Distributed Generation Certified Professional (DGCP)
Study Guide & Sample Questions

The following is a list of the subjects for DGCP examination. Each subject covers a number of topics. Following the list of topics are suggested references with chapter numbers. The primary reference is the Combined Heating, Cooling and Power Handbook: Technologies and Applications, by Neil Petchers, Fairmont Press, Lilburn, GA, 2003. Subsequent references to this book will simply be listed as Petchers. There are two secondary references. One is the Guide to Energy Management, Fourth Edition, by Barney L. Capehart, Wayne C. Turner and William J Kennedy, Fairmont Press, Lilburn, GA, 2003. Subsequent references to this book will simply be listed as GTEM 4th.The other secondary reference is the Energy Management Handbook, 4th Edition, edited by Wayne C. Turner, Fairmont Press, Lilburn, GA, 2001. Subsequent references to this book will simply be listed as EMHB 4th. All of these books are available from the Fairmont Press, Lilburn, GA, www.FairmontPress.com.

This Study Guide is intended to provide adequate guidance to answer the vast majority of questions on the examination. A person with the necessary experience to qualify for the DGCP certification and who reviews the information from this Study Guide should not have any difficulty passing the DGCP examination. The Study Guide will not, however, lead you to the answer to every question on the examination. Some contribution from your experience will also be necessary.

Specific background knowledge is required in the areas of Electric Rates, Gas Rates, and Utility Bill Analysis. For those needing additional work in these areas, there are several sections of the three reference books that will provide the necessary information and background. These sections are Chapters 19, 20, 21 and 22 of Petchers; Chapter 3 of GTEM 4th, and Chapter 18 of HBEM 4th

For those qualified professionals whose goal is to become certified as a DGCP, it is absolutely necessary to be able to perform detailed technical and economic calculations and analyses on the intermediate and advanced DG concepts listed in this Study Guide. The DGCP Certification Examination is 40% quantitative, with these questions ranging from simple one-step equation solutions to questions requiring multiple equations and several steps.

Qualitative questions on the DGCP Certification Examination will have a weight of 10 points per question, and simple one step quantitative questions will have a weight of 15 points per question. There will also be a section on the examination containing 5 questions that are lengthier and more involved, and these questions will have a weight of 20 points per question. There will be a total of 85 questions on the examination, of which 60 are worth 10 points each, 20 questions worth 15 points each, and 5 worth 20 points each. The maximum score on the examination is 1000 points, and the passing requirement is 70%, or 700 points.

Study Guide Topics and References

I. Introduction to Distributed Generation and CHP

SUBJECT TOPICS

Definitions of DG and CHP
Cogeneration Systems
Types of DG and CHP Systems
Benefits of DG and CHP Systems
DG and CHP Technologies
Regulatory Issues in DG and CHP Systems
Barriers to Implementation of DG and CHP Systems

REFERENCES:
Ch 3, and 23 Petchers
Ch 14 GTEM 4th
Ch 7 HBEM 4th

II. Distributed Generation and CHP Technologies

SUBJECT TOPICS

Reciprocating Engines
  Spark ignited
  Self ignited
Combustion Gas Turbines
Microturbines
Steam Turbines
Fuel Cells
Solar Photovoltaic Cells
Wind Energy Conversion Systems
Energy Storage Systems
Electric Generators

REFERENCES
Ch 9, 10, 11, 14, and 25 Petchers
Ch 14 GTEM 4th
Ch 7 HBEM 4th

III. Energy and Thermal Basics of Distributed Generation and CHP Technologies

SUBJECT TOPICS

Energy, Heat and Work
First and Second Laws of Thermodynamics

Power Cycles
  Simple, Topping, Bottoming, Combined, Cogeneration
Carnot Cycle and Carnot Efficiency
Need for Power and Heat
Prime Movers and Simple Cycles
Otto, Diesel, Rankine, and Brayton Cycles
Properties of Steam
Enthalpy and Entropy
Steam Turbine Expansion
Mollier Chart Analysis

REFERENCES
Ch 1, 2 and 6 Petchers
Ch 8 GTEM 4th
Ch 6 and 7 HBEM 4th

IV. Power Cycle Performance Measures for Distributed Generation and CHP Technologies

SUBJECT TOPICS

Power Cycle Performance Measures
Thermal Efficiency
Higher Heating Value of Fuel
Lower Heating Value of Fuel
Heat Rate
Fuel Rate
Fuel Credit and Fuel Credit Value
Net Fuel Rate
Energy Chargeable to Power
Fuel Chargeable to Power
Cost Chargeable to Power
Relationship of ECP, FCP, and CCP
Total and Life Cycle CCP

REFERENCES
Ch 2, 5 and 6 Petchers
Ch 7 HBEM 4th

V. Economic and Life Cycle Cost Analysis for Distributed Generation and CHP Systems
SUBJECT TOPICS

Simple Payback Period
Life Cycle Costing
Time Value of Money
Present Value and Present Worth
Net Present Value

P,A,I, N parameters
Internal Rate of Return
Life Cycle Cost
Savings to Investment Ratio
After Tax Cash Flow
Point of Use Costs
Levelized Cost of Power

REFERENCES
Ch 42 and 43 Petchers
Ch 4 GTEM 4th
Ch 4 HBEM 4th

VI. PURPA and FERC Rules for QF's and SPP's

SUBJECT TOPICS

Public Utilities Regulatory Policy Act (PURPA)
Federal Energy Regulatory Commission (FERC)
QF's - Qualifying Facilities
SPP's - Small Power Producers
Avoided Cost
Ownership Standard
Operating Standard
Efficiency Standard
Topping Cycles and Bottoming Cycles

REFERENCES
Ch 20 and 23 Petchers
Ch 7 HBEM 4th

VII. Summary Data on Distributed Generation and CHP Technologies and A Case Study

SUBJECT TOPICS

DG and CHP System Operating Strategies
Characteristics of DG and CHP Technologies
Comparison of DG and CHP Technologies
Selection of DG and CHP Technologies
Purchase and Operating Cost Data for DG and CHP Systems
Generic Case Study

REFERENCES
Ch 26 Petchers
Ch 14 GTEM 4th
Ch 7 HBEM 4th

VIII. Regulatory and Permitting Systems Issues For Distributed Generation and CHP Systems

SUBJECT TOPICS

Utility Interface Issues
Utility Interconnections
IEEE 929-2000 and UL 1741
IEEE 1547
Net Metering
Air Emission Permitting
The Permitting Process
State Air Emission Limits

REFERENCES
Ch 15, 16, 17, 27, and 28 Petchers

IX. Distributed Generation and CHP Project Management

SUBJECT TOPICS

Analyzing Facility Energy Needs
Selection of DG and CHP Technologies
Screening of Technologies
Addressing Potential Barriers
Acquiring DG and CHP Resources

REFERENCES
Ch 40, 41 and 44 Petchers

X. Distributed Generation and CHP System Case Studies

SUBJECT TOPICS

Basic DG and CHP Systems Analysis
Generic case Studies
Advanced Case Studies

REFERENCES
Ch's 2 through 12 Petchers
Ch 14 GTEM 4th
Ch 7 HBEM 4th

Sample DGCP Examination Questions

These Questions Count Ten Points Each

1. Distributed generation and cogeneration mean the same thing.

a) True
b) False

2. A steam turbine operates in which cycle?

a) Otto cycle
b) Diesel cycle
c) Rankine cycle
d) Brayton cycle

3. The benefits of a properly designed cogeneration system include:

a) Economic
b) Environmental
c) Resource conservation
d) All the above

4. In almost all cogeneration systems, the economic value of the electricity produced compared to the value of the thermal energy produced is:

a) Less
b) More
c) About equal

5. If a microturbine is used to produce electricity and hot water, it must have:

a) A plate and frame heat exchanger
b) An air to air heat exchanger
c) An air to water heat exchanger
d) A water to water heat exchanger

6. Reciprocating engines are rarely used in CHP systems.

a) True
b) False

7. Distributed generation systems must always be smaller than 500 kW of electrical power generation.

a) True
b) False

8. Smaller steam turbines are usually less efficient than larger steam turbines.

a) True
b) False

9. While there may be some small (1-2 MW) generating units located at a utility central power station, we would not say these units represent Distributed Generation.

a) True
b) False

10. Most of the time Distributed Generation means the generation of electrical power.

a) True
b) False

11. Although topping and bottoming cycles are CHP cycles, the Combined Cycle is always used for strictly electric power production.

a) True
b) False

12. The average heating value of a fuel is found by adding the LHV and the HHV for the fuel, and then dividing that sum by two.

a) True
b) False

13. The LHV and HHV for natural gas are so close to each other it really doesn't make much difference which one we use in our calculations.

a) True
b) False

14. The electrical efficiency of a DG system is found by taking the reciprocal of the system's Heat Rate.

a) True
b) False

These Questions Count Fifteen Points Each

15. A CHP project saves a company $25,000 a year in utility costs. If it has a lifetime of 10 years, and the company wants a 20% IRR for this project, how much can they pay for it?

a) $250,632
b) $51,075
c) $104,812
d) $153,659

16. A reciprocating engine without heat recovery has a heat rate of 14,000 Btu per kWh. What is its electrical efficiency?

a) 24.4 %
b) 30.1 %
c) 43.5 %
d) 54.3 %

17. A microturbine operating on natural gas has an electrical efficiency of 28% (LHV). If LHV/HHV for gas is 0.9, what is the efficiency (HHV) of the microturbine?

a) 23.1 %
b) 31.4 %
c) 28.3 %
d) 25.2 %

18. The ECP for a CHP system is 5,000 Btu per kWh. The HHV of gas is 1020 Btu/CF. The gas cost for the prime mover and the displaced fuel use is the same. What is the FCP for the CHP system?

a) 3.5 CF/kWh
b) 4.9 CF/kWh
c) 9.6 CF/kWh
d) 15.35 CF/kWh

19. For question 18, if gas costs $0.004 /CF, what is the CCP for the CHP system?

a) $0.0015/kWh
b) $0.0101/kWh
c) $0.0108/kwh
d) $0.0196/kWh

20. A fuel cell produces 200 kW of electrical power with an efficiency of 37% (LHV). It also produces 800,000 Btu/h of heat, of which 80% can be recovered and used as hot rinse water in a manufacturing process. The displaced gas water heater has an efficiency of 75% (HHV). What is

the fuel input rate to the CHP system in CF/h if the heat content of the fuel is 1000 Btu/CF (HHV), and HHV/LHV = 1.11?

a) 1051 CF/h
b) 1425 CF/h
c) 1915 CF/h
d) 2047 CF/h
e) 3423 CF/h

21.In question 20 above, what is the ECP for the CHP system?

a) 4051 Btu/kWh
b) 5968 Btu/kWh
c) 6537 Btu/kWh
d) 7123 Btu/kWh
e) 8567 Btu/kWh

22. In question 20 above, what is the FCP for the CHP system?

a) 3.51 CF/kWh
b) 4.25 CF/kWh
c) 5.97 CF/kWh
d) 7.03 CF/kWh
e) 9.18 CF/kWh

23. In question 20 above, what is the CCP if gas costs $4.00 per MCF (1 MCF = 1 MMBtu), and the O&M cost is $0.01 per kWh?

a) $0.014/kWh
b) $0.024/kWh
c) $0.034/kWh
d) $0.044/kWh
e) $0.054/kWh

These Questions Count Twenty Points Each

24. A coal fired boiler drives a steam extraction turbine power plant that produces 0.5 MW of electric power. A steam host has been found close by that will buy steam that is tapped off at 55 psig. How many pounds per hour of 55 psig steam must the host buy in order for this topping cycle to be a QF under PURPA rules?

a) 76 lb/h
b) 97 lb/h
c) 153 lb/h

d) 512 lb/h
e) 753 lb/h

25. A 1 MW CHP facility has an FCP of 5 CF/kWh with a fuel cost of $4.00/MCF, and an increased maintenance cost of $0.015/kWh. The CHP system costs $1,000,000, and has an expected lifetime of 15 years. What is the Levelized Cost of Power (LCOP) for this facility, using a discount rate of 10%? The CHP system operates 5000 hours per year at full load.

a) $0.0350/kWh
b) $0.0462/kWh
c) $0.0571/kWh
d) $0.0613/kWh
e) $0.0827/kWh

Answer Key

1. b 14. b
2. c 15. c
3. d 16. a
4. b 17. d
5. c 18. b
6. b 19. d
7. b 20. d
8. a 21. b
9. a 22. c
10. a 23. c
11. b 24. a
12. b 25. d
13. b