Introduction
The Combined Cycle (CC) solution provides for the control and monitoring of a typical CC power plant in a cost effective, pre-engineered package.

Basic Architecture and Layout

Features of this system include:

- Total plant control & monitoring, single window to the plant,
- Control Room Operating and Engineering Stations,
- Combustion and Steam Turbine supervisory control and monitoring interface and software that includes functions for manual/automatic control, motor start/stop, as well as alarming,
- HRSG controls with controller, I/O modules, and control software,
- Condenser & Steam Turbine auxiliary controls with controller, I/O modules, and control software.
- Balance-of-Plant controls with controller, I/O modules
- Operating graphical displays for control and monitoring.
- Performance Calculations for the turbines and unit.
- Sequence of Event monitoring and logging for critical events at a 1 msec resolution.
- Plant data archival for trending or analysis.
- Control configuration design and software for regulatory and motor control
- Optional interfaces to Demineralizer, CEM, Auxiliary Duct Burners, and other systems.
The CC solution is highly modular, allowing great flexibility in reconfiguration and customization. As shown above, the digital turbine governor controllers interface to the DCS using C200 process controllers. This not only provides an inherent amount of isolation, therefore increasing reliability, but also allows for the solution to be easily scaled as needed by the specific application. Also, the number of Operator Stations can be selected to meet the needs of the specific project.

The Experion Server’s built-in Historian provides for much of the required trending and reporting functionality, while the Process History Database (PHD) provides long-term plant archiving as well as performance calculations, reports/logs. The BOP C200 contains all the I/O necessary for the control of the unit’s water circulation and miscellaneous systems. Also, the BOP C200 has space for additional applications. Interfaces to the Experion Server can be added as necessary for the sub-systems such as demineralizer trains, CEMs, or duct burners.

Auxiliary systems that run on Allen Bradley PLCs may be connected peer-to-peer with C200 Process Controllers on ControlNet. Other systems can be connected using built-in OPC channels, Modbus protocol, Ethernet, or one of many other interface protocols supported by the Experion Server.

**Standard Solution I/O Layout & Capability**

The standard CC Solution is based on 4 of Honeywell’s C200 process controllers (1 for each of the 2 CT/HRSGs, 1 ST, and BOP) each housing a varying number of I/O modules. Each of the C200s required for the solution has fully redundant processors and chassis, providing for enhanced safety and security. The I/O and cabinet capacities shown below are considered typical, however the desired amount of I/O can be increased or decreased as required.
Typical CC Specifications and Requirements

The typical CC solution is described as a medium sized plant with approximately 1500 analog and digital I/O connected to the CC controls and 1500 serial interface I/O from the turbines. However, systems with a greater or a lesser amount of I/O can be easily accommodated within the solution, as well as expansion or reduction in the number of CTs, HRSGs, and STs. The typical CC control solution includes the following:

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<th>Function</th>
<th>I/O or Interface</th>
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| **Combustion Turbine:** (2 typical) | Serial, Ethernet or OPC Interface  
- Analog ~225 typical  
- Digital ~275 typical |
| - Quantity 1 or More  
- Digital Turbine Interface  
- Supervisory Control & Monitoring |
| **Heat Recovery Steam Generator:** (2 typical) | Real I/O  
- Analog ~180 typical  
- Digital ~220 typical |
| - Quantity 1 or More  
- Direct Control for CC Controller  
- Incorporates Motor and Regulator |
| **Steam Turbine:** (1 typical) | Serial, Ethernet or OPC Interface  
- Analog ~100 typical  
- Digital ~350 typical |
| - Quantity 1 or More  
- Digital Turbine Governor Interface  
- Supervisory Control & Monitoring |
| **Steam Turbine, Condenser & Misc.:** (1 typical) | Real I/O  
- Analog ~225 typical  
- Digital ~275 typical |
| - Quantity 1 or More  
- Direct Control from CC Controller  
- Includes Misc. Not In Serial Interface |
| **Balance of Plant:** | Real I/O  
- Analog ~70 typical  
- Digital ~130 typical |
| - Direct Control from CC Controller  
- Controls for Misc. Plant Services |

Typical counts shown tend to reflect a well-integrated system, some projects may have greater or lesser amounts of I/O and interface requirements.

Application Overview

The CC solution uses predefined control and display software to provide the highest quality, repeatable solution. Predefined software is more rigorously tested and is specifically designed for optimum human factors and performance. Also, the CC solution's pre-defined application software provides a means to significantly reduce delivery times.

Operator Displays

One of the primary objectives of the CC solution is to provide a single window to the entire combined cycle process. To accomplish this, the solution will incorporate a comprehensive human interface, which will allow for not only control and monitoring but also report generation, data trending, and long-term archiving. The following is a brief listing of the major displays included within the standard solution.

**Combustion Turbine**
- Inlet
- Gears
- Exhaust
- Generator
  - Combustion
- Bearings
- Lubrication
Performance Calculations
Reports on the equipment and Unit performance may be provided with the optional TotalPlant Performance Monitor. The calculations are performed on a periodic basis and are available on operating displays, Web pages, as well as printed format. These include:

- Heat Rate and Efficiency on each Combustion Turbine.
- Efficiency on each HRSG.
- Heat Rate and Efficiency on Steam Turbine.
- Condenser Performance
- Unit Heat Rate and Efficiency

Archiving
The CC solution provides for data collection of process values from CT, HRSG, ST and BOP. This includes values from the HPM I/O, turbine interface, and Experion PKS system data and events. The archiving includes:

- Continuous history for logs and reports, and for trending from the operator stations,
- Event history for event logging,
- Long term archiving of plant process values, control data, and events.

I/O Database Configuration
The system includes the point building or configuration for each input and output signal in the Experion PKS system. This configuration includes range settings, descriptive text, and alarm values.

Interface Configuration
A point database for remote control and alarming of the Combustion Turbine and Steam Turbine interface data is provided. The interface configuration includes range settings, descriptive text, and alarm values, as well as the communication between the turbine controllers and the C200 or Experion Server.

Control Configuration
The control configuration for the HRSGs, Condenser and BOP systems are included. This control configuration includes regulatory (PID) controls and Motor Run/Stop stations (Logical).
The regulatory controls feature predictive feed forward controls and 3-element Drum Level controls. The Motor controls feature visual and audible feedback to the operator of permissive and interlock status.

Services

The CC solution provides engineering and management services required for a high quality design and implementation. Included are:

- Project Management services for coordination of project incorporating scheduling and progress reporting,
- Kick-off Meeting to review controls, project methods, and organization,
- Factory Acceptance Testing to demonstrate the proper operation of control hardware and software.

Documentation

System documentation provided includes:

- Operating instructions and maintenance manuals,
- Cabinet dimensional drawings & equipment layouts,
- Internal cabinet wiring diagrams,
- Parts lists & spare parts recommendations,
- I/O database for configuration,
- Regulatory control configuration,
- Motor and logic configuration.

Options

The CC solution can be expanded to include other plant systems and enhanced application software. The CC solution is designed to allow for these components to be easily added as desired for a specific application.

- Auxiliary Firing (duct) controller hardware and software can be provided. The control hardware for duct burner management can be included, as well as the logic for flame safety. Alternatively, it may be desired to provide serial interface capabilities to an auxiliary burner control system.
- Multiple Fuel Handling systems controller hardware and software for the CT and/or auxiliary burners can be provided.
- Demineralizer controllers and/or software can be provided in Experion PKS hardware, or other specified equipment.

Advanced control functions can be provided to improve performance and operations. These applications include:

- Continuous Temperature Control. This system optimizes the unit start-up and operation to minimize start-up times and reduce thermal stresses. The continuous temperature control system calculates the desired steam temperature and regulates the combustion turbine exhaust gas temperatures to minimize the steam turbine and the HRSG thermal stresses to allowable levels to minimizing the time required to achieve synchronization.

- Supervisory Sequences for Unit wide sequencing for CT, HRSG, ST and BOP systems can be provided. The sequences provide single-button, as well as operator guided, start-up and shut-down operations. These sequence controls work in conjunction with the sequence controls provided by the turbine manufactures for the turbines.

Summary

The Combined Cycle Solution implemented on the TotalPlant Solution system platform is another offering in Honeywell's portfolio to provide complete control and data acquisition functions for utility power plants. This superior solution integrates the gas turbines, steam turbine, HRSG, BOP into an overall control strategy.

Getting Started

The Combined Cycle Solution is offered on Honeywell's revolutionary new Experion PKS™ Process Knowledge System platform. Our Project Services personnel are ready to assist you in getting your boiler control project started. For more information, contact your local Honeywell representative, or call 1-800-288-7491 in the U.S.A.

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More Information
For more information on Combined Cycle Control, visit www.honeywellprocess.com, or contact your Honeywell account manager.

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