AN 19-32-H860

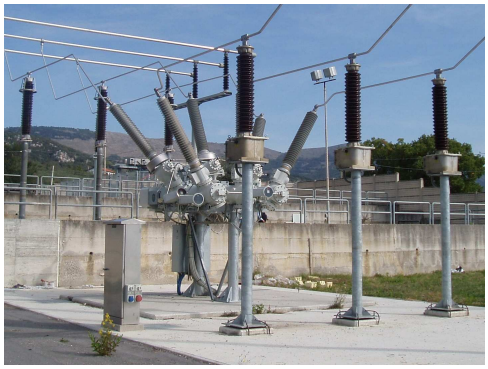
GE Multilin
Value Added Reseller

Application-note

ECS (Electric & Protection Control System) with Load Sharing & Load Shedding Logic for SONATRACH 120 MW POWER PLANT in ALRAR - ALGERIA

Gas Treatment power plant

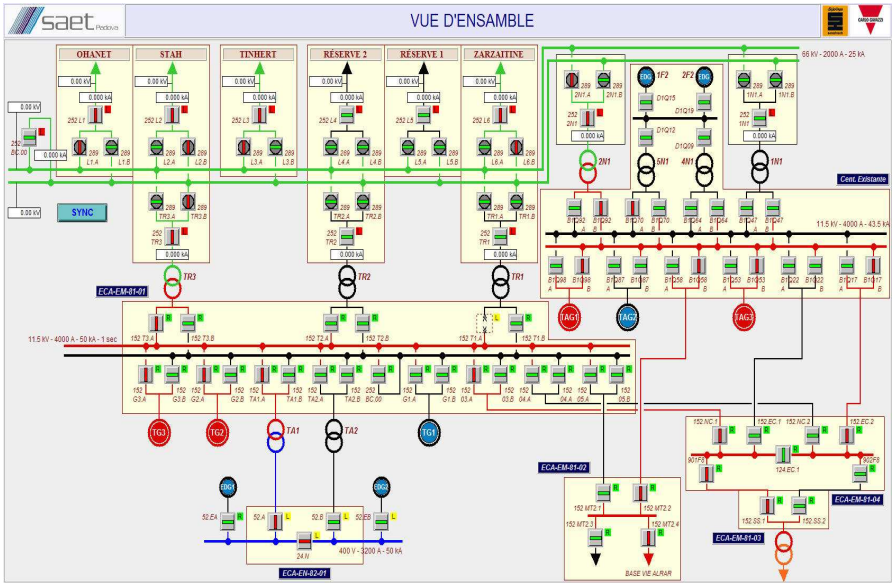
Protection Control & Measuring System



Pass modules in 66 kV Substation

The EPC contract awarded to Consortium Bonatti-Gavazzi is concerning the upgrade to 120 MW of the electric power plant at SONATRACH Gas Treatment installation of Alrar (South-Eastern Algeria).Three new General Electric TurboGenerators (20MW each) will be added to the existing ones for a total of 6x TurboGenerators (120MW), fed by the gas itself of the ALRAR installation and connected to the distribution grid through a 66 KV HV Substation. SAET, Italian VAR (value added reseller) of General Electric Multilin, provides the ECS (Electric Control System) and PCS&ESD (Process Control & Emergency Shut Down) as a turn-key system.

ECS – Electric&Protection Control System. ECS monitors & controls through Load Sharing & Load Shedding logics the whole HV-MV-LV generation & distribution system and is mainly based on a distributed architecture of GE Multilin Protection IEDs (Intelligent Electronic Devices), a redundant GE Fanuc PLC system and 3x SCADA workstations linked together by a redundant fiber optic LAN running a TCP-IP IEC 61850 Protocol. Moreover, a SCADA system allows for the parametrisation, supervision and control of all the equipments. The ECS-LAN includes protection IEDs of the new Generators (TG1,TG2,TG3), protection IEDs and BCUs (Bay Control Unit) of the HV 66 kV Substation (double busbar) and ModBus RS485 interface to the existing Generators (TGa-TGb-TGc), MV-11,5 KV and LV cubicles, UPS and DC sources. The ECS is charged to provide: frequence & voltage regulation of the distribution grid; active & reactive load sharing among the TurboGenerators; load shedding in emergency conditions to keep stable the grid.



Operator screen for 120 MW Power Plant Control

Grid configuration detection. The distribution grid may be configured in two different ways, as an unique island or as two separate islands: ECS monitors and detects the grid configuration and its active Turbogenerators.

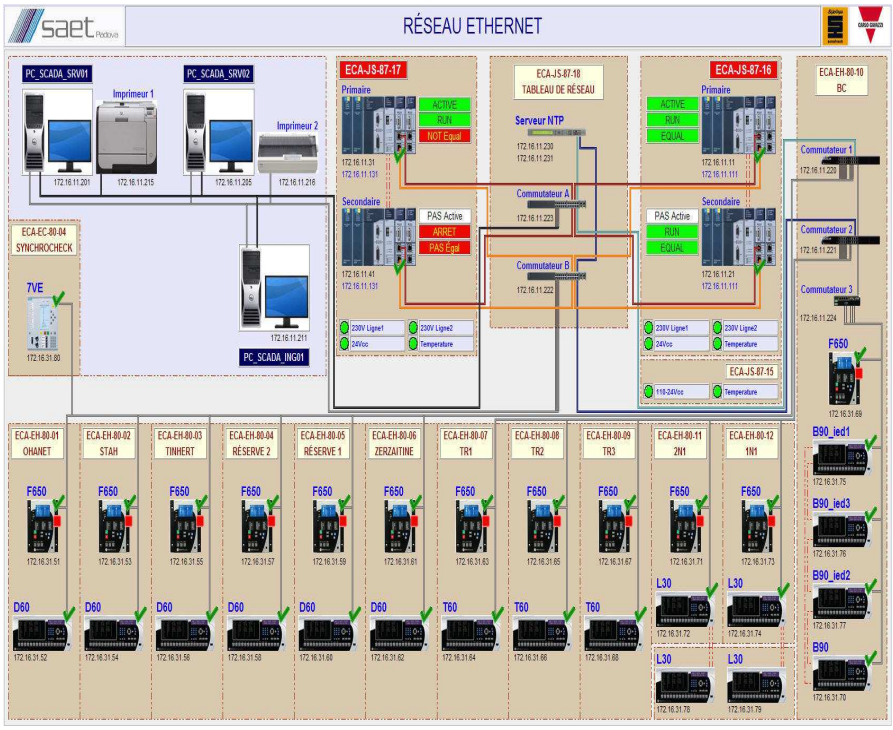
Frequency secondary regulation. ECS detects any frequency slipping out of tolerance and regulates the power sent to the turbines by acting on their speed governors. It calculates for each generator the extra-power (positive or negative) to be generated to compensate the frequency slipping and sends a suitable increase or decrease signal to its speed governor.

Should the extra-power bring the turbogenerator to its limit working conditions, ECS sends an alarm to the operators before activating the Load Shedding logic.

Active power Load Sharing. In order to keep the load percentually balanced among sevaral generators, ECS monitors the difference between the average loading factor (Active Power generated vs Active Power nominal value) of the entire island and the current loading factor of each generator. Whenever this difference (positive or negative) is out of tolerance, ECS sends a suitable increase or decrease power signal to the speed governor of each generator. ECS controlling actions on the speed governor due to the Frequency secondary regulation and to the Active power Load Sharing, might be opposites in some instances (e.g. frequency regulation asking for a power increase and the load sharing for a decrease) so ECS will always send to the speed governor their algebric sum.

Voltage secondary regulation. ECS monitors any voltage slipping out of tolerance and regulates the reactive power generated by acting on the excitation circuit of the generators. It calculates for each generator the extra-reactive power (positive or negative) to compensate the voltage slipping and sends a suitable increase or decrease signal to its excitation circuit. Should the extra-reactive power bring the turbogenerator out of its working range, an alarm is sent to the operators.

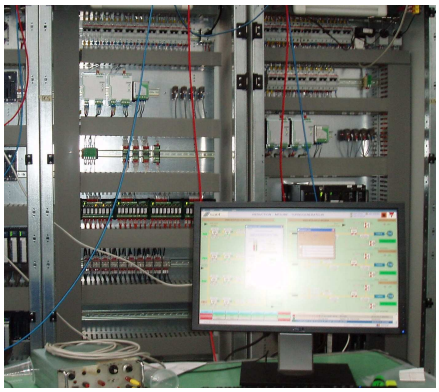
Reactive power Load Sharing. In order to keep the load percentually balanced among sevaral generators, ECS monitors the difference between the average reactive loading factor (Reactive Power generated vs Reactive Power nominal value) of the entire island and the current reactive loading factor of each generator. Whenever this difference (positive or negative) goes out of tolerance, ECS sends a suitable increase or decrease reactive power signal to the excitation circuit of each generator. ECS controlling actions on the excitation circuit due to the Voltage secondary regulation and to the Reactive power Load Sharing, could be opposites in some instances (e.g. voltage regulation asking for a reactive power increase and the reactive power load sharing for a decrease) so ECS will always send to the excitation circuit their algebric sum.



System Architecture

Load Shedding Logic. ECS is preventing through the Load Shedding logic any frequency instability of the grid whenever it takes place a condition of power required by the load greather than the power generated and the Frequency Secondary Regulation is not effective in compensating the frequency slipping as one or more generators are close to their limit working conditions. In such a situation, ECS activates the Load Shedding logic to take off some loads defined as <sheddable> with two different priority levels. Any frequency instability is therefore prevented by the ECS through three steps: a first alarm condition and activation of Frequency secondary regulation logic, a second step activation of Level 1 load shedding and a third step activation of Level 2 load shedding.

PCS&ESD - Process Control & Emergency Shut Down system. A couple of GE Fanuc PLCs in redundant configuration is taking care of the PCS&ESD system. PCS is mainly charged to control pressure & temperature of the gaz feeding the generators, the gaz filtering unit, the pressured air unit and the gaz emptying of generators when stopped. ESD is dedicated to the emergency shut down sequences to guarantee a safe and selective interruption mainly in case of fire and faulty conditions of the gaz treatment unit. Electrical and Process sections are both integrated through the TCP/IP network and operated at the SCADA workstations.



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