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Course Information Letter ---- CT301

COMBINED CYCLE TURBINE GENERATOR FUNDAMENTALS

CT301

Reliability and availability of combined cycle power plants can be a matter of skilled routine operations and maintenance activities. These skilled routine operations and maintenance personnel begin their quest with a thorough understanding of combined cycle fundamentals. Understanding of the interaction of major components is required. Furthermore, understanding the operating needs of the individual components may be crucial to satisfactory operation of the machine.

Topical Outline includes: Thermodynamic principles as they apply to a combined cycle power plant, Descriptions of types of combustion turbines, Application, Major Gas Path Components, Major Auxiliary Systems, Starting Systems, Combustion Turbine Controls Overview, Generator Principles of Operation, Generator Components, HRSG, Steam Turbine Fundamentals, and the Condenser.

This course is intended for individuals who are new to combined cycle operation for power generation. It also provides an excellent refresher for persons that have been involved with combined cycle equipment and generators, but have not received any formal training.

OBJECTIVES:

At the completion of this course the participant will be able to:

1. Describe the thermodynamic principles associated with the combustion turbine.
2. Describe the basic cycles used for different types of combustion engines.
3. List the major components of any combustion turbine and describe their function.
4. Discuss the various ways in which efficiency of a combustion turbine can be changed.
5. Describe the flow through the combustion turbine including any extraction points.
6. Identify and state the function of a given CT auxiliary system and describe its operation.
7. Describe the effects that humidity, ambient temperature, compressor ratio, firing temperature, exhaust temperature, and exhaust pressure have on combustion turbine performance.
8. Describe the ability to determine combustion turbine output and heat rate.
9. Describe those thermodynamic principles associated with a combined cycle power plant.
10. Describe the construction and operation of Steam Turbines.
11. Describe the construction and operation of Heat Recovery Steam Generators.
12. Describe the construction and operation of Generators.
13. Describe the major systems associated with Gas (Combustion) Turbine, Steam Turbines and Generators.
14. Describe the sequencing that occurs in a normal startup, synchronization and operation.
15. Describe the different fuel systems and requirements for operation.
16. Describe the components in the Condensate System.

WHAT YOU WILL RECEIVE:

1. 1 copy of HPC Technical Services' textbook, **CT301 Combined Cycle Turbine Generator Fundamentals**. It is a valuable desktop reference in addition to being able to enhance the learning process.
2. A "Certificate of Completion" with 2.6 CEUs, authorized for issue by the International Associate of Continuing Education/Training.

COURSE DATES/LOCATION/FEE

For current dates / locations / prices, please see HPC's website, www.hpcnet.com.

COURSE OUTLINE

1. **Thermodynamic Principles**: Energy, Energy Conversion, Heat Transfer, Combustion Theory
2. **Combustion Turbine Fundamentals**: Design Considerations, Classifications of Combustion Turbines, Characteristics of Combustion Turbines, Advanced Combustion Turbine Designs
3. **Combustion Turbine Components**: Turbine Main Components, Combustion Section, Turbine Section, Exhaust Section, Gears and Couplings, Turbine Base and Supports, Unit Enclosures
4. **Combustion Turbine Support Systems**: Electrical System, Inlet and Exhaust System, Starting Systems, Fuel and Fuel Treatment Systems, Lubricating Oil Systems, Cooling Water/Air Systems, Water Wash Systems, Fire Protection Systems
5. **Turbine Controls Overview**
6. **Generator**: Generator Major Components, AC Power Generation, Generator Auxiliary Systems
7. **Steam Thermodynamic Principles**: Energy, Laws of Thermodynamics, Water & Steam, Heat Transfers
8. **Introduction to Combined Cycle Power Generation**: Combined Cycle Fundamental Theory and Operation, Cycle Parameters and The Impact Upon Performance, Benefits of Combined Cycle, Fuels
9. **Heat Recovery Steam Generators**: Overview, Function, Principle, Flow Path, Major Components
10. **Steam Turbine**: Turbine Principles, Turbine Components, Steam Turbine Auxiliary Systems, Turbine Supervisory Instruments, Starting and Loading Instructions, Turbine Controls
11. **Condensate System**: Condensers, Feedwater Heaters, Cooling Towers

FREQUENTLY ASKED QUESTIONS

- Will HPC Technical Services bring this course to our location for our personnel only? YES, call or email Stephen Parker, stparker@hpcnet.com for a price quotation.
- Will HPC Technical Services customize the presentation at our site to suit our particular needs? Yes.
- Is HPC Technical Services' textbook available for purchase as a reference document? Soon to be available.
- What is the cost for HPC Technical Service to deliver this course at our location? Well, of course that can vary, but generally speaking, if you're planning on having 6+ attend, when considering your T&L, it is to your advantage to perform the course at your plant (office). You gain from the customization and price.
- Can HPC Technical Services provide "Technical Assistance" in conducting functional checkouts or troubleshooting problems? Yes we can. Call or contact Harold Parker, hparker@hpcnet.com for our rate sheets and any further information required.

RECENT SATISFIED CLIENTS: ABB, AEP, Alabama Power, American National Power, Amoco Oil, Aquila Energies, Associated Electric Cooperative, ATCO Electric, Atlantic Group, Boston Edison, CalEnergy, Canada Utilities, Cardinal Power of Canada, Carolina Power & Light, Central Iowa Power, CNA Insurance, Cogentrix, Commonwealth Edison, Conmec, Cory Cogeneration, Covert Generating, Denver Energy Associates, Dominion Energy, Duke Energy, Dynegy Northeast, El Paso Electric, Entergy Operations, Falcon Operating Company, Florida Natural Growers, Florida Power Corporation, Foster Wheeler Martinez, Gaylord California Mill, GE Contractual Services, GE Global O&M, Gordonsville Energy, Hitachi America, Hutchinson Utilities, MidAmerican Energy, Nevada Cogeneration Association, New Central Energies, North American Energy Services, Ocean State Power, Panda Energy, Panda Global Services, Panda Rosemary Cogen, Pasco Cogeneration, PPL Global, Prime Energy, Progress Energy, PSEG, Public Service New Mexico, Puerto Rica Electric Power Authority, Santee Cooper, SaskPower International, Sithe Energies, South Carolina Electric & Gas, Southern Company, TECO Power Services, Tenaska, Tractebel Power, Trans Canada, Trigen Energy, University of Texas @ Austin, US Borax, UtiliCorp, Vero Beach Municipal Utilities, WE Energies, Western Farmers Electric Cooperative, Westinghouse Operating Services, Wood Group, Woodward Governor, Yuma Cogeneration

GAS TURBINE CERTIFICATION:

There are three levels of certification (All three levels require this course):

1. Field Engineer
2. Combined Cycle Maintenance Mechanic
3. Auxiliary Operator

Those who attend this course are automatically qualified to take HPC Technical Services' Certification Examination. This examination is offered at no additional expense to the participant. An 80% passing grade is required. The examination length will not exceed 2-hours. Those who complete this examination will receive a revised "certificate of completion" that recognizes this accomplishment along with two-copies of a "To Whom It May Concern" letter that states their accomplishment. (Two copies are provided, one for the participants' employer and one for the participants' personal file.)

Consult HPC's website, www.hpcnet.com, for detail on this certification program.

INSTRUCTOR (S):

Dan Anderson is the primary instructor for this course. Dan started his career in the US Navy as a Boiler Technician. After his discharge Dan was a civilian instructor for the US Navy at Great Lakes Naval Training Center. While there Dan instructed Navy personnel in the four-phase steam cycle including balance of plant equipment. In 1990 Dan returned to Minnesota and received his Minnesota State Chief A Engineers license. After a few years in the position as Chief Boiler Engineer For Green Giant Co. and Maintenance Manager for Minnesota Energy, Dan went to work for Hutchinson Utilities Commission in Hutchinson, Minnesota. His position there was Operator 1. His operational responsibilities included GE LM 6000 Combined Cycle, GE Frame 5 Simple Cycle, and a GE Frame 3 Combined Cycle. He also had operations of 6 Diesel Engines for power production. Dan joined HPC Technical Services, June 2001. His main area of instruction is Gas Turbine/Combine Cycle Fundamental, Steam Turbine/Generator Fundamentals, Mechanical Maintenance Courses, and The Boiler Training. Dan currently holds a Chief A Engineers License for Minnesota, A Chief NIULPE Certificate, NIULPE Instructor and Examiners Certificate, Chief ASOPE Certificate, and is a Member of ASME.

Robert Johndrow. Bob Johndrow hired into GE as a field engineer on the same day as HPC's founder, Harold Parker. That was 36-syears ago. Since that date, Bob Johndrow has been a GE Field Engineer specializing in many disciplines including Generator Maintenance and Testing. Bob completed GE's Generator Specialist Training Program early in his career and has been involved in many generator design issues, mechanical maintenance, electrical testing, and troubleshooting O&M problems since then. Bob earned a BS in Industrial Distribution from Clarkson University in Potsdam NY and also has GE Six Sigma Green Belt Certification. Bob accepted an early retirement package late 2003 and has worked as an independent as well as being associated with HPC Technical Services since then. He resides in Rhode Island.

Douglas Lemmo, PE. Mr. Lemmo has 35 years experience in the power generation industry, 31 of them with GE. Within GE he was initially employed as a field engineer (1971-1976). Here he was responsible for the installation and startup of a number of large and medium steam turbine generators and the feed pump turbines. In addition to this installation work, Mr. Lemmo also performed maintenance service on a variety of nuclear, fossil and marine turbine units. After leaving the field, Mr. Lemmo taught in GE's Field Engineering Development Center. Here his specialty was steam turbine generators, installation, alignment and maintenance. After a couple years instructing, he accepted a position selling maintenance and repair services. In 1982, Mr. Lemmo was the Project Manager for a Waste-to-Energy site. Later projects included a modernization of a hydroelectric facility and the management of the installation of a few combined cycle sites. In 2002, Doug left GE and founded Power Generation Consulting Services, which focuses primarily on the operation, maintenance and repair of steam turbine generators. In this last position, Doug has been closely aligned with HPC as he has instructed many of our courses and provided site-engineering support on HPC contracts.

HPC TECHNICAL SERVICES
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REGISTRATION FORM

Company: _____

Plant: _____

Address: _____

City/State/Zip: _____

Telephone: _____ FAX: _____

Course Number/Title: _____

Course Dates: _____/_____/_____ Thru _____/_____/_____

Course Location: _____ Course Fee: _____

Please enroll the following individual(s) listed below:

Student #1: _____

Student #2: _____

☐ **Taking advantage of HPC's 3-4-2 Policy: Send 3, Pay for 2 when paying in advance.**

Student #3: _____

Enrolled by: _____ Date: _____

METHOD OF PAYMENT

- ☐ Check to Follow: _____
- ☐ Check Enclosed #: _____
- ☐ MC/Visa/AMEX #: _____
  Expiration Date: _____ CV Code: _____
- ☐ Purchase Order #: _____

HOW DID YOU LEARN OF THIS COURSE?

- ☐ Attended HPC courses before
- ☐ Magazine advertisement
- ☐ Received a fax
- ☐ Received an email
- ☐ Internet
- ☐ Other: _____