (dark blue): 'open' and 'locked'	<input type="checkbox"/>
.8	Check UPS:	
.1	main switch is in the normal, on-line position	<input type="checkbox"/>
.2	no alarms present on local UPS panel	<input type="checkbox"/>
.9	Check that the emergency stop flaps on the generator air intake are latched open (normal position).	<input type="checkbox"/>
.10	Open the secondary main breaker switch located on the (light blue) control panel in the sub-station using the remote switch located on the panel above the breaker. This will open the normal Hydro low voltage supply and transfer load to the emergency generator.	<input type="checkbox"/>
.11	Check for alarms on the detached generator panel.	<input type="checkbox"/>

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

11 Normal Breaker:

- .1 **Warning:** This breaker switch will be serviced while the secondary bus is hot. Do not service the connection to the bus at this time.
- .2 Isolation and lock-out:
 - .1 Rack breaker out to the "withdrawn" position.
- .3 Switch components:
 - .1 Cabinet - check finish inside and out
 - .2 Insulation and barriers
 - .3 Contacts
 - .4 Contact resistance (micro-ohms):
 - A: _____ B: _____ C: _____
 - .5 Arc chutes
 - .6 Operating mechanism
 - .7 Manual charge (handle)
 - .8 Electrical charge (push to charge)
 - .9 Manual close (push to close)
 - .10 Manual open (push to open)
 - .11 Racking mechanism
 - .12 Insulation resistance in megohms at 1000 VDC: Note:
Open PT disconnect prior to test.
- .13 Battery (press battery test. green LED on if OK)
- .14 Protection trip with test unit

Phase to ground:	A:	B:	C:
Phase to phase:	A-B:	B-C:	C-A:

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

12 Normal Bypass:

- .1 **Warning:** This breaker switch will be serviced while the secondary bus is hot. Do not service the connection to the bus at this time.
- .2 Isolation and lock-out:
 - .1 Rack breaker out to the "withdrawn" position.
- .3 Switch components:
 - .1 Cabinet - check finish inside and out
 - .2 Insulation and barriers
 - .3 Contacts
 - .4 Contact resistance (micro-ohms):
 - A: _____ B: _____ C: _____
 - .5 Arc chutes
 - .6 Operating mechanism
 - .7 Manual charge (handle)
 - .8 Electrical charge (push to charge)
 - .9 Manual close (push to close)
 - .10 Manual open (push to open)
 - .11 Racking mechanism
 - .12 Insulation resistance in megohms at 1000 VDC: Note:
Open PT disconnect prior to test.
- .13 Battery (press battery test. green LED on if OK)
- .14 Protection trip with test unit

Phase to ground:	A: _____	B: _____	C: _____
Phase to phase:	A-B: _____	B-C: _____	C-A: _____

Trip Unit Tests:	Settings:	As found:	As left:
Long Delay Pick-Up	0.8		
Long Delay Time	12		
Long Delay LED indication (off or red)	off		
Short Delay Pick-Up	2		
Short Delay Time	0.3		
Short Delay LED indication (off or red)	off		
Instantaneous Pick-Up	6		
Instantaneous LED indication (off or red)	off		

13 IQ Data line metering controller for Emergency Generator bus.

- .1 Check display for reading reasonableness - line voltage.
- .2 This unit does not require PM service. It controls the automatic emergency generator / hydro power transfers - if these transfers have been OK then this device is OK.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

14 Busses and connections:

- .1 Note: The time available for the PM that follows in this section is limited to the battery capacity of the UPS (approximately one hour).
- .2 Isolation and lock-out:
 - .1 Workers shall place their personal locks on the open secondary Main Breaker.
 - .2 Check that the UPS does not have any alarms. Do not proceed if the UPS is not serviceable.
 - .3 Workers shall open and place their personal locks on the UPS circuit breaker located on the 347-600 V. Maintained Power Supply (dark blue) panel in the substation.
 - .4 Workers shall open and place their personal locks on the Emergency Generator power supply breaker switch (dark blue) in the generator room.
- .3 Rack the following breakers to the "withdrawn" position and inspect and clean the connections to the bus:
 - .1 Emergency Bypass
 - .2 Emergency Breaker
 - .3 Normal Breaker
 - .4 Normal Bypass
- .4 Rack the previous breakers to the "connected" position.
- .5 Secondary Bus:
 - .1 Megger and record resistance prior to cleaning and disassembly.
 - .2 Remove dust from busses, connectors, supports and enclosure surfaces. A vacuum cleaner may be used. Dry compressed air or nitrogen at less than 25 psi may be used. Wipe clean with a warm soap water solution and wipe dry.
 - .3 Check and tighten electrical connections.
 - .4 Visually inspect for physical damage, moisture, overheating and cleanliness.
 - .5 Megger(1000 Volt) and record resistance after cleaning. _____ megohms.
- .6 Normal and Maintained power supply cabinet interiors:
 - .1 Inspect and clean.

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

.7	75 KVA 600/120/208 Transformers (2):	
	.1 Inspect and remove dust from wiring, coils, connectors, supports and enclosure surfaces. Use a vacuum cleaner.	<input type="checkbox"/>
	.2 Inspect iron core and coils.	<input type="checkbox"/>
	.3 Check and tighten electrical connections.	<input type="checkbox"/>
	.4 Inspect for signs of weakened, damaged or overheated insulation, tracking or carbonization and moisture.	<input type="checkbox"/>
	.5 Test Insulation resistance after cleaning. Megger(1000 Volt) and record :	
	Primary to ground _____	
	Secondary to ground _____	
	Secondary to primary _____	
.8	Check the status of the bypass and transfer switches:	
	.1 generator room electrical panel (dark blue): main breaker 'charged' and 'closed'	<input type="checkbox"/>
	.2 emergency bypass (dark blue): 'open' and 'locked'	<input type="checkbox"/>
	.3 emergency breaker (dark blue): 'closed', 'unlocked' and 'charged'	<input type="checkbox"/>
	.4 normal breaker (dark blue): 'open', 'unlocked' and 'charged'	<input type="checkbox"/>
	.5 normal bypass (dark blue): 'open' and 'locked'	<input type="checkbox"/>
.9	Workers shall remove their personal locks from the Emergency Generator power supply breaker switch (dark blue) in the generator room and close the breaker. This will place the Emergency Generator back on line.	<input type="checkbox"/>
.10	Workers shall remove their personal locks from the UPS circuit breaker located on the 347-600 V. Maintained Power Supply (dark blue) panel in the substation and close the breaker. This will take the UPS batteries off line.	<input type="checkbox"/>
.11	Workers shall remove their personal locks from the open secondary Main Breaker and close the breaker. This will close the normal Hydro low voltage supply and transfer load from the emergency generator to normal hydro.	<input type="checkbox"/>
15	IQ Data line metering controller on low voltage hydro supply.	
	.1 Check display for reading reasonableness - line voltage.	<input type="checkbox"/>
	.2 This unit does not require PM service. It controls the automatic emergency generator / hydro power transfers - if these transfers have been OK then this device is OK.	<input type="checkbox"/>

BI-ANNUAL PREVENTIVE MAINTENANCE FOR LOW VOLTAGE SWITCH GEAR, BUS DUCTS AND LOW VOLTAGE TRANSFORMERS

16 Frame Mounted Circuit Breakers and Panels:

- .1 Visually inspect for physical damage, moisture, overheating and cleanliness.
- .2 These panels and devices shall be scanned for hot connections when the MCCs are done.

17 Final checks:

- .1 Check the status of the disconnect, bypass, transfer and load break switches:
 - .1 generator room electrical panel (dark blue): main breaker 'charged' and 'closed'
 - .2 emergency bypass (dark blue): 'open' and 'locked'
 - .3 emergency breaker (dark blue): 'open', 'locked' and 'charged'
 - .4 normal breaker (dark blue): 'closed', 'locked' and, 'charged'
 - .5 normal bypass (dark blue): 'open' and 'locked'
 - .6 sub-station secondary main breaker (light blue) : 'charged' and 'closed'
- .2 The emergency generator will stop after a cool down cycle.
- .3 Check fuel level in day tank - visual check through pipe cap
- .4 Check status of generator alarm indication lights on detached panel. No alarms should be present.
- .5 Record engine hours in generator log book.
- .6 Check UPS: no alarms present on local UPS panel
- .7 Lock doors and return key
- .8 Close the Emergency Backup Panel door in the operators' control room. This will return the fans to computer control.
- .9 Check with tunnel operator and ensure that no alarms are present on the Honeywell computer.

ANNUAL PREVENTIVE MAINTENANCE FOR MCC SWITCH GEAR AND PANEL BOARDS

Item:	<input checked="" type="checkbox"/>																																																																				
<p>1 General:</p> <p>.1 The maintenance listed in this table shall be done once every year.</p> <p>.2 This maintenance shall not be performed during rush hours or emergencies.</p> <p>.3 Notify tunnel operator 48 hours prior to maintenance.</p>																																																																					
<p>2 Equipment:</p> <p>.1 Control time delay relays for the tunnel ventilation fans are located in two MCC cabinets with the Tunnel Ventilation fan MCCs</p> <p>.2 The power factor correction Capacitors (2 banks) are located in two MCC cabinets with the Tunnel Ventilation fan MCCs</p> <p>.3 The MCCs are located in the substation:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-left: 20px;"> <thead> <tr> <th style="width: 25%;">Lighting:</th> <th style="width: 25%;">Tunnel Fans:</th> <th style="width: 25%;">Tunnel Fans:</th> <th style="width: 25%;">Other:</th> </tr> </thead> <tbody> <tr><td>LP-B</td><td>FF-N-1A</td><td>FF-N-1B</td><td>UH-C-1</td></tr> <tr><td>LP-D</td><td>FF-N-2A</td><td>FF-N-2B</td><td>HH-C-1</td></tr> <tr><td>LP-A</td><td>FF-N-3A</td><td>FF-N-3B</td><td>EF-C-5</td></tr> <tr><td>LP-C</td><td>FF-N-4A</td><td>FF-N-4B</td><td>EF-C-6</td></tr> <tr><td>OUTSIDE</td><td>FF-N-5A</td><td>FF-N-5B</td><td>EF-C-7</td></tr> <tr><td>Spare</td><td>FF-N-6A</td><td>FF-N-6B</td><td>North Capacitor</td></tr> <tr><td>Spare</td><td>FF-N-7A</td><td>FF-N-7B</td><td>South Capacitor</td></tr> <tr><td>LP-E</td><td>FF-N-8A</td><td>FF-N-8B</td><td>Spare</td></tr> <tr><td>LP-G</td><td>FF-S-1A</td><td>FF-S-1B</td><td></td></tr> <tr><td>LP-F</td><td>FF-S-2A</td><td>FF-S-2B</td><td></td></tr> <tr><td>LP-M</td><td>FF-S-3A</td><td>FF-S-3B</td><td></td></tr> <tr><td>LP-N</td><td>FF-S-4A</td><td>FF-S-4B</td><td></td></tr> <tr><td></td><td>FF-S-5A</td><td>FF-S-5B</td><td></td></tr> <tr><td></td><td>FF-S-6A</td><td>FF-S-6B</td><td></td></tr> <tr><td></td><td>FF-S-7A</td><td>FF-S-7B</td><td></td></tr> <tr><td></td><td>FF-S-8A</td><td>FF-S-8B</td><td></td></tr> </tbody> </table>		Lighting:	Tunnel Fans:	Tunnel Fans:	Other:	LP-B	FF-N-1A	FF-N-1B	UH-C-1	LP-D	FF-N-2A	FF-N-2B	HH-C-1	LP-A	FF-N-3A	FF-N-3B	EF-C-5	LP-C	FF-N-4A	FF-N-4B	EF-C-6	OUTSIDE	FF-N-5A	FF-N-5B	EF-C-7	Spare	FF-N-6A	FF-N-6B	North Capacitor	Spare	FF-N-7A	FF-N-7B	South Capacitor	LP-E	FF-N-8A	FF-N-8B	Spare	LP-G	FF-S-1A	FF-S-1B		LP-F	FF-S-2A	FF-S-2B		LP-M	FF-S-3A	FF-S-3B		LP-N	FF-S-4A	FF-S-4B			FF-S-5A	FF-S-5B			FF-S-6A	FF-S-6B			FF-S-7A	FF-S-7B			FF-S-8A	FF-S-8B	
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ANNUAL PREVENTIVE MAINTENANCE FOR MCC SWITCH GEAR AND PANEL BOARDS

.4	Panel boards:																											
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3 Warnings and Cautions:																												
<ul style="list-style-type: none"> .1 Workers shall: <ul style="list-style-type: none"> .1 Observe all posted warnings. .2 Use only test equipment, materials and methods approved for this service and voltage. .2 The circuits and equipment are energized while being infrared scanned. 																												
4 Lock-out:																												
<ul style="list-style-type: none"> .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual. 																												

ANNUAL PREVENTIVE MAINTENANCE FOR MCC SWITCH GEAR AND PANEL BOARDS

5 Infrared Scanning and related checks:

- .1 The infrared scanning requires specialized equipment and expert interpretation of the results.
- .2 Energize all circuits, breakers, etc. at least 30 minutes prior to starting the infrared scanning. Note the tunnel fans starters shall be scanned twice - once in forward and once in reverse.
- .1 Check the status of the MCC panel indicator lights while energizing the starters.
- .2 Check the operation of the **Capacitors** while energizing the Tunnel Ventilation Fans. The power factor should be controlled between 85% and 100%.
- .3 Use the Multipoint lighting controller 'on-off-auto' switches to turn on the Tunnel Lighting.
- .4 Use the Emergency Back-up Panel to start the Tunnel Ventilation Fans.
- .3 Remove front cover plate from panel boards and open hinged front covers on MCCs.
- .4 Infrared scan all equipment and related accessible wiring.
- .5 Visually inspect the **Panel boards and Circuit Breakers** and wiring for physical damage, moisture, overheating and cleanliness.
- .6 Record and compare results with previous scans and note any recurring problems for further investigation and/or corrective maintenance:

Lighting:	Tunnel Fans:		Tunnel Fans:			
		fwd	rev		fwd	rev
LP-B	FF-N-1B			FF-N-1A		
LP-D	FF-N-2B			FF-N-2A		
LP-A	FF-N-3B			FF-N-3A		
LP-C	FF-N-4B			FF-N-4A		
OUTSIDE	FF-N-5B			FF-N-5A		
LP-E	FF-N-6B			FF-N-6A		
LP-G	FF-N-7B			FF-N-7A		
LP-F	FF-N-8B			FF-N-8A		
LP-M	FF-S-1B			FF-S-1A		
LP-N	FF-S-2B			FF-S-2A		
	FF-S-3B			FF-S-3A		
	FF-S-4B			FF-S-4A		
	FF-S-5B			FF-S-5A		
	FF-S-6B			FF-S-6A		
	FF-S-7B			FF-S-7A		
	FF-S-8B			FF-S-8A		

ANNUAL PREVENTIVE MAINTENANCE FOR MCC SWITCH GEAR AND PANEL BOARDS

Other:		Panel boards:			
UH-C-1		H			
HH-C-1		J			
EF-C-5		EB			
EF-C-6		ED			
EF-C-7		LP-K			
North Capacitor		LP-EC			
South Capacitor		L			
		EF			
		EG			
		LP-EN			
		EA			

- .7 Replace front cover plate on panel boards and close hinged front covers on MCCs.

6 MCC cabinets:

- .1 Turn off the disconnect breaker on each MCC starter cabinet.
- .2 Visually inspect the cabinets, components and wiring for physical damage, moisture, overheating and cleanliness.
- .3 Clean cabinet interiors and exteriors with a lint free cloth and a mild detergent and water solution.
- .4 Wipe components clean with a lint free cloth moistened with a non-flammable solvent.
- .5 A vacuum cleaner may be used. Dry compressed air or nitrogen at less than 25 psi may be used.
- .6 Inspect and tighten connections showing problems on the infrared scan.

7 Final checks:

- .1 Check that all controls and switches have been returned to the 'auto' or normal operating positions.
- .2 Lock doors and return key.
- .3 Check with tunnel operator and ensure that no alarms are present on the Honeywell computer.

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL LIGHTING

Item:	<input checked="" type="checkbox"/>																					
<p>1 General:</p> <ul style="list-style-type: none"> .1 The maintenance listed in this table shall be done once every year. .2 Perform these checks in the sequence listed. .3 This maintenance shall not be performed during rush hours or emergencies. .4 This maintenance shall not be done on bright, sunny days. This Maintenance is preferably done during the evening when the lighting is not as critical. .5 The tunnel portion of this work will require the use of a bucket truck. .6 Lane closures will be required. 																						
<p>2 Equipment:</p> <ul style="list-style-type: none"> .1 The HPS Tunnel Luminaires are located in the ceiling of the tunnels and fed from MCC starters and panel mounted circuit breakers located in the centre isle of the substation. 																						
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Panel:</th> <th style="width: 40%;">Service:</th> <th style="width: 45%;">Luminaires:</th> </tr> </thead> <tbody> <tr> <td>LP-B</td> <td>Stage 4 tunnel lighting southbound tube</td> <td>4 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.</td> </tr> <tr> <td>LP-D</td> <td>Stage 3 tunnel lighting southbound tube</td> <td>12 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.</td> </tr> <tr> <td>LP-A</td> <td>Stage 4 tunnel lighting northbound tube</td> <td>4 ea.-100 W. 28 ea.-250 W. 34 ea.-400 W.</td> </tr> <tr> <td>LP-C</td> <td>Stage 3 tunnel lighting northbound tube</td> <td>12 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.</td> </tr> <tr> <td>LP-E</td> <td>Stage 2 tunnel lighting northbound tube</td> <td>4 ea.-100 W. 48 ea.-250 W. 68 ea.-400 W.</td> </tr> <tr> <td>LP-G</td> <td>Stage 1 tunnel lighting northbound tube</td> <td>162 ea.-70 W. 4 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.</td> </tr> </tbody> </table>		Panel:	Service:	Luminaires:	LP-B	Stage 4 tunnel lighting southbound tube	4 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.	LP-D	Stage 3 tunnel lighting southbound tube	12 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.	LP-A	Stage 4 tunnel lighting northbound tube	4 ea.-100 W. 28 ea.-250 W. 34 ea.-400 W.	LP-C	Stage 3 tunnel lighting northbound tube	12 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.	LP-E	Stage 2 tunnel lighting northbound tube	4 ea.-100 W. 48 ea.-250 W. 68 ea.-400 W.	LP-G	Stage 1 tunnel lighting northbound tube	162 ea.-70 W. 4 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.
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ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL LIGHTING

LP-F	Stage 2 tunnel lighting southbound tube	4 ea.-100 W. 48 ea.-250 W. 68 ea.-400 W.
LP-M	Stage 1 tunnel lighting southbound tube	162 ea.-70 W. 4 ea.-100 W. 40 ea.-250 W. 68 ea.-400 W.
LP-N	Night tunnel lighting - always on.	162 ea.-70 W.
LP-EN	Emergency lighting - always on - fed from UPS not directly from MCC.	162 ea.-70 W.

- .2 The **Multipoint Controller** is located on the south wall in the operators' control room.
- .3 The two pairs of **field mounted sensors** are in camera housings mounted on poles located 150 meters from and facing the northbound and southbound tunnel entrance portals.

3 Lock-out:

- .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.

4 Tunnel Luminaires (emergency, night and staged) :

- .1 Tunnel luminaires may be isolated and/or locked-out at the following locations:
 - .1 Substation MCC starter
 - .2 Substation Panel mounted circuit breaker
 - .3 Local disconnect (Joy) plug
- .2 The staged tunnel luminaires lamps shall be replaced on a regular basis - the initial estimate is every **three years**.
- .3 The night and emergency tunnel luminaires lamps shall be replaced on a regular basis - the initial estimate is every **eighteen months**.
- .4 Relamping may be scheduled in order that all lamps are not replaced in a single year and may be done in conjunction with the remainder of this PM.
- .5 The relamping cycle shall be reviewed each year and adjusted to keep the failure rate to a minimum.
- .6 Mark lamp shells with the date of installation.
- .7 Keep a detailed record (log) of lamp replacement.

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL LIGHTING

.8	Clean lenses, refractors and inside of housing.	<input type="checkbox"/>
.9	Check lamp operation. Replace lamp if necessary.	<input type="checkbox"/>
.10	Inspect terminals and tighten as necessary.	<input type="checkbox"/>
.11	Inspect housings, lenses, reflectors and gaskets for damage, wear, corrosion or paint deterioration. Replace luminaire assembly as necessary.	<input type="checkbox"/>
.12	Check that fixtures are correctly oriented to the direction of travel.	<input type="checkbox"/>
.13	Inspect capacitors, starters and ballasts for corrosion or damage. Replace ballast sub-assembly as required.	<input type="checkbox"/>
.14	Inspect internal wiring and insulation for wear and damage. Replace luminaire assembly or ballast sub-assembly as required.	<input type="checkbox"/>
5	Cable Trays:	
.1	Inspect trays, steel and cable bracing, fasteners and concrete inserts for physical damage, tightness and corrosion.	<input type="checkbox"/>
6	Night Lighting:	
.1	This lighting is always turned on. It is monitored by the Honeywell control system.	<input type="checkbox"/>
.2	Turn off the MCC starter for panel LP-N and check the Honeywell alarm.	<input type="checkbox"/>
7	Emergency Lighting:	
.1	Turn off all Multipoint lighting stages. Use the Multipoint Controller.	<input type="checkbox"/>
.2	Visually check the Emergency lighting luminaires. They should be the only luminaires on.	<input type="checkbox"/>
.3	Turn off all Multipoint lighting stages. Use the Multipoint Controller.	<input type="checkbox"/>
.4	Turn on the MCC starter for panel LP-N and check the Honeywell alarm reset .	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL LIGHTING

8 Multipoint Controller:

- .1 Clean the exterior and interior of the cabinet. Do not use a vacuum cleaner on the printed circuit boards.
- .2 Inspect internal wiring and components for damage.
- .3 The operation of the Multipoint Controller shall be checked by observing the staging of the Tunnel Luminaires starting in the daylight and ending in darkness.
- .4 Check the panel lux readings for an orderly progression of values. The exact numbers are not critical and vary between the northbound and southbound field mounted sensors.
- .5 Ask the tunnel operator to display the Honeywell computer screen showing the status of the tunnel lighting.
- .6 Check and record that the indicator lights on the Multipoint Controller agree with the Honeywell computer.
- .7 Check and record that the indicator lights on the Multipoint Controller agree with the substation MCC lighting panels:
- .8 Turn on all stages of lighting with the Multipoint Controller and then Switch off each panel in turn with the MCC hand-off -auto switch - check and record the Honeywell system alarm for each panel.

Tunnel:	Stage:	MCC		Multipoint		Honeywell	
		Panel:	Lamps:	Meter:	Reading:	Ind.	Alm.
northbound	1	LP-G		Low			
northbound	2	LP-F		Low			
northbound	3	LP-C		High			
northbound	4	LP-A		High			
southbound	1	LP-M		Low			
southbound	2	LP-E		Low			
southbound	3	LP-D		High			
southbound	4	LP-B		High			

9 Field mounted sensors:

- .1 Clean the lenses of the cabinets.
- .2 Check the operation of the heaters.

10 Final checks:

- .1 Return all switches to automatic operation.
- .2 Ensure that Honeywell alarms are not present.

ANNUAL PREVENTIVE MAINTENANCE FOR CONTROL BUILDING LIGHTING

Item: <input checked="" type="checkbox"/>				
1 General:				
.1 The maintenance listed in this table shall be done once every year.				
.2 This maintenance shall not be performed during rush hours or emergencies.				
2 Equipment:				
.1 The fifteen types of Lighting Fixtures are located in and around the control building:				
Type:	Qty.:	Service:	Fixture:	Lamp:
A	3	Corridor	York Lithonia FH 248-24-8224	2 ea. - F40 CW
B	32	Generator room Mechanical room Storage room Telephone room Tunnel access Radio room Substation	Thomas ATP 248-0	2 ea. - F40 CW
C	11	Outside soffits Corridor	York Lithonia AH 35S 6MB 120	1 ea. - LU35 /D/ Med.HPS
D	5	Tunnel access Diesel storage	Crouse-Hinds VXHB15G	1 ea. - 100W incandescent
E	1	Outside entrance	Holophane WP1B035HP12BZ	1 ea. - 35W HPD Mogul base
F	4	Battery room	York Lithonia FCD 248-120	2 ea. - F40 CW
G	3	Attic	white glazed porcelain incandescent lamp holder	1 ea. - 100W incandescent
H	1	Washroom	York Lithonia DCB 136 4PF	1 ea. - F30 CW
J	1	Kitchen	York Lithonia S10	1 ea. - 60W incandescent
K	8	Control room	York Lithonia 2PM3GB2U40-16D-120V	2 EA. - U40 fluorescent
L	1	Kitchen	York LithoniaS-124-HPF - 120V	1 EA. - 24" - 20W fluorescent

ANNUAL PREVENTIVE MAINTENANCE FOR CONTROL BUILDING LIGHTING

M	9	Control room	York Lithonia D 8BC - 120V	1 ea. - 75W PAR 38 flood
N	2	Kitchen	incandescent wall mount down light - 799-512	1 ea. - 75W incandescent
P	1	Kitchen	York LithoniaS-136-HPF - 120V	1 EA. - 36" - 30W fluorescent
X	2	Substation exit Corridor exit	Ready-Lite RX4100	?

- .2 The **Low Voltage Relay Controller** for the interior lighting is located on the Northeast wall of the substation.
- .3 The **Photocell** for control of the soffit and entrance is located on the control building outside north wall.

3 Lighting Fixtures :

- .1 Check operation of all lamps.
- .2 Clean all fixtures and lamps.
 - .1 A damp cloth without detergent is recommended for wiping lamps.
 - .2 A vacuum is recommended for cleaning lenses.
 - .3 Do not touch the parabolic reflectors on type K fixtures with bare hands as this will mark the surface.

4 Photocell:

- .1 Clean lens.
- .2 Check and observe operation as light level decreases at dusk.

5 Low Voltage Relay Controller:

- .1 Test operation of each local low voltage light switch.
- .2 Test operation of master switch functions:
 - .1 switching of individual rooms.
 - .2 switching all lights together
- .3 Visually inspect and clean the interior of Douglas relay panel:

ANNUAL PREVENTIVE MAINTENANCE FOR CARBON MONOXIDE

Item:	<input checked="" type="checkbox"/>																										
<p>1 General:</p> <p>.1 The maintenance listed in this table shall be done once every year.</p> <p>.2 Perform these checks in the sequence listed.</p> <p>.3 This maintenance shall not be performed during rush hours or emergencies.</p> <p>.4 Tunnel traffic control shall be used for this maintenance.</p> <p>.5 The PM of the Honeywell DDC control panels, PC computer, printer and monitor is a separate standard (section) in this manual.</p>																											
<p>2 Equipment:</p> <p>.1 The Carbon Monoxide (CO) sensors are located in the south and north bound tunnels:</p> <table border="1" style="margin-left: 40px; border-collapse: collapse; width: 60%;"> <thead> <tr> <th style="width: 25%;">CO sensor</th> <th style="width: 75%;">Location</th> </tr> </thead> <tbody> <tr><td>CO-S-1</td><td>south bound tunnel entrance - west side</td></tr> <tr><td>CO-S-2</td><td>south bound tunnel entrance - east side</td></tr> <tr><td>CO-S-3</td><td>south bound tunnel apex (midpoint)- west side</td></tr> <tr><td>CO-S-4</td><td>south bound tunnel apex (midpoint)- east side</td></tr> <tr><td>CO-S-5</td><td>south bound tunnel exit - west side</td></tr> <tr><td>CO-S-6</td><td>south bound tunnel exit - east side</td></tr> <tr><td>CO-N-1</td><td>north bound tunnel entrance - west side</td></tr> <tr><td>CO-N-2</td><td>north bound tunnel entrance - east side</td></tr> <tr><td>CO-N-3</td><td>north bound tunnel apex (midpoint)- west side</td></tr> <tr><td>CO-N-4</td><td>north bound tunnel apex (midpoint)- east side</td></tr> <tr><td>CO-N-5</td><td>north bound tunnel exit - west side</td></tr> <tr><td>CO-N-6</td><td>north bound tunnel exit - east side</td></tr> </tbody> </table> <p>.2 The 120/24VAC Transformers and 24VDC power supplies are located in a panel on the north (west) wall in the substation.</p> <p>.3 Honeywell direct digital control (DDC) panels are located in panels on the north (west) wall in the substation.:</p> <p style="margin-left: 20px;">a. Panel DDC-1 monitors and controls the CO levels and ventilation fans in the Northbound tunnel.</p> <p style="margin-left: 20px;">b. Panel DDC-2 monitors and controls the CO levels and ventilation fans in the Southbound tunnel.</p>		CO sensor	Location	CO-S-1	south bound tunnel entrance - west side	CO-S-2	south bound tunnel entrance - east side	CO-S-3	south bound tunnel apex (midpoint)- west side	CO-S-4	south bound tunnel apex (midpoint)- east side	CO-S-5	south bound tunnel exit - west side	CO-S-6	south bound tunnel exit - east side	CO-N-1	north bound tunnel entrance - west side	CO-N-2	north bound tunnel entrance - east side	CO-N-3	north bound tunnel apex (midpoint)- west side	CO-N-4	north bound tunnel apex (midpoint)- east side	CO-N-5	north bound tunnel exit - west side	CO-N-6	north bound tunnel exit - east side
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CO-S-3	south bound tunnel apex (midpoint)- west side																										
CO-S-4	south bound tunnel apex (midpoint)- east side																										
CO-S-5	south bound tunnel exit - west side																										
CO-S-6	south bound tunnel exit - east side																										
CO-N-1	north bound tunnel entrance - west side																										
CO-N-2	north bound tunnel entrance - east side																										
CO-N-3	north bound tunnel apex (midpoint)- west side																										
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CO-N-5	north bound tunnel exit - west side																										
CO-N-6	north bound tunnel exit - east side																										

ANNUAL PREVENTIVE MAINTENANCE FOR CARBON MONOXIDE

3 Calibration of CO sensors :

- .1 Ask the tunnel operator to display the CO sensor readings on the Honeywell PC monitor.
- .2 Record these opening readings.
- .3 The following equipment is required:
 - .1 Calibration gas standard - 0 ppm CO - vehicle
 - .2 Calibration gas standard - 35 ppm CO - vehicle
 - .3 Flow adjustment valve
 - .4 Bubbler
 - .5 Flow rate indicator
 - .6 Plastic adapter cap, hoses and fittings.
- .4 Refer to CO sensor manufacturer's (ENMET) Calibration Set-up drawing for the attachment of the calibration equipment to the sensor.
- .5 Refer to CO sensor manufacturer's (ENMET) Calibration Prodder drawing for future information if required..
- .6 Open the Emergency Backup Panel door to disable computer control of the fans.
- .7 The following procedure shall be followed:
 - .1 Unscrew sensor retaining cap and push plastic calibration cap over sensor.
 - .2 Connect the 0 ppm CO gas to the calibration assembly.
 - .3 Adjust the flow rate to approximately .5 SCFH
 - .4 Set the Cel Gas Select Rotary Switch on the CO transmitter to position "x" (0 ppm).
 - .5 Press and hold the Calibration Request push-button until the Calibration Indicator comes on.
 - .6 Wait approximately 5 minutes (2 cycles) until the Calibration Indicator starts flashing to indicate the end of the first sample.
 - .7 Shut off the gas flow and replace the first canister with the 35 ppm CO gas.
 - .8 Adjust the flow rate to approximately .5 SCFH
 - .9 Set the Cel Gas Select Rotary Switch on the CO transmitter to position "y" (35 ppm).
 - 10. Press and hold the Calibration Request push-button until the Calibration Indicator comes on.
 - 11. Wait approximately 5 minutes. The Calibration Indicator will turn off and the Status Indicator will remain green to indicate a successful calibration.

ANNUAL PREVENTIVE MAINTENANCE FOR CARBON MONOXIDE

- .12 An error condition is indicated by the Status Indicator turning red.:
 - .1 Check that the Cel Gas Select Switch was correctly set for the second sample.
 - .2 Check that the sensor is secure in its socket.
- .13 Replace faulty sensors and recalibrate.
- .14 Shut off the gas and remove the calibration assembly.
- .15 Replace the sensor retaining cap.
- .16 Repeat this procedure for each sensor.
- .17 Record Honeywell CO readings:

CO sensor	ppm prior to calibration	ppm after calibration complete.	Honeywell alarm <input checked="" type="checkbox"/>
CO-S-1			
CO-S-2			
CO-S-3			
CO-S-4			
CO-S-5			
CO-S-6			
CO-N-1			
CO-N-2			
CO-N-3			
CO-N-4			
CO-N-5			
CO-N-6			

- .8 Close the Emergency Backup Panel door when the calibration work is finished.
- .9 Record Honeywell CO readings after calibration is complete and readings have settled to a normal state. Run the fans if necessary.

5 Final checks:

- .1 Ensure that Honeywell alarms are not present.

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

Item:	<input checked="" type="checkbox"/>
1 General:	
<ul style="list-style-type: none"> .1 The maintenance listed in this table shall be done once every year. .2 Perform these checks in the sequence listed. .3 This maintenance shall not be performed during rush hours or emergencies. .4 Tunnel traffic control shall be used for this maintenance. .5 The PM of the Honeywell DDC control panels, PC computer, printer and monitor is a separate standard (section) in this manual. .6 The vibration analysis and infrared scanning of the tunnel fans may be scheduled to utilize the same lane closures. .7 A small portable generator may be required to power the test equipment. .8 The double bucket truck is preferable to the single truck for this PM. 	
2 Equipment Locations:	
<ul style="list-style-type: none"> .1 The Tunnel Fans are mounted in pairs on the ceilings in the south and north bound tunnels: 	
Fan:	Location:
FF-S-8A	south bound tunnel entrance - west side
FF-S-8B	south bound tunnel entrance - east side
FF-S-7A	south bound tunnel - west side
FF-S-7B	south bound tunnel - east side
FF-S-6A	south bound tunnel - west side
FF-S-6B	south bound tunnel - east side
FF-S-5A	south bound tunnel - west side
FF-S-5B	south bound tunnel - east side
FF-S-4A	south bound tunnel - west side
FF-S-4B	south bound tunnel - east side
FF-S-3A	south bound tunnel - west side
FF-S-3B	south bound tunnel - east side
FF-S-2A	south bound tunnel - west side
FF-S-2B	south bound tunnel - east side
FF-S-1A	south bound tunnel exit - west side
FF-S-1B	south bound tunnel exit - east side
FF-N-8A	north bound tunnel entrance - west side
FF-N-8B	north bound tunnel entrance - east side
FF-N-7A	north bound tunnel - west side

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

FF-N-7B	north bound tunnel - east side
FF-N-6A	north bound tunnel - west side
FF-N-6B	north bound tunnel - east side
FF-N-5A	north bound tunnel - west side
FF-N-5B	north bound tunnel - east side
FF-N-4A	north bound tunnel - west side
FF-N-4B	north bound tunnel - east side
FF-N-3A	north bound tunnel - west side
FF-N-3B	north bound tunnel - east side
FF-N-2A	north bound tunnel - west side
FF-N-2B	north bound tunnel - east side
FF-N-1A	north bound tunnel exit - west side
FF-N-1B	north bound tunnel exit - east side

- .2 Each tunnel fan consists of the following sub-assemblies:
 - .1 fan housing
 - .2 silencers
 - .3 motor
 - .4 hub
 - .5 impeller
 - .6 mounting hardware and fastenings
- .3 The local **Disconnect Switch** for each fan is mounted on the fan housing.
- .4 The **MCC Starters** for each fan are located in MCC cabinets in the substation.
- .5 The **Time Delay Relays** (TDRs) are mounted in three separate MCC cabinets in the substation.

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

3 Operational checks :

- .1 Open the Emergency Back-up Panel to stop all fans.
- .2 Check that the Tunnel Fans MCC starter switches are in the "auto" position and the indicator lamps show "off" green.
- .3 Press the panel buttons to forward each fan pair.
- .4 Check and record the starting time delay (TDR) for each fan pair. This should be a minimum of 5 seconds.
- .5 Confirm the operation of each fan by observing the MCC indicator lamps and recording the running amperage using a clamp-on amp meter on the conductors leaving the forward MCC contactor.
- .6 Stop all fans using the Emergency Back-up Panel buttons.
- .7 Press the panel buttons to reverse each fan pair.
- .8 Check and record the starting time delay (TDR) for each fan pair. This should be a minimum of 5 seconds.
- .9 Confirm the operation of each fan by observing the MCC indicator lamps and recording the running amperage using a clamp-on amp meter on the conductors leaving the reverse MCC contactor.
- .10 Confirm the operation of each fan by observing the MCC indicator lamps and recording the running amperage using a clamp-on amp meter on the conductors leaving the reverse MCC contactor.
- .11 Stop all fans using the Emergency Back-up Panel buttons.
- .12 Close the Emergency Back-up Panel to return control of the fans to the computer.
- .13 Ask the tunnel operator to use the computer to override all fans on.
- .14 Confirm that all fans are running by observing the MCC indicator lamps.
- .15 Sequentially switch off each fan using the MCC selector switch and check that the appropriate Honeywell alarm is annunciated and then reset when the switch is returned to the auto position.
- .16 Ask the tunnel operator to return the fans to normal operation.

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

Fan:	Fwd. Amps	Rev. Amps	Lamps OK	Fwd. TDR	Rev. TDR
FF-S-8A					
FF-S-8B					
FF-S-7A					
FF-S-7B					
FF-S-6A					
FF-S-6B					
FF-S-5A					
FF-S-5B					
FF-S-4A					
FF-S-4B					
FF-S-3A					
FF-S-3B					
FF-S-2A					
FF-S-2B					
FF-S-1A					
FF-S-1B					
FF-N-8A					
FF-N-8B					
FF-N-7A					
FF-N-7B					
FF-N-6A					
FF-N-6B					
FF-N-5A					
FF-N-5B					
FF-N-4A					
FF-N-4B					
FF-N-3A					
FF-N-3B					
FF-N-2A					
FF-N-2B					
FF-N-1A					
FF-N-1B					

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

<p>4 Vibration Analysis :</p> <p>.1 Vibration analysis shall be done by a firm specializing in this work. It is recommended that the same firm be used each year as this will allow a historical data base to be accumulated and used for predictive PM. <input type="checkbox"/></p> <p>.2 The horizontal, vertical and axial displacements, velocities and frequencies shall be measured and analyzed for each of the tunnel fans running in the forward direction. <input type="checkbox"/></p> <p>.3 A comprehensive written report shall be issued showing the detailed readings, methods, equipment used, analytical data, conclusions and recommendations. <input type="checkbox"/></p> <p>.4 Refer to O & M manual volume:2, tab:3 - A for vibration data. <input type="checkbox"/></p> <p>.5 Report recommendations shall be done in accordance with the corrective maintenance standard. <input type="checkbox"/></p>																
<p>5 Infrared Scanning of Local Disconnect Switches :</p> <p>.1 A small portable infrared scanner and a 6" x 8" mirror are necessary to view the inside of the local disconnect switches. <input type="checkbox"/></p> <p>.2 Ensure that each tunnel fan being tested has been running for at least 20 minutes prior to the infrared scanning (warm-up). <input type="checkbox"/></p> <p>.3 Open, visually inspect and infrared scan each tunnel fan local disconnect switch. <input type="checkbox"/></p> <p>.4 Record the results of each test scan. <input type="checkbox"/></p> <p>.5 Analyze and compare the results to the previous scans and plan corrective action for any hot spots and connections that are progressively getting hotter. <input type="checkbox"/></p>																
<p>6 Physical Inspections and Lubrication :</p> <p>.1 Inspect each of the tunnel fan assemblies for the following: Note problems for corrective maintenance.</p> <table><tr><td>.1 paint finish</td><td><input type="checkbox"/></td></tr><tr><td>.2 dirt build-up</td><td><input type="checkbox"/></td></tr><tr><td>.3 wear</td><td><input type="checkbox"/></td></tr><tr><td>.4 corrosion</td><td><input type="checkbox"/></td></tr><tr><td>.5 tightness</td><td><input type="checkbox"/></td></tr><tr><td>.6 physical damage</td><td><input type="checkbox"/></td></tr><tr><td>.7 freedom of rotation</td><td><input type="checkbox"/></td></tr><tr><td>.8 blade clearance</td><td><input type="checkbox"/></td></tr></table> <p>.2 The drive end bearings shall be greased with alvania EP2 or a lithium grease equivalent. Caution DO NOT OVER GREASE .3 oz. max. <input type="checkbox"/></p> <p>.3 The non-drive end bearings are permanently lubricated. <input type="checkbox"/></p>	.1 paint finish	<input type="checkbox"/>	.2 dirt build-up	<input type="checkbox"/>	.3 wear	<input type="checkbox"/>	.4 corrosion	<input type="checkbox"/>	.5 tightness	<input type="checkbox"/>	.6 physical damage	<input type="checkbox"/>	.7 freedom of rotation	<input type="checkbox"/>	.8 blade clearance	<input type="checkbox"/>
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.8 blade clearance	<input type="checkbox"/>															

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

Fan Assembly:	Vibration analysis:	Infrared Scan:	Inspection:	Grease:
FF-S-8A				
FF-S-8B				
FF-S-7A				
FF-S-7B				
FF-S-6A				
FF-S-6B				
FF-S-5A				
FF-S-5B				
FF-S-4A				
FF-S-4B				
FF-S-3A				
FF-S-3B				
FF-S-2A				
FF-S-2B				
FF-S-1A				
FF-S-1B				
FF-N-8A				
FF-N-8B				
FF-N-7A				
FF-N-7B				
FF-N-6A				
FF-N-6B				
FF-N-5A				
FF-N-5B				
FF-N-4A				
FF-N-4B				
FF-N-3A				
FF-N-3B				
FF-N-2A				
FF-N-2B				
FF-N-1A				
FF-N-1B				

ANNUAL PREVENTIVE MAINTENANCE FOR TUNNEL FANS

7 MCC Cabinets :

- .1 Infrared scanning and the inspection and cleaning of the tunnel fan MCC cabinets is done with the other MCC switch gear and panel boards. Refer to the MCC Switch Gear and Panel Boards standard section in this manual.

6 Final checks :

- .1 Ensure that all Honeywell control points have been returned to normal values and that no alarms are present.



MONTHLY PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Item:	<input checked="" type="checkbox"/>																																																																
<p>1 General:</p> <p>.1 The maintenance listed in this table shall be done once a month.</p> <p>.2 Notify tunnel operator 48 hours prior to maintenance.</p> <p>.3 This maintenance shall not be performed during rush hours, emergencies or high volume traffic flows.</p> <p>.4 This maintenance will require the use of a truck mounted traffic diverting signal (directional arrow) in order to keep traffic from entering the high speed shoulder. The high speed lane traffic signal heads shall be placed in flashing amber.</p>																																																																	
<p>2 Equipment:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;">Equipment:</th> <th style="width: 10%;">Qty.</th> <th style="width: 45%;">Locations:</th> </tr> </thead> <tbody> <tr> <td>Fire Alarm Control Panel</td> <td style="text-align: center;">1</td> <td>Operators control room</td> </tr> <tr> <td>Fire Alarm Annunciator Panel</td> <td style="text-align: center;">1</td> <td>Operators control room</td> </tr> <tr> <td>Alarm Chime</td> <td style="text-align: center;">1</td> <td>Operators control room</td> </tr> <tr> <td rowspan="9">Smoke Detectors</td> <td style="text-align: center;">2</td> <td>Electrical substation</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Mechanical room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Radio room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Storage room</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Corridor</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Telephone room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Tunnel access</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Battery room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Operators control room</td> </tr> <tr> <td rowspan="6">Heat Detectors</td> <td style="text-align: center;">1</td> <td>Kitchen</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Generator room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Battery room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Diesel storage vault</td> </tr> <tr> <td style="text-align: center;">33</td> <td>Northbound tunnel</td> </tr> <tr> <td style="text-align: center;">33</td> <td>Southbound tunnel</td> </tr> <tr> <td rowspan="2">Manual Pull Stations</td> <td style="text-align: center;">1</td> <td>Operators control room</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Corridor</td> </tr> <tr> <td>Sprinkler Water Flow Switch</td> <td style="text-align: center;">1</td> <td>Mechanical room</td> </tr> <tr> <td rowspan="3">Gate Valve Tamper Switches</td> <td style="text-align: center;">1</td> <td>North valve pit</td> </tr> <tr> <td style="text-align: center;">1</td> <td>South valve pit</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Mechanical room</td> </tr> <tr> <td rowspan="2">Door Switches</td> <td style="text-align: center;">1</td> <td>Control building main entrance</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Substation double doors</td> </tr> </tbody> </table>		Equipment:	Qty.	Locations:	Fire Alarm Control Panel	1	Operators control room	Fire Alarm Annunciator Panel	1	Operators control room	Alarm Chime	1	Operators control room	Smoke Detectors	2	Electrical substation	1	Mechanical room	1	Radio room	1	Storage room	2	Corridor	1	Telephone room	1	Tunnel access	1	Battery room	1	Operators control room	Heat Detectors	1	Kitchen	1	Generator room	1	Battery room	1	Diesel storage vault	33	Northbound tunnel	33	Southbound tunnel	Manual Pull Stations	1	Operators control room	1	Corridor	Sprinkler Water Flow Switch	1	Mechanical room	Gate Valve Tamper Switches	1	North valve pit	1	South valve pit	1	Mechanical room	Door Switches	1	Control building main entrance	2	Substation double doors
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MONTHLY PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Emergency Cabinets (SOS Boxes) :	30	North and south bound tunnels
Door switch	30	inside SOS Box
Manual Pull Station	30	inside SOS Box
Telephone Handset	30	inside SOS Box
Printed Circuit Boards	30	inside SOS Box
Strip Heater and Thermostat	30	inside SOS Box

3 Fire Alarm Control Panel:

.1 Check that the correct date is displayed on the LED display.

.2 Check that no trouble, supervisory or alarm messages are present.

4 Fire Alarm Annunciator Panel:

.1 Check that no trouble, supervisory or alarms are present.

.2 Check that all lamps are correctly aligned with the face panel.

5 Control Building Manual Pull Stations:

.1 Check that the glass (or plastic) break rods are intact. Do not activate the pull station.

.1 Operators control room

.2 Corridor

6 SOS Boxes:

.1 Check that the opening of each SOS cabinet door is annunciated on the Fire Alarm Annunciator Panel.

.2 Check that the glass (or plastic) break rods are intact at each manual pull station. Do not activate the pull station.

.3 Check that the telephone handset rings the tunnel operator and that the communication is satisfactory - not faint or noisy.

.4 Check that the strip heater and thermostat are operational in cool or cold weather (< 10°C)

MONTHLY PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

.5 Check cabinet and equipment for cleanliness, paint finish and damage.

SOS Box	Door alarm <input checked="" type="checkbox"/>	Glass rod <input checked="" type="checkbox"/>	Phone				Strip heater <input checked="" type="checkbox"/>	Cabinet condition <input checked="" type="checkbox"/>
			Fast lane Tel#	<input checked="" type="checkbox"/>	Slow lane Tel#	<input checked="" type="checkbox"/>		
SB-1			401		416			
SB-2			402		417			
SB-3			403		418			
SB-4			404		419			
SB-5			405		420			
SB-6			406		421			
SB-7			407		422			
SB-8			408		423			
SB-9			409		424			
SB-10			410		425			
SB-11			411		426			
SB-12			412		427			
SB-13			413		428			
SB-14			414		429			
SB-15			415		430			
NB-1			301		316			
NB-2			302		317			
NB-3			303		318			
NB-4			304		319			
NB-5			305		320			
NB-6			306		321			
NB-7			307		322			
NB-8			308		323			
NB-9			309		324			
NB-10			310		325			
NB-11			311		326			
NB-12			312		327			
NB-13			313		328			
NB-14			314		329			
NB-15			315		330			

7 Final checks:

.1 Ensure that the following panels are in their normal operating state and do not display any alarms:

- .1 Honeywell control monitor
- .2 Fire Alarm Control Panel
- .3 Fire Alarm Annunciator Panel

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once a year.	
.2 This shall be scheduled in conjunction with a monthly preventive maintenance.	
.3 This maintenance shall be done by the supplier's representative or a qualified electrician with specific service training for this fire alarm system.	
.4 A small portable generator will be required to power the heat gun.	
.5 The tunnel portion of this work will require the use of a bucket truck.	
.6 Lane closures will be required.	
2 Fire Alarm Control Panel:	
.1 Inspect and clean the interior of this panel	<input type="checkbox"/>
.2 Check that all alarms are correctly annunciated on the LED display and the panel buzzer sounds.	<input type="checkbox"/>
.3 Check that this panel sends the following signals to the Honeywell control system. Ask the tunnel operator to display the appropriate screens or note the relevant alarm. The following conditions may be simulated on the Fire Alarm Control Panel or done by actuating a device. The purpose of this test is check the relays and wiring between the two systems.	<input type="checkbox"/>
.1 General Fire Alarm	<input type="checkbox"/>
.2 Manual Pull Station	<input type="checkbox"/>
.3 Fire System Trouble	<input type="checkbox"/>
.4 Control Building Fire Alarm	<input type="checkbox"/>
.5 SOS Door Switch	<input type="checkbox"/>
.6 Northbound Tunnel Heat Detector	<input type="checkbox"/>
.7 Southbound Tunnel Heat Detector	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

.4	<p>Check that this panel sends the following signals to the CCTV camera system. The following conditions may be simulated on the Fire Alarm Control Panel or done by opening a SOS door in each of the six groups. The CCTV system will change the selected camera on the emergency display monitor. The purpose of this test is check the relays and wiring between the two systems.</p>	□																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">SOS Door:</th> <th style="width: 20%;">Camera Monitor:</th> <th style="width: 30%;"></th> </tr> </thead> <tbody> <tr> <td>Southbound SOS Boxes 1 - 5</td> <td>#2</td> <td style="text-align: center;">☑</td> </tr> <tr> <td>Southbound SOS Boxes 6 - 10</td> <td>#4</td> <td></td> </tr> <tr> <td>Southbound SOS Boxes 11 - 15</td> <td>#6</td> <td></td> </tr> <tr> <td>Northbound SOS Boxes 1 - 5</td> <td>#2</td> <td></td> </tr> <tr> <td>Northbound SOS Boxes 6 - 10</td> <td>#4</td> <td></td> </tr> <tr> <td>Northbound SOS Boxes 11 - 15</td> <td>#6</td> <td></td> </tr> </tbody> </table>			SOS Door:	Camera Monitor:		Southbound SOS Boxes 1 - 5	#2	☑	Southbound SOS Boxes 6 - 10	#4		Southbound SOS Boxes 11 - 15	#6		Northbound SOS Boxes 1 - 5	#2		Northbound SOS Boxes 6 - 10	#4		Northbound SOS Boxes 11 - 15	#6	
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3 Fire Alarm Annunciator Panel:																							
.1	Inspect and clean the interior of this panel	□																					
.2	Check that all alarms are correctly annunciated on the display.	□																					
4 Operators Control Room and Kitchen:																							
.1	<p><u>Caution:</u> Activation of the operators control room and kitchen devices will open a solenoid valve and allow water to flood into the piping and sprinkler heads serving these areas. This should be done only when necessary for testing and when arrangements have been made to drain the piping and pendant heads in the operators control room after the test.</p>																						
.2	Check that the Alarm Chime (bell) sounds when an alarm has been initiated.	□																					
.3	Manual Pull Station, Sprinkler Water Flow Switch and Solenoid Valve:																						
.1	Check the function of these devices by connecting a hose to the drain valve for the operators control room sprinklers and activating the solenoid valve with the manual pull station located in the operators control room.	□																					
.1	The manual pull station initiates an alarm and opens the solenoid valve.	□																					
.2	The sprinkler water flow switch initiates an alarm.	□																					
.2	Reset the devices and clear the alarms.	□																					
.3	Check that the solenoid valve has closed.	□																					

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

.4	Kitchen Heat Detector:	
	.1 Check the alarm function using a heat gun on a low setting.	<input type="checkbox"/>
	.2 Check the tamper/trouble function by removing the detector from its base.	<input type="checkbox"/>
	.3 Check that the solenoid valve opens	<input type="checkbox"/>
	.4 Reset the device and clear the alarms.	<input type="checkbox"/>
	.5 Check that the solenoid valve has closed.	<input type="checkbox"/>
.5	Operators Control Room Smoke Detector:	
	.1 Check the alarm function using a smoke source to activate the detector.	<input type="checkbox"/>
	.2 Check the trouble function by removing the detector from its base.	<input type="checkbox"/>
	.3 Check that the solenoid valve opens	<input type="checkbox"/>
	.4 Reset the device and clear the alarms.	<input type="checkbox"/>
	.5 Check that the solenoid valve has closed.	<input type="checkbox"/>
5	Control Building Smoke Detectors:	
	.1 Check the alarm function using a smoke source to activate each device.	<input type="checkbox"/>
	.2 Check the tamper/trouble function by removing the detector from its base.	<input type="checkbox"/>
6	Control Building and Diesel Storage Heat Detectors:	
	.1 Check the alarm function using a heat gun. Do not overheat.	<input type="checkbox"/>
	.2 Check the tamper/trouble function by removing the detector from its base.	<input type="checkbox"/>
7	Corridor Manual Pull Station:	
	.1 Check the alarm function by opening the station with a screwdriver and operating the switch.	<input type="checkbox"/>
	.2 Reset the switch and close the case.	<input type="checkbox"/>
8	Control Building Door Switches:	
	.1 These switches are currently not in service. They are not required while the tunnel has a full time operator. The wiring and switches have been left in place.	

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

9	Gate Valve Tamper Switches:	<ul style="list-style-type: none"> .1 Check the supervisory alarm function of the gate valve tamper switches by partially closing the valves, waiting for the alarm and then opening the valve. <input type="checkbox"/> .2 Note: The mounting of the switches makes them difficult to reset once they have been moved. (the north valve pit is very touchy!) .3 The switches on each valve in the north valve pit are wired in series as one device - test each switch then reset. .4 The switches on each valve in the south valve pit are wired in series as one device.
10	SOS Door Switches:	<ul style="list-style-type: none"> .1 Do the monthly check. <input type="checkbox"/>
11	SOS Manual Pull Stations	<ul style="list-style-type: none"> .1 Check the alarm function by opening the station with a screwdriver and operating the switch. <input type="checkbox"/> .2 Wait for the alarm, reset the switch and close the case. <input type="checkbox"/>
12	Tunnel Heat Detectors	<ul style="list-style-type: none"> .1 Check the alarm function using a heat gun. Do not overheat. <input type="checkbox"/> .2 Check the tamper/trouble function by removing the detector from its base. <input type="checkbox"/>
13	Record Test Results:	<p>Abbreviations:</p> <ul style="list-style-type: none"> FACP - Fire Alarm Control Panel FAAP - Fire Alarm Annunciator Panel MPS - Manual Pull Station AC - Alarm Chime HD - Heat Detector SD - Smoke Detector DS - Door Switch GVTS - Gate Valve Tamper Switch FS - Flow Switch SV - Solenoid Valve SB - Southbound Tunnel NB - Northbound Tunnel N/A - Not Applicable

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Location	Dev.	Zone and Address	FACP <input checked="" type="checkbox"/>	FAAP <input checked="" type="checkbox"/>	CCTV <input checked="" type="checkbox"/>
SB-SOS Box-1 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	30-101			N/A
	DS	60-102			
	HD	10-103			N/A
	HD	10-103			N/A
	HD	10-103			N/A
SB-SOS Box-2 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	31-104			N/A
	DS	60-105			
	HD	11-106			N/A
	HD	11-106			N/A
SB-SOS Box-3	MPS	32-107			N/A
	DS	60-108			
SB-SOS Box-4 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	33-109			N/A
	DS	60-110			
	HD	12-111			N/A
	HD	12-111			N/A
	HD	12-111			N/A
	HD	12-111			N/A
SB-SOS Box-5 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	39-201			N/A
	DS	60-202			
	HD	13-203			N/A
	HD	13-203			N/A
	HD	13-203			N/A
SB-SOS Box-6	MPS	35-204			N/A
	DS	61-205			
SB-SOS Box-7 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	36-206			N/A
	DS	61-207			
	HD	14-208			N/A
	HD	14-208			N/A
	HD	14-208			N/A
SB-SOS Box-8	MPS	37-209			N/A
	DS	61-210			

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Location	Dev.	Zone and Address	FACP <input type="checkbox"/>	FAAP <input type="checkbox"/>	CCTV <input type="checkbox"/>
SB-SOS Box-9 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	38-211			N/A
	DS	61-212			
	HD	15-213			N/A
	HD	15-213			N/A
	HD	15-213			N/A
SB-SOS Box-10 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	39-214			N/A
	DS	61-215			
	HD	16-216			N/A
	HD	16-216			N/A
SB-SOS Box-11	MPS	40-217			N/A
	DS	62-218			
SB-SOS Box-12 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	41-219			N/A
	DS	62-220			
	HD	17-221			N/A
	HD	17-221			N/A
SB-SOS Box-13	MPS	42-222			N/A
	DS	62-223			
SB-SOS Box-14 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	43-224			N/A
	DS	63-225			
	HD	18-226			N/A
	HD	18-226			N/A
	HD	18-226			N/A
SB-SOS Box-15 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	44-227			N/A
	DS	62-228			
	HD	19-229			N/A
	HD	19-229			N/A
NB-SOS Box-1 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	45-301			N/A
	DS	63-302			
	HD	20-303			N/A
	HD	20-303			N/A
NB-SOS Box-2 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	46-305			N/A
	DS	63-306			
	HD	21-307			N/A
	HD	21-307			N/A
	HD	21-307			N/A

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Location	Dev.	Zone and Address	FACP <input checked="" type="checkbox"/>	FAAP <input checked="" type="checkbox"/>	CCTV <input checked="" type="checkbox"/>
NB-SOS Box-3 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	47-308			N/A
	DS	63-309			
	HD	22-310			N/A
	HD	22-310			N/A
	HD	22-310			N/A
NB-SOS Box-4	MPS	48-311			N/A
	DS	63-312			
NB-SOS Box-5 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	49-401			N/A
	DS	63-402			
	HD	23-403			N/A
	HD	23-403			N/A
NB-SOS Box-6	MPS	50-404			N/A
	DS	64-405			
NB-SOS Box-7 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	51-406			N/A
	DS	64-407			
	HD	24-408			N/A
	HD	24-408			N/A
NB-SOS Box-8	MPS	52-409			N/A
	DS	64-410			
NB-SOS Box-9 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	53-411			N/A
	DS	64-412			
	HD	25-413			N/A
	HD	25-413			N/A
	HD	25-413			N/A
NB-SOS Box-10 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	54-414			N/A
	DS	64-415			
	HD	26-416			N/A
	HD	26-416			N/A
NB-SOS Box-11	MPS	55-417			N/A
	DS	65-418			
NB-SOS Box-12 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	56-419			N/A
	DS	65-420			
	HD	27-421			N/A
	HD	27-421			N/A

ANNUAL PREVENTIVE MAINTENANCE FOR FIRE ALARM AND SOS BOXES

Location	Dev.	Zone and Address	FACP <input checked="" type="checkbox"/>	FAAP <input checked="" type="checkbox"/>	CCTV <input checked="" type="checkbox"/>
NB-SOS Box-13 tunnel ceiling tunnel ceiling tunnel ceiling tunnel ceiling	MPS	57-422			N/A
	DS	65-423			
	HD	28-424			N/A
	HD	28-424			N/A
	HD	28-424			N/A
NB-SOS Box-14	MPS	58-425			N/A
	DS	65-426			
NB-SOS Box-15 tunnel ceiling tunnel ceiling tunnel ceiling	MPS	59-427			N/A
	DS	65-428			
	HD	29-429			N/A
	HD	29-429			N/A
North Valve Pit	GVTS	67-430			N/A
South Valve Pit	GVTS	66-304			N/A
Diesel storage vault	HD	73-509			N/A
Electrical Substation - East	SD	72-505			N/A
Electrical Substation - West	SD	72-510			N/A
Mechanical room	SD	79-511			N/A
Storage room	SD	79-514			N/A
Radio room	SD	79-506			N/A
Corridor - East	SD	70-503			N/A
Corridor - East	MPS	69-502			N/A
Corridor - West	SD	70-508			N/A
Tunnel access	SD	79-507			N/A
Telephone room	SD	79-515			N/A
Battery room	SD	78-518			N/A
Battery room	HD	79-516			N/A
Generator room	HD	76-517			N/A
Mechanical room	SD	79-511			N/A
Operators control room	MPS	80-520			N/A
Operators control room	SD	80-521			N/A
Kitchen	HD	77-519			N/A
Mechanical room	FS	74-512			N/A
Mechanical room	GVTS	75-513			N/A
Control Building ceiling	SV	N/A	N/A		N/A
Operators control room	AC	N/A	N/A		N/A
Control building main entrance	DS	68-501	not in	use	N/A
Substation double doors	DS	71-504	not in	use	N/A

ANNUAL PREVENTIVE MAINTENANCE FOR STANDPIPE

Item:	<input checked="" type="checkbox"/>																
1 General:																	
<ul style="list-style-type: none"> .1 The maintenance listed in this table shall be done once a year prior to the heating season. .2 Notify tunnel operator 48 hours prior to maintenance. .3 This PM shall not be performed during rush hours or emergencies. 																	
2 Equipment:																	
<ul style="list-style-type: none"> .1 The following equipment is located in the mechanical room: <ul style="list-style-type: none"> .1 Pump PP-C-1 .2 Pump PP-C-2 .3 Differential Pressure Transducer .4 Boiler WH-C-1, High Limit Switch, Low Water Cut-off .5 Water Temperature Sensor .6 Water Pressure Sensor .7 Leak Detector .2 The Outside Air Temperature Sensor is located on the roof .3 The Heat Tracing is located on the 30 pipes feeding the fire hose connections in each SOS box from the Main Standpipe Header in the southbound tunnel. 																	
3 Lock-out:																	
<ul style="list-style-type: none"> .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual. 																	
4 Boiler, pumps and related checks:																	
<ul style="list-style-type: none"> .1 Switch-off the following equipment at the local disconnect. <ul style="list-style-type: none"> .1 Pump PP-C-1 <input type="checkbox"/> .2 Pump PP-C-2 <input type="checkbox"/> .3 Boiler WH-C-1 <input type="checkbox"/> .2 Check and record the phase to phase heating element resistance. This should be 52 ohms. <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 100%;"> <thead> <tr> <th></th> <th style="text-align: center;">C1</th> <th style="text-align: center;">C2</th> <th style="text-align: center;">C3</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A - B</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">B - C</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">C - A</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> .3 Check and record the insulation resistance. This should be greater than 500,000 ohms. C1 _____ C2 _____ C3 _____ .4 Check the wiring and tighten connections. <input type="checkbox"/> 			C1	C2	C3	A - B				B - C				C - A			
	C1	C2	C3														
A - B																	
B - C																	
C - A																	

ANNUAL PREVENTIVE MAINTENANCE FOR STANDPIPE

.5	Switch-on the following equipment.	
	.1 Pump PP-C-1	<input type="checkbox"/>
	.2 Pump PP-C-2	<input type="checkbox"/>
	.3 Boiler WH-C-1	<input type="checkbox"/>
.6	Check Honeywell water temperature sensor reading for reasonableness.	<input type="checkbox"/>
.7	Enable the boiler and pumps by overriding the Honeywell water temperature sensor input as follows:	
	.1 7°C. - Pump PP-C-1 on	<input type="checkbox"/>
	.2 4°C. - Boiler Stage 1 heat on	<input type="checkbox"/>
	.3 3°C. - Boiler Stage 2 heat on	<input type="checkbox"/>
	.3 2°C. - Boiler Stage 3 heat on	<input type="checkbox"/>
.8	Check Honeywell water temperature sensor reading for reasonableness.	<input type="checkbox"/>
.9	Check the operation of the Water Pressure Sensor:	
	.1 Note the setting on the pressure switch.	<input type="checkbox"/>
	.2 Lower the setting below the current pressure and check for the Honeywell Alarm and Boiler shutdown.	<input type="checkbox"/>
	.3 Reset the pressure switch to the original setting.	<input type="checkbox"/>
.10	Push-to Test the boiler low water cut-out. The boiler should switch off.	<input type="checkbox"/>
.11	Test the operation of the standby pump PP-C-2:	
	.1 Switch of the local disconnect for PP-C-1	<input type="checkbox"/>
	.2 Note the Honeywell alarm	<input type="checkbox"/>
	.3 PP-C-2 should start after a 60 second delay.	<input type="checkbox"/>
	.4 Switch on the local disconnect for PP-C-1	<input type="checkbox"/>
.12	Circulation pumps PP-C-1 and PP-C-2:	
	.1 Visually check for leakage from the mechanical seals.	<input type="checkbox"/>
	.2 Check for excessive vibration and bearing noise.	<input type="checkbox"/>
.13	Return the Honeywell water temperature to automatic (no override) operation.	<input type="checkbox"/>
.14	Check the operation of the leak detector located on the floor by the west wall.	
	.1 Place a wet rag gently under the housing to make contact with the sensing probes.	<input type="checkbox"/>
	.2 Check the Honeywell alarm.	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR STANDPIPE

5 Heat tracing checks:

- .1 Enable the heat tracing by overriding the Honeywell water temperature sensor input to less than 3°C.
- .2 Check and record the load on each circuit on Panel H. Compare these to previous values and investigate significant differences.
- .3 Check the operation of each heat tracing tape at the SOS box and the north and south valve pits. They should be warm to the touch.
- .4 Switch off each heat tracing circuit breaker in turn at panel H and check the Honeywell alarms.

Circuit	Load amps	Feels warm <input checked="" type="checkbox"/>	Alarm <input checked="" type="checkbox"/>
1 - Valve Pit			
2 - Valve Pit			
3 - SOS 1			
4 - SOS 2			
5 - SOS 3			
6 - SOS 4			
7 - SOS 5			
8 - SOS 6			
9 - SOS 7			
10 - SOS 8			
11 - SOS 9			
12 - SOS 10			
13 - SOS 11			
14 - SOS 12			
15 - SOS 13			
16 - SOS 14			
17 - SOS 15			

- .5 Return the Honeywell water temperature to automatic (no override) operation.

5 Final checks:

- .1 Ensure that no Honeywell or fire alarm panel alarms are present.

FIVE-YEAR PREVENTIVE MAINTENANCE FOR STANDPIPE

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once every five years prior to the heating season.	
.2 This maintenance shall be done with the annual PM.	
.3 Notify tunnel operator 48 hours prior to maintenance.	
.4 This PM shall not be performed during rush hours or emergencies.	
.5 This maintenance shall be done by a tradesman qualified, trained and competent to service electric hot water boilers.	
2 Equipment:	
.1 Boiler WH-C-1 is located in the mechanical room.	
3 Boiler checks:	
.1 Blow down the boiler and inspect the elements.	
.1 Close the inlet and outlet valves.	<input type="checkbox"/>
.2 Drain the boiler.	<input type="checkbox"/>
.3 Open the inspection door and examine the scale build-up on the elements. If greater than 1/32" then remove elements, clean, replace and close inspection door.	<input type="checkbox"/>
.4 Close the drain and open the inlet and outlet valves to refill boiler.	<input type="checkbox"/>

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done once a month.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This maintenance shall be done during the day (the noise level is too high for evening or early morning operation).
.4	This maintenance shall not be performed during rush hours or emergencies.
.5	Notify the cellular telephone utility if any service interruptions are anticipated. The cellular service is not on the UPS and is interrupted whenever normal hydro is switched.
.6	These checks shall be done in the listed sequence.
2 Equipment:	
.1	Engine section - generator room.
.2	Alternator section - generator room.
.3	Attached generator control panel - cabinet mounted on top of alternator.
.4	Detached generator control panel with breaker - dark blue cabinet in the generator room.
.5	Remote transfer switches (dark blue) and related control panels (light blue) in the substation.
.6	Ventilation system - generator room.
.7	Fuel system - generator room, fuel pump PP-C-3 and outside fuel tank.
.8	Honeywell computer - control room and substation.
3 Warnings and Cautions:	
.1	The generator may start automatically.
.2	Refer to posted warnings.
.3	Do not use the generator emergency stop switches located outside the generator room door or on the attached generator control panel unless the generator is in a "run - away" condition or the disconnects do not operate and there is an emergency situation. The use of these switches may cause serious engine damage.
	<input type="checkbox"/>

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

4	Lock-out:	<ul style="list-style-type: none"> .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual. .2 A maintenance lock-out point is provided on the detached generator control panel for service of the engine and alternator sections. 	
5	Prestart checks:	<ul style="list-style-type: none"> .1 Ensure that Emergency Backup Panel door in the operators' control room is closed and locked. The generator load breaker will trip if there are fans turned on using this panel. The Honeywell computer will automatically turn off fans which are running under computer control. <input type="checkbox"/> .2 Ask the tunnel operator to display the Battery room on the Honeywell computer and check that no UPS alarms are present. <input type="checkbox"/> .3 Ask the tunnel operator to display the Generator room on the Honeywell computer and check the following information: <input type="checkbox"/> <ul style="list-style-type: none"> .1 generator is not operating <input type="checkbox"/> .2 has not failed Hydro <input type="checkbox"/> .3 outdoor supply air dampers are closed <input type="checkbox"/> .4 exhaust air dampers are closed <input type="checkbox"/> .5 recirculation air dampers are open <input type="checkbox"/> .6 no alarms are present: <input type="checkbox"/> .7 space temperature (range 12-28° C.) <input type="checkbox"/> .8 Check and record the main fuel tank Honeywell Computer level indication _____ gallons. <input type="checkbox"/> .4 Check and record the main fuel tank level using the calibrated dip stick and chart on side of day tank _____ litres. Also record the level in generator log book. <input type="checkbox"/> .5 Check and record the main fuel tank level using the pneumatic levelometer located on outside of north wall of control building _____ litres <input type="checkbox"/> .6 Ensure that the generator room and equipment are clean and free of loose objects. <input type="checkbox"/> .7 Ensure that ventilation intake louvers and plenum are clean and clear of loose objects. <input type="checkbox"/> .8 Inspect for leaks: <ul style="list-style-type: none"> .1 coolant <input type="checkbox"/> .2 lubricating oil <input type="checkbox"/> .3 fuel oil <input type="checkbox"/> 	

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

.9	Check fluid levels:	
	.1 battery	<input type="checkbox"/>
	.2 engine oil dipstick	<input type="checkbox"/>
	.3 engine coolant - visual check through filler cap	<input type="checkbox"/>
	.4 fuel day tank - visual check through pipe cap	<input type="checkbox"/>
.10	Test run the fuel pump PP-C-3 using the local controller panel - return to automatic control after one minute test.	<input type="checkbox"/>
.11	Record date and engine hours in generator log book	<input type="checkbox"/>
.12	Check status of generator alarm indication lights on detached panel. No alarms should be present. Press lamp test. Relamp as necessary.	<input type="checkbox"/>
.13	Check battery charging voltage on panel meter. This should be greater than 25.5 volts.	<input type="checkbox"/>
.14	Check that the engine block heater is working. The engine block should be warm to the touch.	<input type="checkbox"/>
.15	Check that the emergency stop flaps on the generator air intake are latched open (normal position).	<input type="checkbox"/>
.16	Check the status of the disconnect and transfer switches:	
	.1 generator room electrical panel (dark blue): main breaker 'charged' and 'closed'	<input type="checkbox"/>
	.2 sub-station secondary main breaker (light blue) : 'charged' and 'closed'	<input type="checkbox"/>
	.3 emergency bypass (dark blue): 'open 'and 'locked'	<input type="checkbox"/>
	.4 emergency breaker (dark blue): 'open', 'unlocked' and 'charged'	<input type="checkbox"/>
	.5 normal breaker(dark blue): 'closed', 'unlocked' and 'charged',	<input type="checkbox"/>
	.6 normal bypass (dark blue): 'open' and 'locked'	<input type="checkbox"/>
.17	Check UPS:	
	.1 main switch is in the normal, on-line position	<input type="checkbox"/>
	.2 DC disconnect is "closed"	<input type="checkbox"/>
	.3 no alarms present on local UPS panel	<input type="checkbox"/>
<hr/>		
6	Operating Checks.	
.1	The first generator run will test only the generator related functions - not the electrical switch gear. This test is done in order to verify that the engine functions prior to initiating a load test.	
	.1 turn the engine control selector switch located on the detached generator control panel in the generator room to the "test" position.	<input type="checkbox"/>
	.2 generator will run.	<input type="checkbox"/>
	.3 load will <u>not</u> transfer from Hydro.	<input type="checkbox"/>

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

- .2 Allow the generator to run for 10 minutes. Do not create any conditions to simulate failure conditions.
- .3 Check status of generator alarm indication lights on detached generator control panel. No alarms should be present
- .4 Check and record the frequency - meter (59-60 Hz.) actual: _____ Hz.
- .5 Monitor and record the following from the gauges on the attached generator control panel:
 - .1 oil pressure (normal range: 70 - 90) actual: _____
 - .2 coolant temperature: (normal range: 170 - 200) actual: _____
- .6 Check operation of generator ventilation system dampers:
 - .1 outdoor supply air dampers are open
 - .2 exhaust air dampers are open
 - .3 recirculation dampers modulate to maintain 18.5° C.
- .7 Display the Generator room on the Honeywell computer and check the following information:
 - .1 generator is operating
 - .2 outdoor supply air dampers are open
 - .3 exhaust air dampers are open
 - .4 recirculation air dampers are open (modulating)
 - .5 no alarms are present:
- .8 Turn the selector switch located on the detached generator control panel in the generator room to the "auto" position to stop the generator.
- .9 The following generator test is done in order to verify the automatic operation of the generator and transfer switches in the event of Hydro failure. Refer to the posted metal line drawing on the substation panel for circuit and breaker details.
 - .1 Open the secondary main breaker switch located on the (light blue) control panel in the sub-station using the red "push to open" button located inside the door. This will open the normal Hydro low voltage supply and transfer load to the emergency generator.
 - .2 generator will start after few seconds delay.
 - .3 normal breaker (dark blue) opens after few seconds delay.
 - .4 emergency breaker (dark blue) closes after few seconds delay.
- .10 Check for alarms on the detached generator panel.

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

.11	Display the Generator room on the Honeywell computer and check the following information:	
	.1 generator is operating	<input type="checkbox"/>
	.2 Hydro has failed	<input type="checkbox"/>
	.3 check with tunnel operator for any alarms which have not reset after the generator is on line.	<input type="checkbox"/>
.12	Check UPS:	
	.1 no alarms are present on local UPS panel.	<input type="checkbox"/>
	.2 emergency lighting and computer loads (see single line drawing) were continuously fed from the UPS during the transfer to the generator feed. The control room emergency lighting should stay on and there should not be any Honeywell panel failure alarms.	<input type="checkbox"/>
.13	Load test:	
	.1 Note: The UPS "Battery status alarm" on the Honeywell computer may annunciate during the load test. This is OK as the UPS is sensing the power fluctuations caused by the loading of the generator.	<input type="checkbox"/>
	.2 Open Emergency Backup Panel door in the operators' control room and start every other fan pair at approximately 3 second intervals. Leave the door open for the duration of the test.	<input type="checkbox"/>
	.3 Check and record the Frequency meter (Range: 59-61 Hz.) actual: _____ Hz. from the detached generator control panel.	<input type="checkbox"/>
	.4 Check and record the voltage on each phase of the meters on the detached generator control panel. A: _____ B: _____ C: _____	<input type="checkbox"/>
	.5 Check and record the load on each phase of the meters on the detached generator control panel. A: _____ B: _____ C: _____	<input type="checkbox"/>
	.6 Run this test for 30 minutes.	<input type="checkbox"/>
	.7 Close and lock the Emergency Backup Panel door in the operators' control room. This will stop the fans.	<input type="checkbox"/>
.14	Close the secondary main breaker switch located on the (light blue) control panel in the sub-station using the green "push to close" button located inside the door. This will transfer load to normal Hydro low voltage supply.	<input type="checkbox"/>
.15	Load transfer to Hydro:	
	.1 emergency breaker (dark blue) <u>opens</u> after _____ second delay.	<input type="checkbox"/>
	.2 normal breaker (dark blue) <u>closes</u> after _____ second delay.	<input type="checkbox"/>
.16	The generator will stop after a 5 minute cool down period.	<input type="checkbox"/>

MONTHLY PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

7 Final checks (after generator stops):

- .1 Check the status of the disconnect and transfer switches:
 - .1 generator room electrical panel (dark blue): main breaker 'charged' and 'closed'
 - .2 sub-station secondary main breaker (light blue) : 'charged' and 'closed'
 - .3 emergency bypass (dark blue): 'open' and 'locked'
 - .4 emergency breaker(dark blue): 'open', 'unlocked' and 'charged'
 - .5 normal breaker(dark blue): 'closed', 'unlocked' and 'charged',
 - .6 normal bypass (dark blue): 'open' and 'locked'
- .2 Check fuel level in day tank - visual check through pipe cap.
- .3 Check status of generator alarm indication lights on detached panel. No alarms should be present.
- .4 Record engine hours in generator log book.
- .5 Check UPS: no alarms present on local UPS panel
- .6 Lock doors and return key
- .7 Check with tunnel operator and ensure that no alarms are present on the Honeywell computer.

TRI-ANNUAL PREVENTIVE MAINTENANCE FOR EMERGENCY GENERATOR

Item:	<input checked="" type="checkbox"/>																										
<p>1 General:</p> <p>.1 The maintenance listed in this table shall be done once every three years in conjunction with a monthly preventive maintenance.</p> <p>.2 A qualified Diesel generator service contractor shall be used.</p> <p>.3 A person trained and familiar with the Honeywell computer and control wiring shall be used.</p>																											
<p>2 Diesel Panel Alarms:</p> <p>.1 Simulate and check the status of the following alarm lamps on the detached generator panel.</p> <table style="width: 100%; border: none;"> <tr><td style="padding-left: 20px;">.1 under speed</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.2 low oil pressure</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.3 over voltage</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.4 over crank</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.5 switch abnormal</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.6 Hydro failure</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.7 high water temperature</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.8 frequency abnormal</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.9 under voltage</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.10 low day tank level</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.11 air flap closed</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.12 load on generator</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.13 battery level</td><td style="text-align: right;"><input type="checkbox"/></td></tr> </table>		.1 under speed	<input type="checkbox"/>	.2 low oil pressure	<input type="checkbox"/>	.3 over voltage	<input type="checkbox"/>	.4 over crank	<input type="checkbox"/>	.5 switch abnormal	<input type="checkbox"/>	.6 Hydro failure	<input type="checkbox"/>	.7 high water temperature	<input type="checkbox"/>	.8 frequency abnormal	<input type="checkbox"/>	.9 under voltage	<input type="checkbox"/>	.10 low day tank level	<input type="checkbox"/>	.11 air flap closed	<input type="checkbox"/>	.12 load on generator	<input type="checkbox"/>	.13 battery level	<input type="checkbox"/>
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<p>3 Honeywell Computer Alarms:</p> <p>.1 Simulate and check the status of the following alarms:</p> <table style="width: 100%; border: none;"> <tr><td style="padding-left: 20px;">.1 generator not available</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.2 generator failed to start</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.3 generator over temperature</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.4 generator oil or water leak</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.5 oil storage tank leak</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.6 main tank high and low level</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.7 main tank level falling with pump off</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.8 day tank high level with pump on</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.9 day tank low level with pump off</td><td style="text-align: right;"><input type="checkbox"/></td></tr> <tr><td style="padding-left: 20px;">.10 Fuel oil transfer pump PP-C-3 failure</td><td style="text-align: right;"><input type="checkbox"/></td></tr> </table>		.1 generator not available	<input type="checkbox"/>	.2 generator failed to start	<input type="checkbox"/>	.3 generator over temperature	<input type="checkbox"/>	.4 generator oil or water leak	<input type="checkbox"/>	.5 oil storage tank leak	<input type="checkbox"/>	.6 main tank high and low level	<input type="checkbox"/>	.7 main tank level falling with pump off	<input type="checkbox"/>	.8 day tank high level with pump on	<input type="checkbox"/>	.9 day tank low level with pump off	<input type="checkbox"/>	.10 Fuel oil transfer pump PP-C-3 failure	<input type="checkbox"/>						
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MONTHLY PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done once a month.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This maintenance shall not be performed during rush hours or emergencies.
.4	Notify the cellular telephone utility if any service interruptions are anticipated. The cellular service is not on the UPS and is interrupted whenever normal hydro is switched.
.5	The PM service of the UPS 30 KVA 600/206/120 Transformer shall be done in conjunction with the Low Voltage Switch Gear.
.6	The PM service of the emergency distribution panels shall be done in conjunction with the MCC Switch Gear and Panel Boards.
.7	These checks shall be done in the listed sequence.
2 Equipment:	
.1	UPS System Controller - Cabinet in battery room.
.2	Batteries - Rack mounted in battery room
.3	DC Disconnect Switch - Wall mounted adjacent to UPS system controller
.4	30 KVA 600/206/120 - on floor on west side of battery
.5	Emergency Distribution Panels (green):
.1	EN - 347/600V. north wall of battery room
.2	EA - 120/208V. north wall of battery room
.3	EG - 120/208V. east wall of operators' control room
3 Warnings and Cautions:	
.1	The UPS may switch automatically.
.2	Refer to posted warnings.
.3	The "off" - "0" position on the UPS rotary switch turns off (opens) the input power feeds to the UPS from any source - Hydro, emergency generator or the batteries. The output feed to the three emergency power distribution panels is also open and the equipment fed from these panels will not be powered.
.4	An immediate loss of power will occur to the equipment fed from the three emergency power distribution panels if the rotary handle is operated during a power failure (Hydro and/or Emergency Generator).
.5	The "Time Remaining" message displayed by the UPS is not accurate and shall not be used.

MONTHLY PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

4 Lock-out:

- .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.

5 UPS Console Checks:

- .1 Ask the tunnel operator to display the Battery/UPS room on the Honeywell computer and check that the UPS battery charging alarm is normal.
- .2 Ensure that the battery room and equipment are clean and free of loose objects.
- .3 Check the Digital Display Screen on the UPS cabinet door. The message will read "Normal Operation" indicating that the UPS is currently OK.
- .4 Display and record in the log the metering functions by pressing the down arrow on the UPS cabinet door until the following information is displayed:
- LOAD: _____ %
- A PHASE: _____ KVA
- B PHASE: _____ KVA
- C PHASE: _____ KVA
- DC BUS:
- Voltage _____
- Amps _____
- Charging/Discharging _____
- | | | |
|-------------------|-------------------|-------------|
| INPUT A - PHASE: | INPUT B - PHASE: | INPUT C - |
| PHASE: | | |
| A - B _____ VOLTS | B - C _____ VOLTS | C - A _____ |
| VOLTS | | |
| A - N _____ VOLTS | B - N _____ VOLTS | C - N _____ |
| VOLTS | | |
| A _____ AMPS | B _____ AMPS | C _____ |
| AMPS | | |
- | | | |
|-------------------|-------------------|-------------|
| OUTPUT A - PHASE: | OUTPUT B - PHASE: | OUTPUT C - |
| PHASE: | | |
| A - B _____ VOLTS | B - C _____ VOLTS | C - A _____ |
| VOLTS | | |
| A - N _____ VOLTS | B - N _____ VOLTS | C - N _____ |
| VOLTS | | |
| A _____ AMPS | B _____ AMPS | C _____ |
| AMPS | | |
- FREQUENCY:
- OUTPUT _____ Hz INPUT _____ Hz

MONTHLY PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY



MONTHLY PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

.5	Display and record the alarm history:	
.1	Press the down arrow on the UPS cabinet door until "Alarm History" is displayed.	<input type="checkbox"/>
.2	Press the alarm silence pad to access the Alarm History screen.	<input type="checkbox"/>
.3	Press the down arrow to display any messages.	<input type="checkbox"/>
.4	Record the date, time and description of any messages which have occurred since the last PM.	<input type="checkbox"/>
.6	Check the LCD display segments (equivalent of a lamp test):	
.1	Press the up arrow from the NORMAL OPERATION default screen.	<input type="checkbox"/>
.1	All LCD segments activate	<input type="checkbox"/>
.2	The alarm sounds	<input type="checkbox"/>
.7	Check that both LEDs on the power status diagram are on.	<input type="checkbox"/>
.8	Check the condition of the UPS cabinet air filter. Replace if dirty. Note: a two piece filter is required as the door does not open wide enough to accommodate a single filter.	<input type="checkbox"/>
6	Final checks:	
.1	Check the Digital Display Screen on the UPS cabinet door. The message will read "Normal Operation" indicating that the UPS is currently OK.	<input type="checkbox"/>
.2	Record PM visit in log book. Note any corrective action taken.	<input type="checkbox"/>
.3	Lock doors and return key	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once a year. .2 This shall be scheduled in conjunction with a monthly UPS preventive maintenance. .3 This maintenance shall be done by the UPS supplier's representative or a qualified electrician with specific service training for this UPS. Some of the following tests require expert interpretation of the results.	
2 Wiring:	
.1 Check that the insulation is in good condition and that connections are tight for the following wiring groups:	
.1 DC disconnect switch.	<input type="checkbox"/>
.2 Emergency distribution panels (3-Green).	<input type="checkbox"/>
3 UPS Console Checks (to be done in sequence):	
.1 Record AC input voltage to UPS at input fuses using a digital volt meter (DVM): A-B _____ B-C _____ C-A _____	
.2 Rotate UPS rotary selector switch to position 1- Bypass. (not 0 !)	<input type="checkbox"/>
.3 Check Honeywell DDC UPS charging alarm is "on".	<input type="checkbox"/>
.4 Check all console nuts, bolts, screws and connectors for tightness including:	
.1 Ribbon connectors	<input type="checkbox"/>
.2 Power pole bolts	<input type="checkbox"/>
.3 DC Capacitor screws	<input type="checkbox"/>
.5 inspect for broken, damaged or burned components or cable.	<input type="checkbox"/>
.6 Replace power capacitors showing swelling, leakage or extruded vents.	<input type="checkbox"/>
.7 Clean interior and exterior of cabinet.	<input type="checkbox"/>
.8 Measure and record DC Bus ripple: _____ MV.	
.9 Rotate UPS rotary selector switch clockwise to position 2- UPS Start.	<input type="checkbox"/>
.10 Measure and record the following REGULATED power supply voltages:	
+5VDC _____	+10VDC _____
+12VDC _____	-12VDC _____
.11 Check Honeywell DDC UPS charging alarm is reset "off".	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

- .12 Measure and record the following UNREGULATED power supply voltages with the module not running:
+24VDC _____ -24VDC _____
- .13 Measure and record the following voltages at the AC output terminal strip:
A-B _____ B-C _____ C-A _____
A-N _____ B-N _____ C-N _____
- .14 Measure, adjust if necessary and record DC Bus voltage:
_____ 408 VDC
- .15 Rotate UPS rotary selector switch clockwise to position 3- UPS Check.
- .16 Rotate UPS rotary selector switch clockwise to position 4- ON UPS.
- .17 Measure and record the following UNREGULATED power supply voltages with the module running:
+24VDC _____ -24VDC _____
- .18 Perform **Monthly UPS Console Checks.**
- .19 Test UPS line failure switching by opening "UPS" substation breaker.
- .20 Return to normal Hydro power by closing "UPS" substation breaker.

4 UPS Substation Breaker:

- .1 This breaker shall be serviced with the sub-station switch gear.

ANNUAL PREVENTIVE MAINTENANCE FOR UNINTERRUPTABLE POWER SUPPLY

5 Battery Checks:

- .1 Visually inspect :
 - .1 Supplier product warning labels.
 - .2 Battery electrolyte levels - between 5 mm and 55 mm above plates.
 - .3 Batteries -for swelling, leaks, dirt and foreign objects.
 - .4 Cables and connectors - for overheating, corrosion and damage.
 - .5 Mounting racks - structural integrity and corrosion.
- .2 Addition of distilled water:
 - .1 Use protective clothing - face shield, rubber gloves, etc.
 - .2 Use only distilled water from a closed container.
 - .3 Use only the tools kept in the battery room. Do not use tools such as hydrometers, funnels, dip tubes or filling bulbs which have been used for other types of batteries - especially lead acid.
- .3 Cleaning of battery cell covers:
 - .1 Use protective clothing - face shield, rubber gloves, etc.
 - .2 Use warm water and a mild detergent with a cloth on a wooden stick to remove any salt deposits. Do not use hydrocarbon based cleaners.
 - .3 Do not coat battery terminals; especially not with grease.
- .4 Torque all battery connections to 36 NM.

ANNUAL PREVENTIVE MAINTENANCE FOR THE LANE SIGNAL CONTROLLER AND SIGNAL HEADS

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once a year.	
.2 Notify tunnel operator 48 hours prior to maintenance.	
.3 This maintenance shall not be performed during rush hours or emergencies.	
.4 The tunnel portion of this work will require the use of a bucket truck.	
.5 Lane closures will be required.	<input type="checkbox"/>
2 Equipment:	
.1 The Lane Signal Controller is located on the south wall of the operators control room.	
.2 The Lane Signal Heads are located in the northbound and southbound tunnels - 4 signal heads per lane (8 per tunnel).	
.3 Each signal head has 3 primary and 3 secondary halogen bulbs 8000 hour - GE Q50MR16/FL/1/ENL 12V 50W Narrow Flood 32°	
3 Warnings and Cautions:	
.1 Take note of separate power source within the lane signal controller.	<input type="checkbox"/>
4 Lock-out:	
.1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.	
5 Annual re-lamp:	
.1 Place lane closure in effect for lane to be re-lamped.	<input type="checkbox"/>
.2 Switch off the Lane Signal Controller for the lane being serviced. The 4 toggle switches are located inside the lane control cabinet.	<input type="checkbox"/>
.3 Switch off the power supply to the signal heads for the tunnel being serviced: Panel EA , cct. 13 is south bound, cct. 15 is north bound,	<input type="checkbox"/>
.4 Replace the bulbs.	<input type="checkbox"/>
.5 Clean inside of the lens.	<input type="checkbox"/>
.6 Check gasket condition.	<input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR THE LANE SIGNAL CONTROLLER AND SIGNAL HEADS

<p>.7 Record (✓) PM:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 12.5%;">SB Slow</th> <th style="width: 12.5%;"></th> <th style="width: 12.5%;">SB Fast</th> <th style="width: 12.5%;"></th> <th style="width: 12.5%;">NB Fast</th> <th style="width: 12.5%;"></th> <th style="width: 12.5%;">NB Slow</th> <th style="width: 12.5%;"></th> </tr> </thead> <tbody> <tr> <td>1</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td><td></td> </tr> <tr> <td>2</td><td></td><td>2</td><td></td><td>2</td><td></td><td>2</td><td></td> </tr> <tr> <td>3</td><td></td><td>3</td><td></td><td>3</td><td></td><td>3</td><td></td> </tr> <tr> <td>4</td><td></td><td>4</td><td></td><td>4</td><td></td><td>4</td><td></td> </tr> </tbody> </table>								SB Slow		SB Fast		NB Fast		NB Slow		1		1		1		1		2		2		2		2		3		3		3		3		4		4		4		4	
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<p>6 Lane Signal Controller:</p> <ul style="list-style-type: none"> .1 Clean front panel. <input type="checkbox"/> .2 Check fan operation. <input type="checkbox"/> .3 Check the signal head lamp status: <input type="checkbox"/> <ul style="list-style-type: none"> .1 Select each of the three states in turn and select note if any LEDs are not illuminated. This indicates a faulty signal head lamp. <ul style="list-style-type: none"> .1 Steady red. <input type="checkbox"/> .2 Flashing amber. <input type="checkbox"/> .3 Steady green. <input type="checkbox"/> .2 Repeat the above for each of the steps on the Multipoint controller. Manually select each step on the Multipoint controller panel. <input type="checkbox"/> 																																															
<p>7 Final checks:</p> <ul style="list-style-type: none"> .1 Switch on the Lane Signal Controller. <input type="checkbox"/> .2 Switch on the power supply to the signal heads. <input type="checkbox"/> .3 Drive through tunnel and check each of the three states for each signal head. <input type="checkbox"/> .4 Return the Lane Signal Controller and the Multipoint controller to their normal operating condition. <input type="checkbox"/> 																																															

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERA SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once every six months.	
.2 Notify tunnel operator 48 hours prior to maintenance.	
.3 This maintenance shall not be performed during rush hours or emergencies.	
2 Equipment:	
.1 The following equipment is located in the control console in the operators' control room in the control building:	
.1 Ten Line Amplifiers	
.2 One Compuswitch	
.3 One Formatter	
.4 Seven Quadrant Multiplexers	
.5 One Compularm	
.6 Eight Black and White Monitors	
.7 One Colour Monitor	
.8 One Compuswitch-Coaxitron remote control unit	
.9 One Fibre Optic Modem	
.2 The 28 Black and White Cameras are located as follows:	
.1 One outside the main entrance to the control building.	
.2 One on the south exterior wall of the control building.	
.3 One at the north portal above the southbound lane.	
.4 One at the south portal above the northbound lane.	
.5 Twelve on the southbound tunnel slow lane ceiling.	
.6 Twelve on the northbound tunnel slow lane ceiling.	
.3 Each black and white camera enclosure contains the following components:	
.1 one camera	
.2 one 347/120 V. step-down transformer	
.3 two 40 W. 120 V. heaters	
.4 one window defroster .	
.5 one fan	
.6 one printed circuit (PC) board	
4. One pan, tilt, zoom Colour Camera is located on the sign bridge at the south end of the Second Narrows bridge.	

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERA SYSTEM

5. The colour camera enclosure contains the following components:
- .1 one 1/3" CCD **colour camera** with **10X Zoom Lens**
 - .2 one **window wiper**
 - .3 two 40 W. 120 V. **heaters**
 - .4 one window **defroster**.
 - .5 one **fan**
 - .6 one **Pan/Tilt/Zoom, Voice/Data Multiplex Receiver/Driver**

3 Equipment checks:

- .1 Clean the console area - vacuum behind the console.
- .2 Check the operation of the seven ventilation fans in the CCTV console.
- .3 Check operation of the pan/tilt/zoom on the Second Narrows camera.
- .4 Check operation of the window wiper on the Second Narrows camera.
- .5 Visually check each monitor:
 - .1 Quality of the video image.
 - .2 Target area positioning: tunnel and emergency door coverage.
- .6 Manually select each camera and verify the image on the emergency display monitor.

Camera:	Quad. monitor image: <input checked="" type="checkbox"/>	Emergency monitor image: <input checked="" type="checkbox"/>
N-1		
N-2		
S-13 portal		
Parking area		
N-3		
S-12		
N-4		
S-11		
N-5		
S-10		
N-6		
S-9		
N-7		
S-8		
N-8		
S-7		

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERA SYSTEM

N-9		
S-6		
N-10		
S-5		
N-11		
S-4		
N-12		
S-3		
N-13 portal		
S-2		
S-1		
2nd Narrows		
Entrance	small mon.	

ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERAS

ANNUAL PREVENTIVE MAINTENANCE FOR CCTV CAMERAS	
Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done once every year immediately prior to the heating season.	<input type="checkbox"/>
.2 Notify tunnel operator 48 hours prior to maintenance.	<input type="checkbox"/>
.3 This maintenance shall not be performed during rush hours or emergencies.	<input type="checkbox"/>
.4 The tunnel portion of this work will require the use of a bucket truck.	<input type="checkbox"/>
.5 Lane closures will be required.	<input type="checkbox"/>
.6 Equipment located in the operators' control room requires no annual maintenance.	<input type="checkbox"/>
2 Equipment:	
.1 The following equipment is located in the control console in the operators' control room in the control building:	
.1 Ten Line Amplifiers	
.2 One Compuswitch	
.3 One Formatter	
.4 Seven Quadrant Multiplexers	
.5 One Compularm	
.6 Eight Black and White Monitors	
.7 One Colour Monitor	
.8 One Compuswitch-Coaxitron remote control unit	
.9 One Fibre Optic Modem	
.2 The twenty-eight Black and White Cameras are located as follows:	
.1 One outside the main entrance to the control building.	
.2 One on the south exterior wall of the control building.	
.3 One at the north portal above the southbound lane.	
.4 One at the south portal above the northbound lane.	
.5 Twelve on the ceiling of the southbound tunnel above the slow lane.	
.6 Twelve on the ceiling of the northbound tunnel above the slow lane.	

ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERAS

- .3 Each black and white camera enclosure has the following components:
 - .1 one **camera**
 - .2 one 347/120 V. step-down **transformer**
 - .3 two 40 W. 120 V. **heaters**
 - .4 one window **defroster**.
 - .5 one **fan**
 - .6 one **printed circuit (PC) board**

- 4. One pan, tilt, zoom **Colour Camera** is located on the sign bridge at the south end of the Second Narrows bridge.
- 5. The colour camera enclosure contains the following components:
 - .1 one 1/3" CCD **colour camera** with **10X Zoom Lens**
 - .2 one **window wiper**
 - .3 two 40 W. 120 V. **heaters**
 - .4 one window **defroster**.
 - .5 one **fan**
 - .6 one **Pan/Tilt/Zoom, Voice/Data Multiplex Receiver/Driver**
- 6. One **Fibre Optic Modem** is located at the base of the sign bridge at the south end of the Second Narrows bridge.

3 Lock-out:

- .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.
- .2 Isolate only one tunnel at a time for service.
- .3 Panel EN cct. 13 & 15 feed the north bound tunnel cameras.
- .4 Panel EN cct. 14 & 16 feed the south bound tunnel cameras.
- .5 Panel EC cct. 7 feeds the door monitor and camera.
- .6 The Second Narrows camera is fed from the power supply for the sign bridge.

ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERAS

4 Equipment Checks:

- .1 Cameras:
 - .1 Inspect exterior of enclosure and mounting hardware for physical damage, cleanliness, paint finish, corrosion and security.
 - .2 Interior of the enclosure:
 - .1 Clean the interior.
 - .2 Check for signs of moisture.
 - .3 Check operation the following components using a cold spray.
 - .1 two heaters.
 - .2 window defroster.
 - .4 Check operation of the blower.
 - .5 Record PM (✓):

Camera:	Mounting and exterior: <input checked="" type="checkbox"/>	Interior: <input checked="" type="checkbox"/>	Heater and blower operation: <input checked="" type="checkbox"/>
Entrance			
Parking area			
N- 1			
N- 2			
N- 3			
N- 4			
N- 5			
N- 6			
N- 7			
N- 8			
N- 9			
N-10			
N-11			
N-12			
N-13 portal			

ANNUAL PREVENTIVE MAINTENANCE FOR THE CCTV CAMERAS

Camera:	Mounting and exterior:	Interior:	Heater and blower operation:
S- 1			
S- 2			
S- 3			
S- 4			
S- 5			
S- 6			
S- 7			
S- 8			
S- 9			
S-10			
S-11			
S-12			
S-13 portal			
2nd Narrows			

- .6 Check operation of the pan/tilt/zoom on 2nd Narrows camera.
- .7 Check operation of the window wiper on 2nd Narrows camera.

5 Final checks:

- .1 Check the display on all monitors.

ANNUAL PREVENTIVE MAINTENANCE FOR THE TRAFFIC DETECTION AND MONITORING SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done once every year.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This maintenance shall not be performed during rush hours or emergencies.
.4	Tunnel traffic control shall be used for this maintenance. <input type="checkbox"/>
2 Equipment:	
.1	The following equipment is located in the control console in the operators' control room in the control building:
.1	Remote Terminal Unit (RTU) .
.2	Personal computer (PC) , interface card, monitor and keyboard.
.2	The Printer is located on the counter top on the east side of the operators' control room. It is shared with the Honeywell system.
.3	Sixteen Loops are located in pairs, four pairs per lane in the northbound and southbound tunnels.
.4	Eight 4-channel, digital Loop Detectors and Power Supplies are located in panels on the tunnel walls adjacent to the loop pairs. These are powered from panel EB in the substation.
3 Equipment checks:	
.1	Clean the console area - vacuum behind the console. <input type="checkbox"/>
.2	Loop detector panels:
.1	Inspect exterior of enclosure for physical damage, cleanliness, paint finish, corrosion and security. <input type="checkbox"/>
.2	Interior of the enclosure:
.1	Clean the interior. <input type="checkbox"/>
.2	Check for signs of moisture and corrosion. <input type="checkbox"/>
.3	Ensure all wiring and connections are secure. <input type="checkbox"/>
.4	Check operation the strip heater and thermostat using a cold spray. <input type="checkbox"/>

ANNUAL PREVENTIVE MAINTENANCE FOR THE TRAFFIC DETECTION AND MONITORING SYSTEM

Loop detector panel	Exterior inspection: <input checked="" type="checkbox"/>	Interior inspection: <input checked="" type="checkbox"/>	Heater operation: <input checked="" type="checkbox"/>
NB-1			
NB-2			
NB-3			
NB-4			
SB-1			
SB-2			
SB-3			
SB-4			

.3 Operational checks of the loop detectors:

- .1 Close a lane of traffic.
- .2 Park a vehicle over each loop (one at a time)
- .3 Check the indication on the operators' control room monitor.
- .4 Remove the vehicle from the loop area and note the delay time until the indication resets on the operators' control room monitor.
- .5 Repeat for each of the 32 loops.

Loop:	Reset delay: <input checked="" type="checkbox"/>	Loop:	Reset delay: <input checked="" type="checkbox"/>
NB-1A-Fast		SB-1A-Fast	
NB-1B-Fast		SB-1B-Fast	
NB-1A-Slow		SB-1A-Slow	
NB-1B-Slow		SB-1B-Slow	
NB-2A-Fast		SB-2A-Fast	
NB-2B-Fast		SB-2B-Fast	
NB-2A-Slow		SB-2A-Slow	
NB-2B-Slow		SB-2B-Slow	
NB-3A-Fast		SB-3A-Fast	
NB-3B-Fast		SB-3B-Fast	
NB-3A-Slow		SB-3A-Slow	
NB-3B-Slow		SB-3B-Slow	
NB-4A-Fast		SB-4A-Fast	
NB-4B-Fast		SB-4B-Fast	
NB-4A-Slow		SB-4A-Slow	
NB-4B-Slow		SB-4B-Slow	

6 Final checks:

- .1 Check the display and ensure that all alarms have been reset.

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CONTROL ROOM HVAC SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1 The maintenance listed in this table shall be done twice a year immediately prior to the heating and cooling seasons.	
.2 Notify tunnel operator 48 hours prior to maintenance.	
.3 This PM shall not be performed during rush hours or emergencies.	
.4 This maintenance shall be performed by a licensed refrigeration tradesman.	<input type="checkbox"/>
2 Equipment:	
.1 Heat pump AC-C-1 is located in the fenced compound adjacent to the south wall of the control building.	
.2 The heating and cooling thermostat is located on the north wall of the operators' control room.	
.3 The Honeywell control system temperature sensor is located next to the heating and cooling thermostat.	
3 Lock-out:	
.1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.	
.2 AC-C-1 is fed from Panel J in the substation.	

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CONTROL ROOM HVAC SYSTEM

4	AC-C-1 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, corrosion and security.	<input type="checkbox"/>
	.2 Clean interior of the enclosure.	<input type="checkbox"/>
	.3 Inspect and clean the pan and drain.	<input type="checkbox"/>
	.4 Check for corrosion.	<input type="checkbox"/>
	.5 Inspect, clean and straighten indoor coil fins.	<input type="checkbox"/>
	.6 Inspect, clean and straighten outdoor coil fins.	<input type="checkbox"/>
	.7 Change unit air filter.	<input type="checkbox"/>
	.8 Change return air filter in operators' control room.	<input type="checkbox"/>
	.9 Electrical:	
	.1 Check operation of main breaker.	<input type="checkbox"/>
	.2 Check operation of local disconnect switch.	<input type="checkbox"/>
	.3 Check connections for tightness.	<input type="checkbox"/>
	.4 Check condition of wiring insulation.	<input type="checkbox"/>
	.5 Check contactors and relays for operation, noise, wear and arcing.	<input type="checkbox"/>
	.10 Supply fan and motor:	
	.1 Check mounting and support.	<input type="checkbox"/>
	.2 Check and record amperage draw. _____	<input type="checkbox"/>
	.3 Check V-belts and sheaves for condition, tension, alignment and wear. Adjust if necessary.	<input type="checkbox"/>
	.4 Check bearings for noise, heat and wear.	<input type="checkbox"/>
	.5 Check for fatigue and vibration.	<input type="checkbox"/>
	.11 Condenser fan and motor:	
	.1 Check mounting and support.	<input type="checkbox"/>
	.2 Check and record amperage draw. _____	<input type="checkbox"/>
	.3 Check V-belts and sheaves for condition, tension, alignment and wear. Adjust if necessary.	<input type="checkbox"/>
	.4 Check bearings for noise, heat and wear. Lubricate if necessary.	<input type="checkbox"/>
	.5 Check for fatigue and vibration.	<input type="checkbox"/>
	.12 Refrigerant:	
	.1 Check unit for leaks.	<input type="checkbox"/>
	.2 Check sight glass.	<input type="checkbox"/>
	.13 Compressor:	
	.1 Check for oil leaks.	<input type="checkbox"/>
	.2 Check oil level.	<input type="checkbox"/>
	.3 Check mounting and support.	<input type="checkbox"/>
	.4 Check and record head pressure. _____	<input type="checkbox"/>
	.5 Check and record suction pressure. _____	<input type="checkbox"/>
	.6 Check and record amperage draw. _____	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE CONTROL ROOM HVAC SYSTEM

.14	Local control devices:	
	.1 Check refrigerant pressure controls.	<input type="checkbox"/>
	.2 Check anti-cycle time delay relays.	<input type="checkbox"/>
.15	Check the operation of the differential pressure switch across the unit air filter and the related Honeywell alarm.	<input type="checkbox"/>
.16	Dampers:	
	.1 Cycle and check actuators, linkages, blades.	<input type="checkbox"/>
	.2 Check fully closed position for tight seal.	<input type="checkbox"/>
	.3 Check minimum fresh air position.	<input type="checkbox"/>
	.4 Adjust if necessary.	<input type="checkbox"/>
.17	Cycle and check staged operation:	
	.1 Mechanical DX cooling.	
	.1 Record temperature differential across indoor coil _____	<input type="checkbox"/>
	.2 First stage heating:	
	.1 Reversing valve operation.	
	.1 Record temperature differential across outdoor coil _____	<input type="checkbox"/>
	.2 Record temperature differential across indoor coil _____	<input type="checkbox"/>
	.3 Second stage heating:	
	.1 Check operation of electric heating elements and record amperage _____ ohms.	<input type="checkbox"/>
	.2 Check operation of air flow switch.	<input type="checkbox"/>
	.4 Defrost cycle:	
	.1 Check defrost operation using an ice pack or cold spray.	<input type="checkbox"/>
.18	Check of the Honeywell room temperature sensor:	
	.1 the temperature reading for reasonableness.	<input type="checkbox"/>
	.2 the related alarm. (use a cold spray or ice pack)	<input type="checkbox"/>
5	Final checks:	
	.1 Ensure that the system responds to the room thermostat.	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE ENTRANCE HEATING

Item:	<input checked="" type="checkbox"/>
1 General:	
<ul style="list-style-type: none"> .1 The maintenance listed in this table shall be done twice a year immediately prior to the heating and cooling seasons. .2 Notify tunnel operator 48 hours prior to maintenance. .3 This PM shall not be performed during rush hours or emergencies. 	
2 Equipment:	
<ul style="list-style-type: none"> .1 Unit Heater UH-C-1 is located in the ceiling of the entrance corridor of the control building. .2 The Honeywell control system temperature sensor is located on the north wall of the entrance corridor. 	
3 Lock-out:	
<ul style="list-style-type: none"> .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual. .2 UH-C-1 is fed from a starter in MCC #1 in the substation. 	
4 UH-C-1 checks:	
<ul style="list-style-type: none"> .1 Inspect exterior for physical damage, cleanliness, paint finish and security. <input type="checkbox"/> .2 Clean (vacuum) the interior of the enclosure including the plenum, heating coils and fan . <input type="checkbox"/> .3 Electrical: <ul style="list-style-type: none"> .1 Check operation of main MCC breaker: <ul style="list-style-type: none"> .1 hand-off-auto switch. <input type="checkbox"/> .2 indicator lamps. <input type="checkbox"/> .2 Check operation of local disconnect switch. <input type="checkbox"/> .3 Check connections for tightness. <input type="checkbox"/> .4 Check condition of wiring insulation. <input type="checkbox"/> .5 Check contactors and relays for operation, noise, wear and arcing. <input type="checkbox"/> .4 Fan and motor: <ul style="list-style-type: none"> .1 Check mounting and support. <input type="checkbox"/> .2 Check bearings for noise, heat and wear. <input type="checkbox"/> .3 Check for fatigue and vibration. <input type="checkbox"/> 	

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE ENTRANCE HEATING

.5	Check heating operation:	
.1	Cool the temperature sensor using an ice pack or cool spray.	
.1	Record the heating discharge temperature of UH-C-1_____ ° C.	<input type="checkbox"/>
.6	Check the Honeywell system temperature reading for reasonableness.	<input type="checkbox"/>
5	Final checks:	
.1	Ensure that disconnect switches have been returned to their normal position.	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE BATTERY ROOM HEATING AND VENTILATION SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
<ul style="list-style-type: none"> .1 The maintenance listed in this table shall be done twice a year immediately prior to the heating and cooling seasons. .2 Notify tunnel operator 48 hours prior to maintenance. .3 This PM shall not be performed during rush hours or emergencies. 	
2 Equipment:	
<ul style="list-style-type: none"> .1 Radiant Heater HH-C-1 is located on the east wall of the battery room and the control thermostat is located on the west wall. .2 Supply fan SF-C-1, Exhaust fans EF-C-2 and EF-C-3 are hung from the ceiling. .3 The filter section for SF-C-1 is located on the inlet side of the fan in the duct. .4 The inlet motorized control dampers MD-C-8 and MD-C-9 are located on the inlet side of the exhaust fans in the duct. .5 The local disconnects for the fans are located on the west wall. 	
3 Lock-out:	
<ul style="list-style-type: none"> .1 Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual. .2 HH-C-1 is fed from a starter in MCC #1 in the substation. .3 Fans SF-C-1, EF-C-2 and EF-C-3 are fed from panel J. .4 Damper actuators MD-C-8 and MD-C-9 are fed from panel J. 	
4 HH-C-1 checks:	
<ul style="list-style-type: none"> .1 Inspect exterior for physical damage, cleanliness, paint finish and security. <input type="checkbox"/> .2 Clean (vacuum) the fins. <input type="checkbox"/> .3 Check operation of main MCC breaker: <ul style="list-style-type: none"> .1 hand-off-auto switch <input type="checkbox"/> .2 indicator lamps <input type="checkbox"/> .4 Check operation of thermostat and heater. (cycle thermostat) <input type="checkbox"/> 	

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE BATTERY ROOM HEATING AND VENTILATION SYSTEM

5	SF-C-1 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
	.2 Check the flexible connections on the ducts for breaks or tears.	<input type="checkbox"/>
	.3 Change the inlet filter.	<input type="checkbox"/>
	.4 Check operation of local disconnect switch.	
	.1 Hand-off-auto	<input type="checkbox"/>
	.1 Check the Honeywell system alarm in the "off" position.	<input type="checkbox"/>
	.2 Indicator lamp	<input type="checkbox"/>
	.5 Check the fan wheel and shaft:	
	.1 Secure mounting	<input type="checkbox"/>
	.2 Fatigue	<input type="checkbox"/>
	.3 Dirt build-up	<input type="checkbox"/>
	.4 Bearing noise, heat and wear	<input type="checkbox"/>
	.6 Check the motor for,	
	.1 Secure mounting	<input type="checkbox"/>
	.2 Bearing noise, heat and wear	<input type="checkbox"/>
	.7 Check the V-belt:	
	.1 Tension	<input type="checkbox"/>
	.2 Wear	<input type="checkbox"/>
	.8 Check the sheaves:	
	.1 Secure on shafts	<input type="checkbox"/>
	.2 Groove wear	<input type="checkbox"/>
6	EF-C-2 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
	.2 Check the operation of control damper MD-C-8.	
	.1 Fan stopped - damper tightly closed	<input type="checkbox"/>
	.2 Fan running - damper open 100%	<input type="checkbox"/>
	.3 Check the flexible connections on the ducts for breaks or tears.	<input type="checkbox"/>
	.4 Check operation of local disconnect switch.	<input type="checkbox"/>
	.1 Hand-off-auto:	
	.1 Check that this fan is running during the even numbered months.	<input type="checkbox"/>
	.2 If this fan is running then check that the Honeywell system:	
	.1 Annunciates an alarm.	<input type="checkbox"/>
	.2 Starts EF-C-3.	<input type="checkbox"/>
	.2 Indicator lamp	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE BATTERY ROOM HEATING AND VENTILATION SYSTEM

.5	Check the fan wheel and shaft:	
	.1 Secure mounting	<input type="checkbox"/>
	.2 Fatigue	<input type="checkbox"/>
	.3 Dirt build-up	<input type="checkbox"/>
	.4 Bearing noise, heat and wear	<input type="checkbox"/>
.6	Check the motor for,	
	.1 Secure mounting	<input type="checkbox"/>
	.2 Bearing noise, heat and wear	<input type="checkbox"/>
.7	Check the V-belt:	
	.1 Tension	<input type="checkbox"/>
	.2 Wear	<input type="checkbox"/>
.8	Check the sheaves:	
	.1 Secure on shafts	<input type="checkbox"/>
	.2 Groove wear	<input type="checkbox"/>
.9	Motorized damper MD-C-8:	
	.1 Visually inspect damper for physical damage and tightness of seal.	<input type="checkbox"/>
	.2 Clean with a with a non-flammable solvent.	<input type="checkbox"/>
	.3 Lightly lubricate louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
	.4 Inspect damper motor for oil leaks.	<input type="checkbox"/>
7	EF-C-3 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
	.2 Check the operation of control damper MD-C-9.	
	.1 Fan stopped - damper tightly closed	<input type="checkbox"/>
	.2 Fan running - damper open 100%	<input type="checkbox"/>
	.3 Check the flexible connections on the ducts for breaks or tears.	<input type="checkbox"/>
	.4 Check operation of local disconnect switch.	
	.1 Hand-off-auto:	<input type="checkbox"/>
	.1 Check that his fan is running during the even numbered months.	<input type="checkbox"/>
	.2 If this fan is running then check that the Honeywell system:	
	.1 Annunicates an alarm.	<input type="checkbox"/>
	.2 Starts EF-C-2.	<input type="checkbox"/>
	.2 Indicator lamp	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE BATTERY ROOM HEATING AND VENTILATION SYSTEM

.5	Check the fan wheel and shaft:	
.1	Secure mounting	<input type="checkbox"/>
.2	Fatigue	<input type="checkbox"/>
.3	Dirt build-up	<input type="checkbox"/>
.4	Bearing noise, heat and wear	<input type="checkbox"/>
.6	Check the motor for,	
.1	Secure mounting	<input type="checkbox"/>
.2	Bearing noise, heat and wear	<input type="checkbox"/>
.7	Check the V-belt:	
.1	Tension	<input type="checkbox"/>
.2	Wear	<input type="checkbox"/>
.8	Check the sheaves:	
.1	Secure on shafts	<input type="checkbox"/>
.2	Groove wear	<input type="checkbox"/>
.9	Motorized damper MD-C-9:	
.1	Visually inspect damper for physical damage and tightness of seal.	<input type="checkbox"/>
.2	Clean with a with a non-flammable solvent.	<input type="checkbox"/>
.3	Lightly lubricate louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
.4	Inspect damper motor for oil leaks.	<input type="checkbox"/>
8	Final checks:	
.1	Ensure that breakers and disconnect switches have been returned to their normal positions.	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE EMERGENCY GENERATOR ROOM VENTILATION SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done twice a year immediately prior to the heating and cooling seasons.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This PM shall not be performed during rush hours or emergencies.
2 Equipment:	
.1	Exhaust fan EF-C-1 is located on the south wall of the emergency generator room and the control temperature sensor is located on the north wall.
.2	The recirculation dampers and actuators are mounted in two banks, one on each side of the engine radiator.
.3	The supply dampers and actuators are mounted on the south wall of the emergency generator room
.4	The relief dampers and actuators are mounted on the west wall of the emergency generator room.
.5	The local disconnect for the fan are located on the south wall.
3 Lock-out:	
.1	Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.
.2	Fan EF-C-1 is fed from panel J.
.3	The motorized damper actuators are fed from panel J.

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE EMERGENCY GENERATOR ROOM VENTILATION SYSTEM

4 EF-C-1 checks:	
.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
.2 Check the operation of EF-C-1 by heating the Honeywell sensor with a <u>little</u> heat from a heat gun or by gently blowing into the sensor.	<input type="checkbox"/>
.3 Check the Honeywell alarm by switching EF-C-1 off at the local disconnect while it is running under Honeywell control.	<input type="checkbox"/>
.4 Check the fan wheel:	
.1 Secure mounting	<input type="checkbox"/>
.2 Fatigue	<input type="checkbox"/>
.3 Dirt build-up	<input type="checkbox"/>
.5 Check the motor for bearing noise, heat and wear.	<input type="checkbox"/>
5 Louvers and actuators:	
.1 Visually inspect the recirculation, supply and relief dampers for physical damage and tightness of seal.	<input type="checkbox"/>
.2 Clean with a with a non-flammable solvent.	<input type="checkbox"/>
.3 Lightly lubricate all louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
.4 Inspect all damper motors for oil leaks.	<input type="checkbox"/>
6 Final checks:	
.1 Ensure that breakers and disconnect switches have been returned to their normal positions.	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE SUBSTATION VENTILATION SYSTEM

Item:	<input checked="" type="checkbox"/>
1 General:	
.1	The maintenance listed in this table shall be done twice a year immediately prior to the heating and cooling seasons.
.2	Notify tunnel operator 48 hours prior to maintenance.
.3	This PM shall not be performed during rush hours or emergencies.
2 Equipment:	
.1	Exhaust fans EF-C-5, EF-C-6 and EF-C-7 are located on the north wall of the Substation and the control temperature sensor is located on the north wall on the side of a Honeywell panel.
.2	The motorized control dampers MD-C-10, MD-C-11 and MD-C-12 and actuators are located on the inlet side of the exhaust fans.
.3	The MCC starters for the fans are located in MCC #2
.4	The inlet air louver and replaceable filters is located on the west wall of the substation.
3 Lock-out:	
.1	Refer to the Lock-out Section 103 of the Cassiar Tunnel Electrical Maintenance Standards manual.
.2	Fans EF-C-5, EF-C-6 and EF-C-7 are fed from MCC starters in MCC #2.

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE SUBSTATION VENTILATION SYSTEM

4	EF-C-5 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
	.2 Check the operation of EF-C-5 by heating the Honeywell sensor with a <u>little</u> heat from a heat gun by gently blowing into the sensor.	<input type="checkbox"/>
	.3 Check the sequential operation of this fan with the other fans. Increasing heat starts the next fan.	<input type="checkbox"/>
	.4 Check the operation of control damper MD-C-10.	
	.1 Fan stopped - damper tightly closed	<input type="checkbox"/>
	.2 Fan running - damper open 100%	<input type="checkbox"/>
	.5 Check operation of the disconnect switch.	
	.1 Hand-off-auto	<input type="checkbox"/>
	.2 Check the Honeywell alarm while the fan is running under Honeywell control.	<input type="checkbox"/>
	.3 Indicator lamp	<input type="checkbox"/>
	.6 Check the fan wheel:	
	.1 Secure mounting	<input type="checkbox"/>
	.2 Fatigue	<input type="checkbox"/>
	.3 Dirt build-up	<input type="checkbox"/>
	.7 Check the motor for bearing noise, heat and wear.	<input type="checkbox"/>
	.8 Motorized damper MD-C-10:	
	.1 Visually inspect damper for physical damage and tightness of seal.	<input type="checkbox"/>
	.2 Clean with a with a non-flammable solvent.	<input type="checkbox"/>
	.3 Lightly lubricate louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
	.4 Inspect damper motor for oil leaks.	<input type="checkbox"/>
5	EF-C-6 checks:	
	.1 Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
	.2 Check the operation of EF-C-6 by heating the Honeywell sensor with a <u>little</u> heat from a heat gun by gently blowing into the sensor.	<input type="checkbox"/>
	.3 Check the sequential operation of this fan with the other fans. Increasing heat starts the next fan.	<input type="checkbox"/>
	.4 Check the operation of control damper MD-C-11.	
	.1 Fan stopped - damper tightly closed	<input type="checkbox"/>
	.2 Fan running - damper open 100%	<input type="checkbox"/>

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE SUBSTATION VENTILATION SYSTEM

.5	Check operation of the disconnect switch.	<input type="checkbox"/>
.1	Hand-off-auto	<input type="checkbox"/>
.2	Check the Honeywell alarm while the fan is running under Honeywell control.	<input type="checkbox"/>
.3	Indicator lamp	<input type="checkbox"/>
.6	Check the fan wheel:	
.1	Secure mounting	<input type="checkbox"/>
.2	Fatigue	<input type="checkbox"/>
.3	Dirt build-up	<input type="checkbox"/>
.7	Check the motor for bearing noise, heat and wear.	<input type="checkbox"/>
.8	Motorized damper MD-C-11:	
.1	Visually inspect damper for physical damage and tightness of seal.	<input type="checkbox"/>
.2	Clean with a with a non-flammable solvent.	<input type="checkbox"/>
.3	Lightly lubricate louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
.4	Inspect damper motor for oil leaks.	<input type="checkbox"/>
6	EF-C-7 checks:	
.1	Inspect exterior for physical damage, cleanliness, paint finish, mounting and support.	<input type="checkbox"/>
.2	Check the operation of EF-C-7 by heating the Honeywell sensor with a <u>little</u> heat from a heat gun by gently blowing into the sensor.	<input type="checkbox"/>
.3	Check the sequential operation of this fan with the other fans. Increasing heat starts the next fan.	<input type="checkbox"/>
.4	Check the operation of control damper MD-C-12.	
.1	Fan stopped - damper tightly closed	<input type="checkbox"/>
.2	Fan running - damper open 100%	<input type="checkbox"/>
.5	Check operation of the disconnect switch.	
.1	Hand-off-auto	<input type="checkbox"/>
.2	Check the Honeywell alarm while the fan is running under Honeywell control.	<input type="checkbox"/>
.3	Indicator lamp	<input type="checkbox"/>
.6	Check the fan wheel:	
.1	Secure mounting	<input type="checkbox"/>
.2	Fatigue	<input type="checkbox"/>
.3	Dirt build-up	<input type="checkbox"/>
.7	Check the motor for bearing noise, heat and wear.	<input type="checkbox"/>
.8	Motorized damper MD-C-12:	

SEMI-ANNUAL PREVENTIVE MAINTENANCE FOR THE SUBSTATION VENTILATION SYSTEM

.1	Visually inspect damper for physical damage and tightness of seal.	<input type="checkbox"/>
.2	Clean with a with a non-flammable solvent.	<input type="checkbox"/>
.3	Lightly lubricate louver and linkage bearing points with a SAE #10 weight oil.	<input type="checkbox"/>
.4	Inspect damper motor for oil leaks.	<input type="checkbox"/>
7	Inlet Filters:	
.1	These filters are checked by the weekly patrol and change these if required.	<input type="checkbox"/>
8	Final checks:	
.1	Ensure that breakers and disconnect switches have been returned to their normal positions.	<input type="checkbox"/>

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Item:	<input checked="" type="checkbox"/>
<p>1 General:</p> <p>.1 The maintenance listed in this table shall be done once every second week.</p> <p>.2 This maintenance shall not be performed during rush hours or emergencies.</p>	
<p>2 Control Building:</p> <p>.1 Operators' Control Room:</p> <p>.1 Check operation of room lighting in the operators' control room, kitchen and washroom. <input type="checkbox"/></p> <p>.2 Check the operation of the ventilation fans in the kitchen and washroom. <input type="checkbox"/></p> <p>.3 Check the entries in the tunnel operators maintenance log and ensure that corrective maintenance has been scheduled for outstanding electrical items. <input type="checkbox"/></p> <p>.4 Honeywell Control System</p> <p>.1 Check for alarms on Honeywell PC with tunnel operator. <input type="checkbox"/></p> <p>.2 Check the environmental display screen:</p> <p>.1 Outside Air Temperature Sensor <input type="checkbox"/></p> <p>.2 Anemometer <input type="checkbox"/></p> <p>.3 Wind Vane <input type="checkbox"/></p> <p>.3 Fire-fighters Panel</p> <p>.1 Insert and turn the key and visually inspect the panel. <input type="checkbox"/></p> <p>.2 The "General Fire" lamp should be "off" <input type="checkbox"/></p> <p>.3 The "Hydro Failure" lamp should be "off" <input type="checkbox"/></p> <p>.4 The "Controller Failure" lamp should be "off" <input type="checkbox"/></p> <p>.5 The "Normal" lamp should be "on" <input type="checkbox"/></p> <p>.6 The "Fire S.B. Tube" lamp should be "off" <input type="checkbox"/></p> <p>.7 The "Fire N.B. Tube" lamp should be "off" <input type="checkbox"/></p> <p>.8 Press "Lamp Test" button to test lamps. <input type="checkbox"/></p> <p>.9 Return the key to the red box. <input type="checkbox"/></p>	

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- .4 Emergency Backup Panel
 - .1 Unlock and open panel door. This will disable all other control of the tunnel fans except the MCC - time delay relays and give control to this panel.
 - .2 Visually inspect the panel.
 - .3 Press the panel buttons to run each fan pair forward.
 - .4 Check the status lights on Emergency Backup Panel.
 - .5 Check appropriate indicator lights on substation MCCs.
 - .6 Close and lock panel door. This will stop any fans and return control of the tunnel fans to the Honeywell.
 - .7 Check appropriate indicator lights on substation MCCs.
 - .8 Return the key to the red box.
- .4 Fire Alarm System
 - .1 Fire Alarm Control Panel
 - .1 Check that the correct date is displayed on the LED display.
 - .2 Check that no trouble, supervisory or alarm messages are present.
 - .2 Fire Alarm Annunciator Panel
 - .1 Check that no trouble, supervisory or alarms are present.
- .5 Lane Signal Controller
 - .1 Use caution when testing the lamp controller. Do not test during periods of high traffic flow.
 - .2 Check the signal head lamp status: Select each of the three states in turn and select note if any LEDs are not illuminated. This indicates a faulty signal head lamp.
- .6 CCTV Cameras
 - .1 Visually check the video image quality of each monitor.
 - .2 Target area positioning:
 - .1 Tunnel coverage
 - .2 Emergency door coverage
 - .3 Check pan, tilt and zoom operation of 2nd Narrows camera.

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.7	Traffic Detection and Monitoring	
.1	Ask the tunnel operator if the unit has had an excessive number of "phantom" stopped vehicles, if the answer is affirmative then record for corrective maintenance.	<input type="checkbox"/>
.8	Air conditioning	
.1	Ask the tunnel operator if the unit appears to be operating satisfactorily, if the answer is negative then record for corrective maintenance.	<input type="checkbox"/>
.2	Corridor:	
.1	Check operation of corridor and radio room lighting .	<input type="checkbox"/>
.2	Entrance Heating	
.1	Ask the tunnel operator if the unit appears to be operating satisfactorily, if the answer is negative then record for corrective maintenance.	<input type="checkbox"/>
.3	Battery Room:	
.1	Check operation of room lighting.	<input type="checkbox"/>
.2	Ensure that the battery room and equipment are clean and free of loose objects.	<input type="checkbox"/>
.3	Uninterruptable Power System	
.1	Check the Digital Display Screen on the UPS cabinet door. The message will read "Normal Operation" indicating that the UPS is currently OK.	<input type="checkbox"/>
.2	Visually inspect Batteries -for swelling, leaks, dirt and foreign objects.	<input type="checkbox"/>
.4	Battery Room Heating and Ventilation	
.1	Ensure that the supply fan is running and that there is no abnormal noise or vibration.	<input type="checkbox"/>
.4	Generator Room:	
.1	Check operation of room lighting.	<input type="checkbox"/>
.2	Emergency Generator	
.1	Ensure that the generator room and equipment are clean and free of loose objects.	<input type="checkbox"/>
.2	Check that the engine block heater is working. The engine block should be warm to the touch.	<input type="checkbox"/>
.3	Check battery charging voltage on panel meter. This should be greater than 25.5 volts.	<input type="checkbox"/>
.4	Check status of generator alarm indication lights on detached panel. No alarms should be present. Press lamp test.	<input type="checkbox"/>
.5	Check the status of the generator room electrical panel (dark blue): main breaker 'charged' and 'closed'	<input type="checkbox"/>

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.5	Mechanical Room:	
	.1 Check operation of room lighting in the mechanical and storage rooms.	<input type="checkbox"/>
	.2 Check the pumps for abnormal noise or vibration if they are operating.	<input type="checkbox"/>
	.3 Check the piping and equipment for leaks.	<input type="checkbox"/>
.6	Substation:	
	.1 Check operation of room lighting.	<input type="checkbox"/>
	.2 Ventilation	
	.1 Check that room temperature is not hot.	<input type="checkbox"/>
	.1 Check filters for cleanliness and change if necessary.	<input type="checkbox"/>
	.3 Electrical	
	.1 Low Voltage Switch Gear	
	.1 Check the status of the disconnect and transfer switches:	
	.1 sub-station secondary main breaker (light blue) : 'charged' and 'closed'	<input type="checkbox"/>
	.2 emergency bypass (dark blue): 'open 'and 'locked'	<input type="checkbox"/>
	.3 emergency breaker (dark blue): 'open', 'unlocked' and 'charged'	<input type="checkbox"/>
	.4 normal breaker(dark blue): 'closed', 'unlocked' and 'charged',	<input type="checkbox"/>
	.5 normal bypass (dark blue): 'open' and 'locked'	<input type="checkbox"/>
	.2 Inspect the MCC Switch Gear and Panel Boards for external damage, burned-out indicator lamps and tripped condition.	<input type="checkbox"/>
.7	Building exterior:	
	.1 Check operation of the perimeter lighting	<input type="checkbox"/>
3 Northbound and Southbound Tunnels:		
	.1 Visually check the following equipment for exterior physical damage and abnormal operation:	
	.1 Carbon monoxide cabinets	<input type="checkbox"/>
	.2 Tunnel fans	<input type="checkbox"/>
	.3 Lane Signal Heads	<input type="checkbox"/>
	.4 Tunnel Lighting	<input type="checkbox"/>
	.5 CCTV Cameras	<input type="checkbox"/>
	.6 Emergency Cabinets	<input type="checkbox"/>
	.2 Check the operation of each tunnel emergency telephone.	<input type="checkbox"/>

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4 Final checks:

- .1 Lock all doors and return keys.
- .2 Ensure that no Honeywell alarms are present.