Системийн реле хамгаалалт, автоматикийн программ хангамж /Software of relay protection and automation for electrical systems /

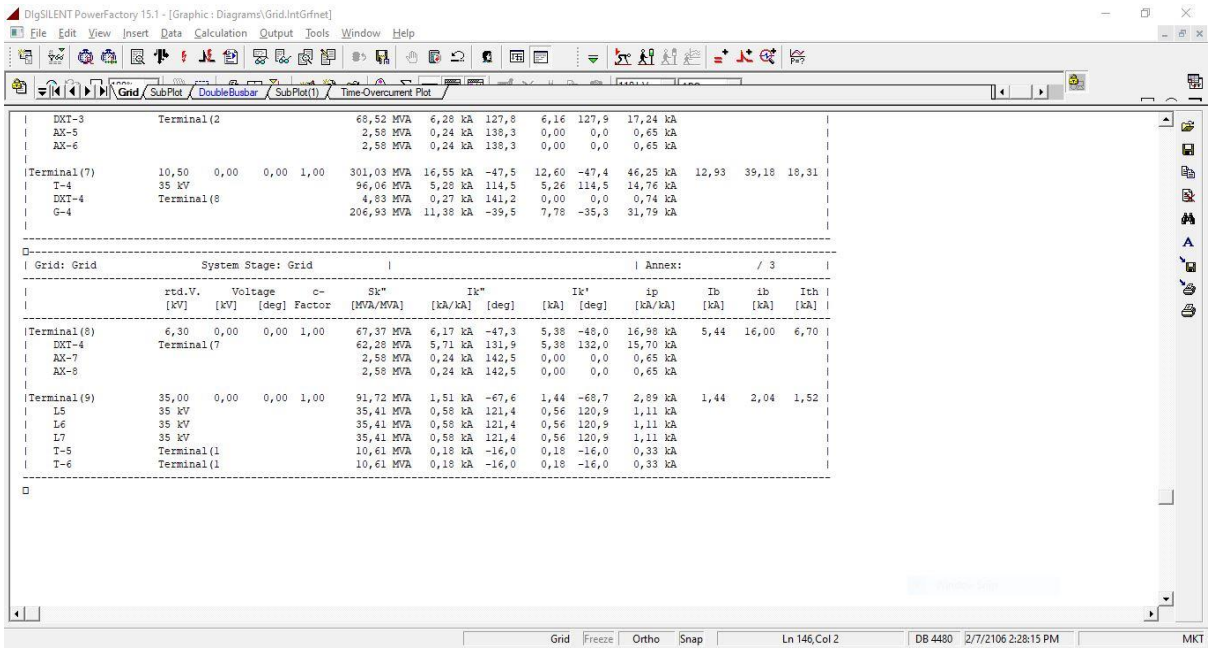
B222130703
Б.Даваахүү

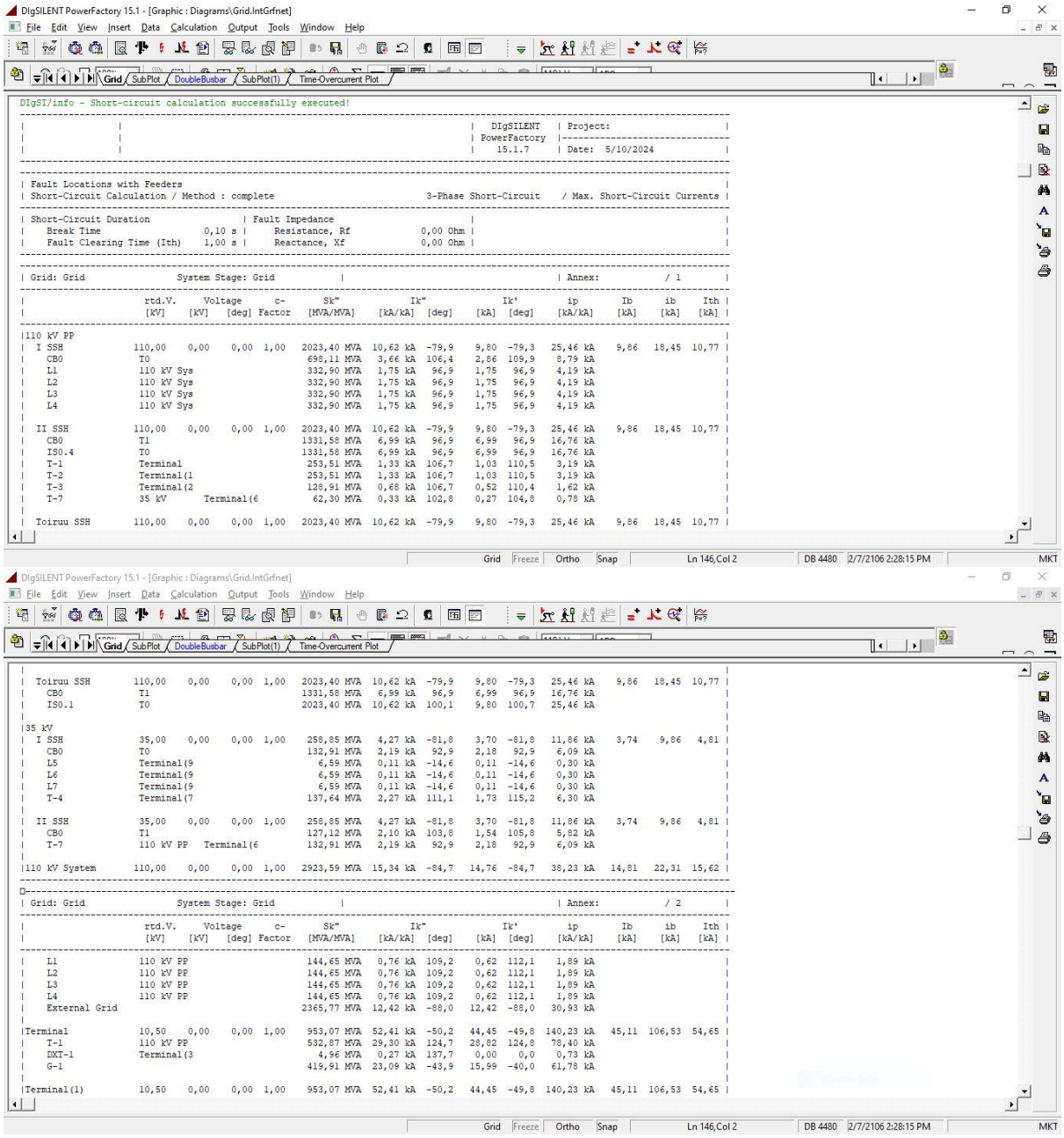
ГАРЧИГ

1. Богино залгааны тооцоо болон стандартууд

Курсын төслийн өгөгдөлөөр power factory программын богино залгааны стандарт бүрээр хийж туршисан байдлыг доорх зурагт үзүүлэв

Доорх зурагт богино залгааны хувьсах гүйдэлийн complete стандартыг ашиглаж хийсэн богино залгааны үр дүнг үзүүлэв.





DIgSI/info - Short-circuit calculation successfully executed!

| | | DIgSILENT PowerFactory 15.1.7 | Project: | Date: 5/10/2024 |

Fault Locations with Feeders
Short-Circuit Calculation / Method : complete — 3-Phase Short-Circuit / Max. Short-Circuit Currents

Short-Circuit Duration		Fault Impedance	
Break Time	0,10 s	Resistance, Rf	0,00 Ohm
Fault Clearing Time (Ith)	1,00 s	Reactance, Xf	0,00 Ohm

Grid: Grid — System Stage: Grid — Annex: / 1

	rtd.V. [kV]	Voltage [kV]	[deg]	c-Factor	Sk" [MVA/MVA]	Ik" [kA/kA]	[deg]	Ik' [kA]	[deg]	ip [kA/kA]	Ib [kA]	ib [kA]	Ith [kA]
110 kV PP													
I SSH	110,00	0,00	0,00	1,00	2023,40 MVA	10,62 kA	-79,9	9,80	-79,3	25,46 kA	9,86	18,45	10,77
CB0	T0				698,11 MVA	3,66 kA	106,4	2,86	109,9	8,79 kA			
L1	110 kV Sys				332,90 MVA	1,75 kA	96,9	1,75	96,9	4,19 kA			
L2	110 kV Sys				332,90 MVA	1,75 kA	96,9	1,75	96,9	4,19 kA			
L3	110 kV Sys				332,90 MVA	1,75 kA	96,9	1,75	96,9	4,19 kA			
L4	110 kV Sys				332,90 MVA	1,75 kA	96,9	1,75	96,9	4,19 kA			
II SSH	110,00	0,00	0,00	1,00	2023,40 MVA	10,62 kA	-79,9	9,80	-79,3	25,46 kA	9,86	18,45	10,77
CB0	T1				1331,58 MVA	6,99 kA	96,9	6,99	96,9	16,76 kA			
IS0.4	T0				1331,58 MVA	6,99 kA	96,9	6,99	96,9	16,76 kA			
T-1	Terminal				253,51 MVA	1,33 kA	106,7	1,03	110,5	3,19 kA			
T-2	Terminal(1				253,51 MVA	1,33 kA	106,7	1,03	110,5	3,19 kA			
T-3	Terminal(2				128,91 MVA	0,68 kA	106,7	0,52	110,4	1,62 kA			
T-7	35 kV	Terminal(6			62,30 MVA	0,33 kA	102,8	0,27	104,8	0,78 kA			
Toiruu SSH	110,00	0,00	0,00	1,00	2023,40 MVA	10,62 kA	-79,9	9,80	-79,3	25,46 kA	9,86	18,45	10,77

Grid | Freeze | Ortho | Snap | Ln 146,Col 2 | DB 4480 | 2/7/2106 2:28:15 PM | MKT

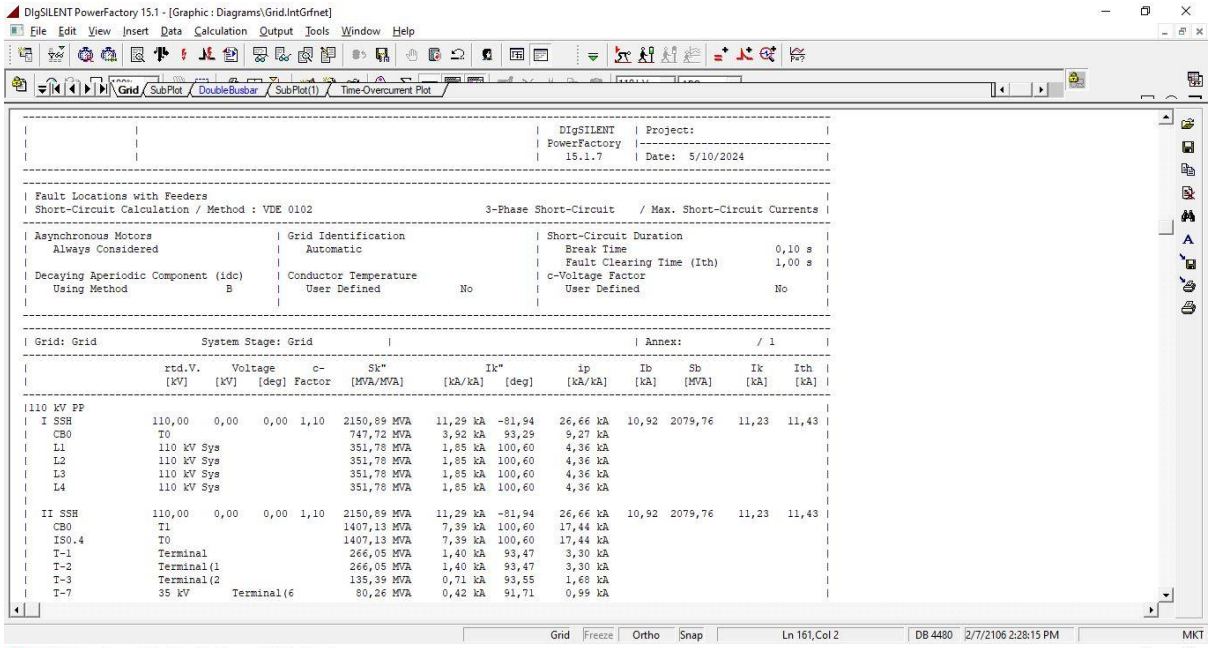
Toiruu SSH	110,00	0,00	0,00	1,00	2023,40 MVA	10,62 kA	-79,9	9,80	-79,3	25,46 kA	9,86	18,45	10,77
CB0	T1				1331,58 MVA	6,99 kA	96,9	6,99	96,9	16,76 kA			
IS0.1	T0				2023,40 MVA	10,62 kA	100,1	9,80	100,7	25,46 kA			
35 kV													
I SSH	35,00	0,00	0,00	1,00	258,85 MVA	4,27 kA	-81,8	3,70	-81,8	11,86 kA	3,74	9,86	4,81
CB0	T0				132,91 MVA	2,19 kA	92,9	2,18	92,9	6,09 kA			
L5	Terminal(9				6,59 MVA	0,11 kA	-14,6	0,11	-14,6	0,30 kA			
L6	Terminal(9				6,59 MVA	0,11 kA	-14,6	0,11	-14,6	0,30 kA			
L7	Terminal(9				6,59 MVA	0,11 kA	-14,6	0,11	-14,6	0,30 kA			
T-4	Terminal(7				137,64 MVA	2,27 kA	111,1	1,73	115,2	6,30 kA			
II SSH	35,00	0,00	0,00	1,00	258,85 MVA	4,27 kA	-81,8	3,70	-81,8	11,86 kA	3,74	9,86	4,81
CB0	T1				127,12 MVA	2,10 kA	103,8	1,54	105,8	5,82 kA			
T-7	110 kV PP	Terminal(6			132,91 MVA	2,19 kA	92,9	2,18	92,9	6,09 kA			
110 kV System	110,00	0,00	0,00	1,00	2923,59 MVA	15,34 kA	-84,7	14,76	-84,7	38,23 kA	14,81	22,31	15,62

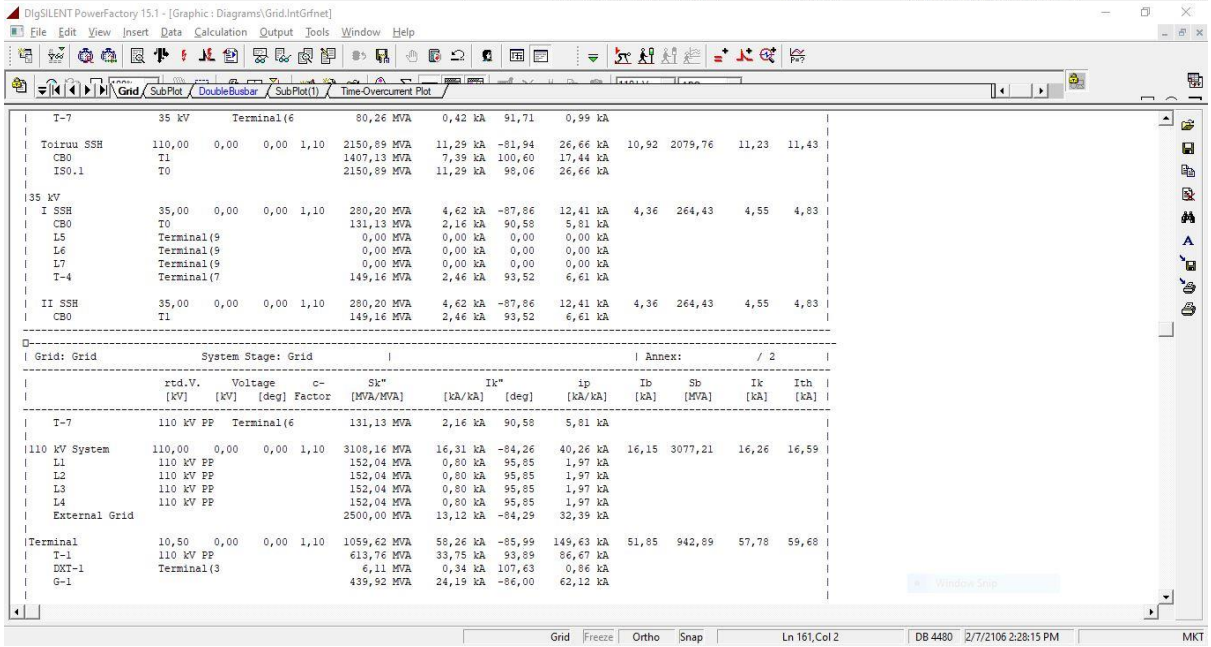
Grid: Grid — System Stage: Grid — Annex: / 2

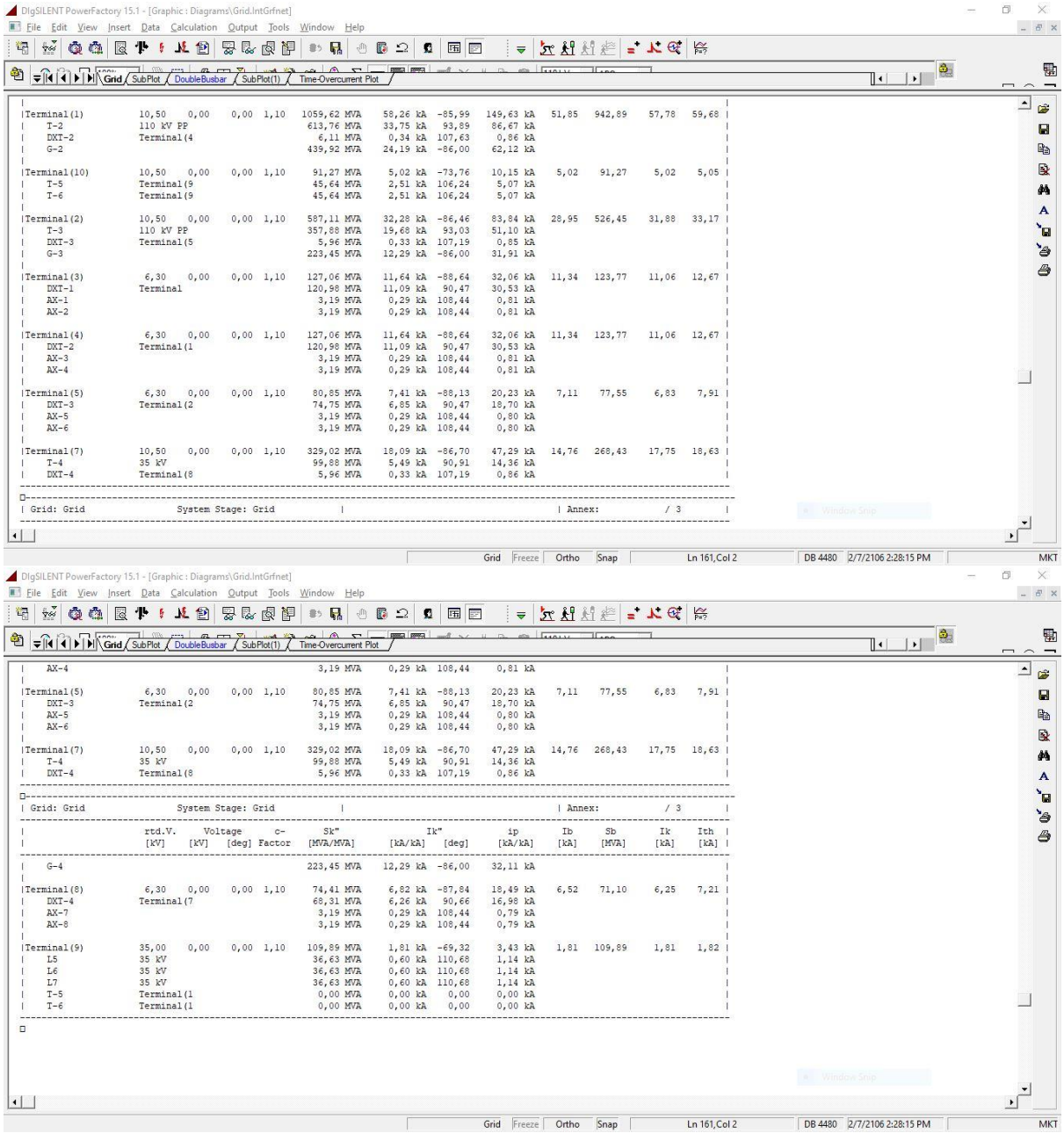
	rtd.V. [kV]	Voltage [kV]	[deg]	c-Factor	Sk" [MVA/MVA]	Ik" [kA/kA]	[deg]	Ik' [kA]	[deg]	ip [kA/kA]	Ib [kA]	ib [kA]	Ith [kA]
L1	110 kV PP				144,65 MVA	0,76 kA	109,2	0,62	112,1	1,89 kA			
L2	110 kV PP				144,65 MVA	0,76 kA	109,2	0,62	112,1	1,89 kA			
L3	110 kV PP				144,65 MVA	0,76 kA	109,2	0,62	112,1	1,89 kA			
L4	110 kV PP				144,65 MVA	0,76 kA	109,2	0,62	112,1	1,89 kA			
External Grid					2365,77 MVA	12,42 kA	-88,0	12,42	-88,0	30,93 kA			
Terminal	10,50	0,00	0,00	1,00	953,07 MVA	52,41 kA	-50,2	44,45	-49,8	140,23 kA	45,11	106,53	54,65
T-1	110 kV PP				532,87 MVA	29,30 kA	124,7	28,82	124,8	78,40 kA			
DXT-1	Terminal(3				4,96 MVA	0,27 kA	137,7	0,00	0,0	0,73 kA			
G-1					419,91 MVA	23,09 kA	-43,9	15,99	-40,0	61,78 kA			
Terminal(1)	10,50	0,00	0,00	1,00	953,07 MVA	52,41 kA	-50,2	44,45	-49,8	140,23 kA	45,11	106,53	54,65

Grid | Freeze | Ortho | Snap | Ln 146,Col 2 | DB 4480 | 2/7/2106 2:28:15 PM | MKT

Зураг 1.1 богино залгааны complete стандартыг ашигласан үр дүн


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
DIgSILENT PowerFactory 15.1.7 Project: Date: 5/10/2024
Fault Locations with Feeders
Short-Circuit Calculation / Method : VDE 0102 3-Phase Short-Circuit / Max. Short-Circuit Currents
Asynchronous Motors Always Considered
Decaying Aperiodic Component (idc) Using Method B
Grid Identification Automatic
Conductor Temperature User Defined No
Short-Circuit Duration Break Time 0,10 s Fault Clearing Time (Ith) 1,00 s
c-Voltage Factor User Defined No
Grid: Grid System Stage: Grid Annex: / 1
rtd.V. [kV] Voltage [kV] c- [deg] Factor Sk" [MVA/MVA] Ik" [kA/kA] [deg] ip [kA/kA] Ib [kA] Sb [MVA] Ik [kA] Ith [kA]
110 kV PP
I SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T0 747,72 MVA 3,92 kA 93,29 9,27 kA
L1 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L2 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L3 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L4 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
II SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T1 1407,13 MVA 7,39 kA 100,60 17,44 kA
IS0.4 T0 1407,13 MVA 7,39 kA 100,60 17,44 kA
T-1 Terminal 266,05 MVA 1,40 kA 93,47 3,30 kA
T-2 Terminal(1 266,05 MVA 1,40 kA 93,47 3,30 kA
T-3 Terminal(2 135,39 MVA 0,71 kA 93,55 1,68 kA
T-7 35 kV Terminal(6 80,26 MVA 0,42 kA 91,71 0,99 kA
Grid Freeze Ortho Snap Ln 161,Col 2 DB 4480 2/7/2106 2:28:15 PM MKT


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
T-7 35 kV Terminal(6 80,26 MVA 0,42 kA 91,71 0,99 kA
Toiuu SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T1 1407,13 MVA 7,39 kA 100,60 17,44 kA
IS0.1 T0 2150,89 MVA 11,29 kA 98,06 26,66 kA
35 kV
I SSH 35,00 0,00 0,00 1,10 280,20 MVA 4,62 kA -87,86 12,41 kA 4,36 264,43 4,55 4,83
CB0 T0 131,13 MVA 2,16 kA 90,58 5,81 kA
L5 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
L6 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
L7 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
T-4 Terminal(7 149,16 MVA 2,46 kA 93,52 6,61 kA
II SSH 35,00 0,00 0,00 1,10 280,20 MVA 4,62 kA -87,86 12,41 kA 4,36 264,43 4,55 4,83
CB0 T1 149,16 MVA 2,46 kA 93,52 6,61 kA
Grid: Grid System Stage: Grid Annex: / 2
rtd.V. [kV] Voltage [kV] c- [deg] Factor Sk" [MVA/MVA] Ik" [kA/kA] [deg] ip [kA/kA] Ib [kA] Sb [MVA] Ik [kA] Ith [kA]
T-7 110 kV PP Terminal(6 131,13 MVA 2,16 kA 90,58 5,81 kA
110 kV System 110,00 0,00 0,00 1,10 3108,16 MVA 16,31 kA -84,26 40,26 kA 16,15 3077,21 16,26 16,59
L1 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L2 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L3 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L4 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
External Grid 2500,00 MVA 13,12 kA -84,29 32,39 kA
Terminal 10,50 0,00 0,00 1,10 1059,62 MVA 58,26 kA -85,99 149,63 kA 51,85 942,89 57,78 59,68
T-1 110 kV PP 613,76 MVA 33,75 kA 93,89 86,67 kA
DXT-1 Terminal(3 6,11 MVA 0,34 kA 107,63 0,86 kA
G-1 439,92 MVA 24,19 kA -86,00 62,12 kA
Grid Freeze Ortho Snap Ln 161,Col 2 DB 4480 2/7/2106 2:28:15 PM MKT



Terminal(1)	10,50	0,00	0,00	1,10	1059,62 MVA	58,26 kA	-85,99	149,63 kA	51,85	942,89	57,78	59,68
T-2	110 kV PP				613,76 MVA	33,75 kA	93,89	86,67 kA				
DXT-2	Terminal(4				6,11 MVA	0,34 kA	107,63	0,86 kA				
G-2					439,92 MVA	24,19 kA	-86,00	62,12 kA				
Terminal(10)	10,50	0,00	0,00	1,10	91,27 MVA	5,02 kA	-73,76	10,15 kA	5,02	91,27	5,02	5,05
T-5	Terminal(9				45,64 MVA	2,51 kA	106,24	5,07 kA				
T-6	Terminal(9				45,64 MVA	2,51 kA	106,24	5,07 kA				
Terminal(2)	10,50	0,00	0,00	1,10	587,11 MVA	32,28 kA	-86,46	83,84 kA	28,95	526,45	31,88	33,17
T-3	110 kV PP				357,88 MVA	19,68 kA	93,03	51,10 kA				
DXT-3	Terminal(5				5,96 MVA	0,33 kA	107,19	0,85 kA				
G-3					223,45 MVA	12,29 kA	-86,00	31,91 kA				
Terminal(3)	6,30	0,00	0,00	1,10	127,06 MVA	11,64 kA	-88,64	32,06 kA	11,34	123,77	11,06	12,67
DXT-1	Terminal				120,98 MVA	11,09 kA	90,47	30,53 kA				
AX-1					3,19 MVA	0,29 kA	108,44	0,81 kA				
AX-2					3,19 MVA	0,29 kA	108,44	0,81 kA				
Terminal(4)	6,30	0,00	0,00	1,10	127,06 MVA	11,64 kA	-88,64	32,06 kA	11,34	123,77	11,06	12,67
DXT-2	Terminal(1				120,98 MVA	11,09 kA	90,47	30,53 kA				
AX-3					3,19 MVA	0,29 kA	108,44	0,81 kA				
AX-4					3,19 MVA	0,29 kA	108,44	0,81 kA				
Terminal(5)	6,30	0,00	0,00	1,10	80,85 MVA	7,41 kA	-88,13	20,23 kA	7,11	77,55	6,83	7,91
DXT-3	Terminal(2				74,75 MVA	6,85 kA	90,47	18,70 kA				
AX-5					3,19 MVA	0,29 kA	108,44	0,80 kA				
AX-6					3,19 MVA	0,29 kA	108,44	0,80 kA				
Terminal(7)	10,50	0,00	0,00	1,10	329,02 MVA	18,09 kA	-86,70	47,29 kA	14,76	268,43	17,75	18,63
T-4	35 kV				99,88 MVA	5,49 kA	90,91	14,36 kA				
DXT-4	Terminal(8				5,96 MVA	0,33 kA	107,19	0,86 kA				

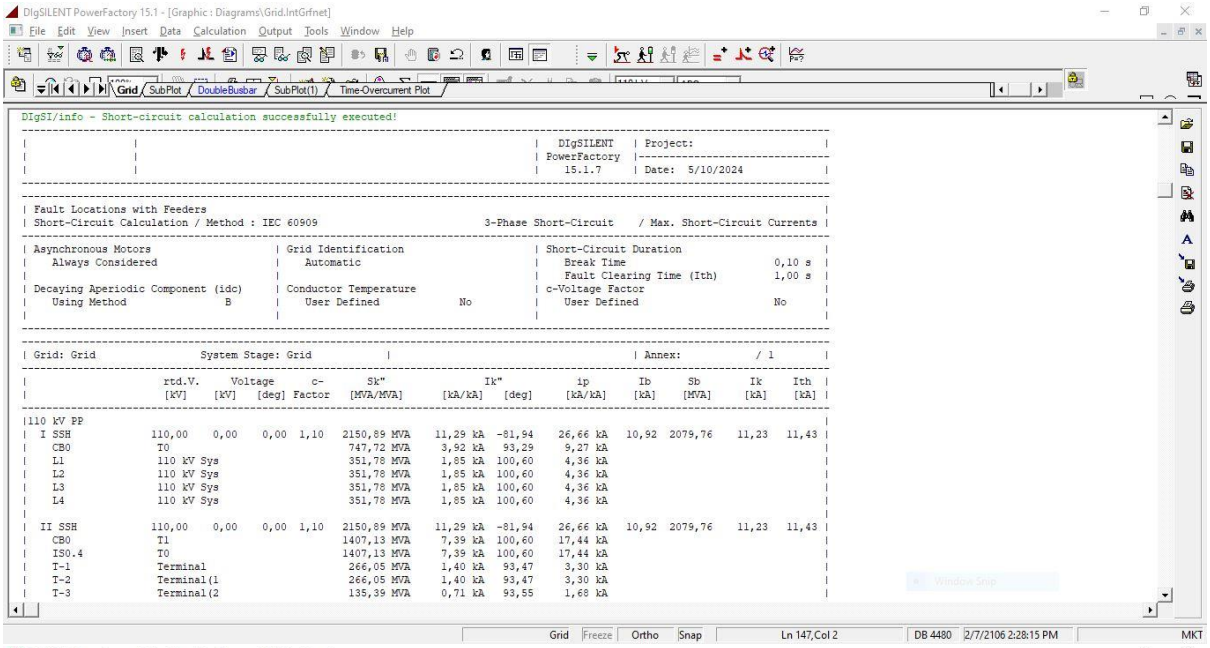
Grid: Grid	System Stage: Grid		Annex: / 3

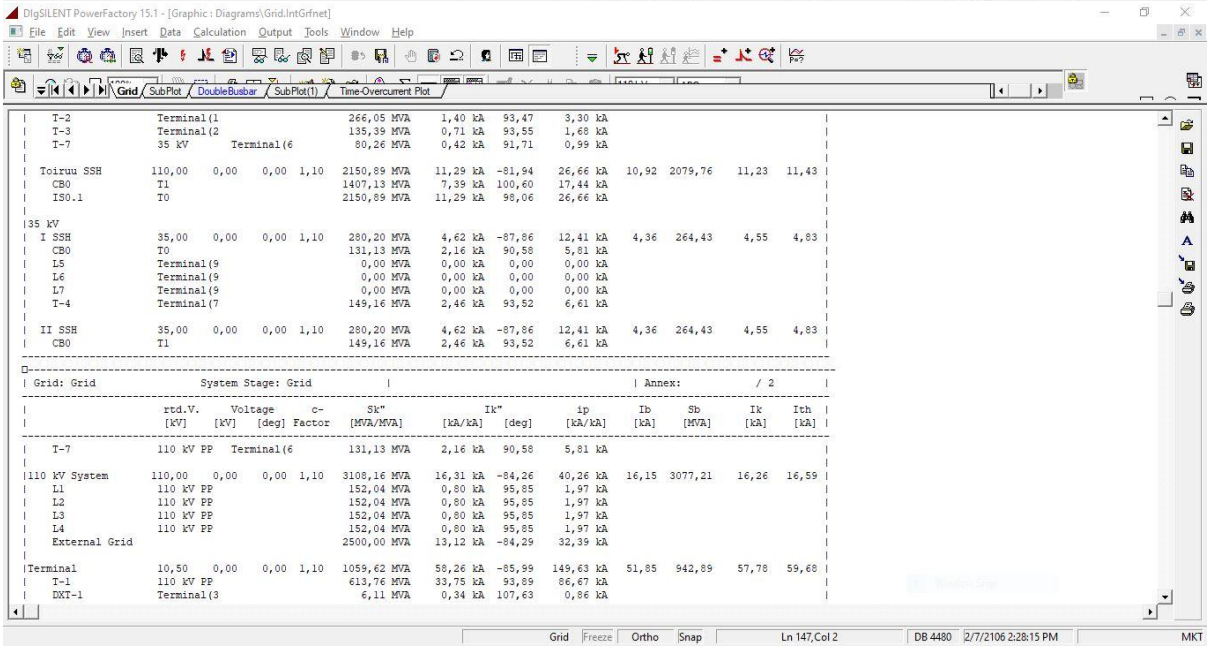
AX-4					3,19 MVA	0,29 kA	108,44	0,81 kA				
Terminal(5)	6,30	0,00	0,00	1,10	80,85 MVA	7,41 kA	-88,13	20,23 kA	7,11	77,55	6,83	7,91
DXT-3	Terminal(2				74,75 MVA	6,85 kA	90,47	18,70 kA				
AX-5					3,19 MVA	0,29 kA	108,44	0,80 kA				
AX-6					3,19 MVA	0,29 kA	108,44	0,80 kA				
Terminal(7)	10,50	0,00	0,00	1,10	329,02 MVA	18,09 kA	-86,70	47,29 kA	14,76	268,43	17,75	18,63
T-4	35 kV				99,88 MVA	5,49 kA	90,91	14,36 kA				
DXT-4	Terminal(8				5,96 MVA	0,33 kA	107,19	0,86 kA				

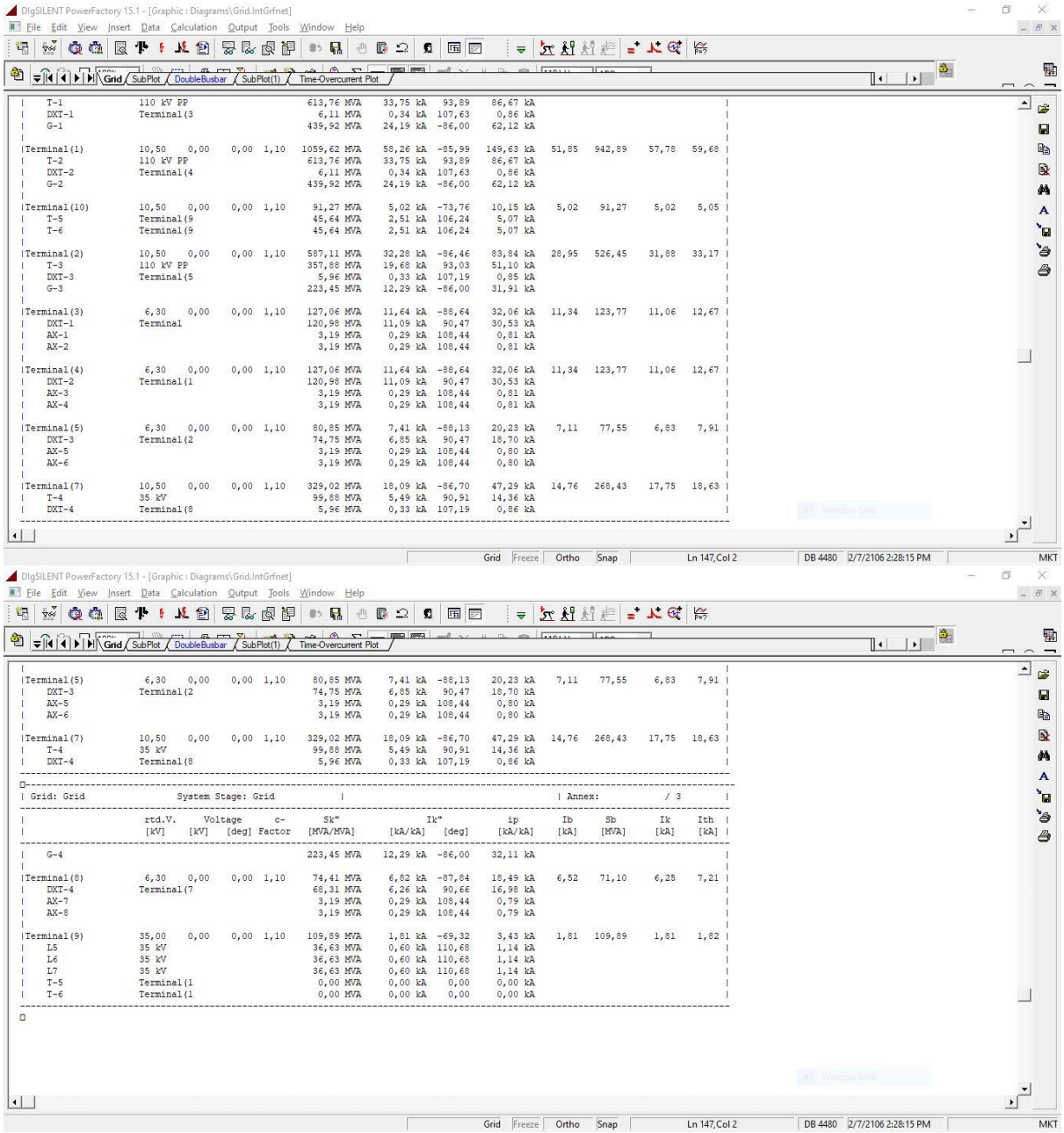
Grid: Grid	System Stage: Grid		Annex: / 3

	rtd.V. [kV]	Voltage [kV]	c- [deg]	Factor	Sk" [MVA/MA]	Ik" [kA/kA]	[deg]	ip [kA/kA]	Ib [kA]	Sb [MVA]	Ik [kA]	Ith [kA]
G-4					223,45 MVA	12,29 kA	-86,00	32,11 kA				
Terminal(8)	6,30	0,00	0,00	1,10	74,41 MVA	6,82 kA	-87,84	18,49 kA	6,52	71,10	6,25	7,21
DXT-4	Terminal(7				68,31 MVA	6,26 kA	90,66	16,98 kA				
AX-7					3,19 MVA	0,29 kA	108,44	0,79 kA				
AX-8					3,19 MVA	0,29 kA	108,44	0,79 kA				
Terminal(9)	35,00	0,00	0,00	1,10	109,89 MVA	1,81 kA	-69,32	3,43 kA	1,81	109,89	1,81	1,82
L5	35 kV				36,63 MVA	0,60 kA	110,68	1,14 kA				
L6	35 kV				36,63 MVA	0,60 kA	110,68	1,14 kA				
L7	35 kV				36,63 MVA	0,60 kA	110,68	1,14 kA				
T-5	Terminal(1				0,00 MVA	0,00 kA	0,00	0,00 kA				
T-6	Terminal(1				0,00 MVA	0,00 kA	0,00	0,00 kA				

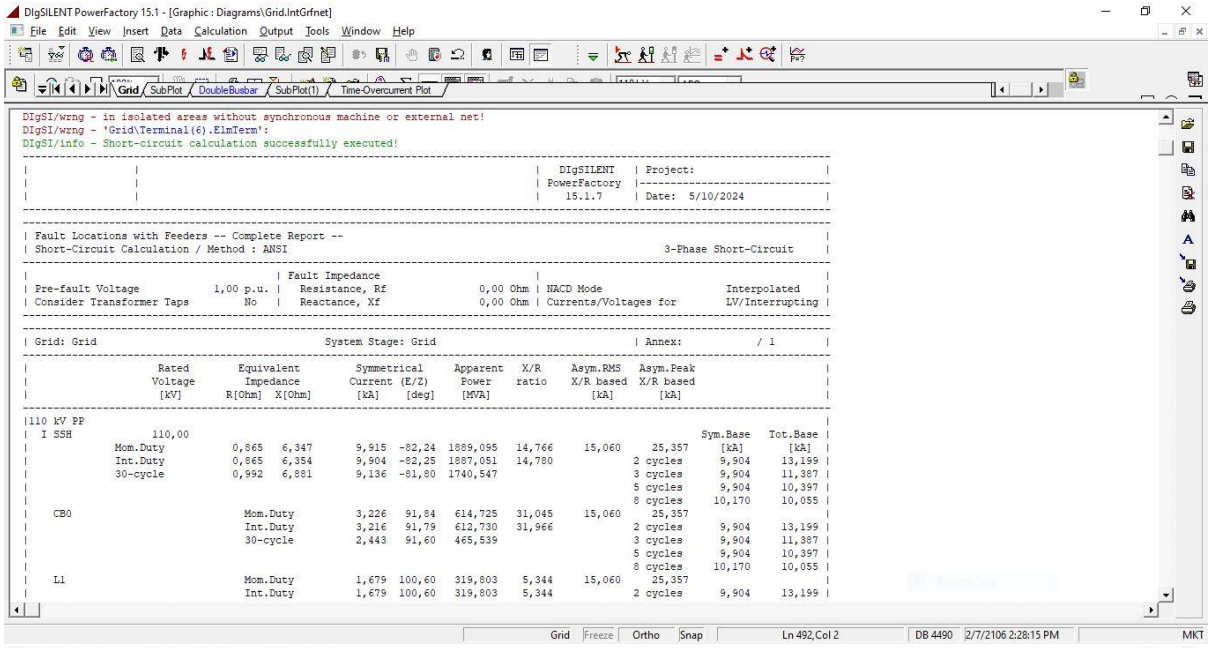
Зураг 1.2 богино залгааны VDE 0102 стандартыг ашигласан үр дүн

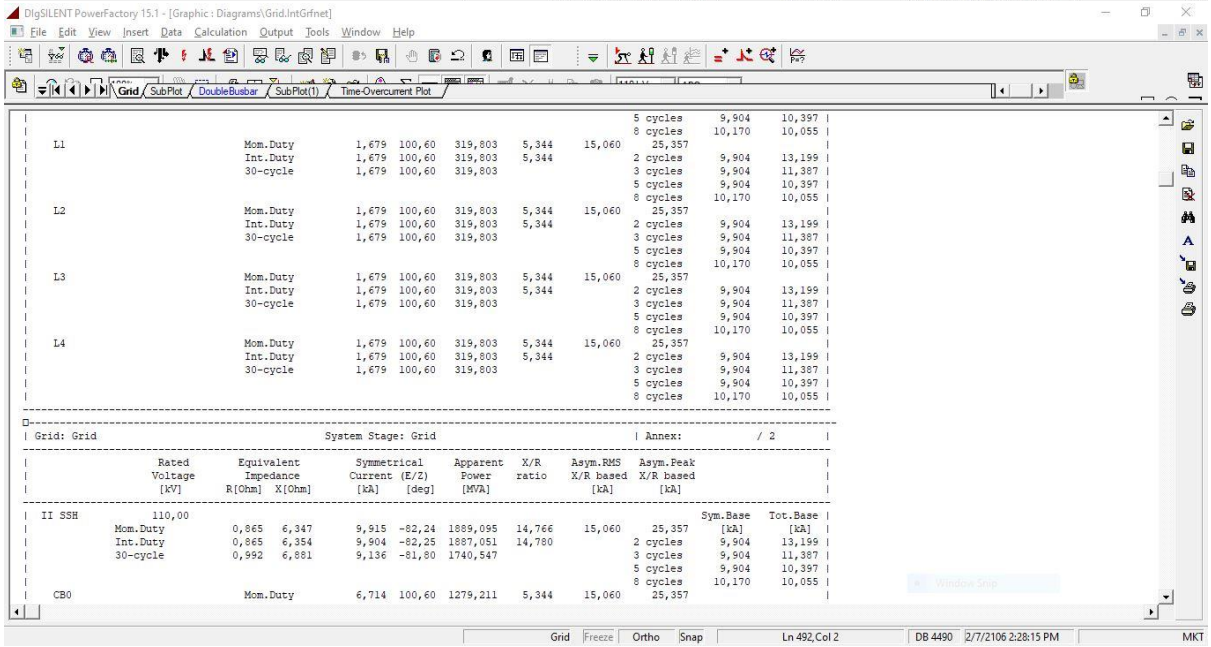

DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
DIgSI/info - Short-circuit calculation successfully executed!
DIgSILENT PowerFactory 15.1.7
Project:
Date: 5/10/2024
Fault Locations with Feeders
Short-Circuit Calculation / Method : IEC 60909
3-Phase Short-Circuit / Max. Short-Circuit Currents
Asynchronous Motors
Always Considered
Decaying Aperiodic Component (idc)
Using Method B
Grid Identification
Automatic
Conductor Temperature
User Defined No
Short-Circuit Duration
Break Time 0,10 s
Fault Clearing Time (Ith) 1,00 s
c-Voltage Factor
User Defined No
Grid: Grid System Stage: Grid
Annex: / 1
rtd.V. [kV] Voltage [kV] [deg] c- Factor Sk" [MVA/MVA] Ik" [kA/kA] [deg] ip [kA/kA] Ib [kA] Sb [MVA] Ik [kA] Ith [kA]
110 kV PP
I SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T0 747,72 MVA 3,92 kA 93,29 9,27 kA
L1 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L2 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L3 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
L4 110 kV Sys 351,78 MVA 1,85 kA 100,60 4,36 kA
II SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T1 1407,13 MVA 7,39 kA 100,60 17,44 kA
IS0.4 T0 1407,13 MVA 7,39 kA 100,60 17,44 kA
T-1 Terminal 266,05 MVA 1,40 kA 93,47 3,30 kA
T-2 Terminal(1 266,05 MVA 1,40 kA 93,47 3,30 kA
T-3 Terminal(2 135,39 MVA 0,71 kA 93,55 1,68 kA
Grid Freeze Ortho Snap Ln 147,Col 2 DB 4480 2/7/2106 2:28:15 PM MKT

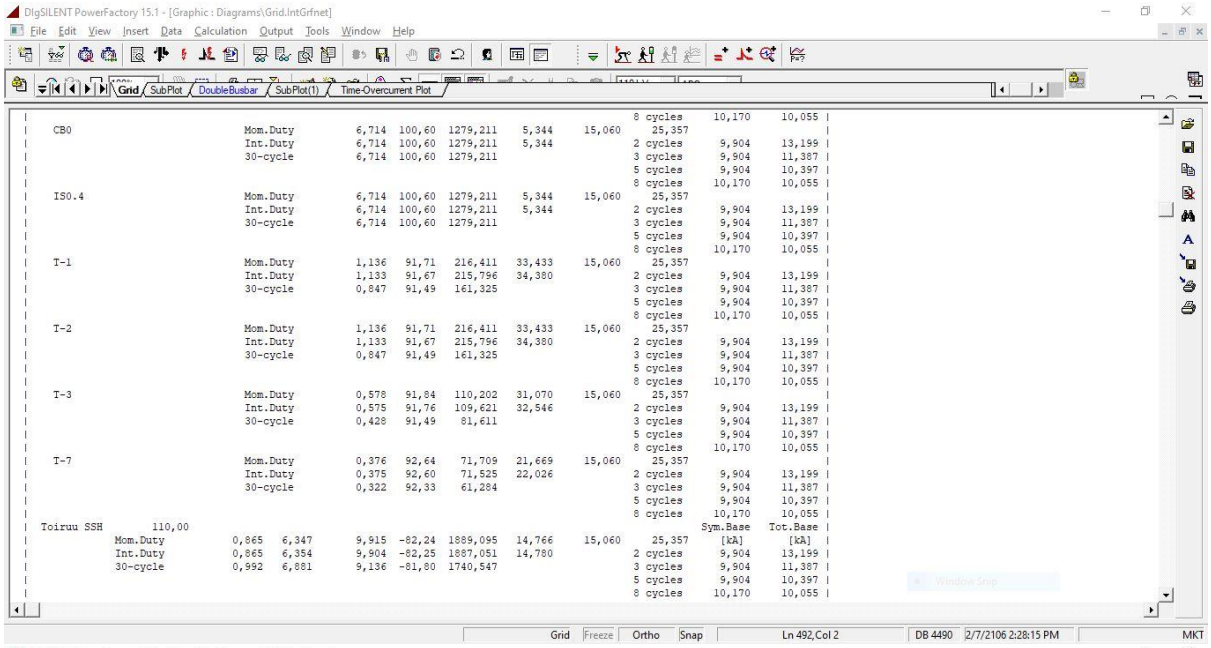

DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
T-2 Terminal(1 266,05 MVA 1,40 kA 93,47 3,30 kA
T-3 Terminal(2 135,39 MVA 0,71 kA 93,55 1,68 kA
T-7 35 kV Terminal(6 80,26 MVA 0,42 kA 91,71 0,99 kA
Toiruu SSH 110,00 0,00 0,00 1,10 2150,89 MVA 11,29 kA -81,94 26,66 kA 10,92 2079,76 11,23 11,43
CB0 T1 1407,13 MVA 7,39 kA 100,60 17,44 kA
IS0.1 T0 2150,89 MVA 11,29 kA 98,06 26,66 kA
35 kV
I SSH 35,00 0,00 0,00 1,10 280,20 MVA 4,62 kA -87,86 12,41 kA 4,36 264,43 4,55 4,83
CB0 T0 131,13 MVA 2,16 kA 90,58 5,81 kA
L5 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
L6 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
L7 Terminal(9 0,00 MVA 0,00 kA 0,00 0,00 kA
T-4 Terminal(7 149,16 MVA 2,46 kA 93,52 6,61 kA
II SSH 35,00 0,00 0,00 1,10 280,20 MVA 4,62 kA -87,86 12,41 kA 4,36 264,43 4,55 4,83
CB0 T1 149,16 MVA 2,46 kA 93,52 6,61 kA
Grid: Grid System Stage: Grid
Annex: / 2
rtd.V. [kV] Voltage [kV] [deg] c- Factor Sk" [MVA/MVA] Ik" [kA/kA] [deg] ip [kA/kA] Ib [kA] Sb [MVA] Ik [kA] Ith [kA]
T-7 110 kV PP Terminal(6 131,13 MVA 2,16 kA 90,58 5,81 kA
110 kV System 110,00 0,00 0,00 1,10 3108,16 MVA 16,31 kA -84,26 40,26 kA 16,15 3077,21 16,26 16,59
L1 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L2 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L3 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
L4 110 kV PP 152,04 MVA 0,80 kA 95,85 1,97 kA
External Grid 2500,00 MVA 13,12 kA -84,29 32,39 kA
Terminal 10,50 0,00 0,00 1,10 1059,62 MVA 58,26 kA -85,99 149,63 kA 51,85 942,89 57,78 59,68
T-1 110 kV PP 613,76 MVA 33,75 kA 93,89 86,67 kA
DXT-1 Terminal(3 6,11 MVA 0,34 kA 107,63 0,86 kA
Grid Freeze Ortho Snap Ln 147,Col 2 DB 4480 2/7/2106 2:28:15 PM MKT

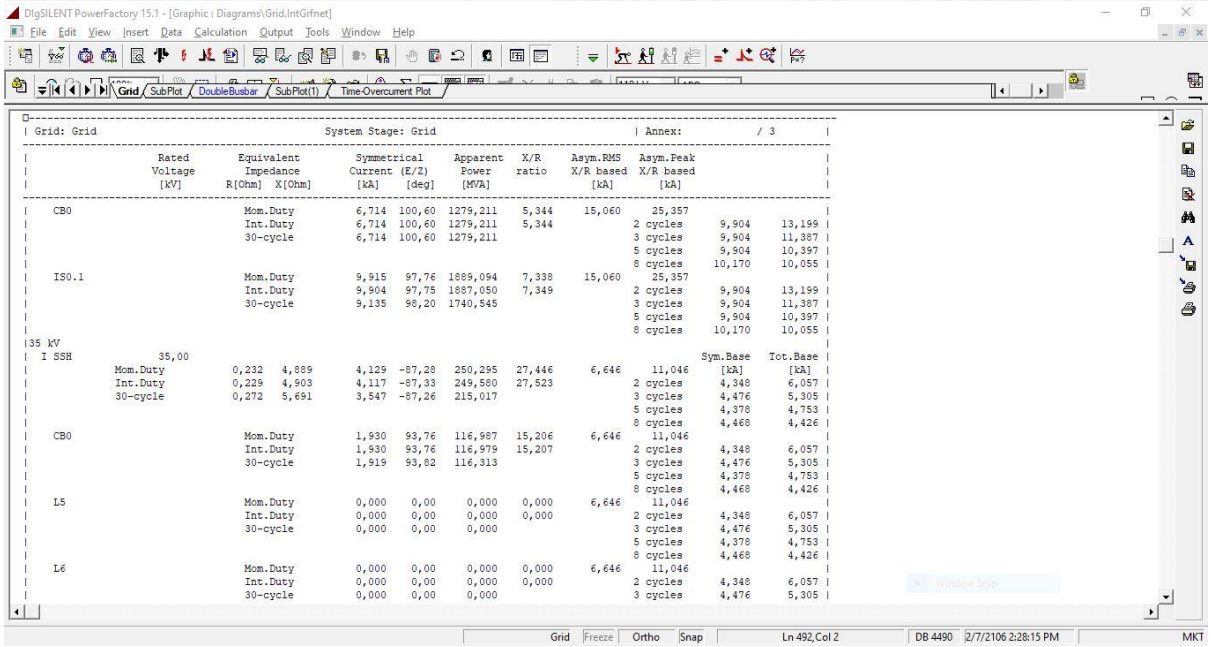


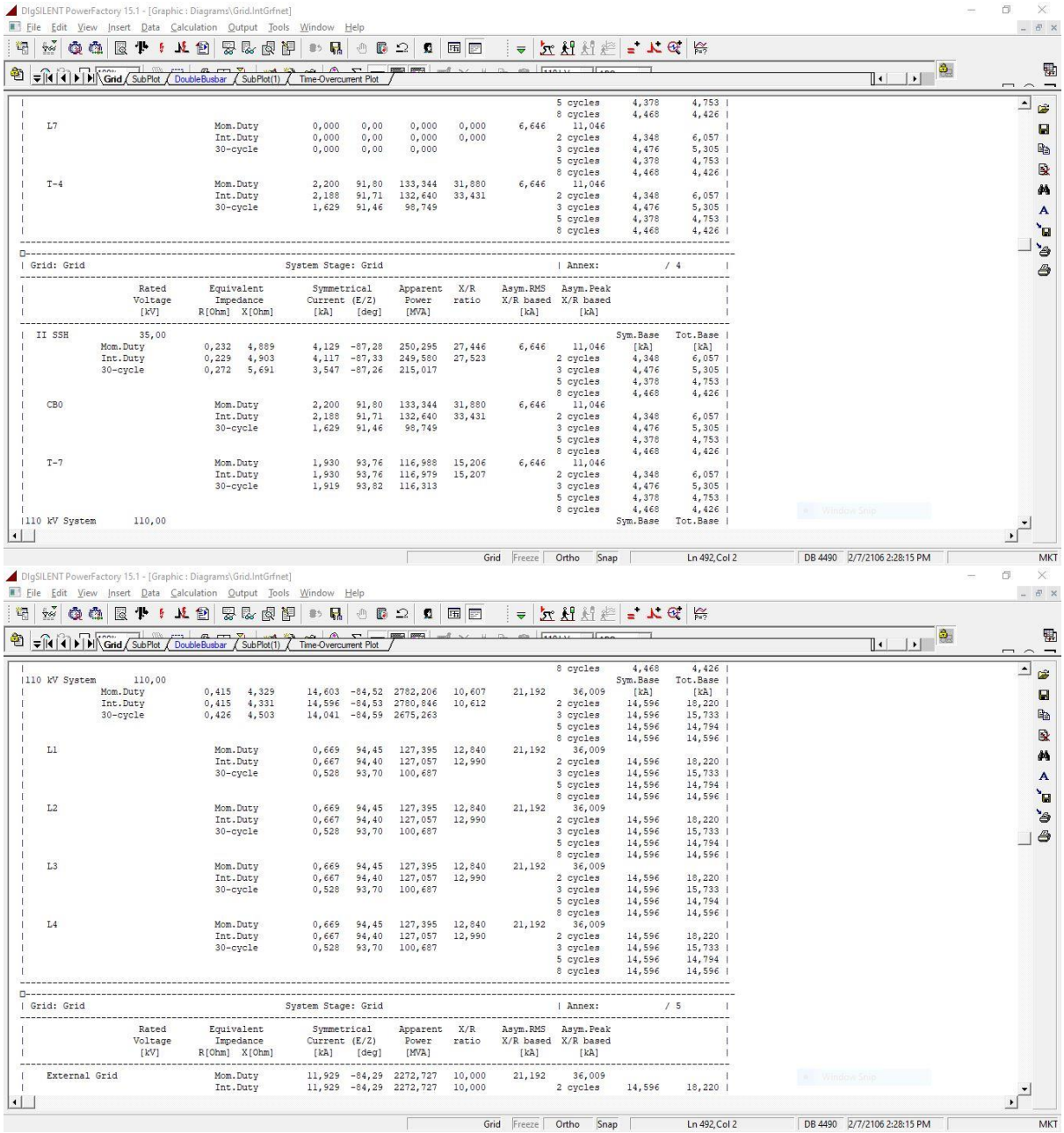
Зураг 1.3 богино залгааны IEC 60909 стандартыг ашигласан үр дүн


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
DIgSI/wrng - in isolated areas without synchronous machine or external net!
DIgSI/wrng - 'Grid\Terminal(6).ElmTerm':
DIgSI/info - Short-circuit calculation successfully executed!
DIgSILENT PowerFactory 15.1.7 Project: Date: 5/10/2024
Fault Locations with Feeders -- Complete Report --
Short-Circuit Calculation / Method : ANSI 3-Phase Short-Circuit
Pre-fault Voltage 1,00 p.u.
Consider Transformer Taps No
Fault Impedance
Resistance, Rf 0,00 Ohm
Reactance, Xf 0,00 Ohm
NACD Mode Interpolated
Currents/Voltages for LV/Interrupting
Grid: Grid System Stage: Grid Annex: / 1
Rated Voltage [kV] | Equivalent Impedance R[Ohm] X[Ohm] | Symmetrical Current (E/Z) [kA] [deg] | Apparent Power [MVA] | X/R ratio | Asym.RMS X/R based [kA] | Asym.Peak X/R based [kA] | Sym.Base [kA] | Tot.Base [kA]
110 kV PP
I SSH 110,00
Mom.Duty 0,865 6,347 9,915 -82,24 1889,095 14,766 15,060 25,357
Int.Duty 0,865 6,354 9,904 -82,25 1887,051 14,780
30-cycle 0,992 6,881 9,136 -81,80 1740,547
2 cycles 9,904 13,199
3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
CB0 Mom.Duty 3,226 91,84 614,725 31,045 15,060 25,357
Int.Duty 3,216 91,79 612,730 31,966
30-cycle 2,443 91,60 465,539
2 cycles 9,904 13,199
3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
L1 Mom.Duty 1,679 100,60 319,803 5,344 15,060 25,357
Int.Duty 1,679 100,60 319,803 5,344
2 cycles 9,904 13,199
Grid Freeze Ortho Snap Ln 492,Col 2 DB 4490 2/7/2106 2:28:15 PM MKT


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
5 cycles 9,904 10,397
8 cycles 10,170 10,055
L1 Mom.Duty 1,679 100,60 319,803 5,344 15,060 25,357
Int.Duty 1,679 100,60 319,803 5,344
30-cycle 1,679 100,60 319,803
2 cycles 9,904 13,199
3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
L2 Mom.Duty 1,679 100,60 319,803 5,344 15,060 25,357
Int.Duty 1,679 100,60 319,803 5,344
30-cycle 1,679 100,60 319,803
L3 Mom.Duty 1,679 100,60 319,803 5,344 15,060 25,357
Int.Duty 1,679 100,60 319,803 5,344
30-cycle 1,679 100,60 319,803
L4 Mom.Duty 1,679 100,60 319,803 5,344 15,060 25,357
Int.Duty 1,679 100,60 319,803 5,344
30-cycle 1,679 100,60 319,803
Grid: Grid System Stage: Grid Annex: / 2
Rated Voltage [kV] | Equivalent Impedance R[Ohm] X[Ohm] | Symmetrical Current (E/Z) [kA] [deg] | Apparent Power [MVA] | X/R ratio | Asym.RMS X/R based [kA] | Asym.Peak X/R based [kA] | Sym.Base [kA] | Tot.Base [kA]
II SSH 110,00
Mom.Duty 0,865 6,347 9,915 -82,24 1889,095 14,766 15,060 25,357
Int.Duty 0,865 6,354 9,904 -82,25 1887,051 14,780
30-cycle 0,992 6,881 9,136 -81,80 1740,547
2 cycles 9,904 13,199
3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
CB0 Mom.Duty 6,714 100,60 1279,211 5,344 15,060 25,357
Grid Freeze Ortho Snap Ln 492,Col 2 DB 4490 2/7/2106 2:28:15 PM MKT


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
CB0 Mom.Duty 6,714 100,60 1279,211 5,344 15,060 25,357
Int.Duty 6,714 100,60 1279,211 5,344 2 cycles 9,904 13,199
30-cycle 6,714 100,60 1279,211 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
IS0.4 Mom.Duty 6,714 100,60 1279,211 5,344 15,060 25,357
Int.Duty 6,714 100,60 1279,211 5,344 2 cycles 9,904 13,199
30-cycle 6,714 100,60 1279,211 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
T-1 Mom.Duty 1,136 91,71 216,411 33,433 15,060 25,357
Int.Duty 1,133 91,67 215,796 34,380 2 cycles 9,904 13,199
30-cycle 0,847 91,49 161,325 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
T-2 Mom.Duty 1,136 91,71 216,411 33,433 15,060 25,357
Int.Duty 1,133 91,67 215,796 34,380 2 cycles 9,904 13,199
30-cycle 0,847 91,49 161,325 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
T-3 Mom.Duty 0,578 91,84 110,202 31,070 15,060 25,357
Int.Duty 0,575 91,76 109,621 32,546 2 cycles 9,904 13,199
30-cycle 0,428 91,49 81,611 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
T-7 Mom.Duty 0,376 92,64 71,709 21,669 15,060 25,357
Int.Duty 0,375 92,60 71,525 22,026 2 cycles 9,904 13,199
30-cycle 0,322 92,33 61,284 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
Toiruu SSH 110,00 Sym.Base Tot.Base
Mom.Duty 0,865 6,347 9,915 -82,24 1889,095 14,766 15,060 25,357 [kA] [kA]
Int.Duty 0,865 6,354 9,904 -82,25 1887,051 14,780 2 cycles 9,904 13,199
30-cycle 0,992 6,881 9,136 -81,80 1740,547 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
Grid Freeze Ortho Snap Ln 492,Col 2 DB 4490 2/7/2106 2:28:15 PM MKT


DIgSILENT PowerFactory 15.1 - [Graphic : Diagrams\Grid.IntGrfnet]
File Edit View Insert Data Calculation Output Tools Window Help
Grid SubPlot DoubleBusbar SubPlot(1) Time-Overcurrent Plot
Grid: Grid System Stage: Grid Annex: / 3
Rated Voltage [kV] Equivalent Impedance R[Ohm] X[Ohm] Symmetrical Current (E/Z) [kA] [deg] Apparent Power [MVA] X/R ratio Asym.RMS X/R based [kA] Asym.Peak X/R based [kA]
CB0 Mom.Duty 6,714 100,60 1279,211 5,344 15,060 25,357
Int.Duty 6,714 100,60 1279,211 5,344 2 cycles 9,904 13,199
30-cycle 6,714 100,60 1279,211 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
IS0.1 Mom.Duty 9,915 97,76 1889,094 7,338 15,060 25,357
Int.Duty 9,904 97,75 1887,050 7,349 2 cycles 9,904 13,199
30-cycle 9,135 98,20 1740,545 3 cycles 9,904 11,387
5 cycles 9,904 10,397
8 cycles 10,170 10,055
35 kV
I SSH 35,00 Sym.Base Tot.Base
Mom.Duty 0,232 4,889 4,129 -87,28 250,295 27,446 6,646 11,046 [kA] [kA]
Int.Duty 0,229 4,903 4,117 -87,33 249,580 27,523 2 cycles 4,348 6,057
30-cycle 0,272 5,691 3,547 -87,26 215,017 3 cycles 4,476 5,305
5 cycles 4,378 4,753
8 cycles 4,468 4,426
CB0 Mom.Duty 1,930 93,76 116,987 15,206 6,646 11,046
Int.Duty 1,930 93,76 116,979 15,207 2 cycles 4,348 6,057
30-cycle 1,919 93,82 116,313 3 cycles 4,476 5,305
5 cycles 4,378 4,753
8 cycles 4,468 4,426
L5 Mom.Duty 0,000 0,00 0,000 0,000 6,646 11,046
Int.Duty 0,000 0,00 0,000 0,000 2 cycles 4,348 6,057
30-cycle 0,000 0,00 0,000 3 cycles 4,476 5,305
5 cycles 4,378 4,753
8 cycles 4,468 4,426
L6 Mom.Duty 0,000 0,00 0,000 0,000 6,646 11,046
Int.Duty 0,000 0,00 0,000 0,000 2 cycles 4,348 6,057
30-cycle 0,000 0,00 0,000 3 cycles 4,476 5,305
Grid Freeze Ortho Snap Ln 492,Col 2 DB 4490 2/7/2106 2:28:15 PM MKT

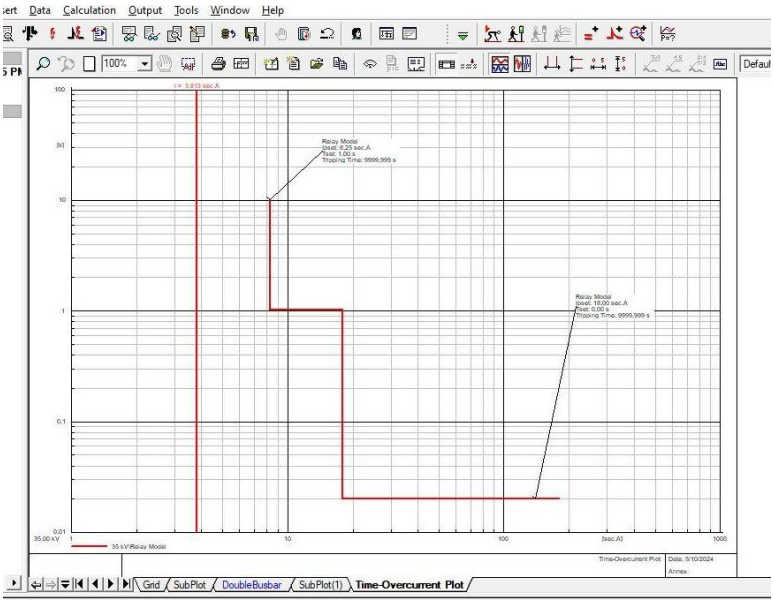


Зураг 1.4 богино залгааны ANSI стандартыг ашигласан үр дүн

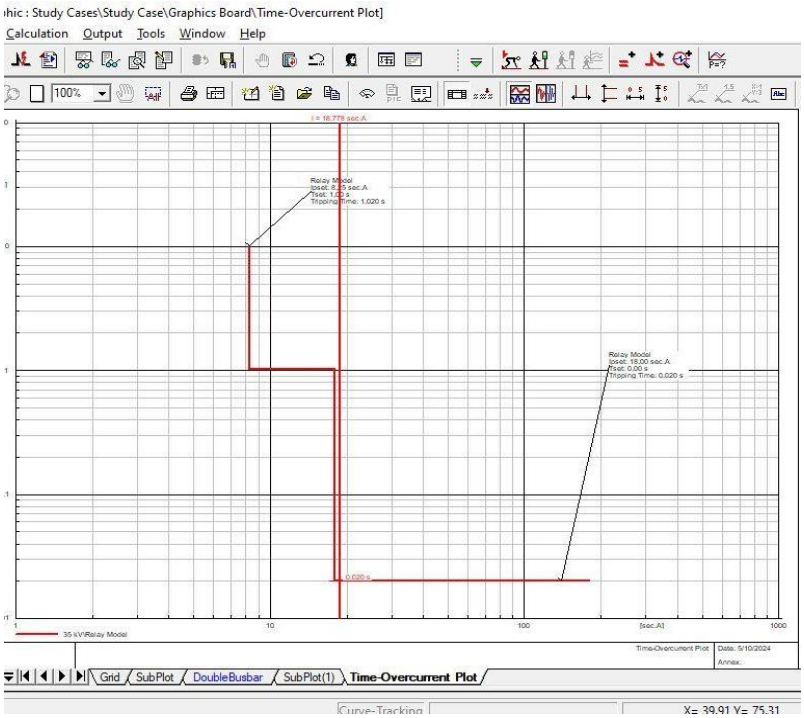
2. Реле хамгаалалт

Курсын төслийн өгөгдөл дээр реле хамгаалалт туршив. Ачааллын 3 хэлхээт шугамын L5 шугам дээр гүйдэл ихсэлтийн хамгаалалт тавив. SEL751 микропроцессорын релейний гүйдэл ихсэлтийн хамгаалалт болох 50P1,50P2-г ашиглав. Бусад функцийг out off service хийж ажиллагаанаас гаргав. 50P1, 50P2-н тавилын гүйдэл хугацаана хамаарлыг зураг

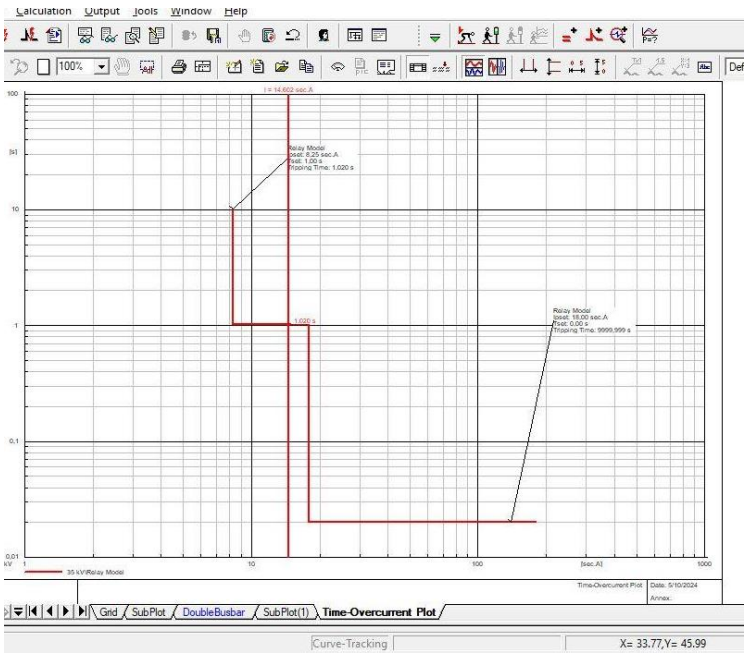
2.1-2.3 үзүүлэв.



Зураг 2.1 хамгаалалтын тавил болон хэвийн үеийн гүйдэл хугацааны хамаарамж

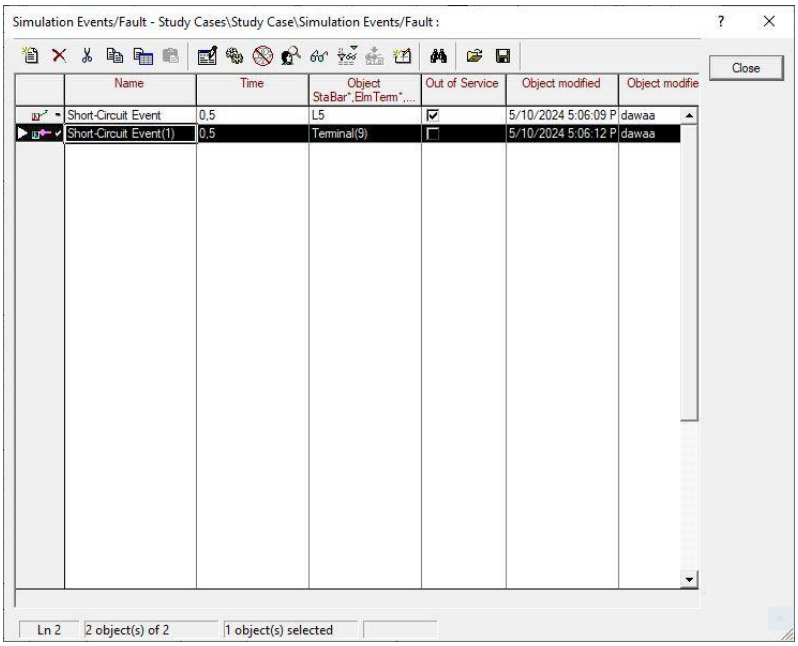


Зураг 2.2 хамгаалалтын тавил болон L5 шугам дээрх БЗ-ны үеийн гүйдэл хугацааны хамаарамж



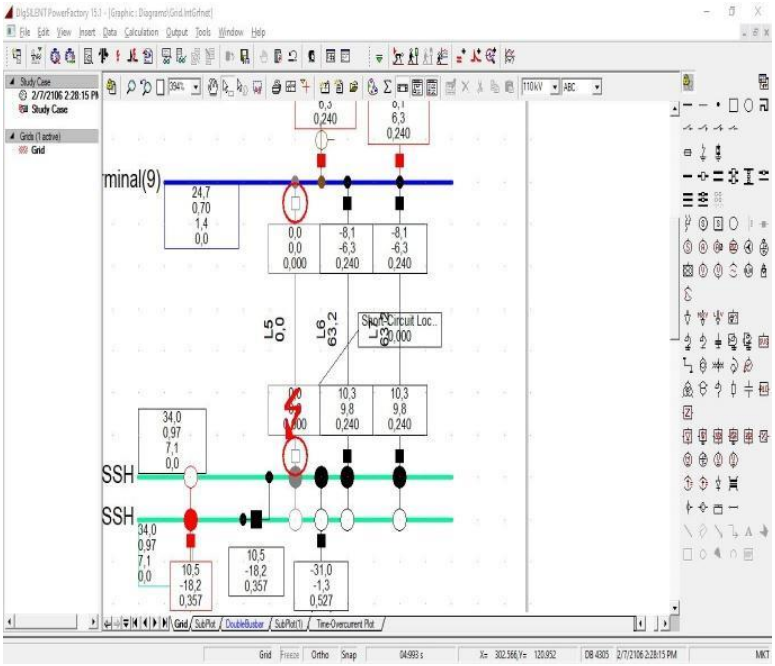
Зураг 2.3 Хамгаалалтын тавил болон Terminal 9 шин дээрх БЗ-ны үеийн гүйдэл хугацааны хамаарамж

Хамгаалалтын ажиллагааг шалгахын тулд short-circuit event үүсгэж RMS/EMT симуляци хийх шаардлагатай. Шугам 5 болон шин Terminal(9) дээр short-circuit event үүсгэсэн байдлыг зураг 2.4-т үзүүлэв.



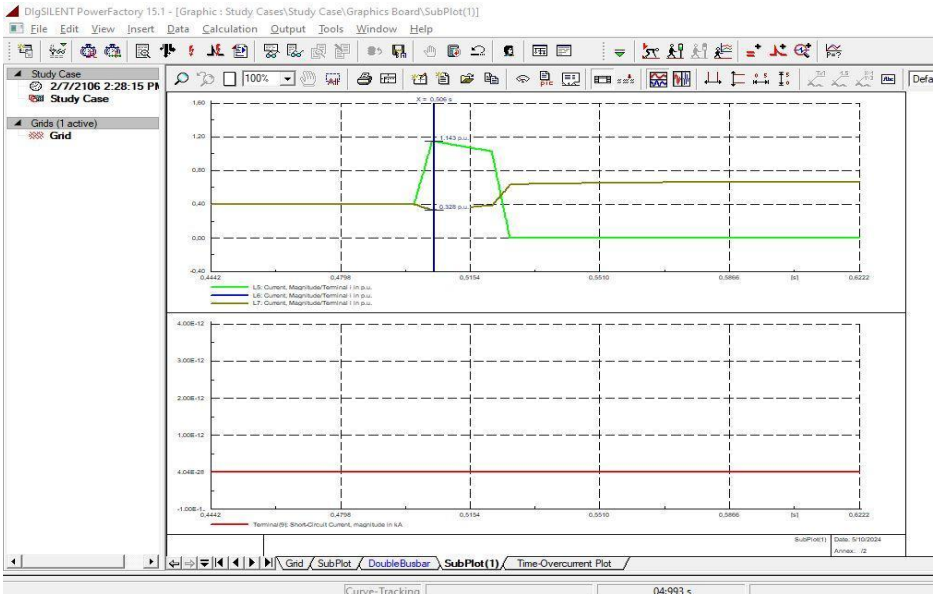
Зураг 2.4

Шугам L5 дээр, богино залгаа болоход зэрэгцээ L5, L6, L7 шугамуудын гүйдэл болон таслуурын байдалыг зураг 2.5 -т үзүүлэв



Зураг 2.5 Шугам дээр богино залгаа болход таслуур тасарсан байдал

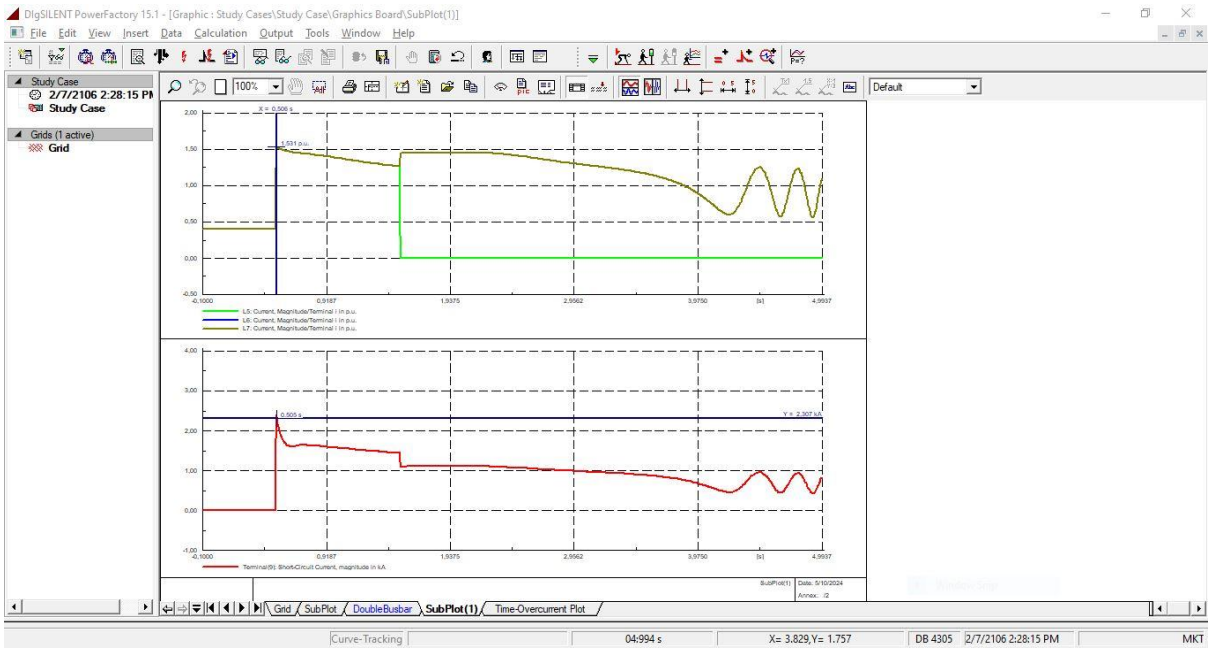
Шугам дээр богино залгаа болход хамгаалалт ажиллах хугцаа болон гүйдэлийн хамаарамжийг зураг 2.6-т үзүүэлэв.



зураг 2.6 гүйдэл хугцааний хамаарамж

Дээрх хамаарамжаас хархад L5 шугам дээр богино залгаа болход L5 шугамын таслуур хугцааны барилтгүй тасарч харин үлдсэн L6 , L7 шугамын гүйдэл нь хэвийн гүйж байгаа нь харагдаж байна.

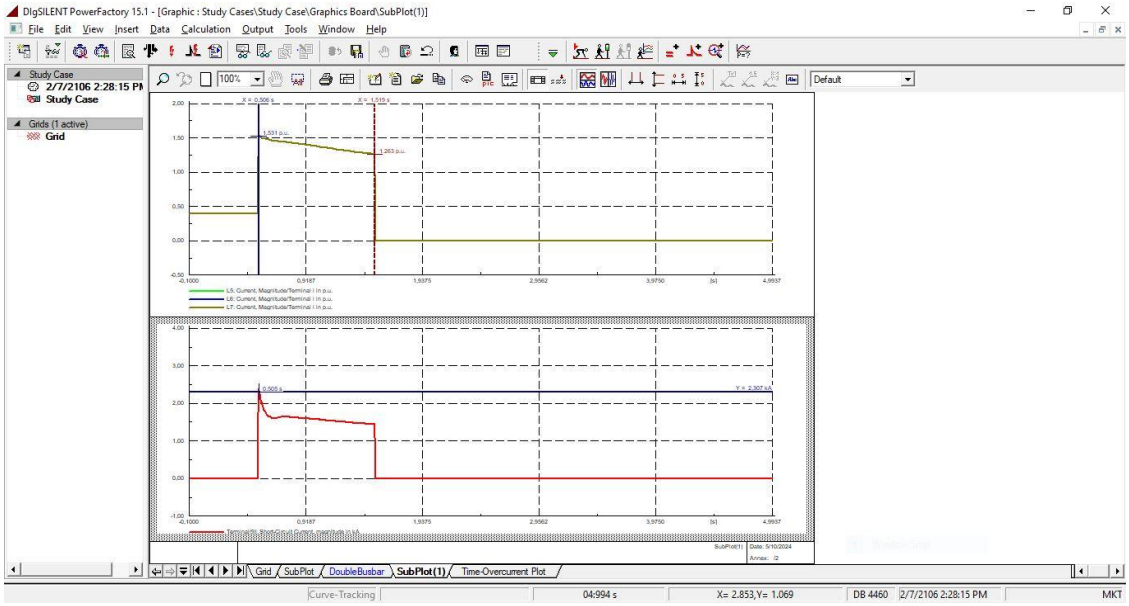
Шин дээр, богино залгаа болоход L5, L6, L7 шугамуудын гүйдэл хугцааны хамаарамжийг зураг 2.7 -т үзүүлэв



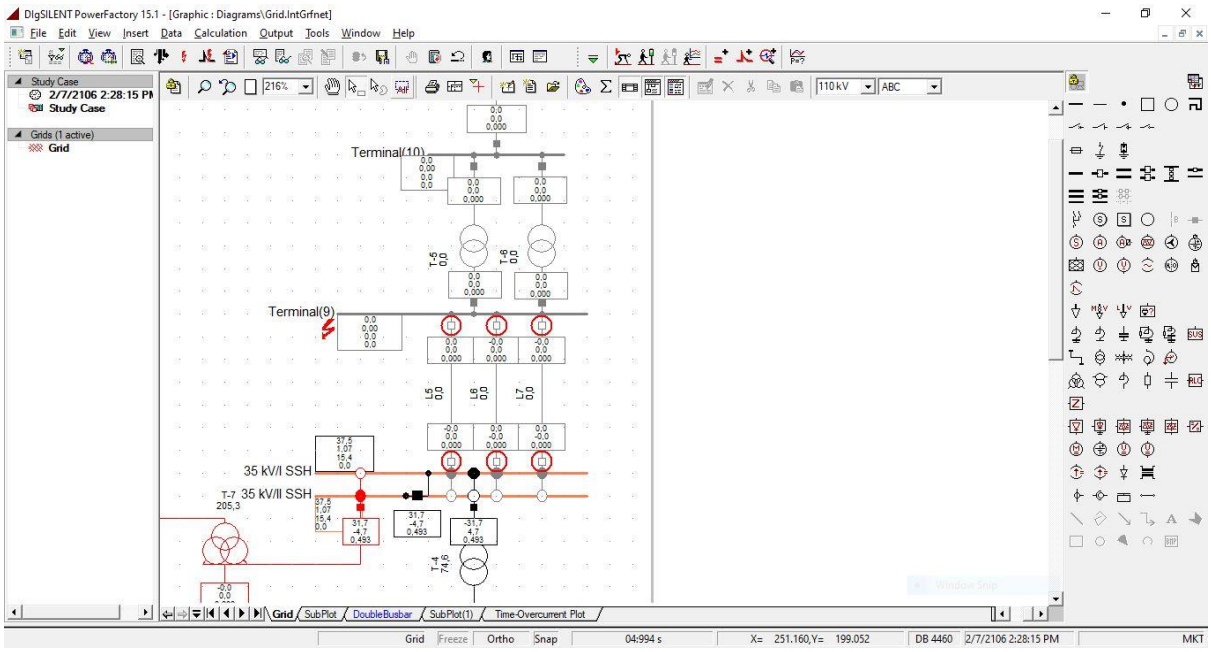
зураг 2.6 гүйдэл хугцааний хамаарамж

Дээрх хамаарамжаас хархад шин дээр богино залгаа болход L5 шугамын таслуур хугцааны барилтгүй тасарч харин үлдсэн L6 , L7 шугамын гүйдэл нь хэвийн гүйж байгаа нь харагдаж байна.

Зураг 2.7 шугамд гүйдэл ихсэлтийн хамгаалалт тавьж шин дээр богино залгаа болход бэлтгэл хамгаалалтаар гүйдэл ихсэлтийн хамгаалалт ажиллаж тасалсан байдлыг харуулав.



Зураг 2.8 шин дээр богино залгаа болход шугамаар гүйж буй гүйдэл хугцааны хамаарамж



Зураг 2.8 таслуурын тасарсан байдал

Жич: Өгөгдөл адилхан тул Болдбаатартай хамтран гүйцэтгэв.