

# POWER STATION CONTROLS CAPABILITY STATEMENT

## 1. Introduction

Provecta Process Automation LLC, based in Chicago, is an Australian-owned controls and electrical professional engineering services company specializing in high-level automation and advanced control solutions for the power generation industry.

Provecta has developed an international reputation as a consistent deliverer of highest quality, cost-effective projects and innovative control design solutions. Projects and services have been delivered to clients throughout Australia and worldwide.

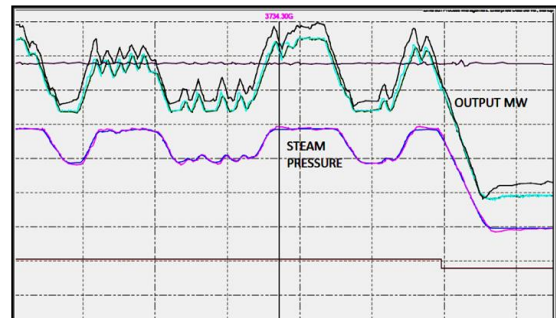
Our senior engineers' extensive experience in power plant operations, performance and investigations as well as in control system design, implementation and optimisation uniquely positions us to take all aspects of the client's environment into account when forming our solutions. This ensures control projects – ranging from adjustments to full equipment replacements - meet each generating station's individual requirements, and to ensure projects deliver the required benefits.

## 2. Background

Provecta Australia was formed in 2003 by nine senior control system professionals specializing in the power generation industry. The company has grown to become one of Australia's largest independent control system project and consultancy providers operating in the power and water critical infrastructure industries.

International clients, particularly in the USA, have been increasingly drawing on Provecta's expertise to help meet changing operational demands such as faster ramping, improved frequency response, wider operating range and reducing manual operations. This has resulted in Provecta's decision to open a permanent office in the USA. In 2017, Provecta opened its first US branch.

Provecta has experience in the design, configuration, commissioning, testing and tuning of various control systems for a wide range of generating plant including wind, hydro, thermal solar, combined and simple cycle gas turbines, with particular expertise in large coal-fired boiler/turbo-generator units (both drum and supercritical once-through units). This experience also extends to control projects for generating station common plant including water treatment, coal handling, ash disposal systems etc.



### 3. Clients

Provecta's US clients have included:

- Bechtel Corporation (Elm Rd, Trimble County, Prairie State, Russell City CCGT, Ivanpah Thermal Solar)
- Prairie State Generating Corporation
- LG&E/KU
- Sandy Creek Services

Major Australian generation clients include:

- AGL Macquarie, Delta Electricity, Energy Australia, Origin Energy, Trustpower in NSW,
- Stanwell Power Corporation, CS Energy, Origin Energy, Millmerran Operating Co. and Intergen in Queensland,
- AGL and Alinta (Flinders Power) in South Australia,
- Power & Water Corporation in Northern Territory,
- Vinalco/Verve and Bluewaters in Western Australia.



Trimble County Generating Station

Other International Clients have included:

- Doosan Babcock UK (design consultancy, tuning, training)
- Toshiba Japan (DCS support, DCS design review, commissioning procedures, training)
- Doosan Sth Korea (design review, on-site tuning advice, training)
- EVN -Vietnam (control system audit; training)

Provecta is accredited and committed to conducting business within the framework of AS/NZS ISO 9001:2008 - Quality Management System, to ensure the delivery of quality services to our clients.

### 4. Specific Expert Capabilities

Provecta has experience in all aspects of implementing controls projects, from assessment and concept through to implementation and system optimisation. Provecta aims to utilise its expertise in high level automation and advanced controls to become "Partners in Performance" with owners and operators.

#### Innovative Solutions

Our staff have developed innovative solutions to many technical challenges in the power industry. These include:

- Operational and control philosophies for unattended operation, single push-button start automation and highly rationalised alarm systems.
- System ancillary services optimisation such as primary and secondary frequency control, dynamic MW reserve margin and AGC rate maximization.
- Coal pulverizer and fuel systems optimization: anti-choking and output response enhancement.
- Advanced steam temperature control utilizing high order, adaptive Internal Model controllers and steam properties calculations; setpoint optimization for improving unit heat rate.
- Model-based, two-degree-of-freedom fuel, steam pressure and flue gas O<sub>2</sub> controller designs for improved performance under sliding pressure operation.
- Control room centralization: ergonomics, options, benefits, operational risk and transition analyses.

Provecta has presented papers at ISA's POWID conferences on some of these topics. Copies can be supplied upon request.

### Investigations and Optimisation

Provecta's extensive experience in power plant operation, dynamics and controls enables root causes of control and performance problems to be quickly identified and addressed. Our capabilities include:

- Use of advanced analysis and simulation tools including Matlab/Simulink to identify system responses and pre-test control adjustments;
- Review and adjustment of actuator dynamics;
- Use of Provecta's own optimisation tools to calculate adaptive gains based on steam properties and system characteristics and PID settings based on adaptations of IMC (Lambda) tuning;
- Preparation of clearly set out procedures for open and closed loop testing;
- Detailed reporting of all tests, design changes, adjustments and results.

### Automation Level and Operator Efficiency Enhancements

Provecta has designed and implemented many improvements to assist in reducing operator workload at the panel, often allowing operators to take on more flexible duties. Examples include:

- Sequences for air/gas systems, feedheaters, pulverizers, auxiliary steam;
- Startup setpoint automation: Boiler demand, SH/RH steam temperature and main steam pressure;
- Operation ergonomics and control room layout for multiple-unit operation (such as 2 operators for 4 units);
- Comprehensive risk assessments associated with operations rationalization projects, including design reviews of alarm system, process protection, modulating controls, sequence automation, and room/desk layout.

### Training in Control Systems Design, Dynamics and Tuning

Provecta has delivered highly customised, simulation-based training of power plant systems, dynamics, control designs and tuning techniques. The courses include:

- Introduction to feedback controllers;
- Stability and tuning techniques;
- Advanced designs: cascade, internal model, adaptive, 2 degree of freedom
- Process controls specific to power plant –air/gas, steam temperature, fuel, feedwater, governor, etc;
- High level control designs: boiler/turbine co-ordinated controls and modes; runbacks, frequency response and advanced control designs for supercritical plant.

Further course detail can be provided upon request.

## 5. Power Station Controls - Reference Projects

Provecta has been engaged to provide engineering assistance on a large number of projects associated with power station control systems. The engineering services provided have encompassed a variety of roles including consulting assignments (from project concept development, specification preparation, tender analysis, tender negotiation, design reviews) and detailed engineering (project management, design, configuration, testing, tuning and documentation). Below is a brief summary of some of these projects:

### A. USA – Controls design review, co-ordinated commissioning scheduling, site control enhancements and tuning.

#### **Elm Road, Wisconsin (Owner: WE Energies Client: Bechtel Corp)**

- 2x677MW, Coal fired, supercritical once-through, Hitachi Boiler and Turbine, Emerson DCS
- Boiler and Co-ordinated Controls concept and design and detailed configuration review
- On-site assistance with Simulator testing and optimisation
- Detailed integrated load ascension and testing program development
- On-site unit controls testing, adjustments, tuning, investigations
- Ramp tuning
- Development of operational procedures and investigation of plant and operation issues (e.g. trip root cause analysis)

#### **Trimble County, Kentucky (Owner: LG&E/KU Clients: Bechtel Corp; LG&E/KU)**

- 1x833MW, Coal fired, supercritical once-through, Babcock Boiler, Hitachi Turbine
- Co-ordinated Controls design review
- Detailed integrated load ascension and testing program development
- On-site controls testing, adjustments, tuning and investigations, including advanced superheater control, enthalpy-based feedwater control and unit co-ordinated controls
- Ramp tuning and acceptance tests
- Re-tuning after burner replacement
- LG&E support: AGC ramp tuning; feed pump control analysis; operator training

#### **Prairie State Energy Campus, Illinois (Clients: Bechtel Corp; Prairie State Generating Company)**

- 2x877MW, Coal fired, supercritical once-through, B&W Boiler, Toshiba Turbine
- On-site assistance with Simulator testing and optimisation
- Detailed integrated load ascension and testing program development
- On-site controls design and configuration reviews, testing, adjustments, tuning, investigations
- Control logic and automation enhancements during commissioning
- Ramp tuning and acceptance tests
- PSEC Support: Automation enhancements; load range optimization; pulverizer control enhancements; controls support for plant and equipment changes.

#### **Russell City Energy Centre (Owner: Calpine Client: Bechtel)**

- 2x2x1 600MW Combined Cycle Siemens Westinghouse 501FD CTGs, GE STG
- Co-ordinated Controls, Bypass System and HRSG: sequence, modulating and protection controls design concept and detailed configuration review
- Integrated total plant start-up and testing/tuning program development
- On-site controls commissioning and tuning support

## B. Australia - Control, Operations, Performance Improvement and Owners' Engineer Services

### Millmerran Power Station Control (Qld), Operation and Plant Process Enhancements Engineering Services

- 2x425MW, Coal fired, supercritical once-through, B&W Boiler, Ansaldo Turbine
- Extensive modifications to Unit Master operation, overfiring, runbacks and frequency response;
- Pulverizer control tuning;
- Improved feedwater master control scheme and startup feedwater control enhancements;
- Major superheater and reheater temperature control enhancements;
- New automated plant sequences including Air Cooled Condenser performance improvements



Millmerran Power Station

### Liddell Power Station (NSW) Control, Operations and Performance Enhancement Services

Provecta has provided extensive engineering services to investigate, develop and implement control, operations and plant performance enhancements. The services include:

- Owner's C&I and electrical engineer on major projects;
- Plant failure investigations;
- Design and implementation of control enhancements for the Yokogawa CS3000 DCS controls;
- DCS IT, security and infrastructure support.
- DCS controls and tuning for Solar Steam Generator and new boiler dry bottom ash system;
- Modification and tuning of the boiler-turbine unit controls, pulverizer choking protection, and introduction of pulverizer and HP heater sequences.

### Northern Power Station (SA)

- 2x275MW sub-critical once-through boiler power plant, Yokogawa Centum VP DCS.

Provecta has:

- provided strategic-level advice regarding aspects of a recent major DCS refit project,
- implemented Frequency Control Ancillary Services involving new algorithms to provide advanced dynamic adjustments to fuel, MW and steam pressure setpoints;
- implement controls design and tuning changes for fast ramping;
- assist in tests and control changes to reduce minimum operating load ;
- design, implement and test logic to allow mill flashing (start without ignition oil).

**Unit Plant Controls Upgrades Owners Engineer and Project Engineering Support Services – Stanwell Power Station (Qld), Torrens Island B Power Station (SA), Tarong Power Station (Qld) and Bayswater Power Station (NSW)**

Provecta has performed engineering support (Owner's engineer) roles for a number significant controls upgrade projects. The work scopes included:

- Development of project structure and upgrade strategy;
- Site investigations and scope development;
- Performance benchmarking;
- Identification of control/operational enhancement options (such as single push-button start, control room redesign);
- Project cost estimation, full technical specification preparation, tender analysis and negotiation;
- Expert assistance during design, testing and implementation.

## 6. Other Advanced Engineering Services

### Control System Benchmarking

Provecta provides detailed benchmarking services to assist in assessing control system performance under a standard set of open and closed loop tests. This is often done as a lead-up to control system replacement or major controls retuning task. Benchmarking can also identify any current plant and control structure or tuning issues and processes that would benefit from advanced control strategies.

### Site Commissioning Co-Ordination

Our staff have been involved in all aspects of site commissioning for controls upgrade projects. This includes loop testing, functional testing, in-service checks, tuning and performance tests. Provecta has developed and managed comprehensive, integrated programs for both green-field and rehabilitation projects to co-ordinate startup and testing of all plant and control systems.

### Alarm System Management

Provecta's engineers have produced alarm design philosophies and principles, conducted detailed alarm application design, investigated and optimised alarm systems, produced alarm management tools, and undertaken research into intelligent advisory systems, all specifically for power plant. Our engineers can undertake an independent review of current system performance and develop and implement a comprehensive design and management philosophy. Our staff can also provide ongoing remote support to help ensure alarms continue to achieve performance targets.

### IT Security

Provecta has taken leading roles in the specification, design, maintenance and enhancement of IT security systems for several large power utility fleet owners, and is extremely well placed to provide independent, expert input into IT security reviews for power plant control systems.

### Process Protection Systems

Provecta has wide experience with achieving the control and protection requirements to comply with specific codes such as NFPA and ASME, as well as safety integrated process protection systems within the processes of AS61508/AS61511. Provecta can undertake formal compliance reviews or recommend enhancements to existing levels of instrument redundancy and protection.

## FURTHER INFORMATION

For further information in regard to the above projects and other projects performed by Provecta, please visit [www.provecta.com.au](http://www.provecta.com.au) or contact:

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