

Electrical Network Calculation

Electrical network calculation studies
and expertise

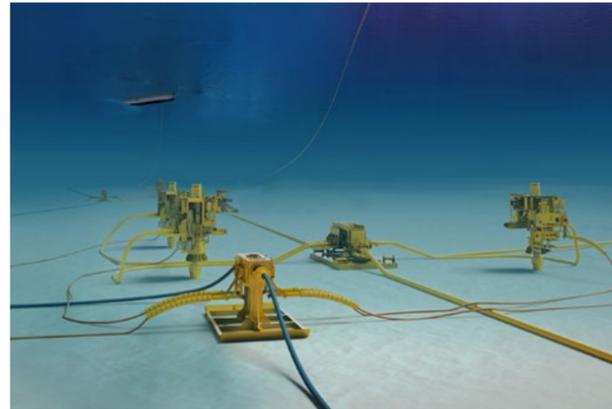


TechnipFMC overview

TechnipFMC is a global leader in subsea, onshore/offshore and surface projects. With our proprietary technologies and production systems, integrated expertise and comprehensive solutions, we are transforming our clients' project economics.

We offer a suite of project development capabilities from conceptual to full EPCI:

- ▶ Feasibility
- ▶ Project management
- ▶ Financing
- ▶ Engineering
- ▶ Procurement
- ▶ Construction
- ▶ Commissioning
- ▶ Operations
- ▶ Plant expansion and debottlenecking
- ▶ Plant decommissioning



Subsea

Optimizing subsea fields from concept to project delivery and beyond

We are setting new project economic standards with smarter design, industry-leading technologies, and seamless management, and execution.

Subsea products

- ▶ Trees, manifolds, controls, templates, flowline systems, umbilicals, and flexibles
- ▶ Subsea processing

Subsea projects

- ▶ Front end to decommissioning
- ▶ Field architecture, integrated design
- ▶ Engineering, procurement, construction, and installation

Subsea services

- ▶ Drilling
- ▶ Installation, completion, and life of field Asset management
- ▶ Well intervention and IMR
- ▶ ROVs and manipulator systems



Onshore/Offshore

Delivering unrivaled technology and project capabilities

We bring strong technical, technological, and project management expertise across fixed, floating, and onshore facilities, as well as offshore services.

Onshore

- ▶ Liquefied natural gas (LNG)
- ▶ Gas treatment
- ▶ Petrochemicals and fertilizers
- ▶ Refining and hydrogen
- ▶ Mining and metals

Offshore

- ▶ Fixed facilities: jackets, self-elevating platforms, GBS, and artificial islands
- ▶ Floating facilities: FPSO, semi-submersibles, Spar, TLP, and FLNG

Services

- ▶ Project management consultancy, process technologies



Surface Technology

Combining field-proven equipment, services, and integrated solutions

Our global product and service platform gives clients access to leading solutions in measurement and production systems, surface wellhead systems, and integrated services.

Surface

- ▶ Drilling, completion and production wellhead equipment, chokes, compact valves, manifolds, and controls
- ▶ Treating iron, manifolds, and reciprocating pumps for stimulation and cementing
- ▶ Frac-stack, manifold rental, and operation services
- ▶ Flowback and well testing services
- ▶ Advanced separation, flow-treatment systems
- ▶ Flow metering products and systems
- ▶ Marine, truck and railcar loading systems
- ▶ Installation, maintenance services

Electrical Network Calculation

Our mission

Our Paris-based Electrical Network Calculation Division's mission is declined around three main axes:

- ▶ Perform electrical network calculation studies for all types of downstream and upstream projects
- ▶ Support projects and develops calculation methodologies to comply with the highest international standards on electrical engineering
- ▶ Ensure continuous technology foresight on the development of equipment, standards and calculation technologies

Extensive expertise and experience

TechnipFMC has developed best-in-industry expertise in electrical studies for major EPC projects by collecting and consolidating data, developing designs, experiencing methodologies and work processes, acting on commissioning and startup activities and reviewing and analyzing subcontracted electrical studies.

With electrical studies playing a key part in our EPC projects, our Electrical Network Calculation Division has gained vital experience over the years in performing electrical network studies, providing global overviews, ensuring full electrical network consistency, providing superior management and delivering top-quality calculations.

An experienced team

Our global team of electrical network calculation experts benefits from 20 years of experience in the industry.

Many of our engineers have been part of the division for 10 years or longer and offer an extensive knowledge base.

Our software tools

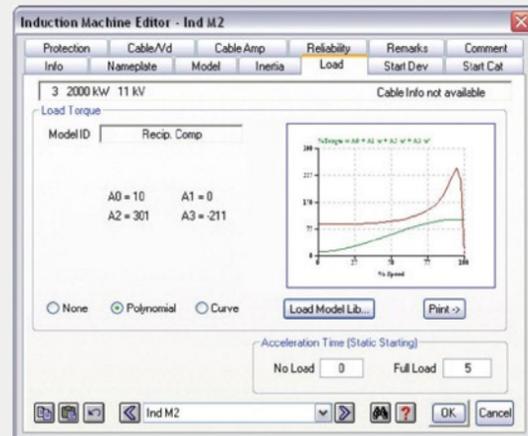
Our calculation and studies methodologies rely on specialized software tools such as:

- ▶ 4 ETAP network licenses with the latest release, 5000 bus
- ▶ 1 EMTP license



Our offering

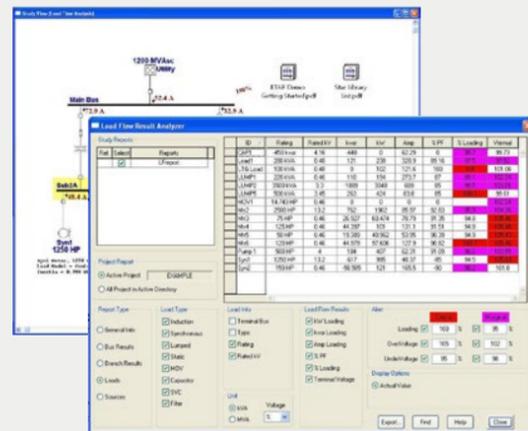
TechnipFMC offers a portfolio of proven network calculation modules.



Motor starting

ETAP software

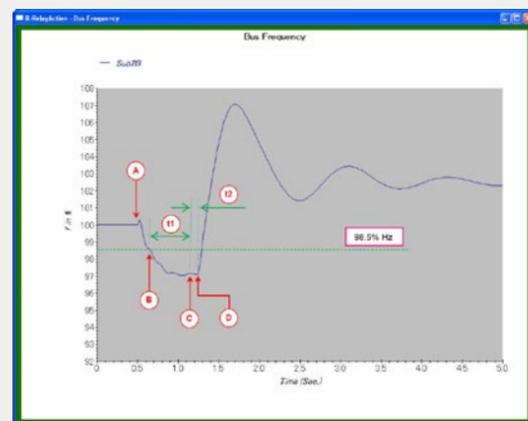
- Assesses the impact of motors' dynamic acceleration and reacceleration on electrical networks by considering the mechanical behavior of driven machines.



Load flow

ETAP software

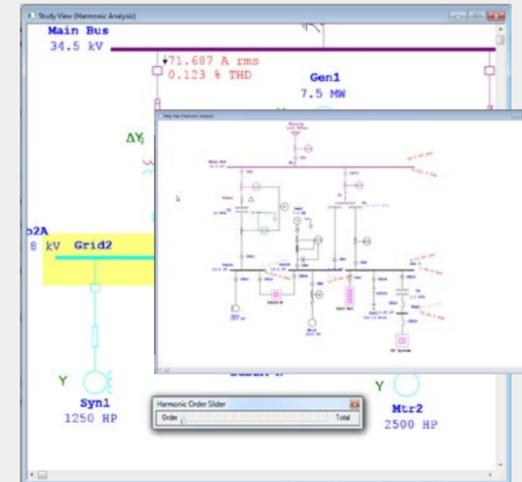
- Confirms power flows and corresponding voltage variations to assess plant operation performance.
- Design banks capacitors for power factor.



Short circuit calculations

ETAP software

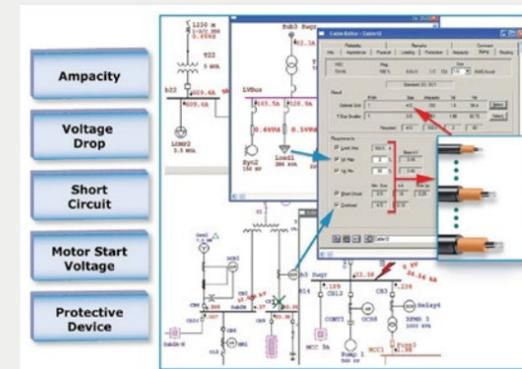
- Calculates size equipment in accordance with transient fault conditions.
- Based on IEC 60909, three-phase single line to earth, double line to earth and line-to-line faults are simulated to cover the complete design.



Harmonic studies

ETAP software

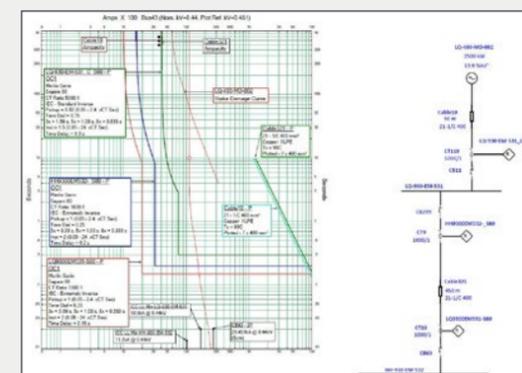
- Analyzes harmonic current and voltage sources at multiple locations in the power system, including voltage and current distortion evaluation according to IEEE519 standards.



Cable sizing study

ETAP software

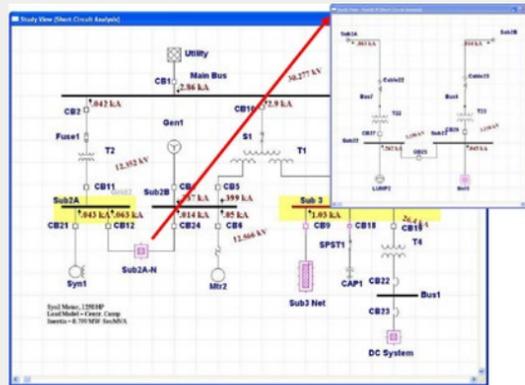
- Performs cable sizing studies according to IEC60364, IEC60092 and IEC60502 standards.
- Defines cable thermal analysis according to Neher-McGrath and IEC60287 methods.



Selectivity and protections studies

ETAP software

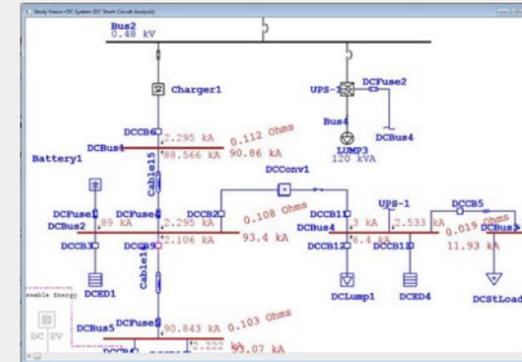
- Performs global coordination and selectivity studies and achieves protections relays settings.



Network controllability

ETAP software

- Confirms power flows and corresponding voltage variations to assess plant operation performance.
- Design banks capacitors for power factor.



DC load flow and DC short circuit calculation

ETAP software

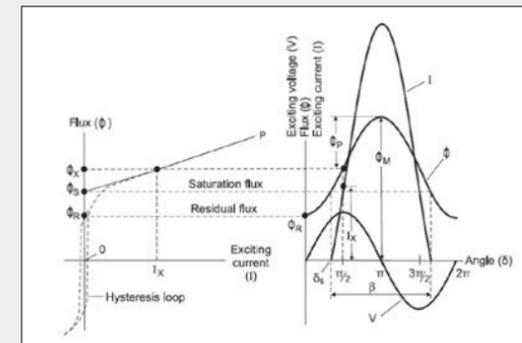
- Performs direct current (DC) load flow and short circuit current on DC electrical networks to assess protective device rating, cables ampacities and source capacities.

Category	Calculated	User-Defined
Bus Fault Current	28.07 kA	29 kA
Bus Arcing Current (a)	17.62 kA	18.146 kA
Source PD	CB22	
Source PD Arcing Current	17.62 kA	
Fault Clearing Time (FCT)	0.175 Sec	0.1 Sec
Grounding	Grounded	Grounded
Incident Energy	11.536 Cal/cm ²	6.003 Cal/cm ²
Protection Boundary	4.680 ft	3.571 ft
Category (NFPA70E 2004)	3	2
Working Distance	18 inch	

Arc flash study

ETAP software

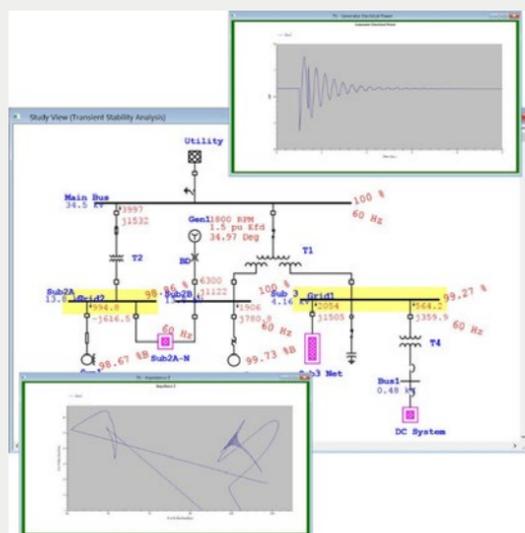
- Analyzes the quantification of thermal energy that personnel might be exposed to during an arc fault.



Transformer magnetization

EMTP-RV software

- Analyzes the phenomena of inrush power transformers' current and impact on the electrical network.



System stability studies

ETAP software

- Simulates system response during and after disturbances such as faults, load changes, motor starting, loss of generation and loss of excitation or governor.

Key client benefits

Offering	Safety	Maintenance OPEX	Regulations compliance	Sizing capex
Motor starting			✓	✓
Load flow		✓	✓	✓
Short circuit calculations	✓		✓	✓
Network controllability	✓	✓	✓	✓
System stability studies	✓	✓	✓	✓
Harmonic studies			✓	✓
Cable sizing studies	✓		✓	✓
Selectivity and protections studies	✓	✓	✓	✓
Arc flash studies	✓	✓	✓	✓
DC load flow/DC short circuit calculation	✓	✓	✓	✓
Transformer magnetization		✓		✓

Our latest projects

Projects	Yamal LNG Modular LNG plant in North Siberia	Martin Linge Oil production platform in North Sea	ZapSib Neftekhim Polyethylene plant in Russia	ENI East Africa Floating LNG	R&D For Subsea
Short circuit current study	✓	✓	✓	✓	✓
Load flow study	✓	✓	✓	✓	✓
Harmonic study	✓			✓	
Dynamic motor study	✓	✓		✓	
System stability study	✓			✓	
Load sharing of GTG's study	✓			✓	
HV, MV, LV cables sizing (high, medium, low voltage)	✓	✓	✓	✓	✓
125 MVA transformer energization study	✓				
DC short circuit current and load flow studies		✓		✓	
HV, LV selectivity and protections studies	✓	✓	✓	✓	✓

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