Industrial Rectifiers and Power Converters: TR Unit Maintenance and Fault Analysis

1 – 5 March 2027
Barcelona - Eixample district four-star



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Introduction:

Industrial rectifiers and power converters feed electrolysis cells, plating lines, cathodic protection systems and DC plant buses, yet many sites run them until a thyristor stack fails, a fuse clears without explanation or a transformer-rectifier unit overheats under full load. This Core Concept course gives electrical and instrument staff a practical method to read converter topologies, check firing circuits, test semiconductor devices, commission units and trace faults with oscilloscope traces and thermographic surveys. Participants produce a TR Unit Fault Analysis and Maintenance Plan for a case installation.

Course Objectives:

- Identify converter classes and rectifier topologies on site drawings and explain how each shapes output voltage, ripple and supply current
- Test diodes, thyristors and IGBTs and interpret device ratings, gate trigger data and thermal limits before replacement
- Verify firing circuits, regulation loops and cooling systems and adjust them to hold current and voltage setpoints
- Carry out pre-energisation and load commissioning checks on transformer-rectifier units and record acceptance results
- Diagnose rectifier and inverter faults using oscilloscope waveforms, fuse evidence, thermographic images and alarm logs
- Build a preventive maintenance and spares plan that reduces unplanned outages of rectifier and converter assets

Target Audience:

- Electrical maintenance engineers responsible for transformer-rectifier units and DC plant in process, chemical and metals facilities
- Electrical and instrument technicians responsible for first-line testing and repair of thyristor and IGBT converter panels
- Cathodic protection staff responsible for impressed current rectifier output, adjustment and monitoring
- Maintenance planners and supervisors responsible for converter spares, inspection intervals and outage scheduling
- Commissioning staff responsible for energising and accepting new or refurbished rectifier installations

Course Outline:

Day 1: Rectifier and Converter Duty in Process Plants

- Converter Classes: AC/DC Rectifiers, DC/AC Inverters, DC/DC Choppers and AC/AC Cycloconverters
- Load Duty Profiles for Electrolysis Cells, Plating Tanks, Cathodic Protection and DC Buses
- Transformer-Rectifier Unit Anatomy: Tap Changer, Rectifier Transformer, Bridge Stack and DC Busbars
- Nameplate and Single-Line Diagram Reading for an Installed TR Unit
- Current-State Survey Sheet: Alarm History, Fuse Replacements and Output Drift Records

Day 2: Power Semiconductors and Rectifier Topologies

- Diode, Thyristor and IGBT Ratings: Voltage Class, Surge Current and Junction Temperature Limits
- Uncontrolled Diode Bridges Versus Thyristor Phase-Controlled Bridges
- Six-Pulse Bridge Waveforms, Commutation Overlap and Output Ripple Calculation
- Twelve-Pulse Arrangement with Star-Delta Phase Shift and Interphase Reactor
- PWM Inverter Legs, DC Link Capacitors and Freewheeling Diodes

Day 3: Firing Circuits, Regulation, Cooling and Commissioning

- Firing Angle Control, Gate Pulse Transformers and Pulse Amplifier Boards
- Constant Current and Constant Voltage Loops with Shunt and Hall-Effect Feedback
- Forced-Air, Oil-Immersed and Deionised Water Cooling Circuits and Heatsink Checks
- Pre-Energisation Checks: Insulation Resistance, Polarity, Phase Sequence and Interlocks
- Load Commissioning Test Sheet: Current Sharing Between Bridge Arms and Setpoint Verification

Day 4: Protection, Line-Side Effects and Failure Modes

- Semiconductor Fuses, I2t Coordination and Fuse-Blown Microswitch Indication
- RC Snubbers, Varistors and di/dt and dv/dt Limits for Thyristor Stacks
- Line-Side Harmonic Signatures and Passive Filter Duty on Converter Feeders
- Failure Mode Atlas: Shorted Thyristors, Gate Misfiring, Capacitor Ageing and Bond-Wire Lift-Off
- Oscilloscope Diagnosis with Differential Probes and Missing-Pulse Patterns

Day 5: Case TR Unit Walkthrough and Fault Analysis Plan

- Guided Inspection Walkthrough of a Case Cathodic Protection and Electrolysis TR Unit
- Infrared Thermography Review of Busbar Joints, Fuses and Heatsinks from the Case
- Fault Tree Construction from Case Waveforms, Alarm Logs and Trip Records
- Preventive Maintenance Task List, Intervals and Critical Spares for Rectifier Stacks
- TR Unit Fault Analysis and Maintenance Plan Presentation and Peer Review

Skills You Will Gain:

- Converter Topology Identification
- Power Semiconductor Testing
- Firing Circuit Verification
- Converter Cooling Inspection
- TR Unit Commissioning
- Oscilloscope Waveform Diagnosis
- Infrared Thermography Interpretation
- Rectifier Spares Planning

Why Attend This Course:

- Return with a TR Unit Fault Analysis and Maintenance Plan built on a case installation and ready to adapt to your own units
- Find the cause of blown fuses, unbalanced bridge arms and drifting output before a stack fails in service
- Read converter waveforms with confidence and tell a firing fault from a device or supply fault
- Compare rectifier and converter maintenance practice with peers from chemicals, metals, oil and gas, water and utility plants

Conclusion:

Rectifier and converter reliability depends on staff who can connect a waveform, a hot joint or a blown fuse to its cause. The one week move from converter classes and transformer-rectifier anatomy, through power semiconductors and six- and twelve-pulse topologies, to firing circuits, regulation, cooling and commissioning, then protection, line-side effects and failure modes. The final day applies these methods in a case walkthrough that produces a TR Unit Fault Analysis and Maintenance Plan ready for the next outage review.