

### SHORT CIRCUIT CALCULATION ACC. TO IEC 363

YARD: XXXXXXXXXXXXXXXXXXXX

Hull No XXXXXXXXXXXXXXXX

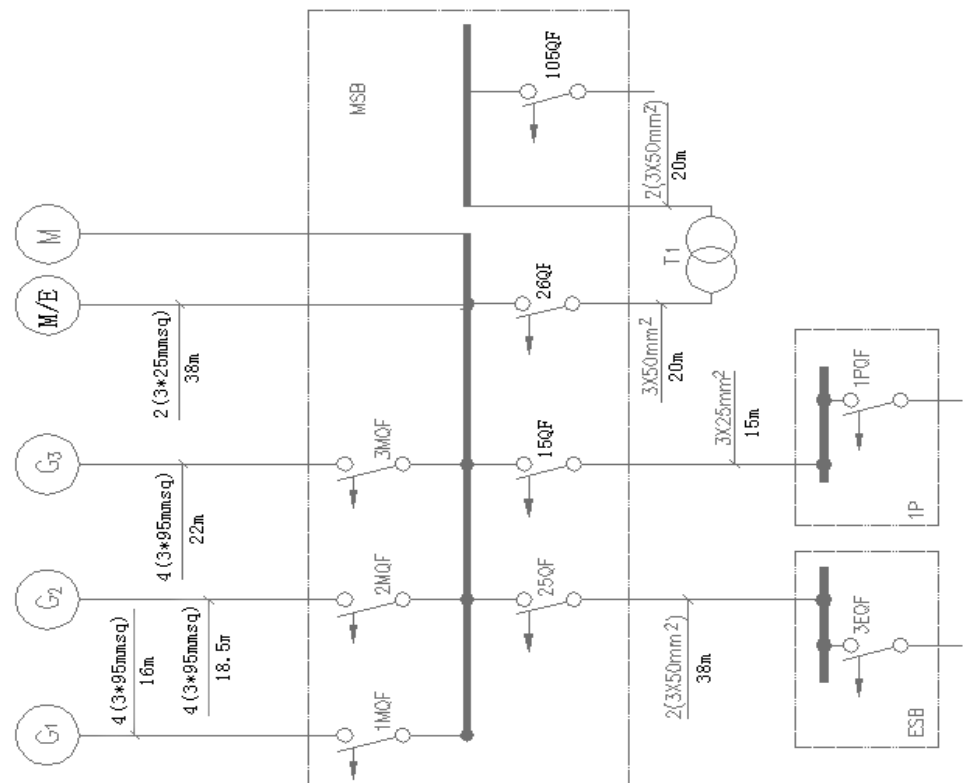
OBJECT: XXXXXXXXXXXXXXXXXXXX

Motors and generators combined to an equivalent generator.  
Calculation of time constants and calculation of d.c. components  
under consideration of  $I_p$ .

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05.07.04	mingzi				Drwg No	SE05079SCC	
Date	Desigend	Checked	Appro				

CIRCUIT DIAGRAM OF CALCULATION OF SHORT-CIRCUIT CURRENT OF POWER NETWORK



<b>SHORT CIRCUIT CALCULATION</b> <b>ACC. TO IEC 363</b> <b>0</b>	<b>SCHNEIDER</b>	Revision	0	page
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A	B	C	D	E	F	G	H	I	J	K	L
2											
3	CALCULATION OF SHORT CIRCUIT CURRENT OF A SYNCHRONOUS MACHINE (DIESEL GENERATOR 1)										
4											
5											
6	Data of machine			LVM634C1				Cable generator - busbar			
7											
8	P <sub>RG</sub> :	550 kW	x <sub>d</sub> " [%]	9.00%				cross-sect.	120 mm <sup>2</sup>		
9	cos phi:	0.8	x <sub>d</sub> ' [%]	12.00%				length	25 m		
10	S <sub>RG</sub> :	687.5 kVA	x <sub>d</sub> [%]	219.80%				No. of cables	6 Cables		
11	U <sub>RG</sub> :	400 V	r <sub>a</sub> [%]								
12	I <sub>RG</sub> :	0.99 kA	T <sub>d</sub> "	13 ms							
13	fr:	50 Hz	T <sub>d</sub> '	99 ms							
14	R <sub>a</sub> :	3.40 mOhm	T <sub>dc</sub>	34 ms							
15	I <sub>k</sub> :	2.98 kA (Steady-state short circuit symmetrical current acc. to company data, otherwise 3 times nom. current)									
16											
17											
18	Impedances of machine										
19											
20	R <sub>a</sub>	3.40 mOhm	X <sub>d</sub> "	20.95 mOhm	Z <sub>d</sub> "	21.22 mOhm					
21											
22	X <sub>d</sub> '	27.93 mOhm	X <sub>d</sub>	511.53 mOhm	Z <sub>d</sub> '	28.13 mOhm					
23											
24											
25	Impedances of cable		calculated	R	0.68 mOhm	X	0.36 mOhm				
26			input	R	mOhm	X	mOhm				
27											
28											
29	Impedances of short circuit										
30		R [mOhm]		X <sub>d</sub> " [mOhm]		X <sub>d</sub> ' [mOhm]		X <sub>d</sub> [mOhm]			
31											
32	Generator	3.40		20.95		27.93		511.53			
33	Cable	0.68		0.36		0.36		0.36			
34											
35	Total	4.08		21.30		28.29		511.89			
36											
37		Z <sub>d</sub> "	21.69 mOhm	Z <sub>d</sub> '	28.58 mOhm	Z <sub>d</sub>	511.91 mOhm				
38											
39											
40	Short circuit current at rated duty (t=0)										
41											
42		E"	247.29 V		E'	251.82 V					
43											
44		I <sub>k</sub> "(I <sub>AC</sub> )	11.40 kA	I <sub>k</sub> '	8.81 kA	i <sub>DC</sub>	15.28 kA				
45											
46											
47	Fitted time constants										
48											
49		T <sub>d</sub> "	13.17 ms	T <sub>d</sub> '	102.17 ms	T <sub>DC</sub>	16.61 ms				
50											
51											
52	Time dependent short circuit current			t [ms]	periods	I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]	i <sub>p</sub> [kA]			
53											
54				0.00	0.0	11.40	15.28				
55		9.25141723		10.00	0.5	9.48	9.25	22.66			
56				20.00	1.0	8.34	5.60				
57				30.00	1.5	7.59	3.39				
58				40.00	2.0	7.05	2.05				
59				50.00	2.5	6.61	1.24				
60				60.00	3.0	6.25	0.75				
61											
62											
63											
64											
65											
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A	B	C	D	E	F	G	H	I	J	K	L
2											
3	CALCULATION OF SHORT CIRCUIT CURRENT OF A SYNCHRONOUS MACHINE (DIESEL GENERATOR 2)										
4											
5											
6	Data of machine			LVM634C1				Cable generator - busbar			
7											
8	P <sub>RG</sub> :	550 kW	x <sub>d</sub> " [%]	9.00%				cross-sect.	120 mm <sup>2</sup>		
9	cos phi:	0.8	x <sub>d</sub> ' [%]	12.00%				length	25 m		
10	S <sub>RG</sub> :	687.5 kVA	x <sub>d</sub> [%]	219.80%				No. of cables	6 Cables		
11	U <sub>RG</sub> :	400 V	r <sub>a</sub> [%]								
12	I <sub>RG</sub> :	0.99 kA	T <sub>d</sub> "	13 ms							
13	fr:	50 Hz	T <sub>d</sub> '	99 ms							
14	R <sub>a</sub> :	3.40 mOhm	T <sub>dc</sub>	34 ms							
15	I <sub>k</sub> :	2.98 kA (Steady-state short circuit symmetrical current acc. to company data, otherwise 3 times nom. current)									
16											
17											
18	Impedances of machine										
19											
20	R <sub>a</sub>	3.40 mOhm	X <sub>d</sub> "	20.95 mOhm	Z <sub>d</sub> "	21.22 mOhm					
21											
22	X <sub>d</sub> '	27.93 mOhm	X <sub>d</sub>	511.53 mOhm	Z <sub>d</sub> '	28.13 mOhm					
23											
24											
25	Impedances of cable		calculated	R	0.68 mOhm	X	0.36 mOhm				
26			input	R	mOhm	X	mOhm				
27											
28											
29	Impedances of short circuit										
30		R [mOhm]		X <sub>d</sub> " [mOhm]		X <sub>d</sub> ' [mOhm]		X <sub>d</sub> [mOhm]			
31											
32	Generator	3.40		20.95		27.93		511.53			
33	Cable	0.68		0.36		0.36		0.36			
34											
35	Total	4.08		21.30		28.29		511.89			
36											
37		Z <sub>d</sub> "	21.69 mOhm	Z <sub>d</sub> '	28.58 mOhm	Z <sub>d</sub>	511.91 mOhm				
38											
39											
40	Short circuit current at rated duty (t=0)										
41											
42		E"	247.29 V		E'	251.82 V					
43											
44		I <sub>k</sub> "(I <sub>AC</sub> )	11.40 kA	I <sub>k</sub> '	8.81 kA		i <sub>DC</sub>	15.28 kA			
45											
46											
47	Fitted time constants										
48											
49	T <sub>d</sub> "	13.17 ms	T <sub>d</sub> '	102.17 ms	T <sub>DC</sub>	16.61 ms					
50											
51											
52	Time dependent short circuit current			t [ms]	periods	I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]	i <sub>p</sub> [kA]			
53											
54				0.00	0.0	11.40	15.28				
55		9.25141723		10.00	0.5	9.48	9.25	22.66			
56				20.00	1.0	8.34	5.60				
57				30.00	1.5	7.59	3.39				
58				40.00	2.0	7.05	2.05				
59				50.00	2.5	6.61	1.24				
60				60.00	3.0	6.25	0.75				
61											
62											
63											
64											
65											

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A	B	C	D	E	F	G	H	I	J	K	L
2											
3	CALCULATION OF SHORT CIRCUIT CURRENT OF A SYNCHRONOUS MACHINE (DIESEL GENERATOR 3)										
4											
5											
6	Data of machine			LVM634C1				Cable generator - busbar			
7											
8	P <sub>RG</sub> :	550 kW	x <sub>d</sub> '' [%]	9.00%				cross-sect.	120 mm <sup>2</sup>		
9	cos phi:	0.8	x <sub>d</sub> ' [%]	12.00%				length	25 m		
10	S <sub>RG</sub> :	687.5 kVA	x <sub>d</sub> [%]	219.80%				No. of cables	6 Cables		
11	U <sub>RG</sub> :	400 V	r <sub>a</sub> [%]								
12	I <sub>RG</sub> :	0.99 kA	T <sub>d</sub> ''	13 ms							
13	fr:	50 Hz	T <sub>d</sub> '	99 ms							
14	R <sub>a</sub> :	3.40 mOhm	T <sub>dc</sub>	34 ms							
15	I <sub>k</sub> :	2.98 kA (Steady-state short circuit symmetrical current acc. to company data, otherwise 3 times nom. current)									
16											
17											
18	Impedances of machine										
19											
20	R <sub>a</sub>	3.40 mOhm	X <sub>d</sub> ''	20.95 mOhm	Z <sub>d</sub> ''	21.22 mOhm					
21											
22	X <sub>d</sub> '	27.93 mOhm	X <sub>d</sub>	511.53 mOhm	Z <sub>d</sub> '	28.13 mOhm					
23											
24											
25	Impedances of cable		calculated	R	0.68 mOhm	X	0.36 mOhm				
26			input	R	mOhm	X	mOhm				
27											
28											
29	Impedances of short circuit										
30		R [mOhm]		X <sub>d</sub> '' [mOhm]		X <sub>d</sub> ' [mOhm]		X <sub>d</sub> [mOhm]			
31											
32	Generator	3.40		20.95		27.93		511.53			
33	Cable	0.68		0.36		0.36		0.36			
34											
35	Total	4.08		21.30		28.29		511.89			
36											
37		Z <sub>d</sub> ''	21.69 mOhm	Z <sub>d</sub> '	28.58 mOhm	Z <sub>d</sub>	511.91 mOhm				
38											
39											
40	Short circuit current at rated duty (t=0)										
41											
42		E''	247.29 V		E'	251.82 V					
43											
44		I <sub>k</sub> ''(I <sub>AC</sub> )	11.40 kA	I <sub>k</sub> '	8.81 kA		i <sub>DC</sub>	15.28 kA			
45											
46											
47	Fitted time constants										
48											
49		T <sub>d</sub> ''	13.17 ms	T <sub>d</sub> '	102.17 ms	T <sub>DC</sub>	16.61 ms				
50											
51											
52	Time dependent short circuit current			t [ms]	periods	I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]	i <sub>p</sub> [kA]			
53											
54				0.00	0.0	11.40	15.28				
55		9.25141723		10.00	0.5	9.48	9.25	22.66			
56				20.00	1.0	8.34	5.60				
57				30.00	1.5	7.59	3.39				
58				40.00	2.0	7.05	2.05				
59				50.00	2.5	6.61	1.24				
60				60.00	3.0	6.25	0.75				
61											
62											
63											
64											
65											
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2												
3	<b>SHORT CIRCUIT CURRENT OF A SINGLE ASYNCHRONOUS MOTOR</b>											
4												
5	Motor	Bowthruster					Transformer					
6												
7	Power	400 kW		if available...				SrT:			kVA	
8	Nom. voltage	400 V		$r_{Stator}$ (rs %)				Urt(1):			V	
9	Frequency	50 Hz		$r_{Rotor}$ (rr %)				Urt(2):			V (Motor)	
10	Nom. current	0.76 kA		$x_{Stator}$ (xs %)				uk:				
11	Load	100% [%]		$x_{Rotor}$ (xr %)				Pk			kW	
12												
13	if available...						Cable of transformer		Cable of transformer			
14	cos phi						(busbar side)		(motor side)			
15	eta											
16	IA/IN:						Cross-sect.	95 mm <sup>2</sup>	Cross-sect.		mm <sup>2</sup>	
17							No. of cables	3 Cable	No. of cables		Cable	
18							Length	90 m	Length		m	
19												
20												
21	Nominal current of motors			0.76		kA		Load current			0.76	kA
22												
23	Resistance	R	16.71	mOhm	$R_s$	10.33	mOhm	$R_R$	6.38	mOhm		
24												
25	Reactance / impedance			$X''$	45.58	mOhm	$Z_K''$	48.55	mOhm			
26												
27	Time constants			$T_M''$ [ms]	22.74		$T_{DCM}$ [ms]	14.04				
28												
29												
30	Resistance / reactances of motors						16.71 mOhm		45.58 mOhm			
31												
32	Cable of transf. (motor side) resist. / react.						calculated	8.00 mOhm		5.00 mOhm		
33							input					
34												
35	Total						24.71 mOhm		50.58 mOhm			
36												
37												
38	<b>Conversion to busbarside (if transformer is used)</b>											
39												
40	Nom. current of motors			0.98		kA		Load current			0.98	kA
41												
42	Resistance / reactance						14.20 mOhm		38.72 mOhm			
43												
44	Resistance / reactance of transformer						20.00 mOhm		42.00 mOhm			
45												
46	Cable of transf. (busbar side) resist. / react.						calculated	6.18 mOhm		2.25 mOhm		
47							input					
48												
49	<b>Total resistance / reactance</b>						<b>40.38 mOhm</b>		<b>82.97 mOhm</b>			
50												
51												
52					$Z_K$	92.27 mOhm		$EMK_{Motor}$		223.96 V		
53												
54	<b>Short circuit current (t=0) [kA]</b>				$I_K''$	2.43		$I_{DC}$		4.08		
55												
56												
57	<b>Time constants [ms]</b>				$T_M''$	22.40		$T_{DCM}$		14.08		
58												
59												
60	<b>Time depend. short circuit current</b>				t [ms]	periods	$I_{AC}$ [kA]	$i_{DC}$ [kA]	$i_P$ [kA]			
61												
62					0.00	0.0	2.43	4.08				
63					10.00	0.5	1.55	2.00	4.20			
64					60.00	3.0	0.17	0.06				
65												
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2												
3	<b>SHORT CIRCUIT CURRENT OF EQUIVALENT MOTOR</b>											
4												
5	Motor	Equivalent motor					Transformer					
6												
7	Power	600 kW		if available...			SrT:		kVA			
8	Nom. voltage	400 V		r <sub>Stator</sub> (rs %)			U <sub>rt</sub> (1):		V			
9	Frequency	50 Hz		r <sub>Rotor</sub> (rr %)			U <sub>rt</sub> (2):		V (Motor)			
10	Nom. current	1.08 kA		x <sub>Stator</sub> (xs %)			uk:					
11	Load	100% [%]		x <sub>Rotor</sub> (xr %)			Pk		kW			
12												
13	if available...						Cable of transformer		Cable of transformer			
14	cos phi	0.8		(busbar side)			(motor side)					
15	eta											
16	IA/IN:			Cross-section			mm <sup>2</sup>		Cross-section		mm <sup>2</sup>	
17				No. of cables			Kabel		No. of cables		Kabel	
18				Length			m		Length		m	
19												
20												
21	Nominal current of motors			1.08		kA		Load current			1.08 kA	
22												
23	Resistance	R	11.76	mOhm	R <sub>s</sub>	7.27	mOhm	R <sub>R</sub>	4.49	mOhm		
24												
25	Reactance / Impedance			X"	32.08	mOhm	ZK"	34.16	mOhm			
26												
27	Time constants			T <sub>M</sub> " [ms]	22.74		T <sub>DCM</sub> " [ms]	14.04				
28												
29												
30	Resistance / reactance of motors			11.76 mOhm				32.08 mOhm				
31												
32	Cable of transf. (motor side) resist. / react.			calculated input		0.00 mOhm		0.00 mOhm				
33						mOhm		mOhm				
34												
35	Total			11.76 mOhm				32.08 mOhm				
36												
37												
38	<b>Conversion to busbar side (if transformer is used)</b>											
39												
40	Nominal current of motors			1.08		kA		Load current			1.08 kA	
41												
42	Resistance / reactance			11.76 mOhm				32.08 mOhm				
43												
44	Resistance / reactance of transformer			0.00 mOhm				0.00 mOhm				
45												
46	Cable of transf. (busbar side) resist. / react.			calculated input		0.00 mOhm		0.00 mOhm				
47						mOhm		mOhm				
48												
49	<b>Total resistance / reactance</b>			<b>11.76 mOhm</b>				<b>32.08 mOhm</b>				
50												
51												
52	Z <sub>K</sub>			34.16 mOhm		EMK <sub>Motor</sub>		201.00 V				
53												
54	<b>Short circuit current (t=0) [kA]</b>			I <sub>K</sub> "		5.88		I <sub>DC</sub>		9.24		
55												
56												
57	<b>Time constants [ms]</b>			T <sub>M</sub> "		22.74		T <sub>DCM</sub>		14.04		
58												
59												
60	<b>Time depend. short circuit current</b>			t [ms]	periods	I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]	i <sub>P</sub> [kA]				
61												
62				0.00	0.0	5.88	9.24					
63				10.00	0.5	3.79	4.53	9.89				
64				60.00	3.0	0.42	0.13					
65												
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2											
3											
4											
5	CALCULATION OF AN EQUIVALENT GENERATOR WITH FOLLOWING COMPONENTS										
6	Designation of equ. generator Main busbar MSB										
7	Voltage 440 V Frequency 50 Hz cos(phi)GEN 0.8										
8											
9											
10	Generators		Page	Number	I_K'' [kA]	I_K' [kA]	I_KD [kA]	T_d'' [ms]	I_K''-I_K' [kA]	I_K'-I_D [kA]	
11								incl. Kabel	(M)	(N)	
12	Generator	1	3	1	11.40	8.81	2.98	13.17	2.59	5.83	
13	Generator	2	4	1	11.40	8.81	2.98	13.17	2.59	5.83	
14	Generator	3	5	1	11.40	8.81	2.98	13.17	2.59	5.83	
15											
16											
17	Total				34.20	26.43	8.93		7.77	17.50	
18											
19	Generators		I_0 [kA]	I_K'' [kA]	I_AC T=0,5 [kA]	I_AC T=3,0 [kA]	i_DC T=0 [kA]	i_DC T=0,5 [kA]	i_DC T=3,0 [kA]	i_p [kA]	
20											
21	Generator	1	0.99	11.40	9.48	6.25	15.28	9.25	0.75	22.66	
22	Generator	2	0.99	11.40	9.48	6.25	15.28	9.25	0.75	22.66	
23	Generator	3	0.99	11.40	9.48	6.25	15.28	9.25	0.75	22.66	
24											
25											
26	Total		2.98	34.20	28.44	18.74	45.84	27.75	2.26	67.97	
27											
28	Motors		Page	I_K'' [kA]	I_AC T=0,5 [kA]	I_AC T=3,0 [kA]	i_DC T=0 [kA]	i_DC T=0,5 [kA]	i_DC T=3,0 [kA]	i_p [kA]	
29											
30											
31											
32											
33	Bowthruster	6	2.43	1.55	0.17	4.08	2.00	0.06		4.20	
34	Equivalent motor	7	5.88	3.79	0.42	9.24	4.53	0.13		9.89	
35											0.00
36	Total motors			8.31	5.34	0.59	13.31	6.54	0.19	14.09	
37	Total generators+motors			42.51	33.78	19.33	59.16	34.29	2.44	82.06	
38											
39	Calculation of time constants										
40											
41	Generator		DG1	DG2	DG3	I_ACMOT(T=0,5)		K'' [kA]			
42											
43	K''_GEN + I_ACMOT(t=0,5) [kA]		10.02	10.02	10.02			5.34	35.41		
44											
45	T_d'' 17.16 ms		T_d' 102.17 ms		T_DC 19.28 ms						
46											
47											
48	Calculation of impedances										
49											
50	Z''		5.98 mOhm	Z'	9.61 mOhm	Z_d	28.44 mOhm				
51											
52	X''		5.90 mOhm	X'	9.56 mOhm	X_d	28.43 mOhm				
53											
54	R		0.97 mOhm								
55											
56											
57	Time depend. short circuit current										
58											
59	t [ms]		periods	I_AC [kA]	i_DC [kA]	i_p [kA]					
60											
61	0.00		0.0	42.51	59.16						
62	10.00		0.5	33.78	34.29	82.06					
63	60.00		3.0	19.33	2.44						
64											
65											
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2											
3	<b>SHORT CIRCUIT CALCULATION FOR DISTRIBUTION BOARDS WITH AND WITHOUT TRANSFORMER</b>										
4											
5	Equ. generator	MSB 400 V			to		MSB 220 V				
6											
7	Voltage	400 V		Frequency	50 Hz		cos(phi) <sub>GEN</sub>				
8											
9	Data of equ. generator	from page 8 (MSB 400V)									
10											
11		T <sub>d</sub> "	17.1628023		T <sub>d</sub> '	102.1705919		T <sub>DC</sub>	19.2840368		
12											
13		X"	5.89587704 mOhm		X'	9.560626625 mOhm		X	28.4277911 mOhm		
14											
15		R	0.97 mOhm								
16											
17											
18	<b>Transformer(s)</b>					<b>Cable A</b>					
19		S <sub>RT</sub>	60 kVA			Equ. gen. - transformer	Cross-sect.	50 mm <sup>2</sup>			
20		U <sub>RT1</sub> (Gen.)	400 V				No. of cables	1			
21		U <sub>RT2</sub> (DB)	230 V				Length	10 m			
22		u <sub>K</sub>	3.25% [%]			<b>Cable B</b>					
23		u <sub>R</sub>	[%]			sec. side of transf.	Cross-sect.	50 mm <sup>2</sup>			
24		P <sub>K</sub>	0.98 kW				No. of cables	2			
25		parallel	1				Length	10 m			
26											
27											
28											
29	<b>Impedances</b>										
30			R [mOhm]		X" [mOhm]		X' [mOhm]		X [mOhm]		
31											
32		Equ. generator		0.97		5.90		9.56		28.43	
33											
34		Cable A	calculated	3.93		0.75		0.75		0.75	
35			input							0.00	
36											
37		<b>Total</b>		<b>4.90</b>		<b>6.65</b>		<b>10.31</b>		<b>29.18</b>	
38											
39		<b>converted for U<sub>RT2</sub></b>		1.62		2.20		3.41		9.65	
40											
41		Transformer		14.40		24.77		24.77		24.77	
42											
43		Cable B	calculated	1.97		0.38		0.38		0.38	
44			input								
45											
46		<b>Total</b>		<b>17.99</b>		<b>27.34</b>		<b>28.56</b>		<b>34.79</b>	
47											
48		Z"	32.73 mOhm		Z'	33.75 mOhm		Z	39.17 mOhm		
49											
50		T"	17.39 ms		T'	107.65 ms		T <sub>DC</sub>	4.84 ms		
51											
52		E	132.79 V					i <sub>DC</sub>	5.74 kA		
53											
54		I <sub>K</sub> "	4.06 kA		I <sub>K</sub> '	3.93 kA		I <sub>KD</sub>	3.39 kA		
55											
56											
57	<b>Time depend. short circuit current</b>			t [ms]	periods	I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]	i <sub>p</sub> [kA]			
58											
59				0.00	0.0	4.06	5.74				
60				10.00	0.5	3.96	0.73	6.32			
61				60.00	3.0	3.71	0.00				
62											
63											
64											
65											
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2											
3	<b>SHORT CIRCUIT CALCULATION FOR SWITCHBOARDS WITH AND WITHOUT TRANSFORMER</b>										
4											
5	<b>Equ. generator</b>		MSB 400V			to		ESB 400V			
6											
7	Voltage		400 V		Frequency		50 Hz		cos(phi) <sub>GEN</sub>		0.8
8											
9	<b>Data of equ. generator</b>		from page 8 (MSB 400V)								
10											
11	T <sub>d</sub> "		17.16 ms		T <sub>d</sub> '		102.17 ms		T <sub>DC</sub>		19.28 ms
12											
13	X"		5.90 mOhm		X'		9.56 mOhm		X		28.43 mOhm
14											
15	R		0.97 mOhm								
16											
17											
18	<b>Cable</b>										
19	Cable A		from		MSB 440V		to		ESB 440V		
20	Cable B		from				to				
21	Cable C		from				to				
22											
23	Cable A				Cable B				Cable C		
24											
25	Cross-sect.		50 mm <sup>2</sup>				mm <sup>2</sup>				mm <sup>2</sup>
26	No. of cables		2								
27	Length		40 m				m				m
28											
29											
30	<b>Impedances</b>										
31											
32			R [mOhm]		X" [mOhm]		X' [mOhm]		X [mOhm]		
33											
34	Equ. generator		0.97		5.90		9.56		28.43		
35											
36	Cable A		calculated		7.86		1.50		1.50		1.50
37			input								
38											
39	Cable B		calculated								
40			input								
41											
42	Cable C		calculated								
43			input								
44											
45	<b>Total</b>		<b>8.83</b>		<b>7.40</b>		<b>11.06</b>		<b>29.93</b>		
46											
47	Z"		11.52 mOhm		Z'		14.15 mOhm		Z		31.20 mOhm
48											
49	T"		21.31 ms		T'		135.41 ms		T <sub>DC</sub>		2.67 ms
50											
51	E		230.94 V						I <sub>KD</sub>		7.40
52											
53	I <sub>K</sub> "		20.05 kA		I <sub>K</sub> '		16.32 kA		i <sub>DC</sub>		28.35 kA
54											
55											
56	<b>Time dependent short circuit current</b>										
57											
58			t [ms]		periods		I <sub>AC</sub> [kA]		i <sub>DC</sub> [kA]		i <sub>p</sub> [kA]
59											
60			0.00		0.0		20.05		28.35		
61			10.00		0.5		18.01		0.67		26.14
62			60.00		3.0		13.35		0.00		
63											
64											
65											
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2													
3	<b>SHORT CIRCUIT CALCULATION FOR SWITCHBOARDS WITH AND WITHOUT TRANSFORMER</b>												
4													
5	Equ. generator	MSB 400V			to		1P 400V						
6													
7	Voltage	400 V		Frequency	50 Hz		cos(phi) <sub>GEN</sub>		0.8				
8													
9	Data of equ. generator	from page 8 (MSB 400V)											
10													
11		T <sub>d</sub> "	17.16 ms		T <sub>d</sub> '	102.17 ms		T <sub>DC</sub>	19.28 ms				
12													
13		X"	5.90 mOhm		X'	9.56 mOhm		X	28.43 mOhm				
14													
15		R	0.97 mOhm										
16													
17													
18	Cable												
19		Cable A	from	MSB 400V		to	1P 400V						
20		Cable B	from			to							
21		Cable C	from			to							
22													
23		Cable A				Cable B				Cable C			
24													
25	Cross-sect.	25 mm <sup>2</sup>				mm <sup>2</sup>				mm <sup>2</sup>			
26	No. of cables	1											
27	Length	25 m				m				m			
28													
29													
30	Impedances												
31													
32		R [mOhm]			X" [mOhm]			X' [mOhm]			X [mOhm]		
33													
34	Equ. generator	0.97		5.90		9.56		28.43					
35													
36	Cable A	calculated	19.65		2.05		2.05		2.05				
37		input											
38													
39	Cable B	calculated											
40		input											
41													
42	Cable C	calculated											
43		input											
44													
45	Total	20.62		7.95		11.61		30.48					
46													
47	Z"	22.10 mOhm		Z'		23.67 mOhm		Z		36.80 mOhm			
48													
49	T"	23.67 ms		T'		192.80 ms		T <sub>DC</sub>		1.23 ms			
50													
51	E	230.94 V						I <sub>KD</sub>		6.28			
52													
53	I <sub>K</sub> "	10.45 kA		I <sub>K</sub> '		9.76 kA		i <sub>DC</sub>		14.78 kA			
54													
55													
56	Time dependent short circuit current												
57													
58		t [ms]	periods		I <sub>AC</sub> [kA]	i <sub>DC</sub> [kA]		i <sub>p</sub> [kA]					
59													
60		0.00	0.0		10.45	14.78							
61		10.00	0.5		10.04	0.00		14.20					
62		60.00	3.0		8.88	0.00							
63													
64													
65													
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2											
3		SUMMARY OF SHORT CIRCUIT CURRENTS									
4											
5											
6							short circuit current				
7		designation			page		I <sub>AC</sub> [kA]		i <sub>p</sub> [kA]		
8							(t=0,5T)				
9											
10											
11		DG1			3		9.48		22.66		
12		DG2			4		9.48		22.66		
13		DG3			5		9.48		22.66		
14											
15											
16											
17		bow thruster			6		1.55		4.20		
18		equivalent motors			7		3.79		9.89		
19											
20											
21											
22											
23											
24		main switchboard 400V			8		33.78		82.06		
25											
26		main switchboard 220V			9		3.96		6.32		
27											
28											
29		emergency switchboard 440V			10		18.01		26.14		
30											
31		No.1 power distrubution			11		10.04		14.20		
32											
33											
34											
35											
36											
37											
38											
39											
40											
41											
42											
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