

● **The Australian Power Institute**

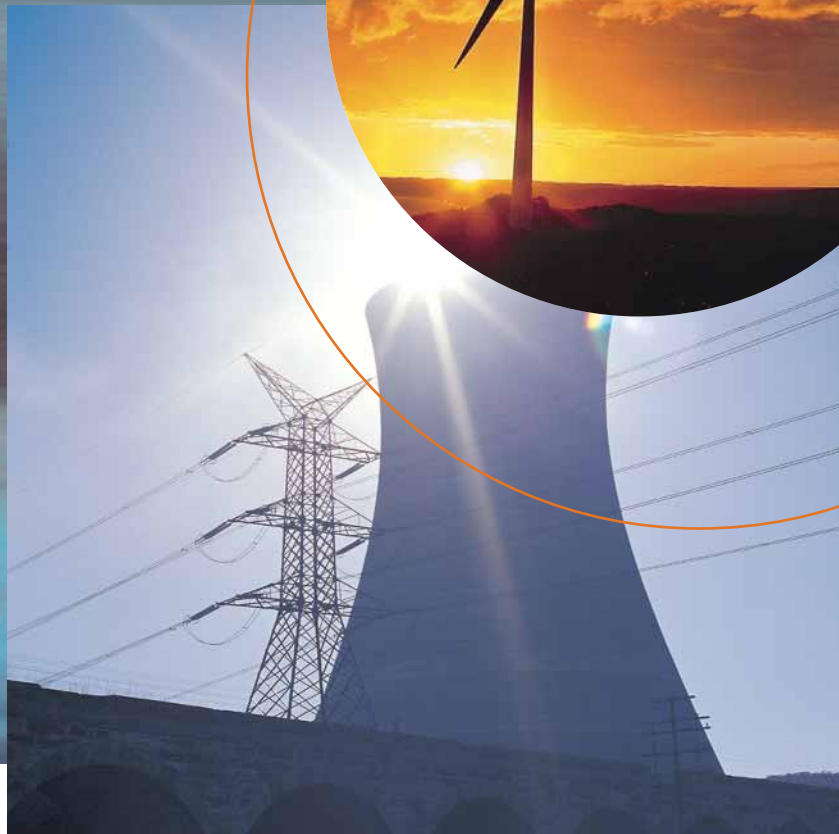
**Intensive Short Course**

# **Generator Technology Design and Operation**

**Presenter - Geoff Klempner**

**API**

**The Australian  
Power Institute**



**Sydney – 7th to 10th June 2005**



## The Presenter

GEOFF KLEMPNER

**Geoff Klempner** is Senior Technical Expert, Structural Integrity Directorate, Nuclear Safety Solutions, where his present duties include:

Large generator consulting including, inspection, testing, design evaluation, failure analysis, electromagnetic and stress FE analysis, life assessment, preparation of technical specifications and test procedures.

As Senior Engineer-Specialist with Power equipment Department, Ontario Power Generation, his responsibilities included:

Engineering improvements and modifications to generating station power equipment, specifically large generators and motors. He provided advice to project engineers and generating station maintenance and operation staff.

This covered technical areas as above, also including financial evaluations and tender evaluation.

He was earlier Design Engineer – Specialist with Ontario Hydro, with similar responsibilities.

His consulting activities include assistance to Pacific Power in New South Wales in 1991, with advice and evaluation of proposals to rewind and refurbish a 500MW generator stator. In 1995 he provided technical training to the Electricity Commission of New Zealand on large generator operation and design theory, maintenance, inspection and testing. He has provided consultant services to Delta Electricity on a number of occasions.

He has worked extensively on EPRI projects, concerning electrical machines and monitoring and has conducted four seminars for EPRI, titled *Large Generator Maintenance and Troubleshooting Course*.

He has authored or co-authored numerous papers and documents, listing some 41 articles.

He is co-author of the book *“Operation and Maintenance of Large Turbo-Generators”*, a copy to be provided with the course.

Geoff has an extensive background of professional activities, with IEEE, EPRI and CIGRE, the later on SC11 (now A1) Rotating Machines.

## Course Details

The course is based on the book; ‘Operation and Maintenance of Large Turbo-Generators’, co-Authored by Geoff Klempner, the course presenter, with I. Kerszenbaum.

A copy of the book will be supplied as course material.

### DAY1 7TH JUNE

8:30 am	Introduction
8:45 am	PRINCIPLES OF OPERATION OF SYNCHRONOUS MACHINES <ul style="list-style-type: none"><li>■ Introduction to Basic Notions on Electric Power</li><li>■ Electrical – Mechanical Equivalence</li><li>■ Alternated Circuits (AC)</li><li>■ Three-Phase Circuits</li><li>■ Basic Principles of Machine Operation</li><li>■ The Synchronous Machine</li><li>■ Basic Operation of the Synchronous Machine</li></ul>
10:00 am	Break
10:30 am	GENERATOR DESIGN AND CONSTRUCTION <ul style="list-style-type: none"><li>■ Stator Core and Frame</li><li>■ Flux and Armature Reaction</li><li>■ Electro-magnetics</li><li>■ End-Region Effects and Flux Shielding</li><li>■ Stator Core and Frame Forces</li><li>■ Stator Windings and Wedges</li><li>■ End-Winding Support Systems</li><li>■ Stator Winding Configurations</li><li>■ Stator Terminal Connections</li></ul>
12:00 noon	Lunch
1:00 pm	GENERATOR DESIGN AND CONSTRUCTION <ul style="list-style-type: none"><li>■ Rotor Forging</li><li>■ Rotor Winding and Slot Wedges</li><li>■ Amortisseur Winding</li><li>■ Retaining-Rings</li><li>■ Bore Copper and Terminal Connectors</li><li>■ Slip/Collector Rings and Brushgear</li><li>■ Rotor Shrink Coupling</li><li>■ Rotor Turning Gear</li><li>■ Bearings</li><li>■ Air and Hydrogen Cooling / Rotor Fans</li><li>■ Hydrogen Containment / Hydrogen Coolers</li></ul>
2:30 pm	Break
3:00 pm	GENERATOR AUXILIARY SYSTEMS <ul style="list-style-type: none"><li>■ Lube Oil System</li><li>■ Hydrogen Cooling System</li><li>■ Seal Oil System</li><li>■ Stator Cooling Water System</li><li>■ Exciter Systems</li></ul>
4:30 pm	Adjourn

### DAY 2 8TH JUNE

8:30 am	OPERATION AND CONTROL <ul style="list-style-type: none"><li>■ Basic Operating Parameters</li><li>■ Operating Modes</li><li>■ Machine Curves</li><li>■ Special Operating Conditions</li><li>■ Basic Operation Concepts</li><li>■ System Considerations</li><li>■ Excitation and Voltage Regulation</li><li>■ Performance Curves</li><li>■ Sample of Generator Operating Instructions</li></ul>
10:00 am	Break



- 10:30 am MONITORING AND DIAGNOSTICS
- Generator Monitoring Philosophies
  - Simple Monitoring with Hi Level Alarm Limits
  - Dynamic Monitoring with Load Varying Alarm Limits
  - Artificial Intelligence Diagnostic Systems
  - Monitored Parameters

12:00 noon Lunch

- 1:00 pm GENERATOR PROTECTION
- Basic Philosophy
  - Generator Protective Functions
  - Brief Description of Protective Functions
  - Specialized Protection Schemes
  - Tripping and Alarming Methods

2:30 pm Break

- 3:00 pm INSPECTION PRACTICES AND METHODOLOGIES
- Site Preparation
  - Experience and Training
  - Safety Procedures & Electrical Clearances
  - Inspection Frequency
  - Generator Accessibility
  - Inspection Tools
  - Inspection Forms – Turbo Generator Inspection and Test Report

4:30 pm Adjourn

### DAY 3 9TH JUNE

- 8:30 am STATOR INSPECTION
- Stator Frame and Casing
  - Stator Core

10:00 am Break

- 10:30 am STATOR INSPECTION
- Stator Windings
  - Phase Connectors and Terminals
  - Hydrogen Coolers

12:00 noon Lunch

- 1:00 pm ROTOR INSPECTION
- Rotor Cleanliness
  - Retaining Rings
  - Fretting/Movement at Interference-Fit Surfaces of Wedges and Rings
  - Centering (Balance) Rings
  - Fan Rings or Hubs
  - Fan Blades
  - Bearings and Journals
  - Balance Weights and Bolts
  - End Wedges and Damper Windings
  - Other Wedges
  - End-Windings and Main Leads

2:30 pm Break

3:00 pm ROTOR INSPECTION

- Collector Rings
- Collector Ring Insulation
- Bore Copper and Radial (Vertical) Terminal Stud Connectors
- Brush-Spring Pressure and General Condition
- Brush Rigging
- Shaft Voltage Discharge (Grounding) Brushes
- Rotor Winding Main Lead Hydrogen Sealing - Inner and Outer
- Circumferential Pole Slots (Body Flex Slots)
- Blocked Rotor Radial Vent Holes & Shifting of Winding and/or Insulation
- Couplings and Coupling-Bolts
- Bearing Insulation
- Hydrogen Seals

4:30 pm Adjourn

### DAY 4 10TH JUNE

- 8:30 am AUXILIARIES INSPECTION
- Lube Oil System
  - Hydrogen Cooling System
  - Seal Oil System
  - Stator Cooling Water System
  - Exciters

10:00am Break

- 10:30 am GENERATOR MAINTENANCE TESTING
- Stator Core Mechanical Tests
  - Stator Core Electrical Tests
  - Stator Winding Mechanical Tests
  - Water Cooled Stator Winding Tests
  - Stator Winding Electrical Tests
  - Rotor Mechanical Testing
  - Rotor Electrical Testing
  - Hydrogen Seals
  - Bearings
  - Thermal Sensitivity Test & Analysis

12:00 noon Lunch

- 1:00 pm MAINTENANCE
- General Maintenance Philosophies
  - Operational and Maintenance History
  - Maintenance Intervals / Frequency
  - Type of Maintenance

2:30 pm Break

- 3:00 pm GENERATOR FAILURE EXAMPLES
- Rotor failures
  - Stator Failures

4:30 pm Adjourn

# Course Details

**Date:** 7th to 10th June 2005  
**Time:** 8.30 am start each day  
**Location:** University of Technology, Sydney  
Building 6, Harris Street Ultimo, Room CB06.04.04  
**Cost:** \$1950 plus GST  
Concessions for Members of The Australian Power Institute  
**Enquiries:** Bryce Corderoy Tel: 02 9484 6356 Mob: 0419 400 542  
Email: bryce.corderoy@api.edu.au



## Registration Form

Please register the following delegates for the event - **“Generator Technology Design and Operation”**

### DELEGATES

Name: \_\_\_\_\_ Job Title: \_\_\_\_\_

Email: \_\_\_\_\_ Telephone: \_\_\_\_\_

Name: \_\_\_\_\_ Job Title: \_\_\_\_\_

Email: \_\_\_\_\_ Telephone: \_\_\_\_\_

Name: \_\_\_\_\_ Job Title: \_\_\_\_\_

Email: \_\_\_\_\_ Telephone: \_\_\_\_\_

Name of Organisation / Company: \_\_\_\_\_

Address: \_\_\_\_\_

Contact Person: \_\_\_\_\_ Job Title: \_\_\_\_\_

Department: \_\_\_\_\_ Email: \_\_\_\_\_

Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_

### METHOD OF PAYMENT

Cheque attached - Payable to The Australian Power Institute Ltd

Direct debit to: The Australian Power Institute Ltd  
Westpac Bank, Martin Place, Sydney  
BSB: 032-024  
Account No: 41 8205

Credit Card:  Visa  Mastercard  Bankcard

Name on Card: \_\_\_\_\_

Card No.: \_\_\_\_\_ Expiry Date: \_\_\_\_\_

Signature: \_\_\_\_\_



*This course is recognised by Engineers Australia for Continuing Professional Development (CPD) purposes.  
The Australian Power Institute will issue a Certificate of Attendance on completion.*