CYMCAP power cable ampacity software
Brightlayer Utilities suite

Expand the engineering analysis scope of your CYMCAP software with add-on analysis modules

Supported by a long history and deep knowledge in cable modeling, CYMCAP software provides a complete set of analysis tools to help engineers understand the main factors affecting cable behavior in various environments. Develop comprehensive cable installation assessments with add-on analysis modules; these tools provide key complementary data to analyze the impact of cable installations.

Parametric studies module

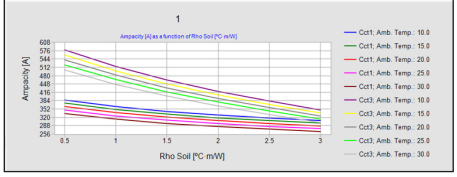
The parametric studies add-on module allows cable engineers to perform simulations in batch mode by varying one or more installation parameters.

Instead of defining fixed specific parameters, users can define a range of values for multiple selected parameters (soil temperature, soil resistivity, installation depth, distance between cables, installation dimensions, etc.), saving time and producing more meaningful results.

Key benefits of this module include:

- Analyze and review the relation among various parameters and the thermal/current rating of cables through graphics and reports
- Determine the effect of user-defined parameters in the simulation
- Design with a flexible tool that supports an unlimited number of variable parameters
- Create automatically selected executions corresponding to a specific simulation
- Develop a summary report containing the main results for relevant cases

Simulation Data			Simulation Results								
Simulation N°	Simulation Native Soil Thermal Resistivity [°C.m/W]	Simulation Ambient Temperature [°C]	Ampacity (per phase) [A]			Total Losses (per phase) [W/m]			Conductor Max. Temperature [°C]		
			Circuit 01	Circuit 02	Circuit 03	Circuit 01	Circuit 02	Circuit 03	Circuit 01	Circuit 02	Circuit 03
1	0.5	10.0	386.8	481.7	578.2	19.5	18.5	30.5	90.0	90.0	90.0
2	0.5	15.0	374.6	466.5	560.2	18.3	17.3	28.7	90.0	90.0	90.0
3	0.5	20.0	362.0	450.7	541.6	17.1	16.2	26.9	90.0	90.0	90.0
4	0.5	25.0	349.0	434.4	522.2	15.9	15.0	25.0	90.0	90.0	90.0
5	0.5	30.0	335.3	417.3	502.1	14.7	13.9	23.1	90.0	90.0	90.0
6	1.0	10.0	362.0	453.4	515.1	17.1	16.4	24.1	90.0	90.0	90.0
7	1.0	15.0	350.6	439.1	498.9	16.1	15.4	22.6	90.0	90.0	90.0
8	1.0	20.0	338.8	424.2	482.1	15.0	14.4	21.2	90.0	90.0	90.0
9	1.0	25.0	325.9	408.5	465.0	13.9	13.3	19.7	89.9	89.9	90.0
10	1.0	30.0	313.6	392.7	446.6	12.9	12.3	18.2	90.0	90.0	90.0
11	1.5	10.0	343.3	432.2	483.6	15.4	14.9	19.4	90.0	90.0	90.0



Soil dry-out analysis

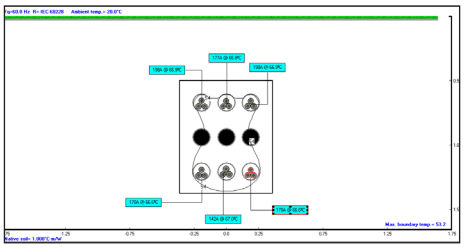
IEC standards consider the soil dry-out effect only when cables are directly buried. However, it doesn't provide a methodology that includes the dry-out of the soil when cables are installed in ducts or in the presence of other layers around the installation, such as a backfill or a duct bank.

The CYMCAP soil dry-out analysis (SDO) add-on module allows engineers to determine ampacity when cables are installed in duct banks or backfills while preventing the heat produced by the cables from causing the dry-out of the soil around the installation.

More precisely, the module uses a finite element model of the installation to compute the temperatures on a selected number of points in the soil while maintaining every point at the selected layer boundary below a user-defined temperature, so avoiding the dry out of soil. The contour line in the illustration represents the maximum temperature reached at the boundary of the duct bank.

Modeling features include:

- Heat sources are supported by this add-on module
  Convergence issues can be created in some specific cases
- Cyclic loading is supported
- Soil dry-out analysis module is not allowed in Temperature mode
- Multiple duct banks and backfills add-on module (MDB) is required



Powering Business Worldwide

CYMCAP software — additional analysis modules

Perform additional analysis for a complete assessment of the key aspects related to cable projects.

Cable impedance calculation

The cables impedance calculation add-on module (ZMAT) calculates the electrical parameters for cables necessary for performing load flow and short-circuit studies at the power frequency (50/60 Hz).

The calculation of impedances is performed after a steady-state ampacity or temperature simulation has been successfully completed. The results are the positive and zero sequence impedances and admittances for all the cables present in the installation.

All impedance and admittance matrices are displayed in the report, including the primitive matrices per section per metallic component, the bonding matrices, the phase and circuit matrices and the resulting symmetrical components matrices.

The following features are supported:

- Computation of the sequence impedances for all the cables present in an installation
- Multiple cables per phase are supported
- One or more neutrals can be represented and are considered in the calculations
- Resistivity of the soil can be changed

Short-circuit cable rating

The short-circuit cable rating (SCR) add-on module is dedicated to the rating of cables for short-circuit currents. The implemented method is based on the IEC Standard 60949 (1988).

CYMCAP software computes both adiabatic and non-adiabatic ratings. The SCR module offers two possibilities according to the known input data:

- Compute the maximum short circuit current that a cable component can carry given the short-circuit time together with the initial and final temperatures
- Compute the final temperature that a given cable component will reach for a specified short-circuit current, initial temperature and time interval

Short-circuit ratings can be computed for all metallic layers supported in the CYMCAP software: conductor, sheath, concentric neutrals, skid wires and armour.

Cable damage curves can be also created which can be exported in a CYMTCC format.

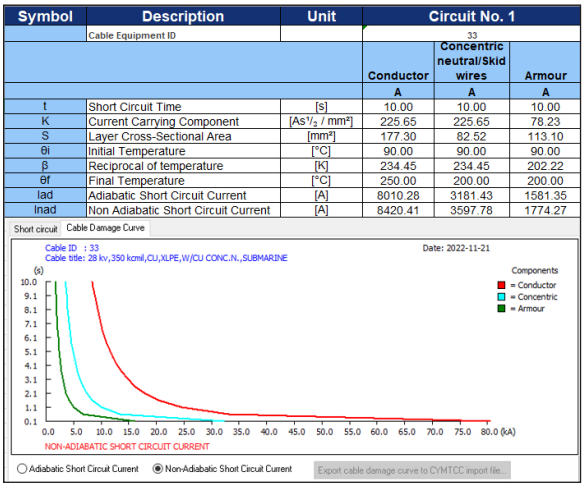
Circuits crossing module

The circuits crossing (XING) add-on module allows the user to determine the steady-state ampacity of two circuits crossing each other.

When two circuits cross each other, each of them behaves as a heat source for the other one. The amount of generated heat, the vertical distance between the crossing circuits and the crossing angle are the main parameters that influence the crossing rating.

In the absence of crossing calculations, the general practice is to use the conservative result where the circuits are assumed to be parallel. When the circuits are parallel, the thermal interaction is maximum. The conservative approach unnecessarily de-rates both circuits. By using the circuits crossing module, one can achieve ratings up to 20 percent higher than the conservative ampacities that are obtained based on the parallel installation scenario. Modeling features include:

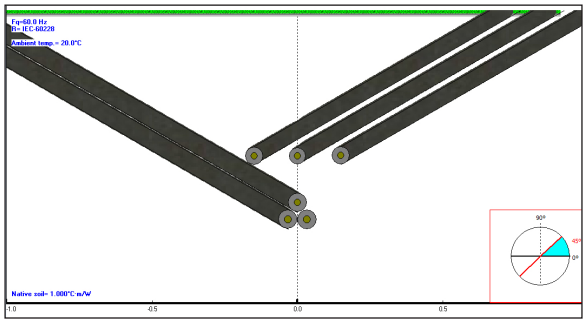
- Modeling of two circuits crossing each other in the same installation
- Circuits crossing directly buried underground, in buried ducts and in buried pipes underground
- Rating methodology as per the IEC standard 60287-3-3



Symbol	Description	Unit	Circuit No. 1		
	Cable Equipment ID		33		
			Conductor	Concentric neutral/Skid wires	Armour
			A	A	A
t	Short Circuit Time	[s]	10.00	10.00	10.00
K	Current Carrying Component	[As$^{1/2}$ / mm^2]	225.65	225.65	78.23
S	Layer Cross-Sectional Area	[mm^2]	177.30	82.52	113.10
θi	Initial Temperature	[°C]	90.00	90.00	90.00
β	Reciprocal of temperature	[K]	234.45	234.45	202.22
θf	Final Temperature	[°C]	250.00	200.00	200.00
Iad	Adiabatic Short Circuit Current	[A]	8010.28	3181.43	1581.35
Inad	Non Adiabatic Short Circuit Current	[A]	8420.41	3597.78	1774.27

Short circuit | Cable Damage Curve

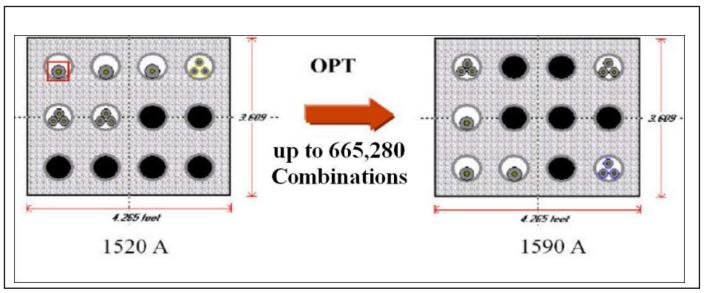
Cable ID : 33
Cable title: 28 kv,350 kcmil,CU,XLPE,W/CU CONC.N.,SUBMARINE
Date: 2022-11-21
(s)
Components
= Conductor
= Concentric
= Armour
NON-ADIABATIC SHORT CIRCUIT CURRENT
Adiabatic Short Circuit Current
Non-Adiabatic Short Circuit Current
Export cable damage curve to CYMTCC import file



Duct bank optimizer module

The duct bank optimizer add-on module allows the user to determine the optimal placement of several circuits within a duct bank. More specifically, the module can propose various circuit configurations within a duct bank so that:

- The duct bank overall ampacity (the sum of the ampacities for all circuits) is maximized or minimized, according to project requirements.
- The ampacity of any given circuit is maximized or minimized based on project needs.

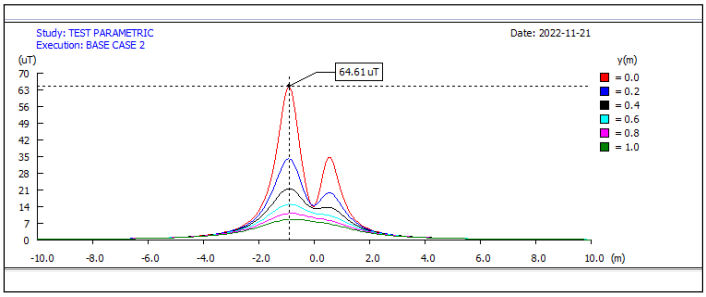


For a 3-by-4 duct bank with three trefoils and one three-phase circuit (one phase per conduit), there are up to 665,280 possible combinations. The elaborated mathematical algorithm of the module prevents the repetitive calculation of equivalent cases; therefore, the solution is obtained very efficiently. The condition presented on the right-hand side of the illustration shows the cable locations for maximum ampacity.

Magnetic fields module

The magnetic fields module (EMF) is an add-on module to the CYMCAP software. After a steady-state ampacity or temperature simulation, the EMF module computes the magnetic flux density at any point on or above the ground of an underground cable installation. The output is a plot (or a table) of magnetic flux density versus position. Modeling features include:

- Infinite-length thin-wire two-dimensional approach
- Consideration of time-varying currents producing an elliptically polarized rotating magnetic vector
- The currents in a three-phase circuit can be unbalanced (in magnitude and phase)
- All media is assumed homogenous, isotropic and linear
- The induced currents are neglected



For more information on CYMCAP software, visit **Eaton.com/cymcap** or contact us at **cymeinfo@eaton.com**.

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