

	TITLE:		
	<b>Engineering Specification</b>		
	PREP: <b>G. Magill</b>	NO: <b>ECS0013</b>	1
APPD: <b>C. Malone</b>	OF		
REV DATE: <b>2002-02-21</b>	14		

**13.2 kV Customer Owned Switchgear General Guideline**

# Revision Sheet

<u>Revision</u>	<u>Description</u>	<u>Date</u>	<u>Initials</u>
0	Original Document	2002-02-21	GM/CSM

© For Hydro Ottawa Use Only - 2002	NO: <b>ECS0013</b>	2	REV: <b>0</b>
		OF	
		14	

## Table of Contents

<b>1.</b>	<b>Scope -----</b>	<b>4</b>
<b>2.</b>	<b>Purpose -----</b>	<b>4</b>
<b>3.</b>	<b>Drawings and Inspection -----</b>	<b>4</b>
<b>4.</b>	<b>Equipment Requirements -----</b>	<b>5</b>
<b>5.</b>	<b>Load break Switches-----</b>	<b>6</b>
<b>6.</b>	<b>Isolating Switches -----</b>	<b>7</b>
<b>7.</b>	<b>Circuit Breakers -----</b>	<b>7</b>
<b>8.</b>	<b>Fuses -----</b>	<b>8</b>
<b>9.</b>	<b>Barriers-----</b>	<b>9</b>
<b>10.</b>	<b>Enclosures -----</b>	<b>9</b>
<b>11.</b>	<b>Compartmentation-----</b>	<b>10</b>
<b>12.</b>	<b>Doors-----</b>	<b>10</b>
<b>13.</b>	<b>Lightning Arrestors -----</b>	<b>10</b>
<b>14.</b>	<b>Grounding -----</b>	<b>11</b>
<b>15.</b>	<b>Current Transformers -----</b>	<b>11</b>
<b>16.</b>	<b>Protective Relays -----</b>	<b>11</b>
<b>17.</b>	<b>Primary Metering-----</b>	<b>12</b>
<b>18.</b>	<b>Gas Insulated Switchgear -----</b>	<b>13</b>

# 1. Scope

- 1.1 This publication covers Hydro Ottawa construction requirements of customer-owned switchgear for connection to the Hydro Ottawa 13.2 kV system. All switchgear shall be designed for the 13.2 kV system, even if it is to be connected at 4.16 kV initially.
- 1.2 These requirements cover enclosed type switchgear only; open type switchgear for new or upgraded installations is not acceptable.
- 1.3 Nothing contained in this specification shall prejudice or supersede any regulation or requirement made by Ontario Hydro.
- 1.4 Hydro Ottawa reserves the right to refuse to energize any piece of 13.2 kV equipment that does not satisfy this specification.
- 1.5 The following are Hydro Ottawa documents which define the interface between Hydro Ottawa and its customers:
  - The Hydro Ottawa Conditions of Service ([ECS0012](#))
  - Primary Voltage Service Specification ([GCS0002](#))
  - 13.2 KV Customer-Owned Switchgear Specification ([ECS0013](#))
  - General Construction Specification: Residential Underground Distribution in Subdivisions ([GCS0001](#))
  - General Construction Specification: Civil Works for Underground Distribution ([GCS0005](#))
  - Metering Specification ([GCS0008](#))

# 2. Purpose

This specification is intended to provide guidance to Hydro Ottawa customers and their agents in designing and manufacturing customer-owned 13.2 kV switchgear. It should be used as a supplement to Hydro Ottawa Primary Voltage Specification GCS0002 for the purpose of:

- 2.1 Assuring safe conditions for customers and Hydro Ottawa personnel in operating and maintaining primary voltage power service equipment.
- 2.2 Assuring a high degree of power supply reliability to the customers fed from the 4.16 kV and 13.2 kV systems by the use of adequate design factors.

# 3. Drawings and Inspection

Two copies of detailed dimensional manufacturer's shop drawings for the switchgear shall be

© For Hydro Ottawa Use Only - 2002	NO:	4	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

submitted to Hydro Ottawa for review before manufacturing. The drawings shall provide the plan, elevation and cross sectional views of the switchgear including electrical and working clearances. All components must be clearly identified and properly cross-referenced to a bill of materials. Hydro Ottawa Engineering Department will review drawings and provide comments as required. Prior to energizing the switchgear Hydro Ottawa will conduct an on-site inspection. Our inspection is to verify conformance to these specifications and includes visual inspection only. It is not intended to ensure the ongoing safe and reliable operation of the equipment.

Wiring diagrams for control circuits shall be submitted to Hydro Ottawa well in advance of the in-service date and the equipment must be manufactured according to the drawings submitted for review.

Detailed instruction manual for testing, calibrating, maintenance and installation of all equipment contained within the switchgear shall be included with the delivery of each switchgear.

**Please Note**

Any new device, i.e. relay, fuse, circuit breaker or interrupter, proposed for use by the manufacturer must be approved by Hydro Ottawa before being offered to the customer for use on the Hydro Ottawa 13.2 kV system.

**4. Equipment Requirements**

4.1 The switchgear shall be either metal enclosed or metal clad type for both outdoor and indoor installations.

4.1.2 The switchgear shall conform to the current CSA Standard CAN/CSA-C22.2 No. 31-M89.

4.1.3 The switchgear shall have the following minimum ratings:

- Rated Maximum Voltage 15 kV rms
- Rated Nominal Voltage 13.2 kV rms
- Rated Frequency 60 Hz
- Continuous Current Rating 600A rms
- Rated Momentary Current 40 kA rms asym
- Short Circuit Rating 500 MVA
- Impulse Withstand Voltage 95 kV
- Power Frequency Withstand Voltage\* 36 kV

\*Label to be affixed to exterior on front of gear verifying proof of factory hi-pot.

© For Hydro Ottawa Use Only - 2002	NO:	5	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

## 5. Load break Switches

- 5.1 Load break switches shall have the following minimum ratings:
- Continuous Current 600A rms
  - Load Current Interrupting 600A rms
  - Momentary Current 40 kA rms asym
  - Fault Close Current 40 kA rms asym
- 5.2 Each switch shall be 3 pole, group operated by a handle mounted external to the compartment which contains the switch. The handle must be arranged to allow the operator to open or close the switch from a position not immediately in front of the switch contacts. The handle must have provisions for padlocking in the open and closed position. The provisions for padlocking must be capable of accepting a Hydro Ottawa padlock with a 8mm (5/16") shackle.
- The switch positions shall be clearly labelled as follows:
- Green = Closed
  - Red = Open
- 5.3 The operating mechanism shall be designed so that a mechanical failure of a component, e.g. linkage, chain, etc., shall not result in an electrical fault. It shall not be necessary to exert a force of more than 16 kg (35 lbs.) on the operating handle when opening or closing the switch.
- 5.4 Phase-to-phase and phase-to-ground barriers are required at the switch.  
(Please see section 9.).
- 5.5 All switches shall be hinged at the bottom and the incoming supply shall be connected to the hinged end of the switch.
- 5.6 The size and number of incoming supply feeders shall be specified by Hydro Ottawa. If the incoming cable as specified by Hydro Ottawa is 3/c Cu, 500 MCM compact sector, 15 kV PILC, then the switch cell shall come equipped with a pothead capable of terminating this cable. These potheads shall be equivalent to pothead no. NT3755-B of G & W Electric or pothead no. NF534-WS-4 of Patton & Cooke Limited. Braided flexible connections rated 600 amps continuous shall be provided to connect this pothead to the switch.
- 5.7 Potheads shall be mounted to allow termination of the cable from below.
- 5.8 Viewing windows of 13mm (1/2") Lexan clear polycarbonated sheet or equivalent shall be provided to permit a full view of all switch contacts in the closed and open positions.
- 5.9 Each switch frame shall have a separate connection to switchgear ground bus with a minimum no. 2/0 AWG copper wire.

© For Hydro Ottawa Use Only - 2002	NO:	6	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

- 5.10 There shall be no interlocks between each incoming switch or between each incoming switch and the main customer protective device.
- 5.11 Each switch and pothead combination shall be in its own compartment so that one incoming switch/pothead may be isolated for service while the other combination remains in service. This switch and pothead shall be separated from adjacent cells by minimum #11 MSG sheet steel. Any current-carrying bus penetrating this enclosure shall be supported by through bushings and the penetration sealed to prevent the spread of arcs or arc products from propagating between cells.
- 5.12 Each switch shall have provisions for portable grounds on the line side of the interrupter as outlined in section 14.
- 5.13 Each switchgear assembly shall contain a spare arc chute and arc tip where applicable.

## 6. Isolating Switches

- 6.1 An isolating switch shall be installed on the line side of a customer's main feeder circuit breaker when a fixed circuit breaker is used.
- 6.2 Isolating switches shall be 3 poles; group operated and shall conform to the requirements listed in section 5 except that the isolating switches need not have a closing or interrupting rating.
- 6.3 The isolating switch shall be interlocked with the feeder circuit breaker to prevent its operation without first breaking or making load with the feeder circuit breaker.

## 7. Circuit Breakers

Circuit breakers shall have the following minimum ratings:

- Rated Maximum Voltage 15 kV rms
- Rated Nominal Voltage 13.2 kV rms
- Impulse Withstand Voltage 95 kV
- Rated Continuous Current 600 amps
- Nominal 3 Phase Interrupting MVA 500 MVA
- Minimum Interrupting Capability 23 kA rms sym
- 3 sec. Short Time Current Capability 23 kA rms sym
- Closing and Latching Capability 40 kA rms asym
- Rated Interrupting Time 5 cycles

© For Hydro Ottawa Use Only - 2002	NO:	7	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

- 7.1 The circuit breaker shall be either a fixed breaker with interlocked isolation switch or a draw out circuit breaker. The draw out breaker shall have provisions to padlock it in the fully withdrawn portion.
- 7.2 The circuit breaker cell shall be arc-proof to EEMAC G-14 Class B. Certified proto-type test results shall be submitted with shop drawings.
- 7.3 The circuit breaker shall be located next to the transformer vault personnel access door.
- 7.4 On both fixed circuit breakers and draw-out circuit breakers that incorporate secondary umbilical cords, the umbilical cords shall be interlocked with the circuit breaker to prevent the circuit breaker from being closed without the umbilical cord being connected.
- 7.5 The colour for circuit breaker status shall be:
  - Green = Closed
  - Red = Open
- 7.6 The circuit breaker and its associated protection shall co-ordinate with the Hydro Ottawa feeder protection.

## 8. Fuses

- 8.1 Fuses shall have the following minimum ratings:
  - Rated Maximum Voltage                      15 kV rms
  - Rated Nominal Voltage                        13.2 kV rms
  - Rated Interrupting Capacity                 23 kA sym
  - Rated Impulse Withstand                    95 kV
- 8.2 The use of fuses shall incorporate the minimum items listed in the EEMAC G8-2 specification section 11, item 3.4.
- 8.3 Fuses may be used as the main protective device as long as they coordinate with Hydro Ottawa's protective device.
- 8.4 Six spare fuses shall be left as spares in vaults with one fused switch. Where vaults contain more than one fused switch each subsequent switch requires an additional three spares.
- 8.5 When the power fuses are of a type which expels gases during the interruption of short circuit currents, the construction of the enclosure shall follow the fuse manufacturer's recommendation with regard to the following:
  - 8.5.1 Clearances between exhaust ports and other metallic parts.

© For Hydro Ottawa Use Only - 2002	NO:  <b>ECS0013</b>	8	REV:
		OF	<b>0</b>
		14	



8.5.2 Mechanically designed to withstand internal pressures.

8.6 Current limiting fuses shall be used to protect transformers sized 100 kVA and smaller.

8.7 Phase-to-phase and phase-to-ground barriers are required at the switch and fuse unit. (Please see section 9).

8.8 Where current limiting fuses are used they shall be of the full-range type, that is: A fuse capable of interrupting all currents from rated interrupting current down to the minimum continuous current that causes melting of the fusible elements. (Per ANSI/IEEE C37.40-1993)

## 9. Barriers

- 9.1 Phase-to-phase and phase-to-ground barriers shall be installed on the following equipment:
- Each load break switch.
  - Each disconnect switch.
  - Each set of fuses.
  - Each set of fixed metering voltage transformer fuses.

Such barriers shall extend from the base of the insulator supports to a point 50 mm (2") beyond the fuse ferrules on the open blades of switches and 50 mm (2") beyond the terminal pads.

## 10. Enclosures

10.1 All enclosures shall be sheet steel not less than #11 MSG between compartments containing high voltage components and not less than #14 MSG for all other covers, barriers, panels and doors.

10.2 Each cell within the enclosures shall have a minimum 250-watt heater. These heaters shall be controlled by both a thermostat and humidistat.

10.3 The switchgear shall be drip-proof to EEMAC G8-2 1972 for installations indoor. Where the switchgear is installed in rooms with sprinklers it must be sprinkler-proof to EEMAC G8-2 1972.

10.4 All current-carrying bus work within the enclosure shall be made of copper.

10.5 Each switchgear enclosure shall have a mimic bus diagram showing single line arrangement on the front of the assembly with lines a minimum of 10mm wide and yellow in colour.

© For Hydro Ottawa Use Only - 2002	NO:	9	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

## 11. Compartment Construction

- 11.1 There shall be no openings whatsoever in compartment walls that will permit the flow of ionized gases or flame into adjacent compartments.
- 11.2 The following switchgear components shall be installed within separate compartments formed by sheet steel barriers:
- Each load break switch and incoming cable termination combination.
  - Each group-operated isolating switch.
  - Each group-operated circuit breaker.
  - Each set of three-phase fuses and interlocked interrupter combination.
  - Each set of metering current transformers.
  - Each set of voltage transformers.

## 12. Doors

- 12.1 Individual hinged access doors are required to give access to each compartment listed in section 11.
- 12.2 All access doors shall have padlock hasps measuring at least 30 mm (1¼") wide by 5mm (3/16") thick capable of accepting a Hydro Ottawa padlock with a 8mm (5/16") shackle.
- 12.3 Access doors shall be secured with a minimum of three 25mm (1") knurled head bolts, (which require no tools to unscrew) or handles with at least three latching points.

## 13. Lightning Arrestors

Lightning arrestors are not required by Hydro Ottawa. If the customer wishes to install lightning arrestors they shall be located on the load side of the first 13.2 kV protective device. All lightning arrestors are to be reviewed by Hydro Ottawa before the switchgear is manufactured.

© For Hydro Ottawa Use Only - 2002	NO:  <b>ECS0013</b>	10	REV:
		OF	<b>0</b>
		14	

## 14. Grounding

14.1 Hydro Ottawa requires ground studs at the following locations:

- On the line side of each incoming interrupter.
- On the load side of the fuse holder.
- On the load side of each circuit breaker and located before the over current protective current transformers.
- Where more than one circuit breaker or fused switch is used there shall be grounding studs located directly in front (on the vault ceiling) of the transformer bank each fuse or circuit breaker protects.

14.2 The ground studs shall have the following specifications:

- Ball Diameter            25 mm (1 inch)
- Fault Current            30,000 amperes for 30 cycles
- Threaded Stud            M16 (or ½ - 13 UNC)
- Ground Stud Material    CuAl Bronze

## 15. Current Transformers

Three current transformers suitable for use with over current relays shall be provided in an easily accessible location on the load side of the breaker. The current transformer ratio shall be determined by the Hydro Ottawa Engineering Department. The current transformer case shall be grounded with a minimum size no. 2/0 AWG copper wire.

## 16. Protective Relays

16.1 The protection circuit shall be series AC tripping using the current from the protective current transformers to trip the circuit breaker for both phase-to-phase and phase-to-ground faults. Capacitor trip circuits are not acceptable. The use of auxiliary circuits for protection is not acceptable.

16.2 A shorting device is required on the operating door or in the control compartment of the circuit breaker compartment and in series with the current transformers and relays to allow insertion of an ammeter into the circuit for testing.

16.3 Hydro Ottawa requires three element relaying; either one instantaneous ground relay and two over current phase relays, or three phase relays shall be used. Hydro Ottawa Engineering Department will decide if ground relaying is required.

© For Hydro Ottawa Use Only - 2002	NO:	11	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

- 16.4 The relays shall be equipped with both instantaneous and very inverse time elements. The operating range for the phase relays shall be 4-16 amperes on the very inverse time element and 20-80 amperes on the instantaneous element. The ground relay instantaneous element shall have an operating range of 2.5-10 amperes. Solid-state relays must have these characteristics and be capable of operating in the temperature range of -40°C to +40°C. Certified test data on all relays shall be provided prior to approval for use on the Hydro Ottawa system.
- 16.5 The relays shall be able to coordinate with Hydro Ottawa's upstream feeder circuit breaker.
- 16.6 The relays shall be equipped with targets for permanent indication of relay operation.

## 17. Primary Metering

- 17.1 Instrument transformers and primary fuse supports shall be mounted in an arrangement acceptable to Hydro Ottawa. They shall be capable of being easily installed or removed without interference to other compartments. The secondary connection terminal block shall be accessible and located in the front of the cell door.
- 17.2 Access doors to instrument transformers shall have provisions for padlocking. The hardware shall be in accordance with section 12 of this specification.
- 17.3 The voltage transformers shall be connected on the line side of the current transformers. A separate standoff insulator shall support the moving contact of the voltage transformer connection.
- 17.4 Customer owned instrumentation should be connected on the load side of the Hydro Ottawa metering.
- 17.5 Provision shall be made for three current transformers (although in most cases only two will be installed initially) in each metering current transformer compartments.
- 17.6 Hydro Ottawa will supply and install the instrument transformers once the switchgear is in its final position on site. Provisions for grounding each instrument transformer casing shall be provided.
- 17.7 The voltage transformers shall be of the draw-out type. The draw-out drawer shall have provisions for a Hydro Ottawa padlock to lock the drawer in the drawn out position. When the voltage transformers are in the fully drawn-out position a solid copper bus must ground the fuse holders.
- 17.8 Piping required for secondary connections to the instrument transformers shall be installed on-site under the direction of a Hydro Ottawa Metering Foreman.

© For Hydro Ottawa Use Only - 2002	NO:  <b>ECS0013</b>	12	REV:
		OF	<b>0</b>
		14	

17.9 Draw-out doors for potential transformers shall have viewing windows to check fuse status without opening drawer.

## 18. Gas Insulated Switchgear

Where gas insulated switchgear is proposed for use on the Hydro Ottawa system it shall meet or exceed the requirements in this specification.

### 18.1 Viewing Windows

Viewing windows are required to allow viewing of the interrupter switch or the series ground switch on each incoming interrupter switch module.

### 18.2 Gas Pressure Indication

The gas enclosure shall contain a mechanical pressure gauge that verifies the presence of the interrupting medium.

### 18.3 Test Points

Capacitive test points are required on each incoming feeder for the purpose of phasing and potential testing. Expected test voltages and any special tools required for testing shall be included with the switchgear.

### 18.4 Cable Termination

18.4.1 Cable termination components shall be included with the switchgear. For installations that will have 3/c, 500 MCM copper, 15 kV PILC cable, each incoming switch module shall come equipped with a RAYCHEM HVT-3-1593-G cable termination kit or equivalent.

18.4.2 For installations that will have 1/c, 500 MCM copper, 15 kV XLPE cable, the switchgear shall come equipped with a RAYCHEM RICS 5144 600 amp non-load break elbow or equivalent for termination of the cable.

18.4.3 For installations that will have 1/c, no. 1/0 AWG, copper, 15 kV, XLPE cable, the switchgear shall come equipped with a RAYCHEM RICS 5114 non-load break elbow or equivalent for termination of the cable.

18.4.4 The minimum dimension from the bottom of the switchgear to the termination point on the switchgear shall be 610mm (24").

18.4.5 The cable termination point shall have ground studs complete with approved stud

© For Hydro Ottawa Use Only - 2002	NO:	13	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	

covers. There shall be a minimum 1.8 m (6') unimpeded access in front of the ground stud in the operating area of transformer vault.

18.4.6 Cable termination points shall have interlocked removable covers.

18.5 Interlocks are required in the following locations:

18.5.1 Between the incoming interrupter and its associated grounding switch.

18.5.2 Between the transformer feeder ground switch and the fuse access cover.

18.5.3 Between each ground switch and the cable compartment covers.

© For Hydro Ottawa Use Only - 2002	NO:	14	REV:
	<b>ECS0013</b>	OF	<b>0</b>
		14	