



TECHNICAL OFFER TO

TURBOENERGY POWER SRL

for the

Three Excitation Systems (SEE) Replacement

at the

CET 1 Chisinau, Moldova



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

1. PROJECT OVERVIEW	2
2. BILL OF MATERIAL	5
2.1. Static Excitation Equipment	5
2.2. Spares Parts.....	9
3. EXCITATION SYSTEM OVERVIEW	10
3.1. Retrofit Advantages with Ovation DEC	11
3.2. Controllers configuration – main control components	13
3.3. Ovation General Architecture: Fully Integrated with Ovation.....	14
5. OVATION DOCUMENTATION.....	20
6. FAT	21
7. START UP AND COMMISSIONING SERVICES.....	22
7.1. Start up and commissioning services.....	22
8. HOT COMMISSIONING LOAD TIMES	23
9. TRAINING	24
10. PROJECT MANAGEMENT.....	25
10.1. General.....	27
10.2. Applicable Standards	27
11. GUARANTEES	28



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

1. PROJECT OVERVIEW

Emerson Automation Solutions (Emerson) makes this proposal to TURBOENERGY POWER SRL for supply of services, equipment and materials for the Three Static Excitation Equipment (SEE) at the CET - 1 Chisinau in Moldova.

The offered solution is for the front-end replacement of the Static Excitation Equipment (SEE) at the CET - 1 Chisinau in Moldova.

Emerson will provide complete services for design, manufacturing, testing, supply, installation and supervision, start-up, commissioning and Grid Code Compliance testing for Static Excitation System upgrade according to the technical requirements.

The offer is prepared based on documentation provided by TURBOENERGY POWER SRL in the request for quotation.

Scope of deliveries:

- Static Excitation front end replacement.
- Documentation and design of delivered equipment.
- PSS Stability Study.

The scope of services offered by Emerson includes:

- Site review and analysis by the Emerson project team,
- Project management and project engineering,
- Factory Acceptance Test,
- Packing and transport to the Site,
- Installation and supervision,
- Site Acceptance test,
- Cold commissioning,
- Hot Commissioning,
- System Tuning (including PSS),
- Assistance to grid compliance test,
- Operator Training.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

Exceptions (out of the offered scope):

- Other than described in this offer,

Limits of supply:

- For system powering: power terminals in modified panels,
- For system grounding: grounding points in modified panels,
- For connections to existing field equipment (measuring, CTs, VTs etc.): The limits are terminals in Emerson system cabinets on the IO modules.

It is assumed that:

- The project will be executed in close co-operation between the Emerson and Customer to ensure maximum quality and acceptance.
- At the moment of starting with the assembly works Customer shall hand over the proper documentation enabling Emerson to perform offered scope of works. Both parties will follow and respect the: “hardware cut-off date” for implementation of changes in delivered hardware and “software cut-off date” for changes in application software developed by Emerson for the Project.
- At the moment of starting with erection supervision works on site Customer shall make the working area fully available. In the case that it fails to provide the above, Emerson reserves a right to change the schedule or/and prices.
- During the kickoff meeting, the Project Schedule will be finalized, and the System Hardware and Application Software Freeze Dates will be established. Any hardware and/or software change, requested after the applicable freeze date, may represent additional scope of supply, and result in a contractual change (delivery schedule and/or price).
- In case of different scenario this bid requires revision in terms of technical solution and price.
- If any cable will require replacement due to its bad condition, works related to such replacement will be subject of separate order.
- For Emerson staff customer will provide on-site:
 - Contractor's room, including furniture, office equipment and supplies,
 - Sanitation access,
 - Telephone and internet connections,
 - Safety, Safety Equipment, and First Aid (materials, equipment, on-site training) free of charge.
- If any more than offered Emerson activities will be needed or project duration will extend due to factors not related to Emerson, Emerson will charge Customer basing on man-day rates.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

Work Order:

See below preliminary work order for the job:

1. Design based on site survey and documentation received from the Customer,
2. Cabinets or mounting plates assembly ended with FAT,
3. Delivery to site,
4. Installation,
5. Test and start-up of provided solution,
6. Training
7. Final documentation.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

2. BILL OF MATERIAL

2.1. Static Excitation Equipment

Ovation Controllers to be installed in the existing SEE cabinet.

The offer includes Ovation Controllers with:

- 24 VDC power supplies,
- Redundant CPUs with 128 MB flash memory + 256 MB RAM,
- dual-attach Network Interface Card (making 4 lines of network interface per controller),
- local I/O Interface to Ovation R-Line modules,
- I/O modules defined by type and quantity.

Table 2.1 OVATION Controller

Item	Description	Quantity		
		Unit 1	Unit 2	Unit 3
A	Ovation redundant controller	1	1	1



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

Ovation DCS Input / Output and Communication Modules to be installed in the SEE cabinet.

Table 2.2 OVATION DCS Input / output modules

Item	Module Type	Description	Quantity		
			Unit 1	Unit 2	Unit 3
A	Analog HART Input	8-channel HART High Performance Analog Input (4-20mA) Local or Remote Power Supply, A/D16 bits resolution, channel ↔ channel and channel ↔ system galvanic isolation 1000 VAC/VDC for one minute	2	2	2
B	Analog HART Output	8-channel HART High Performance Analog Output (4-20mA) Local or Remote Power Supply, A/D16 bits resolution, channel ↔ channel and channel ↔ system galvanic isolation 1000 VAC/VDC for one minute	2	2	2
C	Digital Input SOE	16-channel Compact 24/48VDC SOE Single-ended digital input, dry-contact, channel ↔ individually fused	4	4	4
D	Digital Output	16 - channels of 24 VDC High-Side single-ended Digital Output switching	3	3	3
E	Redundant Analog Output	Two 4-20 mA analog output modules. Each analog output module provides 4 - individually isolated 4-20 mA analog output channels capable of driving up to a 750 Ω load.	2	2	2
F	DEC (AVR)	Module Assy (Wide) Digital Excitation Controller +/-10v Analog Output	2	2	2
G	PT Panel	Module Assy, Digital Excitation PT Panel	2	2	2
H	CT Panel	Module Assy, Digital Excitation CT Transducer Panel	1	1	1
I	ELC	Ethernet Link Connection Module (Modbus TCP)	1	1	1
J	Relays	DO Relays	35	35	35

Environmental conditions for DCS system hardware:

Local Controller and I/O Cabinet:

- Operating Temperature - 0-50°C
- Non condensing Relative Humidity - 0-95%

Notes:

Ovation system may be also equipped with additional communication modules to integrate data from 3-rd party systems using most popular industrial communication protocols: Modbus TCP/IP, Modbus RTU,



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

IEC 60870-5-104, Profibus DP/PA, Foundation Fieldbus, DNP 3, IEC61850, IEC61870, ICCP, ODBC, DDE, SDTRP, OPTO 22, Nepac, Allen-Bradley PLC, GSM, GE Mark V & VI and others.

Other Equipment to be installed in the SEE cabinet.

Table 2.3 Other Equipment for SEE

Item	Description	Quantity		
		Unit 1	Unit 2	Unit 3
A	Knick current transducers	6	6	6
B	Knick voltage transducers	2	2	2
C	SL-12 with pulse transformer and rectifier	4	4	4
D	Excitation mounting plate	1	1	1
E	Crowbar	1	1	1

OVATION NETWORK EQUIPMENT

Table 2.4 Network Equipment

Item	Description	Quantity		
		Unit 1	Unit 2	Unit 3
A	Cisco Industrial Ethernet Switch Installed in the SEE cabinet	2	2	2



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
 PWRO2420051
 Revision 00

USER INTERFACE EQUIPMENT (HMI)

Table 2.5 OVATION Workstation

Item	Description	Quantity		
		Unit 1	Unit 2	Unit 3
A	Database/ Historian/ Engineering /Operator/ Antivirus Server Workstation with: 1 – PANEL MOUNT PC, 15” DISPLAY Installed on the SEE cabinet	1	-	-
B	Operator Workstation with: 1 – PANEL MOUNT PC, 15” DISPLAY Installed on the SEE cabinet	-	1	1
C	Laptop	1	-	-

SOFTWARE AND LICENCES

Table 2.6 OVATION System Software Licenses

Item	Description	Quantity		
		Unit 1	Unit 2	Unit 3
A	Database Server Station Software (License includes Engineer and System Administrator tools for Ovation system)	1	-	-
B	Ovation Historian Software License is for 10,000 points.	1	-	-
C	Engineering Workstation Software (License includes Engineer and System Administrator tools for Ovation system)	1	-	-
D	Operator Workstation Software (all Ovation workstation are equipped with operator software)	1	1	1
E	Windows Server license (for Database Server)	1	-	-
F	Windows license (for Operator Station)	-	1	1
G	Trellix Antivirus Antivirus software for Ovation workstations	1	1	1



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
 PWRO2420051
 Revision 00

H	VxWorks – Ovation Redundant Controller Operating System (RTOS – Real Time Operating System, single license is covering one controller)	1	1	1
I	Ethernet Link Connection Module (Modbus TCP)	1	1	1

2.2. Spares Parts

Table 2.7 OVATION Spare Parts

Item	Description	Quantity
A	Analog HART Input	1
B	Analog HART Output	1
C	Digital Input SOE	2
D	Digital Output	1
E	Redundant Analog Output	1
F	DEC (AVR)	1
G	PT Panel	1
H	CT Panel	1
I	ELC	1
J	Voltage Transducer	2
K	Current Transducer	1
L	SL-12	1
M	Crowbar Controller	1



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

3. EXCITATION SYSTEM OVERVIEW

Emerson’s Ovation excitation system offers precise excitation control for a broad range of synchronous generators. The system provides a highly flexible and reliable retrofit solution for most OEM excitation systems. It can be used to replace rotating, brushless or static excitation Systems ranging from 5A to more than 8,000A. The Ovation excitation system also provides an exceptional solution when applied as “Front End” replacement, where there is a desire or requirement to interface with the existing excitation power amplifiers, whether they are diode or SCR bridges.

The Ovation excitation system consists of Ovation controller(s) coupled with standard Ovation I/O modules, high speed excitation specific I/O modules and power electronics to drive the generator field. The high-speed excitation I/O module is equipped with a powerful processor executing Emerson’s exclusive excitation control application software as well as high speed analog and digital inputs and outputs to support the excitation application. The high-speed analog inputs monitor the generator voltage and current output via signals from the potential transformers (PT) and current transformers (CT). The excitation I/O module uses these signals to adjust the generator output voltage through fault tolerant SCR bridge rectifiers connected to the generator or rotating exciter field. The Ovation excitation application provides all the features and functions necessary for precise and predictable control of the synchronous machine under both normal and fault conditions.

In addition to the normal control actions identified above, the excitation module also monitors for abnormal conditions and takes definitive actions to protect the generator via limiters, forcing of manual operation and tripping the generator lockout.

In standard configurations the Ovation controller executes the start/stop logic, auxiliary logic and provides the base demand signal to the firing system while the Ovation excitation I/O module provides a high-speed trim signal that adjusts the excitation current. These two signals provide the overall demand to the SCR firing system which ultimately controls the DC output of the rectifiers to the generator field or rotating exciter. Typical excitation system applications also include an AC field breaker, voltage suppression, de-excitation control with discharge resistor, ground detection and field-flashing for generator voltage build-up support where needed.

All channels of the regulator and control loops (Auto, Manual) have tracking systems, and smoothly switch over.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

The inherent installation flexibility of the Ovation excitation system allows it to be panel or cabinet mounted. When coupled with the expertise of the Emerson excitation project team, it makes a perfect solution for a direct replacement of the existing excitation system.

3.1. Retrofit Advantages with Ovation DEC



- Seamless operator interface
- Enhanced alarms and diagnostics
- Historical trending of generator data to DCS
- Enhanced control options
- Eliminate third party protocols
- DCS Compatibility
- Adaptable to various bridge sizes
- Minimize spare parts inventory

Competitive Advantages of the Ovation DEC vs other OEM's

- Same hardware platform as other Ovation equipment
- Same service center with 24/7 support using local Emerson personnel in United Kingdom



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

- Can be installed into existing enclosures
- Redundant manual base adjusters
- Integrated PSS Software
- Project execution expertise
- Published product support policy
- Influential User's Group focused on Power Generation

Ovation DEC module



- QorIQ P1010 533 MHz Processor
- Integrated security engine
- On-board excitation control scheme
- Firmware downloads from Ovation Workstation
- Redundant Configuration available
- Control rate (2,560 Hz)
- I/O scan rate of 130uS (7,680 Hz)
- On-board high speed I/O channels
- PSS filter time constants down to 1 mS
- Oscillography at control loop speed
- 6 PT Channels
- 3 CT Channels
- 2 10/100 Ethernet Connections

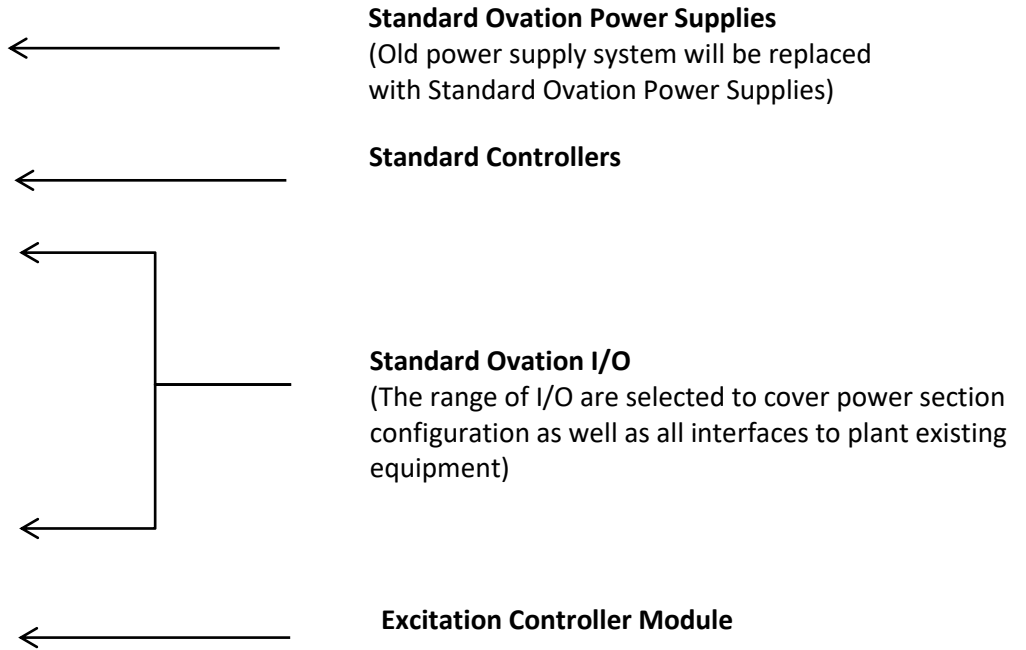


TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

3.2. Controllers configuration – main control components

Ovation DEC Control System Architecture



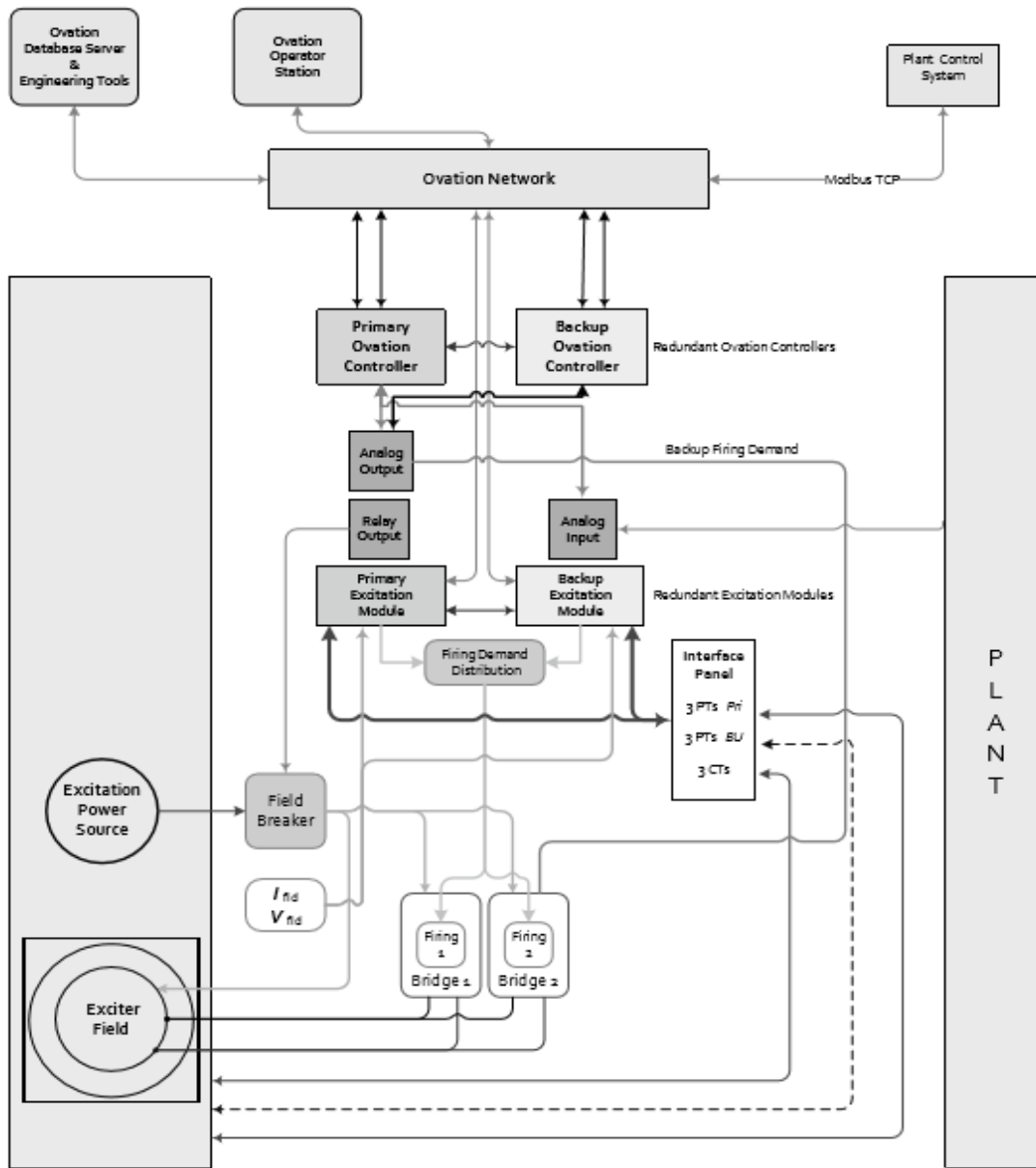


TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

3.3. Ovation General Architecture: Fully Integrated with Ovation

Operation modes



The block diagram above is generic one, project specific will contain DC Filed Breaker and 4 thyristor rectifiers.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

Each channel can operate in one of the following modes:

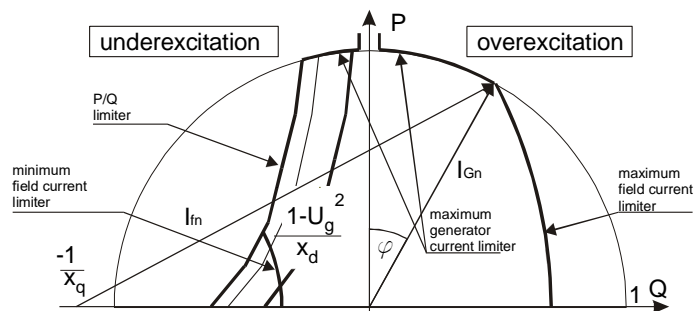
- Generator voltage control (automatic control mode) is used during normal operation of voltage regulation and thyristor firing. The actual measured value of the terminal voltage is compared with the set point value. The thyristor gate firing angle is changed accordingly to the difference between the two signals.
- Exciter field current control is mainly used for service and commissioning. In this mode field current regulation is performed. The actual value of field current is measured and compared with the reference value.
- Power factor control
- Generator reactive power control

Operating mode is selected by a mode switch from the DCS or control room.

Limiters

Philosophy of limitation:

- All the limiters have an actual value, which represents the value to be limited, and threshold, which represents the limiter operation point.
- When overexcitation limiter is not operating, the limiter output signal is set up to 100% level. When measuring value exceeds the threshold, the limiter output signal starts to decrease. When its output decreases below level of the main loop, the limiter causes deexcitation of the generator.
- When underexcitation limiter is operating, the limiter output signal starts to increase above zero. When its output exceeds the level of the main loop signal, the limiter causes excitation of the generator.



Typical power chat of a synchronous machine



Volts-per Hertz limiter

Volts-per Hertz limiter is used to protect the generator and step-up transformer from damage due to excessive magnetic flux resulting from low frequency and/or overvoltage. This limiter causes deexcitation of the generator in case of exceeding the limiter settings.

P/Q limiter

The P/Q limiter is intended to prevent reduction of generator excitation to a level where the small-signal stability limit of the stator core and region heating limit is exceeded.

The limiting curve can be defined by setting 5 reactive power values for the five levels of active power: $0.0P_n$, $0.2P_n$, $0.4P_n$, $0.6P_n$, $0.8P_n$, $1.0P_n$ where P_n corresponds to a nominal apparent power of the generator.

The limiting characteristic is also influenced by squared generator terminal voltage - an increase of voltage allows a higher power output.

Maximum field current limiter

The Field current limiter is designed to protect the generator from overheating due to the prolonged field overcurrent. This limiter limits the field current to two individually adjustable set-points.

The first limit determines the ceiling current of $2.0 \cdot I_{fn}$. Whenever necessary and without delay, the excitation current has to be kept at "maximum current limit" for a predetermined period and has to be then reduced to the thermal current limit following an inverse time characteristic. If, during limiter operation, there is a steep dip in the terminal voltage (dv/dt), the maximum current limit shall be released once again and field forcing can start again providing that the allowed energy I^2t is not exceeded.

Maximum generator current limiter

The generator current limiter controls the field current in order to keep the stator current below a set value and prevents the stator windings from thermal overload.

The actual value of this limiter is the absolute value of the stator current. When the machine is operating in the overexcitation region, the stator current limiter is working like an overexcitation limiter, and if the machine is operating in the under excitation region, the limiter is working like an under excitation limiter, changing the output sign.

The stator current limiter cannot influence the active current. If the value of the active current reaches the setpoint of the stator current limiter, the reactive power will be regulated to zero in order to avoid incorrect operation of the limiter.

Protections

The rotor temperature protection



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

The rotor temperature is monitored by the controller which calculates the temperature in the rotor field by its field current and field voltage. The algorithm for the evaluation takes into account: the voltage drops across the brushes and the specific resistance value of the field winding copper-material.

The loss of VT (voltage transformer) protection

The excitation system is performing a changeover to the second channel when a VT failure is detected.

The loss of field current measuring protection

The excitation system is performing a changeover to the automatic mode and disables the field current limiters if the failure is detected.

Field overcurrent

A two-stage generator field overcurrent protection detects the exceed of the field current in selected time. In the first step, the protection switches to the second channel if it exists, in the second step trip the unit.

Power System Stabilizer

The additional signal from the power system stabilizer function is added to the voltage regulator. The power system stabilizer is of type PSS2A, according to the IEEE421.1 standard. Oscillations of acceleration power and frequency is detected, processed and added to the AVR-control loop. With this sub-program, the active power oscillations are damped effectively.

FCR Mode control (manual control limit device)

While operating in FCR control mode, the Ovation Excitation System utilizes the Digital Excitation Controller to regulate generator field current. The system operator specifies a field current setpoint by using the FCR Mode Control faceplate (see the below figure). The excitation system compares the field current setpoint to the actual field current and sends a trim demand signal to the firing cards to adjust excitation accordingly. The operator setpoint is expressed in engineering units, Amps DC (ADC) and per unit (PU) notation where 1.0PU represents 'rated' field current. Generator reactive power output (MVAR) is displayed for operational convenience for when adjusting the field current setpoint. The field current setpoint is adjusted by selecting either the raise or lower action buttons. Many excitation systems impose a field current control window which must not be exceeded; generally, this is between 10% -110% of rated field current. Unlike AVR control mode, excitation limiters are not automatically enforced while operating in FCR control mode. During a limiter event, either of the setpoint adjust buttons may become disabled, preventing the operator setpoint from increasing into the limiting condition. The system operator must manually respond to the limiter action by either increasing or decreasing the FCR setpoint in order to clear



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

the limiter. After the limiter has cleared, the setpoint adjust button will be enabled. A complete description of excitation limiters is available in the Software and Alarming for Ovation Excitation user's manual. During FCR control mode, the AVR control loop automatically tracks generator terminal voltage ensuring a bumpless transfer into AVR control mode. While in FCR control mode, the manual controller "follows" the automatic trim signal and adjusts its own output to carry the excitation demand, keeping the output of the Ovation Excitation Module near zero during steady state operation. This also ensures a bumpless transfer into BASE control mode.

Integration to the Ovation Turbine Governor System and HMI

Emerson solution assumes integration to the existing Ovation Turbine Governor System through ELC card. That means monitoring and control of offered solution will be available from two places local HMI and operator station.

Base Mode Control

While operating in BASE control mode, the Ovation Excitation System utilizes the Ovation-integrated Manual Controller to regulate generator field current. The system operator specifies a field current setpoint by using the BASE Mode Control faceplate (see the below figure). The Ovation Excitation System compares the field current setpoint to the actual field current and sends a base demand signal to the firing cards to adjust excitation accordingly. The operator setpoint is expressed in engineering units of Amps DC (ADC). Generator reactive power output (MVAR) is displayed for operations convenience for when adjusting the field current setpoint. The field current setpoint is adjusted by selecting either the raise or lower action buttons. By default, there are no operator setpoint limitations when operating in BASE control mode. The operator must also be aware that the excitation limiters are not enabled when operating outside of AVR control mode. The system operator must manually respond to the limiter action by either increasing or decreasing the BASE mode setpoint in order to clear the limiter. A complete description of the excitation limiters is available in the Software and Alarming for Ovation Excitation user's manual. The Manual Controller receives field current feedback from two independent sources. The primary source is from a dedicated field current transducer referred to as 'XD4'. The backup source is the field current reading from the Digital Excitation Controller. In an event where the primary source is unavailable, the source will be declared invalid, and the Manual Controller will automatically use the backup source. The Manual Controller permits two modes of operation; manual and automatic. Manual control mode allows the operator to directly control the Manual Controller base demand output. The controller follow-up feature is disabled while operating in manual. Automatic control mode allows the operator to enter a field current setpoint to which the Manual Controller will provide closed-loop field current regulation. The controller follow-up feature is enabled while operating in automatic. The manual



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

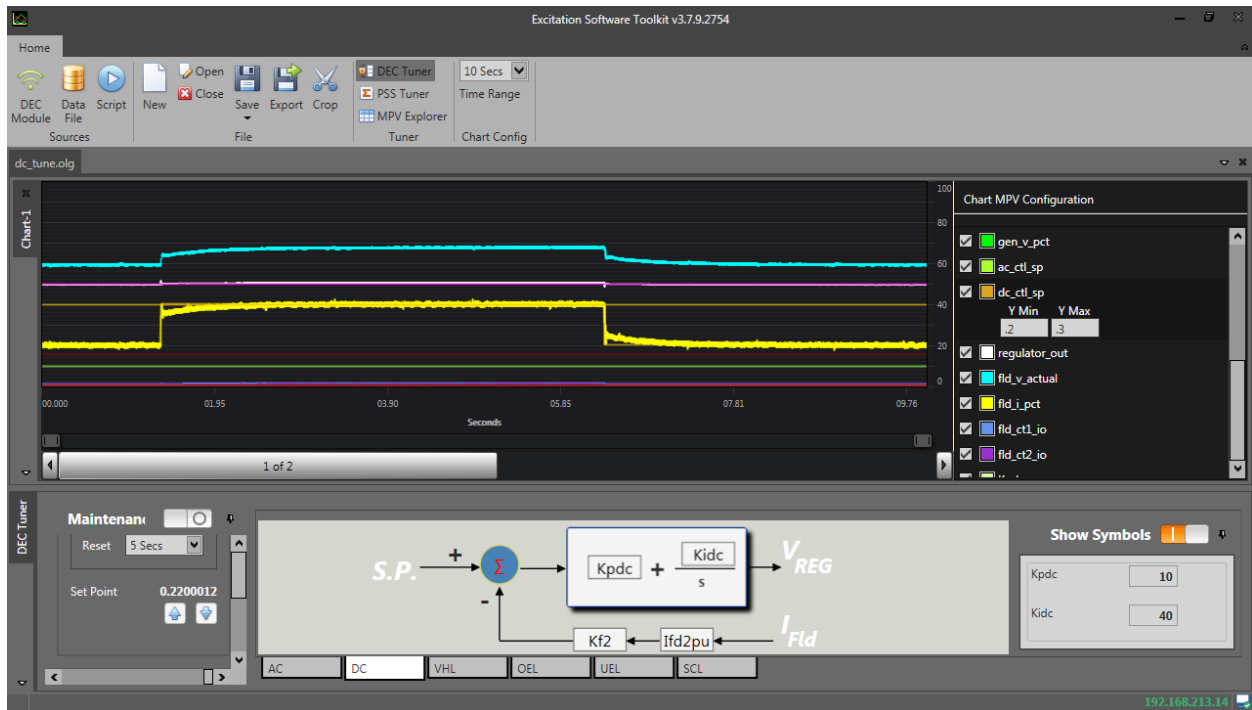
Technical Proposal
PWRO2420051
Revision 00

control mode should only be used during excitation system commissioning and is generally not available to system operators.

Step injection

Step injection facility is included and available for customer engineers in order to verify dynamic performance of SEE.

Step injection required connection of maintenance laptop directly to DEC module using the Excitation Software toolkit – included in scope of delivery.



Picture above is presenting the screenshot from Excitation toolkit used for step response test.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

5. OVATION DOCUMENTATION

Engineering Drawings

A CDROM containing a single set of engineering drawings will be provided with the project. Included in the drawings will be both standard system drawings and project specific drawings. As a part of the executed project the following part of design are foreseen for AVR (with implementation of the existing drawings)

- basic design,
- detailed design
- as built

In addition to above the following documentation will be provided:

- Organization chart of the executed project
- Schematic diagrams
- Bloc diagram including PSS stability study
- Disassembly drawings
- Assembly drawings
- Operation and Maintenance Manual
- Factory Test Report and Manufacturer Declaration
- Commissioning Procedure

Peripheral Equipment

Emerson will provide a CDROM that contains available peripheral documentation in PDF format. Any third-party vendor documentation received with the equipment will be shipped to you with the original third-party packaging.

User Guides

The CD library, termed SmartDocs, provides manuals in html format for easy searching and electronic viewing, while also providing manuals in PDF format for download and print.

In addition, Emerson provides free access to the online SmartDocs library, a comprehensive library of all Power & Water Solutions' user documentation including the most up-to-date manual releases plus all manual updates. The online SmartDocs library provides manuals in html and PDF and offers an online ordering capability so you can order hard copy versions of a manual.

Scope of project documentation will be created according to Technical Requirements by the Contract Agreement. The documentation will be in English as well as the HMI graphics.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

6. FAT

For Emerson and for Customer, the Factory Acceptance Test (FAT) is an important milestone of the project. FAT demonstrates the operation of delivered equipment as Ovation Excitation and provides verification of the application being supplied.

FAT is executed before the final installation to discover any potential issues prior to installation and to make sure that equipment operates as intended. This reduces costly outage delays and rework. Moreover, FAT increase customer's confidence that the provided system can be implemented without any discrepancies and will function per the customer's requirements.

Emerson assumes FAT in Poland with possibility of Customer engineer's attendance.

FAT duration, for one unit:

- AVR – 2 days



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

7. START UP AND COMMISSIONING SERVICES

Field service engineering includes the following activities:

- Site Management,
- Site Acceptance Tests (SAT),
- Start-Up and Hot Commissioning,
- Systems taken over.

7.1. Start up and commissioning services

Based on the received RFQ Emerson assumed and included in the offer and its price on-site services for implementation of the project.

The exact and final amount of onsite services man days needed will be defined after the site survey and final customer requirements.

Man-hours calculation of supply included in the price is based on required Time Schedule.

The offered on-site engineering services are calculated using week-day rates, without overtime. Weekends and holidays are not included and shall be paid separately if work on these days is required.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

8. HOT COMMISSIONING LOAD TIMES

Step	Time	Units	MW		Percent Load - MW		Description
			Minimum	Maximum	Minimum	Maximum	
A. Pre-test: Exciter Shutdown							
A.1	15	Min	0,0	0,0	0%	0%	Pre-test exciter shut down
A.2	30	Min	0,0	0,0	0%	0%	Configure and check initial PSS and AVR tuning settings
A.3	15	Min	0,0	0,0	0%	0%	Connect and configure field voltage isolation transducer
A.4	15	Min	0,0	0,0	0%	0%	Configure Manual Controller and DEC for safe starting values
A.5		Min	0,0	0,0	0%	0%	If required perform DEC firmware upgrade. (Additional 1 hour required - not expected at this time)
Total Time	75	Min					
B. Steady-state Measurements: Full Speed, No Load, Breaker Open							
B.1	0	Min	0,0	0,0	0%	0%	Turbine at rated speed; field breaker closed; generator breaker open
B.2	5	Min	0,0	0,0	0%	0%	Flash the field in DC control (Static only)
B.3	30	Min	0,0	0,0	0%	0%	Tune DC controller for offline operation
B.4	30	Min	0,0	0,0	0%	0%	Tune manual controller for offline operation
B.5	30	Min	0,0	0,0	0%	0%	Tune AC controller for offline operation
B.6	5	Min	0,0	0,0	0%	0%	Flash the field in AC control (Static only)
B.9	15	Min	0,0	0,0	0%	0%	Calibrate generator PT signals
B.10	5	Min	0,0	0,0	0%	0%	Perform offline 2% step response tests
B.11	5	Min	0,0	0,0	0%	0%	Perform offline ceiling voltage tests
B.12	15	Min	0,0	0,0	0%	0%	Perform offline V/Hz tests
B.13	30	Min	0,0	0,0	0%	0%	HOLD POINT for results verification on step response and V/Hz
Total Time	170	Min					
C. On-line Measurements: Breaker Closed, Minimum Load (Less than 10%)							
C.1	0	Min	0,0	0,0	3%	10%	Sync to grid, achieve minimum MW load
C.2	5	Min	0,0	0,0	3%	10%	Tune manual controller for field current control
C.3	5	Min	0,0	0,0	3%	10%	Perform online 2% step response tests
C.4	5	Min	0,0	0,0	3%	10%	Take low-load CT calibration measurement
C.6	30	Min	0,0	0,0	3%	10%	Perform online frequency response tests
C.7	30	Min	0,0	0,0	3%	10%	HOLD POINT for results verification on step & frequency response
C.8	15	Min	0,0	0,0	3%	10%	Capture reactive capability (if required)
C.10	30	Min	0,0	0,0	10%	15%	HOLD POINT for results verification on partial load rejection
C.11	5	Min	0,0	0,0	10%	15%	Enter PSS tuning data
Total Time	125	Min					
D. Unit Online, Partial to Full Load							
D.1	30	Min	0,0	0,0	50%	70%	Perform PSS gain margin tests (2% steps a ~60% load)
D.2	30	Min	0,0	0,0	50%	70%	HOLD POINT for results on gain margin
D.5	15	Min	0,0	0,0	50%	70%	Tune OEL step response
D.6	0	Min	0,0	0,0	50%	70%	Perform OEL instantaneous limiter tests - if required
D.7	30	Min	0,0	0,0	50%	70%	Tune UEL step response
D.8	15	Min	0,0	0,0	70%	75%	Take high-load CT calibration measurement
D.9	15	Min	0,0	0,0	70%	75%	Calibrate generator phase angles
D.10	15	Min	0,0	0,0	70%	75%	Capture reactive capability (if required)
D.12	15	Min	0,0	0,0	95%	100%	Perform gain limit margin tests (2% steps at full load)
D.13	30	Min	0,0	0,0	95%	100%	HOLD POINT for results verification on Final Step response
D.14	15	Min	0,0	0,0	95%	100%	Capture reactive capability (if required)
D.15	15	Min	0,0	0,0	95%	100%	Perform UEL step tests - Unity Pf
Total Time	230	Min					
E. Testing Complete							
E.1	15	Min	0,0	0,0	0%	0%	Disconnect test equipment
E.2	15	Min	0,0	0,0	0%	0%	Collect all device settings
Total Time	30	Min					



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

9. TRAINING

Emerson is offering one session of training for operators.

2 days for training will take place on-site. Up to 10 participants are foreseen for training session.

For the training purposes delivered equipment will be utilized.

The program scope will cover design concept, commissioning procedures, operating instructions and fault finding on the new equipment.

Training will be maintained during the onsite works before commissioning, so no additional travel costs are included in the offer.

The training will be in English language.



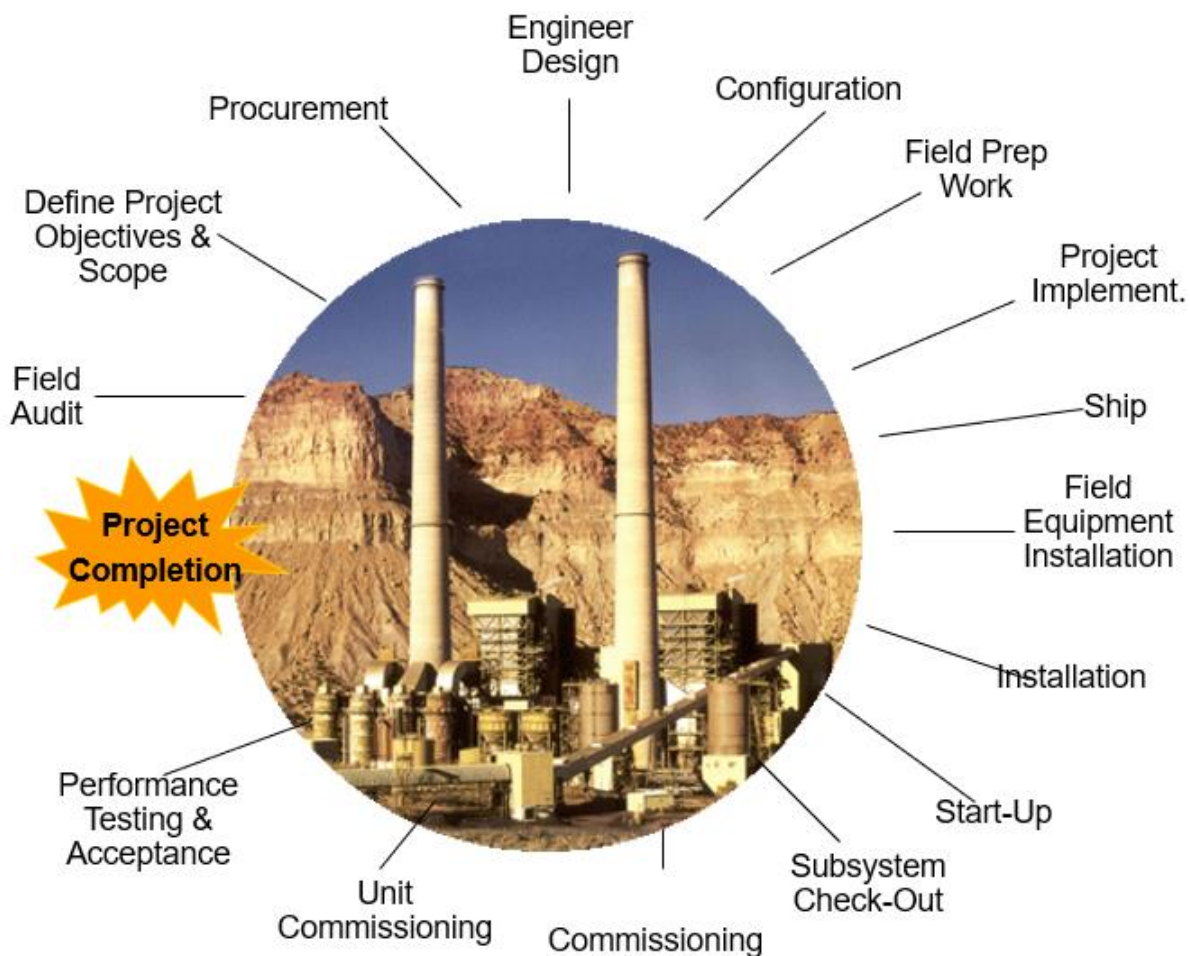
TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

10. PROJECT MANAGEMENT

A key factor in the success of any project is experienced Project Management. For the AVR, Protection, LAVT & NGT and DC starter System Project., Emerson has included time for an experienced person to plan, control, monitor and report the status of the overall project.

During the kickoff meeting, the Project Schedule will be finalized. System Hardware and Control Philosophy Freeze Dates will be established.





TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

Emerson will perform the following project management functions:

Item	Description
A	<p>Project Kickoff Meeting</p> <p>The Emerson Project Manager will conduct a project kick-off meeting with Customer, at Purchaser's Site within one month after receiving purchase order.</p> <p>Subjects to be covered in the meeting include:</p> <ul style="list-style-type: none"> • Project Plan • Commercial Issues • Project Schedule • System Hardware and Application Software • Drawings and Documentation
B	<p>System Configuration and Hardware Manufacturing Schedule</p> <p>The proposed system configuration and project schedule included in the offer book will be finalized during the kickoff meeting. Emerson will perform the system manufacturing according to the hardware-manufacturing schedule.</p>
C	<p>Project Schedule</p> <p>With Customer input, the Emerson project engineer will develop a detailed project schedule and keep it updated as a tool for management and tracking. Project reporting will originate from the project engineer. Progress reports will be provided monthly through the project. The reports will address the status of the project development against milestones as defined in the project schedule. All changes in project scope, schedule, and/or status will be documented at this time.</p>
D	<p>Contract administration and monthly status reports</p>
E	<p>Factory Acceptance Test (FAT) with the customer project team:</p> <p>FAT shall be carried out as per the approved test procedure of Emerson.</p> <p>Duration – 2 days</p> <p>Location: (to be discussed)</p> <p>Remark: The travelling and accommodation of customer shall be out of Emerson's scope.</p>
F	<p>Project Documentation</p>
G	<p>Warranty – as per the commercial offer.</p> <p>After sales service shall be provided by the certified engineer.</p>
H	<p>System Shipment</p> <p>Upon completion of acceptance testing, Emerson will ready Project hardware, software and documentation for shipment to the site.</p> <p>Delivery at Site:6 months from date of customer purchase order</p> <p>Please refer a project schedule.</p>
I	<p>Overall Project Follow Up</p> <p>The Emerson Project Engineer will provide overall project follow up to ensure that the project is executed according to the agreed scope and schedule.</p>



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

10.1. General

The Factory and Acceptance Test (FAT) plan provided by the supplier will indicate all inspections and tests to be performed with the specified equipment. The FAT will refer to the applicable inspection and test instruction.

The client has the right to witness the FAT. They are granted access to the supplier's facility, while all tests or inspections are being performed there.

10.2. Applicable Standards

Standards includes, but is not limited to:

- Waste Electrical and Electronic Equipment Directive (WEEE Directive)
- Electrical Equipment (Safety) Regulations (Low Voltage Directive 2006/95/EC)
- Electricity at Work Regulations
- Management of Health and Safety at Work Regulations
- Electromagnetic Compatibility Regulations (EMC Directive 2004/108/EC)
- Lifting Operations and Lifting Equipment Regulations (LOLER)
- Manual Handling Operations (MHO)
- Provision and Use of Work Equipment Regulations (PUWER) (Safe Use of Work Equipment Directive 89/655/EEC)
- Working at Height Regulations
- BS 7671 Requirements for electrical installations: 18th edition IEE wiring regulations
- HSE The Construction (Design and Management) Regulations 2007
- The Health & Safety at Work Act etc. 1974
- ISO 9001 Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing
- ISO 14001 Environmental management systems – Requirements with guidance for use
- EN ISO 9001:2008: International Standard - Quality Management Systems Requirements
- BS ISO 10005:1995 – Quality / Project Plan Guidelines
- IEC 61131-3:2003 - Standard for Programmable Controller Programming Languages
- BS EN 61508:2002 [all parts] - Functional safety of electrical / electronic / programmable electronic safety related systems (E/E/PES).
- BS EN 61511:2004 [all parts] - Functional Safety - Safety Instrumented Systems for The Process Industry sector.



TURBOENERGY POWER SRL
Three Excitation Systems (SEE)
Replacement
CET 1 Chisinau, Moldova

Technical Proposal
PWRO2420051
Revision 00

- Generation Safety rules, Electrical & Mechanical, 1st Edition
- COSHH Regulations
- DSEAR
- ATEX
- BS 6387 Specification for performance requirements for cables required to maintain circuit integrity under fire conditions
- BS 7430 Code of practice for Earthing

11.GUARANTEES

Emerson guarantees the product as a reliable and maintainable system.

End of document