

## **CHAPTER 4**

# **PROTECTION REQUIREMENTS**

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### PROTECTION REQUIREMENTS

#### 4.1 General

Means of protection for automatic disconnection against phase and earth faults shall be provided on the customer main switch. The type and settings of protective devices shall be so selected that they can grade properly with HK Electric infeed protection.

The customer shall provide Time-Current curve showing that the proposed protection scheme for the main switch can grade properly with HK Electric system under both phase fault and earth fault conditions.

#### 4.2 Customer HV Main Switch

1. Anticipated maximum 11-kV fault level:

Phase fault: 18.4 kA (350 MVA)

Earth fault: 2.0 kA

To grade with HK Electric 11-kV feeder protection, the protective relays of customer 11-kV main switch shall have an operating time not exceeding the maximum allowable time-current curves for phase fault and earth fault as shown in Drg. Nos. GCS/4/01 and GCS/4/02 respectively.

2. Anticipated maximum 22-kV fault level:

Phase fault: 25 kA (952 MVA)

Earth fault: 2.5 kA

To grade with HK Electric 22-kV feeder protection, the protective relays of customer 22-kV main switch shall have an operating time not exceeding the maximum allowable time-current curves for phase fault and earth fault as shown in Drg. Nos. GCS/4/03 and GCS/4/04 respectively.

3. Protection C.T.s shall have adequate output to prevent C.T. saturation. The customer shall provide document/calculation sheet to show that the proposed C.T.s have adequate output for the application under both phase and earth fault conditions.

### 4.3 **Customer LV Main Switch**

1. The anticipated maximum LV (380 V) fault level is 40 kA (26 MVA). The overcurrent protection of customer LV main switch shall grade with HK Electric transformer overcurrent protection and has an operating time not exceeding the maximum allowable time-current curves for various ratings of LV main switches as shown in Drg. No. GCS/4/05.
2. The customer's protective devices shall be set so that disconnection is achieved within 5 seconds during an earth fault.
3. Bonding Between HK Electric and Customer's Earthing Systems
  - a. Under the current regulations, the customer's earthing system shall be bonded to that of the HK Electric earthing system for transformer supplies. This will cause a significant increase in LV earth fault current, the magnitude of which can be as high as phase fault current.
  - b. If the customer's LV overcurrent and earth fault protections share the same set of C.T.s, high output C.T.s and low burden type earth fault relay shall be used to prevent C.T. saturation. The customer shall provide document/calculation sheet to show that the proposed protection C.T.s have adequate output for the application under earth fault condition.
  - c. As an alternative to the use of high output C.T.s and low burden type earth fault relay, separate sets of C.T.s can be used for overcurrent and earth fault protections as shown in Drg. No. GCS/4/06.

### 4.4 **Protection Scheme For Main Switch**

The customer is advised to provide a summary sheet as shown in Drg. No. GCS/4/07 and GCS/4/08 for LV and HV main switch protection scheme respectively to HK Electric for consideration.

### 4.5 **Auxiliary Supply for Protection Scheme and Relay**

If the customer's protection scheme or relay requires an auxiliary supply, the auxiliary supply shall be reliable and not be interrupted during LV or HV faults on the customer's equipment to ensure that the customer's protection scheme and relay perform the protection function properly.

#### 4.6 **Typical Protection Scheme for LV Main Switch Directly Fed by HK Electric Transformer**

We provide some typical protection schemes for low voltage main switch directly fed by transformer on our website. REWs may make reference to the typical protection schemes for preparation of their electrical installation in order to speed up the provision of electricity supply.

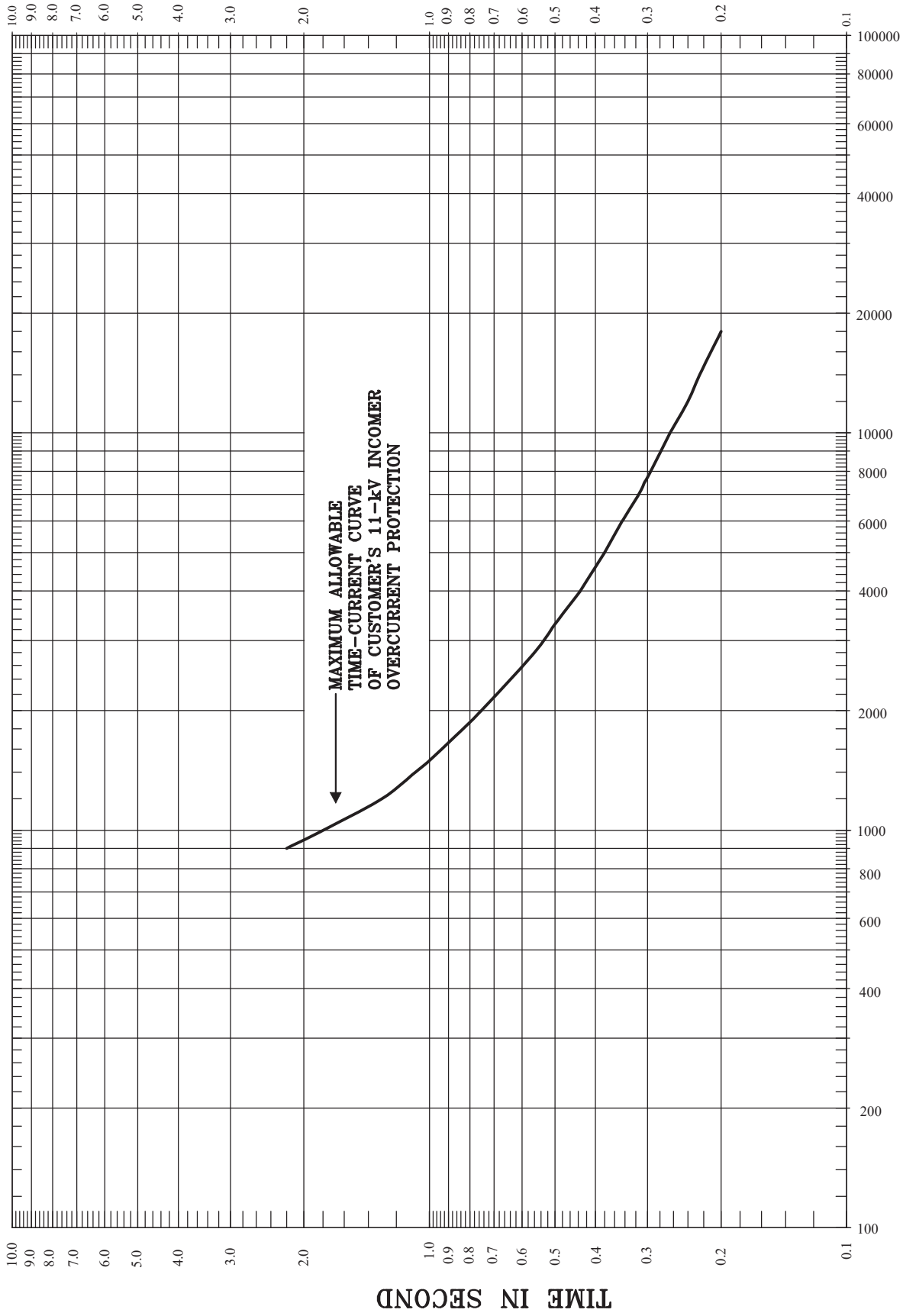
To get the information on typical protection schemes, please visit our website:

<https://www.hkelectric.com/en/customer-services/contractors-work-corner>



#### 4.7 **Schedule of Drawings - Protection Requirements**

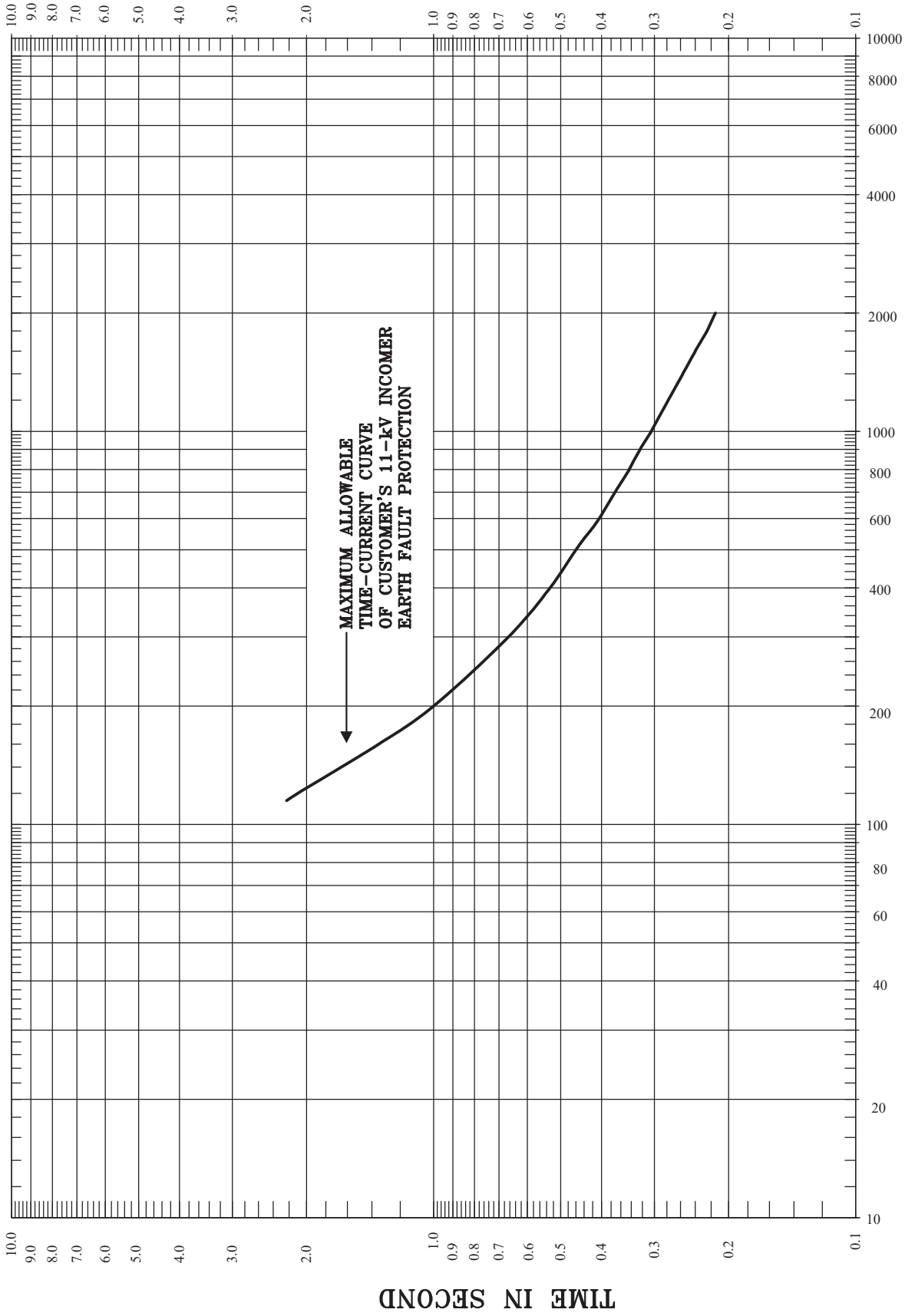
<u>Drawing No.</u>	<u>Drawing Title</u>
GCS/4/01	Maximum Allowable Time-Current Curve of Overcurrent Protection at Customer 11-kV Main Switch
GCS/4/02	Maximum Allowable Time-Current Curve of Earth Fault Protection at Customer 11-kV Main Switch
GCS/4/03	Maximum Allowable Time-Current Curve of Overcurrent Protection at Customer 22-kV Main Switch
GCS/4/04	Maximum Allowable Time-Current Curve of Earth Fault Protection at Customer 22-kV Main Switch
GCS/4/05	Maximum Allowable Time-Current Curves of Overcurrent Protection at Customer LV Main Switch
GCS/4/06	Recommended C.T. Arrangement for Customer's Protective Device at LV Main Switch
GCS/4/07	LV Main Switch Protection Scheme Summary Sheet
GCS/4/08	HV Main Switch Protection Scheme Summary Sheet



CURRENTS IN AMPERES AT 11-kV SIDE

Drg. No. GCS/4/01

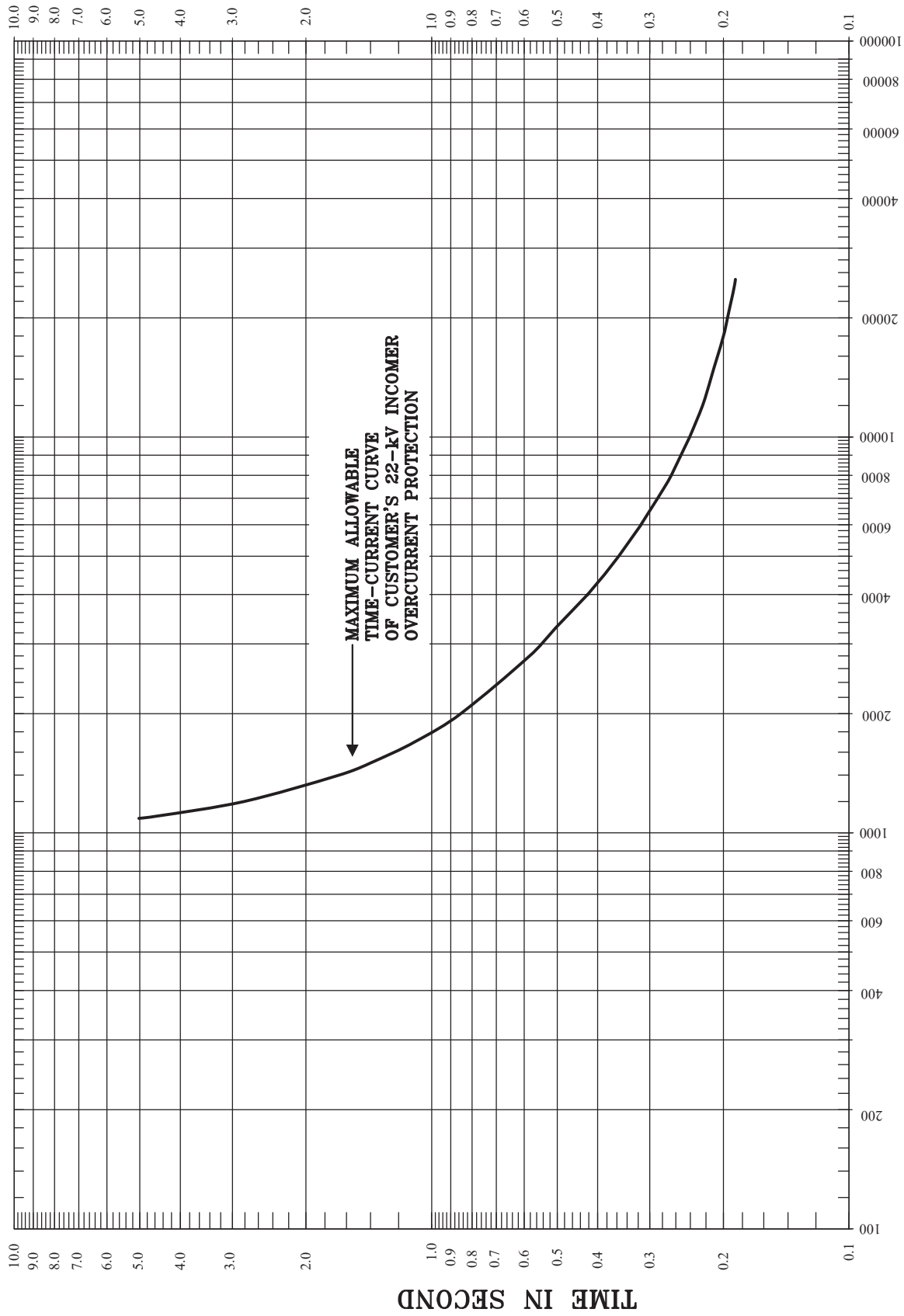
**MAXIMUM ALLOWABLE TIME-CURRENT CURVE OF OVERCURRENT PROTECTION  
AT CUSTOMER 11-kV MAIN SWITCH**



**CURRENTS IN AMPERES AT 11-kV SIDE**

Drg. No. GCS/4/02

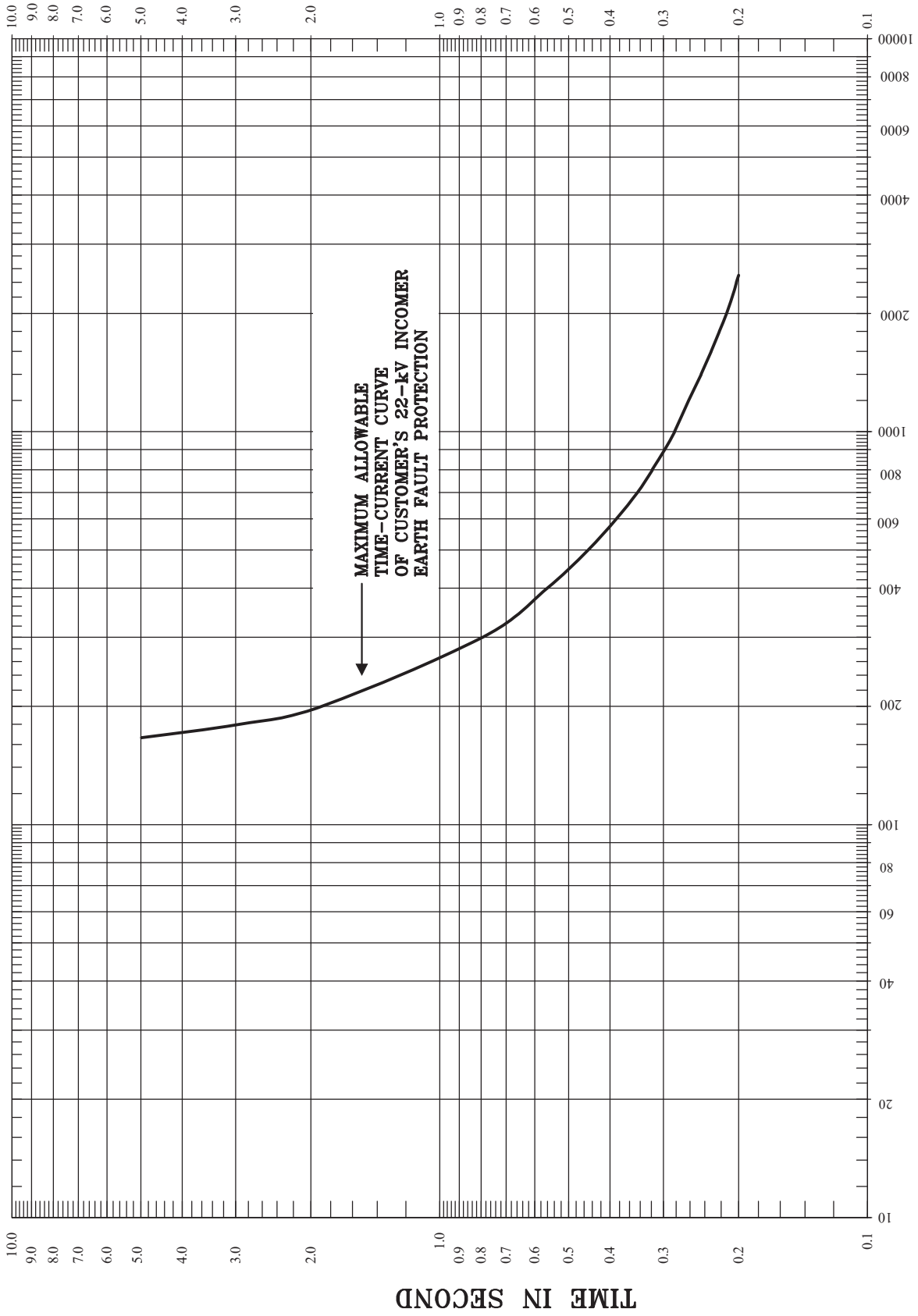
**MAXIMUM ALLOWABLE TIME-CURRENT CURVE OF EARTH FAULT PROTECTION  
AT CUSTOMER 11-kV MAIN SWITCH**



**CURRENTS IN AMPERES AT 22-kV SIDE**

Drg. No. GCS/4/03

**MAXIMUM ALLOWABLE TIME-CURRENT CURVE OF OVERCURRENT PROTECTION  
AT CUSTOMER 22-kV MAIN SWITCH**



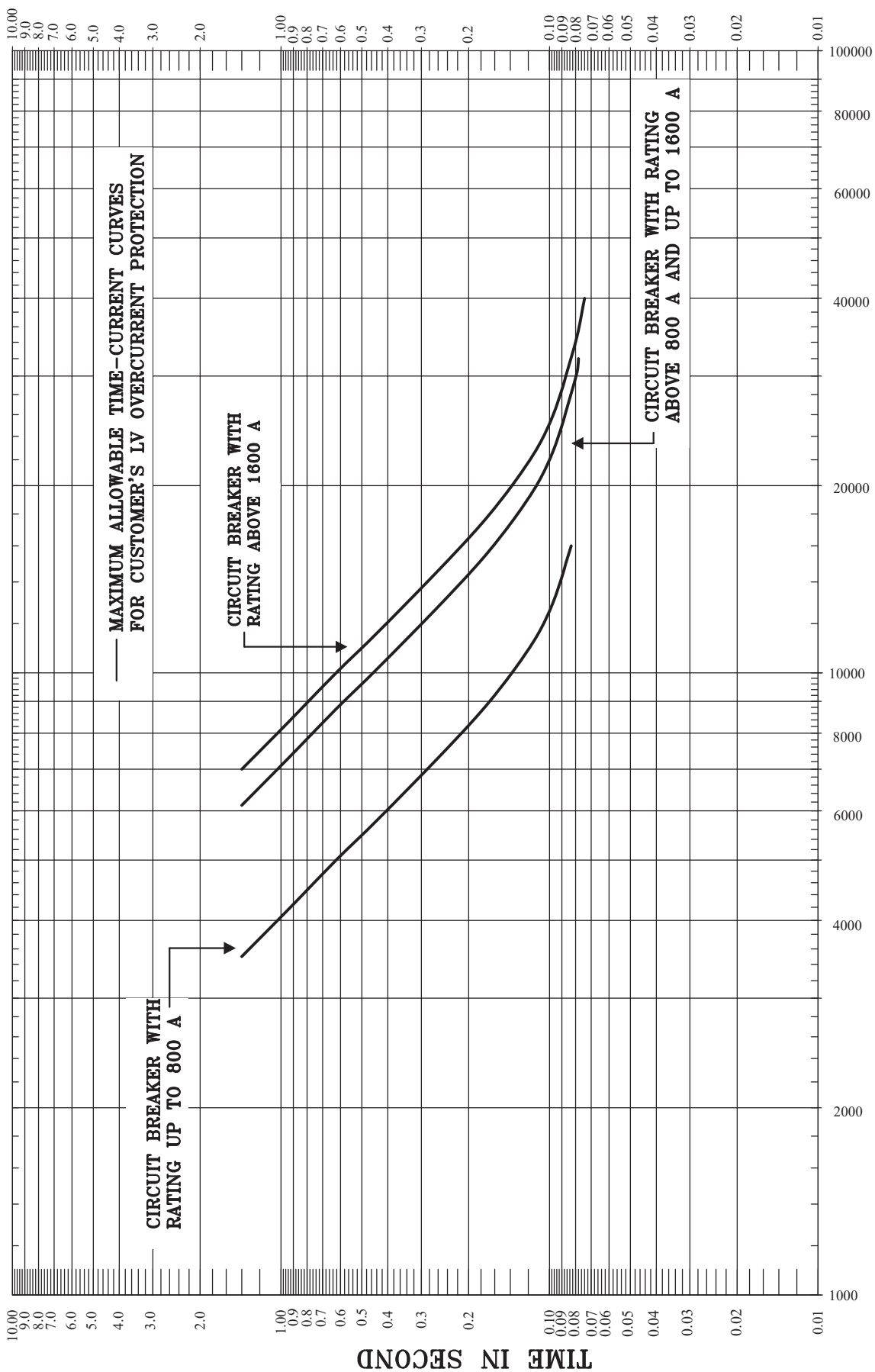
**CURRENTS IN AMPERES AT 22-kV SIDE**

Drg. No. GCS/4/04

**MAXIMUM ALLOWABLE TIME-CURRENT CURVE OF EARTH FAULT PROTECTION**

**AT CUSTOMER 22-kV MAIN SWITCH**

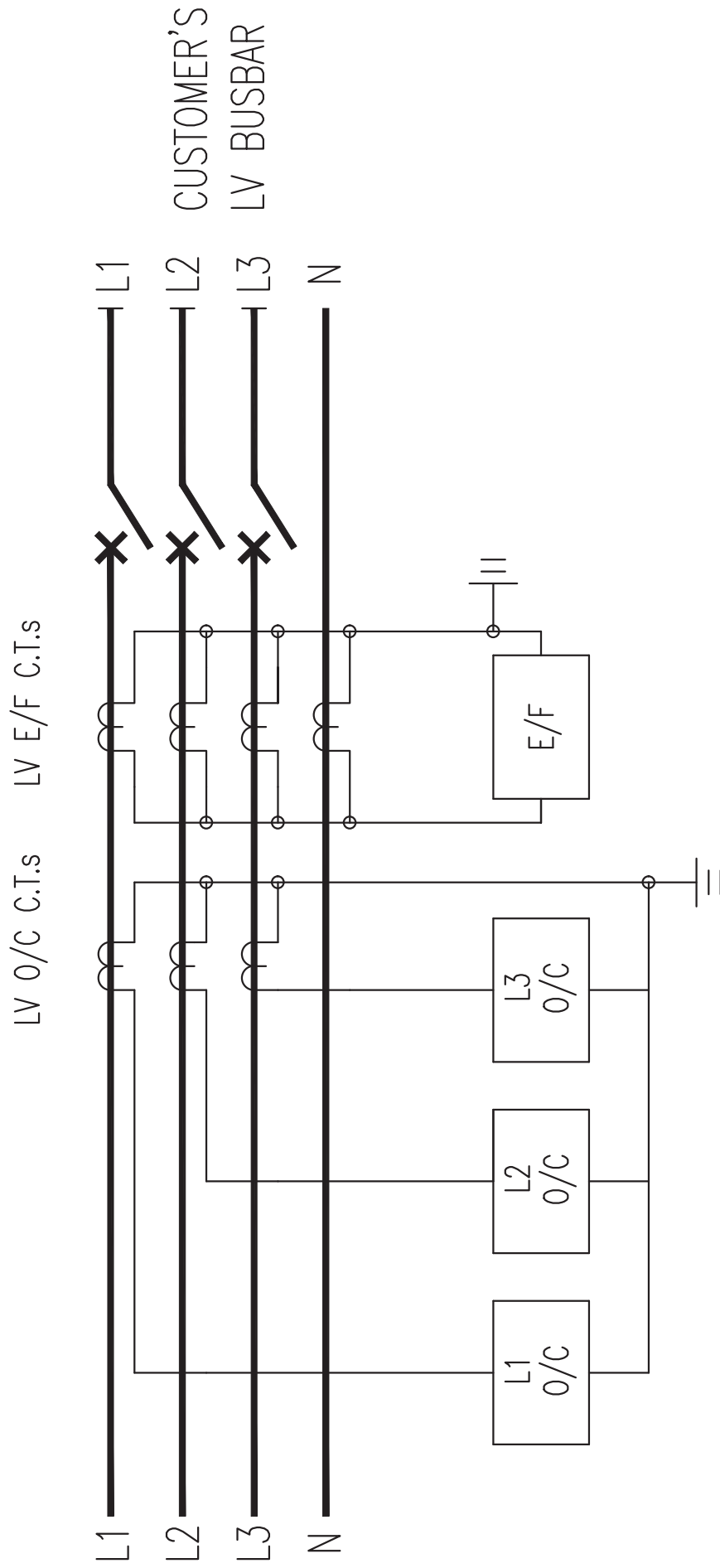




CURRENTS IN AMPERES AT LV SIDE

Drg. No. GCS/4/05

**MAXIMUM ALLOWABLE TIME-CURRENT CURVES OF OVERCURRENT PROTECTION  
AT CUSTOMER LV MAIN SWITCH**



Drg. No. GCS/4/06  
RECOMMENDED C.T. ARRANGEMENT FOR CUSTOMER'S  
PROTECTIVE DEVICE AT LV MAIN SWITCH

1. Circuit Breaker Information : (Main Switch No. : \_\_\_\_\_ )

Main Switch Rating	Any Built-in Protective Device ? <input type="checkbox"/> Yes <input type="checkbox"/> No	Instantaneous Trip Current Setting (kA) and Max. Setting Error	Setting Details

2. Current Transformer :

Function	Make	Model Number	Ratio	V/A and Class	Any C.T. Magnetisation Curve Provided to HK Electric ?	C.T. Resistance (ohm)	Connection Lead Resistance (ohm)
Overcurrent Protection C.T.					<input type="checkbox"/> Yes <input type="checkbox"/> No, to be submitted later		
Earth Fault Protection C.T.					<input type="checkbox"/> Yes <input type="checkbox"/> No, to be submitted later		
Will the overcurrent protection and earth fault protection share the same set of C.T.s ? <input type="checkbox"/> Yes <input type="checkbox"/> No							

3. Relay Information :

Function	Make	Model Number	Rated Current (A)	Burden at Rated Current (VA)	Auxiliary Supply# (A.C., D.C. or N.A.)	* Characteristics e.g. EI, VI, NI (1.3 s), NI (3 s)	Plug Setting Range	Plug Setting	Time Multiplier Setting	Relay Impedance at Plug Setting (ohm)
Overcurrent Relay										
Earth Fault Relay										

(\* : EI = Extremely Inverse, VI = Very Inverse, NI= Normal Inverse)

# If the customer protection scheme or relay requires an auxiliary supply, the auxiliary supply shall be reliable and not be interrupted during LV or HV faults on the customer equipment to ensure that the customer protection scheme and relay perform the protection function properly.

4. Maximum Earth Fault Loop Impedance, if available at the time of submission : \_\_\_\_\_ ohm

Notes :

Following information shall be provided :

1. Catalogues for main switch (with details of built-in protective device, if any), C.T.s (including C.T. magnetisation curve) and relays.
2. A.C. connection diagram of overcurrent and earth fault protection for the main switch.
3. Calculation sheet showing that the proposed C.T.s have adequate output for the application under both phase and earth fault conditions.
4. Time-current characteristic curve of overcurrent protection at the proposed settings plotted at the Drg. No. GCS/4/05.

Drg. No. GCS/4/07

LV MAIN SWITCH PROTECTION SCHEME SUMMARY SHEET

1. Circuit Breaker Information : (Main Switch No. : \_\_\_\_\_ )

Main Switch Rating	Any Built-in Protective Device ? <input type="checkbox"/> Yes <input type="checkbox"/> No	Instantaneous Trip Current Setting (kA) and Max. Setting Error	Setting Details

2. Current Transformer :

Function	Make	Model Number	Ratio	V/A and Class	Any C.T. Magnetisation Curve Provided to HK Electric ?	C.T. Resistance (ohm)	Connection Lead Resistance (ohm)
Overcurrent Protection C.T.					<input type="checkbox"/> Yes <input type="checkbox"/> No, to be submitted later		
Earth Fault Protection C.T.					<input type="checkbox"/> Yes <input type="checkbox"/> No, to be submitted later		
Will the overcurrent protection and earth fault protection share the same set of C.T.s ? <input type="checkbox"/> Yes <input type="checkbox"/> No							

3. Relay Information :

Function	Make	Model Number	Rated Current (A)	Burden at Rated Current (VA)	Auxiliary Supply# (A.C., D.C. or N.A.)	* Characteristics e.g. EI, VI, NI (1.3 s), NI (3 s)	Plug Setting Range	Plug Setting	Time Multiplier Setting	Relay Impedance at Plug Setting (ohm)
Overcurrent Relay										
Earth Fault Relay										

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# If the customer protection scheme or relay requires an auxiliary supply, the auxiliary supply shall be reliable and not be interrupted during LV or HV faults on the customer equipment to ensure that the customer protection scheme and relay perform the protection function properly.

Notes : Following information shall be provided :

1. Catalogues for main switch (with details of built-in protective device, if any), C.T.s (including C.T. magnetisation curve) and relays.
2. A.C. connection diagram of overcurrent and earth fault protection for the main switch.
3. Calculation sheet showing that the proposed C.T.s have adequate output for the application under both phase and earth fault conditions.
4. Time-current characteristic curves of overcurrent protection and earth fault protection at the proposed settings plotted at the Drg. No. GCS/4/01 & GCS/4/02 (for 11-kV main switch) or Drg. No. GCS/4/03 & GCS/4/04 (for 22-kV main switch) respectively.

Drg. No. GCS/4/08

HV MAIN SWITCH PROTECTION SCHEME SUMMARY SHEET