Course S349

Simulator training on power plant
State of the art system & training courses to develop a competent operations & maintenance team

Safe, reliable and efficient operation & maintenance are of paramount importance for any power plant. This cannot be achieved without having a competent operations & maintenance staff.

A competent professional is one who has a combination of both theoretical knowledge and practical experience. While theoretical knowledge can be acquired through reading, training, coaching etc., practical experience can only be achieved through hands-on working experience and long years of service.

Experience is acquired by handling different scenarios and situations, while operating or doing maintenance. A single mistake on the part of an operator can result in huge production loss, equipment damage and serious safety hazards and can even cause a catastrophe in a power plant environment. Even the most trained & experienced operator is at the risk of making a mistake if he has not faced a similar situation for a long period of time.

Simulator located in ABB learning zone in Al Dar HQ, Abu Dhabi, UAE

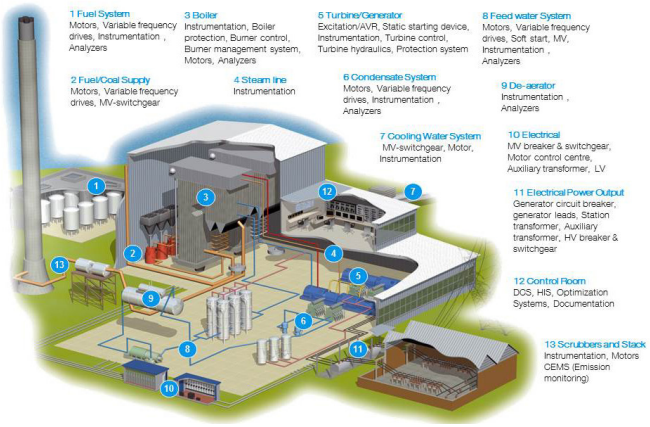
A need has been felt by most plant managers for a means to develop power plant professionals through comprehensive training programs involving both theory & practical sessions.

ABB power plant Simulator

Understanding the above need and leveraging its own expertise and experience in delivering all electrical & control products and systems for power plants, ABB has installed a high fidelity power plant simulator in our learning zone in Abu Dhabi, UAE. The system is expected to cater to all the power plants in the Middle East region and is first of its kind in the region.

The training on the simulator system and various other courses are also a part of ABB's endeavor to develop local talent through comprehensive training programs.

The high fidelity training simulator solution utilizes real-time scenarios as in an actual power plant. The system can be adapted to create different fault scenarios to understand how the thermo-dynamic & electrical process behaves during transients, thus equipping the operator to face any challenges during actual power plant operations.



Simulator power plant topology

The simulator represents the operation and dynamics of 2x1 combined cycle power plant with two combustion turbines, two HRSGs, a steam turbine and the electrical power generation equipment.

The system is on a core thermo-dynamic emulator. The computer based system is flexible and configurable to run on server client architecture or as independent servers.

The unit, with two gas turbines (rated 175 MW each) and a steam turbine (rated at 210 MW), with net rated output of 540 MW using natural gas.

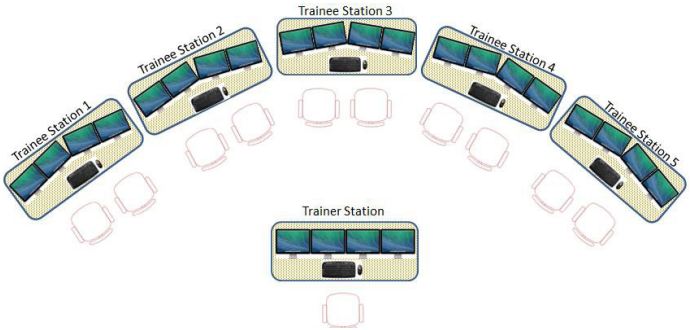
The simulation contains heat recovery steam generators (HRSGs), with overall control of the combined-cycle plants with an emulated Balance Of Plant Distributed Control System (BOP DCS), incorporating replicated control logic software from established reference plants. The plant monitoring and control operations are performed from the operator stations.

Thus, the real-time nature of the training simulator environment gives the student operator a valuable exercise in learning how actual controls will perform during plant scenarios like start-ups, shutdowns & during any abnormal operating conditions.

Classroom arrangement

There are six servers or clients, which can run six different simulators if required or trainer – trainee mode (server - client)

While tutoring a class the trainer can use the client server structure to have all six systems controlled from one server. But during the practice sessions, each of the workstations (all six of them) work like 6 independent power plants. This helps



the trainees to really practice different operation scenarios independently, without any interference.

Each station has 4 monitors to view different operational screens like plant graphics (mimics), operational trends, alarms & events etc. Operation is controlled through alphanumeric keyboard or through a mouse.

The training class room is set-up in a way that the trainer is always able to see and monitor the action of the trainees, while they are operating the plant. ABB uses ergonomically designed furniture and state of the art training equipment in the simulator class room.

Simulator features

Simulator provides

- Process knowledge
- Operations reaction experience
- DCS familiarity

Scenarios or Initial Conditions (ICs)

- Pre-defined plant onditions
- Capability to take the Simulator in defined specific conditions also called as Initial Conditions to save time and a targeted experience.

Simulator Freeze

Selecting the freeze mode causes the simulation to stop dynamic functions, and values remain static at their value when the freeze was selected

Back track

Back track automatically snaps periodic store-points as the simulator is running. This is used to rerun events or to correct errors and continue running. This saves considerable amount of time.

Instructor Station

Instructor Station plays a pivotal role within the simulator with malfunction capabilities performed through scenarios and event triggers.

Instructor has the flexibility to initiate training at cold, hot, shutdown, full power operation or any Initial Condition (IC) required for training.

Training Program

The training courses can be adapted to the customized requirement of the customers. ABB intends to offer training through an integrated set of classroom (fundamentals and theory) and hands on simulator training.

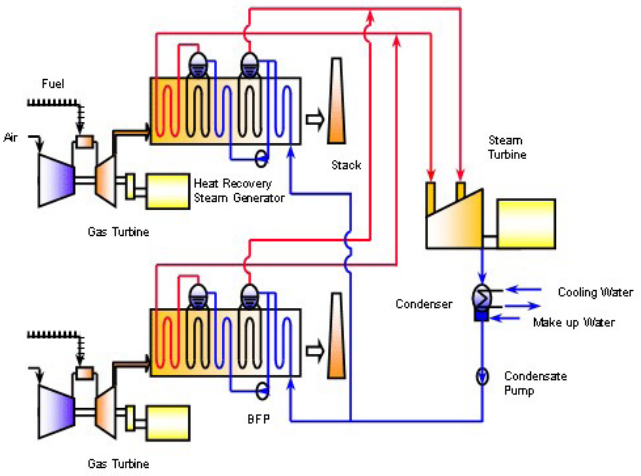
Typical course outline: The training program is structured for duration of Six (6) weeks to give detailed theoretical and practical (hands-on) experience for understanding and operating a typical combined cycle power plant

Trainers

ABB uses the service of highly experienced professional power plant trainers, who conduct similar courses around the world.

Documentation

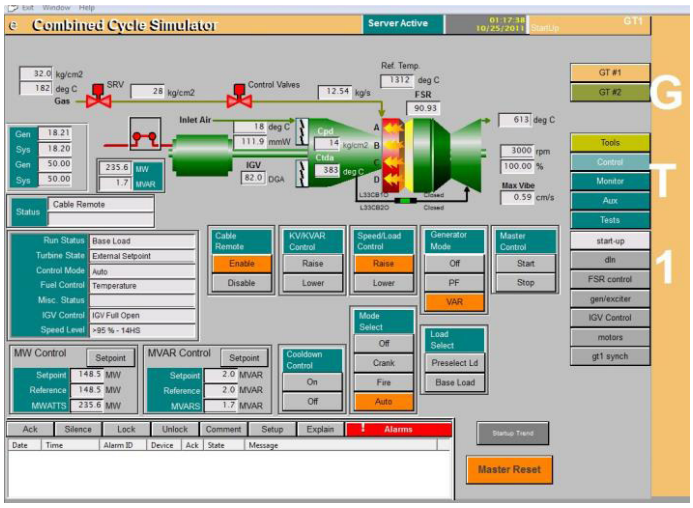
ABB will provide detailed documentation for different courses offered.



Simulated power plant training

Course Description:

The course covers the principles associated with the operation of a combined cycle power plant. Fundamentals of plant operation are emphasized and reinforced through the use of the simulator.



Snapshot of Gas Turbine Graphic

Simulator interface for trainee:

High fidelity combined cycle simulator with an operator station for each student (or shared by two) being trained in the class.

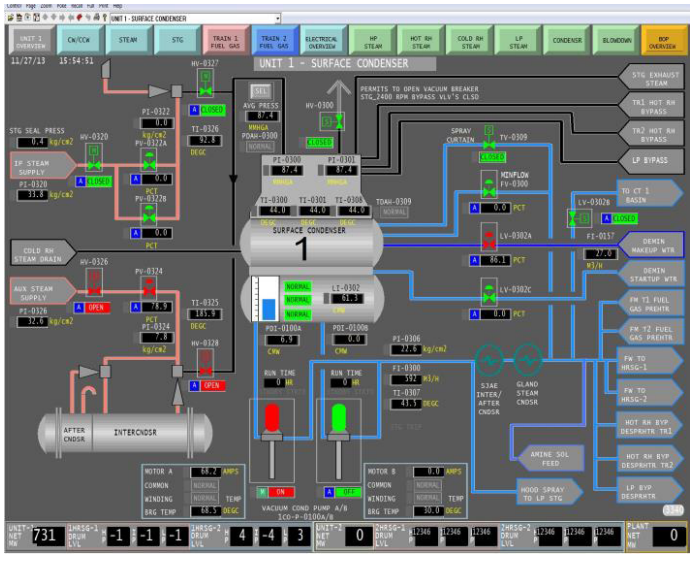
Students:

It is assumed the students have had an exposure to the technical aspects of physics and thermodynamics in a technical college environment without having a practical application of these principles.

Content:

The following topics will be covered during the course:

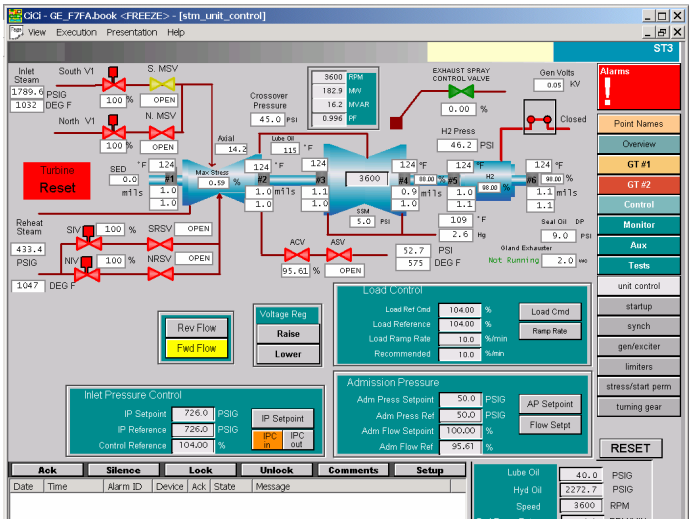
- Combined cycle power plant thermodynamic principles
- Combined cycle power generation
- Gas turbine / generator
- Heat Recovery Steam Generator (HRSG)
- Steam turbine / generator
- Auxiliary systems
- Combined cycle plant controls and operation



Training Objectives:

1. Provide each student with an opportunity to apply theory taught in a technical college to the operation of a combined cycle power station.
2. Apply the principals of pressure, temperature, heating value, thermodynamics, heat transfer and fluid flow, and electrical theory to the operation of a combined cycle power station.
3. Provide a proficiency in the startup,shutdown, and abnormal operations of the simulated combined cycle power station.
4. At the end of this course, students should understand:

– Laws of thermodynamics and energy conversion
– General purpose and basic operation of various plant systems
– Purposes and primary functions of each major component
– Primary flow paths for fuel, air, steam, cooling water, and power
– Sequence of events for a plant startup and shutdown
– Recovery from abnormal or emergency conditions.



Snapshot of Steam Turbine training screen

Training Approach:

The training would consist of approximately 50% classroom instruction and 50% practical exercises using the simulator. The intial weeks of training would require more classroom training while the latter weeks involve more simulator training.

The classroom training would provide a discussion of system applications in relations to other combined cycle power stations. All aspects of thermodynamic and heat transfer and fluid flow would be applied to fluid system operations. All aspects of electrical theory would be applied to electrical system operations.

Plant controls and logic would be covered in each system discussion along with a separate controls discussion of overall plant controls. Safety aspects would be covered where applicable during the systems training.

The simulator operation would start with normal plant operations while at load, allowing the student to become familiar with the overall plant controls. All aspects of plant

operations in a one-on-one, one-on-two, and simple cycle operations will be covered in the classroom and on the simulator.

Plant startup training would cover both a cold overhaul startup and hot restarts on the unit. Shutdown training would cover all types of unit shutdowns including; partial unit shutdowns, shutdowns for maintenance, overnight shutdowns and unit trip conditions

Abnormal plant operations would be covered on a system-by-system basis allowing the student to apply the problem to overall plant operations. All abnormal conditions would be covered in a cause, results, corrective actions format along with practice exercises on the simulator.

Each day, Classroom Training (theory and operation fundamentals) will be provided, which is then reinforced through exercises on the simulator. Time is allocated for question and answers every day.

Trainee Performance Evaluation (TPR)

The instructor station contains a Trainee Proficiency Review (TPR) program, which automatically monitors, records and grades critical trainee performance.

Student proficiency would also be assessed using written tests for knowledge and understanding of basic concepts.

Benefits of simulator training:

Increased operator efficiency and prepare operators to handle critical situations.

- Soft landing and damage limitation, fast recovery.
- Saving of plant life and limiting penalties.
- Ability to meet demanding operating schedules.
- In-depth understanding of the process.
- Provide virtual on-the-job experience.
- Gather “best practices” in plant operation.
- Training of situations with rare occurrence.
- Incident analysis.

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