RMG SUSTAINABILITY COUNCIL

SINGLE LINE DIAGRAM (SLD) Or, ONE LINE DIAGRAM

The single-line diagram is the blueprint for electrical system analysis. It is the first step in preparing a critical response plan, allowing you to become thoroughly familiar with the electrical distribution system layout and design in your facility.

Why it's required?

Whether you have a new or existing facility, the single-line diagram is the vital roadmap for all future testing, service and maintenance activities. As such, the single-line diagram is like a balance sheet for your facility and provides a snapshot of your facility at a moment in time. It needs to change as your facility changes to ensure that your systems are adequately protected.

To make all the changes documented in a common file, making the electrical system easily understandable for any technical person inside/outside of the factory.

An up-to-date single-line diagram is vital for a variety of service activities including:

- Short circuit calculations
- Coordination studies
- Load flow studies
- Safety evaluation studies
- All other engineering studies
- Electrical safety procedures
- Efficient maintenance

What Should Be In A Single Line Diagram (SLD)?

A typical package of single line diagram shall include:

- SLD must be started with an index, legend, page references.
- All proper symbols shall be used.
- Incoming lines showing voltage and size.
- Incoming main fuses, cutouts, switches, and main/tie breakers.
- Power transformers (kVA rating, voltage rating, winding connection and grounding means, % impedance, cooling type).
- Feeder breakers and fused switches rating and type.
- All incoming circuits shall have a page reference (mention the page number from where it comes). All outgoing panels shall have a page reference (mention the page number to where this outgoing circuit is detailed-This link-up is required).

- Relays (function, use and type) is required to be mentioned. The fault current clearing time setting is required to be achieved from inverse definite minimum time (IDMT) relay or over current relay (OCR) of the vacuum circuit breaker (VCB) panel. Where only load breaking switch (LBS) is available and no VCB panel is available fault current clearing time setting is not required.
- Current and / or potential transformers with size, type and ratio
- All service-main cable and wire runs with their associated isolating switches shall be clearly mentioned.
- All substations, including integral relays and main panels with total load of each feeder and each substation
- Critical equipment voltage and size (uninterruptible power supply or UPS, battery, generator, power distribution, transfer-switch, computer room air conditioning).
- A load schedule for each distribution panels, busbar trunking or BBT, tap-off boxes of TOB and switch board (load table format is provided later in this guideline) is required to be prepared.
- Rating and dimension of bus bar shall be mentioned. The calculated rating of copper busbar equals to 1.55 Ampere per mm^2 of cross section area. The calculated rating of Aluminum busbar equals to 1.09 Ampere per mm^2 of cross section area.
- All outgoing cables shall be mentioned with number of cables, number of cores, cable size and along with number of poles associated with it. For example, $1x4Cx6mm^2$, NYY, TPN represents a 4-core (C) single NYY-type cable of $6mm^2$ cross section area connected to 3-phases (TP) and a neutral (N); Again, $3x1Cx4mm^2$, BYA, TP represents 3 numbers of single-core (C) and BYA-type cable of $4mm^2$ cross section area connected to 3-phases (TP). There are many cable types. Here NYY and BYA are only 2 examples of cable types and used as example
- The rating and type of their all-isolating switches and protective devices (e.g. circuit breaker, fuse, overload relay, magnetic contactor) shall be mentioned.
- The set point of all circuit breakers, thermal overload relay, rating of magnetic contactor shall be mentioned.
- Length of Cable laying is required where no protection is provided for an outgoing circuit or incoming circuit (where rules of tapping circuits is applicable)
- PFI, changeover, ATS, generators with associated protection and isolating switch, synchronizer and interlocking arrangements shall be properly mentioned with rating, proper symbols and details.
- For ATS, all protective ratings of protective device shall be mentioned.
- All earth conductors' size and type shall be mentioned with quantity
- Earth conductors and Earth pit-identification number with page references shall be mentioned in transformer, generators, panelboards and equipment (if directly connected with Earth pits)
- Total connected load (kilo watt or kW) with their individual load capacity (kW) shall be mentioned.
- All connected equipment (loads) shall be identified with marking and mentioned in the load description. The marking/identification number of each load shall also be mentioned in the point reference or load reference column.

- All spare switches (outgoing circuit breaker) shall be mentioned.

  Earthing system (excluding LPS Earth pits) must be included with dimension of earthing pit, boring, busbar, earth electrode size, earth lead and ECC size and type in a separate page.

- An example of a typical SLD has been given which includes the substation, LT panel, distribution panel with load table format.

Sketch 1: Example of SLD of typical substation, low tension or LT panel and MDB (main distribution board)

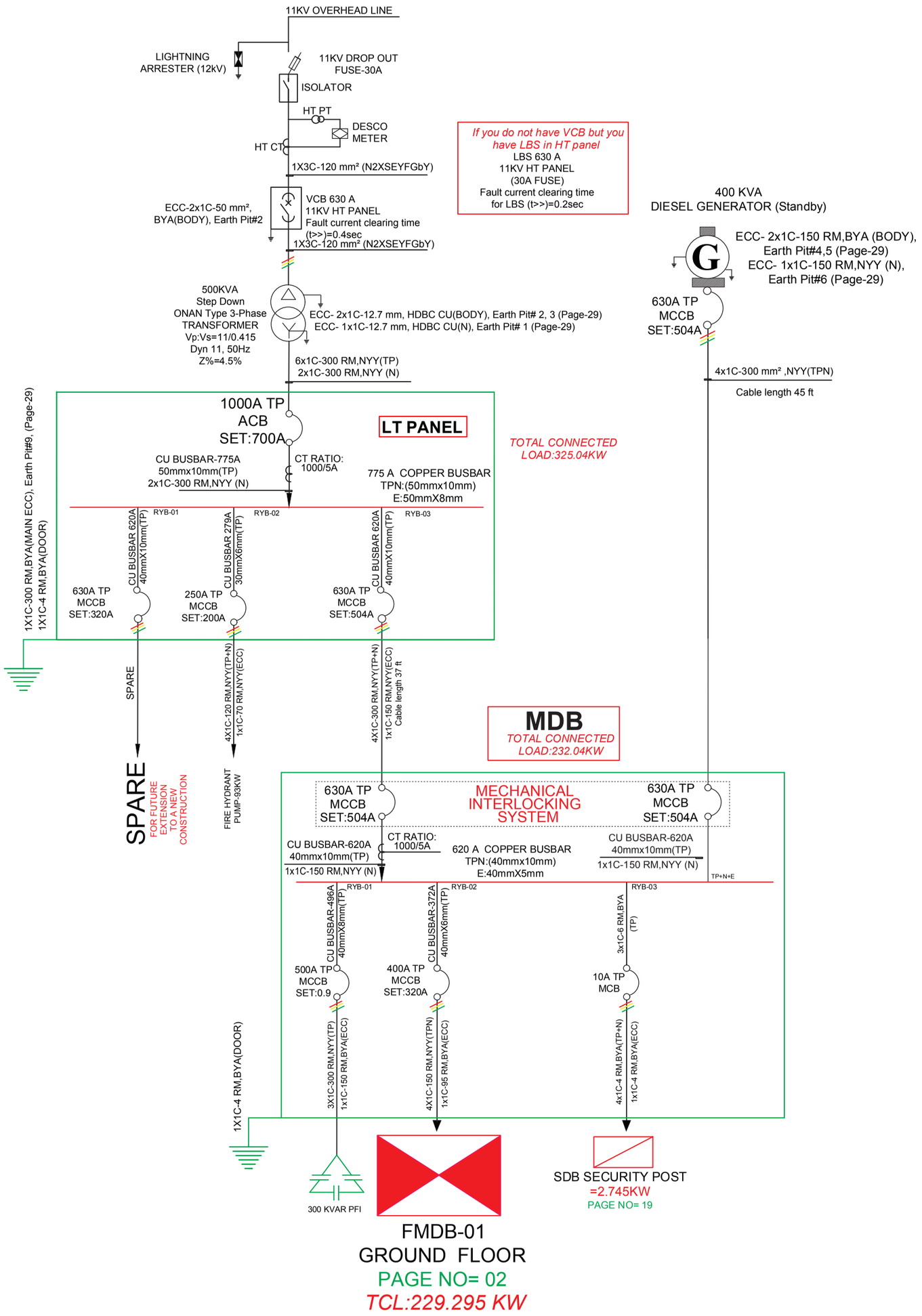
Table 1: Example of load table of a typical LT panel

Table 2: Example of load table of a typical MDB

Sketch 2: Example of SLD of typical floor MDB (FMDB)

Table 3: Example of load table of a typical FMDB

Table 4: Example of load table of a typical sub distribution board or SDB



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Substation & LT			Rev: 01 Rev: 02					

Table 1: Example of load table of a typical LT panel

LT PANEL, LOCATION: GROUND FLOOR, FEED ROOM: TRANSFORMER

From SLD page-1

Main Incoming Ckt.	CKT REF.	Breaker MCCB/MCB Rat/Amp	Phase Neutral Size(rm)	Earth Size (re)	Load Type	Point Reference	Number of Points/ Pcs	Watt Per Point	Location	Total Watt	Phase Load in kW			Remarks
											R	Y	B	
1000A MCCB, set: 700A	RYB1	630A MCCB set:320A	Spare		Future extension	Spare	0	0	-	0	0.00	0.00	0.00	
	RYB2	250A MCCB set:200A	4x120.0	1x70.0	Fire Hydrant Pump	Fire Hydrant Pump	1	93000	Fire Pump room	93000	31.00	31.00	31.00	
	RYB3	630A MCCB set:504A	4x300.0	1x150.0	Main Distribution Panel	MDB	1	232140	Ground Floor	232140	78.12	78.13	75.79	
										Total Phase Load/kW=	**109.12**	**109.13**	**106.79**	
										Total Connected Load=	**325.04**		**kW**	Page No-1

Table 2: Example of load table of a typical MDB

MDB, LOCATION: SUB STATION, FEED ROOM: LT PANEL, REF: RYB-03. AND FROM GENERATOR (400KVA)

From SLD page-1

Main Incoming Ckt.	CKT REF.	Breaker MCCB/MCB Rat/Amp	Phase Neutral Size(rm)	Earth Size (re)	Load Type	Point Reference	Number of Points/ Pcs	Watt Per Point	Location	Total Watt	Phase Load in kW			Remarks
											R	Y	B	
MCCB 630A (set:504A) X 2, (interlocked)	RYB1	500A MCCB set:450	4x300	1x150	PFI	PFI	1	0	0	0	0.00	0.00	0.00	
	RYB2	400A MCCB set:320	4x150	1x95	FMDB	FMDB-01	1	229295	Ground Floor	229295	77.38	77.32	74.59	
	RYB3	10A TP	4x4.0	1x4.0	SDB	SDB-Security Post	1	2745	Security Post	2745	0.74	0.81	1.20	
									Total Phase Load/kW=		**78.12**	**78.13**	**75.79**	
									Total Connected Load=		**232.04**		**kW**	Page No-1

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L=Light
F=Fan
SM=Sewing M/C
M/C=Machine
EXH=Exhaust Fan

FEED FROM MDB (RYB-02, PAGE 01) GROUND FLOOR

4X1C-150 RM,NYY(TPN)
1x1C-95 RM,BYA(ECC)

FMDB-01 GROUND FLOOR

TOTAL CONNECTED LOAD: 229.295 KW

400A TP MCCB SET:320A

CU BUSBAR-558A
30mmx12mm(TP)
2x1C-150 RM,NYY (N)

558A COPPER BUSBAR
TPN:(30mmx12mm)
E:30mmX6mm

RYB-01	RYB-02	RYB-03	RYB-04	RYB-05	RYB-06	RYB-07	RYB-08	RYB-09	R-10	B-11	Y-12
3x1C-16 RM, NYY(TP)	3x1C-35 RM, NYY(TP)	3x1C-35 RM, NYY(TP)	3x1C-35 RM, NYY(TP)	3x1C-35 RM, NYY(TP)	3x1C-25 RM, NYY(TP)	3x1C-35 RM, NYY(TP)	3x1C-10RM, BYA(TP)	1x1C-4 RM, BYA(P)	1x1C-6 RM, NYY(P)	1x1C-6 RM, NYY(P)	1x1C-6 RM, NYY(P)
63A TP MCCB SET: 50.4A	100A TP MCCB SET:70A	100A TP MCCB SET:70A	100A TP MCCB SET:70A	100A TP MCCB SET:70A	25A TP MCCB SET:15A	63A TP MCCB SET:44A	100A TP MCCB FIXED	16A TP MCB	6A SP MCB	10A SP MCB	10A SP MCB
4X1C-16 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-25 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-25 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-25 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-25 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-16 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	4X1C-25 RM,NYY(TPN) 1X1C-16 RM,BYA(ECC)	SPARE	4X1C-6 RM,BYA(TPN) 1X1C-6 RM,BYA(ECC) Neutral cable is for control only	2x1C-4 RM,BYA(P+N)	2x1C-4 RM,BYA(P+N) 1x1C-4RM,BYA(ECC)	2x1C-4 RM,BYA(P+N) 1x1C-4RM,BYA(ECC)
DB-01 GROUND FLOOR PAGE-03 *TCL:28.37KW*	DB-02 1ST FLOOR PAGE-04 *TCL:28.37KW*	DB-03 2ND FLOOR PAGE-08 *TCL:38.78KW*	DB-04 3RD FLOOR PAGE-11 *TCL:36.77KW*	DB-05 4TH FLOOR PAGE-14 *TCL:40.85KW*	DB-06 5TH FLOOR PAGE-17 *TCL:16.54KW*	DB-07 UTILITY SHADE PAGE-18 *TCL:33.00KW*	SPARE	EXHAUST FAN (4X746W)=2.98KW Each Exhaust Fan is protected by a 5A thermal overload relay with 12A Magnetic contactor *(EXH101--EXH104)*	OFFICE-2 8 nos LIGHT (18W)+1 no FAN (80W) (8X18W)+(01X80W)=0.224KW *(L101--L108), F-101.*	OFFICE-2 4 nos POWER SOCKET(5A, 200W) (04X200W)=0.8KW *PS101--PS 104.*	6 nos SEWING M/C, LINE-1 (06X400W)= 2.40KW Each M/C is protected by a 5A fuse in socket plug *(SM101--SM106)*

1X1C-4 RM,BYA(DOOR)

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FMDB01/GF			Rev: 01					
			Rev: 02					

Version 1.0

Table: 3 Example of load table of a typical FMDB

FMDB-01, LOCATION: GROUND FLOOR, FEED ROOM: MDB, REF: RYB-02.

From SLD page-2

Main Incoming Ckt.	CKT REF.	Breaker MCCB/MCB Rat/Amp	Phase Neutral Size	Earth Size	Load Type	Point Reference	Number of Points/ Pcs	Watt Per Point	Location	Total Watt	Phase Load in kW			Remarks
											R	Y	B	
MCCB 400A (set:320A)	RYB1	63A MCCB Set at 50A	4x16.0	1x16.0	DB-1	DB-01	1	28370	Ground Floor	28370	9.34	9.21	9.82	
	RYB2	100A MCCB Set at 70A	4x25.0	1x16.0	DB-2	DB-02	1	28373	Ist Floor	28373	9.76	9.28	9.34	
	RYB3	100A MCCB Set at 70A	4x25.0	1x16.0	DB-3	DB-03	1	38786	2nd Floor	38786	14.43	12.36	12.00	
	RYB4	100A MCCB Set at 70A	4x25.0	1x16.0	DB-4	DB-04	1	36770	3rd Floor	36770	12.49	12.38	11.90	
	RYB5	100A MCCB Set at 70A	4x25.0	1x16.0	DB-5	DB-05	1	40850	4th Floor	40850	13.75	13.85	13.25	
	RYB6	25A MCCB Set at 15A	4x16.0	1x16.0	DB-6	DB-06	1	16540	5th Floor	16540	5.40	5.80	5.34	
	RYB7	63A MCCB Set at 44A	4x25.0	1x16.0	DB-7	DB-07	1	33198	Utility Shed	33198	11.00	11.05	11.148	
	RYB8	100A MCCB	Spare			Spare	1	0	-	0	0.00	0.00	0.00	
	RYB9	16A TP	4X6.0	1x6.0	Exhaust Fan	EXH.101---EXH.104	4	746	Sample office room	2984	0.99	0.99	0.99	
	R10	6A SP	2X4.0		Light, Fan	L.101---L.108 F.101	8 (L)+1(F)	18 (L)+80(F)	Ground Floor	144(L) + 80(F)	0.22			
	B11	10A SP	2X4.0	1x4.0	Power Socket	PS.101---PS.104	4	200	Ground Floor	800			0.80	
	Y12	10A SP	2X4.0	1x4.0	Sewing Machine	SM.101---SM.106	6	400	Ground Floor	2400		2.40		
									Total Phase Load/kW=		**77.38**	**77.32**	**74.59**	
									Total Connected Load=		**229.295**		**kW**	Page No-2

Table 4: Example of load table of a typical SDB

SDB-03, LOCATION: WEST, LINE NO-01, 3rd FLOOR, FEED ROOM: DB-04, REF: RYB-01.

From SLD page-9

Main Incoming Ckt.	CKT REF.	Breaker MCB Rat/Amp	Phase Neutral Size(rm)	Earth Size (re)	Load Type	Point Reference	Number of Points/Pcs	Watt Per Point	Location	Total Watt	Phase Load in kW			Remarks
											R	Y	B	
MCB 16A TP	B1	2A SP	2X2.5		Light	L.325---L.335	11	18	West Side , Line no-1	198			0.198	
	R2	6A SP	2X4.0	1x4.0	Sewing Machine	SM.347---SM.352	6	350	"	2100	2.1			
	B3	6A SP	2X4.0	1x4.0	Sewing Machine	SM.353---SM.358	6	350	"	2100			2.1	
	RYB4	6A TP	3X4.0	1x4.0	Exhaust Fan	Exh.309---Exh.310	2	1125	"	2250	0.75	0.75	0.75	
	Y5	6A SP	2X4.0	1x4.0	Sewing Machine	SM.359---SM.363	5	350	"	1750		1.75		
	Y6	2A SP	2X2.5		Light	L.336---L.346	11	18	"	198		0.198		
	RYB7	6A TP	2X4.0		Ceiling Fan	F.301-F.310	10 (R-3, Y-5, B-2)	70	"	700	0.21	0.35	0.14	
									Total Phase Load/kW=		**3.06**	**3.048**	**3.188**	
									Total Connected Load=		**9.296**		**kW**	Page No-17