# Sample Monthly Station Logs

# AUGUST 2020

## TS MONTHLY LOGS

Revised June 2018

DATE: Aug. 24, 25/2020 BY: CM Note- All deficiencies are to be recorded on the Station Deficiency Form

| Transformer Equipment | HSTS T1 | HSTS T2 | HSTS T3 | HSTS T4 | HSTS T5 | HSTS T6 | ERTS T1 | ERTS T2 | TS3 T1 | TS3 T2 | TS3 T3 | TS3 T4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Main Conservator Oil Level | OK | OK | OK | OK | | | OK | OK | OK | OK | | |
| TC Conservator Oil Level | | | OK | OK | | | OK | OK | OK | OK | | |
| Bushing Oil Level | OK | OK | OK | OK | | | OK | OK | OK | OK | | |
| Gas Press Relay | OK | OK | OK | OK | | | OK | OK | OK | OK | | |
| Fans/Pumps Operation Check | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| MF Breather Operation Check | OK | OK | OK | OK | | | OK | OK | OK | OK | | |
| Silica Gel Breather | | | | | | | | | | | | |
| DGA Monitor | | | OK | OK | | | OK | OK | OK | OK | | |
| Sealed Tank Pressure | | | | | +1 | +1 | | | | | +4 | +5 |
| Sealed Tank Oil Level | | | | | OK | OK | | | | | OK | OK |
| Physical Check | OK | OK | DEF | DEF | OK | OK | OK | OK | OK | OK | OK | OK |

| Tap Changers | HSTS T1 | HSTS T2 | HSTS TC3A | HSTS TC3B | HSTS TC4A | HSTS TC4B | ERTS T1 | ERTS T2 | TS3 T1 | TS3 T2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Present count | 2600 | 87778 | 123025 | ? | 99927 | ? | 19283 | 21395 | 41382 | 40775 |
| Gladhand min/max (Reset) | 6/13 | 6/11 | 7/13 | 7/14 | 7/15 | 7/14 | 6/12 | 6/12 | 7/12 | 7/12 |
| Operation Check | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| Counter | OK | OK | OK | ? | OK | ? | OK | OK | OK | OK |
| Tapchanger Physical check | OK | OK | OK | ? | OK | ? | OK | OK | OK | OK |
| Compartment Oil Level | | | OK | OK | OK | OK | OK | OK | | |

| Auxiliary | HSTS | ERTS | TS3 |
|---|---|---|---|
| Bank Breaker Fans | OK | | |
| Relay/LDC/Comms Alarms/Flags | OK | OK | OK |
| LDC/TC Positions Match - *(Note 1)* | OK | OK | OK |
| CS/AB Physical Check | OK | DEF | DEF |
| Switchgear Physical Check | OK | OK | DEF |
| Air Brake Mech Box Ind. Lights | DEF | | |
| Security System/ Door Alarms | OK | OK | DEF |
| Fence Vibration Security | | OK | |
| Cameras (Apr / Oct) | — | — | — |
| IR Scanning -(if needed) | — | — | — |
| Cont. Pit Oil Det. Failure/alarms | OK | OK | |
| Cros3 & Cros4 Scada update | DEF | | |
| Capacitor Bank Physical Check | DEF | | |
| Spare 44kv TX Condition | | | DEF |
| Switch gear gas pressure | | | DEF |

| Batteries | HS A | HS B | ERTS | TS3 A | TS3 B |
|---|---|---|---|---|---|
| DC Volts | 132.6 | 134.7 | 134 | 134 | 134 |
| Charging Amps | 8.0 | 5.7 | 5 | 5 | 3 |
| Battery Level | DEF | DEF | OK | OK | OK |
| Equalize Batteries | OK | OK | OK | OK | OK |
| Physical Check | OK | OK | OK | OK | OK |

| Oil Temperatures | HSTS T1 | HSTS T2 | HSTS T3 | HSTS T4 | HSTS T3 X | HSTS T3 Y | HSTS T4 X | HSTS T4 Y | HSTS T5 | HSTS T6 |
|---|---|---|---|---|---|---|---|---|---|---|
| Current Oil Temperature | 40.8 | 39.6 | 52.5 | 56.2 | | | | | 36 | 40 |
| Peak Oil Temperature | 56.1 | 49.9 | 64.6 | 70.4 | | | | | 41 | 47 |
| Current Winding Temperature | 41.9 | 40.6 | | | 54.4 | 53.5 | 58.5 | 56.7 | 44 | 40 |
| Peak Winding Temperature | 65.8 | 52.1 | | | 64.9 | 66.3 | 75.1 | 74.0 | 49 | 47 |
| Current LTC Oil Temperature | 37.1 | 37.7 | | | | | | | | |
| Peak LTC Oil Temperature | 50.5 | 45.2 | | | | | | | | |

| Oil Temperatures | TS3 T1 | TS3 T2 | TS3 T3 | TS3 T4 | ERTS T1 | ERTS T2 |
|---|---|---|---|---|---|---|
| Current Oil Temperature | 40 | 40 | 43 | 50 | 46 | 48 |
| Peak Oil Temperature | 54 | 44 | 48 | 55 | 50 | 56 |
| Current Winding Temperature | 42 | 40 | 45 | 51 | 47 | 50 |
| Peak Winding Temperature | 60 | 44 | 52 | 55 | 48 | 60 |
| Current LTC Oil Temperature | | | | | 41 | 38 |
| Peak LTC Oil Temperature | | | | | 46 | 39 |

*Note*

*1 - If LDC and TC indications do not match, log into LDC relay and adjust position indication*

# WATERLOO NORTH HYDRO MS & DS MONTHLY LOG

DATE: Aug. 24, 25 /2020 BY: CM Revised: Mar 2018

| RECLOSERS | R26-2 | R26-3 | R27-1 | R27-2 | R28-1 | R28-2 | R29-1 | R29-2 | R29-3 | R29-4 |
|---|---|---|---|---|---|---|---|---|---|---|
| BATTERY VOLTAGE | 28 | 25 | 13.35 | 13.34 | 13.49 | 13.37 | 13.44 | 13.43 | 13.43 | 13.42 |
| CHARGING CURRENT (mA) | -8 | -12 | 10 | -10 | 0 | -10 | 10 | 10 | 0 | 0 |
| LOAD TEST (10 SEC) | 22 | 22 | | | | | | | | |
| HEATER | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| STATUS CHECK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| PHYSICAL CHECK OF RECLOSERS | DEF | DEF | OK | OK | OK | OK | OK | OK | OK | OK |

| | R30-1 | R30-2 | R30-3 | R31-1 | R31-2 | R31-3 | R32-1 | R32-2 | R32-3 |
|---|---|---|---|---|---|---|---|---|---|
| BATTERY VOLTAGE | 13.42 | 13.34 | 13.45 | 29 | 28 | 29 | | | |
| CHARGING CURRENT (mA) | 10 | 0 | -20 | -8 | -8 | -9 | | | |
| LOAD TEST (10 SEC) | | | | 24 | 25 | 25 | | | |
| HEATER | OK | OK | OK | OK | OK | OK | | | |
| STATUS CHECK | OK | OK | OK | OK | OK | OK | | | |
| PHYSICAL CHECK OF RECLOSERS | OK | OK | OK | DEF | OK | OK | | | |

| TRANSFORMER EQUIPMENT | R26 | R27 | R28 | R29 T1 | R29 T2 | R30 | R31 | R32 | MUS |
|---|---|---|---|---|---|---|---|---|---|
| OIL TEMP- MAX / PRESENT | 46/43 | 50/44 | 40/40 | 52/52 | 53/52 | 40/35 | 45/36 | | |
| MAIN / CONS. TANK OIL LEVEL | OK | OK | OK | OK | OK | OK | OK | | OK |
| TRANSFORMER OIL PRESSURE- PSI | -0.5 | | +1 | | | +1 | -1 | | 0 |
| TRANSFORMER FANS | | | | | | | OK | | |
| SILICA GEL BREATHER | OK | OK | | OK | OK | OK | OK | | |
| O.L.T.C. PRESENT COUNT | 225809 | | | | | 18323 | 130411 | | |
| O.L.T.C. MIN/MAX POSITION | 4/7 | | | | | 18/28 | 11/17 | | |
| O.L.T.C. OIL LEVEL | OK | | | | | OK | OK | | |
| O.L.T.C. IINVERTER OIL LEVEL | | | | | | OK | | | |
| O.L.T.C. FUNCTIONAL CHECK | OK | | | | | OK | OK | | |
| CHECK OF ULTC COMPARTMENT | OK | | | | | OK | OK | | |
| PHYSICAL CHECK OF TX | OK | DEF | OK | DEF | OK | OK | OK | OK | OK |

| STATION EQUIPMENT CHECKS | R26 | R27 | R28 | R29 | R30 | R31 | R32 | MUS |
|---|---|---|---|---|---|---|---|---|
| PHYSICAL CHECK OF STRUCTURE | OK | OK | OK | OK | OK | DEF | OK | DEF |
| INFRARED CHECK OF STATION (BI-MONTHLY) | | | | | | | | |
| PHYSICAL CHECK OF STATION | OK | OK | OK | DEF | OK | OK | OK | DEF |
| RADIO BATT VDC -FLOAT VOLTAGE | 27.12 | 26.49 | RTAC | 26.56 | 26.42 | 14.03 | | |
| 1 MINUTE - LOAD VOLTAGE | 26.91 | 26.25 | | 26.22 | 25.93 | 13.73 | | |
| RTU BATT VDC- - FLOAT VOLTAGE | 13.72 | | | | | 13.90 | | |
| 1 MINUTE -LOAD VOLTAGE | 12.88 | | | | | 12.56 | | |
| Site Security Alarm(s) | | | | | OK | | | |

**Note- All deficiencies are to be recorded on the Station Deficiency Form**
Note: If there is a hold off do not perform battery test at station

***Note: For Recloser controllers displays.***
651-R2 is blank when charging and indicates (-) when discharging.
Form C is blank when discharging and indicates (-) when charging.

# WATERLOO NORTH HYDRO ELMIRA MONTHLY LOG

Revised: Mar 2018

DATE: Aug. 24 /2020

| STATION/KYLE BATTERIES | M23-1 | M23-3 | M24-1 | M24-2 |
|---|---|---|---|---|
| BATTERY VOLTAGE | | | | |
| CHARGING CURRENT | | | | |
| CHARGER LOAD TEST (10 SEC) | | | | |
| BATTERY LOAD TEST (10 SEC) | | | | |
| EQUALIZE CHECK (30 SEC), (Timed high rate) | | | | |
| BATTERY LIQUID LEVEL | | | | |
| BATTERY GROUND | | | | |
| PHYSICAL CHECK OF BANK/CHARGER | | | | |

| STATION RTU/RADIO BATTERIES | MS23 | MS24 |
|---|---|---|
| RADIO BATTERY VOLTAGE | | |
| RADIO BATTERY LOAD TEST (1 MINUTE) | | |
| RTU BATTERY VOLTAGE | | |
| RTU BATTERY LOAD TEST (30 sec) | | |

| TRANSFORMER EQUIPMENT | MS23 | MS24 |
|---|---|---|
| OIL TEMP , MAX / PRESENT IN DEG C | | |
| OIL LEVEL | | |
| TRANSFORMER OIL PRESSURE- psi | | |
| TRANSFORMER FANS | | |
| OIL LEAKS | | |
| PHYSICAL CHECK OF TRANSFORMER | | |
| SILICA GEL BREATHER | | |

| STATION EQUIPMENT | MS23 | MS24 |
|---|---|---|
| PHYSICAL CHECK OF SWITCHGEAR | | |
| INDICATOR LAMPS | | |
| RECLOSE RELAY NEON LIGHT | | |
| ELEC RECLOSER LOCK OUT LAMP TEST | | |
| ELEC RECLOSER & RTU HEATERS | | |
| PHYSICAL CHECK OF RECLOSERS | | |
| INFRARED CHECK OF STATION (BI-MONTHLY) | | |

BOTH OK

***Oil drained from transformers. Perform quick visual inspection, (look), of station equipment. Nothing falling apart, stolen, vandalized, etc***

**Note- All deficiencies are to be recorded on the Station Deficiency Form**

***Note: For Recloser controllers displays.***

651-R2 is blank when charging and indicates (-) when discharging.

Form C is blank when discharging and indicates (-) when charging.

## Waterloo North Hydro Distribution Capacitor Controller Logs

DATE: Aug. 24, 25 / 2020 BY: CM

| | Status - mark 'O' with an X | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Operational Mode | | Last Bank Command | | On SCADA | | Scada Comms Lamp Test | | * Physical Check - If 'Deficient' add to list | | Active 'non ok' alarms on display - *do not add 'ok' alarms* |
| C8 -4222 | O Auto | O Manual | O Close | O Open | O Rem. | O Local | O Xmt | O Rcv | O Ok | O Def. | OOS. - removed from site |
| Manser Rd., south of Linwood | | | | | | | | | | | |
| C8 -4224 | ⊙ Auto | O Manual | ⊙ Close | O Open | O Rem. | ⊙ Local | O Xmt | O Rcv | ⊙ Ok | O Def. | |
| Ament Line, east of Linwood | | | | | | | | | | | |
| C8 -4226 | O Auto | O Manual | O Close | O Open | On SCA | O Local | O Xmt | O Rcv | O Ok | O Def. | OOS - Removed from site |
| Northfield Dr., north of Conestogo | | | | | | | | | | | |
| C14 -4262 | ⊙ Auto | O Manual | ⊙ Close | O Open | O Rem. | ⊙ Local | O Xmt | O Rcv | ⊙ Ok | O Def. | |
| 200 Weber St North, north of Lodge St | | | | | | | | | | | |
| C14 -4263 | ⊙ Auto | O Manual | ⊙ Close | O Open | O Rem. | ⊙ Local | O Xmt | O Rcv | ⊙ Ok | O Def. | |
| 220 Frobisher Dr., between Superior & Bridge | | | | | | | | | | | |
| C14 -4264 | ⊙ Auto | O Manual | O Close | ⊙ Open | O Rem. | ⊙ Local | O Xmt | O Rcv | O Ok | ⊙ Def. | Neutral sensor Lock-out. - reset, stayed open. |
| 584 Weber St North, north of Northfield | | | | | | | | | | | |
| C14 -4265 | O Auto | O Manual | O Close | O Open | O Rem. | O Local | O Xmt | O Rcv | O Ok | O Def. | OOS - Removed from site |
| 603 Kumpf Drive, south of Randall | | | | | | | | | | | |

** Physical check deficiencies include - moisture ingress, corrosion of parts & wiring, lights & display not working, broken cabinet, etc*

## INSPECTION GUIDELINES

***Physical Check of Transformer Includes:***

Paint condition & corrosion

Oil leaks

Flashed or cracked bushings

Cabinet damage

Ground wire condition

Bird or animal nests

Vines or brush growth interference

Accessibility compromised

Cabinet heaters

**MS1 North west corner of switch gear room near bathroom and front window - mc

PRD's

Explosion vents

***Physical Check of Indoor Switchgear Includes:***

Indicator Lamps

SF6 Gas Pressure (TS3)

***Physical Check of Structure/Switchgear Includes:***

Bent/ broken insulators

Damaged lightning arresters, control boxes, CT/PT transformers

Ground wire condition

Paint condition and corrosion

***Physical Check of ULTC Compartment Includes***

Animal nests

Damaged wiring

Heater functioning

Condition of Belts & Pulleys

Oil level/ oil leaks

Loose hardware

***Physical Check of Circuit Switcher/Air Break Mech Box Includes:***

Indicator Lamps

Heaters

SF6 Gas Pressure

Animal nests

Damaged wiring

***Physical Check of Capacitor Bank Includes:***

Condition of bushings

Tank corrosion/leaks

Damaged cutout, disconnects, oil switches or control cabinet

***Physical Check of Reclosers Includes:***

Flashed or cracked bushings

Cabinet damage

Ground wire condition

Paint condition and corrosion

Oil leaks

***Physical Check of Batteries and Charger Includes***

Leaks

Condition of terminals/connections

Electrolyte level

Exhaust fan working properly

Battery Charger Alarms

# WATERLOO NORTH HYDRO - STATION DEFICIENCY FORM

Date - Aug. 24, 25 / 2020

By - CM

Grade 1- Immediate correction needed.

Grade 2 - Correction can be scheduled.

| | | Priority | | | | |
|---|---|---|---|---|---|---|
| Station | Problem | Gr 1 | Gr 2 | Date Corrected | By | Comment - Stns Spvr |
| ERTS | Hornet nest above T1 AB mech box under B Ø blades. | | ✓ | | | |
| R31 | Large wasp nest under BØ air break LB-27-R31 | | ✓ | | | |
| HSA | battery levels low | ✓ | OM | | | |
| HSA | GROS4 monitors not working (IT?) | ✓ | | | | |
| HSB | Hornets nest on back of TC box and under BPD box | | ✓ | | | |
| HSB | TC3B - wasp nest inside stairs railing, unable to get to TC box. | ✓ | | | | |
| HSB | TC - hornets nest back of TC box LB + under BPD box too | | ✓ | | | |
| HSB | TC4B - wasp nest inside stairs railing handle, unable to get to TC box | ✓ | | | | |
| MUS | Multiple wasp nests on / in MUS | | ✓ | | | |
| TS3 | 3F6 SW. GR. SF6 gas approaching low level. | | ✓ | | | |
| TS3 | 07V/T2 SF6 gas sensors for R+WØ read ERROR | | ✓ | | | |
| TS3 | Fence is in pieces!!!! | | ✓ | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Revised July 17 - 15 RB

| | | | | | | |
|---|---|---|---|---|---|---|
| TS3 | Line Ptn relay 69/52 T1 SF6 gas monitor trouble led on (need outage) ✓ | | ✓ | | | D6V & D7V Gas monitor comm issue, need H1 D6V & D7V outages to repair. |
| TS3 | ~~D6V CS gas sensorA on B ph showing 0%, (Part of above issue)~~ | | ✓ | | | Part above issue, see note |
| Spare 44 | Leaking to TC, little rusty | | | | | SGB installed on main tank, Herb aware |
| * HS A | CROS4 monitor array not working - still not working | ✓ | | | | |
| * HS A | battery levels approcaching low - battery levels are low, just above MIN. | ✓ | | | | |
| HS A | Top floor emerg light near kitchen not working | | | | | |
| HS A | Basement emerg light not working | | | | | |
| HS A | Y Bus A Ptn - 'system exception alarm - see diagnostics' - Jan11 20, 'corrupt dsp program' - relay rebooted | | | | | |
| * HS A | T2 AB Mech box close light burnt out - still burnt out | | | | | P&C to replace |
| HS A | T1 NE4R Fan not working | | | | | P&C to investigate / remove. Rade to order new part |
| HS A | Water leaking into basement from ducts between A & B | | | | | Probably crack is duct structure outside & underground |
| HS A | T1 AB motor box conduits pulled apart | | | | | Cold weather shrinks pipe. Expansion joints? Size____2"__ |
| HS A | T1 Blue phase bushing oil a little low | | | | | Btwn 'Ok' and 'Low' - Monitor, No change from 2017 |
| HS A | T1 D6V cable duct pulled out of bottom of mech box | | | | | Cold weather shrinks pipe. Expansion joints? Size __2"__ |
| HS A | HS07, HS10, HS11, T1B, D7V, T2Y, Y Bus A, HMI relay display not working | | ✓ | | | Eng to order new panels & spare |
| * HS B | Battery levels low - battery levels are low. May need to top up. | | | | | |
| * HS B | T3 DGA ~~Calsta - Error~~ - Low oil flow | | | | | Sent to Morgan Schaffer April 30 2020 |
| * HS B | HS30 ~~Sw Grelectd~~ bulb out | | | | | |
| HSB | T3 Cap bank enclosure lid rusty | | | | | Refurbish during T3 Outage |
| HS B | T4 has oil stains from neutral bushing | | ✓ | | | P&C to co-ordinate repair with other outage |
| HS B | T5, Possible oil leak on rad | | | | | Rade checked, none found. Will monitor |
| HS B | T3 and T4 oil leaks | | | | | P&C to clean around stains to determine leak locations |
| HS B | T5 oil staining in CT junction box | | | | | Monitor |
| HS B | T6 HV cable ducts slightly separated from box | | | | | Cold weather shrinks pipe. Expansion joints? Size __4"__ |
| MUS | Door and latch hinges rusted / siezed. - unable to open most access doors. | | | | | |
| MUS | Drill out door latches for existing locks, or get smaller locks " | | | | | P&C to repair |
| MUS | Oil pressure gage leaks oil at vent, - not coonected to very top ✓ | | | | | High oil level in main tank?, May need higher conn'n pt. |
| Crosshill Rptr | Wimax mounting shifted in bracket | | | | | Repair during cabinet upgrade 2020 |
| Crosshill Rptr | Antenna cable not grounded. | | ✓ | | | Repair during cabinet upgrade 2020 |
| Hssn Strs Rptr | Moisture issue in cabinet | | | | | Need to vent, somehow |
| Hssn Strs Rptr | *Antenna cables need additional hangers* | | ✓ | | | *P&C to add grounding & hangers in 2018* |
| Shantz Rptr | Antenna cables need more hangers. | | ✓ | | | P&C to add more hangers, in 2018 |

| WATERLOO NORTH HYDRO - STATION DEFICIENCY FORM | | | | | | |
|---|---|---|---|---|---|---|
| Last Updated - | 1-Mar-20 | Grade 1- Immediate correction needed. | | | | |
| Inspected By - | | Grade 2 - Correction can be scheduled. | | | | |
| | | Priority | | | | |
| Station | Problem | Grade 1 | Grade 2 | Date Corrected | By | Supervisor Comment |
| DS26 | Repeater Antenna mounts need grounds | | √ | | | P&C to repair, OOS mid 2020 |
| DS27 | Radio cabinet heater not working - fixed | | | | | |
| DS27 | Small leak on around secondary bushing - present | | | | | Monitor, TX to be replaced in 2021 |
| DS28 | Excess of moisture inside Tx temp gage | | | | | |
| DS28 | Station service tx rusted at botton | | | | | Rade to check. Next maint in 2022 |
| DS29 | Fence by T1 pushed in at bottom + stone pushing into fence | | ✓ | | | Rade to check |
| DS29 | T1 small oil leak from top of tx - present | | √ | | | Very minor, monitor |
| DS29 | Material from Creative Landscape next to fence | | √ | | | Fence to be relocated?. Ex fence at P.L. |
| DS31 | Light in rtu shack burnt out | | | | | Fac or P&C to replace |
| DS31 | OLTC motor chain loose | | | | | P&C to adjust, outage in summer 2020 |
| DS31 | Radio antenna mount not grounded | | √ | | | To be scheduled - filler / summer |
| DS31 | 31-1 recloser lifter needs repair | | | | | Good one in shop. Reclosers OOS in 2020 |
| ERTS | DC gnd during fan check of T1 - didn't happen in August. | | | | | |
| ERTS | 42, 44 T2B2 reclose led out - still out | | | | | |
| ERTS | Mold on drywall under stairs in basement | | | | | Facilities to investigate |
| ERTS | ER48 Riser pole rotting | | | | | Bryon aware, line to be rebuilt |
| ERTS | Ducts from SS Tx's leaking water | | | | | May need to excavate to repair. P&C to investigate first. |
| ERTS | T2 oil stain on lower rad valve | | | | | Monitor, could be packing. P&C to tighten bolts |
| ERTS | RTU main IED failed light activated | | √ | | | Stns eng to program |
| ERTS | Water in basement alarm toggles to much | | | | | P&C to repair |
| * TS3 | Battery 19 needs cleaning | | | | | |
| ~~TS3~~ | ~~T2 neutral cable needs remounting~~ | | | | | |
| TS3 | NW corner emerg light not working | | | | | |
| TS3 | T1 DGA - Leaks at Tx flanges | | | | | Eng to order new flanges and gaskets |
| TS3 | Hornets nest under T2 gantry / red ph insulator | | | | | Remove during Aug D7V outage. |
| TS3 | T2 oil staining under tx pump | | | | | Monitor |
| TS3 | Switches 2 alarm | | | | | Eng to investigate |
| TS3 | T4 cabinet latch broken | | | | | P&C to repair, Rade to order parts |

5573

Transformer Station:

Sample Transformer Test Record

# 2020-06-23 – Report (97001544)

| | | | |
|---|---|---|---|
| Client | | 6/16/2020 Job | |
| Execution date | 6/16/2020 | Reason of the job | Routine |
| Tested by | Jeremy Bearss | Location | TS3 |
| Approved by | | Asset | Transformer |
| Report ID | 1 | Asset type | Two-winding |
| Report issue date | 6/23/2020 1:10:01 PM | Asset serial number | 97001544 |
| Work order | | Manufacturer | PAUWELS |

| Summary |
|---|
| |

| Performed tests | Assessment |
|---|---|
| Overall PF & CAP | Pass |
| Bushing H PF & CAP - C1 | Pass |
| TTR H-X | Pass |
| DC Winding Resistance X | Pass |
| Surge Arrester Watt Losses H | Not assessed |
| Surge Arrester Watt Losses X | Not assessed |
| Insulation Resistance | Not assessed |
| Core/Clamp Insulation Resistance | Not assessed |
| Inspection test | Not assessed |

| | |
|---|---|
| Overall Assessment | No faults |

Tested by: _____

Approved by: _____

## Transformer nameplate data

| | | | |
|---|---|---|---|
| Serial number | 97001544 | Apparatus ID | T1 |
| Manufacturer | PAUWELS | Feeder | |
| Manufacturing year | 2000 | No. phases | 3 |
| Manufacturer type | | Vector group | Yzn1 |

Comment

## Voltage ratings

| Winding | Voltage L-L | Voltage L-N | Insul. level L-L |
|---|---|---|---|
| H | 215.500 kV | kV | 900 kV |
| X | 28.000 kV | 16.166 kV | 170 kV |

## Power ratings

| Rated power | Cooling class | Temp. rise wind. |
|---|---|---|
| 40.000 MVA | ONAN | 65 |
| 53.300 MVA | ODAF | 65 |
| 66.700 MVA | ODAF | 65 |

## Current ratings at rated power

| Winding | | |
|---|---|---|
| H | X | Rated power |
| A | A | 40.000 MVA |
| A | A | 53.300 MVA |
| 178.700 A | 1375.300 A | 66.700 MVA |

## Short-circuit rating

| | | |
|---|---|---|
| Max. short-circuit current | kA | s |

## Impedances

| | |
|---|---|
| Ref. temp. | 75 °C |

## Leakage reactance H - X

| Zk[%] | Base power | Base voltage | Load losses Pk | OLTC position | DETC position |
|---|---|---|---|---|---|
| % | MVA | kV | W | | |

## Zero sequence impedance

| | |
|---|---|
| Base power | 40.00 MVA |
| Base voltage | 28.000 kV |
| Description | Z0[%] |
| Secondary | 12.50 % |

## Others

| | |
|---|---|
| Category | Distribution |
| Status | In operation |
| Tank type | Free breathing |
| Insulation medium | Mineral oil |
| Fluid insulation volume | 15257 gals |
| Fluid insulation weight | 108606 lbs |
| Total weight | 331972 lbs |

## Bushings nameplate data

| Pos. | Serial No. | Manufact. | Manufacturer type | Man. year | Voltage L-ground | Max. system voltage | Rated current |
|---|---|---|---|---|---|---|---|
| H1 | 00-84692 | Lapp | | | 156.0 kV | 245.0 kV | 600.0 A |
| H2 | 00-84702 | Lapp | | | 156.0 kV | 245.0 kV | 600.0 A |
| H3 | 00-84694 | Lapp | | | 156.0 kV | 245.0 kV | 600.0 A |
| X1 | 00-191996 | LAPP | | 2000 | 25.0 kV | 35.0 kV | 3000.0 A |
| X2 | 00-191403 | LAPP | | 1997 | 25.0 kV | 35.0 kV | 3000.0 A |
| X3 | 00-191405 | LAPP | | 1997 | 25.0 kV | 35.0 kV | 3000.0 A |
| X0 | 01-195866 | LAPP | | 2000 | 25.0 kV | 35.0 kV | 3000.0 A |

| Pos. | Insul. level LL | Cap. (C1) | PF (C1) | Cap. (C2) | PF (C2) | Insulation type | Tap type |
|---|---|---|---|---|---|---|---|
| H1 | 950 kV | 378.00 pF | 0.250 % | 3052.00 pF | 0.220 % | Oil-impregnated paper | With potential tap |
| H2 | 950 kV | 380.00 pF | 0.250 % | 2986.00 pF | 0.230 % | Oil-impregnated paper | With potential tap |
| H3 | 950 kV | 379.00 pF | 0.250 % | 3092.00 pF | 0.200 % | Oil-impregnated paper | With potential tap |
| X1 | 200 kV | 650.00 pF | 0.610 % | pF | % | Oil-impregnated paper | Without tap |
| X2 | 200 kV | 667.00 pF | 0.650 % | pF | % | Oil-impregnated paper | Without tap |
| X3 | 200 kV | 657.00 pF | 0.680 % | pF | % | Oil-impregnated paper | Without tap |
| X0 | 200 kV | 623.00 pF | 0.650 % | pF | % | Oil-impregnated paper | Without tap |

## Tap Changers nameplate data

### OLTC

| | |
|---|---|
| Serial number | |
| Manufacturer | MR |
| Manufacturer type | M |
| Winding | H |
| Tap scheme | 1...33 |
| No. of taps | 33 |

| Tap | Voltage |
|---|---|
| 1 | 255500.0 V |
| 2 | 253000.0 V |
| 3 | 250500.0 V |
| 4 | 248000.0 V |
| 5 | 245500.0 V |
| 6 | 243000.0 V |
| 7 | 240500.0 V |
| 8 | 238000.0 V |
| 9 | 235500.0 V |
| 10 | 233000.0 V |
| 11 | 230500.0 V |
| 12 | 228000.0 V |

| Tap | Voltage |
|---|---|
| 13 | 225500.0 V |
| 14 | 223000.0 V |
| 15 | 220500.0 V |
| 16 | 218000.0 V |
| 17 | 215500.0 V |
| 18 | 213000.0 V |
| 19 | 210500.0 V |
| 20 | 208000.0 V |
| 21 | 205500.0 V |
| 22 | 203000.0 V |
| 23 | 200500.0 V |
| 24 | 198000.0 V |
| 25 | 195500.0 V |
| 26 | 193000.0 V |
| 27 | 190500.0 V |
| 28 | 188000.0 V |
| 29 | 185500.0 V |
| 30 | 183000.0 V |
| 31 | 180500.0 V |
| 32 | 178000.0 V |
| 33 | 175500.0 V |

## Surge Arrester nameplate data

| Surge arrester H1 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | 2000 | 217752 | 2 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-27970 | kV | 192.00 kV | 152.00 kV | |
| 2 | P-27975 | kV | 192.00 kV | 152.00 kV | |

| Surge arrester H2 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | 2000 | 217752 | 2 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-27972 | kV | 192.00 kV | 152.00 kV | |
| 2 | P-27974 | kV | 192.00 kV | 152.00 kV | |

| Surge arrester H3 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | 2000 | 217752 | 2 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-27971 | kV | 192.00 kV | 152.00 kV | |
| 2 | P-27973 | kV | 192.00 kV | 152.00 kV | |

| Surge arrester X1 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | | 218517 | 1 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-33859 | kV | 21.00 kV | 17.00 kV | |

| Surge arrester X2 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | | 218517 | 1 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-33858 | kV | 21.00 kV | 17.00 kV | |

| Surge arrester X3 | | | | |
|---|---|---|---|---|
| Overall ID | Manufacturer | Manufacturing year | Manufacturer type | Units in stack |
| | Ohio Brass | | 218517 | 1 |

| Position | Serial No. | Voltage L-L | Voltage L-N | MCOV rating | Unit ID |
|---|---|---|---|---|---|
| 1 | P-31922 | kV | 21.00 kV | 17.00 kV | |

## Test set information

| **Model** | **Serial number** | **Calibration date** |
|---|---|---|
| CPC100 | VK266E | 03/30/2020 14:51:59 |
| CP TD12 | BE255C | Not available |

## Global test conditions

| | | | |
|---|---|---|---|
| Weather | Clear | Humidity | 55 % |
| Unit location | Outside | Ambient temperature | 20 °C |

## Overall PF & CAP

| | | | |
|---|---|---|---|
| Ambient temperature | 26 °C | Weather | Clear |
| Top oil temperature | 24 °C | Humidity | 45 % |

Comments

## Standard test

### Block 1: injection at H

| | |
|---|---|
| Corr. temperature | 24 °C |
| Corr. factor | 0.98 |

| No. | Meas. | Test mode | Freq. | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ICH+ICHL | GST | 60.00 Hz | 2.00 kV | 7.57 mA | 41.35 mW | 0.2732 % | 0.2677 % | 10033.0 pF | Pass |
| 2a | ICH | GSTg-A | 60.00 Hz | 9.99 kV | 20.09 mA | 651.43 mW | 0.3245 % | 0.3180 % | 5329.3 pF | Pass |
| 3a | ICHL | UST-A | 60.00 Hz | 10.01 kV | 17.77 mA | 324.57 mW | 0.1826 % | 0.1789 % | 4709.3 pF | Pass |

### Block 2: injection at X

| | |
|---|---|
| Corr. temperature | 24 °C |
| Corr. factor | 0.98 |

| No. | Meas. | Test mode | Freq. | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | ICL+ICLH | GST | 60.00 Hz | 2.00 kV | 12.46 mA | 99.03 mW | 0.3973 % | 0.3893 % | 16530.3 pF | Pass |
| 5a | ICL | GSTg-A | 60.00 Hz | 10.00 kV | 44.59 mA | 2173.06 mW | 0.4873 % | 0.4776 % | 11823.1 pF | Pass |
| 6a | ICLH | UST-A | 60.00 Hz | 2.00 kV | 3.55 mA | 12.55 mW | 0.1769 % | 0.1733 % | 4705.8 pF | Pass |

## Frequency sweep

### Measurement: ICH

| | | | |
|---|---|---|---|
| Corr. factor | | | 0.98 |
| No. | 2b | Test mode | GSTg-A |

| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 1.02 mA | 11.46 mW | 0.5625 % | 0.5513 % | 5407.8 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 2.00 mA | 35.03 mW | 0.8746 % | 0.8571 % | 5308.4 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 3.01 mA | 26.07 mW | 0.4332 % | 0.4245 % | 5319.4 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 4.02 mA | 27.94 mW | 0.3478 % | 0.3409 % | 5324.1 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 9.73 mA | 59.26 mW | 0.3046 % | 0.2985 % | 5335.9 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 15.48 mA | 107.50 mW | 0.3471 % | 0.3402 % | 5350.8 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 21.28 mA | 174.48 mW | 0.4099 % | 0.4017 % | 5373.9 pF | N. rated |
| 400.00 Hz | 2.00 kV | 1.99 kV | 27.04 mA | 263.44 mW | 0.4895 % | 0.4797 % | 5405.2 pF | N. rated |

**Measurement: ICHL**

| Corr. factor | | 0.98 |
|---|---|---|
| No. 3b | Test mode | UST-A |

| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 0.89 mA | 3.23 mW | 0.1817 % | 0.1781 % | 4714.0 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 1.78 mA | 6.40 mW | 0.1803 % | 0.1767 % | 4710.8 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 2.66 mA | 9.65 mW | 0.1812 % | 0.1776 % | 4708.9 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 3.55 mA | 12.94 mW | 0.1823 % | 0.1786 % | 4707.8 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 8.58 mA | 32.15 mW | 0.1873 % | 0.1836 % | 4709.4 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 13.63 mA | 53.38 mW | 0.1960 % | 0.1921 % | 4715.7 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 18.71 mA | 78.97 mW | 0.2110 % | 0.2068 % | 4726.8 pF | N. rated |
| 400.00 Hz | 2.00 kV | 1.99 kV | 23.73 mA | 110.07 mW | 0.2330 % | 0.2283 % | 4742.5 pF | N. rated |

**Measurement: ICL**

| Corr. factor | | 0.98 |
|---|---|---|
| No. 5b | Test mode | GSTg-A |

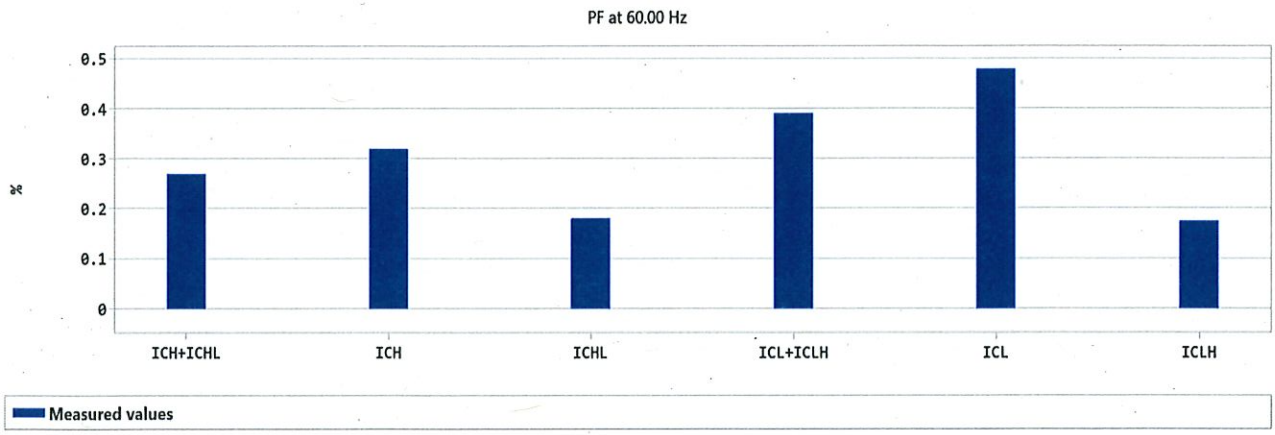
| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 2.23 mA | 17.30 mW | 0.3885 % | 0.3807 % | 11854.6 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 4.46 mA | 37.01 mW | 0.4146 % | 0.4063 % | 11837.7 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 6.69 mA | 60.13 mW | 0.4494 % | 0.4404 % | 11827.4 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 8.92 mA | 86.53 mW | 0.4852 % | 0.4755 % | 11823.5 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 21.50 mA | 290.75 mW | 0.6763 % | 0.6627 % | 11795.2 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 34.03 mA | 584.23 mW | 0.8589 % | 0.8417 % | 11775.6 pF | N. rated |
| 315.00 Hz | 2.00 kV | 1.99 kV | 46.41 mA | 958.69 mW | 1.0360 % | 1.0153 % | 11757.0 pF | N. rated |
| 400.00 Hz | 2.00 kV | 2.00 kV | 59.13 mA | 1433.43 mW | 1.2097 % | 1.1855 % | 11737.1 pF | N. rated |

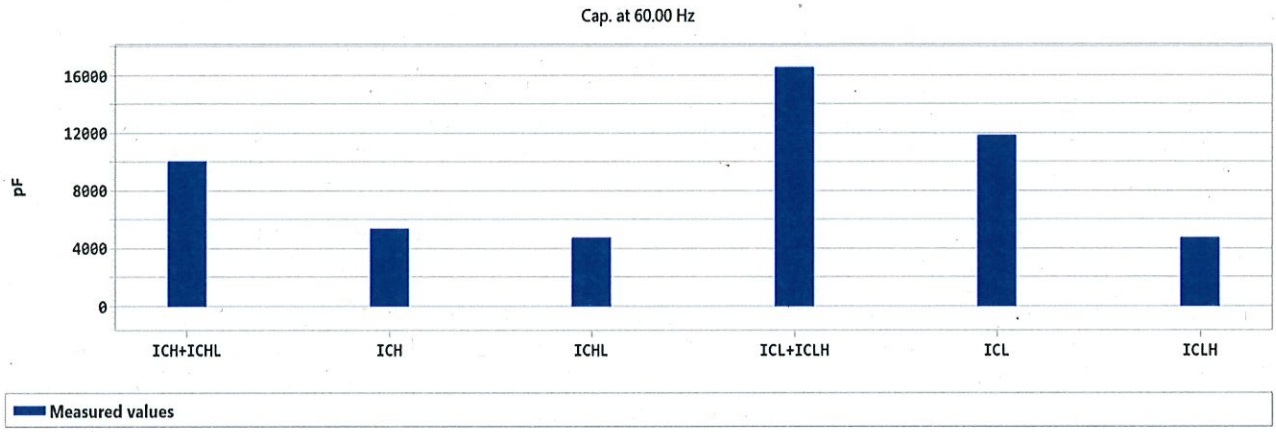
**Measurement: ICLH**

| Corr. factor | | 0.98 |
|---|---|---|
| No. 6b | Test mode | UST-A |

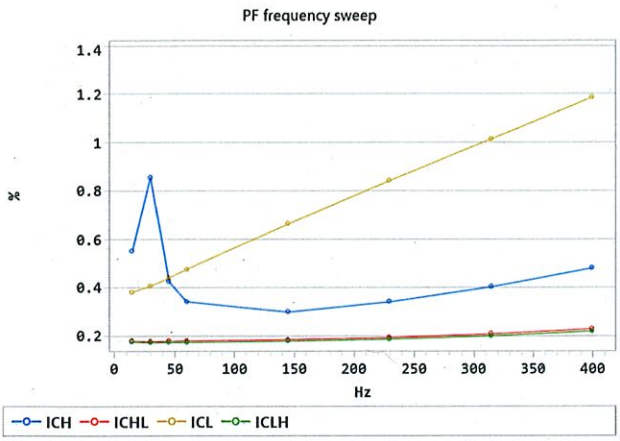
| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 0.89 mA | 3.19 mW | 0.1787 % | 0.1751 % | 4711.7 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 1.78 mA | 6.23 mW | 0.1756 % | 0.1721 % | 4708.6 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 2.66 mA | 9.37 mW | 0.1761 % | 0.1726 % | 4706.9 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 3.55 mA | 12.56 mW | 0.1770 % | 0.1734 % | 4705.8 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 8.58 mA | 31.22 mW | 0.1820 % | 0.1784 % | 4707.5 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 13.62 mA | 51.61 mW | 0.1896 % | 0.1858 % | 4713.9 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 18.65 mA | 75.69 mW | 0.2034 % | 0.1993 % | 4725.0 pF | N. rated |
| 400.00 Hz | 2.00 kV | 2.01 kV | 23.89 mA | 107.24 mW | 0.2238 % | 0.2194 % | 4740.6 pF | N. rated |

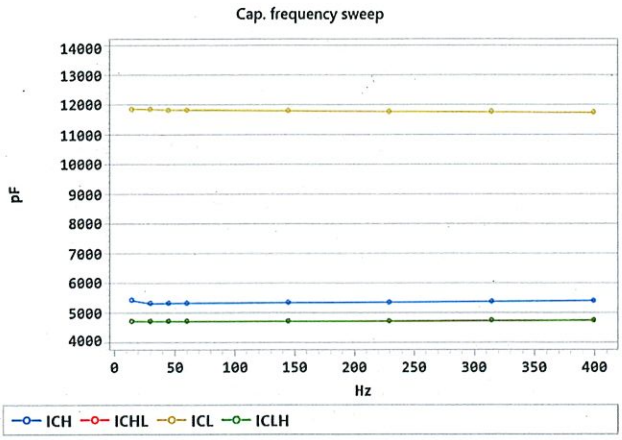
## Graphs for standard test



## Graphs for frequency sweep



## Bushing H PF & CAP - C1

| | | | |
|---|---|---|---|
| Ambient temperature | 26 °C | Weather | Clear |
| Top oil temperature | 24 °C | Humidity | 45 % |

Comments

## Standard test

| Corr. factor | 0.98 |
|---|---|

| No. | Meas. | Test mode | Freq. | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|---|---|
| 1a | H1 | UST-A | 60.00 Hz | 10.00 kV | 1.43 mA | 35.75 mW | 0.2501 % | 0.2451 % | 379.2 pF | Pass |
| 2a | H2 | UST-A | 60.00 Hz | 10.01 kV | 1.43 mA | 35.66 mW | 0.2487 % | 0.2437 % | 379.9 pF | Pass |
| 3a | H3 | UST-A | 60.00 Hz | 10.01 kV | 1.42 mA | 35.25 mW | 0.2472 % | 0.2423 % | 377.6 pF | Pass |

## Frequency sweep

### Measurement: H1

| Corr. factor | 0.98 | | |
|---|---|---|---|
| No. | 1b | Test mode | UST-A |

| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 0.07 mA | 0.34 mW | 0.2385 % | 0.2337 % | 380.0 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 0.14 mA | 0.69 mW | 0.2417 % | 0.2368 % | 379.6 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 0.21 mA | 1.05 mW | 0.2458 % | 0.2409 % | 379.4 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 0.29 mA | 1.43 mW | 0.2497 % | 0.2447 % | 379.2 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 0.69 mA | 3.66 mW | 0.2655 % | 0.2602 % | 378.7 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 1.09 mA | 6.07 mW | 0.2776 % | 0.2721 % | 378.4 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 1.50 mA | 8.60 mW | 0.2876 % | 0.2818 % | 378.2 pF | N. rated |
| 400.00 Hz | 2.00 kV | 2.00 kV | 1.90 mA | 11.10 mW | 0.2935 % | 0.2876 % | 378.0 pF | N. rated |

### Measurement: H2

| Corr. factor | 0.98 | | |
|---|---|---|---|
| No. | 2b | Test mode | UST-A |

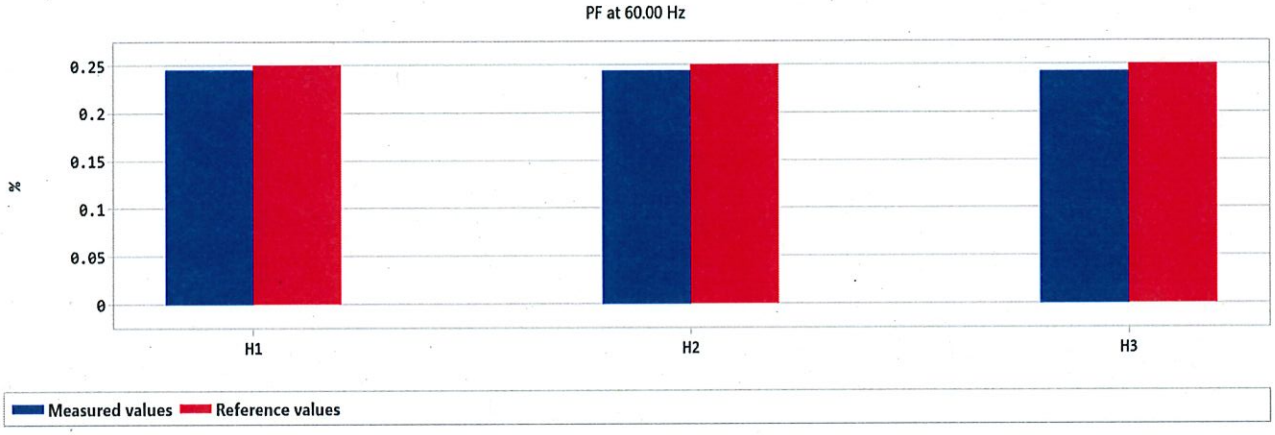
| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 0.07 mA | 0.34 mW | 0.2367 % | 0.2320 % | 380.7 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 0.14 mA | 0.69 mW | 0.2397 % | 0.2349 % | 380.3 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 0.21 mA | 1.05 mW | 0.2447 % | 0.2398 % | 380.0 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 0.29 mA | 1.42 mW | 0.2485 % | 0.2436 % | 379.9 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 0.69 mA | 3.66 mW | 0.2649 % | 0.2596 % | 379.3 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 1.10 mA | 6.07 mW | 0.2768 % | 0.2713 % | 379.1 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 1.50 mA | 8.60 mW | 0.2869 % | 0.2811 % | 378.9 pF | N. rated |
| 400.00 Hz | 2.00 kV | 2.00 kV | 1.90 mA | 11.09 mW | 0.2928 % | 0.2869 % | 378.7 pF | N. rated |

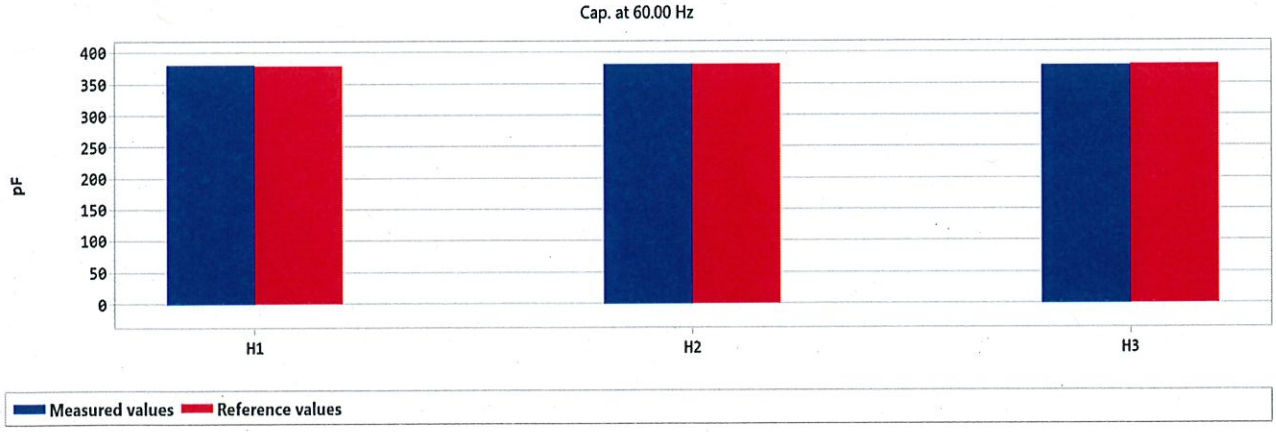
### Measurement: H3

| Corr. factor | | 0.98 |
|---|---|---|
| No. 3b | Test mode | UST-A |

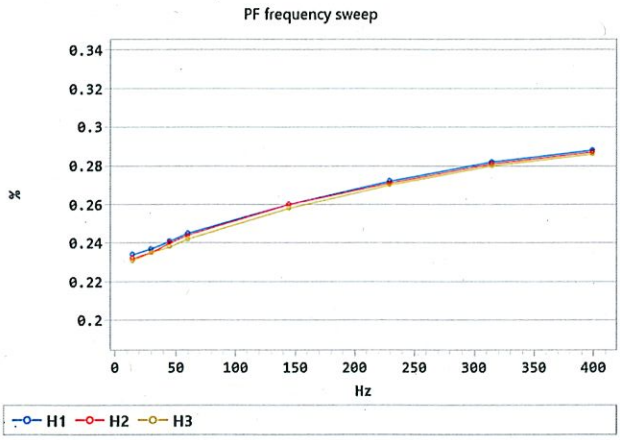
| Freq. | V test | V out | I out | Watt losses | PF meas | PF corr | Cap. meas | Assessment |
|---|---|---|---|---|---|---|---|---|
| 15.00 Hz | 2.00 kV | 2.00 kV | 0.07 mA | 0.34 mW | 0.2362 % | 0.2315 % | 378.4 pF | N. rated |
| 30.00 Hz | 2.00 kV | 2.00 kV | 0.14 mA | 0.68 mW | 0.2396 % | 0.2348 % | 378.0 pF | N. rated |
| 45.00 Hz | 2.00 kV | 2.00 kV | 0.21 mA | 1.04 mW | 0.2432 % | 0.2383 % | 377.8 pF | N. rated |
| 60.00 Hz | 2.00 kV | 2.00 kV | 0.28 mA | 1.41 mW | 0.2472 % | 0.2422 % | 377.6 pF | Pass |
| 145.00 Hz | 2.00 kV | 2.00 kV | 0.69 mA | 3.62 mW | 0.2631 % | 0.2579 % | 377.1 pF | N. rated |
| 230.00 Hz | 2.00 kV | 2.00 kV | 1.09 mA | 6.00 mW | 0.2753 % | 0.2698 % | 376.8 pF | N. rated |
| 315.00 Hz | 2.00 kV | 2.00 kV | 1.49 mA | 8.50 mW | 0.2854 % | 0.2797 % | 376.6 pF | N. rated |
| 400.00 Hz | 2.00 kV | 1.99 kV | 1.89 mA | 10.97 mW | 0.2914 % | 0.2856 % | 376.5 pF | N. rated |

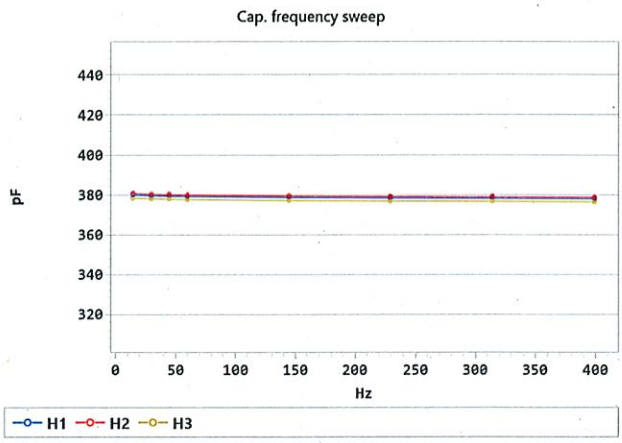
## Graphs for standard test



## Graphs for frequency sweep



## TTR H-X

| | | | |
|---|---|---|---|
| Test voltage | 150 V | Use CP SB1 | Yes |
| Type of tap changer | OLTC | Mode | Auto switching of taps and phases |
| | | Tap time | 30 s |
| IEC 61378-1 | No | Impulse time | 2 s |

Comments

## Standard test

| | | Phase A | | Phase B | | Phase C | | |
|---|---|---|---|---|---|---|---|---|
| Tap | Nom. ratio | TTR | Ratio dev | TTR | Ratio dev | TTR | Ratio dev | Assessment |
| 1 | 15.805 | 15.8087 | 0.02 % | 15.8077 | 0.02 % | 15.8072 | 0.01 % | Pass |
| 2 | 15.6503 | 15.6537 | 0.02 % | 15.6534 | 0.02 % | 15.651 | 0.00 % | Pass |
| 3 | 15.4957 | 15.4984 | 0.02 % | 15.4985 | 0.02 % | 15.4963 | 0.00 % | Pass |
| 4 | 15.341 | 15.3434 | 0.02 % | 15.3429 | 0.01 % | 15.3411 | 0.00 % | Pass |
| 5 | 15.1864 | 15.1886 | 0.01 % | 15.1879 | 0.01 % | 15.187 | 0.00 % | Pass |
| 6 | 15.0317 | 15.0336 | 0.01 % | 15.0319 | 0.00 % | 15.0308 | -0.01 % | Pass |
| 7 | 14.8771 | 14.8789 | 0.01 % | 14.8769 | 0.00 % | 14.8768 | 0.00 % | Pass |
| 8 | 14.7224 | 14.7248 | 0.02 % | 14.7223 | 0.00 % | 14.7224 | 0.00 % | Pass |
| 9 | 14.5678 | 14.5694 | 0.01 % | 14.5681 | 0.00 % | 14.5667 | -0.01 % | Pass |
| 10 | 14.4131 | 14.4143 | 0.01 % | 14.4124 | -0.01 % | 14.4127 | 0.00 % | Pass |
| 11 | 14.2585 | 14.2596 | 0.01 % | 14.2577 | -0.01 % | 14.2569 | -0.01 % | Pass |
| 12 | 14.1038 | 14.104 | 0.00 % | 14.1015 | -0.02 % | 14.1021 | -0.01 % | Pass |
| 13 | 13.9492 | 13.949 | 0.00 % | 13.9477 | -0.01 % | 13.9477 | -0.01 % | Pass |
| 14 | 13.7945 | 13.7942 | 0.00 % | 13.7922 | -0.02 % | 13.7913 | -0.02 % | Pass |
| 15 | 13.6399 | 13.6391 | -0.01 % | 13.6366 | -0.02 % | 13.6373 | -0.02 % | Pass |
| 16 | 13.4853 | 13.4849 | 0.00 % | 13.4829 | -0.02 % | 13.4825 | -0.02 % | Pass |
| 17 | 13.3306 | 13.329 | -0.01 % | 13.327 | -0.03 % | 13.3278 | -0.02 % | Pass |
| 18 | 13.176 | 13.1748 | -0.01 % | 13.1711 | -0.04 % | 13.1716 | -0.03 % | Pass |
| 19 | 13.0213 | 13.0199 | -0.01 % | 13.0165 | -0.04 % | 13.0167 | -0.04 % | Pass |
| 20 | 12.8667 | 12.865 | -0.01 % | 12.8628 | -0.03 % | 12.8627 | -0.03 % | Pass |
| 21 | 12.712 | 12.7102 | -0.01 % | 12.7067 | -0.04 % | 12.7076 | -0.03 % | Pass |
| 22 | 12.5574 | 12.5555 | -0.02 % | 12.552 | -0.04 % | 12.5529 | -0.04 % | Pass |
| 23 | 12.4027 | 12.4008 | -0.02 % | 12.3971 | -0.05 % | 12.396 | -0.05 % | Pass |
| 24 | 12.2481 | 12.2462 | -0.02 % | 12.242 | -0.05 % | 12.2416 | -0.05 % | Pass |
| 25 | 12.0934 | 12.0908 | -0.02 % | 12.0873 | -0.05 % | 12.0877 | -0.05 % | Pass |
| 26 | 11.9388 | 11.9361 | -0.02 % | 11.9327 | -0.05 % | 11.9313 | -0.06 % | Pass |
| 27 | 11.7841 | 11.7815 | -0.02 % | 11.7771 | -0.06 % | 11.7779 | -0.05 % | Pass |
| 28 | 11.6295 | 11.6265 | -0.03 % | 11.6218 | -0.07 % | 11.6221 | -0.06 % | Pass |
| 29 | 11.4748 | 11.4712 | -0.03 % | 11.4668 | -0.07 % | 11.4665 | -0.07 % | Pass |
| 30 | 11.3202 | 11.3166 | -0.03 % | 11.3126 | -0.07 % | 11.312 | -0.07 % | Pass |
| 31 | 11.1655 | 11.1617 | -0.03 % | 11.1573 | -0.07 % | 11.1585 | -0.06 % | Pass |
| 32 | 11.0109 | 11.0068 | -0.04 % | 11.0028 | -0.07 % | 11.0017 | -0.08 % | Pass |
| 33 | 10.8562 | 10.8518 | -0.04 % | 10.8471 | -0.08 % | 10.8467 | -0.09 % | Pass |

## Per-phase

### Phase A

| Tap | Nom. ratio | V prim | I prim | I phase | V sec | V phase | TTR | Ratio dev |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.805 | 149.97 V | 544.000 µA | -38.61 ° | 9.49 V | 0.090 ° | 15.8087 | 0.02 % |
| 2 | 15.6503 | 149.97 V | 543.000 µA | -40.17 ° | 9.58 V | 0.090 ° | 15.6537 | 0.02 % |
| 3 | 15.4957 | 149.97 V | 563.000 µA | -41.70 ° | 9.68 V | 0.100 ° | 15.4984 | 0.02 % |
| 4 | 15.341 | 149.97 V | 592.000 µA | -41.82 ° | 9.77 V | 0.090 ° | 15.3434 | 0.02 % |
| 5 | 15.1864 | 149.97 V | 606.000 µA | -44.35 ° | 9.87 V | 0.080 ° | 15.1886 | 0.01 % |
| 6 | 15.0317 | 149.97 V | 619.000 µA | -44.48 ° | 9.98 V | 0.090 ° | 15.0336 | 0.01 % |
| 7 | 14.8771 | 149.97 V | 640.000 µA | -45.80 ° | 10.08 V | 0.090 ° | 14.8789 | 0.01 % |
| 8 | 14.7224 | 149.98 V | 670.000 µA | -46.21 ° | 10.19 V | 0.080 ° | 14.7248 | 0.02 % |
| 9 | 14.5678 | 149.97 V | 689.000 µA | -48.00 ° | 10.29 V | 0.080 ° | 14.5694 | 0.01 % |
| 10 | 14.4131 | 149.97 V | 710.000 µA | -47.72 ° | 10.40 V | 0.080 ° | 14.4143 | 0.01 % |
| 11 | 14.2585 | 149.97 V | 720.000 µA | -48.78 ° | 10.52 V | 0.100 ° | 14.2596 | 0.01 % |
| 12 | 14.1038 | 149.97 V | 748.000 µA | -49.06 ° | 10.63 V | 0.070 ° | 14.104 | 0.00 % |
| 13 | 13.9492 | 149.97 V | 768.000 µA | -50.41 ° | 10.75 V | 0.070 ° | 13.949 | 0.00 % |
| 14 | 13.7945 | 149.97 V | 784.000 µA | -50.05 ° | 10.87 V | 0.070 ° | 13.7942 | 0.00 % |
| 15 | 13.6399 | 149.97 V | 819.000 µA | -51.35 ° | 11.00 V | 0.080 ° | 13.6391 | -0.01 % |
| 16 | 13.4853 | 149.97 V | 831.000 µA | -52.08 ° | 11.12 V | 0.070 ° | 13.4849 | 0.00 % |
| 17 | 13.3306 | 149.96 V | 851.000 µA | -52.17 ° | 11.25 V | 0.080 ° | 13.329 | -0.01 % |
| 18 | 13.176 | 149.97 V | 890.000 µA | -52.38 ° | 11.38 V | 0.080 ° | 13.1748 | -0.01 % |
| 19 | 13.0213 | 149.97 V | 898.000 µA | -52.89 ° | 11.52 V | 0.070 ° | 13.0199 | -0.01 % |
| 20 | 12.8667 | 149.97 V | 926.000 µA | -53.78 ° | 11.66 V | 0.060 ° | 12.865 | -0.01 % |
| 21 | 12.712 | 149.97 V | 948.000 µA | -53.37 ° | 11.80 V | 0.060 ° | 12.7102 | -0.01 % |
| 22 | 12.5574 | 149.97 V | 987.000 µA | -54.28 ° | 11.94 V | 0.070 ° | 12.5555 | -0.02 % |
| 23 | 12.4027 | 149.97 V | 999.000 µA | -54.67 ° | 12.09 V | 0.060 ° | 12.4008 | -0.02 % |
| 24 | 12.2481 | 149.97 V | 1.019 mA | -54.58 ° | 12.25 V | 0.060 ° | 12.2462 | -0.02 % |
| 25 | 12.0934 | 149.97 V | 1.035 mA | -54.73 ° | 12.40 V | 0.060 ° | 12.0908 | -0.02 % |
| 26 | 11.9388 | 149.97 V | 1.076 mA | -55.64 ° | 12.56 V | 0.060 ° | 11.9361 | -0.02 % |
| 27 | 11.7841 | 149.97 V | 1.105 mA | -55.37 ° | 12.73 V | 0.070 ° | 11.7815 | -0.02 % |
| 28 | 11.6295 | 149.97 V | 1.138 mA | -55.57 ° | 12.90 V | 0.050 ° | 11.6265 | -0.03 % |
| 29 | 11.4748 | 149.97 V | 1.147 mA | -55.43 ° | 13.07 V | 0.040 ° | 11.4712 | -0.03 % |
| 30 | 11.3202 | 149.97 V | 1.195 mA | -55.89 ° | 13.25 V | 0.050 ° | 11.3166 | -0.03 % |
| 31 | 11.1655 | 149.97 V | 1.216 mA | -55.93 ° | 13.44 V | 0.060 ° | 11.1617 | -0.03 % |
| 32 | 11.0109 | 149.97 V | 1.254 mA | -56.74 ° | 13.63 V | 0.040 ° | 11.0068 | -0.04 % |
| 33 | 10.8562 | 149.97 V | 1.285 mA | -56.58 ° | 13.82 V | 0.040 ° | 10.8518 | -0.04 % |

### Phase B

| Tap | Nom. ratio | V prim | I prim | I phase | V sec | V phase | TTR | Ratio dev |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.805 | 149.98 V | 335.000 µA | 6.29 ° | 9.49 V | 0.100 ° | 15.8077 | 0.02 % |
| 2 | 15.6503 | 149.97 V | 322.000 µA | -5.83 ° | 9.58 V | 0.090 ° | 15.6534 | 0.02 % |

Phase B

| Tap | Nom. ratio | V prim | I prim | I phase | V sec | V phase | TTR | Ratio dev |
|---|---|---|---|---|---|---|---|---|
| 3 | 15.4957 | 149.97 V | 324.000 µA | -4.28 ° | 9.68 V | 0.080 ° | 15.4985 | 0.02 % |
| 4 | 15.341 | 149.98 V | 334.000 µA | 0.71 ° | 9.78 V | 0.090 ° | 15.3429 | 0.01 % |
| 5 | 15.1864 | 149.97 V | 334.000 µA | -7.80 ° | 9.87 V | 0.070 ° | 15.1879 | 0.01 % |
| 6 | 15.0317 | 149.97 V | 347.000 µA | -4.71 ° | 9.98 V | 0.080 ° | 15.0319 | 0.00 % |
| 7 | 14.8771 | 149.97 V | 349.000 µA | -5.01 ° | 10.08 V | 0.070 ° | 14.8769 | 0.00 % |
| 8 | 14.7224 | 149.97 V | 333.000 µA | -3.34 ° | 10.19 V | 0.080 ° | 14.7223 | 0.00 % |
| 9 | 14.5678 | 149.97 V | 367.000 µA | -10.27 ° | 10.29 V | 0.080 ° | 14.5681 | 0.00 % |
| 10 | 14.4131 | 149.97 V | 356.000 µA | -8.07 ° | 10.41 V | 0.080 ° | 14.4124 | -0.01 % |
| 11 | 14.2585 | 149.98 V | 369.000 µA | -8.17 ° | 10.52 V | 0.070 ° | 14.2577 | -0.01 % |
| 12 | 14.1038 | 149.97 V | 363.000 µA | -7.48 ° | 10.64 V | 0.070 ° | 14.1015 | -0.02 % |
| 13 | 13.9492 | 149.97 V | 389.000 µA | -20.40 ° | 10.75 V | 0.090 ° | 13.9477 | -0.01 % |
| 14 | 13.7945 | 149.98 V | 392.000 µA | -13.02 ° | 10.87 V | 0.070 ° | 13.7922 | -0.02 % |
| 15 | 13.6399 | 149.97 V | 394.000 µA | -18.32 ° | 11.00 V | 0.060 ° | 13.6366 | -0.02 % |
| 16 | 13.4853 | 149.97 V | 419.000 µA | -24.57 ° | 11.12 V | 0.070 ° | 13.4829 | -0.02 % |
| 17 | 13.3306 | 149.97 V | 416.000 µA | -22.02 ° | 11.25 V | 0.060 ° | 13.327 | -0.03 % |
| 18 | 13.176 | 149.97 V | 413.000 µA | -16.06 ° | 11.39 V | 0.060 ° | 13.1711 | -0.04 % |
| 19 | 13.0213 | 149.97 V | 431.000 µA | -19.39 ° | 11.52 V | 0.060 ° | 13.0165 | -0.04 % |
| 20 | 12.8667 | 149.97 V | 466.000 µA | -29.39 ° | 11.66 V | 0.080 ° | 12.8628 | -0.03 % |
| 21 | 12.712 | 149.97 V | 437.000 µA | -21.63 ° | 11.80 V | 0.050 ° | 12.7067 | -0.04 % |
| 22 | 12.5574 | 149.97 V | 465.000 µA | -25.47 ° | 11.95 V | 0.050 ° | 12.552 | -0.04 % |
| 23 | 12.4027 | 149.97 V | 487.000 µA | -27.30 ° | 12.10 V | 0.070 ° | 12.3971 | -0.05 % |
| 24 | 12.2481 | 149.97 V | 497.000 µA | -27.39 ° | 12.25 V | 0.040 ° | 12.242 | -0.05 % |
| 25 | 12.0934 | 149.97 V | 501.000 µA | -29.74 ° | 12.41 V | 0.050 ° | 12.0873 | -0.05 % |
| 26 | 11.9388 | 149.97 V | 541.000 µA | -32.73 ° | 12.57 V | 0.060 ° | 11.9327 | -0.05 % |
| 27 | 11.7841 | 149.97 V | 529.000 µA | -30.83 ° | 12.73 V | 0.040 ° | 11.7771 | -0.06 % |
| 28 | 11.6295 | 149.97 V | 533.000 µA | -28.90 ° | 12.90 V | 0.050 ° | 11.6218 | -0.07 % |
| 29 | 11.4748 | 149.97 V | 545.000 µA | -30.35 ° | 13.08 V | 0.060 ° | 11.4668 | -0.07 % |
| 30 | 11.3202 | 149.97 V | 560.000 µA | -31.00 ° | 13.26 V | 0.050 ° | 11.3126 | -0.07 % |
| 31 | 11.1655 | 149.97 V | 573.000 µA | -32.68 ° | 13.44 V | 0.040 ° | 11.1573 | -0.07 % |
| 32 | 11.0109 | 149.97 V | 619.000 µA | -35.52 ° | 13.63 V | 0.020 ° | 11.0028 | -0.07 % |
| 33 | 10.8562 | 149.97 V | 607.000 µA | -33.51 ° | 13.83 V | 0.050 ° | 10.8471 | -0.08 % |

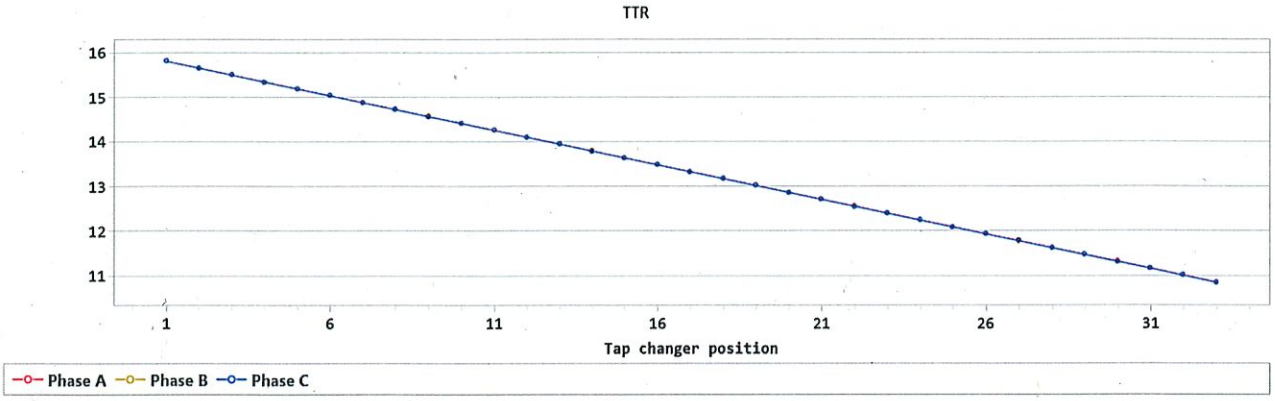
Phase C

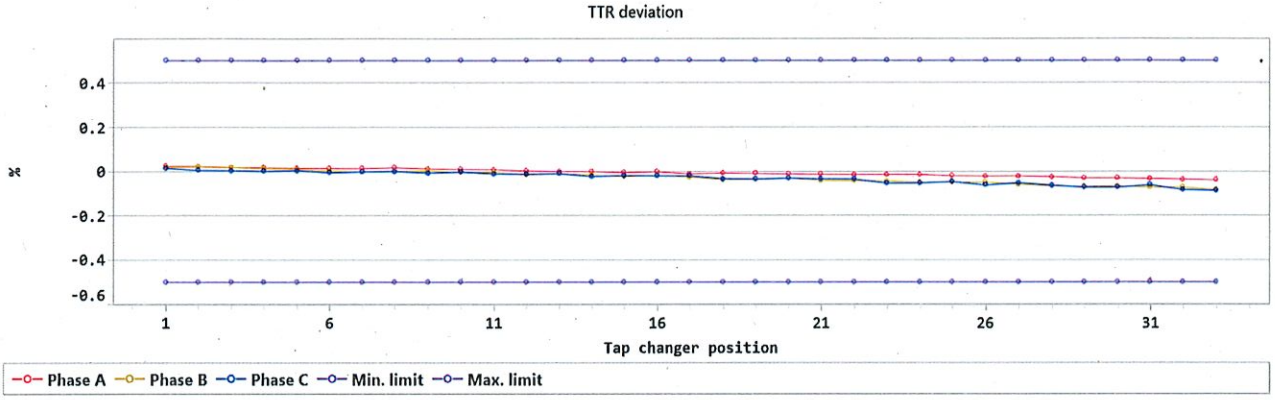
| Tap | Nom. ratio | V prim | I prim | I phase | V sec | V phase | TTR | Ratio dev |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.805 | 149.97 V | 326.000 µA | 5.74 ° | 9.49 V | 0.110 ° | 15.8072 | 0.01 % |
| 2 | 15.6503 | 149.96 V | 340.000 µA | 5.37 ° | 9.58 V | 0.110 ° | 15.651 | 0.00 % |
| 3 | 15.4957 | 149.97 V | 335.000 µA | 7.30 ° | 9.68 V | 0.110 ° | 15.4963 | 0.00 % |

Phase C

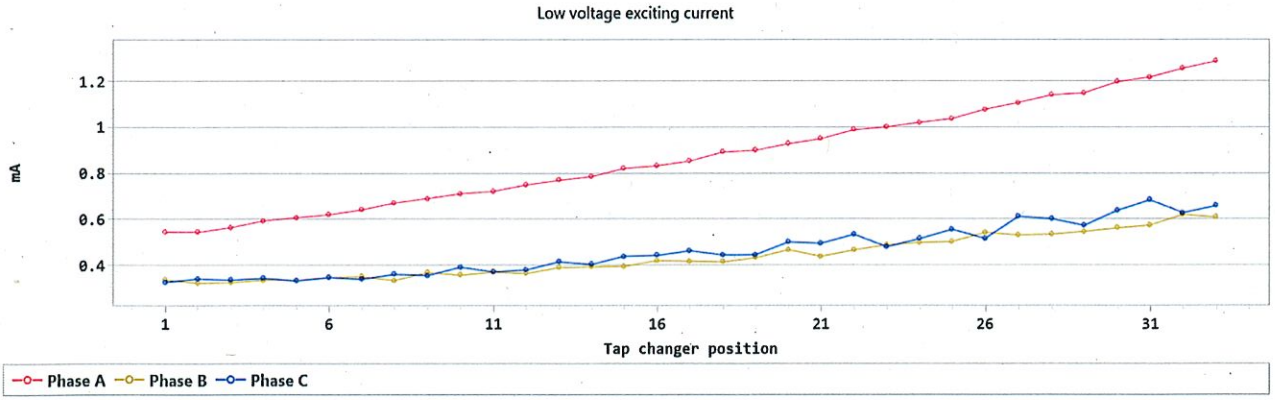
| Tap | Nom. ratio | V prim | I prim | I phase | V sec | V phase | TTR | Ratio dev |
|---|---|---|---|---|---|---|---|---|
| 4 | 15.341 | 149.97 V | 342.000 µA | 4.47 ° | 9.78 V | 0.120 ° | 15.3411 | 0.00 % |
| 5 | 15.1864 | 149.97 V | 332.000 µA | -2.65 ° | 9.87 V | 0.110 ° | 15.187 | 0.00 % |
| 6 | 15.0317 | 149.97 V | 346.000 µA | 1.92 ° | 9.98 V | 0.120 ° | 15.0308 | -0.01 % |
| 7 | 14.8771 | 149.97 V | 339.000 µA | -6.72 ° | 10.08 V | 0.090 ° | 14.8768 | 0.00 % |
| 8 | 14.7224 | 149.97 V | 360.000 µA | -10.95 ° | 10.19 V | 0.090 ° | 14.7224 | 0.00 % |
| 9 | 14.5678 | 149.97 V | 355.000 µA | -5.82 ° | 10.30 V | 0.090 ° | 14.5667 | -0.01 % |
| 10 | 14.4131 | 149.97 V | 391.000 µA | -15.44 ° | 10.41 V | 0.110 ° | 14.4127 | 0.00 % |
| 11 | 14.2585 | 149.97 V | 370.000 µA | -11.71 ° | 10.52 V | 0.100 ° | 14.2569 | -0.01 % |
| 12 | 14.1038 | 149.97 V | 379.000 µA | -14.52 ° | 10.63 V | 0.100 ° | 14.1021 | -0.01 % |
| 13 | 13.9492 | 149.97 V | 414.000 µA | -25.19 ° | 10.75 V | 0.120 ° | 13.9477 | -0.01 % |
| 14 | 13.7945 | 149.98 V | 403.000 µA | -14.96 ° | 10.87 V | 0.100 ° | 13.7913 | -0.02 % |
| 15 | 13.6399 | 149.97 V | 438.000 µA | -27.52 ° | 11.00 V | 0.090 ° | 13.6373 | -0.02 % |
| 16 | 13.4853 | 149.97 V | 442.000 µA | -28.02 ° | 11.12 V | 0.080 ° | 13.4825 | -0.02 % |
| 17 | 13.3306 | 149.97 V | 462.000 µA | -29.55 ° | 11.25 V | 0.100 ° | 13.3278 | -0.02 % |
| 18 | 13.176 | 149.97 V | 444.000 µA | -23.91 ° | 11.39 V | 0.080 ° | 13.1716 | -0.03 % |
| 19 | 13.0213 | 149.97 V | 445.000 µA | -25.34 ° | 11.52 V | 0.080 ° | 13.0167 | -0.04 % |
| 20 | 12.8667 | 149.97 V | 500.000 µA | -34.05 ° | 11.66 V | 0.080 ° | 12.8627 | -0.03 % |
| 21 | 12.712 | 149.97 V | 494.000 µA | -32.02 ° | 11.80 V | 0.070 ° | 12.7076 | -0.03 % |
| 22 | 12.5574 | 149.97 V | 533.000 µA | -35.82 ° | 11.95 V | 0.090 ° | 12.5529 | -0.04 % |
| 23 | 12.4027 | 149.97 V | 479.000 µA | -24.56 ° | 12.10 V | 0.080 ° | 12.396 | -0.05 % |
| 24 | 12.2481 | 149.97 V | 514.000 µA | -28.41 ° | 12.25 V | 0.060 ° | 12.2416 | -0.05 % |
| 25 | 12.0934 | 149.97 V | 555.000 µA | -36.17 ° | 12.41 V | 0.070 ° | 12.0877 | -0.05 % |
| 26 | 11.9388 | 149.97 V | 515.000 µA | -28.69 ° | 12.57 V | 0.080 ° | 11.9313 | -0.06 % |
| 27 | 11.7841 | 149.97 V | 611.000 µA | -40.17 ° | 12.73 V | 0.070 ° | 11.7779 | -0.05 % |
| 28 | 11.6295 | 149.97 V | 601.000 µA | -36.05 ° | 12.90 V | 0.060 ° | 11.6221 | -0.06 % |
| 29 | 11.4748 | 149.97 V | 572.000 µA | -33.60 ° | 13.08 V | 0.060 ° | 11.4665 | -0.07 % |
| 30 | 11.3202 | 149.97 V | 637.000 µA | -38.48 ° | 13.26 V | 0.070 ° | 11.312 | -0.07 % |
| 31 | 11.1655 | 149.98 V | 683.000 µA | -43.41 ° | 13.44 V | 0.050 ° | 11.1585 | -0.06 % |
| 32 | 11.0109 | 149.97 V | 627.000 µA | -35.89 ° | 13.63 V | 0.070 ° | 11.0017 | -0.08 % |
| 33 | 10.8562 | 149.97 V | 657.000 µA | -37.88 ° | 13.83 V | 0.050 ° | 10.8467 | -0.09 % |

## Graphs for standard test




## Graphs for low voltage exciting current



## DC Winding Resistance X

| | | | |
|---|---|---|---|
| Test current | 3.0 A | Use CP SB1 | Yes |
| Winding temperature | 20 °C | Mode | Auto switching of phases |

| | |
|---|---|
| Type of tap changer | None |

Comments

### Standard test

| | Phase A | | | Phase B | | | Phase C | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Tap | R meas | R dev | R corr | R meas | R dev | R corr | R meas | R dev | R corr | Assessment |
| | 11.756 mΩ | 0.071 % | 11.756 mΩ | 11.678 mΩ | 0.086 % | 11.678 mΩ | 11.638 mΩ | 0.072 % | 11.638 mΩ | Pass |

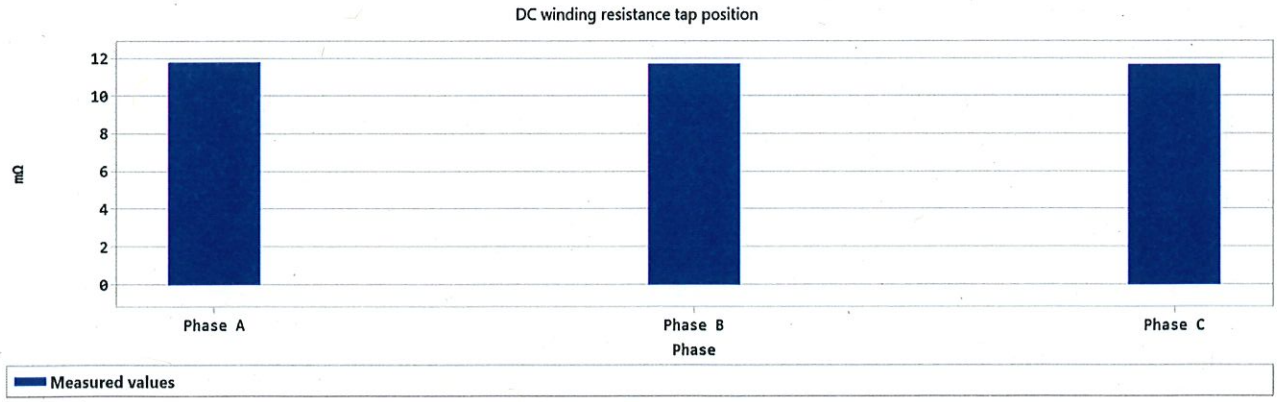
### Per-phase

| Phase A | | | | | | |
|---|---|---|---|---|---|---|
| Tap | I DC | V DC | Time | R meas | R dev | R corr |
| | 3.00 A | 35.27 mV | 34 s | 11.756 mΩ | 0.071 % | 11.756 mΩ |

| Phase B | | | | | | |
|---|---|---|---|---|---|---|
| Tap | I DC | V DC | Time | R meas | R dev | R corr |
| | 3.00 A | 35.04 mV | 43 s | 11.678 mΩ | 0.086 % | 11.678 mΩ |

| Phase C | | | | | | |
|---|---|---|---|---|---|---|
| Tap | I DC | V DC | Time | R meas | R dev | R corr |
| | 3.00 A | 34.92 mV | 43 s | 11.638 mΩ | 0.072 % | 11.638 mΩ |

### Graphs for standard test



## Surge Arrester Watt Losses H

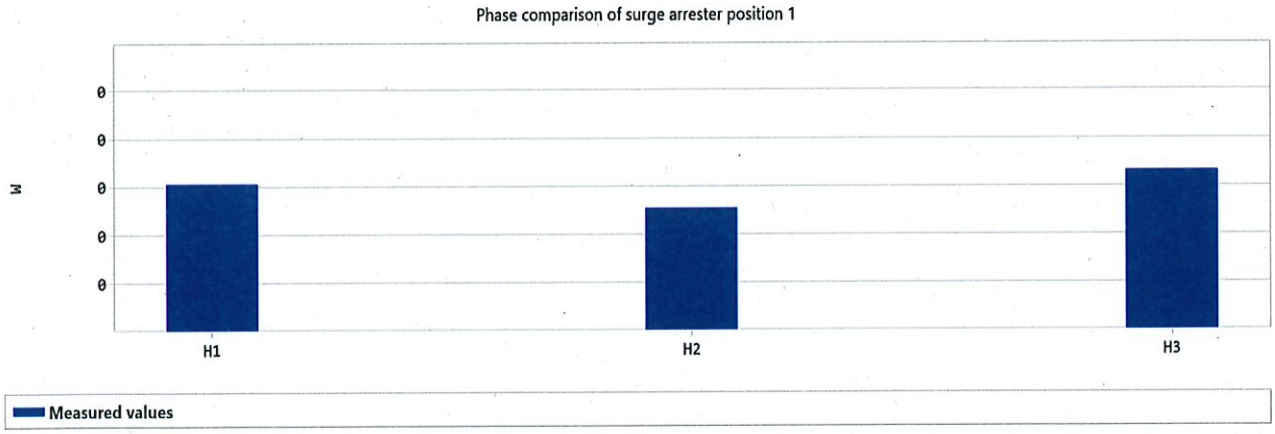
| | | | |
|---|---|---|---|
| Ambient temperature | 21 °C | Weather | Clear |
| Top oil temperature | 21 °C | Humidity | 64 % |

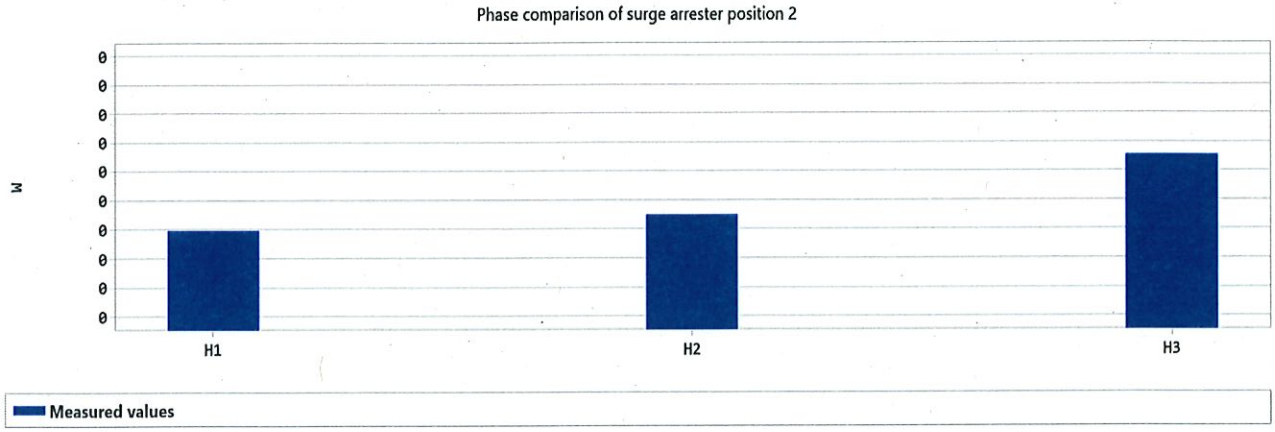
Comments

## Standard test

| Meas. | Position | Test mode | Freq. | V out | I out | Watt losses | Assessment |
|---|---|---|---|---|---|---|---|
| H1 | 1 | UST-A | 60.00 Hz | 1.01 kV | 0.02 mA | 0.65 mW | Not ass. |
| H1 | 2 | GSTg-A | 60.00 Hz | 1.01 kV | 0.04 mA | 1.69 mW | Not ass. |
| H2 | 1 | UST-A | 60.00 Hz | 1.01 kV | 0.02 mA | 0.63 mW | Not ass. |
| H2 | 2 | GSTg-A | 60.00 Hz | 1.01 kV | 0.04 mA | 1.75 mW | Not ass. |
| H3 | 1 | UST-A | 60.00 Hz | 1.01 kV | 0.02 mA | 0.67 mW | Not ass. |
| H3 | 2 | GSTg-A | 60.00 Hz | 1.00 kV | 0.04 mA | 1.95 mW | Not ass. |

## Graphs for standard test




Phase comparison of surge arrester position 2
W
0
0
0
0
0
0
0
0
0
0
H1
H2
H3
Measured values

## Surge Arrester Watt Losses X

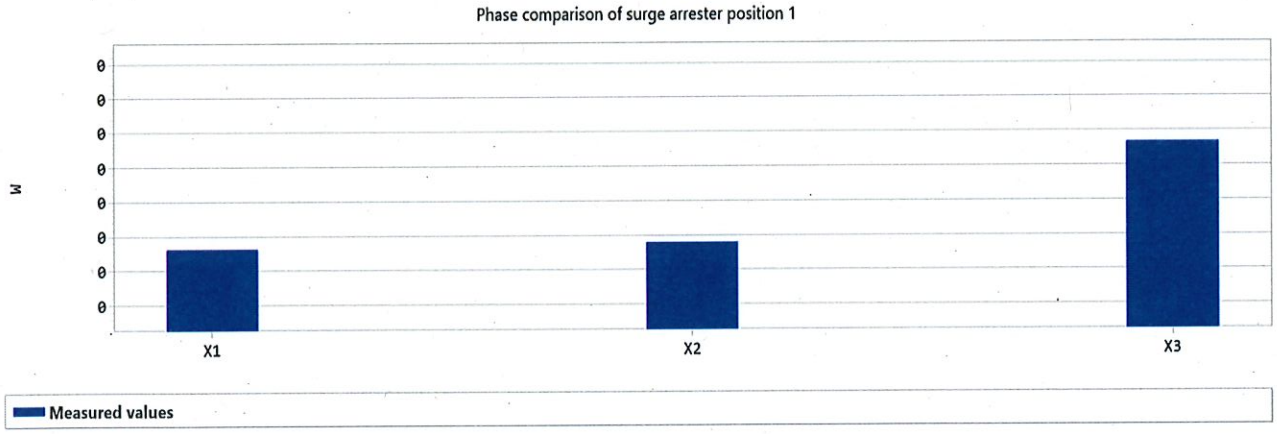
| | | | |
|---|---|---|---|
| Ambient temperature | 21 °C | Weather | Rain |
| Top oil temperature | 21 °C | Humidity | 64 % |

Comments

## Standard test

| Meas. | Position | Test mode | Freq. | V out | I out | Watt losses | Assessment |
|---|---|---|---|---|---|---|---|
| X1 | 1 | GST | 60.00 Hz | 1.00 kV | 0.05 mA | 2.32 mW | Not ass. |
| X2 | 1 | GST | 60.00 Hz | 1.01 kV | 0.05 mA | 2.36 mW | Not ass. |
| X3 | 1 | GST | 60.00 Hz | 1.01 kV | 0.05 mA | 2.93 mW | Not ass. |

## Graphs for standard test

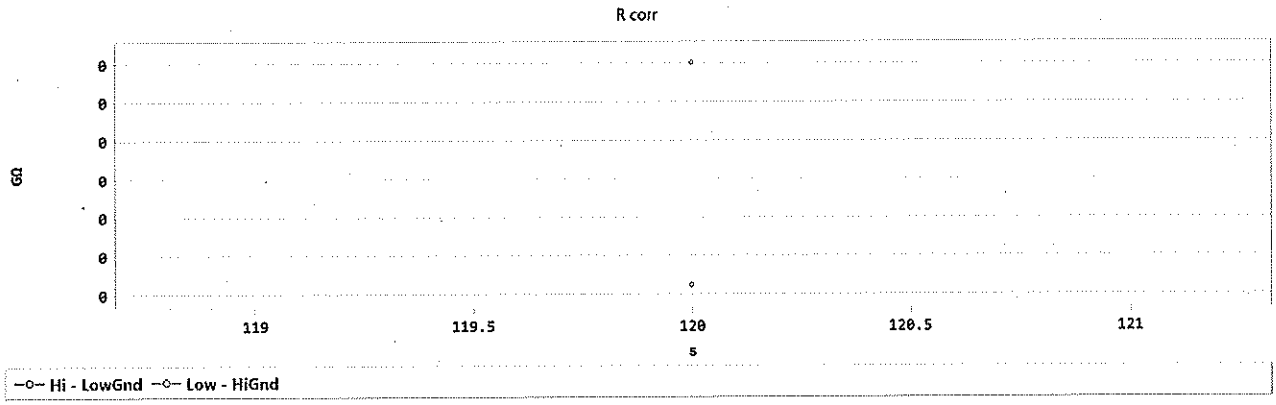


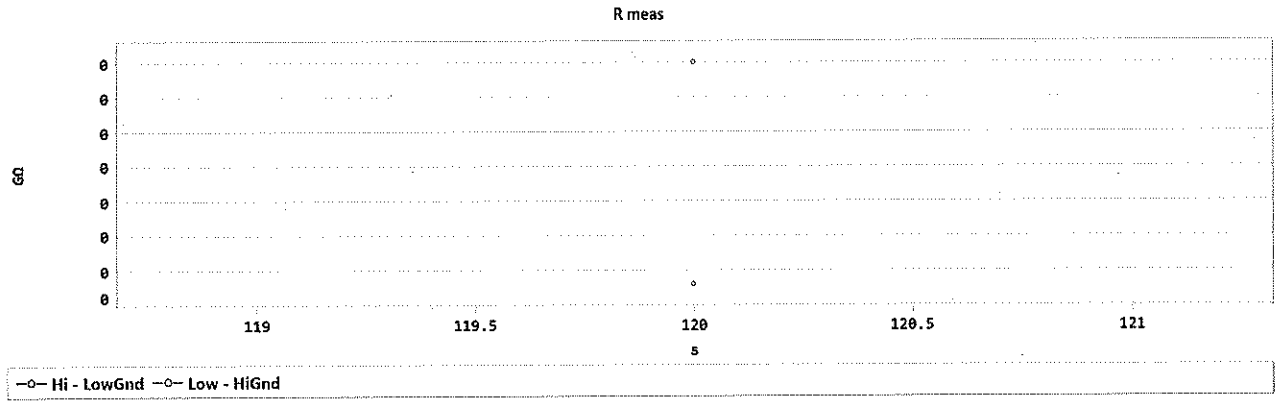
## Insulation Resistance

Comment

| | |
|---|---|
| Test object temperature | 18 °C |
| Reference temperature | 20 °C |
| Correction Temperature | 0.90 |

| | |
|---|---|
| Ambient temperature | 20 °C |
| Humidity | 55 % |



| Name | Hi - LowGnd |
|---|---|

| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | 9.180 kΩ | 8.262 kΩ | 10.00 kV | 1.089 A |

| Name | Low - HiGnd |
|---|---|

| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | 9.500 kΩ | 8.550 kΩ | 10.00 kV | 1.053 A |

| Name | Core to Gnd |
|---|---|

| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | Ω | Ω | 10.00 kV | A |

| Name | Clamp - Gnd |
|---|---|

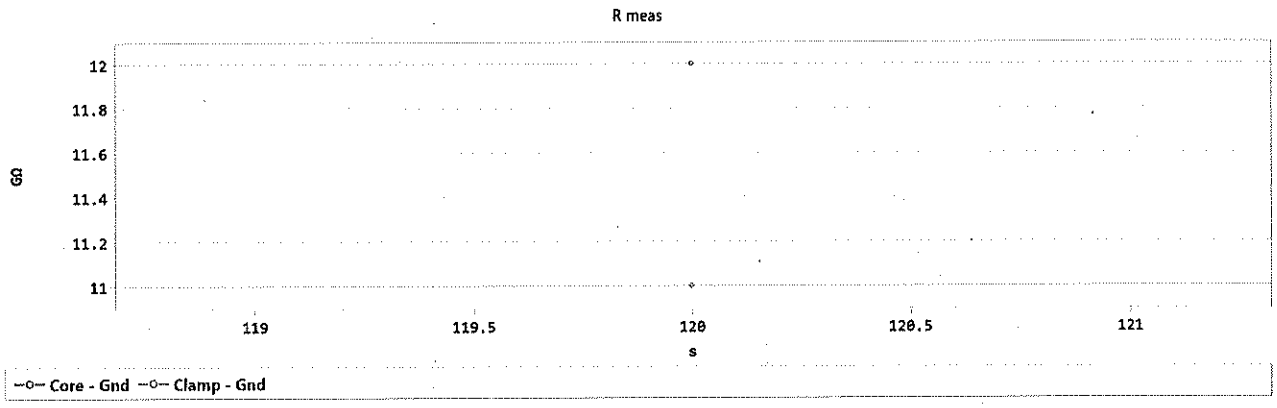
| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | Ω | Ω | 10.00 kV | A |

## Insulation Resistance

Comment

| | |
|---|---|
| Test object temperature | 21 °C |
| Reference temperature | 20 °C |

| | |
|---|---|
| Ambient temperature | 20 °C |
| Humidity | 55 % |



| Name | Core - Gnd |
|---|---|

| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | 12.000 GΩ | 12.000 GΩ | 10.00 kV | 833.333 nA |

| Name | Clamp - Gnd |
|---|---|

| Time | R meas | R corr | V DC | I DC |
|---|---|---|---|---|
| 120 s | 11.000 GΩ | 11.000 GΩ | 10.00 kV | 909.091 nA |

## Inspection test (21/21)

Comment

PRD 2 alarm found defective. Extensive water damage found in PRD2 junction box. Repairs made and circuit verified. Extensive water damaged found in junction box mounted to conservator frame from level gauge. Repairs made and circuit verified. Winding temp 115°C alarm microswitch defective. To be replaced. Oil temp 100°C alarm microswitch defective. To be replaced. Adjusted variable rheostats in winding heater circuit to bring back to spec. Replaced flanges on calisto main tank plumbing connections with proper flanges and o-rings. Calisto pushbuttons not working; cannot operate from hmi. To be investigated. MFB bottle screen fillup up with fine white silica dust; repaired.

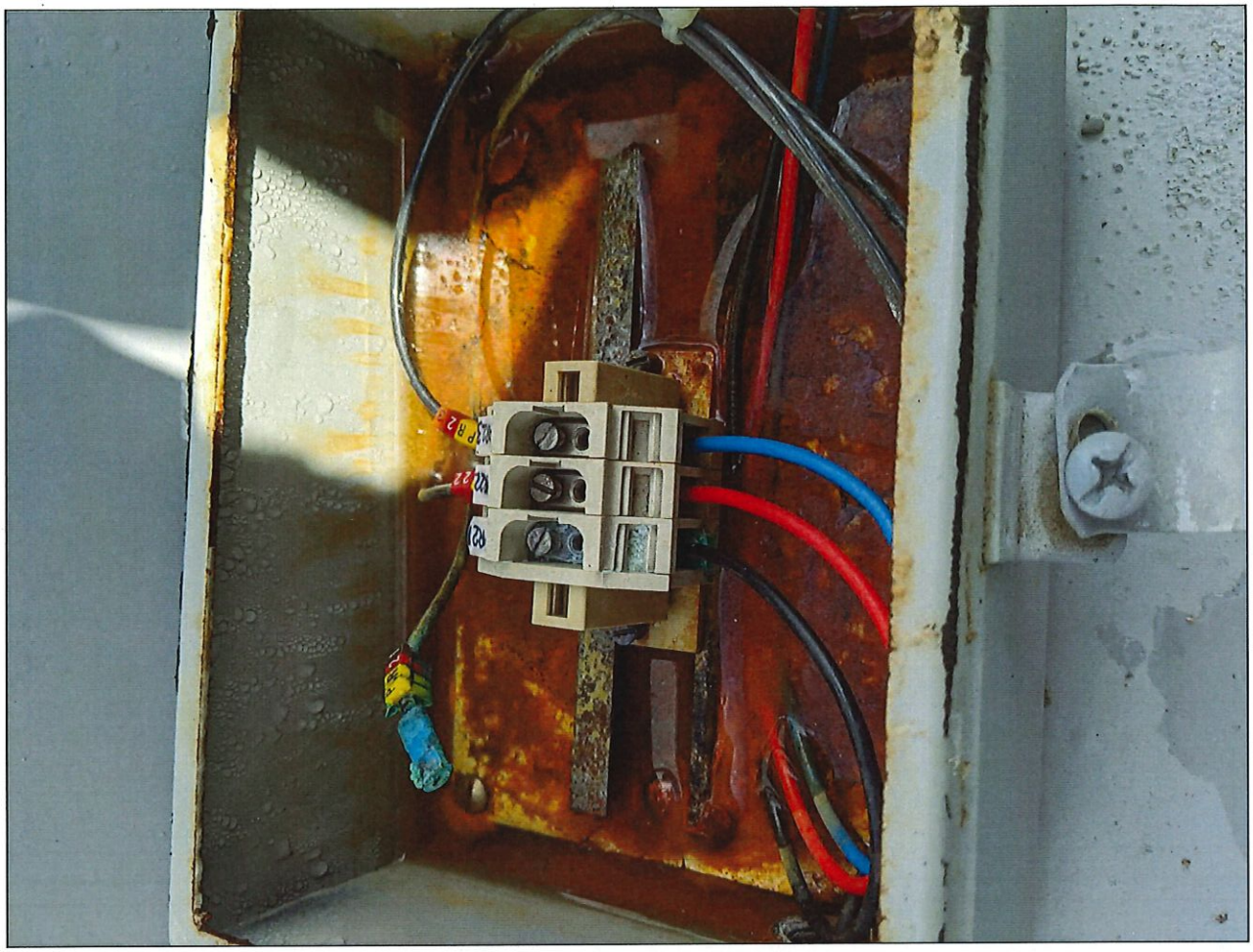
### Visual Inspection (8/8)

| | |
|---|---|
| Paint Condition | Good |
| Oil Leaks | Good |
| Bushings | Good |
| Arrestors | Good |
| Maintenance Free Breather | Good |
| Main and TC Cabinets | Good |
| Plumbing Valves | Pass |
| Connections | Pass |

### Operation (13/13)

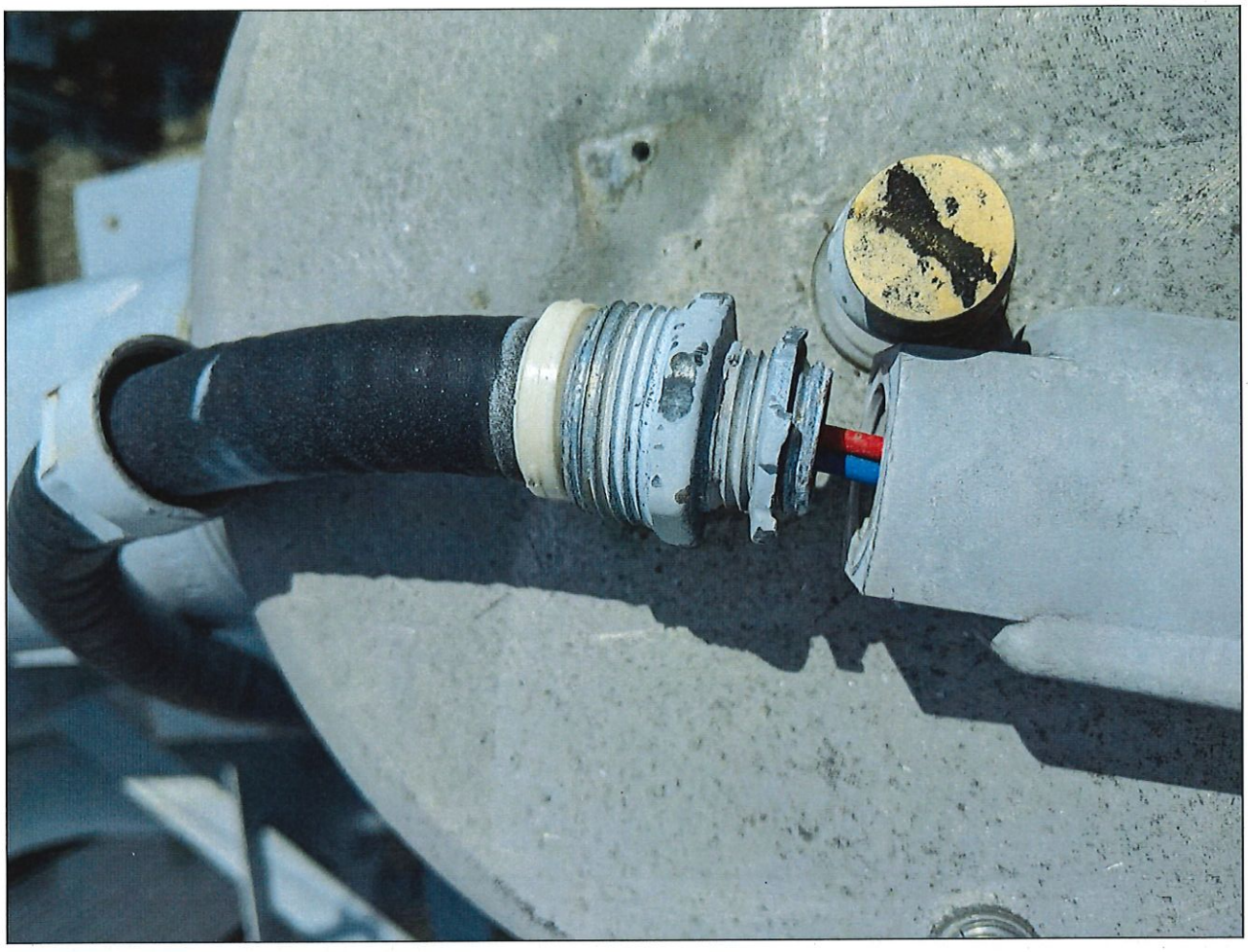
| | |
|---|---|
| Tapchanger Operation | Pass |
| Fan and Pump Manual Operation | Pass |
| Oil Temperature Guage Operation | Investigate |
| WInding Temperature Guage Operation | Investigate |
| Winding Temperature Heater Circuit Operation | Investigate |
| RTD's | Pass |
| Main Conservator Oil Level Guage Operation | Pass |
| TC Conservator Oil Level Guage Operation | Pass |
| Main Tank Gas Relay Operation | Pass |
| TC Sudden Pressure Relay | Pass |
| Breather Operation | Pass |
| Pressure Relief Device Operation | Fail |
| Calisto DGA Operation | Investigate |

PRD2 JB.jpg



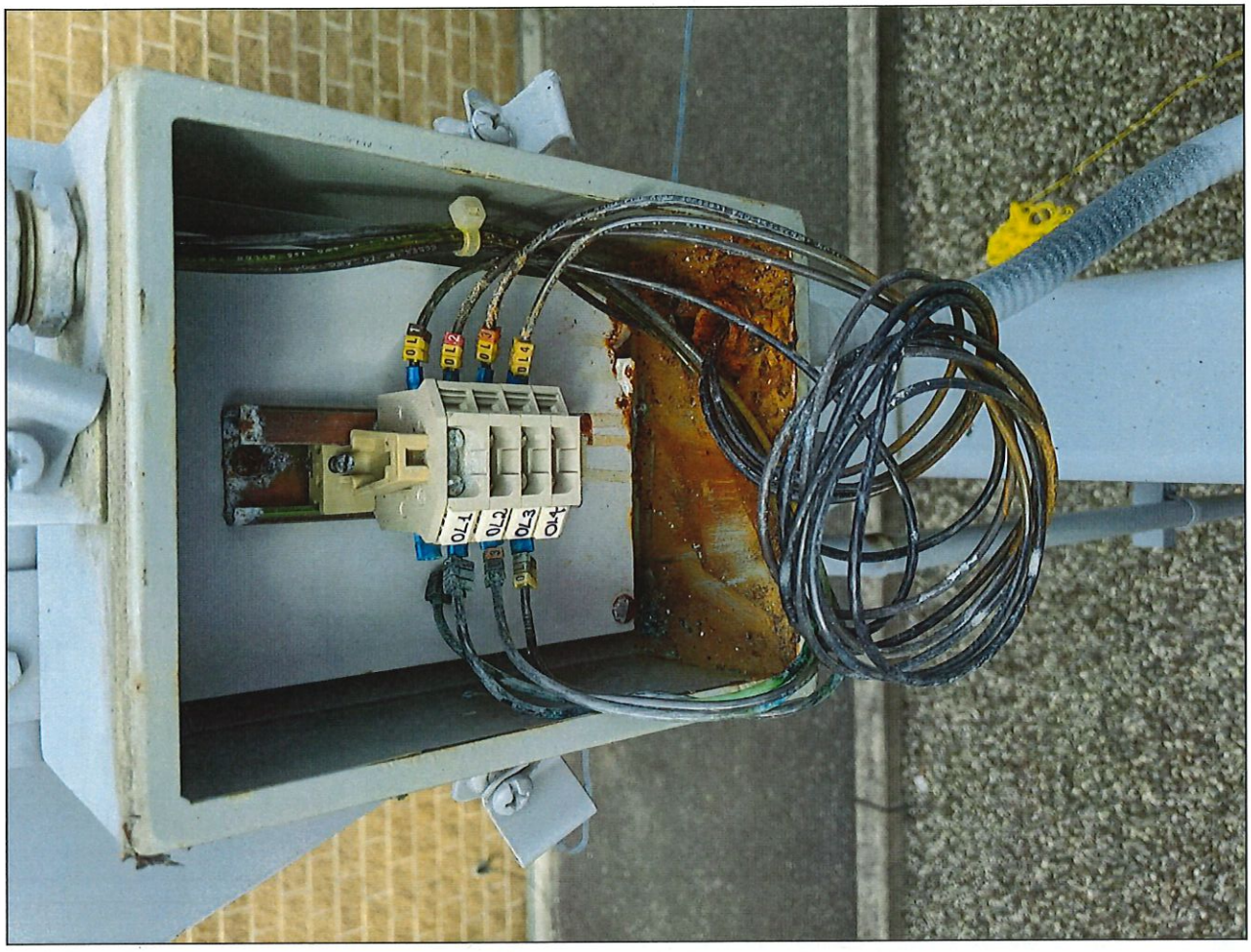
| Description |
| --- |
| |

PRD2 Microswitch Housing.jpg



Description

Oil Level Guage JB.jpg




Description

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723536 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | BG |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-02 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 T1 (TIM) | MVA: | 40 | Oil Temp. (°C): | 20 |
| Equipment No: | 97001544 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 97001544 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TX | | | | |

## DGA

| 2018-06-21 | 2019-03-14 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|
| *16* | **< 10** | Hydrogen | | D3612-17 |
| *< 2* | **< 1** | Acetylene | | ppm (V/V) |
| *4* | **3** | Ethane | | at 273 K |
| *24* | **25** | Ethylene | | and 760 Torr |
| *11* | **9** | Methane | | |
| *238* | **240** | Carbon Monoxide | | |
| *1225* | **1158** | Carbon Dioxide | | |
| *71840* | **86575** | Nitrogen | | |
| *28016* | **38966** | Oxygen | | |
| *293* | **285** | TDCG (ppm) | | |
| *10.14* | **12.7** | Total Dissolved Gas (%) | | |

## OIL QUALITY

| | Previous | 2019-03-14 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|---|
| | | | Moisture in Oil (ppm) | | WI017-00 |
| 2018-06-21 | *7* | **3** | Moisture in Oil (ppm) | | D 1533-12 |
| 2018-06-21 | *40.1* | **43.4** | Interfacial Tension (mN/m) | | D 971-12 |
| 2018-06-21 | *< 0.01* | **< 0.01** | Acid Number (mg KOH/g) | | D 974-14e2 |
| 2018-06-21 | *<0.5* | **<0.5** | Color Number | | D1500-12 |
| 2018-06-21 | *Pass* | **Pass** | Visual Examination | | D 1524-15 |
| 2018-06-21 | *49* | **53** | Dielectric Breakdown (kV) | | D 877-13 |
| | | | Dielectric Breakdown 2 mm (kV) | | D 1816-12 |
| 2018-06-21 | *0.016* | **0.018** | Power Factor @ 25 °C (%) | | D 924-15 |
| | | | Power Factor @ 100 °C (%) | | D 924-15 |
| 2018-06-21 | *0.8795* | **0.8803** | Specific Gravity | | D 1298-12b |
| | | | Oxidation Inhibitor DBP (wt. %) | | D 4768-11 |
| | | | Oxidation Inhibitor DBPC (wt. %) | | D 4768-11 |
| | | | PCB - Total Arochlor Content (ppm) | | D 4059-2018 |
| | | | Corrosive Sulphur Copper | | D 1275-15 |
| | | | 5-hydroxymethyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | furfuryl alcohol (ppb) | | D 5837-15 |
| | | | 2-furaldehyde (ppb) | | D 5837-15 |
| | | | 2-acetylfuran (ppb) | | D 5837-15 |
| | | | 5-methyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | Methanol (ppb) | | |
| | | | Ethanol (ppb) | | |

COMMENTS:

**** Morgan Schaffer is an ISO/IEC 17025 accredited laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

# OIL ANALYSIS REPORT

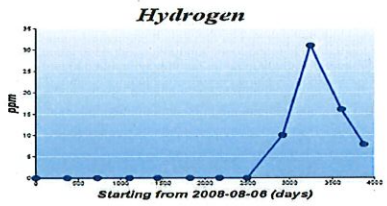
## REFERENCE

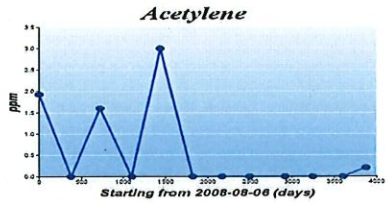
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723536 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | BQ |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-02 |

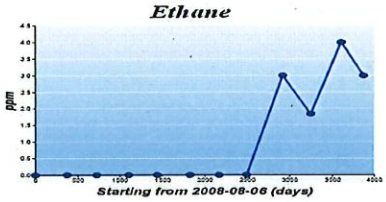
## EQUIPMENT

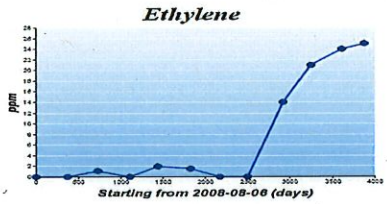
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 T1 (TIM) | MVA: | 40 | Oil Temp. (°C): | 20 |
| Equipment No: | 97001544 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 97001544 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TX | | | | |

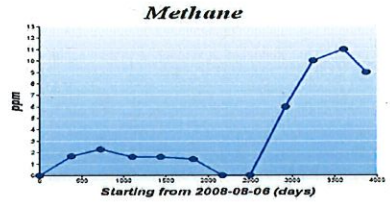
## TRENDING

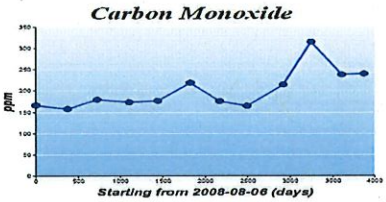


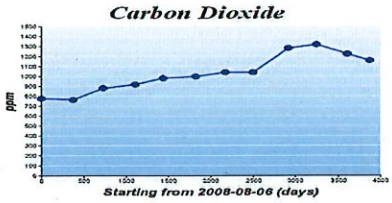



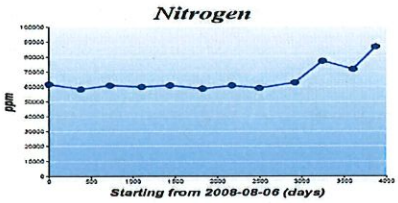



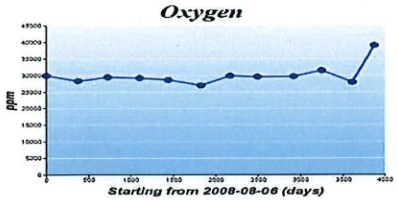



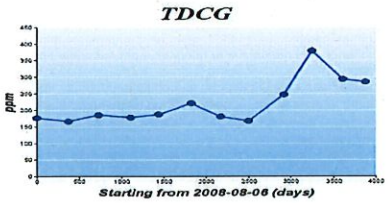



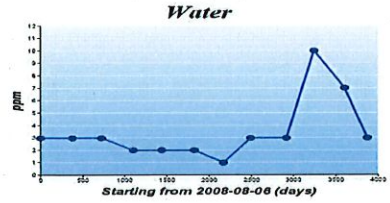




**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

# OIL ANALYSIS REPORT

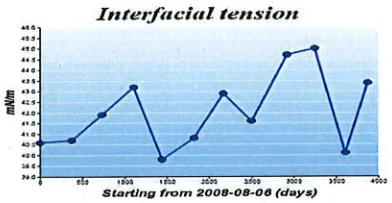
## REFERENCE

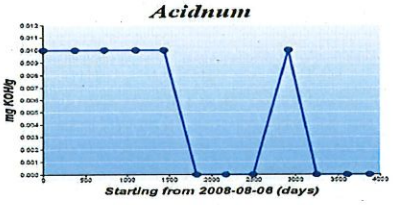
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723536 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | BQ |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-02 |

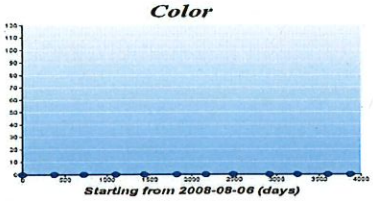
## EQUIPMENT

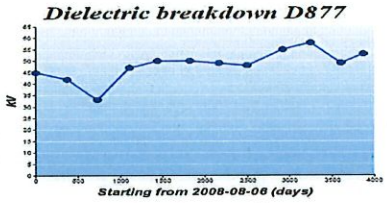
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 T1 (TIM) | MVA: | 40 | Oil Temp. (°C): | 20 |
| Equipment No: | 97001544 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 97001544 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TX | | | | |

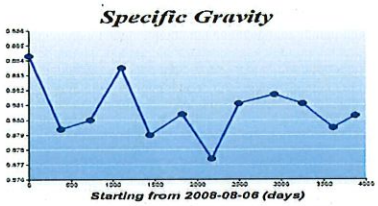
## TRENDING

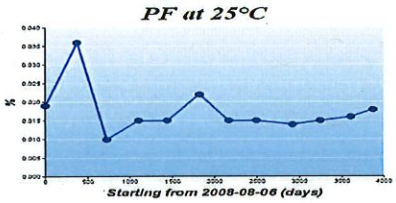



**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

# *OIL ANALYSIS REPORT*

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723536 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | BQ |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-02 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 T1 (TIM) | MVA: | 40 | Oil Temp. (°C): | 20 |
| Equipment No: | 97001544 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 97001544 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TX | | | | |

## GAS THRESHOLDS

| Gas | Input | DORNENBURG & STRITTMATTER | U.S. BUREAU OF RECLAMATION |
|---|---|---|---|
| Hydrogen($H_2$) | 7.7471598 | - | - |
| Carbon Monoxide(CO) | 240 | - | - |
| Methane($CH_4$) | 9 | - | - |
| Carbon Dioxide($CO_2$) | 1158 | - | - |
| Ethylene($C_2H_4$) | 25 | - | - |
| Ethane($C_2H_6$) | 3 | - | - |
| Acetylene($C_2H_2$) | 0.2046562 | - | - |

+ above the limit - below the limit

## RATIOS INDICATORS

| Ratio | Value | Indication |
|---|---|---|
| $C_2H_2/H_2$ | N/A | NOT CALCULATED |
| $H_2/C_2H_6$ | N/A | NOT CALCULATED |
| $C_2H_2/CH_4$ | N/A | NOT CALCULATED |
| $CO_2/CO$ | N/A | NOT CALCULATED |
| $C_2H_6/C_2H_2$ | N/A | NOT CALCULATED |
| $CH_4/H_2$ | N/A | NOT CALCULATED |
| $C_2H_4/C_2H_2$ | N/A | NOT CALCULATED |

## DUVAL TRIANGLE DIAGNOSTIC

**Duval triangle not available, DORNENBURG & STRITTMATTER positive ranges**

**** Morgan Schaffer is an ISO/IEC 17025 accredited laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

# OIL ANALYSIS REPORT

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723532 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | LTC | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 TC1 (TIM) | MVA: | 40 | Oil Temp. (°C): | |
| Equipment No: | 580799 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 580799 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TC | | | | |

## DGA

| 2018-06-21 | 2019-03-14 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|
| *11211* | **7653** | Hydrogen | | D3612-17 |
| *12346* | **10829** | Acetylene | | ppm (V/V) |
| *102* | **53** | Ethane | | at 273 K |
| *1496* | **1306** | Ethylene | | and 760 Torr |
| *850* | **617** | Methane | | |
| *302* | **217** | Carbon Monoxide | | |
| *1555* | **1353** | Carbon Dioxide | | |
| *54123* | **53053** | Nitrogen | | |
| *17235* | **21854** | Oxygen | | |
| *26307* | **20675** | TDCG (ppm) | | |
| *9.92* | **9.8** | Total Dissolved Gas (%) | | |

## OIL QUALITY

| | Previous | 2019-03-14 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|---|
| 2018-06-21 | *28* | | Moisture in Oil (ppm) | | WI017-00 |
| | | **11** | Moisture in Oil (ppm) | | D 1533-12 |
| 2018-06-21 | *28.9* | **30.1** | Interfacial Tension (mN/m) | | D 971-12 |
| 2018-06-21 | *0.01* | **0.01** | Acid Number (mg KOH/g) | | D 974-14e2 |
| 2018-06-21 | *3.0* | **<3.5** | Color Number | | D1500-12 |
| 2018-06-21 | *Fail* | **Pass** | Visual Examination | | D 1524-15 |
| 2018-06-21 | *51* | **53** | Dielectric Breakdown (kV) | | D 877-13 |
| | | | Dielectric Breakdown 2 mm (kV) | | D 1816-12 |
| 2018-06-21 | *0.390* | **0.281** | Power Factor @ 25 °C (%) | | D 924-15 |
| | | | Power Factor @ 100 °C (%) | | D 924-15 |
| 2018-06-21 | *0.8763* | **0.8758** | Specific Gravity | | D 1298-12b |
| | | | Oxidation Inhibitor DBP (wt. %) | | D 4768-11 |
| | | | Oxidation Inhibitor DBPC (wt. %) | | D 4768-11 |
| | | | PCB - Total Arochlor Content (ppm) | | D 4059-2018 |
| | | | Corrosive Sulphur Copper | | D 1275-15 |
| | | | 5-hydroxymethyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | furfuryl alcohol (ppb) | | D 5837-15 |
| | | | 2-furaldehyde (ppb) | | D 5837-15 |
| | | | 2-acetylfuran (ppb) | | D 5837-15 |
| | | | 5-methyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | Methanol (ppb) | | |
| | | | Ethanol (ppb) | | |

COMMENTS:

****** Morgan Schaffer is an ISO/IEC 17025 accredited laboratory ******

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

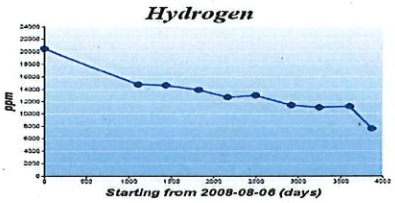
## REFERENCE

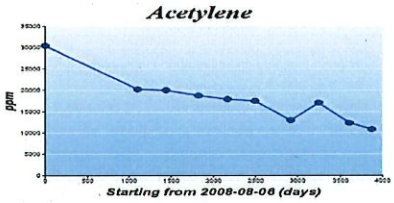
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723532 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

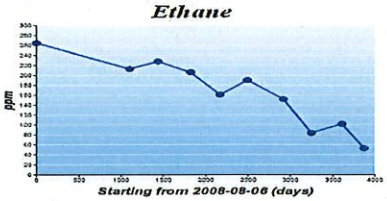
## EQUIPMENT

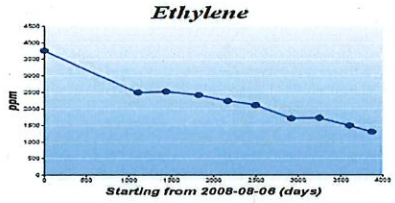
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | LTC | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 TC1 (TIM) | MVA: | 40 | Oil Temp. (°C): | |
| Equipment No: | 580799 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 580799 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TC | | | | |

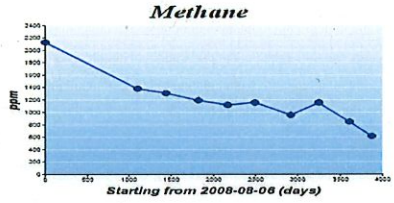
## TRENDING

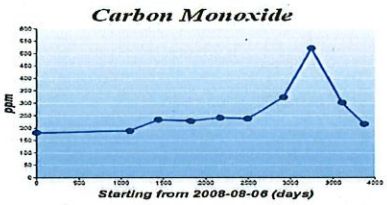


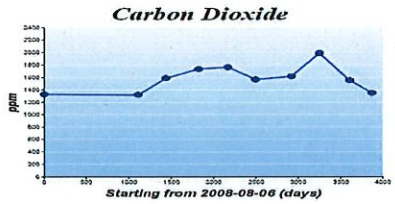



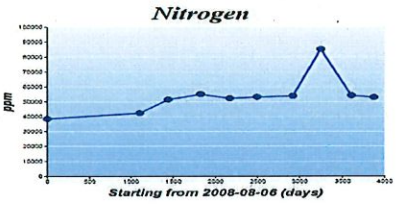



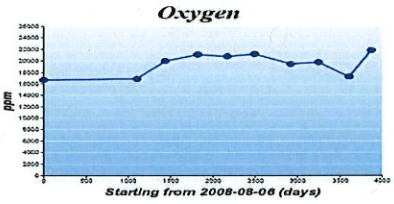



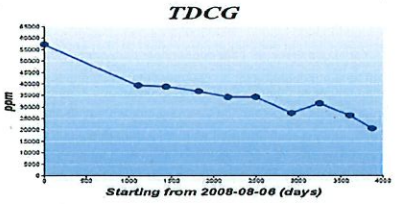



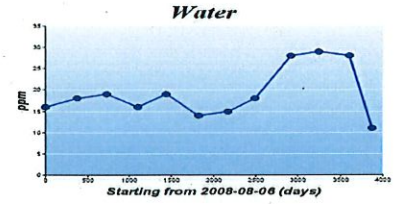




**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

# OIL ANALYSIS REPORT

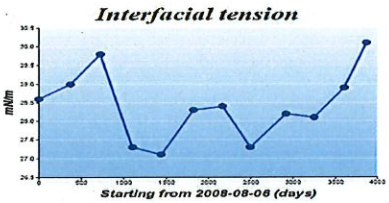
## REFERENCE

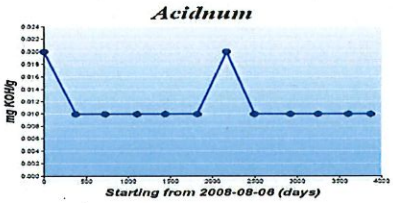
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723532 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

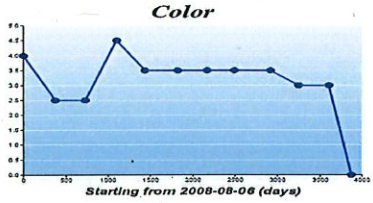
## EQUIPMENT

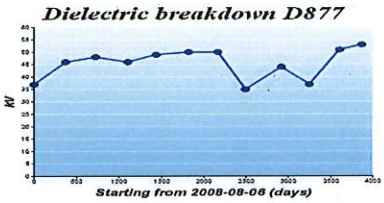
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | LTC | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 TC1 (TIM) | MVA: | 40 | Oil Temp. (°C): | |
| Equipment No: | 580799 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 580799 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TC | | | | |

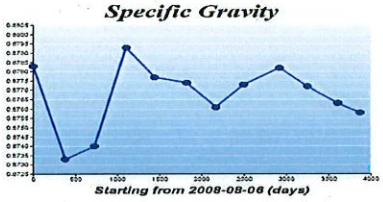
## TRENDING

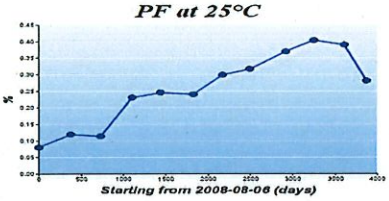



**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

# OIL ANALYSIS REPORT

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723532 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | LTC | KV: | 230 | Sampling Point: | MAIN |
| Location: | TS3 TC1 (TIM) | MVA: | 40 | Oil Temp. (°C): | |
| Equipment No: | 580799 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 580799 | Year built: | 2000 | Sampling Date: | 2019-03-14 07:15 |
| Additional info: | | | | | |
| Description: | TC | | | | |

## GAS THRESHOLDS

## RATIOS INDICATORS

## DUVAL TRIANGLE DIAGNOSTIC

**Duval triangle not available, DGA tests not requested**

**** Morgan Schaffer is an ISO/IEC 17025 accredited laboratory ****

# Transformer Station:

# Sample Switchgear Test Record

REV Jan 15

**LOCATION- HS H Bus switchgear**

DATE- Jan 29 - 17
BY- MG / TT
VOLTAGE RATING = 15KV

TEMPERATURE= 22

HUMIDITY- 40%

**DUCTOR TEST of main bus**
Tested at 100 amps Jan 27 - 17 , MG TT

| | uOhms | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| JH Cell (see below | T4H | HS 15 | HS 16 | HS 17 | HS 18 | JH | Bus Pots | Arrester Cable |
| Red | 63 | 88 | 82 | 75 | 68 | 31 | 213 | 150 |
| White | 87 | 81 | 76 | 69 | 62 | 30 | 176 | 167 |
| Blue | 85 | 82 | 69 | 62 | 55 | 29 | 172 | 138 |

from JH back of cell grounding studs to bus stabs behind shutters

**MEGGER TEST** Jan 29 - 17, TT
CORRECTION FACTOR- 1
TEST VOLTAGE= 10 KV

PT FUSES OPENED
REMOVED SURGE PROTECTION
Test point JH back of cell connected to grounding studs

MIN ACCEPTABLE READING = 130 MEGS

TEMPERATURE 20 °C

TEMPERATURE CORRECTION FACTOR TO 20 °C, TCF 1.00 ← ENTER TCF

*Display Every 0.1 Minutes or 0.1 % IR Change or 10 Delta uAmps*

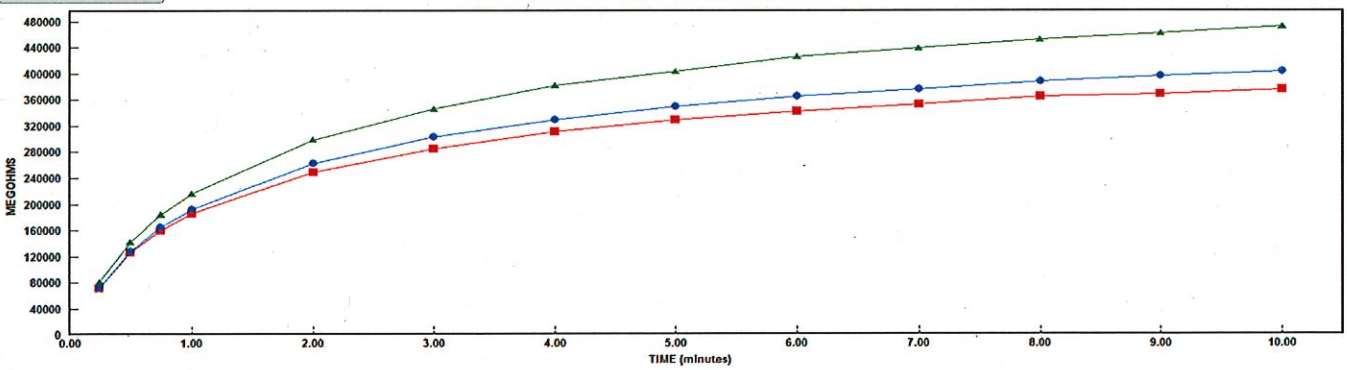
*Click on blue label fields to edit*

...CLICK HERE TO SELECT DEVICE

| R | | | | | W | | | | | B | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TIME (minutes) | Volts (kV) | READING (megohms) | TEMP CORR. (megohms) | CURRENT uA | TIME (minutes) | Volts (kV) | READING (megohms) | TEMP CORR. (megohms) | CURRENT uA | TIME (minutes) | Volts (kV) | READING (megohms) | TEMP CORR. (megohms) | CURRENT uA |
| 0.25 | 10.22 | 71,700.00 | 71,700.00 | 0.14 | 0.25 | 10.22 | 71,700.00 | 71,700.00 | 0.14 | 0.25 | 10.22 | 80,900.00 | 80,900.00 | 0.13 |
| 0.50 | 10.22 | 126,000.0 | 126,000.0 | 0.08 | 0.50 | 10.22 | 128,000.0 | 128,000.0 | 0.08 | 0.50 | 10.22 | 142,000.0 | 142,000.0 | 0.07 |
| 0.75 | 10.22 | 160,000.0 | 160,000.0 | 0.06 | 0.75 | 10.22 | 165,000.0 | 165,000.0 | 0.06 | 0.75 | 10.22 | 184,000.0 | 184,000.0 | 0.06 |
| 1.00 | 10.22 | 186,000.0 | 186,000.0 | 0.05 | 1.00 | 10.22 | 192,000.0 | 192,000.0 | 0.05 | 1.00 | 10.22 | 216,000.0 | 216,000.0 | 0.05 |
| 2.00 | 10.22 | 250,000.0 | 250,000.0 | 0.04 | 2.00 | 10.22 | 263,000.0 | 263,000.0 | 0.04 | 2.00 | 10.22 | 299,000.0 | 299,000.0 | 0.03 |
| 3.00 | 10.22 | 285,000.0 | 285,000.0 | 0.04 | 3.00 | 10.22 | 303,000.0 | 303,000.0 | 0.03 | 3.00 | 10.22 | 346,000.0 | 346,000.0 | 0.03 |
| 4.00 | 10.22 | 312,000.0 | 312,000.0 | 0.03 | 4.00 | 10.22 | 330,000.0 | 330,000.0 | 0.03 | 4.00 | 10.22 | 382,000.0 | 382,000.0 | 0.03 |
| 5.00 | 10.22 | 329,000.0 | 329,000.0 | 0.03 | 5.00 | 10.22 | 350,000.0 | 350,000.0 | 0.03 | 5.00 | 10.22 | 403,000.0 | 403,000.0 | 0.03 |
| 6.00 | 10.22 | 343,000.0 | 343,000.0 | 0.03 | 6.00 | 10.22 | 365,000.0 | 365,000.0 | 0.03 | 6.00 | 10.22 | 426,000.0 | 426,000.0 | 0.02 |
| 7.00 | 10.22 | 353,000.0 | 353,000.0 | 0.03 | 7.00 | 10.22 | 376,000.0 | 376,000.0 | 0.03 | 7.00 | 10.22 | 439,000.0 | 439,000.0 | 0.02 |
| 8.00 | 10.22 | 365,000.0 | 365,000.0 | 0.03 | 8.00 | 10.22 | 388,000.0 | 388,000.0 | 0.03 | 8.00 | 10.22 | 452,000.0 | 452,000.0 | 0.02 |
| 9.00 | 10.22 | 369,000.0 | 369,000.0 | 0.03 | 9.00 | 10.22 | 396,000.0 | 396,000.0 | 0.03 | 9.00 | 10.22 | 462,000.0 | 462,000.0 | 0.02 |
| 10.00 | 10.22 | 376,000.0 | 376,000.0 | 0.03 | 10.00 | 10.22 | 403,000.0 | 403,000.0 | 0.03 | 10.00 | 10.22 | 473,000.0 | 473,000.0 | 0.02 |
| | | | | | | | | | | | | | | |

Format Graph Axis

INSULATION RESISTANCE CURVE




R : Red Square W : Blue Circle B : Green Triangle

Transformer Station:

Sample Feeder Circuit Breaker Test Record

# MV Vacuum Circuit Breaker

Waterloo North Hydro Inc.

TTsept06

| | | | |
|---|---|---|---|
| LOCATION = | HS 7 | | |
| SERIAL # = | 60702381 | DATE- | Mar 20-18' |
| MODEL# = | 150 DHP-VR 500 | TESTED BY- | JB |

BREAKER NAMEPLATE DATA , Cutler Hammer , 150 DHP - VR 500
Style= 94A7011G02
Rtd Max. V.- 15KV, Impulse Volt.- 95 KV Peak, Rtd Current-1200A, Rtd Freq- 60Hz,
Rtd S-C Current-18 kA, V.Range Fac-K-1.3, Rtd Int time- 5 cycles, C & L Current- 62 kA,peak
BUILT= 2006 Motor Volts 125 V dc

| CLOSE COIL DATA- | | TRIP COIL DATA- | |
|---|---|---|---|
| Close Current= 6.6 A, Volt range= 100-140 vdc | | Trip Current= 6.6 A, Volt range= 70-140 vdc | |
| CLOSE COIL RESISTANCE = | 19.3 | TRIP COIL RESISTANCE = | 19.3 |

| | |
|---|---|
| COUNTER FOUND AT = | 303 |
| LEFT AT = | |

| | | |
|---|---|---|
| Trip Time | 1 | sec |
| Rating= 5cy | 60.0 | cycles |

**MISC. CHECKS**

| | | | |
|---|---|---|---|
| MECHANICAL TRIP/CLOSE- | ok | BREAKER INSULATION CLEAN | ok |
| ELECTRICAL TRIP/CLOSE- | ok | LUBRICATION- | ok |
| COUNTER CHECKED- | ok | CELL PALLET SWITCHES CHECKED | ok |
| INTERLOCKS CHECKED- | ok | MOC switch travel and breaker MOC drive spring | ok |
| SECONDARY WIRING HYPOT AT 500 VOLTS (Disconnect motor leads ) | | | ok |
| CONTACT EROSION INDICATOR CHECK (Done with breaker closed) , USE BLUE MARK ON ALL PHASES | | | ok |

WEATHER =

VACUUM INTERRUPTER INTEGRITY HYPOT TEST
WARNING: STAY AT LEAST 1 METER AWAY DURING THE TEST.
DONE AT 40KVdc FOR 1 MINUTE, TOP CONTACTS CONNECTED TOGETHER, BOTTOM CONTACTS AND BREAKER FRAME GROUNDED.

| | uAMP LEAKAGE | Megohms |
|---|---|---|
| Line as Cathode | 21 | 1,905 |
| Load as Cathod | 70 | 571 |

MEGGAR TEST
RESULTS CORRECTED TO 20 C
CORRECTION FACTOR= 1
DONE AT 10 KV FOR 2 MIN.

| TEST | PHASE | MEGAOHMS |
|---|---|---|
| CONTACTS OPEN | RED LINE | 12200000 |
| | RED LOAD | 10700000 |
| | WHITE LINE | 31200000 |
| | WHITE LOAD | 278000 |
| | BLUE LINE | 18500000 |
| | BLUE LOAD | 24600000 |
| CONTACTS CLOSED | RED | 22400000 |
| | WHITE | 376000 |
| | BLUE | 9480000 |

All other testing results in Omicron test file
Interlocks include coding plate, tripping lever, levering interlock, anti-pump, anti-slam, spring release lever, trip free operation

REMARKS-

# Test Report Circuit breaker
# Vacuum breaker

Waterloo North Hydro Inc.

| | | | |
|---|---|---|---|
| Client | WNH | 060702381 | |
| Execution date | 1/28/2016 | Reason of the job | Routine |
| Tested by | JB, ZS | Location | HSA |
| Approved by | | Asset | Circuit breaker |
| Report ID | 3 | Asset type | Vacuum breaker |
| Report issue date | 2/2/2016 3:09:01 PM | Asset serial number | 060702381 |
| | | Manufacturer | Eaton/ Cutler-Hammer |

## Summary

Routine maintenance of breaker currently in HS07 cell. The breaker passed all of the tests. Things to note; The contact errosion indicators are barely visible from the back of the breaker, a mirror is required to be able to see them fully. This would indicate that the contacts need replacement in the near future. Eaton came by to take a look at the breaker. They told us that as long as the errosion indicator line is visible (not barried) the breaker contacts pass the errosion indicator checks. The second item that we brought up with Eaton was the contact bounce that can be observed on the white phase when closing the breaker. They said that this was not an issue and is acceptable.

| Performed tests | Assessment |
|---|---|
| Motor Current | Not assessed |
| C Timing | Pass |
| O Timing | Pass |
| OC Timing | Pass |
| CO Timing | Pass |
| O-CO Timing | Pass |
| Minimum Pickup | Pass |
| Contact Resistance | Pass |

| | |
|---|---|
| Overall Assessment | No faults |

Tested by: _____

Approved by: _____

## Location & company information

| Location | |
|---|---|
| Name | HSA |
| Region | |
| Division | |
| Area | |
| Plant | |
| Address | 530 Conestoga Rd |
| City | Waterloo |
| State/Province | Ontario |
| Postal code | |
| Country | Canada |

| Company | |
|---|---|
| Company | WNH |
| Department | P&C/Stations |
| Address | |
| City | |
| State/Province | |
| Postal code | |
| Country | |
| Phone No. | |
| Fax No. | |
| E-mail | |

| | |
|---|---|
| Geo coordinates | |

| Contact person | |
|---|---|
| Name | |
| Phone No. 1 | |
| Phone No. 2 | |
| Fax No. | |
| E-mail | |

| Comment |
|---|
| |

## Vacuum breaker nameplate data

| | |
|---|---|
| Serial number | 060702381 |
| Manufacturer | Eaton/ Cutler-Hammer |
| Manufacturing year | 2006 |
| Manufacturer type | 150 DHP - VR 500 |
| Asset system code | 060702381 |
| Apparatus ID | 060702381 |
| Feeder | HS7 |
| No. of phases | 3 |

| | |
|---|---|
| No. of interrupters p. phase | 1 |
| Pole operation | Ganged |
| Pre-insertion resistors | No |
| PIR value | Ω |
| Grading capacitors | No |
| Capacitor value | pF |
| Interrupting medium | Vacuum |
| Tank type | Dead tank |

Comment

| |
|---|
| |

| Ratings | |
|---|---|
| Rated frequency | 60.00 Hz |
| Rated voltage L-L | 15.0 kV |
| Rated current | 1200.0 A |
| Rated SC breaking current | 18.0 kA |
| Short-circuit nominal duration | s |
| Rated insul. level L-G (BIL) | 95.0 kV |
| Rated interrupting time | 83.5 ms |
| Interrupting duty cycle | 23KA |
| Rated power at closing | W |
| Rated power at opening | W |
| Rated power at motor charge | W |

| Contact system | |
|---|---|
| Total travel | in |
| Damping time | ms |

| Others | |
|---|---|
| Total weight | 551 lbs |

| Spring Operating mechanism nameplate data | |
|---|---|
| Serial No. | 060702381 |
| Manufacturer | Eaton/Cutler-Hammer |
| Manufacturer type | 150 DHP - VR 500 |
| Manufacturing year | 2006 |
| Asset system code | 060702381 |

| Component | Rated voltage | Rated current | Frequency | |
|---|---|---|---|---|
| Trip coil 1 | 125.0 V | 6.6 A | Hz | DC |
| Close coil 1 | 125.0 V | 6.6 A | Hz | DC |
| Auxiliary circuits | 125.0 V | A | Hz | DC |
| Motor | 125.0 V | A | Hz | DC |

## Bushings nameplate data

| Pos. | Serial No. | Manufact. | Man. year | Voltage L-ground | Max. system voltage | Rated current | Insul. level LL |
|---|---|---|---|---|---|---|---|
| 1 | | | | kV | kV | A | V |
| 2 | | | | kV | kV | A | V |
| 3 | | | | kV | kV | A | V |
| 4 | | | | kV | kV | A | V |
| 5 | | | | kV | kV | A | V |
| 6 | | | | kV | kV | A | V |

| Pos. | Cap. (C1) | PF (C1) | Cap. (C2) | PF (C2) | Insulation type | Tap type |
|---|---|---|---|---|---|---|
| 1 | pF | % | pF | % | | |
| 2 | pF | % | pF | % | | |

| Pos. | Cap. (C1) | PF (C1) | Cap. (C2) | PF (C2) | Insulation type | Tap type |
|---|---|---|---|---|---|---|
| 3 | pF | % | pF | % | | |
| 4 | pF | % | pF | % | | |
| 5 | pF | % | pF | % | | |
| 6 | pF | % | pF | % | | |

## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## Global test conditions

| | | | |
|---|---|---|---|
| Weather | Partly cloudy | Humidity | 80 % |
| Unit location | Enclosed | Ambient temperature | 20 °C |

## Operations counter

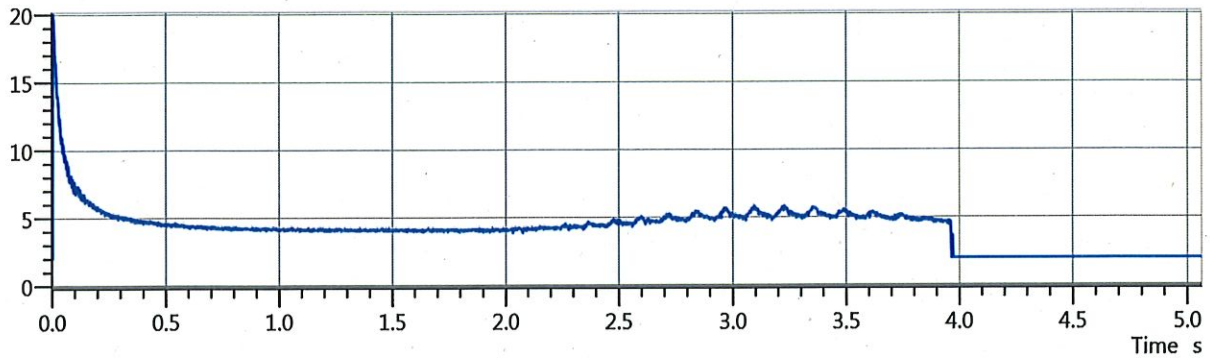
| | |
|---|---|
| Counter reading found | 222 |
| Counter reading left | 293 |

## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## Motor Current

| | |
|---|---|
| Execution date/Time | 1/28/2016 11:17:36 AM |
| Motor supply voltage | 125.0 V DC |
| Sample rate | 1 kHz |




| Label | | Unit/div. | Y-Axis pos. |
|---|---|---|---|
| Motor (A) | ■ | 1 A | 2 |

Comments

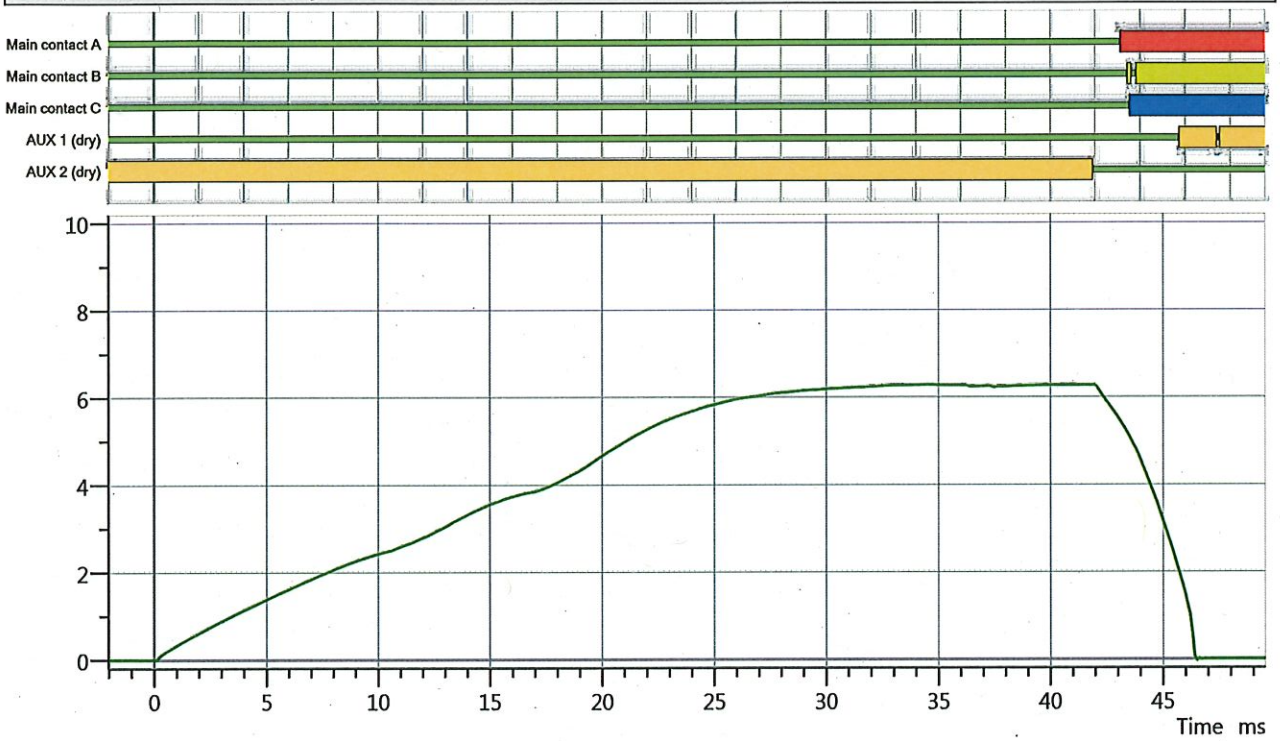
## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## C Timing

| | |
|---|---|
| Execution date/Time | 1/28/2016 11:20:27 AM |
| Sequence | C |
| Coil supply voltage | 125.0 V DC |
| Sample rate | 10 kHz |

## Main, resistive and auxiliary contacts




| Label | Unit/div. | Y-Axis pos. |
|---|---|---|
| Close coil (A) | 1.00 A | 0.00 |

## Operating times

| Meas. | Closing time (ms) | Closing sync. (ms) | Assessment |
|---|---|---|---|
| Breaker | 43.50 | 0.40 | Man. pass |
| A | 43.10 | | Man. pass |
| Main contact A | 43.10 | | Man. pass |
| B | 43.40 | | Man. pass |
| Main contact B | 43.40 | | Man. pass |
| C | 43.50 | | Man. pass |
| Main contact C | 43.50 | | Man. pass |

## Coil characteristics

| | Peak current (A) | Assessment |
|---|---|---|
| Close 1 | 6.29 | Man. pass |

Comments

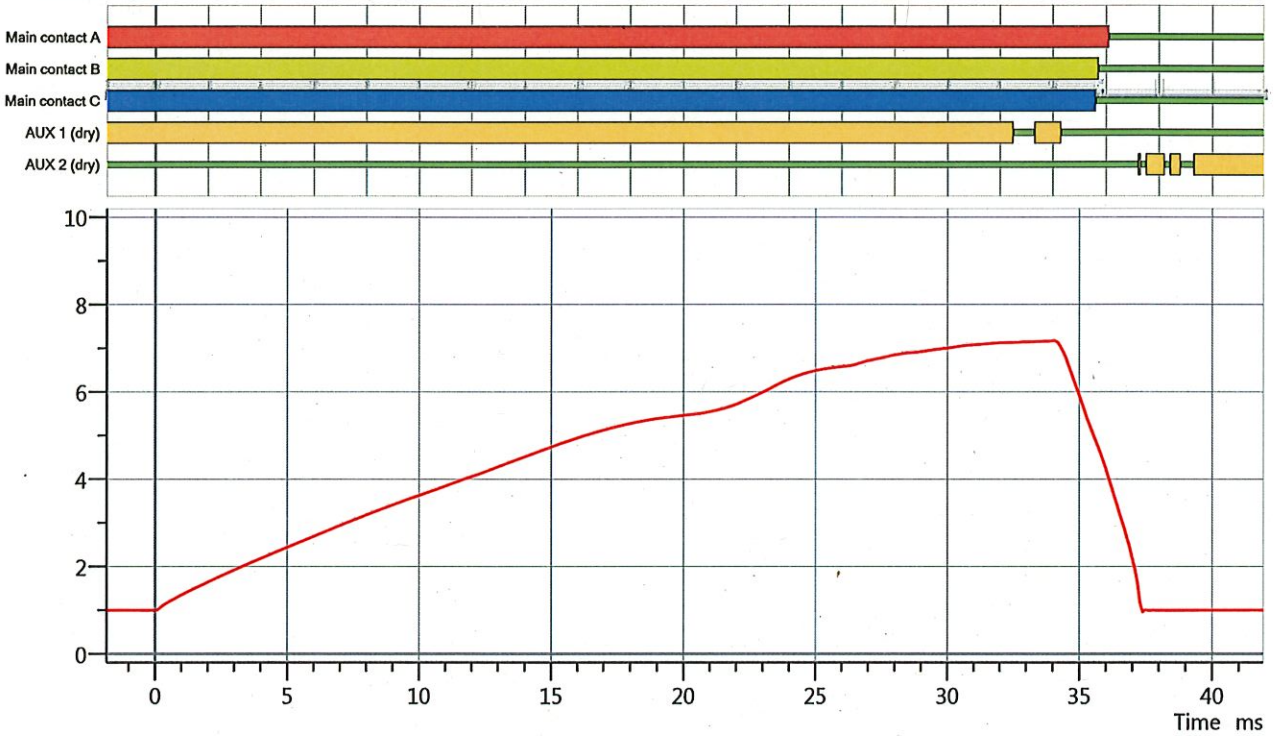
## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## O Timing

| | |
|---|---|
| Execution date/Time | 1/28/2016 11:29:29 AM |
| Sequence | O |
| Coil supply voltage | 125.0 V DC |
| Sample rate | 10 kHz |

## Main, resistive and auxiliary contacts




| Label | | Unit/div. | Y-Axis pos. |
|---|---|---|---|
| Trip coil (A) | ■ | 1.00 A | 1.00 |

## Operating times

| Meas. | Opening time (ms) | Opening sync. (ms) | Assessment |
|---|---|---|---|
| Breaker | 36.10 | 0.50 | Man. pass |
| A | 36.10 | | Man. pass |
| Main contact A | 36.10 | | Man. pass |
| B | 35.70 | | Man. pass |
| Main contact B | 35.70 | | Man. pass |
| C | 35.60 | | Man. pass |
| Main contact C | 35.60 | | Man. pass |

## Coil characteristics

| | Peak current (A) | Assessment |
|---|---|---|
| Open 1 | 6.17 | Man. pass |

Comments

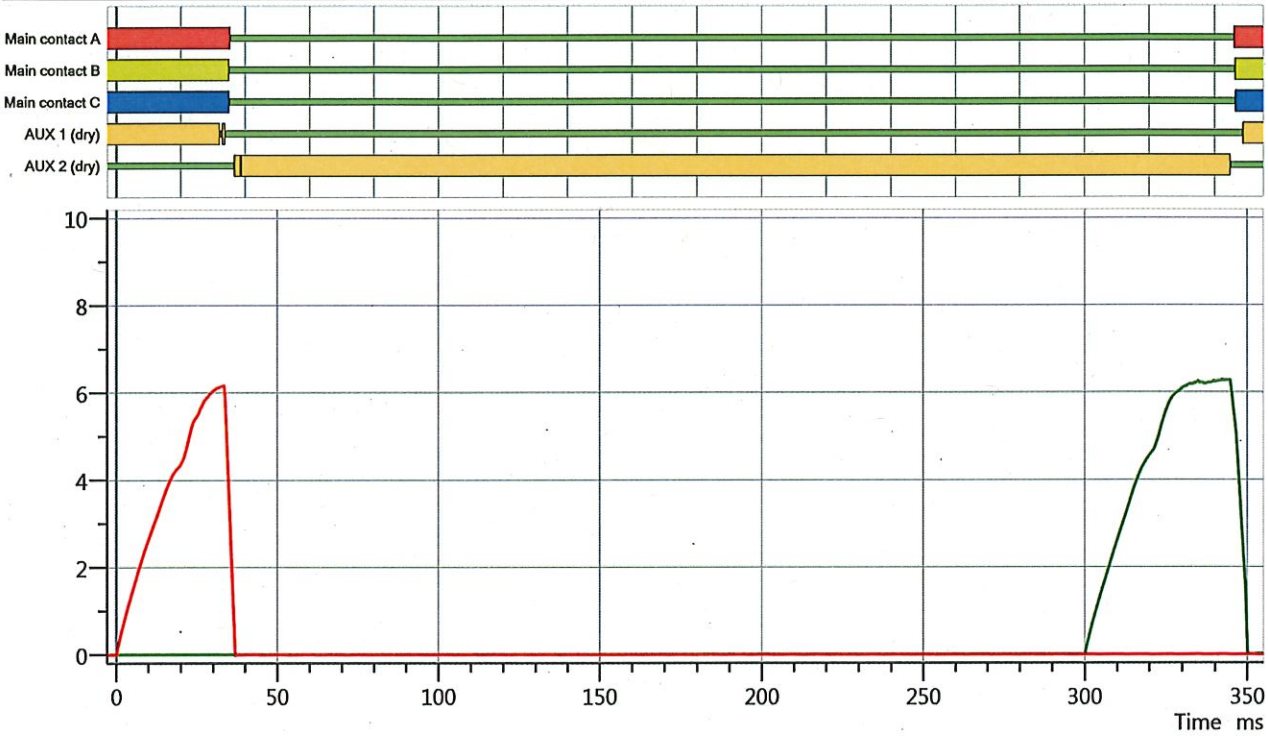
## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## OC Timing

| | |
|---|---|
| Execution date/Time | 1/28/2016 11:39:01 AM |
| Sequence | OC |
| Coil supply voltage | 125.0 V DC |
| Sample rate | 10 kHz |

## Main, resistive and auxiliary contacts




| Label | | Unit/div. | Y-Axis pos. | Label | | Unit/div. | Y-Axis pos. |
|---|---|---|---|---|---|---|---|
| Close coil (A) | ■ | 1.00 A | 0.00 | Trip coil (A) | ■ | 1.00 A | 0.00 |

## Operating times

| Meas. | Opening time (ms) | Opening sync. (ms) | Reclosing time (ms) | Assessment |
|---|---|---|---|---|
| Breaker | 35.30 | 0.40 | 346.30 | Man. pass |
| A | 35.30 | | 345.90 | Man. pass |
| Main contact A | 35.30 | | 345.90 | Man. pass |
| B | 34.90 | | 346.20 | Man. pass |
| Main contact B | 34.90 | | 346.20 | Man. pass |
| C | 35.00 | | 346.30 | Man. pass |
| Main contact C | 35.00 | | 346.30 | Man. pass |

## Coil characteristics

| | Peak current (A) | Assessment |
|---|---|---|
| Open 1 | 6.17 | Man. pass |
| Close 1 | 6.28 | Man. pass |

Comments

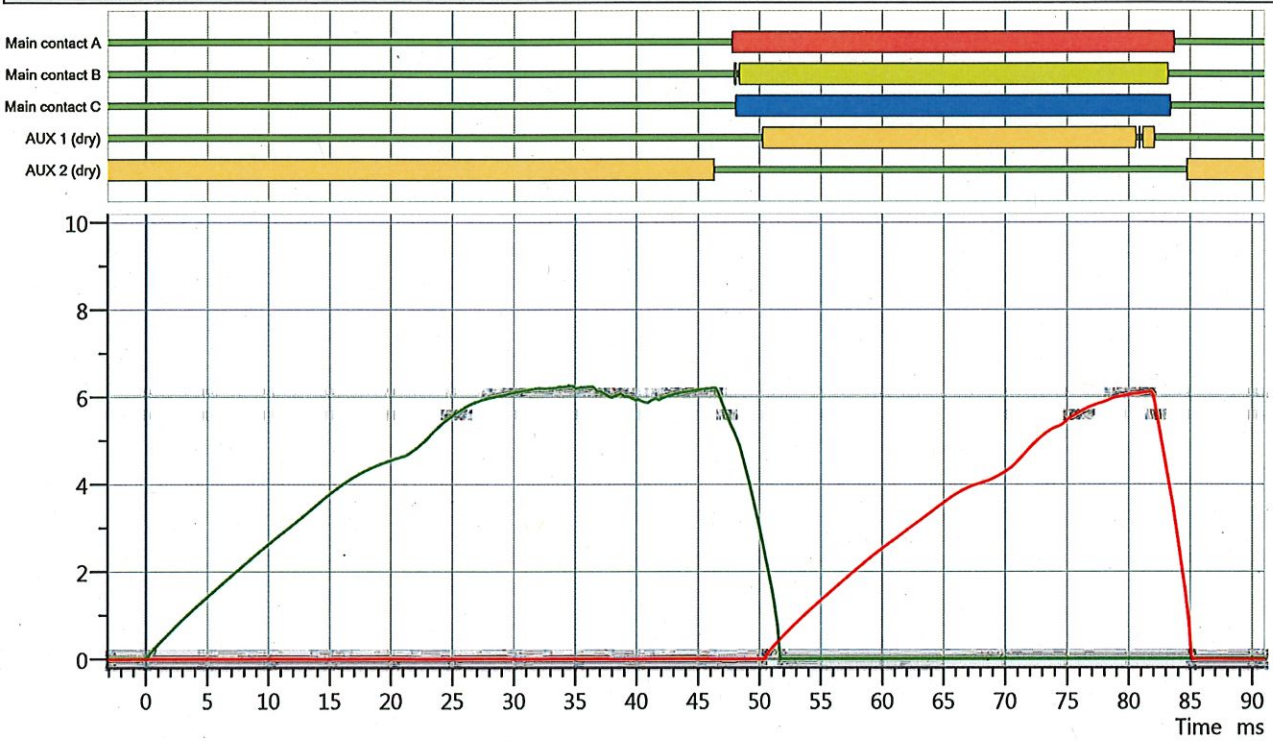
## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## CO Timing

| | |
|---|---|
| Execution date/Time | 1/28/2016 11:59:04 AM |
| Sequence | CO |
| Coil supply voltage | 125.0 V DC |
| Sample rate | 10 kHz |

## Main, resistive and auxiliary contacts




| Label | Unit/div. | Y-Axis pos. | Label | Unit/div. | Y-Axis pos. |
|---|---|---|---|---|---|
| Close coil (A) | 1.00 A | 0.00 | Trip coil (A) | 1.00 A | 0.00 |

## Operating times

| Meas. | Closing time (ms) | Closing sync. (ms) | Close-Open time 1 (ms) | Assessment |
|---|---|---|---|---|
| Breaker | 48.00 | 0.30 | 36.00 | Man. pass |
| A | 47.70 | | 36.00 | Man. pass |
| Main contact A | 47.70 | | 36.00 | Man. pass |
| B | 47.90 | | 35.30 | Man. pass |
| Main contact B | 47.90 | | 35.30 | Man. pass |
| C | 48.00 | | 35.40 | Man. pass |
| Main contact C | 48.00 | | 35.40 | Man. pass |

## Coil characteristics

| | Peak current (A) | Assessment |
|---|---|---|
| Open 1 | 6.12 | Man. pass |
| Close 1 | 6.25 | Man. pass |

Comments

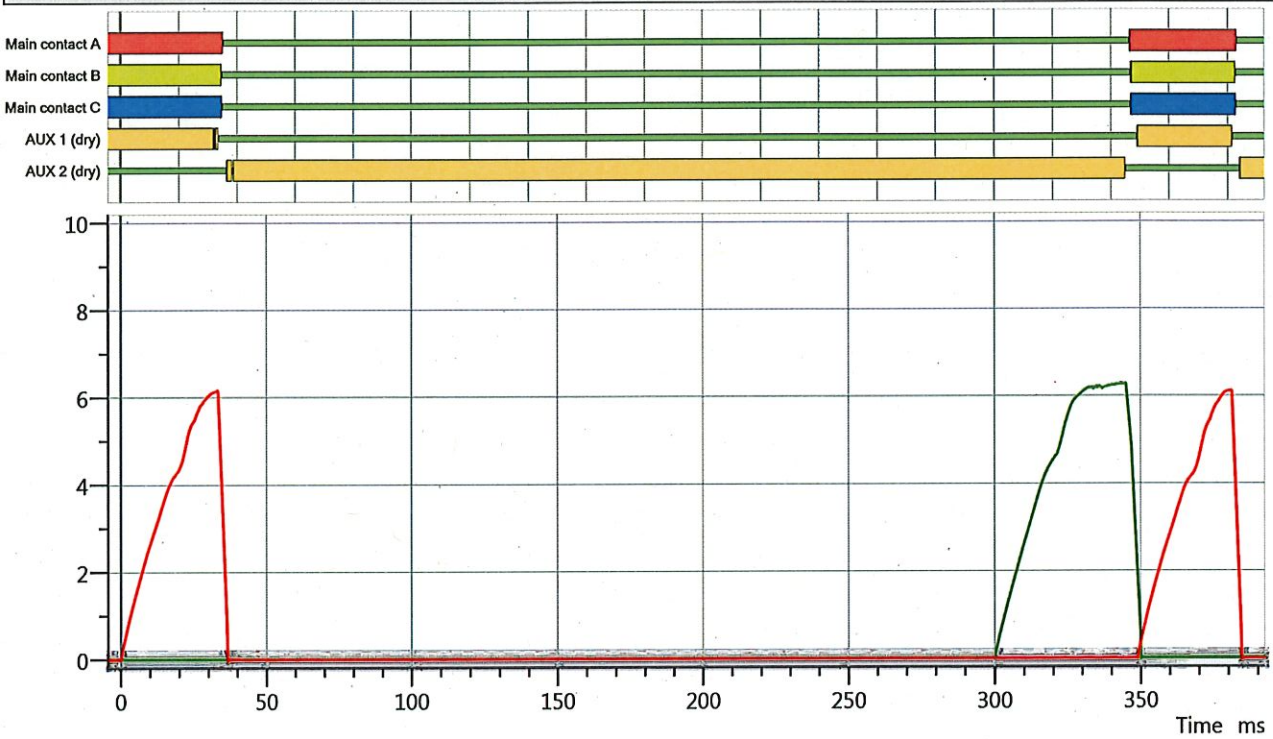
## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## O-CO Timing

| | |
|---|---|
| Execution date/Time | 1/28/2016 12:07:19 PM |
| Sequence | O-CO |
| Coil supply voltage | 125.0 V DC |
| Sample rate | 10 kHz |

## Main, resistive and auxiliary contacts




| Label | Unit/div. | Y-Axis pos. | Label | Unit/div. | Y-Axis pos. |
|---|---|---|---|---|---|
| Close coil (A) | 1.00 A | 0.00 | Trip coil (A) | 1.00 A | 0.00 |

## Operating times

| Meas. | Opening time (ms) | Opening sync. (ms) | Open-Close time (ms) | Close-Open time 1 (ms) | Assessment |
|---|---|---|---|---|---|
| Breaker | 35.10 | 0.50 | 311.10 | 36.70 | Man. pass |
| A | 35.10 | | 311.10 | 36.70 | Man. pass |
| Main contact A | 35.10 | | 311.10 | 36.70 | Man. pass |
| B | 34.60 | | 311.90 | 36.00 | Man. pass |
| Main contact B | 34.60 | | 311.90 | 36.00 | Man. pass |
| C | 34.80 | | 311.80 | 36.10 | Man. pass |
| Main contact C | 34.80 | | 311.80 | 36.10 | Man. pass |

## Coil characteristics

| | Peak current (A) | Assessment |
|---|---|---|
| Open 1 | 6.17 | Man. pass |
| Close 1 | 6.28 | Man. pass |
| Open 2 | 6.12 | Man. pass |

Comments

## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## Minimum Pickup

| | |
|---|---|
| Execution date/Time | 1/28/2016 1:13:21 PM |
| Coil supply voltage start | 20.0 V |
| Coil supply voltage end | 80.0 V |
| Coil supply voltage step | 1.0 V |

| No. | Operation | V pickup | Assessment |
|---|---|---|---|
| 1 | Trip | 25.00 V | Man. pass |
| 2 | Close | 28.00 V | Man. pass |

Comments

## Test set information

| Test set model | Test set serial number | Calibration date |
|---|---|---|
| CIBANO 500 | BM317E | 2012-01-01 |

## Contact Resistance

| | |
|---|---|
| Execution date/Time | 1/28/2016 1:28:41 PM |
| Test current | 100.0 A |
| Ambient temperature | °C |

| Main contact | I DC | V DC | R meas | Assessment |
|---|---|---|---|---|
| A | 100.00 A | 3.820 mV | 38.20 µΩ | Man. pass |
| B | 99.99 A | 3.773 mV | 37.73 µΩ | Man. pass |
| C | 99.99 A | 3.871 mV | 38.71 µΩ | Man. pass |

Comments

Transformer Station:

Sample Feeder Cable Test Record

Megger
www.megger.com

# CABLE POLARIZATION INDEX (PI)TEST

Waterloo North Hydro Inc.

DATE 5/4/2020 PAGE 1

AMBIENT TEMP. 10 °C JOB #

SUBSTATION HSB HUMIDITY 50 % ASSET ID HS19

POSITION Connected at Feeder. Disconnected at Transformer. TEST STATUS Pass

EQUIPMENT LOCATION HS19 to T5 Cables

CABLE SOURCE HS19 CABLE TERMINATION POINT T5

OPERATING VOLTAGE 13.8 kV INSTALLED IN 1992 LENGTH 50 m

MANUFACTURER Canada Wire INSULATION TYPE XLPE INSULATION THICKNESS MILS

SIZE 750 KCMIL NO. OF CONDUCTORS 1C CONDUCTOR MATERIAL CU

RATED VOLTAGE 15 kV ○ GROUNDED ◉ UNGROUNDED ◉ BELTED ○ SHIELDED AGE

PHASE IDENTIFICATION: PHASE A Red PHASE B White PHASE C Blue

CONNECTED EQUIPMENT Load Side of Feeder Busbar CABLE TEMPERATURE 10 °C

TEST VOLTAGE 10.226 kVDC Enter TCF Manually: ☐ TEMPERATURE CORRECTION FACTOR TO 20°C, TCF 0.6300

K = INSULATION RESISTANCE CONSTANT IN MEGOHMS 10,000 TEST CONDUCTED ◉ BEFORE ○ AFTER HIGH POTENTIAL TEST

D = OUTSIDE DIAMETER OF INSULATION d = INSIDE DIAMETER OF INSULATION

$R = [K \text{ Log}_{10} (\frac{D}{d})] (\frac{1000}{L \text{ (ft)}})$ Use Instrument PI Value: ☐

| MINUTES | PHASE A MEGOHMS | | | | PHASE B MEGOHMS | | | | PHASE C MEGOHMS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEMP. CO FACTOI | FILTER SETTING | TEMP. CORR FACTOR | 20°C READING (megohms) | TEMP. CORR FACTOR | FILTER SETTING | TEMP. CORR FACTOR | 20°C READING (megohms) | TEMP. CORR FACTOR | FILTER SETTING | TEMP. CORR FACTOR | 20°C READING (megohms) |
| 0.25 | 166,000.0 | | 0.63 | 104,580.0 | 159,000.0 | | 0.63 | 100,170.0 | 191,000.0 | | 0.63 | 120,330.0 |
| 0.50 | 272,000.0 | | 0.63 | 171,360.0 | 364,000.0 | | 0.63 | 229,320.0 | 338,000.0 | | 0.63 | 212,940.0 |
| 0.75 | 331,000.0 | | 0.63 | 208,530.0 | 448,000.0 | | 0.63 | 282,240.0 | 413,000.0 | | 0.63 | 260,190.0 |
| 1.00 | 379,000.0 | | 0.63 | 238,770.0 | 501,000.0 | | 0.63 | 315,630.0 | 469,000.0 | | 0.63 | 295,470.0 |
| 2.00 | 482,000.0 | | 0.63 | 303,660.0 | 672,000.0 | | 0.63 | 423,360.0 | 624,000.0 | | 0.63 | 393,120.0 |
| 3.00 | 549,000.0 | | 0.63 | 345,870.0 | 748,000.0 | | 0.63 | 471,240.0 | 691,000.0 | | 0.63 | 435,330.0 |
| 4.00 | 578,000.0 | | 0.63 | 364,140.0 | 809,000.0 | | 0.63 | 509,670.0 | 697,000.0 | | 0.63 | 439,110.0 |
| 5.00 | 600,000.0 | | 0.63 | 378,000.0 | 845,000.0 | | 0.63 | 532,350.0 | 720,000.0 | | 0.63 | 453,600.0 |
| 6.00 | 616,000.0 | | 0.63 | 388,080.0 | 895,000.0 | | 0.63 | 563,850.0 | 795,000.0 | | 0.63 | 500,850.0 |
| 7.00 | 604,000.0 | | 0.63 | 380,520.0 | 915,000.0 | | 0.63 | 576,450.0 | 802,000.0 | | 0.63 | 505,260.0 |
| 8.00 | 626,000.0 | | 0.63 | 394,380.0 | 911,000.0 | | 0.63 | 573,930.0 | 838,000.0 | | 0.63 | 527,940.0 |
| 9.00 | 631,000.0 | | 0.63 | 397,530.0 | 948,000.0 | | 0.63 | 597,240.0 | 829,000.0 | | 0.63 | 522,270.0 |
| 10.00 | 645,000.0 | | 0.63 | 406,350.0 | 957,000.0 | | 0.63 | 602,910.0 | 817,000.0 | | 0.63 | 514,710.0 |
| P.I. | 1.7 | | | | 1.91 | | | | 1.74 | | | |

POLARIZATION INDEX = 10 MINUTE READING / 1 MINUTE READING

* MINIMUM DESIGN INSULATION RESISTANCE, R = _____ MEGOHMS

***Press F1 for form help***

| Filter Setting Codes: |
|---|
| |

TEST EQUIPMENT USED: S1-1052/2 TESTED BY: MG

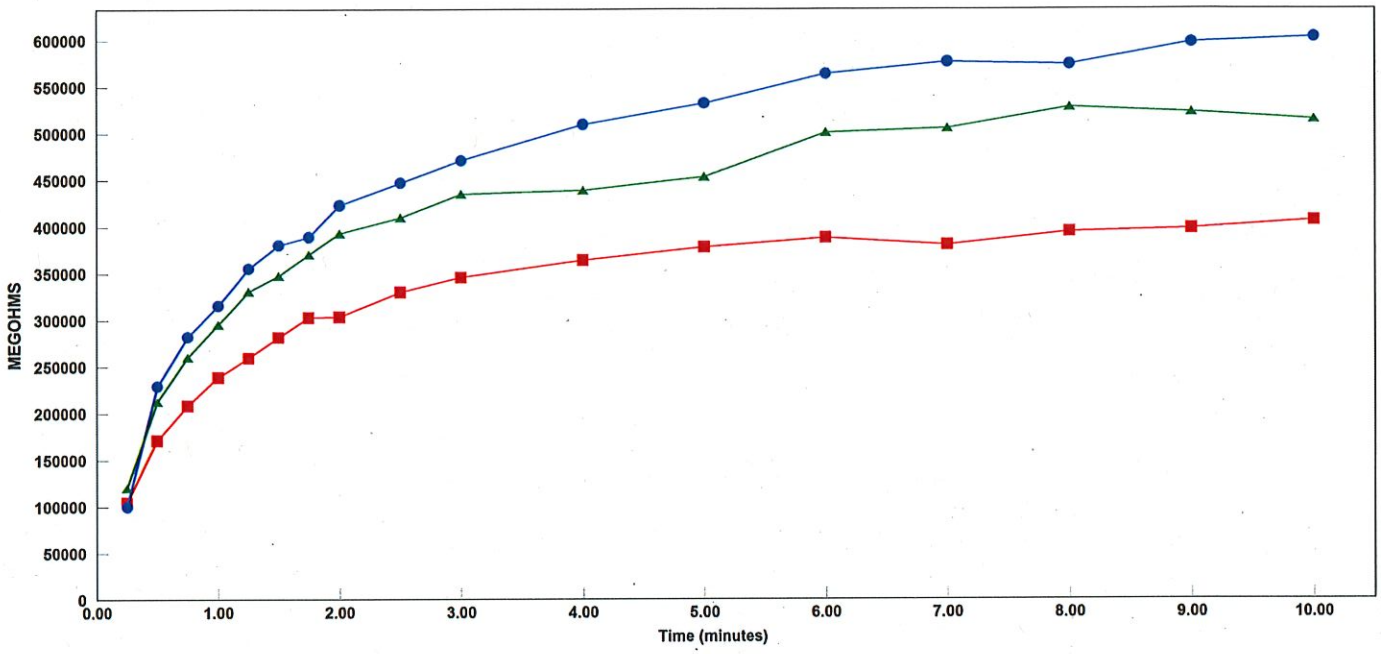
Megger.
www.megger.com

# CABLE POLARIZATION INDEX (PI)TEST

Waterloo North Hydro Inc.



## POLARIZATION CURVE




Phase A: Red Square
Phase B: Blue Circle
Phase C: Green Triangle

COMMENTS:
DEFICIENCIES:

Transformer Station:

Sample Feeder Protection Relay Test Record

HS 07 Protection

Microprocessor Relay

Waterloo North Hydro Inc.

TTsept2016

## HS A FEEDER PROTECTIONS

## HS 7

DATE- 16/Mar/18

BY- MG

OUT GOING TRIPS= FEEDER BREAKER & FEEDER CBF

INCOMING TRIPS = 87 & 51 BUS PROTECTION , Bank & tie Breaker CBF PROTECTION

RELAY DATA- GEUR F60

NOTE

**CBF blocking switch open , before testing**

**Warning .Disconnect Transmit fibre before over current testing. GOOSE messages to Bus 87A relay**

**PHASE PICKUP**

| | | |
|---|---|---|
| HIset 51 P | 960 | LINE AMPS |
| Curve | IEEE Mod Inverse | |
| HIset 50 P-1 | Disabled | LINE AMPS |
| .owSet 50 P-2 | 1200 | LINE AMPS |
| xtreme 50 P-3 | 12000 | LINE AMPS |
| CT RATIO= | 1200 | /5 |
| = | 240 | /1 |

**GROUND PICKUP**

| | | |
|---|---|---|
| HIset 51 N | 480 | LINE AMPS |
| Curve | IEEE Mod Inverse | |
| HIset 50 N-1 | Disabled | LINE AMPS |
| LowSet 50 N-2 | 600 | LINE AMPS |
| Extreme 50 N-3 | 12000 | LINE AMPS |

| | pri. | sec. |
|---|---|---|
| PT ratio = | 8400 | 70 |
| | 120 | /1 |

**PHASE**

| # | DIAL | PU | MULT PU | RELAY AMP | LINE AMPS | TIME IN SECONDS IDEAL | R-G | W-G | B-G |
|---|---|---|---|---|---|---|---|---|---|
| 51P | 0.65 | 4.00 | 1 | 4.00 | 960 | - | OK | OK | OK |
| PU, test point = Phase TOC1 PKP | | | **1.5** | **6.00** | **1440** | **4.2** | **4.209** | **4.212** | **4.188** |
| Timing , TP = Phase TOC1 OP | | | 2 | 8.00 | 1920 | 2.5 | 2.5 | 2.502 | 2.496 |
| | | | 4 | 16.00 | 3840 | 1.3 | 1.283 | 1.285 | 1.288 |
| | | | 5 | 20.00 | 4800 | 1.2 | 1.117 | 1.119 | 1.121 |
| 50P-1 | | Disabled | 1 | #VALUE! | Disabled | - | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Test Point = Phase IOC1 OP | | | 1.2 | #VALUE! | #VALUE! | <0.05 | | | |
| | | | 1.5 | #VALUE! | #VALUE! | <0.05 | | | |
| 50P-2 | 1 | 5.00 | 1 | 5.00 | 1200 | - | OK | OK | OK |
| Test Point = Phase IOC2 OP | | | 1.2 | 6.00 | 1440 | <0.05 | 0.028 | 0.027 | 0.028 |
| Low Set | | | 1.5 | 7.50 | 1800 | <0.05 | 0.023 | 0.022 | 0.023 |
| 50P-3 | 10 | 50.00 | 1 | 50.00 | 12000 | - | OK | OK | OK |
| Test Point = VO45= IOC3 | | | 1.2 | 60.00 | 14400 | <0.05 | 0.024 | 0.024 | 0.025 |

**GROUND**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 51N | 0.4 | 2 | 1 | 2.00 | 480 | - | OK |
| PU, TP = Ground TOC1 PKP | | | **1.5** | **3.00** | **720** | **4.2** | **4.254** |
| Timing , TP = GroundTOC1 OP | | | 2 | 4.00 | 960 | 2.5 | 2.512 |
| | | | 4 | 8.00 | 1920 | 1.3 | 1.287 |
| | | | 6 | 12.00 | 2880 | 1.03 | 1.012 |
| 50N-1 | 0 | Disabled | 1 | #VALUE! | Disabled | - | |
| Test Point = Ground IOC1 OP | | | 1.2 | #VALUE! | #VALUE! | <0.05 | |
| | | | 1.5 | #VALUE! | #VALUE! | <0.05 | |
| 50N-2 | 0.48 | 2.5 | 1 | 2.50 | 600 | - | OK |
| Test Point = Ground IOC2 OP | | | 1.2 | 3.00 | 720 | <0.05 | 0.027 |
| Low Set | | | 1.5 | 3.75 | 900 | <0.05 | 0.022 |
| 50N-3 | 10 | 50.00 | 1 | 50.00 | 12000 | - | OK |
| Test Point = IOC3G = FE4 OP | | | 1.2 | 60.00 | 14400 | <0.05 | 0.024 |

**AUXILLARY TIMER RELAY TEST**

| | | | | TIME IN SEC | |
|---|---|---|---|---|---|
| TIMER | **Timer Function** | **Test Point Operand =** | action | REQ. | found |
| 79L | Lowset blocked after any close | VO13 ( 79L ) | TODO | 10 | 10 |
| 79T | Breaker open time, Dead time shot 1 ( 79 close ) | 52b ON | TOPU | 1 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 79 Reset | Reset after RECLOSE | AR 1 shot CNT = 1 | TODO | 10 | 10 |
| 79-48 | Incomplete sequence time ( 79-48 ) | AR 1 RIP | TOPU | 30 | 30 |
| Hiset O/P | Highset output sealin ( 94T) | VO8 | TODO | 0.5 | 0.5 |
| Lowset O/P | Lowset output sealin ( 94T ) | VO9 | TODO | 0.5 | 0.5 |
| 79 Block | Reclose blocked after a manual close ( scada ) | AR 1 DISABLED | TODO | 10 | 10 |
| Lowset | Lowset delay Timer 11 | VO17 ( Lowset Prot ) | TCPU | 0 | 0 |

## Circuit Breaker Failure

### 62 B Current Check

Test Point Operand = BRK FAIL 1 TRIP OP

DO = .5 amps

| Ph | Relay amps | Line amps |
|---|---|---|
| RED | 0.495 | 118.8 |
| WHITE | 0.494 | 118.56 |
| BLUE | 0.493 | 118.32 |

### TIMERS

| | REQ TIME (S) | ACTUAL TIME(S) | Dial | Operand used | ACTION |
|---|---|---|---|---|---|
| 62 A | 0.15 | 0.172 | 0.15 | BRK Fail 1 T1 OP (timer#1) | TCPU |
| 62 B | 0.2 | 0.221 | 0.2 | BRK Fail 1 Trip OP (timer#2 ) | TCPU |
| 94T | 0.5 | 0.502 | 0.5 | BRK Failure ( VO15 )&timer 6 | TODO |
| | | | | | |

### OTHER TESTS

| | |
|---|---|
| SCADA , Relay & GUI STATUS | OK |
| SCADA , Relay & GUI ANALOG | OK |
| SCADA , Relay & GUI control | OK |
| SCADA , Relay & GUI metering | OK |
| WIRING | OK |
| reset Event History | OK |
| ONE CT GND | OK |
| check clock | OK |
| Trip coil monitor ,Digital element 1 | OK |
| Close coil monitor ,Digital element 2 | OK |
| Fiber transmit reconnected | OK |
| Relay not in maintenance mode | OK |

### Frequency Trip

Disabled

| Test | Test Point Operand = | action | nom | Actual |
|---|---|---|---|---|
| Pickup | UNDERFREQ 1 PKP | TCPU | 58.8 | NA |
| PU Delay | UNDERFREQ 1 OP | TCPU | min 0.3 s | NA |
| Sealin | UNDERFREQ 1 OP | TODO | 2 sec | NA |
| Min V/A | UNDERFREQ 1 OP | TCPU | 7 Volts | NA |

**TEST TRIP**

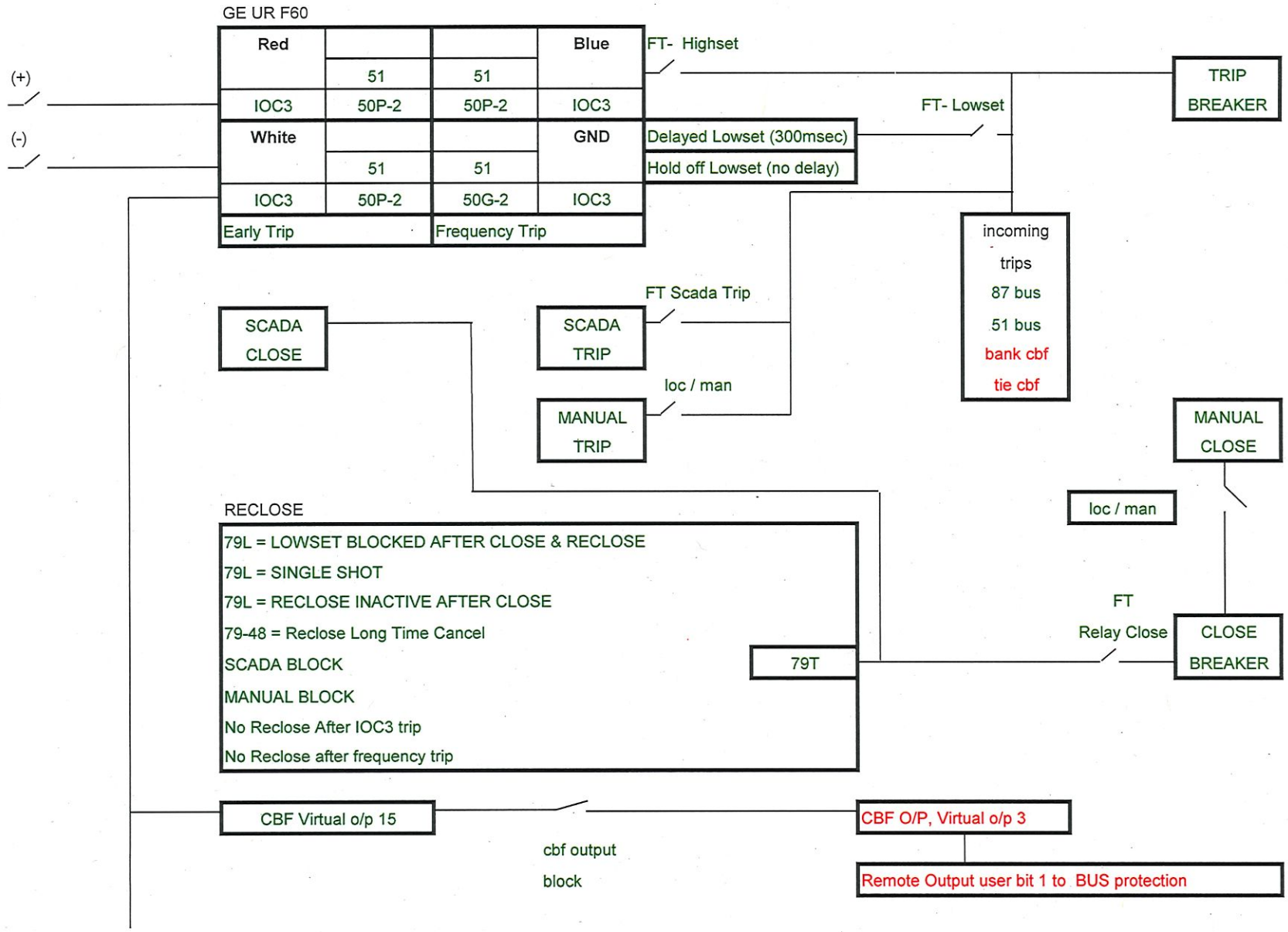
RED TEXT = NOT TESTED

HS 07 Protection

Microprocessor Relay

Waterloo North Hydro Inc.

GREEN TEXT = SUCCESSFULLY TESTED



HS 07 Protection

Microprocessor Relay

Waterloo North Hydro Inc.

IOC3 Pick up ( VO 22 = Feeder Fault ) to Bus 87A relay. Delays 87 trip

Remote Output user bit 2 to BUS protection

**Remarks**

- Wired TOC N.O. contact into relay input for racked in status. TOC now disables CBF and breaker remote status if breaker not racked in.

Transformer Station:

Sample Station Battery Test Record

# WATERLOO NORTH HYDRO
## BATTERY LOAD AND BITE TEST REPORT SHEET

revapril 2017

## Station - HS A

Test Date - 17th Apr 2018
By - ZS, JB

Battery Data: PowerSafe Ogi - Lead Acid Battery
Part #: 3 Ogi 200
Specific Gravity: 1.24SG +/- 0.01 at 25°C at MAX Lever
Nominal Ah: 200Ah
Nominal V: 6V
Weight: 43kg
Float Foltage: 2.21v/c @ 25°C
Rated At: 197Ah @ 8 Hr Rate to 1.75v/c @ 25°C

Installation Date: Apr 2018

| | | |
|---|---|---|
| Cells 1,2,3. | PowerSafe. Ogi 200 | Installed April 18 - 17 |
| Cells 4, 5 | PowerSafe. Ogi 200 | Installed Nov 23 - 17 |
| Cells 6-20 | PowerSafe. Ogi 200 | Installed April 17 - 18 |

## General Specifications

| Battery Type | Nominal Voltage (V) | Nominal Capacity[1] | Nominal Dimensions Length in | Length mm | Width in | Width mm | Height in | Height mm | Typical Weight lbs | Typical Weight kg | Battery Short Circuit Current (Amps) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 OGi 200 | 6 | 197 | 10.71 | 272 | 8.07 | 205 | 15.20 | 385 | 95.87 | 43.50 | 4040 |

| Battery Type | Battery Short Circuit Current (Amps) | Cell Internal Resistance* Milli-Ohms | Electrolyte (1.240 S.G.) Volume (per jar) gal | Volume L | Weight (per jar) lbs | Weight kg | Pure Acid ($H_2SO_4$) Acid Volume (per jar) gal | Volume L | Weight (per jar) gal | Weight L | Lead Weight (per jar) lbs | Lead Weight kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 OGi 200 | 4040 | 0.50 | 1.22 | 4.63 | 12.65 | 5.74 | 0.29 | 1.09 | 4.32 | 1.96 | 71.59 | 32.47 |

**Charger** Primax , model# = P400TT-3-125-50 , ser# 3837 , Project # = 2579, built = 09 / 2006
AC = 208 v, 3PH , 24 Amp
DC = 125 v , 50 Amp Float = 133.8v
Imax = 50 Amps Eq = 141 v EQTime = 10 Hrs

Temperature of Cells

| Cell # | 2 | 17 | 32 | 47 | 59 |
|---|---|---|---|---|---|
| Temperature | 20.75 | 20.75 | 20.5 | 21 | 21 |

Average Cell Ten . 20.8
Temperature Correction Factor to add to Specific Gravity Readings -0.00056
Average Corrected Specific Gravity= 1.22

# WATERLOO NORTH HYDRO
## BATTERY LOAD AND BITE TEST REPORT SHEET

revapril 2017

## Station - HS A

Test Date - 17th Apr 2018
By - ZS, JB

**BITE Test**

| | | | | |
|---|---|---|---|---|
| | Average Cell Impedance = | | 508 | AC mOhms |
| +/-20%= | 406.57 | TO | 610 | AC mOhms |
| +/-10%= | 457.40 | TO | 559 | AC mOhms |
| | Initial Total Impedance of Bank = | | 34120 | AC mOhms |
| | Terminal Total Impedance of Bank = | | 43163 | AC mOhms |

| INITIAL | Specific Gravity | | Impedance (mohms) | | | Specific Gravity | | Impedance (mohms) | |
|---|---|---|---|---|---|---|---|---|---|
| Cell # | Hrydrometer | Corrected | Cell | Intercell | Cell # | Hrydrometer | Corrected | Cell | Intercell |
| 1 | 1.23 | 1.229 | 464 | 59 | 31 | 1.225 | 1.224 | 537 | 64 |
| 2 | 1.23 | 1.229 | 449 | 50 | 32 | 1.22 | 1.219 | 511 | 68 |
| 3 | 1.23 | 1.229 | 462 | 68 | 33 | 1.21 | 1.209 | 515 | 55 |
| 4 | 1.23 | 1.229 | 459 | 47 | 34 | 1.23 | 1.229 | 493 | 60 |
| 5 | 1.215 | 1.214 | 452 | 50 | 35 | 1.215 | 1.214 | 526 | 61 |
| 6 | 1.215 | 1.214 | 458 | 59 | 36 | 1.22 | 1.219 | 533 | 55 |
| 7 | 1.225 | 1.224 | 465 | 55 | 37 | 1.225 | 1.224 | 498 | 70 |
| 8 | 1.225 | 1.224 | 451 | 56 | 38 | 1.225 | 1.224 | 492 | 47 |
| 9 | 1.23 | 1.229 | 474 | 72 | 39 | 1.215 | 1.214 | 514 | 68 |
| 10 | 1.225 | 1.224 | 500 | 42 | 40 | 1.225 | 1.224 | 511 | 62 |
| 11 | 1.21 | 1.209 | 500 | 43 | 41 | 1.22 | 1.219 | 507 | 42 |
| 12 | 1.235 | 1.234 | 500 | 70 | 42 | 1.22 | 1.219 | 489 | 51 |
| 13 | 1.235 | 1.234 | 513 | 44 | 43 | 1.225 | 1.224 | 500 | 72 |
| 14 | 1.245 | 1.244 | 527 | 74 | 44 | 1.22 | 1.219 | 515 | 49 |
| 15 | 1.24 | 1.239 | 518 | 71 | 45 | 1.22 | 1.219 | 485 | 53 |
| 16 | 1.23 | 1.229 | 501 | 38 | 46 | 1.22 | 1.219 | 510 | 60 |
| 17 | 1.23 | 1.229 | 514 | 76 | 47 | 1.22 | 1.219 | 505 | 51 |
| 18 | 1.225 | 1.224 | 500 | 67 | 48 | 1.23 | 1.229 | 503 | 54 |
| 19 | 1.235 | 1.234 | 575 | 52 | 49 | 1.23 | 1.229 | 490 | 59 |
| 20 | 1.23 | 1.229 | 585 | 64 | 50 | 1.225 | 1.224 | 491 | 45 |
| 21 | 1.23 | 1.229 | 564 | 87 | 51 | 1.225 | 1.224 | 498 | 44 |
| 22 | 1.23 | 1.229 | 568 | 77 | 52 | 1.225 | 1.224 | 495 | 73 |
| 23 | 1.22 | 1.219 | 600 | 85 | 53 | 1.23 | 1.229 | 582 | 42 |
| 24 | 1.22 | 1.219 | 568 | 82 | 54 | 1.225 | 1.224 | 523 | 51 |
| 25 | 1.23 | 1.229 | 509 | 49 | 55 | 1.22 | 1.219 | 500 | 66 |
| 26 | 1.225 | 1.224 | 506 | 69 | 56 | 1.23 | 1.229 | 500 | 47 |
| 27 | 1.225 | 1.224 | 512 | 64 | 57 | 1.225 | 1.224 | 482 | 55 |
| 28 | 1.235 | 1.234 | 498 | 48 | 58 | 1.21 | 1.209 | 503 | 54 |
| 29 | 1.23 | 1.229 | 502 | 70 | 59 | 1.22 | 1.219 | 522 | 41 |
| 30 | 1.22 | 1.219 | 555 | 220 | 60 | 1.22 | 1.219 | 514 | |

**Battery Load Test setup**

| | |
|---|---|
| Amp Hour rating of bank= | 197 |
| Estimated duration of load test in Hours = | 8 |
| Discharge Test Current = | 24.625 |

| | |
|---|---|
| Actual duration of load test in Hours = | 8 |
| Capacity of Bank = | 100% |

| TERMINAL | Impedance (mohms) | | | Impedance (mohms) | |
|---|---|---|---|---|---|
| Cell # | Cell | Intercell | Cell # | Cell | Intercell |
| 1 | 700 | 41 | 31 | 716 | 59 |
| 2 | 624 | 54 | 32 | 663 | 60 |
| 3 | 647 | 77 | 33 | 685 | 59 |
| 4 | 624 | 45 | 34 | 652 | 50 |
| 5 | 644 | 63 | 35 | 689 | 57 |
| 6 | 648 | 55 | 36 | 737 | 60 |
| 7 | 647 | 61 | 37 | 638 | 75 |
| 8 | 627 | 60 | 38 | 636 | 56 |
| 9 | 632 | 63 | 39 | 680 | 64 |
| 10 | 600 | 45 | 40 | 639 | 60 |
| 11 | 621 | 50 | 41 | 679 | 62 |
| 12 | 610 | 66 | 42 | 666 | 58 |
| 13 | 616 | 53 | 43 | 669 | 57 |
| 14 | 626 | 86 | 44 | 668 | 48 |
| 15 | 612 | 70 | 45 | 680 | 60 |
| 16 | 681 | 47 | 46 | 565 | 60 |
| 17 | 662 | 63 | 47 | 655 | 35 |
| 18 | 653 | 76 | 48 | 652 | 44 |
| 19 | 655 | 46 | 49 | 617 | 68 |
| 20 | 672 | 63 | 50 | 651 | 42 |
| 21 | 640 | 81 | 51 | 622 | 55 |
| 22 | 664 | 89 | 52 | 647 | 69 |
| 23 | 696 | 72 | 53 | 647 | 42 |
| 24 | 659 | 84 | 54 | 676 | 54 |
| 25 | 652 | 37 | 55 | 672 | 62 |
| 26 | 646 | 59 | 56 | 724 | 59 |
| 27 | 675 | 63 | 57 | 754 | 55 |
| 28 | 648 | 53 | 58 | 660 | 79 |
| 29 | 704 | 59 | 59 | 680 | 47 |
| 30 | 781 | 107 | 60 | 734 | |

**WATERLOO NORTH HYDRO**

BATTERY LOAD AND BITE TEST REPORT SHEET

revapril 2017

## Station - HS A

Test Date - 17th Apr 2018

By - ZS, JB

**Battery Load Test** Load = 24.6 Amps Minimum Terminal Voltage Per Cell = 1.75

| | Initial | HOURLY READINGS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CELL # | Cell Volts | 1 Hour | 2 Hour | 3 Hour | 4 Hour | 5 Hour | 6 Hour | 7 Hour | 8 Hour | Term Volts |
| AVG | 2.153 | 2.02 | 2.00 | 1.99 | 1.98 | 1.96 | 1.94 | 1.91 | 1.90 | 1.97 |
| Bank Total | 128.4 | 120.9 | 120.3 | 119.4 | 118.6 | 117.7 | 116.7 | 115.5 | 114.2 | 117.8 |
| 1 | 2.206 | 2.028 | 2.015 | 2.001 | 1.987 | 1.97 | 1.953 | 1.933 | 1.913 | 1.966 |
| 2 | 2.208 | 2.03 | 2.017 | 2.002 | 1.988 | 1.971 | 1.954 | 1.934 | 1.914 | 1.969 |
| 3 | 2.205 | 2.027 | 2.014 | 1.999 | 1.985 | 1.969 | 1.951 | 1.932 | 1.911 | 1.967 |
| 4 | 2.206 | 2.03 | 2.016 | 2.002 | 1.988 | 1.972 | 1.955 | 1.936 | 1.916 | 1.97 |
| 5 | 2.207 | 2.029 | 2.015 | 1.999 | 1.985 | 1.969 | 1.951 | 1.932 | 1.911 | 1.968 |
| 6 | 2.209 | 2.032 | 2.018 | 2 | 1.986 | 1.97 | 1.952 | 1.933 | 1.912 | 1.968 |
| 7 | 2.204 | 2.028 | 2.015 | 2 | 1.986 | 1.97 | 1.952 | 1.932 | 1.912 | 1.968 |
| 8 | 2.206 | 2.029 | 2.018 | 2.003 | 1.989 | 1.973 | 1.955 | 1.936 | 1.915 | 1.972 |
| 9 | 2.207 | 2.031 | 2.02 | 2.005 | 1.992 | 1.975 | 1.958 | 1.938 | 1.918 | 1.975 |
| 10 | 2.184 | 2.019 | 2.007 | 1.993 | 1.981 | 1.965 | 1.949 | 1.931 | 1.912 | 1.97 |
| 11 | 2.18 | 2.015 | 2.003 | 1.988 | 1.976 | 1.961 | 1.44 | 1.926 | 1.908 | 1.966 |
| 12 | 2.183 | 2.018 | 2.008 | 1.993 | 1.981 | 1.966 | 1.95 | 1.931 | 1.913 | 1.971 |
| 13 | 2.184 | 2.02 | 2.01 | 1.996 | 1.984 | 1.969 | 1.953 | 1.935 | 1.917 | 1.974 |
| 14 | 2.183 | 2.02 | 2.011 | 1.997 | 1.984 | 1.968 | 1.953 | 1.934 | 1.916 | 1.975 |
| 15 | 2.185 | 2.021 | 2.012 | 1.998 | 1.986 | 1.971 | 1.955 | 1.937 | 1.919 | 1.978 |
| 16 | 2.137 | 2.01 | 2.001 | 1.986 | 1.973 | 1.957 | 1.94 | 1.919 | 1.897 | 1.961 |
| 17 | 2.137 | 2.009 | 2.001 | 1.986 | 1.972 | 1.957 | 1.94 | 1.92 | 1.899 | 1.962 |
| 18 | 2.123 | 2.009 | 2.001 | 1.986 | 1.973 | 1.957 | 1.94 | 1.92 | 1.899 | 1.962 |
| 19 | 2.16 | 2.016 | 2.005 | 1.989 | 1.975 | 1.959 | 1.941 | 1.921 | 1.901 | 1.968 |
| 20 | 2.161 | 2.015 | 2.005 | 1.989 | 1.975 | 1.958 | 1.941 | 1.921 | 1.9 | 1.968 |
| 21 | 2.162 | 2.017 | 2.007 | 1.991 | 1.977 | 1.961 | 1.944 | 1.924 | 1.904 | 1.971 |
| 22 | 2.164 | 2.015 | 2.001 | 1.985 | 1.971 | 1.954 | 1.937 | 1.917 | 1.896 | 1.969 |
| 23 | 2.165 | 2.015 | 2.001 | 1.985 | 1.971 | 1.954 | 1.937 | 1.917 | 1.897 | 1.968 |
| 24 | 2.166 | 2.015 | 2.001 | 1.985 | 1.971 | 1.954 | 1.937 | 1.918 | 1.897 | 1.969 |
| 25 | 2.147 | 2.011 | 2.002 | 1.988 | 1.975 | 1.958 | 1.942 | 1.921 | 1.9 | 1.966 |
| 26 | 2.138 | 2.009 | 2 | 1.986 | 1.973 | 1.958 | 1.941 | 1.921 | 1.901 | 1.966 |
| 27 | 2.132 | 2.008 | 1.999 | 1.984 | 1.971 | 1.955 | 1.938 | 1.918 | 1.896 | 1.963 |
| 28 | 2.143 | 2.01 | 2.001 | 1.986 | 1.973 | 1.957 | 1.94 | 1.92 | 1.898 | 1.965 |
| 29 | 2.126 | 2.008 | 2 | 1.986 | 1.969 | 1.955 | 1.938 | 1.917 | 1.894 | 1.961 |
| 30 | 2.113 | 2.001 | 1.991 | 1.977 | 1.963 | 1.945 | 1.927 | 1.905 | 1.88 | 1.951 |

Remarks -

New Batteries

| | Initial | HOURLY READINGS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CELL # | Cell Volts | 1 Hour | 2 Hour | 3 Hour | 4 Hour | 5 Hour | 6 Hour | 7 Hour | 8 Hour | Term Volts |
| AVG | | | | | | | | | | |
| | | | | | | | | | | |
| 31 | 2.125 | 2.09 | 2.001 | 1.987 | 1.974 | 1.958 | 1.942 | 1.921 | 1.9 | 1.967 |
| 32 | 2.14 | 2.012 | 2.003 | 1.987 | 1.976 | 1.956 | 1.944 | 1.924 | 1.903 | 1.971 |
| 33 | 2.13 | 2.006 | 2.002 | 1.988 | 1.975 | 1.958 | 1.941 | 1.92 | 1.989 | 1.968 |
| 34 | 2.128 | 2.012 | 2.002 | 1.989 | 1.976 | 1.959 | 1.943 | 1.24 | 1.903 | 1.969 |
| 35 | 2.131 | 2.013 | 2.004 | 1.986 | 1.976 | 1.954 | 1.942 | 1.921 | 1.898 | 1.972 |
| 36 | 2.126 | 2.011 | 2.001 | 1.987 | 1.976 | 1.956 | 1.938 | 1.915 | 1.89 | 1.968 |
| 37 | 2.139 | 2.014 | 2.005 | 1.991 | 1.978 | 1.962 | 1.947 | 1.927 | 1.907 | 1.973 |
| 38 | 2.141 | 2.009 | 2.003 | 1.988 | 1.977 | 1.959 | 1.944 | 1.923 | 1.901 | 1.973 |
| 39 | 2.131 | 2.011 | 2.002 | 1.989 | 1.976 | 1.959 | 1.943 | 1.923 | 1.902 | 1.973 |
| 40 | 2.137 | 2.013 | 2.003 | 1.989 | 1.977 | 1.961 | 1.945 | 1.926 | 1.906 | 1.973 |
| 41 | 2.125 | 2.011 | 2.002 | 1.987 | 1.974 | 1.952 | 1.941 | 1.92 | 1.898 | 1.971 |
| 42 | 2.136 | 2.011 | 2.004 | 1.99 | 1.977 | 1.95 | 1.944 | 1.905 | 1.903 | 1.973 |
| 43 | 2.119 | 2.012 | 2.002 | 1.988 | 1.975 | 1.959 | 1.943 | 1.922 | 1.901 | 1.971 |
| 44 | 2.13 | 2.011 | 2.002 | 1.988 | 1.975 | 1.959 | 1.943 | 1.923 | 1.902 | 1.973 |
| 45 | 2.135 | 2.015 | 2.006 | 1.99 | 1.979 | 1.956 | 1.946 | 1.925 | 1.904 | 1.977 |
| 46 | 2.134 | 2.01 | 2.001 | 1.987 | 1.975 | 1.959 | 1.942 | 1.923 | 1.902 | 1.972 |
| 47 | 2.133 | 2.01 | 2 | 1.986 | 1.973 | 1.956 | 1.94 | 1.92 | 1.899 | 1.97 |
| 48 | 2.125 | 2.012 | 2.003 | 1.989 | 1.976 | 1.959 | 1.943 | 1.922 | 1.901 | 1.973 |
| 49 | 2.136 | 2.014 | 2.005 | 1.991 | 1.978 | 1.962 | 1.947 | 1.927 | 1.908 | 1.974 |
| 50 | 2.131 | 2.012 | 2.002 | 1.988 | 1.976 | 1.959 | 1.943 | 1.923 | 1.902 | 1.973 |
| 51 | 2.128 | 2.013 | 2.004 | 1.99 | 1.977 | 1.961 | 1.945 | 1.926 | 1.906 | 1.975 |
| 52 | 2.13 | 2.013 | 2.004 | 1.99 | 1.977 | 1.954 | 1.945 | 1.926 | 1.906 | 1.976 |
| 53 | 2.134 | 2.012 | 2 | 1.989 | 1.976 | 1.955 | 1.944 | 1.924 | 1.903 | 1.974 |
| 54 | 2.117 | 2.011 | 2 | 1.987 | 1.974 | 1.957 | 1.941 | 1.92 | 1.899 | 1.972 |
| 55 | 2.126 | 2.009 | 2 | 1.986 | 1.973 | 1.956 | 1.94 | 1.919 | 1.897 | 1.971 |
| 56 | 2.124 | 2.012 | 2.002 | 1.988 | 1.975 | 1.957 | 1.94 | 1.918 | 1.893 | 1.975 |
| 57 | 2.127 | 2.012 | 2.002 | 1.981 | 1.973 | 1.955 | 1.937 | 1.913 | 1.884 | 1.974 |
| 58 | 2.125 | 2.013 | 2.003 | 1.987 | 1.976 | 1.958 | 1.943 | 1.922 | 1.9 | 1.975 |
| 59 | 2.188 | 2.01 | 1.997 | 1.987 | 1.974 | 1.957 | 1.941 | 1.921 | 1.899 | 1.974 |
| 60 | 2.188 | 2.01 | 2.001 | 1.987 | 1.974 | 1.957 | 1.941 | 1.92 | 1.899 | 1.974 |

Distribution Station:

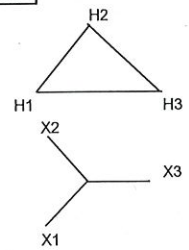
Sample Transformer Test Record

Waterloo North Hydro Inc.

revTTjuly04

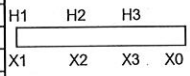
## STATION- R27

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | Commonwealth Electric | | | | |
| SERIAL # = | 24500 | Type | ONAN , FREE BREATHING , SILICA BREATHER | | |
| KVA = | 3600 | BUILT- | 1947 | Weight with oil | 40,000 lbs |
| PRIM volts = | 26400 / 13200 | OIL in GAL = | 1485 | Weight empty | 27300 lbs |
| SEC. volts = | 8000/4624 | PRIM. BIL = | | | |
| # PRI TAPS = | 5 | SEC. BIL = | | | |
| IMPEDANCE = | 6.15% | HZ = | 25 / 60 | | |




**Taps**

| H.V. POS | HIGH VOLTS | LOW VOLTS | CALC RATIO |
|---|---|---|---|
| 1 | 26400 | 4624 | 5.7093 |
| 2 | 25740 | 4624 | 5.5666 |
| 3 | 25080 | 4624 | 5.4239 |
| 4 | 24420 | 4624 | 5.2811 |
| 5 | 23760 | 4624 | 5.1384 |




| | Final | Init. | Final | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | June 14 - 96 | July 16 - 04 | Aug 3 - 04 | Sept 30 - 08 | 1-Jun-17 | | | | |
| Tested by | KJM TT | MD TT | TT | TT | MG | | | | |
| LIQ.TEMP = | 22C | 20C | 24C | 15C | 18C | | | | |
| AIR TEMP = | 22C | 22C | 25C | 15C | 18C | | | | |
| Weather conditions | | sunny , dry | humid 76% | cloudy/rain, 75% | Sunny & Windy | | | | |
| FOUND ON TAP | 2 | 2 | 2 | 2 | 2 | | | | |
| LEFT ON TAP | 2 | 2 | 2 | 2 | 2 | | | | |
| | Oil work | Regasket lid | | painted Tx | Gnd Grid Upgrade | | | | |
| **INSULATION RESISTANCE TEST** | | | | | | | | | |
| MEGOHMS @ 1000 VDC FOR 2 MIN. | | | | | | | | | |
| C.F. TO 20 C = | 1.2 | 1 | 1.5 | 0.72 | 0.9 | 1 | 1 | 1 | 1 |
| HI to Low&Gnd , measured = | 8000 | 5000 | 5000 | 15000 | 8600 | | | | |
| HI to Low&Gnd , corrected = | 9,600 | 5,000 | 7,500 | 10,800 | 7,740 | 0 | 0 | 0 | 0 |
| Low to Hi&Gnd , measured = | 4800 | 4500 | 3000 | 10000 | 4770 | | | | |
| Low to Hi&Gnd , corrected = | 5,760 | 4,500 | 4,500 | 7,200 | 4,293 | 0 | 0 | 0 | 0 |
| Core to gnd , measured = | | | | | | | | | |
| Core to gnd , corrected = | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIN ALLOWED 900M | | | | | | | | | |
| **Cap & DF** cap in pf | | | | | | | | | |
| C.F. TO 20 C = | 0.91 | 1 | 0.79 | 1.2 | 1.08 | 1 | 1 | 1 | 1 |
| DF in % , 2% or less is good | | | | | | | | | |
| CH-L , CH-G Cap = | 6002 | 5972 | 5992 | 5970 | 5866 | | | | |
| DF meas. = | 1.33 | 1.05 | 1.33 | 0.878 | 0.421 | | | | |
| DF corrected = | 1.210 | 1.050 | 1.051 | 1.054 | 0.455 | 0.000 | 0.000 | 0.000 | 0.000 |
| CH-G Cap = | 1522 | 1520 | 1518 | 1521 | 1510 | | | | |
| DF meas. = | 0.641 | 0.446 | 0.61 | 0.391 | 0.235 | | | | |
| DF corrected = | 0.583 | 0.446 | 0.482 | 0.469 | 0.254 | 0.000 | 0.000 | 0.000 | 0.000 |
| CH-L Cap = | 4483 | 4459 | 4478 | 4448 | 4361 | | | | |
| DF meas. = | 1.57 | 1.28 | 1.57 | 1.04 | 0.503 | | | | |
| DF corrected = | 1.429 | 1.280 | 1.240 | 1.248 | 0.543 | 0.000 | 0.000 | 0.000 | 0.000 |
| CL-G Cap = | 6035 | 6094 | 6020 | 6077 | 5953 | | | | |
| DF meas. = | 1.85 | 1.48 | 1.84 | 1.26 | 0.695 | | | | |
| DF corrected = | 1.684 | 1.480 | 1.454 | 1.512 | 0.751 | 0.000 | 0.000 | 0.000 | 0.000 |
| CL-H , CL-G Cap = | 10514 | 10548 | 10496 | 10522 | 10316 | | | | |
| DF meas. = | 1.71 | 1.35 | 1.71 | 1.15 | 0.604 | | | | |
| DF corrected = | 1.556 | 1.350 | 1.351 | 1.380 | 0.652 | 0.000 | 0.000 | 0.000 | 0.000 |
| **WINDING RESISTANCE** | | | | | | | | | |
| READING IN m OHMS | | | | | | | | | |
| Pri tap = | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| test current (mA) = | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| H1-H2= | 1335 | 1151 | 1104 | 1081 | 1126 | | | | |
| H2-H3= | 1323 | 1290 | 1104 | 1079 | 1246 | | | | |
| H3-H1= | 1390 | 1231 | 1107 | 1080 | 1155 | | | | |
| X1-X0= | 33 | 32 | 32 | 32 | 31.39 | | | | |
| X2-X0= | 32 | 32 | 32 | 32 | 31.38 | | | | |
| X3-X0= | 33 | 32 | 32 | 32 | 32.18 | | | | |
| **RATIOMETER READINGS** | | | | | | | | | |
| calc.Tap ratio = | 5.5666 | 5.5666 | 5.5666 | 5.5666 | 5.5666 | | | | |
| Red X1 - X0 H1 - H2 Ratio = | 5.607 | 5.607 | 5.607 | 5.6065 | 5.601 | | | | |
| % error = | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| Phase= | 0.03 | 0.04 | 0.04 | -0.39 | -0.21 | | | | |
| mAmps= | 18 | 17 | 17 | 10.9 | 11.5 | | | | |
| White X2 - X0 H2 - H3 Ratio = | 5.608 | 5.607 | 5.607 | 5.6068 | 5.609 | | | | |
| % error = | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| Phase= | 0.04 | 0.04 | 0.04 | -0.34 | -0.21 | | | | |
| mAmps= | 17 | 14 | 14 | 11 | 10.1 | | | | |
| Blue X3 - X0 H3 - H1 Ratio = | 5.609 | 5.607 | 5.607 | 5.6068 | 5.603 | | | | |
| % error = | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| Phase= | 0.03 | 0.04 | 0.04 | -0.39 | -0.22 | | | | |
| mAmps= | 21 | 18 | 18 | 8.74 | 12.6 | | | | |

80V test

**Comments**

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723583 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 27.6 | Sampling Point: | MAIN |
| Location: | DS27 | MVA: | 2 | Oil Temp. (°C): | 22 |
| Equipment No: | 24500 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 24500 | Year built: | 1947 | Sampling Date: | 2019-03-19 07:25 |
| Additional info: | | | | | |
| Description: | TX | | | | |

## DGA

| 2018-06-26 | 2019-03-19 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|
| *54* | **40** | Hydrogen | | D3612-17 |
| *5* | **4** | Acetylene | | ppm (V/V) |
| *6* | **6** | Ethane | | at 273 K |
| *20* | **20** | Ethylene | | and 760 Torr |
| *9* | **10** | Methane | | |
| *439* | **513** | Carbon Monoxide | | |
| *3749* | **4287** | Carbon Dioxide | | |
| *69247* | **101189** | Nitrogen | | |
| *12980* | **22999** | Oxygen | | |
| *533* | **593** | TDCG (ppm) | | |
| *8.65* | **12.91** | Total Dissolved Gas (%) | | |

## OIL QUALITY

| | Previous | 2019-03-19 | Parameter | Screening Code(T/R) | Test Method |
|---|---|---|---|---|---|
| | | | Moisture in Oil (ppm) | | WI017-00 |
| 2018-06-26 | *20* | **8** | Moisture in Oil (ppm) | | D 1533-12 |
| 2018-06-26 | *27.8* | **28.2** | Interfacial Tension (mN/m) | | D 971-12 |
| 2018-06-26 | *0.05* | **0.06** | Acid Number (mg KOH/g) | | D 974-14e2 |
| 2018-06-26 | *<2.0* | **<2.0** | Color Number | | D1500-12 |
| 2018-06-26 | *Pass* | **Pass** | Visuál Examination | | D 1524-15 |
| 2018-06-26 | *57* | **51** | Dielectric Breakdown (kV) | | D 877-13 |
| | | | Dielectric Breakdown 2 mm (kV) | | D 1816-12 |
| 2018-06-26 | *0.063* | **0.030** | Power Factor @ 25 °C (%) | | D 924-15 |
| | | | Power Factor @ 100 °C (%) | | D 924-15 |
| 2018-06-26 | *0.8632* | **0.8656** | Specific Gravity | | D 1298-12b |
| | | | Oxidation Inhibitor DBP (wt. %) | | D 4768-11 |
| | | | Oxidation Inhibitor DBPC (wt. %) | | D 4768-11 |
| | | | PCB - Total Arochlor Content (ppm) | | D 4059-2018 |
| | | | Corrosive Sulphur Copper | | D 1275-15 |
| | | | 5-hydroxymethyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | furfuryl alcohol (ppb) | | D 5837-15 |
| | | | 2-furaldehyde (ppb) | | D 5837-15 |
| | | | 2-acetylfuran (ppb) | | D 5837-15 |
| | | | 5-methyl-2-furaldehyde (ppb) | | D 5837-15 |
| | | | Methanol (ppb) | | |
| | | | Ethanol (ppb) | | |

COMMENTS:

**** Morgan Schaffer is an ISO/IEC 17025 accredited laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

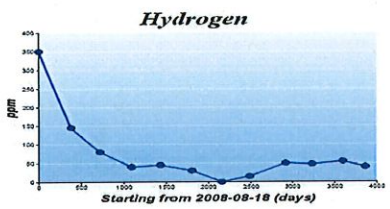
## REFERENCE

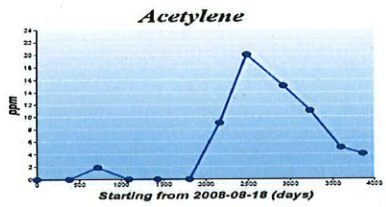
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723583 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

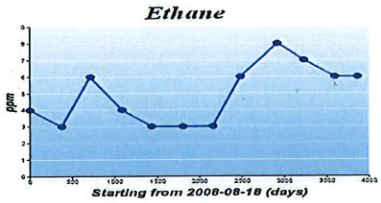
## EQUIPMENT

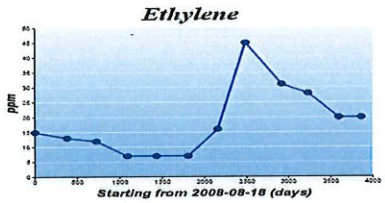
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 27.6 | Sampling Point: | MAIN |
| Location: | DS27 | MVA: | 2 | Oil Temp. (°C): | 22 |
| Equipment No: | 24500 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 24500 | Year built: | 1947 | Sampling Date: | 2019-03-19 07:25 |
| Additional info: | | | | | |
| Description: | TX | | | | |

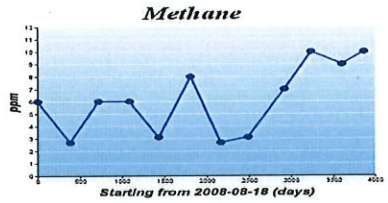
## TRENDING

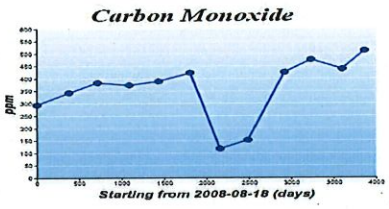


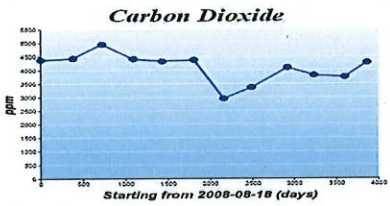



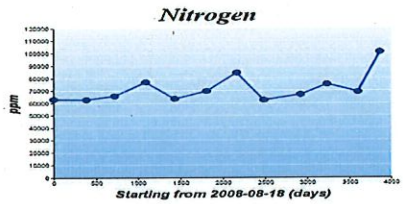



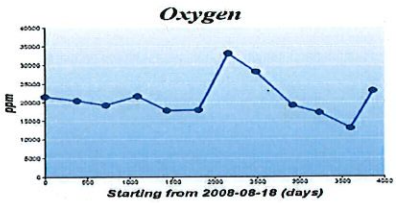



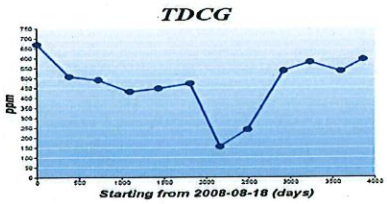



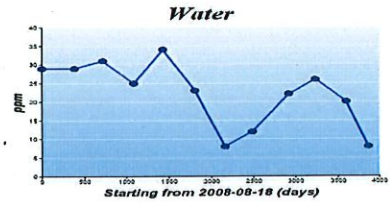




**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

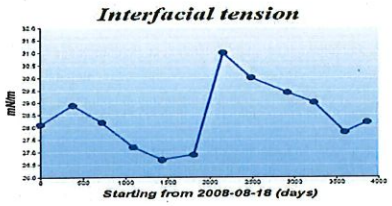
## REFERENCE

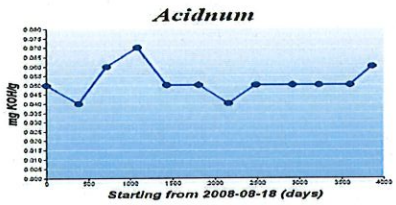
| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723583 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | BG |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

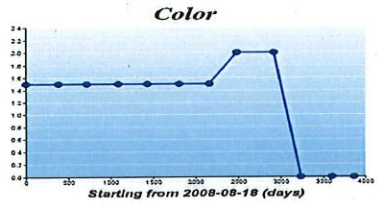
## EQUIPMENT

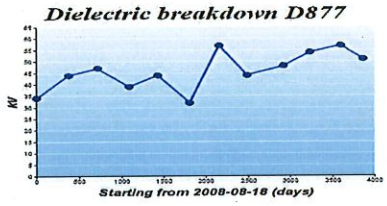
| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 27.6 | Sampling Point: | MAIN |
| Location: | DS27 | MVA: | 2 | Oil Temp. (°C): | 22 |
| Equipment No: | 24500 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 24500 | Year built: | 1947 | Sampling Date: | 2019-03-19 07:25 |
| Additional info: | | | | | |
| Description: | TX | | | | |

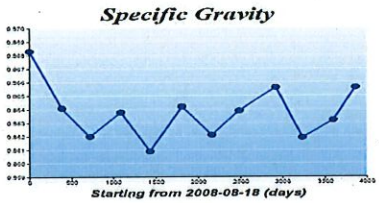
## TRENDING

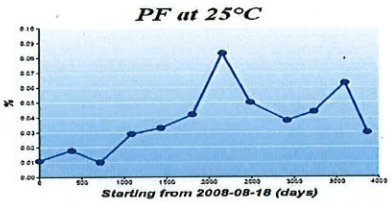



**** Morgan Schaffer is an ISO/IEC 17025 certified laboratory ****

MORGAN SCHAFFER
A DOBLE COMPANY

doble

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

# OIL ANALYSIS REPORT

## REFERENCE

| | | | | | |
|---|---|---|---|---|---|
| Client: | Mr. Rade Breberina (CWA01) | P.O. No | 53145 | Sample No: | M0723583 |
| E-mail: | rbreberina@wnhydro.com | Work Order | | Authorized by: | |
| Company: | Waterloo North Hydro | | | Sent Date: | 2019-04-03 |

## EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Apparatus Type: | TRN | KV: | 27.6 | Sampling Point: | MAIN |
| Location: | DS27 | MVA: | 2 | Oil Temp. (°C): | 22 |
| Equipment No: | 24500 | Oil type: | Mineral Oil | Sampled by: | J.Bearss |
| Serial No.: | 24500 | Year built: | 1947 | Sampling Date: | 2019-03-19 07:25 |
| Additional info: | | | | | |
| Description: | TX | | | | |

## GAS THRESHOLDS

| Gas | Input | DORNENBURG & STRITTMATTER | U.S. BUREAU OF RECLAMATION |
|---|---|---|---|
| Hydrogen($H_2$) | 40 | - | - |
| Carbon Monoxide(CO) | 513 | + | - |
| Methane($CH_4$) | 10 | - | - |
| Carbon Dioxide($CO_2$) | 4287 | - | - |
| Ethylene($C_2H_4$) | 20 | - | - |
| Ethane($C_2H_6$) | 6 | - | - |
| Acetylene($C_2H_2$) | 4 | - | + |

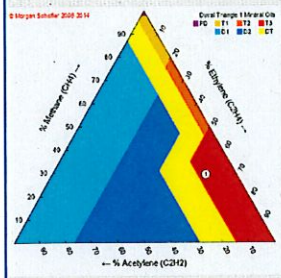
+ above the limit - below the limit

## RATIOS INDICATORS

| Ratio | Value | Indication |
|---|---|---|
| $C_2H_2/H_2$ | 0.1 | DISCHARGE AND HEATING |
| $H_2/C_2H_6$ | 0.1 | NOT CALCULATED |
| $C_2H_2/CH_4$ | 0.4 | ARCING |
| $CO_2/CO$ | 8.357 | PROBABLY NORMAL AGING |
| $C_2H_6/C_2H_2$ | 1.5 | DISCHARGE AND HEATING |
| $CH_4/H_2$ | N/A | NOT CALCULATED |
| $C_2H_4/C_2H_2$ | 5 | OVERHEATING |

## DUVAL TRIANGLE DIAGNOSTIC

| CH4(ppm) | C2H4(ppm) | C2H2(ppm) | H2(ppm) | C2H6(ppm) |
|---|---|---|---|---|
| 10 | 20 | 4 | 40 | 6 |




T3 - Thermal faults, temperature above 700°C

*** *Morgan Schaffer is an ISO/IEC 17025 accredited laboratory* ***

Distribution:

Sample Capacitor Bank Inspection Record

| SubtypeCD | FacilityID | Address | Installati | FeederID_1 | EnergizedP | Date Inspected | Comments |
|---|---|---|---|---|---|---|---|
| Fixed Bank Capacitor | C-27-4412 | 13 MENNO ST | 2010 | 21M25 | RWB | Sept 21st/16 | ~~Down ground missing~~ repaired |
| Fixed Bank Capacitor | C-14-4138 | COLUMBIA ST | 2006 | 3F-51 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-27-4152 | 2925 KRESSLER RD | 2006 | 3F-68 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-27-4151 | 161 HAWKESVILLE RD | 2006 | 3F-63 | RWB | Sept 21st/16 | Replaced Ø markers |
| Fixed Bank Capacitor | C-27-4164 | HENRY ST & RAILWAY | 2006 | 3F-63 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-14-4148 | UNIVERSITY AVE & PORTSMOUTH GATE | 2006 | ER-44 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-14-4136 | 250 KEATS WAY | 2006 | ER-45 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-14-4147 | 101 FATHER DAVID BAUER DR | 2006 | ER-45 | RWB | Sept 20th/16 | No damages found |
| Fixed Bank Capacitor | C-14-4153 | 350 ERBSVILLE RD | 2006 | ER-43 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-14-4149 | 590 ERBSVILLE CRT | 2006 | ER-48 | RWB | Sept 21st/16 | Replaced Ø markers |
| Fixed Bank Capacitor | C-14-4157 | 580 NORTHFIELD DR W | 2006 | HS-10 | RWB | Sept 20th/16 | Needs phase markers ✓ repaired |
| Fixed Bank Capacitor | C-14-4158 | 100 BRIDLE TRAIL | 2006 | HS-11 | RWB | Sept 20th/16 | No damages found |
| Fixed Bank Capacitor | C-14-4173 | 188 KING ST N | 2006 | HS-12 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4160 | 460 PHILLIP ST | 2006 | HS-13 | RWB | Sept 20th/16 | Down ground missing (110 cu) Repaired CR/ZF 28/9/16 |
| Fixed Bank Capacitor | C-14-4174 | 200 UNIVERSITY AVE E | 2006 | HS-14 | RWB | Sept 20th/16 | No damages found |
| Fixed Bank Capacitor | C-14-4177 | 120 NORTHFIELD DR E | 2006 | HS-15 | RWB | Sept 20th/16 | Needs phase markers ✓ + wood moulding repaired |
| Fixed Bank Capacitor | C-14-4162 | 435 KING ST N | 2006 | HS-16 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4139 | 622 NORTHFIELD DR W | 2006 | 3F-50 | RWB | Sept 20th/16 | St. Jacobs Market sign covering fuse Repaired CR/ZF 28/9/16 |
| Fixed Bank Capacitor | C-14-4159 | 400 PHILLIP ST | 2009 | HS-18 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4166 | 55 BARHURST DR | 2006 | HS-21 | RWB | Sept 20th/16 | Needs phase markers ✓ repaired |
| Fixed Bank Capacitor | C-14-4167 | 295 UNIVERSITY AVE | 2006 | HS-22 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4172 | DAVENPORT RD AT ZEHRS | 2006 | HS-23 | RWB | Sept 20th/16 | Needs phase markers ✓ repaired |
| Fixed Bank Capacitor | C-14-4161 | 400 FORWELL CREEK RD | 2006 | HS-24 | RWB | Sept 20th/16 | Needs wood moulding REPAIRED WP/KS 26/9/16. |
| Fixed Bank Capacitor | C-27-4175 | 250 UNIVERSITY AVE | 2006 | HS-26 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-27-4176 | 726 UNIVERSITY AVE | 2006 | HS-26 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-27-4427 | 537 SAWMILL RD | 2010 | HS-26 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-14-4165 | 92 ERB ST E | 2006 | HS-27 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4178 | 300 HAZEL ST | 2006 | HS-29 | RWB | Sept 20th/16 | Needs phase markers ✓ repaired |
| Fixed Bank Capacitor | C-14-4179 | 20 COLUMBIA ST W | 2006 | HS-30 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4154 | 605 RANDALL DR | 2006 | HS-7 | RWB | Sept 20th/16 | Down ground cut (#4 down ground) + needs phase markers REPAIRED WP/ |
| Fixed Bank Capacitor | C-8-4282 | 6280 DEBORAH GLAISTER LN | 0 | R26-2 | R | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-8-11 | 2335 HUTCHISON RD | 0 | R26-2 | RWB | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-8-14 | 5295 BUEHLER LINE | 0 | R27-2 | W | Sept 21st/16 | No damage found |
| Fixed Bank Capacitor | C-8-4766 | 5362 WOOLWICH-GUELPH TOWLINE RD | 2013 | R32-3 | B | Sept 21st/16 | Pole needs shrubs removed |
| Fixed Bank Capacitor | C-14-4155 | 645 MCMURRAY RD | 2006 | HS-28 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-14-4137 | BEARINGER RD & HAGEY BLVD | 2006 | 3F-50 | RWB | Sept 20th/16 | No damage found |
| Fixed Bank Capacitor | C-8-5211 | 5790 SCHUMMER LINE | 2015 | R27-2 | B | Sept 21st/16 | No damages |
| Fixed Bank Capacitor | C-14-4156 | 565 CONESTOGA RD | 2006 | HS-9 | RWB | Sept 20th/16 | Needs phase markers ✓ + wood moulding Repaired CR/ZF 28/9/16 |
| Fixed Bank Capacitor | C-14-4134 | 13 ROSLIN AVE N | 2006 | ER-46 | RWB | Sept 20th/16 | Needs wood moulding REPAIRED WP/KS 26/9/16. |
| Fixed Bank Capacitor | C-14-4140 | 33 ALLEN ST E | 0 | HS-27 | RWB | Sept 20th/16 | No damages found |
| Switched Bank Capacitor | C-14-4264 | 255 WEBER ST N | 2008 | HS-10 | RWB | Sept 20th/16 | Needs wood moulding REPAIRED WP/KS 26/9/16. |
| Switched Bank Capacitor | C-14-4262 | 200 WEBER ST N | 2008 | HS-24 | RWB | Sept 20th/16 | No damage found |
| Switched Bank Capacitor | C-14-4263 | 235 FROBISHER DR | 2008 | HS-28 | RWB | Sept 20th/16 | phase markers R.W.B ✓ + wood moulding required. Repaired CR/ZF 28/ |
| Switched Bank Capacitor | C-14-4265 | 603 KUMPF DR | 2008 | HS-7 | RWB | Sept 20th/16 | No damage found |
| Switched Bank Capacitor | C-8-4224 | 5055 AMENT LINE | 2007 | R27-2 | RWB | Sept 21st/16 | No damages |
| Switched Bank Capacitor | C-8-4222 | 3240 MANSER RD | 2007 | R27-2 | RWB | Sept 21st/16 | No damages |

C-8-5211 ~~Schummer Line~~

Distribution:

Sample Pole Inspection Record

# POLE INSPECTION

| | |
|---|---|
| OBJECTID * | 16 |
| SHAPE * | Point |
| Construction Status | In Service |
| Subtype | 1 |
| FacilityID * | 71613 |
| Owner | Waterloo North Hydro |
| Material | Pine |
| Height | 50' |
| NumberOfCircuits | 0.3 |
| InstallationYear | 2016 |
| Pole_Top_Condition | 5 |
| Pole_Middle_Condition | 5 |
| Pole_Bottom_Condition | 5 |
| Pole_Surrounding | 5 |
| Assembly_Xarm_Condition | N/A |
| Assembly_Hardware_Condition | 5 |
| Assembly_Insulator_Condition | 5 |
| Assembly_Arrestor_Condition | N/A |
| Assembly_Conductor_Condition | 5 |
| Supports_Guy_Condition | 5 |
| Supports_GuyGuard_Condition | 5 |
| Supports_Grounding_Condition | N/A |
| ThirdPartyRoadTopRegular | Rogers |
| ThirdPartyRoadTopOverlash | N/A |
| ThirdPartyRoadMidRegular | Rogers |
| ThirdPartyRoadMidOverlash | N/A |
| ThirdPartyRoadBottomRegular | Bell |
| ThirdPartyRoadBottomOverlash | N/A |
| PowerSupply | N/A |
| InspectionComments | <Null> |
| Pole_Replacement | <Null> |
| Pole_Surrounding_Repair | <Null> |
| Assembly_Xarm_Repair | <Null> |
| Assembly_Hardware_Repair | <Null> |
| Assembly_Insulator_Repair | <Null> |
| Assembly_Arrestor_Repair | <Null> |
| Assembly_Conductor_Repair | <Null> |
| Supports_Guy_Repair | <Null> |
| Supports_GuyGuard_Repair | <Null> |
| Supports_Grounding_Repair | <Null> |
| RepairComments | <Null> |
| InspectionStatus * | Inspected |
| RepairStatus | <Null> |
| ThirdPartyFieldRegular | N/A |
| ThirdPartyFieldOverlash | N/A |

# POLE INSPECTION

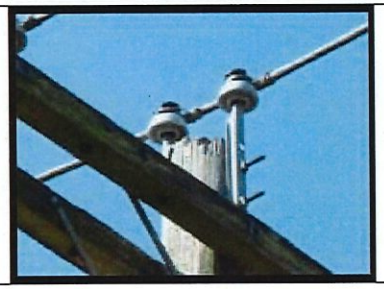
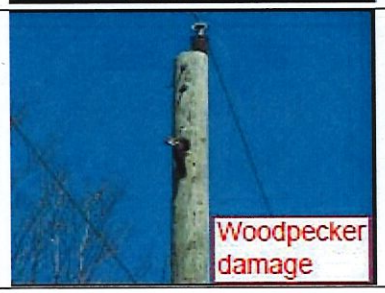
| | |
|---|---|
| GlobalID * | {C69B99FF-3D82-450A-986F-40BAC0E01254} |
| Inspected_By | Ken Stephens |
| Date_of_Inspection | 5/27/2020 14:19 |
| NUH_Claimed_By | <Null> |
| Date_of_Repair | <Null> |
| CreationDate * | 4/21/2020 18:18 |
| Creator * | smacdonald_WNH |
| EditDate * | 5/27/2020 14:19 |
| Editor * | dyoung_WNH |

## POLES

| | Collector Fields | Domain | Default Value | Data Type | Things to Check | Inspection Format |
|---|---|---|---|---|---|---|
| Asset Inventory | ConstructionStatus | ConstructionStatus - Poles | | Long Integer - 5 | Populated from GIS | NOT EDITABLE ON FORM |
| | SubtypeCD | N/A | | Long Integer | Populated from GIS | NOT EDITABLE ON FORM |
| | FacilityID | N/A | | Text - 20 | Populated from GIS | NOT EDITABLE ON FORM |
| | Owner | Owner - Poles | | Text - 20 | Populated from GIS | NOT EDITABLE ON FORM |
| | Material | Pole Wood Material | | Text - 5 | Populated from GIS | NOT EDITABLE ON FORM |
| | Height | Pole Height | | Text - 5 | Populated from GIS | NOT EDITABLE ON FORM |
| | NumberOfCircuits | Circuit Count | | Long Integer | Populated from GIS | NOT EDITABLE ON FORM |
| | InstallationYear | N/A | | Long Integer | Populated from GIS | NOT EDITABLE ON FORM |
| Asset Conditions | Pole_Top_Condition | 1-5 | | Text - 5 | split, crack, holes | |
| | Pole_Middle_Condition | 1-5 | | Text - 5 | split, crack, fracture, buckling, holes, scalling, cut | |
| | Pole_Bottom_Condition | 1-5 | | Text - 5 | rot, decay, degradation, damage | |
| | Pole_Surrounding | 1-5 | | Text - 5 | Grading changes, in water, vegetation | |
| Assemblies & Supports | Assembly_Xarm_Condition | 1,3,5, N/A | | Text - 5 | Split, degradation, burn dagmage | |
| | Assembly_Hardware_Condition | 1,3,5 | | Text - 5 | Loose, broken, missing, worn | |
| | Assembly_Insulator_Condition | 1,3,5, N/A | | Text - 5 | broken, crack, flashed, erosion, un_attached | |
| | Assembly_Arrestor_Condition | 1,3,5, N/A | | Text - 5 | broken, missing | |
| | Assembly_Conductor_Condition | 1,3,5, N/A | | Text - 5 | primary, secondary, cable terminations, cable gurad | |
| | Supports_Guy_Condition | 1,3,5, N/A | | Text - 5 | guy wire loose, damage, corrode, rust | |
| | Supports_GuyGuard_Condition | 1,3,5, N/A | | Text - 5 | missing, off_position | |
| | Supports_Grounding_Condition | 1,3,5, N/A | | Text - 5 | Ground wire missing, damage, erosion, cut/stolen | |
| Attachment | ThirdPartyRoadTopRegular | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyRoadTopOverlash | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyRoadMidRegular | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyRoadMidOverlash | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyRoadBottomRegular | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyRoadBottomOverlash | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyFieldRegular | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | ThirdPartyFieldOverlash | Foreign Attachment Owner | | Text - 15 | R,A,B,T,H1,Z,N/A,Unknown | |
| | PowerSupply | PowerSupply | | Text - 15 | R,B,Traffic,N/A,Unknown | |
| Repair | Pole_Replacement | Y/N | | Text - 5 | Y/N | HIDDEN ON FORM |
| | Pole_Surrounding_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Assembly_Xarm_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Assembly_Hardware_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Assembly_Insulator_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Assembly_Arrestor_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Assembly_Conductor_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Supports_Guy_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Supports_GuyGuard_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Supports_Grounding_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| Admin | InspectionComments | Text | | Text - 255 | | |
| | InspectionStatus | InspectStatus | | Text - 15 | To Inspect, Inspected | |
| | RepairComments | Text | | Text - 255 | | HIDDEN ON FORM |
| | RepairStatus | RepairStatus | | Text - 15 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | GlobalID | Text | | System Generated | | HIDDEN ON FORM |
| | Inspected_By | Inspectors | | Text - 50 | Line supervisor initials | NEW |
| | Date of Inspection | | | Date | Specific date, current date | NEW |
| | NUH_Claimed_By | Inspectors | | Text - 50 | Line supervisor initials | HIDDEN ON FORM |
| | Date of Repair | | | Date | Specific date, current date | HIDDEN ON FORM |

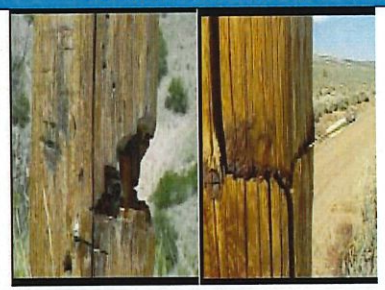
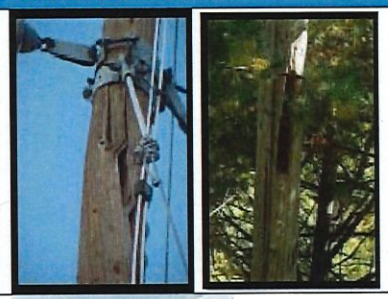
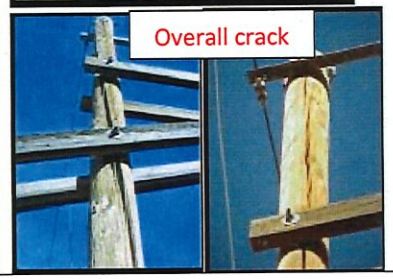
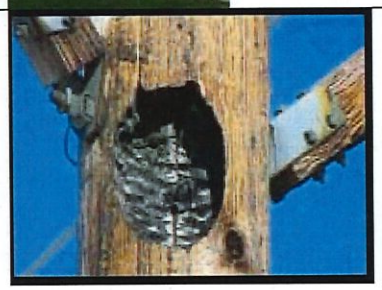
**<u>Things to check:</u> pole top rot, decay, feathering, split, crack, holes, and etc.**

## Condition Grade - Pole Top

| | | | | |
|---|---|---|---|---|
| Grade 1 |  |  |  | |
| Grade 2 |  |  |  | |
| Grade 3 & 4 |  |  |   |  |

<u>Things to check:</u> **split, crack, fracture, buckling, holes, scaling, cut, fire damage and etc.**

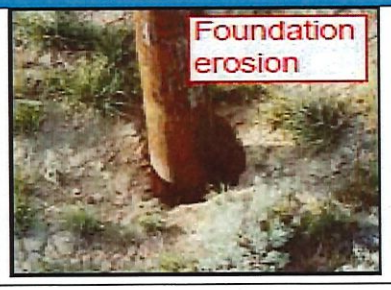
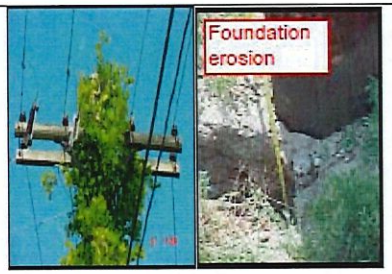
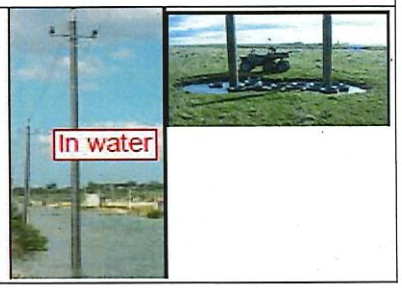
## Condition Grade - Pole Middle Portion

| | | | | |
|---|---|---|---|---|
| Grade 1 |  |  |  | |
| Grade 2 |  |  |  | |
| Grade 3 & 4 |    |  |  |   |

**<u>Things to check:</u> rot, decay, degradation, damage, and etc.**

## Condition Grade - Pole Bottom (Ground Line)

| | | | | |
|---|---|---|---|---|
| Grade 1 |  |  |  |  |
| Grade 2 |  |  |   | |
| Grade 3 & 4 |  |   | | |

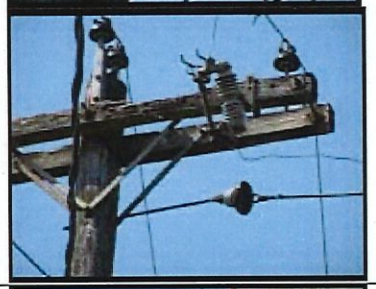
| Condition Grade - Pole Surrounding | | | | |
|---|---|---|---|---|
| Grade 1 |  |   | | |
| Grade 2 | | | | |
| Grade 3 & 4 |  |   |  |   |

Pole Surrounding condition category is more focused on the conditions that are external to pole itself, such as the soil and the grading, the vegetation around the pole, the location of the pole whether in a ditch or in water, pole is badly leaning due to earth settle or poor installation etc.

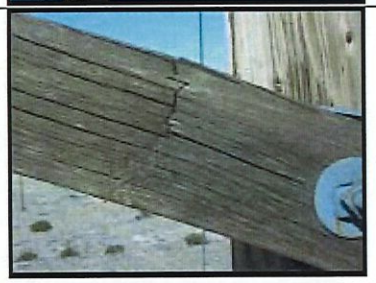
Pole surrounding conditions contribute to more criticality and safety aspects of the asset rather than the health index and the remaining life of the asset.

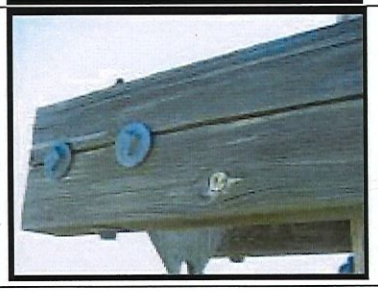
## Condition Grade – Assemblies & Supports

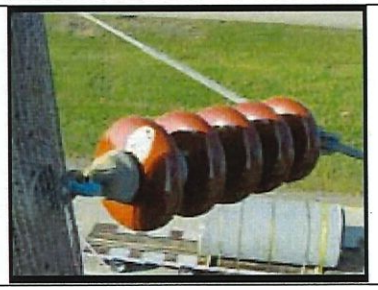
**Grade 1**




**Grade 3**







Distribution:

Sample Underground Cable Inspection Record

## UG CABLE INSPECTIONS

| | |
|---|---|
| Cable Number | M46 |
| From | SC-62 W3 |
| To | SC-60 |
| GIS Object | 951 |
| Phase | W |
| System Voltage (kV) | 13.8kv |
| Cable Length, from TDR (m) | 72.87 |
| Voltage Rating (kV) | 15kv |
| Conductor Size | 1/0 |
| Conductor Material | CU |
| Insulation Type (XLPE or TR-XLPE) | XLPE |
| Insulation Thickness (100% or 133%) | 100% |
| Jacketed or Unjacketed | JACKETED |
| Estimated Year of Install | 1989 |
| Civil Installation | DIRECT BURIED |
| Number of Splices | 0 |
| Splice Location from Device 1 (m) | 0 |
| Final %Q | 9 |
| Condition | Good |
| Date Tested | 28/11/19 |
| Notes | |

Distribution:

Sample Padmounted, Vault or Submersible Inspection Record

# OEB Inspection Template - Padmounted, Vault or Submersible Transformer

| | |
|---|---|
| OBJECTID * | 213 |
| SHAPE * | Point |
| SubtypeCD | 5 |
| Facility ID | 10981 |
| Operating Voltage | 8.0 kV |
| Construction Status | In Service |
| Phase Designation | B |
| Rated kVA | 50 |
| Low Side Voltage | 120/240 V |
| Owner | WNH |
| Address | 436 STILLMEADOW CIR |
| InstallationYear | 1996 |
| Tx_Enclosure_Condition | 5 |
| Tx_Placement_Condition | 5 |
| Tx_Foundation_Condition | 5 |
| Tx_OilLeak_Condition | 5 |
| Tx_GradingChanges | 5 |
| Tx_AccessChanges | 5 |
| Is_Nomenclature_Correct | Yes |
| Nomenclature_Condition | 5 |
| Bushing_Condition | 5 |
| HVLV_Spade_Condition | 5 |
| Termination_Condition | 5 |
| Arrestor_Condition | N/A |
| Lock_Bolt_Condition | 5 |
| PowerSupply_To | N/A |
| Grounding_Condition | 5 |
| InspectionComments | <Null> |
| InspectionStatus | Inspected |
| GlobalID * | {E8AD3D36-8CDA-4E70-80AC-ED0DB36B08DF} |
| CreationDate * | 10/11/2019 16:31 |
| Creator * | smacdonald_WNH |
| EditDate * | 11/29/2019 14:40 |
| Editor * | smiller_wnh |

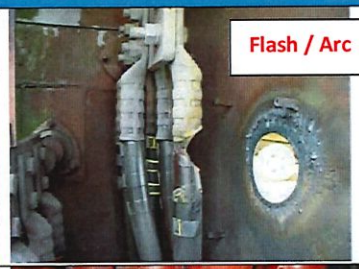
## OEB Inspection Template - Padmounted, Vault or Submersible Transformer

| UG Tx | Collector Fields | Domain | Data Type | Things to Check | Inspection Format |
|---|---|---|---|---|---|
| Asset Inventory | FacilityID | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Subtype | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | InstallationYear | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Owner | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | RatedKVA | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | PhaseDesignation | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Operating_Voltage | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Lowside_Voltage | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Address | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | ConstructionStatus | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| Asset Conditions | Tx_Metal_Condition | 1,3,5 | Text-20 | 1-severe rust/damage, 3-some rust/damage, 5-little or zero rust/damage | |
| | Tx_Paint_Condition | 1,3,5 | Text-20 | | |
| | Tx_Graffiti_Condition | 1,3,5 | Text-20 | 1-bad graffiti, 3-some graffiti, 5-no graffiti | |
| | Tx_Placement_Condition | 1,3,5 | Text-20 | check placement on pad, shifted, off pad | |
| | Tx_Foundation_Condition | 1,3,5 | Text-20 | crack, chipped and knocked, aged | |
| | Tx_OilLeak | 1,3,5 | Text-20 | oil leaks | |
| | Tx_GradingChanges | 1,3,5 | Text-20 | washes, sink holes, diggings, dirt piles | |
| | Tx_AccessChanges | 1,3,5 | Text-20 | blocked by trash, vegetation, in water, animal nests | |
| Assemblies | Nomenclature_Is_Correct | Y/N | Text-5 | check if phasing ID & nomenclature matches GIS | |
| | Nomenclature_Condition | 1,3,5 | Text-20 | illegibility, letters, numbers missing or fading | |
| | Bushing_Condition | 1,3,5 | Text-20 | crack, flash mark, erosion | |
| | HV_Termination_Condition | 1,3,5 | Text-20 | elbows, flash/burn marks on HV elbows or spades (vault room Tx) | |
| | LV_Connection_Conditon | 1,3,5 | Text-20 | loose cable connection, neutral and ground connection | |
| | Grounding_Condition | 1,3,5 | Text-20 | missing or loose neutral and ground connection | |
| | Arrestor_Condition | 1,3,5, N/A | Text-20 | blew up | |
| | Lock_Bolt_Condition | 1,3,5 | Text-20 | damaged lock, missing bolt | |
| | PowerSupply_To | S/L, T/L, Bus Shelter, R, B, etc | Text-20 | | |
| Repair | Tx_Unit_Replacement | Y/N | Text-5 | Y/N | |
| | Tx_Paint_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Graffiti_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Placement_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Foundation_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Grading_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Access_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Tx_Nomenclature_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | HV_Termination_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | LV_Connection_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Grounding_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Arrestor_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Lock_Bolt_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| Admin | InspectionComments | N/A | Text - 255 | | |
| | InspectionStatus | InspectStatus | Text - 15 | To Inspect, Inspected | |
| | RepairComments | N/A | Text - 255 | | HIDDEN ON FORM |
| | RepairStatus | RepairStatus | Text - 15 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | GlobalID | Text | System Generated | | HIDDEN ON FORM |
| | Inspected_By | Inspectors | Text - 50 | Line supervisor initials | NEW |
| | Date_of_Inspection | | Date | Specific date, current date | NEW |
| | NUH_Claimed_By | Inspectors | Text-50 | Line supervisor initials | HIDDEN ON FORM |
| | Date_of_Repair | | Date | Specific date, current date | HIDDEN ON FORM |

**<u>Things to check:</u> Enclosure paint, rust, graffiti; placemen on pad whether shifted or even off the pad; oil leaks; foundation cracks, damages; wash out, sink holes, diggings, dirt piles; access conditions such as in water, blocked by vegetation, animal nests, and etc.**

| Condition Grade – Asset | | | | |
|---|---|---|---|---|
| Grade 1 |   Oil leaks |  Animal nests |  Holes | |
| Grade 3 |  Access block |  Rust  Shift |  Graffiti  Animal nests |  Fdtn sink |

**<u>Things to check:</u> nomenclature correctness; nomenclature faded, missing letters or numbers; transformer bushing crack, flash mark, erosion; HV&LV spades burn marks; bad cable elbow and arrester elbow; missing lock bolt, damaged lock and etc.**

| Condition Grade - Assemblies | | | | |
|---|---|---|---|---|
| Grade 1 |  Flash / Arc |  Overheat | | |
| Grade 3 |  Overheat | | | |

Distribution:

Sample Polemount Transformer Inspection Record

# OH TRANSFORMER INSPECTION

| | |
|---|---|
| OBJECTID * | 97 |
| SHAPE * | Point |
| Subtype | 1 |
| FacilityID * | 5724 |
| Construction Status | In Service |
| Owner | Waterloo North Hydro |
| InstallationYear | 2004 |
| Tank_Corrosion | 5 |
| Tank_Leak | 5 |
| Damage_Bushing | 5 |
| Damage_Arrestor | 5 |
| InspectionComments | <Null> |
| Damage_HV_Terminal | 5 |
| Damage_LV_Connection | 5 |
| Tx_Unit_Replacement | <Null> |
| Damage_Arrestor_Repair | <Null> |
| Damage_HV_Terminal_Repair | <Null> |
| Damage_LV_Connection_Repair | <Null> |
| RepairComments | <Null> |
| InspectionStatus * | Inspected |
| RepairStatus | <Null> |
| GlobalID * | {A166AB61-47E1-40A1-B473-CD3D613621D1} |
| Inspected_By | Ken Stephens |
| Date_of_Inspection | 5/25/2020 16:45 |
| NUH_Claimed_By | <Null> |
| Date_of_Repair | <Null> |
| CreationDate * | 4/21/2020 18:18 |
| Creator * | smacdonald_WNH |
| EditDate * | 5/25/2020 16:45 |
| Editor * | dyoung_WNH |

## TRANSFORMERS

| | OH Transformer | Domain | Default Value | Data Type | Things to Check | |
|---|---|---|---|---|---|---|
| Asset Inventory | SubtypeCD | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | FacilityID | Populated from GIS | | Text - 20 | | NOT EDITABLE ON FORM |
| | ConstructionStatus | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | Owner | Populated from GIS | | Text - 20 | | NOT EDITABLE ON FORM |
| | InstallationYear | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| Asset Conditions | Tank_Corrosion | 1, 3, 5 | | Text - 5 | | |
| | Tank_Leak | 1, 3, 5 | | Text - 5 | | |
| | Damage_Bushing | 1, 3, 5 | | Text - 5 | | |
| | Damage_Arrestor | 1, 3, 5 | | Text - 5 | | |
| | Damage_HV_Terminal | 1, 3, 5 | | Text - 5 | flash/burn marks on HV spades | |
| | Damage_LV_Connection | 1, 3, 5 | | Text - 5 | loose cable connection, damaged lugs | |
| Repair | Tx_Unit_Replacement | Y/N | | Text - 5 | Y/N | |
| | Damage_Arrestor_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Damage_HV_Terminal_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Damage_LV_Connection_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| Admin | InspectionComments | | | Text - 255 | | |
| | RepairComments | | | Text - 255 | | HIDDEN ON FORM |
| | InspectionStatus | To Inspect, Inspected | | Text - 15 | | |
| | RepairStatus | RepairStatus | | Text - 15 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | GlobalID | Text | | System Generated | | HIDDEN ON FORM |
| | Inspected_By | Inspectors | | Text - 50 | Line supervisor initials | NEW |
| | Date_of_Inspection | | | Date | Specific date, current date | NEW |
| | NUH_Claimed_By | Inspectors | | Text - 50 | Line supervisor initials | HIDDEN ON FORM |
| | Date_of_Repair | | | Date | Specific date, current date | HIDDEN ON FORM |

Distribution:

Sample Metering Record of Installation

## RECORD OF INSTALLATION

| INSTALLATION NO.: | | Location No: |
|---|---|---|
| **0000003319-001** | MV90 PH#: | 3002779 |

Utility:
*Waterloo North Hydro Inc.* MV90 IP#:

Customer:
WNH EMBEDDED GENERATION METER Modem IP: Meter IP:

Address:
- 1315 HUTCHISON RD, WELLESLEY

| Primary: | Volts | Amperes | Phase | Wire | System |
|---|---|---|---|---|---|
| | 347/600 | 400 | 3 | 4 | WYE |

| Multiple used for billing: | Ke: | Kh: | MM: |
|---|---|---|---|
| 90 | 0.050 | 1.8 | 1 |

| Demand Units: | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 |
|---|---|---|---|---|---|---|---|---|
| kW & kVA | KWh-Del | KWh-Rec | KVAh-Del | KVAh-Rec | | | | |

Meter Seal Dates:

| COMPONENTID | REVERIFICATIONYEAR |
|---|---|
| 700098 | 2029 |

Harness Length
0 (ft)

**METERS**

| Inspection No. | Maker | Serial No. | Type | Volts | Amps | Mult | Phase | Wire | Element |
|---|---|---|---|---|---|---|---|---|---|
| 700098 | ELSTER | 22661112 | A3RAL | 120 | 20 | 1 | 3 | 4 | 3.0 |

**CT'S**

| Inspection No. | Serial No. | Type | Amps High | Amps Low | Amps Actual | Sec. | Acc. High | Class High | Rating High | Acc. Low | Class Low | Rating Low | Wire | Primary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CT507832 | 507832 | MV7 | 150 | 0 | **150** | 5 | 0.3 | B0.9 | CRF=1 | | | | | BAR |
| CT507833 | 507833 | MV7 | 150 | 0 | **150** | 5 | 0.3 | B0.9 | CRF=1 | | | | | BAR |
| CT507834 | 507834 | MV7 | 150 | 0 | **150** | 5 | 0.3 | B0.9 | CRF=1 | | | | | BAR |

**PT'S**

| Inspection No. | Maker | Serial No. | Type | Primary Volts | Sec. Volts | Acc.1 | Class 1 | Acc.2 | Class 2 |
|---|---|---|---|---|---|---|---|---|---|
| PT627137 | RITZ | 627137 | ME7 | 360 | 120 | 0.3 | W | 0.6 | X |
| PT627136 | RITZ | 627136 | ME7 | 360 | 120 | 0.3 | W | 0.6 | X |
| PT627135 | RITZ | 627135 | ME7 | 360 | 120 | 0.3 | W | 0.6 | X |

For Utility: BRADS

Date: 20200522

Notes:
Embedded 133kW Generation

CANDURA instruments

Meter/Inst #: 700098
Service Type: 3 Element
PT/CT Ratios: 360:120V 150:5A

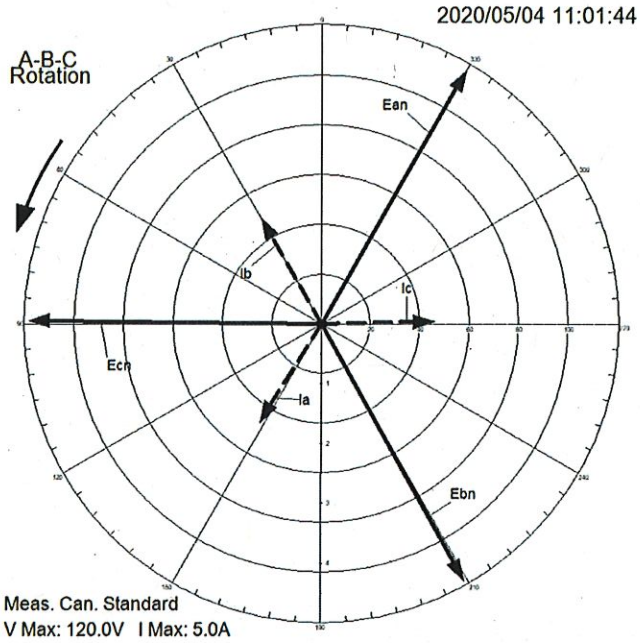
Technician: BS
Instrument: PQPro-00195
File: 700098.pdf
Created: 2020/05/04 11:05:09

Primary Values

2020/05/04 11:01:44

| | A | B | C | Tot/Avg |
|---|---|---|---|---|
| Volt | 350.4 V | 354.3 V | 354.0 V | 352.9 V |
| Amp | 58.589 A | 60.454 A | 57.433 A | 58.825 A |
| PF | 1.00 | 1.00 | 1.00 | 1.00 |
| V Φ | 0.0° | -120.7° | 119.5° | |
| I Φ | 178.3° | 59.9° | -59.1° | |
| Watt | -20.477 kW | -21.374 kW | -20.275 kW | -62.126 kW |
| VA | 20.486 kVA | 21.375 kVA | 20.281 kVA | 62.126 kVA |
| Var | -0.596 kVar | 0.247 kVar | 0.499 kVar | 0.151 kVar |
| THDV | 2.31 % | 2.17 % | 2.19 % | 2.22 % |
| THDI | 5.18 % | 5.14 % | 5.65 % | 5.32 % |
| Freq | 59.96 Hz | | | |

2020/05/04 11:01:44




Meas. Can. Standard
V Max: 120.0V I Max: 5.0A

## CT Ratios (Auto)

| Phase | Ratio | Angle | Primary | Secondary | CT Error |
|---|---|---|---|---|---|
| A | 30 : 1 | 0.1 ° | 59.2 A | 1.973 A | 0.0 % |
| B | 30 : 1 | 0.0 ° | 62.9 A | 2.100 A | -0.2 % |
| C | 30 : 1 | -0.3 ° | 61.1 A | 2.033 A | 0.2 % |

## PT Ratios

| Phase | Ratio | Primary | Secondary | PT Error |
|---|---|---|---|---|
| Van | 359 : 120 | 350 V | 116.9 V | -0.2 % |
| Vbn | 358 : 120 | 352 V | 118.0 V | -0.6 % |
| Vcn | 358 : 120 | 352 V | 118.0 V | -0.6 % |

## Watt/Var Registration

| | | | |
|---|---|---|---|
| # of Pulses: | 0 | 0 | 0 |
| | Wh / Pulse | VAh / Pulse | Varh / Pulse |
| Meter Kh | 1.8 | 1.8 | 1.8 |
| Measured | 0.0000 | 0.0000 | 0.0000 |
| Accuracy | ---- | ---- | ---- |

APC

Distribution:

Sample Manual Load Break Switch Inspection Record

# SWITCH INSPECTION

| | |
|---|---|
| OBJECTID * | 1 |
| SHAPE * | Point |
| Subtype | 1 |
| FacilityID * | FC-8-2446 |
| Construction Status | In Service |
| Phase Designation | B |
| Type | FUSED |
| InstallationYear | 2011 |
| Owner | Waterloo North Hydro |
| Bushing_Flashover | 5 |
| Bushing_Contamination | 5 |
| Damage_Mounting | 5 |
| Damage_Insulator | 5 |
| Damage_Arrestor | No |
| InspectionComments | <Null> |
| SW_Unit_Replacement | <Null> |
| Damage_Arrestor_Repair | <Null> |
| RepairComments | <Null> |
| InspectionStatus * | Inspected |
| RepairStatus | <Null> |
| GlobalID * | {F2740DE5-3EAA-4D8B-9906-1A7659EA4419} |
| Inspected_By | Ken Stephens |
| Date_of_Inspection | 5/26/2020 12:58 |
| NUH_Claimed_By | <Null> |
| Date_of_Repair | <Null> |
| CreationDate * | 4/21/2020 18:18 |
| Creator * | smacdonald_WNH |
| EditDate * | 5/26/2020 12:58 |
| Editor * | dyoung_WNH |

## SWITCH

| | OH Switchs | Domain | Default Value | Data Type | Things to Check | |
|---|---|---|---|---|---|---|
| Asset Inventory | SubtypeCD | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | FacilityID | Populated from GIS | | Text - 20 | | NOT EDITABLE ON FORM |
| | ConstructionStatus | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | PhaseDesignation | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | Type | Populated from GIS | | Text - 15 | | NOT EDITABLE ON FORM |
| | InstallationYear | Populated from GIS | | Long Integer | | NOT EDITABLE ON FORM |
| | Owner | Populated from GIS | | Text - 20 | | NOT EDITABLE ON FORM |
| Asset Conditions | Bushing_Flashover | 1-5 | | Text - 5 | burning and flash over mark | |
| | Bushing_Contamination | 1-5 | | Text - 5 | | |
| | Damage_Mounting | 1-5 | | Text - 5 | | |
| | Damage_Insulator | 1-5 | | Text - 5 | | |
| | Damage_Arrestor | Y/N | | Text - 5 | | |
| Repai | SW_Unit_Replacement | Y/N | | Text - 5 | Y/N | |
| | Damage_Arrestor_Repair | RepairStatus | | Text - 5 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| Admin | InspectionComments | | | Text - 255 | | |
| | RepairComments | | | Text - 255 | | HIDDEN ON FORM |
| | InspectionStatus | To Inspect, Inspected | | Text - 15 | | |
| | RepairStatus | RepairStatus | | Text - 15 | | HIDDEN ON FORM |
| | GlobalID | Text | | System Generated | | HIDDEN ON FORM |
| | Inspected_By | Inspectors | | Text - 50 | Line supervisor initials | NEW |
| | Date_of_Inspection | | | Date | Specific date, current date | NEW |
| | NUH_Claimed_By | Inspectors | | Text - 50 | Line supervisor initials | HIDDEN ON FORM |
| | Date_of_Repair | | | Date | Specific date, current date | HIDDEN ON FORM |

Distribution:

Sample Padmounted Switching Device Inspection Record

## OEB Inspection Template - Padmounted Switching Device

| | |
|---|---|
| OBJECTID * | 44 |
| SHAPE * | Point |
| Construction Status | In Service |
| SubtypeCD | 2 |
| Facility ID | SC 68 |
| Owner | WNH |
| InstallationYear | 2018 |
| OperatingVoltage | <Null> |
| SW_Enclosure_Condition | 5 |
| SW_Placement_Condition | 5 |
| SW_Foundation_Condition | 5 |
| SW_GradingChanges | 5 |
| SW_AccessChanges | 5 |
| Is_Nomenclature_Correct | Yes |
| Nomenclature_Condition | 5 |
| Bushing_Condition | 5 |
| HV_Spade_Condition | 5 |
| Termination_Condition | 5 |
| Arrestor_Condition | 5 |
| Lock_Bolt_Condition | 5 |
| Grounding_Condition | 5 |
| InspectionComments | <Null> |
| InspectionStatus | Inspected |
| GlobalID * | {1E76BD31-A000-4CC1-9692-92B41B5602FB} |
| CreationDate * | 10/11/2019 16:18 |
| Creator * | smacdonald_WNH |
| EditDate * | 12/13/2019 16:00 |
| Editor * | SHAWNM |

## OEB Inspection Template - Padmounted Switching Device

| UG SW | Collector Fields | Domain | Data Type | Things to Check | Inspection Format |
|---|---|---|---|---|---|
| Asset Inventory | FacilityID | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | InstallationYear | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Subtype | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Owner | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | Operating_Voltage | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| | ConstructionStatus | By System | | Populated from GIS | NOT EDITABLE ON FORM |
| Asset Conditions | SW_Metal_Condition | 1,3,5 | Text-20 | 1-severe rust/damage, 3-some rust/damage, 5-little or zero rust/damage | |
| | SW_Paint_Condition | 1,3,5 | Text-20 | | |
| | SW_Graffiti_Condition | 1,3,5 | Text-20 | 1-bad graffiti, 3-some graffiti, 5-no graffiti | |
| | SW_Placement_Condition | 1,3,5 | Text-20 | check placement on pad, shifted, off pad | |
| | SW_Foundation_Condition | 1,3,5 | Text-20 | crack, chipped and knocked, aged | |
| | SW_GradingChanges | 1,3,5 | Text-20 | washes, sink holes, diggings, dirt piles | |
| | SW_AccessChanges | 1,3,5 | Text-20 | blocked by trash, vegetation, in water, animal nests | |
| Assemblies | Nomenclature_Is_Correct | Y/N | Text-20 | check if phasing ID & nomenclature matches GIS | |
| | Nomenclature_Condition | 1,3,5 | Text-20 | illegibility, letters, numbers missing or fading | |
| | Bushing_Condition | 1,3,5 | Text-20 | crack, flash mark, erosion on bushings | |
| | HV_Spade_Condition | 1,3,5 | Text-20 | flash marks and burn marks on the spades (live front type) | |
| | HV_Termination_Conditon | 1,3,5 | Text-20 | elbows,loose cable connection, ~~neutral and ground connection~~ | |
| | Grounding_Condition | 1,3,5 | Text-20 | missing or loose neutral and ground connection | |
| | Arrestor_Condition | 1,3,5,N/A | Text-20 | blew up | |
| | Lock_Bolt_Condition | 1,3,5 | Text-20 | damaged lock, missing bolt | |
| Repair | SW_Unit_Replacement | Y/N | Text-5 | Y/N | |
| | SW_Paint_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | SW_Graffiti_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | SW_Placement_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | SW_Foundation_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | SW_Grading_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | SW_Access_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Nomenclature_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | HV_Termination_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Grounding_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Arrestor_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | Lock_Bolt_Repair | RepairStatus | Text-20 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| Admin | InspectionComments | N/A | Text - 255 | | |
| | InspectionStatus | InspectStatus | Text - 15 | To Inspect, Inspected | |
| | RepairComments | N/A | Text - 255 | | HIDDEN ON FORM |
| | RepairStatus | RepairStatus | Text - 15 | Repaired, Needs Further Repair, Repair Not Needed | HIDDEN ON FORM |
| | GlobalID | Text | System Generated | | HIDDEN ON FORM |
| | Inspected_By | Inspectors | Text - 50 | Line supervisor initials | NEW |
| | Date_of_Inspection | | Date | Specific date, current date | NEW |
| | NUH_Claimed_By | Inspectors | Text-50 | Line supervisor initials | HIDDEN ON FORM |
| | Date_of_Repair | | Date | Specific date, current date | HIDDEN ON FORM |