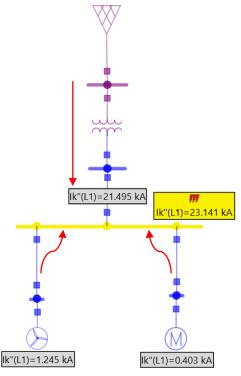


Short Circuit Analysis

Short circuit calculations is used to define the sizing of the installation (equipment rating), location, sizing and coordination of protection devices. This module performs single-, two- (with and without earth connection) and three-phase faults on symmetrical as well as unsymmetrical AC and DC networks. Faults on busbars as well as on lines with user defined fault distance can be computed. NEPLAN provides an option to simulate special faults such as double earth faults, faults between two voltage levels, conductor opening, etc.



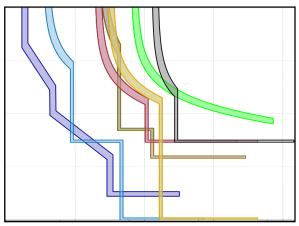
- Short circuit equipment rating
- Contribution from Static converter
 & adjustable frequency drive

Why Short Circuit Analysis?

- If unusual high currents exceed the capability of an equipment, it can result in a large release of energy in the form of heat which could eventually lead to explosion
- Short Circuit calculations are necessary to properly select the type, interrupting rating and tripping characteristics of protection devices
- To determine the currents that flow in a power system under fault conditions
- To determine both the switchgear ratings and the relay settings
- The results of Short Circuit Analysis are used to selectively co-ordinate protection devices



• Arc flash evaluation using short circuit results



• Relay co-ordination using short circuit results

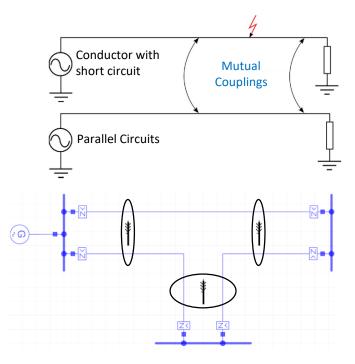
Benefits of Short Circuit Analysis

- Helps avoid unplanned outages and downtime
- Critical for avoiding interruptions of essential services
- Reduces risk of equipment damage and fires
- Increases safety and protects people from injuries
- Determines the level and type of protection devices that are needed
- Reduces the risk a facility could face and helps avoid catastrophic losses
- Increases the safety and reliability of the power system and related equipment



General Characteristics

- Fault calculation according to the following standards:
 - IEC 60909:2016 / VDE 0102:2016
 - IEC 60909:2001 / VDE 0102:2002
 - IEC 909:1998 / VDE 0102:1.90
 - ANSI/IEEE C37.010
 - ANSI/IEEE C37.013
 - G74 Engineering Recommendation
 - IEC 61363-1 for off-shore/ship plants
 - IEC 61660 for DC networks
- Superposition method with consideration of prefault voltage from load flow
- Accurate model for transformer earthing connection
- Earthing system for common earthing of any number of transformers, generators, etc.
- Peterson coil tuning in resonance earthed networks
- Current limiting due to circuit breaker and MOV
- Transformer phase shift
- Correction factor for transformers in parallel with different Un/Ur ratio
- IEC + superposition method for calculation of voltages in order to have right settings of distance relays
- Consideration of arc impedances



► 🕖 Parameters	Primary Side	Commence and these offensive an
		Common earthing (for Y-Y)
 Caracteristics Caracteristics Caracteristics Caracteristics Continual Power Flow 	Direct Impedance Isolated Re1Ohm: 100000	Common Earthing
Southal Power Flow Southal Power Flow	Xe1 Ohm: 100000	
- S Connection Frame	Ze1 active %: 0	
- 🧐 User Defined Model	Petersen Coil tuning	
Earthing	Secondary Side	Z earthing for model change (for Y-Y)
Harmonic Analysis	Direct	Z level Ohm: 100
📑 Reliability	Impedance	
Appendixes	Olsolated	Petersen Coil tuning
- 🍓 Investment Analysis	Re2 Ohm: 2	Consider other coils
🚨 User	Xe2 Ohm: 366.500274	
	Ze2 active %: 100	
Debug	Petersen Coil tuning	

• Peterson coil tuning for transformer

Parameters	Fault Des	scription					
C Nodes			Phase From	To Node	Phase To	Rf Ohm	Xf Ohm
🕻 Arc flash	+ C	lick to add a nev	v item				
Special fault	- × 1	X 1 🔻	L2 🔻	2 🔻	L2 🔻	0	0
Selected result		X 1 •	L3 🔻	2 🔻	L3 •	0	0
	Fault Nar Fault Des		Open Conductor ieries Line Fault (L	1)			
	Fault Des		ieries Line Fault (L		odes		
	Fault Des	scription scription scription	ieries Line Fault (L		odes 		
	Fault Des	ent of the faulted no	ieries Line Fault (L odes (see above) t				

- Simulation of special (user-defined) faults such as:
 Double earth fault
 - Open conductor fault, etc.

Line Coupling

- Mutual impedances and capacitances in the positive and zero sequence systems can be computed using line coupling element
- Circuit and coupling parameters of the overhead lines are computed from the conductor configuration
- Overhead lines with up to six 3-phase systems and three earth wires can be computed (earthing of 3-phase systems considered)
- Unrestricted number of overhead lines can be entered
- Parameters and conductor configuration are saved in the database



Results

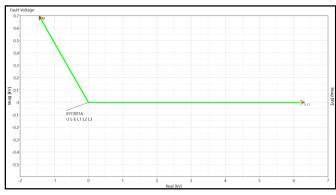
- Key short-circuit results:
 - Initial symmetrical short-circuit current Ik" and power Sk"
 - Peak current ip
 - Breaking current Ib
 - R/X ratio
 - Fault Voltage Ule
- Computation of minimum and maximum short-circuit current
- Thermal and asymmetrical breaking currents, plus DC component
- Calculation of relay tripping time for overcurrent and distance protection
- Contribution of adjustable frequency drives ands static converters to short-circuit currents
- Fault flow calculation (currents and voltages in the whole network) for a single fault location
- Overloaded equipment (current transformer, voltage transformer, circuit-breaker, etc.) are highlighted
- Phase values as well as symmetrical components are available for shot-circuit currents and impedances
- Short-currents and voltage can be plotted as vectors on the chart
- Fault current direction

ti=c 160 ky t_off=1.199 s	16 Ohm
IK"(L1)=2 Zf=0.02 IK"(L1)=2 Zf=0.02	0.925 kA
tOff=0.800 s	Ik"(L1)=0.185 kA Zf=0.155 Ohm
[k"(L1)=1.245 kA	Ik"(L1)=0.185 kA Zf=0.155 Ohm

Graphical representation of results

	Locatio	n	S/C I	'C FaultLocation				Elapsed Time s 0.0122				35
Relay	s with T	ripping t	ime - S	elect rel	ay to be tripp	ed						
√ [Distance	Protect	on					Vero Over	current Prot	tection		
	Trip	Name	2	Ŧ	From		T	Element	T	Trip ti	me [s]	1
÷		Outlet	t Sub I	Distrib.	L/V Main I	Distribut	ion	DISTRIBUTI	ON-LINE	2.8564	ļ.	
		Main	incom	er	L/V Main I	Distribut	ion	TRAFO 630	KVA	15.554	12	
-							_					
	ed Relay	/s / Disco	onnecte	d Eleme	ents							
ripp						-		nent 7	Trip ti	mo [e]	T Z	0
ripp	Trip	۲ Ni	ame	7 Fi	rom	T	Elen	nent /	mp a	ne [ə]		-

• Fault clearing procedure for tripped relays



• Phasor representation of the short circuit results

Ort Circu	uit v						now all results	s ies at fault loca	tion		
							iow only valu	ies at laurt loce			
Dra	ag a colum	nn header and drop it here	to group by	that column							
		Name T	lk"(L1) ▼ kA	lk2L1Angle T	Sk2L1 y kVA	lpL1 y kA	ldcL1 Ţ kA	UleL1 y kV	UleL1Angle T	ZToFault1 y Ohm	ZToFault1Angle
- 10	९ 🚰	87CB01A	22.4	-79.5	387210.2	49	9.3	6.4	180		
	۹ 🚰	K-BT01-US	20.9	100.5	362439.1	46.8	9.3			0	0
	۹ 🚰	Line1	1.2	100.5	21569.2	1.8	0				0
	۹ 🚰	Line2	0.2	95.9	3212.2	0.4	0.1			0	0
	۹ 🐣	87BT01-US	0	0	0	0	0	5.8	181.4		
	۹ 🚰	K-BT01-US	20.9	-79.5	362439.1	46.8	9.3			0	64.4
	۹ 😁	87BT01	20.9	100.5	362439.1	46.8	9.3			0	244.4
	۹ 💾	BM1	0	0	0	0	0	6.3	180.1		
	۹ 🚰	Line1	1.2	-79.5	21569.2	1.8	0				0
	۹ 🕋	AC-Disp-Gen-299173545	1.2	100.5	21569.2	1.8	0				0

• Short circuit results for faulted node and fault contribution from the rest of the network