
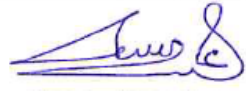





شركة مسقط لتوزيع الكهرباء  
Muscat Electricity Distribution Company

إحدى شركات مجموعة نماء  
Member of Nama Group

**MEDC GUIDELINE FOR SHORT CIRCUIT CONTRIBUTION**  
**CALCULATION**

0	New Document			
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## SHORT CIRCUIT CALCULATION PROCESS

### Table of Contents

1	INTRODUCTION.....	2
2	SUGGESTED WAY TO CALCULATE SHORT CIRCUIT CURRENT .....	2
2.1	DATA PREPARATION: .....	2
2.2	CALCULATIONS:.....	3
2.3	RESULTS PRESENTATION:.....	4



## **SHORT CIRCUIT CALCULATION PROCESS**

### **1 INTRODUCTION**

Short circuit current calculations (or alternatively referred as fault level calculations) are requested to confirm the adequacy of customer and MEDC switchgear (including the switchboard) to handle the fault currents corresponding to 3 phase maximum fault levels without failing; especially when adding new large motoric and/or power generation equipment which leads to increase in fault level.

### **2 SUGGESTED WAY TO CALCULATE SHORT CIRCUIT CURRENT**

#### **2.1 Data Preparation:**

- 1- Estimate the amount of Low and Medium voltage generation units [Photovoltaic and/or Diesel/Gas Generators] operating in parallel with MEDC network (if any) and obtain their datasheets for calculations and submission to MEDC;
- 2- Estimate the amount of Low and Medium voltage motoric load connected and supplied from each transformer;
- 3- Classify the motor loads according to their operation philosophy i.e., Continuous, Stand-by and Intermittent;
- 4- Classify the motor loads according to their starting method i.e., either via a Variable Frequency Drive (VFD), via Soft Starters or as Direct Online methods;
- 5- Identify large motors (>37kW) separately in above categorization and obtain their datasheets for documenting their Locked Rotor Current (LRC) and considering this and the associated cable lengths in the short circuit calculations;
- 6- For small motors (<37kW), lump these motor loads into one motor by summing up their rated electrical input power ratings;
- 7- Document the summed-up kW rating of each of the above classified motor types under the Main Distribution Board (MDB) Level of each distribution transformer;
- 8- Estimate the amount of motoric load of each class (i.e. VFD fed, DOL type etc.) operational at the same time under each transformer under maximum load (i.e. worst case) conditions and mention them on the SLD as shown in figure 1 below:
- 9- 11kV RMU in client's side is the Point of Common Coupling (PCC) between MEDC and client as shown in figure 1



## SHORT CIRCUIT CALCULATION PROCESS

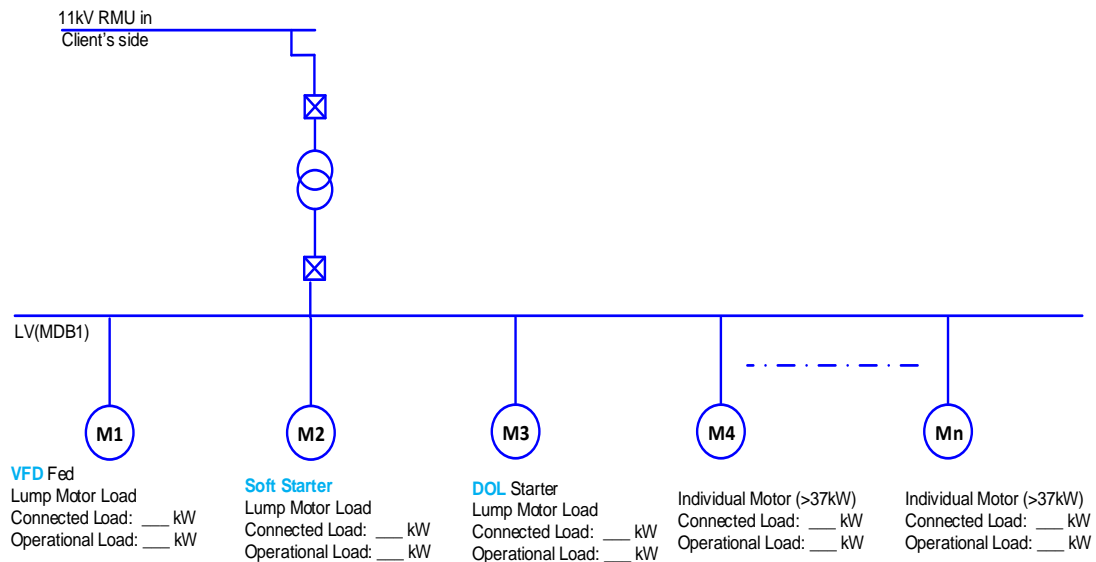


Figure 1 – Representation of Input Data – Individual and Lumped Motor Loads with Starting Methods

### 2.2 Calculations:

Short Circuit calculations can be performed by hand or using any power systems analysis tool like PSS@SINCAL, SIMARIS Design, ETAP or any other software. The aim is to calculate the contribution of fault current from the client's network onto MEDC 11kV network at PCC, meaning downstream contribution from motoric loads and generation sources (if any). To calculate Short Circuit, you can follow the below guide:

1. If hand calculations are being performed, fault current contribution from MEDC side (i.e. upstream) is not necessary. However, if software is used, a worst-case MEDC side contribution of 350 MVA short circuit power can be used for the MEDC equivalent infeed source.
2. For the standard MV to LV transformers, the voltage ratings to be used are 11 / 0.433 kV [not 0.415kV]. Relevant document from Oman Electrical Standards [OES] must be referred.
3. The fault current contribution calculation must include only the Continuous and Intermittent operating motoric loads; Stand-by motors are not to be included in the calculations.
4. Calculate the nominal current for each of the above motor load types. The following factors must be considered while calculating the nominal current for motoric loads:
  - a. Rated electrical input power;
  - b. Voltage rating for 3-phase LV motors to be 0.415 kV [unless other value specified in the datasheet]. For MV motors, as per the datasheet;
  - c. Motor rated power factor;
  - d. Motor efficiency (include this in calculations when the output mechanical equivalent power is used to define motor load).

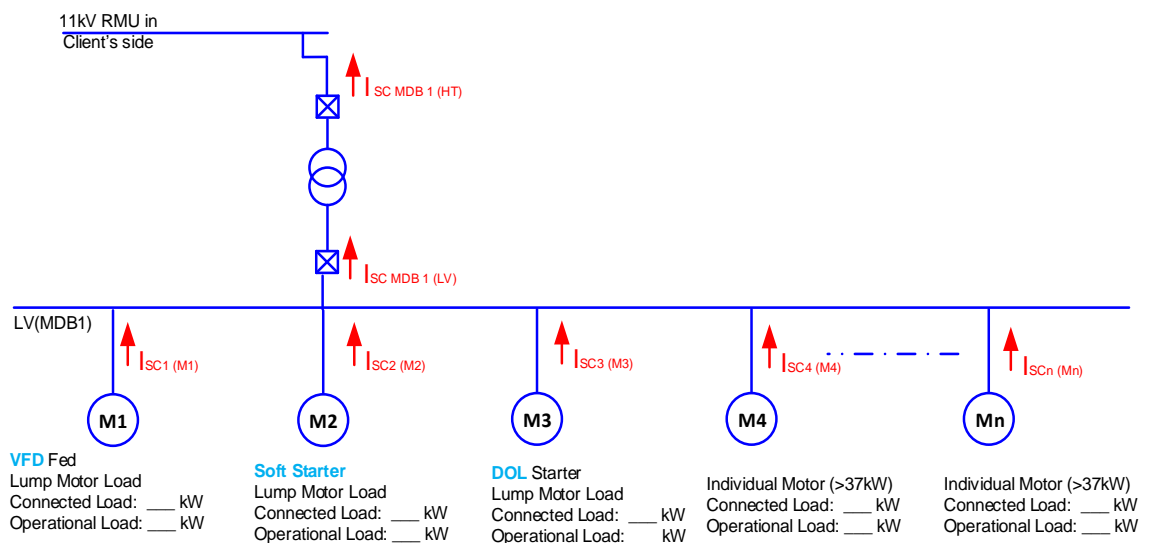


## SHORT CIRCUIT CALCULATION PROCESS

5. For 3 phase maximum fault current contribution calculation from each motor load type, perform the following:
  - a) **Direct On Line [DOL] Started Lumped LV Motor:** Fault Current (DOL lump) = Nominal Current x 5;
  - b) **Variable Frequency Drives [VFD] Started Lumped LV Motor:** Fault Current (VFD lump) = Nominal Current x 1;
  - c) **Soft Starter Lumped LV Motor:** Fault Current (SS lump) = Nominal Current x 3;
  - d) **DOL started large LV / MV Individual Motor (>37kW):** Fault Current (Individual Motor) = Locked Rotor Current (from datasheet);
  - e) **VFD started large LV / MV Individual Motor (>37 kW):** Fault Current (Individual Motor) = Nominal Current x 1;
  - f) **Soft Starter large LV / MV Individual Motor (>37kW):** Fault Current (Individual Motor) = Locked Rotor Current (from datasheet).
6. In case of using by-pass switches with the motor starter, post motor starting, select the worst case locked rotor multiplier as may become applicable from the above for the calculations.
7. The appropriate cable impedance must be included, where available, especially for the large individual motors.

### 2.3 Results Presentation:

Reflect the LV MDB side fault level, which is the sum of all the individual LV branch contributions from all motoric load classes, on the HV side of the transformers as shown in Figure 2 below:

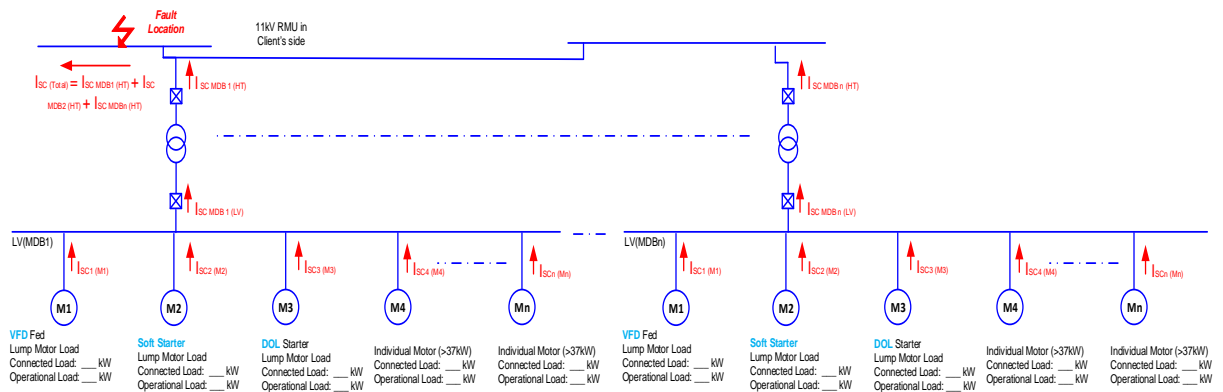


**Figure 2** – Representation of LV branch short circuit current contributions on MV side of the distribution transformer



**SHORT CIRCUIT CALCULATION PROCESS**

Repeat the above process for all the MDBs for all the transformers as shown below and sum the  $I_{sc}$  MDB1 (HT) to  $I_{sc}$  MDBn (HT) to provide the value of total fault current contributions from client's network at Fault Location point mentioned in figure 3 below. The Fault Location point typically will be the point of connection for the customer.



**Figure 3 – Representation of branch short circuit current contributions from all the distribution transformers at the Point of Common Coupling / Fault Location**

Sum up all transformer branch contributions on HT side to provide Total Fault current contribution from your plant and show the ISC on SLD.

Table 1 below shows an example structure of MS® Excel based calculation for fault current contribution from LV motoric loads (with example data only). When performing hand calculations, this must be prepared for every supply transformer for its branch contribution and the total fault contribution from the client's network to be calculated and documented.

By undertaking this process, the customer is confirming that their fault level is within the rating of their switchgear. Customer is also fulfilling their application obligation by informing MEDC that this is the worst-case fault infeed from their network to the MEDC network; using this information only MEDC can confirm if the existing MEDC switchgear where the customer is connecting is within safe operational limits or not.



**SHORT CIRCUIT CALCULATION PROCESS**

System Voltage (HV) [V]	11000
System Voltage (LV) [V]	433

Motor Equipment Rated Voltage (LV) [V]	415
Power Factor	0.8

Transformer Reference	Panel Reference	Motor / Bulk Load Reference	Motor Rating / Lump Load [kW]	Load Type Individual / Lump	Starter Type	LRA Multiplier	Locked Rotor Current [A]	Motor Impedance [ohm]	Cable Size [mm <sup>2</sup> ]	Cable Quantity (No. of runs)	Cable Unit Impedance [ohm/km]	Cable Length [m]	Cable Impedance [ohm]	Total Motor and Circuit Impedance [ohm]	Fault Current Back feed at Transformer LV Terminal [kA]	Total Fault Current Back feed at Transformer LV Terminal [kA]	Total Fault Current Back feed at Transformer HV Terminal [kA]
TX-01	LV MDB 1	Unit A	100.00	Individual	VFD	1	174	2.386	240	1	0.104	60	0.006	2.393	0.181	3.803	0.150
	LV MDB 1	Unit B	250.00	Individual	DOL	7.5	3261	0.127	240	1	0.104	120	0.013	0.140	3.098		
	LV MDB 2	Unit C	55.00	Lump	Soft Starter	3.0	287	1.446	50	1	0.394	10	0.004	1.450	0.299		
	LV MDB 2	Unit D	25.00	Lump	DOL	5.0	217	1.909	16	1	1.153	10	0.012	1.921	0.225		

**Table 1** – Suggested structure for MS® Excel based fault current contribution calculations