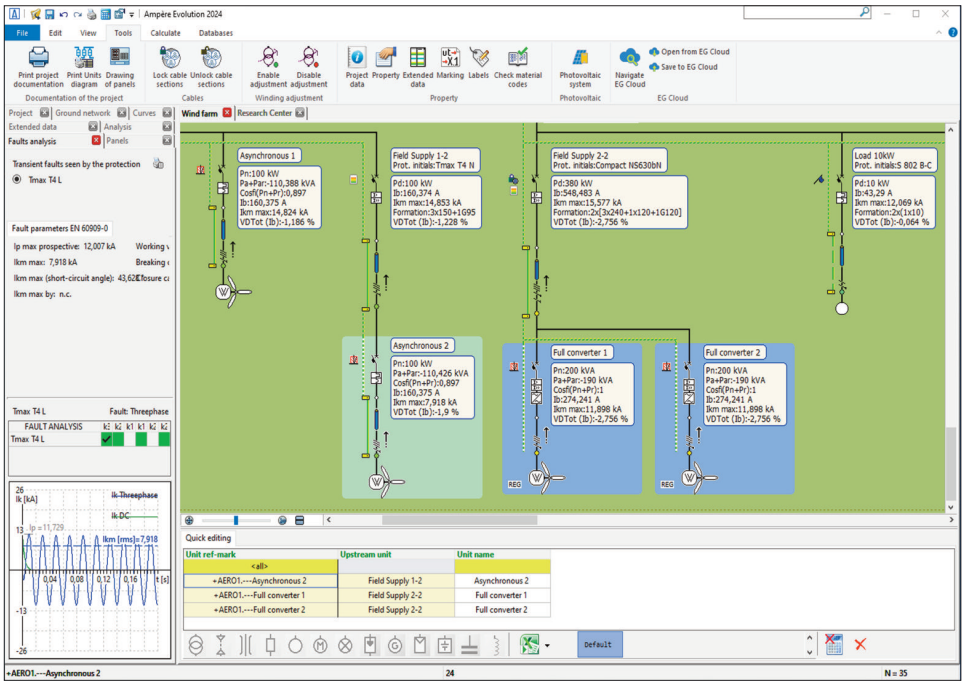
Ampere EVOLUTION

CALCOLO IMPIANTI ELETTRICI

Calculation of LV and MV electricity grid with distributed generation from RES sources



Ampère Evolution is the software for calculating extended electricity networks, with distributed generation from RES, wind and photovoltaic sources. Calculates LV and MV networks, alternating and direct, according to CEI 64-8, 11-17, 11-25, 17-1, CEI EN 62271-100, IEC 60364, 60909, 61660-1, 61936-1 and international standard NF C 15-100 (French), UNE 20460 (Spanish), BS 7671 (English), NBR 5410 (Brazilian), NFPA 70: NEC (American).
Includes EGlink for integration into the BIM environment with Autodesk-Revit®.

Main features

Ampère Evolution is an extension of Ampère Professional and it maintains all its features, summarized below.
- Management of job orders.
- Saving and sharing projects in EG Cloud.
- "Multi-project" mode for collaborative work between multiple operators or on complex networks.
- HV/MV/BT supply from one or more connections.
- Synchronous and asynchronous generators and UPS.
- Sizing of the ground network.
- Guided definition of panels and overtemperature verification.
- Definition of users, import from CAD, multiple editing.
- HV/MV/LV transformers with continuous or discrete automatic regulation, TWT, Zig-Zag, according to EU n.548/2014.
- Analysis of the harmonic profile.
- Definition of the network with uprights, joints and parallels.
- Network configurations and analysis.
- Variable frequency and AC/DC, AC/AC and DC/AC converters.
- Sizing of LV cables according to EU regulation no. 305/11 for CPR cables.
- Calculation of MV faults, with 67 or 67N type directional protections and calculation of the total UE earth voltage on the primary of MV transformers in fault conditions.
- Balancing of single-phase loads.
- Automatic grid power factor correction.
- Sizing with busbars.
- Motor starting with VFD inverter.
- AC and DC storage systems.
- Power dissipated by the network.
- Archive with over 90,000 protective equipment with complete features.
- Use of electronic releases with ANSI/IEEE C37.2 functions.
- Calibration of MV releases according to CEI EN 62271-100 (CEI 17-1).
- CT, VT and TO measurement and protection transformers in MV, with saturation checks according to CEI 0-16 for CT and TO and dynamic analysis on all types of fault current.
- Check lines and protections, check the interrupting capacity according to EN 60947 or EN 60898 and any cost-effectiveness criterion.
- Verification of the maximum voltage drop when starting the motors.
- MV/LV selectivity.
- Fault conditions according to IEC 60909 and IEC 61660-1 standards for direct current.
- Calculation of overtemperature in panels according to CEI 17-43.
- Arc Flash analysis according to IEEE 1584-2018.
- Calculation reports.
- Generation of single-line and multi-line diagrams or functional diagrams related to auxiliary elements of the devices, on DWG and PDF files, compatible with CADelet, Eplus and iDEA.

Extended Networks with Distributed Generation from Renewable Energy Sources (RES)

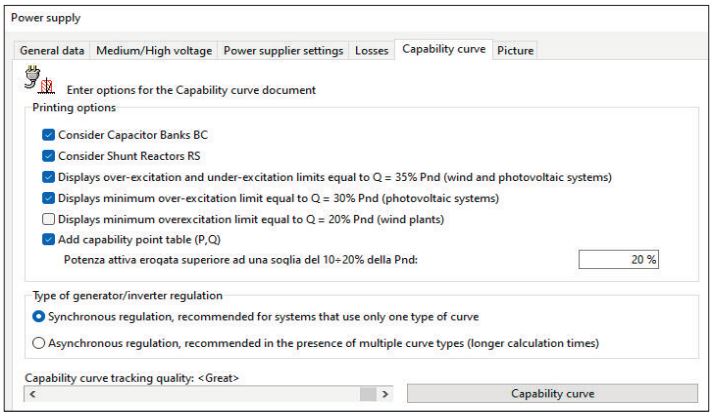
A calculation model has been implemented to conduct a comprehensive study of extended networks, particularly those with distributed generation, whether it be from wind or photovoltaic sources.
The model takes into account the dissipative and reactive elements of the lines, as well as managing capacitor banks and shunt reactors.
Naturally, wind generator units are included, with three types, as well as guided and controlled definition of photovoltaic generators. For the latter, an automated process is provided to guide the correct selection of photovoltaic panels, associable inverters, and the definition of connections and sectionalizations for the photovoltaic array.

Longitudinal and transversal grid's elements

The calculation model considers the longitudinal elements of the lines, both resistive and inductive, which typically exhibit their influence on extended networks beyond kilometers.
Additionally, the capacitive transversal elements of the network are taken into account, calculating their contribution to the total circulating currents.
This allows for the balancing of reactive powers, typically inductive, of the loads.

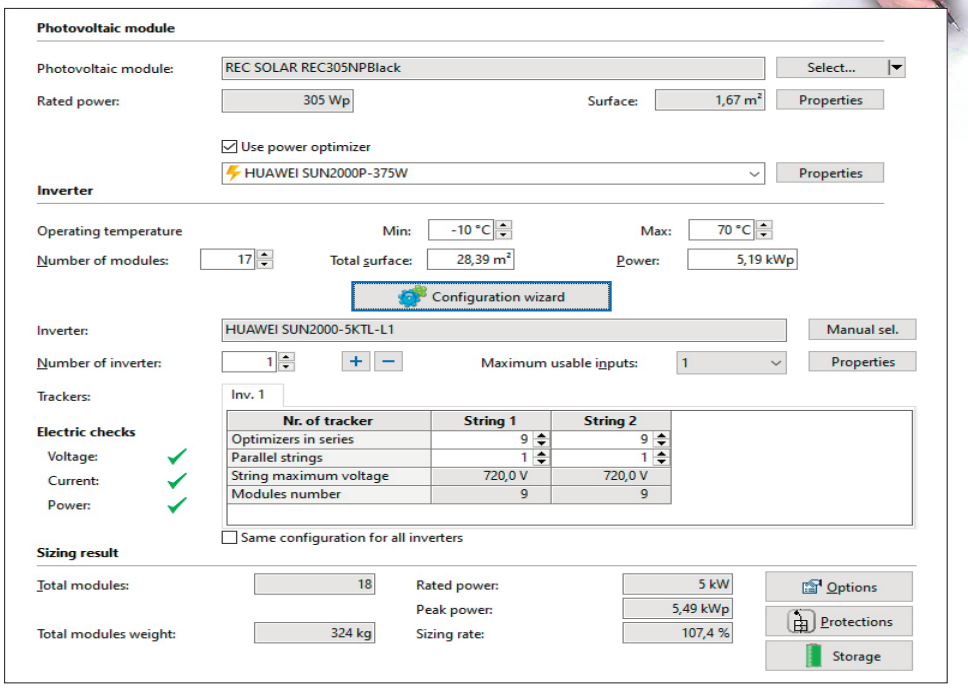
Active and reactive powers

The active and reactive powers dissipated along the lines due to the resistances and inductances of the cables and transformers are calculated. To the powers (P, Q) absorbed by the loads, the line powers (Pr, Qr) are added, representing the total powers (P+Pr, Q+Qr) calculated at the upstream node of each load and supply.
These powers are used for advanced study of



Integrations

CADelet Impianti, **Eplus**: electrical system engineering.
CADelet Schemi, **iDEA**: wiring diagrams for industrial automation.
CADelet Professional: electrical system and wiring diagrams engineering.



the capability curve when it's necessary to consider the network contribution as the load varies throughout the day, from idle to full load.

Propagation of capacitive currents

In modeling reality, a decision was necessary to strike a balance between ensuring accurate voltage drop calculations and currents seen by protections, while also ensuring fair propagation of currents in interconnected networks.
Therefore, a capacitance model called pi-greco is used: it is assumed that capacitance, uniformly distributed along the line, is concentrated in two half-value capacitors positioned at the ends of the load.
There are exceptions:

- in terminal loads, all capacitance is placed upstream of protections to ensure that (P, Q) represents only the load power;
- in distribution loads connected to the supply, all capacitance is placed downstream. Thus, protections read total currents, and the supply provides the total value for connection points and capability curve calculations.

Wind turbine

Three types of wind turbines are envisaged, each with an electrical model defined according to the specifications of standard CEI EN 60909.
These models enable the calculation of short-circuit currents for asynchronous generators, doubly fed asynchronous generators, and full-size converter generators.

Photovoltaic generator

A guided procedure allows for the complete definition of the photovoltaic generator. From a vast database, photovoltaic modules can be selected, and based on the desired peak power or available surface area, the optimal inverter is chosen to meet the electrical coupling conditions, with proposals for various resulting string solutions. It is possible to define the field segmentation and the type of cables and protections to be used. Then, the definition proceeds to the protections on the DC and AC side (general device, interface device, and related protection) with the introduction of protections against external overvoltages (SPD).

Inverter configuration

The selection of the inverter is carried out with criteria for energy and economic optimization. It is coupled with the strings, analyzing various possible combinations based on the characteristics of the trackers mounted on the inverter. A homogeneous layout of the strings is assigned for each individual tracker.
Search filters by manufacturers and types are available.

Capacitor banks

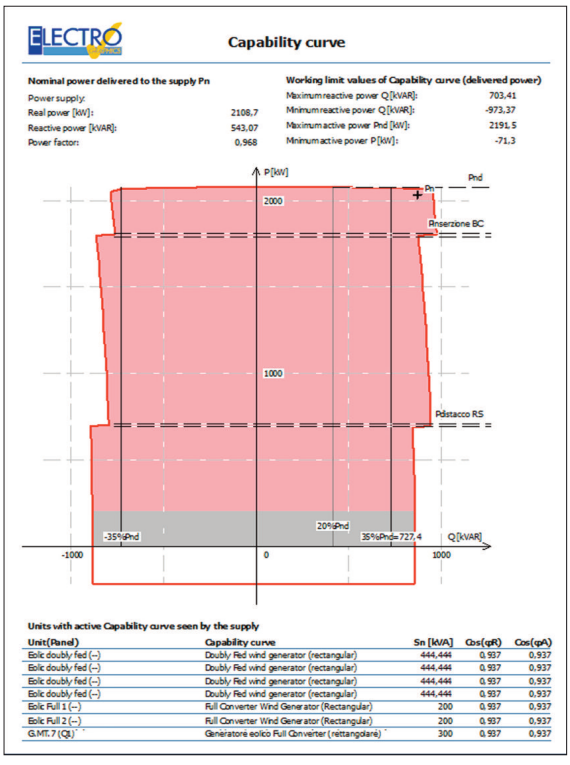
Capacitor banks are managed as a variant of capacitive loads. In particular, to comply with Terna's regulations, they have an active insertion power that triggers the closure of the bank's protection when this threshold is exceeded, and disconnects it when the active power absorbed at the supply level returns to a lower value. Additionally, these capacities cannot be step-regulated, therefore constituting a single bank with fixed reactive power. The designer can create multiple similar loads with different reactive power values and insertion powers, but they are independent of each other.

Shunt reactors

Shunt reactors are managed as a variant of inductive loads. In particular they have a disconnecting active power, which triggers the opening of the reactor's protection when this threshold is exceeded and re-engages when the active power absorbed at the supply level returns to a lower value. Additionally, these inductances cannot be step-regulated, therefore constituting a single shunt reactor with fixed reactive power. The designer can create multiple similar loads with different reactive power values and insertion powers, but they are independent of each other.

Capability curve

The capability curve is calculated at the connection point based on the curves of each generator, the influence of loads present in the network, and takes into account the influence of the longitudinal and transversal parameters of the network, namely resistances, inductances, and capacitances, as well as the losses incurred by transformers. Additionally, if present in the network, capacitive and inductive loads used for automatic compensation of reactive powers will be considered, defined as capacitor banks and shunt reactors.



System requirements: Computer with 3 GHz or higher processor.
At least 8 GB RAM. Hard disk with at least 6 GB free space. 1024x768 screen resolution. USB port, mouse, printer or plotter.
64-bit O.S. Windows 10 or 11.