
Generator Voltage Control, Exciter Reliability and Upgrade Decisions Training Course

16 – 20 August 2027
Cape town





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Programme Summary

Generator voltage control and exciter reliability is the subject of this five-day training course for plant directors, heads of operations and asset managers at managerial level, ending in a generator excitation decision dossier for one unit. Regulator and exciter faults cause trips, grid penalties and costly outages. The approach moves from control principles, through failure diagnosis and grid interaction, to upgrade options, and then to a worked decision. Mars Training Centre UK delivers this programme in generator voltage control.

The Business Case

When the excitation system is poorly understood, upgrade proposals rest on vendor advice and grid compliance problems surface during testing. Leaders who read the evidence on exciter condition and replacement options decide earlier and defend the budget with facts.

- Forced Outage Exposure: Falls as exciter reliability evidence guides inspection and replacement timing.
- Grid Compliance Risk: Reduces as voltage and reactive power requirements are tested against unit capability.
- Capital Allocation Quality: Improves as refurbish, replace and retain options are compared on cost and outage risk.

Principles and Evidence Base

- IEC 60034-16: Its classification of excitation systems for synchronous machines structures the comparison of exciter types in Session 1.
- IEEE Std 421.5: Its excitation system models for stability studies guide how Session 3 reads regulator and stabiliser behaviour.
- IEEE Std 421.2: Its approach to identifying, testing and evaluating excitation control systems shapes the acceptance and response test work in Sessions 3 and 4.

Intended Participants

- Plant directors who approve outages and capital spend on generating units.
- Heads of operations who answer for unit availability and grid performance.
- Asset and reliability managers who plan refurbishment and replacement.
- Project and procurement leads who specify and accept regulator and exciter packages.
- Technical authorities who challenge vendor proposals.



The programme serves power utilities, oil and gas facilities, industrial cogeneration and desalination operators.

Learning Outcomes

1. Participants will be able to explain how the voltage regulator, exciter and limiters work together in generator voltage control.
2. Participants will be able to diagnose the likely causes of exciter trips and regulator faults from unit records.
3. Participants will be able to evaluate unit capability against grid voltage and reactive power requirements.
4. Participants will be able to interpret response test results and power system stabiliser behaviour.
5. Participants will be able to prioritise refurbish, replace and retain options by cost and outage risk.
6. Participants will be able to justify an excitation upgrade decision to a plant director and a technical authority.

Programme Structure

Day 1: Generator Voltage Control Foundations

How does generator voltage control work, and where does the excitation system sit in it?

- Generator Voltage Control Loop Map
- Reactive Power and Capability Curve Reading
- Static, Brushless and Rotating Exciter Comparison
- Automatic Voltage Regulator Functions and Modes
- IEC 60034-16 Excitation System Classes

Day 2: Exciter Reliability Diagnosis

Where do excitation systems fail, and how is exciter reliability measured?

- Failure Mode Register for Exciters and Regulators
- Field Flashing and Start-Up Fault Review
- Under-Excitation and Over-Excitation Limiter Behaviour
- Trip and Forced Outage Cause Analysis
- Condition Evidence from Rectifiers, Diodes and Cooling

Day 3: Grid Interaction and Stability

How does generator excitation affect grid stability and compliance?



- Power System Stabiliser Purpose and Tuning Logic
- IEEE Std 421.5 Model Use in Stability Studies
- Grid Code Voltage and Reactive Requirements
- Response Tests and Step Test Reading
- IEEE Std 421.2 Test and Evaluation Concepts

Day 4: Upgrade Decisions and Commissioning Oversight

When should an exciter or regulator be refurbished, replaced or left alone?

- Refurbish, Replace or Retain Option Matrix
- Outage Window and Interface Risk Plan
- Specification Clauses for Regulators and Exciters
- Factory and Site Acceptance Test Witness Sheet
- Spares and Obsolescence Review

Day 5: Applying Generator Voltage Control to a Unit

Is the excitation upgrade case ready for the plant director to approve?

- Applying the Session 1 Loop Map to the Chosen Unit
- Testing the Session 2 Failure Register on Unit History
- Checking Session 3 Grid Requirements Against Unit Capability
- Applying the Session 4 Option Matrix to Cost and Outage Risk
- Completing the Generator Excitation Decision Dossier

Methodology

The programme uses case analysis. Participants work with anonymised unit records and test traces, compare options in small teams and defend their conclusions before a simulated review panel. No circuit design or software skills are required.

- Suggested activity: Reading a fault log to identify the likely cause of a regulator trip.
- Suggested activity: Comparing a static and a brushless exciter for an ageing steam unit.
- Suggested activity: Drafting the outage plan for an exciter replacement.

Capstone Output

Each participant completes a generator excitation decision dossier for one unit. It contains a voltage control loop map, a failure register, a grid requirement check, an options matrix with cost and outage risk, and a recommendation. The dossier briefs the plant director and supports a capital request.



Frequently Asked Questions

Is generator voltage control training suitable for managers without an electrical background?

Yes. Generator voltage control is taught at managerial level and assumes experience of plant operation or asset decisions, not electrical design. Technical terms are explained as they arise.

Which standards does generator voltage control rest on in this programme?

Generator voltage control rests on IEC 60034-16 for excitation system classes, IEEE Std 421.5 for stability models and IEEE Std 421.2 for testing and evaluation of excitation control systems.

How is the generator voltage control dossier used at work?

You use the generator voltage control dossier to brief the plant director, support a capital request and set out requirements for suppliers of regulators and exciters.

How does generator voltage control differ from a course on generator protection?

Generator voltage control concerns regulating voltage and reactive power through excitation. Generator protection concerns detecting faults and tripping the unit.