Power Generation Skills Development

UNIT OUTLINE AND LEARNING GUIDE

EPG07 Advanced Power Plant
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UNIT OUTLINE

Course details

Program Master of Engineering (Power Generation)

Level One

Units of credit Six

Prerequisite/Corequisite Introduction to Power Plant (EPG01) or relevant industry experience

Faculty website [http://fseh.cqu.edu.au](http://fseh.cqu.edu.au)

Campus Gladstone

Rationale

Power station ownership, operation and maintenance can involve the employment of large and expensive assets with potentially huge affects on the economic viability of the owner and on the environment. Effective use of these assets requires a good appreciation of the economics of power station design, construction, operation and maintenance. This appreciation should be based on a thorough understanding of energy sources, thermodynamics, materials of construction, and their interactions in plant design and operation.

There are a wide variety of potential energy sources and plants can be designed to achieve optimal economic results for any of these. Improved thermal efficiency contributes directly to bottom-line profit because of reduction in fuel costs, but also contributes to a reduction in environmental impacts. Fuel preparation is the foundation of efficient operation of the plant. It impacts on environmental performance and is the highest maintenance item in PF plants. Modern power station operation involves exposing high temperature components to degradation by mechanisms such as creep, fatigue, creep-fatigue, wear, erosion and corrosion. Poor operation can cripple a major plant and destroy a business, whereas informed operation and maintenance can maximise the value of the generating assets.

Engineers working with power plant need the theoretical and practical background knowledge relating to fuel preparation plant to ensure it meets the business needs. They also need the theoretical and practical background knowledge relating to the operating environment of the plant, its degradation mechanisms, and the economics and trade-offs involved in the use of different fuels, efficiency changes and plant life consumption. An understanding of the reasons for inspection, the relevant standards, NDE techniques, risk assessment, industry practice, is required. This includes the basic inspections of main plant and field mountings, plant hangers and buckstays.
Course objectives

On successful completion of this course, you should be able to:
1. describe the features, operations, advantages and limitations of common power plants
2. explain the drivers for improvement and main features of advanced power plants
3. analyse the thermal performance and explain the principles of power plant design
4. apply comminution theory to fuel crushing and pulverising plant
5. analyse and optimise the combustion processes
6. analyse and recommend opportunities for performance improvement
7. identify and resolve operation and maintenance problems
8. assess the economics of plant operation
9. understand the statutory inspections.

Study schedule

To be supplied separately.

Assessment and assignment submission

Course delivery strategy:

This course will be delivered in two modules each containing 16 face-to-face contact hours. Each module will be delivered in intensive mode over two days respectively.

There will be two workshops held for this course that students will be required to attend.

Both workshops will be held in Gladstone:

Module A
Monday, July 9 and Tuesday, July 10
Start: 9am to 5pm
Location: CQU Gladstone Campus

Module B
Monday, July 30 and Tuesday, July 31
Start: 9am to 5pm
Location: CQU Gladstone Campus
General Topics include:

Module A
- Thermodynamics and performance improvement of power plants
- Combustion processes and plant operation
- Fuel and milling systems

Module B
- Plant design and selection
- Economics of plant operation

Related Courses
- Plant Materials (EPG12)
- Power Plant Chemistry (EPG09)
- Asset Management Systems (EPG02)

Assessment
In order to pass this course you must score 50 percent or more in total.

Assessment for all students
Assessment for the course will be on the basis of:

| Assessment item 1—Case study | 20% |
| Assessment item 2—Assignment | 80% |

There is no formal final examination for this course.

Facilitators and Contact Details

Course Developer and Coordinator:
Dr Mohammad Rasul
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Course Developer and Lecturer:
Mr Malcolm Leinster
Retired Mechanical Engineer, Queensland Power Generation Industry
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Course Peer Reviewer and Lecturer:
Mr Kerry Waraker MIEAust. CPEng. RPEQ
Retired Chief Mechanical and Combustion Engineer—AUSTA Electric

Course Peer Reviewer and Industry Expert
Mr Des Covey
Managing Director, Covey Energy
Course Developer and Co-ordinator: Dr Mohammad Rasul

Dr Rasul obtained his PhD on Energy and Thermodynamics from University of Queensland, Australia. Currently, Dr Rasul is working as a Senior lecturer in Mechanical Engineering, College of Engineering and the Built Environment, Faculty of Sciences, Engineering and Health, Central Queensland University, Rockhampton, Australia. He is specialised and experienced in research, teaching and consultancy in the areas of thermodynamics and energy, process and power industry’s energy and pollution analysis, desalination using renewable energy and process engineering and light metals. Dr Rasul was responsible for overall coordination of the course and developing Modules 1, 2 and 3.

Course Developer and Lecturer: Malcolm Leinster

Mr Leinster graduated as a Mechanical Engineer from Queensland Institute of Technology (now QUT) and worked in Queensland’s power generation industry for over 35 years, covering areas such as the design, contract administration, commissioning, operation, maintenance, life extension and asset management of power stations.

In 1978 Mr Leinster was seconded to an industry-wide special investigation team, Gladstone Task Force, who were given the task of overcoming early reliability and performance problems with the first units at Gladstone Power Station. He later led another Burner Front Investigation Group charged with overcoming all remaining reliability problems with Gladstone’s burner systems. This led to the development of an integrated burner, pulveriser, instrumentation and control system package incorporating much new technology which was subsequently implemented, with some aspects being transferred to other QEC power stations. He was intimately involved in major projects including boiler refurbishment, and the provision of new dry ash handling plants.

During his service at Gladstone Mr. Leinster was also involved in auditing maintenance and asset management aspects of other organisations.

Since leaving Gladstone Power Station he has continued with research work to improve aspects of creep life assessment. He has been engaged both alone and with other consultants to undertake asset management and due diligence reports and investigations for other power generation organisations. Malcolm was responsible for developing Modules 5 to 8.

Course Developer and Peer Reviewer: Kerry Waraker

Kerry Waraker graduated as a Mechanical Engineer from Queensland Institute of Technology (now QUT) and has worked in the Queensland power generation industry for the past 40 years. Following an initial period of three years as a maintenance engineer at Tennyson Power Station he joined the Operations Department at head office and worked on plant and performance related issues including responsibility for performance acceptance testing of new plant. During this time the new plants at Swanbank B and Gladstone were commissioned and performance tested. For the design and construction period of the 350MW units for Tarong, Callide and Stanwell, Kerry was responsible for ensuring that Operation Division’s requirements of the new plant were met by working closely with both the designers and contractors for the main thermal plant of these stations. In latter years Kerry moved to the design area when appointed Chief Combustion Engineer. He was Chief Mechanical Engineer for a period and also was acting Manager Technology for a year.
Since the closure of the Government owned AUSTA Energy in 2000 Kerry has worked as a consultant to the industry, being engaged in such areas as providing advice to the power generating industry, problem solving of plant operating difficulties at the Rocky Point Sugar Mill Cogeneration Plant, performance testing of the combined cycle gas turbine plant at Yabulu in North Queensland, and design review of the 750MW Kogan Creek Power Station thermal plant. Kerry was responsible for developing Module 4.

**Industry Expert and Peer Reviewer: Des Covey**

Mr Covey is a mechanical engineer who has used technology, control and instrumentation as well as computers to focus and drive change within the power industry. He has been in managerial leadership positions in the industry developing renewables and cogeneration technologies while maintaining asset management of Stanwell Power Station to a very high level of reliability. More recently he has taken up consulting and is working on optimising operations at Callide C, and performance testing of Tarong North Power Stations and Indonesia’s Paiton Power. Mr Covey is a site manager and owner’s representative for project management of start-up and station alarm review projects, and a technical consultant for potential development of the 400MW combined cycle plant at Townsville South Power Station.

He has commissioned and performance tested processes and systems at Gladstone, Tarong, Callide B and Stanwell Power Stations, including cooling towers. He is considered as a leading technologist in the electricity industry with skills to work in the conceptual and philosophical framework and then be able to bring those plans to fruition through others working on the details.