Grid Solutions
a GE and Alstom joint venture

AUTOMATION SUPPORT AND SERVICES SOLUTIONS

Support & Services

Electrical network analysis and expertise

Grid Solutions is a world leader in electricity transmission and distribution, offering its customers a complete range of products and solutions for enhanced grid stability and energy efficiency.

Optimizing your investments

Utilities are looking for flexible, reliable, cost-effective and sustainable solutions to optimize the lifecycle performance of their electrical grids. Grid Automation's Network Expertise teams are close to our customers to provide them with the professional engineering support needed to satisfy their technical and economic requirements.

In addition to the guarantees of an acknowledged world leader in the power industry, our network analysis and expertise services will help you to:

- Optimize your investments
- Reduce your operating costs
- Extend the lifecycle of your electrical equipment
- Improve the security of persons and equipment
- Provide more reliable detection, tripping and analysis of electrical disturbances

ELECTRICAL NETWORK ANALYSIS OVERVIEW

ANALYSIS	OBJECTIVES	TYPE OF APPLICATION
Load flow report and voltage drop	• Identify weak points in the grid and improve operating costs • Reduce losses • Propose network architecture and modes of operation	• On any new or existing installation • In case of a change in architecture or mode of operation
Neutral rating specification	• Ensure the safety of persons and property • Optimize the detection of grounded faults	• On any new installation • In case of a change in architecture or mode of operation
Short circuit	• Equipment sizing • Reduce the risk of damage • Optimize the detection of faults	
Measurement reducer specification	• Reduce the purchase costs of current and voltage measurement reducers • Ensure proper operation of protection relays and measuring devices	• On any new installation • In case of change in architecture or mode of operation or protection plan
Selectivity and settings files	• Rapidly eliminate the area of the network disturbed • Improve the security of persons and equipment • Optimise network operating quality	
Dynamic stability, motor starting and re-acceleration	• Reduce the risk of damage • Reduce the risk of operating loss	• On any facility involving rotating machines (generators, synchronous or asynchronous motors)

LOAD FLOW AND VOLTAGE DROP ANALYSIS

- Balance the power production/power consumption ratio
- Avoid under-sizing of electrical equipment
- Reduce losses
- Regulate voltage across the network

Methodology

For each operating mode, the analysis determines:

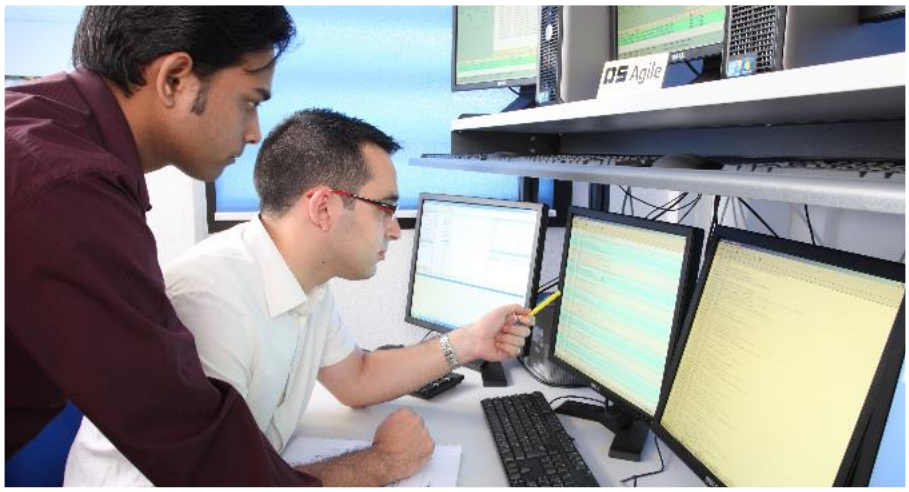
- The contribution of the generated and consumed power at all points in the network
- Total losses in the network
- The peak operating conditions of equipment: the reactive power limit of synchronous equipment, the upper or lower tap limit of power transformers with tap changers, the maximum load limit of cables and overhead lines, etc.

Items included in the analysis

The analysis is carried out using CYME International's PSAF-FLOW software, acknowledged worldwide and used by many research and engineering specialists.

The analysis report includes the following:

- A summary of the entire data and the assumptions used for the analysis. The collection of the technical data needed to execute the analysis is based on a document that is sent to the customer on receipt of the order
- A complete single line diagram of the network
- A detailed technical note commenting on the results of simulations and the technical and economic choices
- A report on the transit values at all points and branches of the network, as well as weak points identified



NEUTRAL MODE SPECIFICATION ANALYSIS

- Optimize the detection and removal of earth defects
- Avoid the phenomena of overvoltage transients and temporary overvoltage when clearing the earth fault risk of destruction of equipment
- Verify the proper performance of high voltage equipment on short circuit to earth (thermal and electro-dynamic)

Methodology

Define the optimal neutral rating mode of the network depending on:

- The required level of protection and security of persons and equipment
- The short-circuit capabilities of the equipment in the network
- The operating strategy chosen

Items included in the analysis

This analysis takes into account the technical requirements associated with any change of neutral rate and can be carried out in two ways:

- Specify one or several neutral impedances to obtain a neutral rate congruent with the original specification transmitted by the customer
- Make a number of technical proposals for the neutral rate, depending on the rules applied for the protection and security of persons, equipment and on the strategy chosen for network operation

SHORT CIRCUIT ANALYSIS

- Size the settings for protection relays to ensure co-ordination of the protection
- Verify the proper sizing of metering reducers connected to the protection relays
- Verify the proper sizing of the equipment regarding the thermal and electro-dynamic withstand in the short-circuit rate: busbar, OT lines, wires, etc.
- The ability to cut off circuit-breakers

Methodology

Calculate, at all strategic points in the network, all the parameters (current, voltage, power) relating to multi-phase faults and earth faults.

Items included in the analysis

The analysis is carried out using the PSAF-FAULT software, acknowledged worldwide and used by many research and engineering specialists.

A default simulation scenario can be established in accordance with IEC 60909, ANSI C37.010 and C37.05 standards.

The analysis report includes the following:

- A summary of all data and the assumptions used for the analysis. The collection of the technical data needed to execute the analysis is based on a document that is sent to the customer on receipt of the order
- A simplified single line diagram
- A detailed technical note commenting the results of simulations and highlighting the technical challenges
- A report on the fault values at all strategic points in the network

MEASUREMENT REDUCERS SPECIFICATION ANALYSIS

Lower the cost of the measurement reducers (current transformers (CT) and voltage transformers (VT) by:

- Specifying the design parameters necessary for the proper operation of protection relays
- Optimizing the homogeneity of the system measurements: primary network CT/TP and secondary wiring protection

Methodology

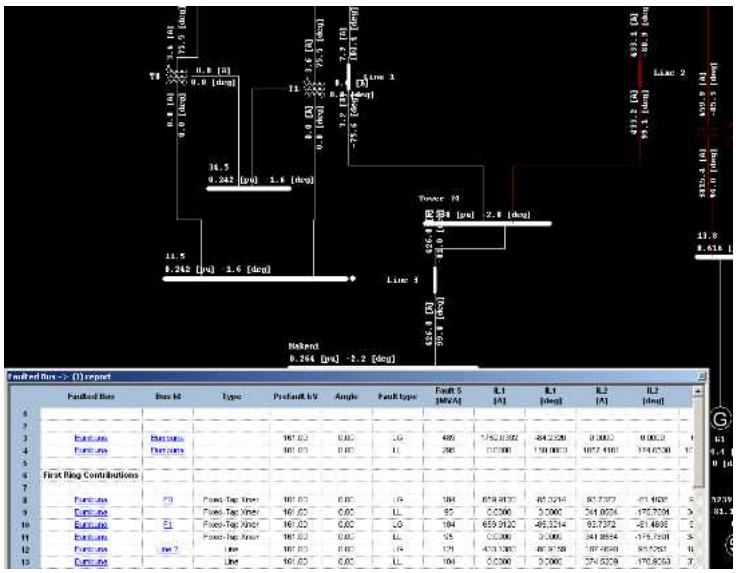
Specify the current and voltage transformers in accordance with international standards IEC 44-1, IEC 44-6 and BS3938.

Items included in the analysis

The analysis report includes the following:

- A summary of all data and the assumptions used for the analysis. The collection of the technical data needed to execute the analysis is based on a document that is sent to the customer on receipt of the order
- A phase and earth short-circuit analysis
- For each measurement reducer (measurement coil and protection coil):
  - A detailed note describing the calculation methodology
  - The values of parameter specifications

These parameters are subsequently transmitted for manufacturing operations



Short circuit analysis

SELECTIVITY ANALYSIS AND SETTINGS FILES

- Co-ordinate the whole protection plan to be able to rapidly isolate the area of the network affected by a fault while maintaining all non-fault areas in service
- Improve the protection and security of persons and equipment
- Optimize network operating quality and availability

Methodology

Optimize a protection plan in terms of functions and equipment, taking into account the network specifications and all operating techniques.

Items included in the analysis

The analysis is carried out using CYM-TCC software, acknowledged worldwide and used by many research and engineering specialists. The analysis report includes the following:

- A summary of all data and the assumptions used for the analysis. The collection of the technical data needed to execute the analysis is based on a document that is sent to the customer on receipt of the order
- A complete single line diagram of the analyzed grid
- A phase and earth short-circuit analysis
- The selectivity phases and earth curves (on LOG/LOG time/current graphs) created using expert software
- A detailed technical note commenting on and justifying the protection settings and highlighting the technical challenges
- A settings file for each protection relay (Grid Automation or third party). For the MiCOM range of protection relays, the settings are made and then loaded directly into the relay using the MiCOM S1 Agile settings software

MOTOR STARTING AND RE-ACCELERATING ANALYSIS

Analyze the transient phenomena caused either by starting and re-accelerating motors in a normal phase of operation, or from the result of the occurrence / elimination of faults.

The recommended solutions allow verification that starting or re-accelerating motors will not involve:

- Tripping of the protection relays (and therefore operational losses)
- Risks of unacceptable voltage drops (specification of load shedding automatisms)
- The non-stability of the network (risks of partial or total blackout)

Methodology

Starting and/or re-accelerating asynchronous motors involves disruptive phenomena such as:

- Significant current peaks
- Voltage drops due to such current peaks

Items included in the analysis

Transient phenomena resulting from disturbances are the focus of this analysis. Therefore, the approach and content are similar to those of a dynamic stability analysis carried out using the PSAF-STAB software from CYME International.

TECHNICAL STUDIES AND EXPERTISE SERVICES

Examine the electrical network onsite, with particular focus on substation control and monitoring

Examination No. 1: study of the electrical network and expertise
Prior to carrying out the examination of the electrical network, it is necessary to collect and analyse the technical data concerning the network. This preliminary phase can be executed by specialists from the Grid Automation competence centre for analysis, expertize and training via site surveys (level 1 or level 2), with a series of measurements and complementary tests.

This service produces a survey report, with details and commentary describing all the characteristics of the equipment in the network architecture.

Examination No. 2: seeking improvements in control systems
An onsite equipment survey will highlight solutions to optimise the protection and control systems for substations.

The survey inspections provide an analysis of operations, technical feasibility and the appropriateness of the installed control systems.

At the conclusion of these inspections any site weaknesses are identified, highlighting the improvements to be made to find the best technological solution.

DYNAMIC STABILITY ANALYSIS

Estimate the risks of damaging the rotating machines (alternators and motors) through losses of synchronism, swinging or insufficient damping and validate the regulating parameters of the machines and maximum tripping time of the protection relays.

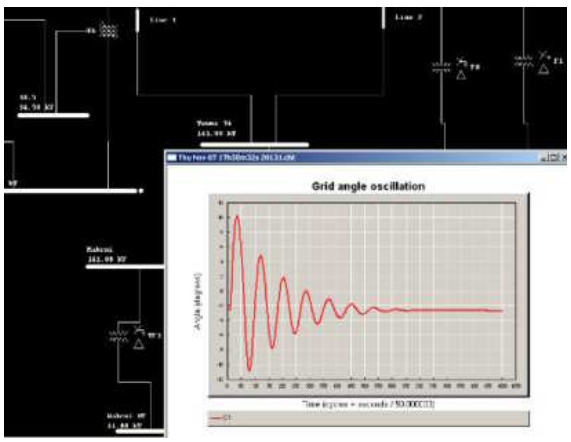
Simulations and analysis enable solutions for:

- Limiting voltage and frequency variations in time by specifying load shedding automatisms
- Protecting the rotating machines
- Limiting operating losses and avoiding risks of blackouts

Methodology
Some events can cause transient instability. These can be the appearance of an electrical fault, a modification of the network configuration, switching in island operating mode, starting of large motors, etc. The instability may involve large fluctuations in frequency and voltage (major risks of blackouts) and mechanical constraints that could damage the drive shafts of the rotating machines.

Items included in the analysis
The analysis is carried out using PSAF-STAB software, acknowledged worldwide and used by many research and engineering specialists. The analysis report includes the following:

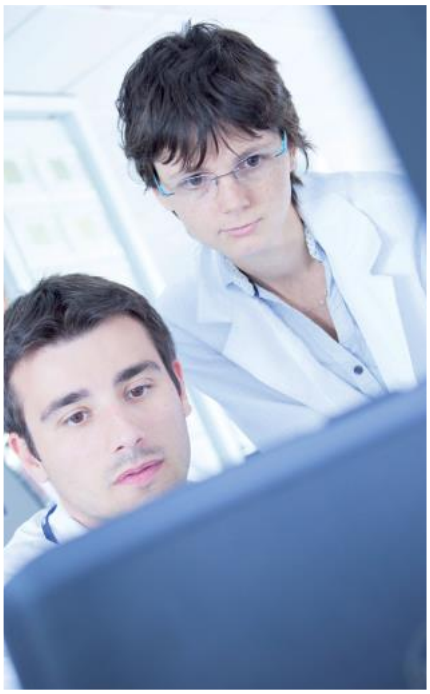
- A summary of all data and the assumptions used for the analysis
- The collection of the technical data needed to execute the analysis is based on a document that is sent to the customer on receipt of the order
- The curves indicating the evolution of parameters (voltage, current, power, etc.)
- A detailed technical note commenting on the results of the simulations and curves, explaining the technical and economic choices to improve network stability and highlighting the technical challenges



Network stability study

NETWORK TRAINING

We provide training sessions to transmit theoretical knowledge (at novice, advanced or expert levels) in a variety of fields: operations, maintenance and protection



The themes covered in the network training offer include:

- Choosing the right methodology and protection for MV/HV networks
- Choosing the right methodology and digital control system for substations
- Communications protocols (IEC 61850, etc.)
- Topology for MV/HV networks
- Calculating methods for fault current
- Neutral specification methods
- Measurement reducers specification methods
- Co-ordination analysis
- Stability analysis
- Network simulation software

Grid Automation Technical Institutes provide a wide range of high-level professional training courses in the domain of protection and digital control systems. For detailed information:

- Global Grid Automation training offer - refer to the online training catalog http://viewer.zmags.com/publication/a038b7ab#/a038b7ab/1
- Customized training sessions (content, duration and location) tailored to customers' specific needs

The training sessions can be delivered:

- At Grid Automation premises
- At your site

With its long term vision, Grid Automation provides a large range of dedicated courses to help you maintain high levels of operational skills and expertise

KEY REFERENCES

Electrical utilities transmission and distribution

COUNTRY	PROJECT/CUSTOMER	DESCRIPTION	STUDIES/DELIVERIES
Saudi Arabia	GCCIA	400 kV transmission network - interconnecting substations	HV network interconnection, protection plan
New Caledonia	SAGEES	33 kV/20 kV/15 kV/11 kV distribution networks	Short-circuit, measurement transformers specification, selectivity
Singapore	Pulau Sakra		
Vietnam	Than Hoa		
Chile	Ingedesa Encuentro		
Brazil	ITA Electrosul		
Senegal	SENELEC		
Nigeria	NEPA		
Guinea	Garafiri Enelgui		
Gabon	Owendo		
Ghana	Accra Ghana, Elubo Essiama, Ahafo		
Benin	Onigbolo, Sakete, Maria Gléta		
Ethiopia	Efacec, EEPCO	33 kV/15 kV distribution network 400 kV/220 kV /132 kV/66 kV transmission networks, transformation substations	Short-circuit, power balance, power balance improvement, selectivity, harmonics, transient stability, contingence study, network planification for 2015
Cameroon	AES SONEL	Complete network - south & north (distribution 30 kV/ 15 kV, transmission 225 kV/110 kV/90 kV, transformation substations, production)	Short- circuit, power balance, power balance improvement, selectivity, transient stability, shedding, networks planification, proposal for electrical control organisation
Mali	Manantali	30 kV distribution network, 225 kV/90 kV transmission network, transformation substations	Measurement transformers specification, selectivity, validation of the protection plan
France	Régie de Chartres, EDF PEI, PCCN Trévins, Neuf Brisach, Electricité de Mayotte	15 kV/20 kV distribution network, 63/20 kV or 90/20 kV source substations, impedent earthing and/or Petersen coil, earthing (MALTEN)	Short-circuit, selectivity
Switzerland	SI Moutier	16 kV distribution network	Short-circuit, selectivity
Italy	Sicily - Malta interconnection	Sicily - Malta 230 kV underwater cable	Selectivity study, CT-VT calculation

GRID SOLUTIONS' NETWORK EXPERTISE TEAMS

The network expertise teams ambition is to be the preferred partner of utility customers by providing a broad range of solutions aimed at optimizing the lifecycle performance of electricity infrastructures and therefore helping improve business.

The Grid Automation Expertise Centers worldwide provide:

- Skilled and experienced engineering teams
- Considerable expertise to evaluate and audit medium, high and very high voltage electrical networks
- A broad palette of solutions to improve the quality and reliability of networks and to optimise systems protection, control and operations
- The Grid Automation Expertise Centers are located in Sao Paolo (Brazil), Stafford (United Kindom), Montpellier (France), Dubai (UAE) and Chennai (India).

The Grid Automation network expertise teams: Know-how and expertise at your service

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