

Advanced Energy Solutions - Overview



Honeywell in Power Generation

Honeywell Process Solutions has more than four decades of power generation experience and has delivered state-of-the-art control systems and services to power generation facilities in more than 50 countries. Honeywell’s control systems are ensuring reliable, efficient and safe operation of industrial power operations all over the world.

Honeywell’s Advanced Energy Solutions

The industrial world is facing challenges of escalating fuel costs, emissions regulations, and to remain competitive, industrial power plants have to focus on:

- Reducing production costs
- Remaining within emission limits
- Maximizing unit production and flexibility
- Extending asset life
 - Optimizing asset utilization

Most industrial power plants use automation and distributed control systems to manage their steam and power generating assets. Adding a sophisticated advanced control layer in the form of optimization solutions is a logical step for improving



Figure 1: Industrial Power Plant

efficiencies and reducing waste.

Advanced Energy Solutions is an integrated set of software applications to aid the industrial power generator in better management of plant needs, and also meet the demands of their customers and regulatory commissions. Advanced Energy Solutions has a common platform which supports a suite of applications. It includes functions to optimize the combustion process, both heat and power load allocation, and electric power delivery. Typical benefits include:

- **Heat and power production costs savings**
- **Increased effective boiler operation range**
- **Optimized flue gas emissions, production capacity utilization, and transient states control**
- **Extended production asset life**
- **Reduced maintenance**

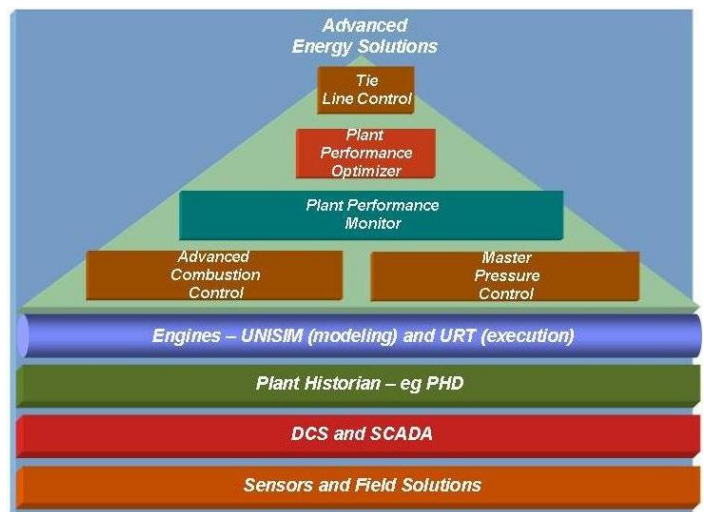


Figure2: Advanced Energy Solutions Architecture

Improving the efficiency of industrial power plants allow:

- Heat and power production costs savings
- Final industrial product production savings
- Extended production asset life
- Reduced maintenance

An advanced control strategy if deployed can enable the plant to react to uncertain conditions and reduce steam and electricity production costs with:

- Optimized production capacity utilization
 - Optimized economic load allocation to boilers and turbines
 - Optimized operation of turbines to extract maximum power

Reduced flue gas emissions through optimized combustion process:

- Tightly coordinated control of fuel and air
 - Optimized air-fuel ratio along with emissions constraints
- Prediction of electricity and steam demands
 - Helps meet external power contracts and internal commitments without accruing penalties
- Stable and tight operation of the generating assets through predictive control technology
 - Tight control of boilers and efficient use of fuel
 - Improves plant operation by stabilizing the various header pressures

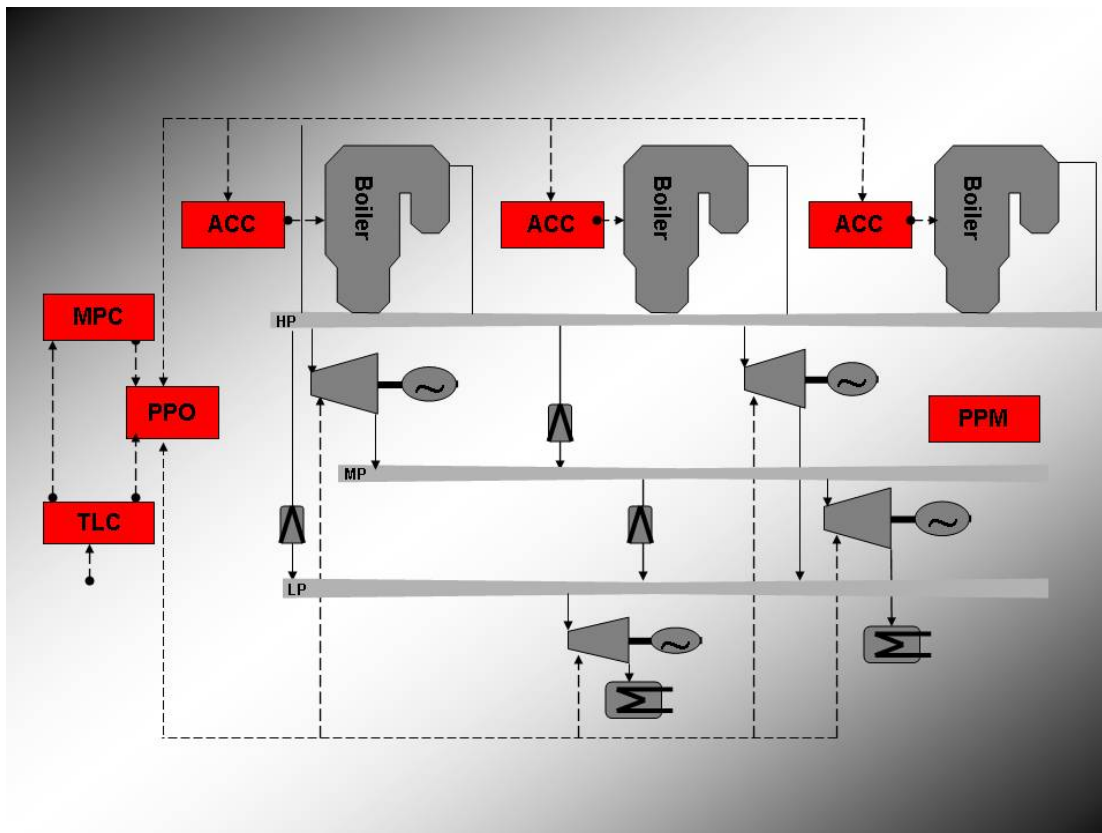


Figure 3: Advanced Energy Solutions Scheme for Industrial Power and District Heating Plants

Advanced Energy Solutions - Features

- Portfolio of modular solution packages use common infrastructure platform and shared components
- Advanced control and optimization for power generation and process steam production
- Optimization in the combustion process, heat load allocation, power load allocation, power delivery and ancillary services
- State-of-the-art advanced control strategies for superior response in transient states, support of open control systems, and support of standard communication protocols

Advanced Energy Solutions - Advantages

- Increase the boiler effectiveness and turbine operation range
- Optimize:
 - Combustion process
 - Multiple load allocation
 - Power generation
 - Steam production
- Extend asset life
- On-line prediction, optimization and contract compliance of electric consumption and generation
- Increase the overall process efficiency
- Operation mode stability and flexibility
- NO_x, SO_x emission limitations (within constraints)
- Stability of CO emissions under constraints (greenhouse gas effect)

Advanced Energy Solutions - Applications

The following components are integrated into Advanced Energy Solutions.

- **Advanced Combustion Control (ACC)**
- **Master Pressure Control (MPC)**
- **Plant Performance Optimizer (PPO)**
- **Plant Performance Monitor (PPM)**
- **Tie Line Control (TLC)**

Advanced Combustion Control (ACC)

Advanced Combustion Control optimizes the boiler combustion process to provide maximum efficiency while respecting the equipment and the environmental constraints.

Following are the specific advantages of ACC:

- Optimum air/fuel ratio
- Optimize thermal efficiency of individual boiler or minimize loss of heat in flue gas
- Stabilize and minimize flue gas emissions below environmental regulation levels
- 2-5% reduction in fuel consumption
- 2-4% reduction of greenhouse gas emissions
- 3-5% reduction in overall operation and maintenance cost

Master Pressure Control (MPC)

The control of main steam header pressure is referred to as Master Pressure Control. The basic control scheme keeps the different header pressures. The advance control scheme will reduce the variation further by using multivariable predictive technology. Excessive fluctuations in the main stream header can lead to trip of the boiler due to drop in drum level or can trip turbines due to variations in steam temperature.

The main role of the MPC is to:

- Minimize the error between the pressure set-point range and the actual pressure
- Guarantee continuous balance between produced and consumed steam
- Control total heat input into boilers
- Control total steam flow into each header
- Minimize the violations on soft limits such as set-point high of the header pressure

MPC is a predictive controller; it utilizes both the current input data and predictions on steam consumption to optimize total heat input. The required header steam pressure is entered as a narrow set range between low and high limits, rather than a single set point value. This results in “stable process control” without any process disturbances, and has a positive impact on asset lifetime, achievable combustion quality, and stability of the output steam temperature control.

Plant Performance Optimizer (PPO)

Plant Performance Optimizer is a dynamic resource allocation for steam and power to meet the load demand in a closed loop. This closed loop in a cascade mode co-ordinates the set points for the

optimizers/control systems. It considers various constraints for optimization.

PPO accepts overall load demands in multiple forms like power or steam load. It also determines optimal allocation of online power generation to meet the load demands. The energy saving achievable makes dynamic, economic load allocation an attractive choice to meet the generation demand with minimum fuel cost.

PPO achieves load allocation optimization for industrial plants by performing the following:

- Load demand forecast and management
- Generation monitoring
- Unit performance monitoring
- Cost saving evaluation
- Optimal allocation in closed loop mode
- “What-if” analysis based on first principle simulation model

PPO minimizes electric and heat losses by distributing the load onto all operating boilers and turbines.

PPO has the following two modules:

- Economic Load Allocation for Boilers (ELA-B)
- Economic Load Allocation for Turbines (ELA-T)

ELA-B together with the MPC allocates load efficiently to different boilers while considering the boiler dynamics. The main objective is to allocate the steam demand optimally to different boilers by considering all operational and business constraints. It evaluates operational cost curves for steam production in different boilers and finds their steam output levels corresponding to minimal production costs.

ELA-T supplies the power generation set points for individual turbines providing the most effective utilization of steam for power generation and meeting requirements for heating or process steam output. It can run in a wide range of multiple turbine setups, including condensing, back-pressure, extraction turbines, and pressure reduction units.

Plant Performance Monitor (PPM)

Plant Performance Monitor is a software tool that evaluates the boiler or turbine efficiency for plant operations. It also evaluates the operational efficiency and operational parameters such as specific oil consumption, unit auxiliary power consumption, plant load factor, plant availability and so on. Equipment monitored by PPM are:

- Boilers
- Turbines
- Heat exchangers (HP, LP, GAH, SCAH, Feed Water Tanks, condenser)
- Steam extractions
- Mass balances
- Losses in desulphurization

PPM features:

- Operations surveillance tool for managers
 - Continuous improvement of operations KPI
 - Systematic approach to operations KPI evaluation
- Problem identification
 - Troubleshooting tool for quick tracking down efficiency weakness points
 - Allows for immediate qualified measures to bring KPI's back on track
- Report
 - Generate report on a schedule or event based
 - Reports is generated in pdf, html or excel format
 - Reports are stored in server as well mailed to a group or individual
- Short-term operations management
 - Speed up the decision process for short-term production scheduling
- Additional value to process history data
 - Computation output – operations KPI's
 - Automatic archiving
 - Available on-the-fly for long-term monitoring and evaluation

PPM provides insight into the efficiency of different process equipment which improves the decision making in operations and maintenance. It also helps in real-time performance monitoring.

Tie-Line Control (TLC)

Industrial power assets are increasingly expected to work in an integrated manner with external power contracts both on an import and export basis to reduce the overall cost of power, or take advantage of external power market sales. TLC provides real time power production control and monitoring by integrating internal demand with external contractual commitments allowing for changing generation output trajectory.

The TLC uses the following functions:

- Real-time optimization of power generation
 - Monitors real time power generation and internal consumption
 - Predicts cumulative power supply/consumption to/from the grid within contract period
 - Optimizes generation trajectory to meet the contractual power quota
- Power quota planning database tools

Closed Loop Control Strategy of Advanced Energy Solutions

Advanced Energy Solutions can be implemented by individual components or as a complete integrated solution, in order to maximize the process optimization benefit. The components are tightly interconnected; have common architecture and compatible interfaces.

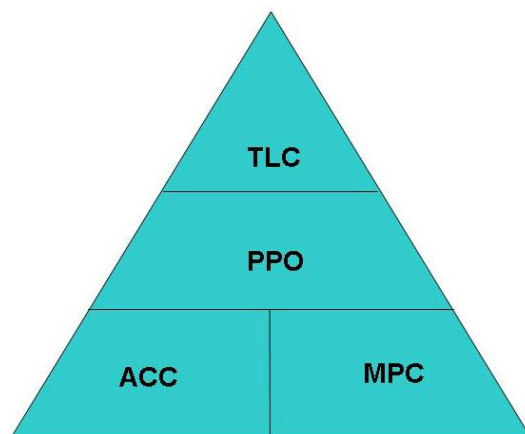


Figure 4: Advanced control strategy – closed loop solutions

Figure 4 shows the closed loop solutions strategy. At the lowest level is the Advanced Combustion Control, which is used for boiler control. It enables tighter, optimized combustion control with optimized steam. The next supervisory level is the Plant Performance Monitor for boilers and turbines. This provides optimal load set-points to individual boilers and turbines. The Master Pressure Control addresses the stability of steam headers through predictive control technology and this is crucial for the normal operation of the overall the boiler. Tie Line Control optimizes the steam and electricity production considering the overall process steam and power demand along with external contracts and uncertainties such as power tariffs, fuel cost and so on.

Advanced Energy Solutions - Data Services

Advanced Energy Solutions platform provides a common data server infrastructure layer to acquire plant data and provide the data to the Advanced Energy Solutions applications. The platform:

- Provides the user the ability to select & configure the interfaces to the data sources
- Supports real-time data sources like OPC Data Access 2.0
- Provides the ability to specify the scan rates for parameter access
- Detects failure of the communication to the data source and indicates the failure to all consuming modules and applications
- Provides basic value processing including data validation, quality check and quality propagation
- Provides the ability to specify the order and priority of execution of application tasks if needed
- Advanced Energy Solutions supports the necessary execution of all the algorithm blocks
 - Supports a calculation engine to execute the calculations
 - Provides services for converting the engineering units
 - Provides alarms to alert the user when any Advanced Energy Solutions application fails

Advanced Energy Solutions - User Management

- The Advanced Energy Solutions platform provides a user management system that is based on windows security

- Advanced Energy Solutions manages users in configuring the application for plant specific requirements
- The Advanced Energy Solutions manages the creation, deletion and editing of user roles. It has a predefined set of privileges that can be assigned to roles using the Advanced Energy Solutions user management system
- Valid windows users can be assigned to one of the predefined or user created roles, and the user will inherit all the privileges associated to that role
- The privileges are predefined by the system and cannot be modified.

Conclusion

Advanced Energy Solutions provide a low-cost, high return alternative to expensive boiler retrofits for improving operational efficiency as well as reducing emissions. Its applications are designed to meet specific requirements of the industrial power generator enabling operation of the plant with maximum process efficiency and operational profit under the constraints imposed by technology and environmental regulations.

More Information

For more information on Advanced Energy Solutions, visit our website www.honeywell.com/ps, or contact your Honeywell account manager.

Automation & Control Solutions

Process Solutions

Honeywell

2500 W. Union Hills Dr.

Phoenix, AZ 85027

Tel: +1-602-313-6665 or 877-466-3993

www.honeywell.com/ps

SO-08-67-ENG
November 2008
© 2008 Honeywell International Inc.

The Honeywell logo is displayed in a bold, red, sans-serif font.