APPENDIX E
CONTROL SYSTEMS ENGINEERING DESIGN AND CRITERIA

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1.0 INTRODUCTION

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and installation of instrumentation and controls for the Pio Pico Energy Center (PPEC). More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification, and construction specifications.

2.0 CODES AND STANDARDS

The design of the control systems and components will be in accordance with the applicable laws, ordinances, and regulations of the federal government, State of California, and local agencies, as well as industry standards. The most current issue or revision of rules, regulations, codes, ordinances, and standards at the time of filing this Application for Certification will apply, unless otherwise noted. If conflicts exist between cited documents, the more conservative requirements will apply.

The following codes and standards are applicable to the control system and component aspects of the power facility:

- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- The Institute of Electrical and Electronics Engineers (IEEE)
- Instrument Society of America (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)

3.0 CONTROL SYSTEMS DESIGN CRITERIA

3.1 GENERAL PLANT CONTROL PHILOSOPHY

An overall facility distributed control system (DCS) will be used as the top-level supervisor and controller for the project. DCS operator workstations will be located in the control room area of the administration and control building. The intent is for the plant operator to be able to completely run the entire power island from a DCS operator station, without the need to interface with other local control system panels or devices. The DCS system will provide appropriate hard-wired signals to enable control and operation of all plant systems required for complete automatic operation.

Each combustion turbine-generator will be provided with its own microprocessor-based control system, with a local operator workstation in each CTG control module, and remote operator workstations installed in the remote main control room. The DCS will provide supervisory control and monitoring of each combustion turbine-generator.

Some of the larger packaged subsystems associated with the project, such as water treatment, may include their own programmable logic control (PLC)based dedicated control systems. For larger systems that have dedicated control systems, the balance-of-plant (BOP) DCS will function mainly as a monitor, using network data links to collect, display, and archive operating data received from the PLCs.

Pneumatic signal levels, where used, will be 3 to 15 per square inch gauge (psig) for pneumatic transmitter outputs, controller outputs, electric-to-pneumatic converter outputs, and valve positioner inputs.

Instrument analog signals for electronic instrument systems will be 4 to 20ma dc.

The primary sensor full-scale signal level, other than thermocouples, will be between 10mV and 125 volts (V).

3.2 PRESSURE INSTRUMENTS

In general, pressure instruments will have linear scales with units of measurement in psig.

Pressure gauges will have either a blowout disk or a blowout back and an acrylic or shatterproof glass face.

Pressure gauges on process piping will be suitable for the plant atmospheres.

Pressure test points will have isolation valves and caps or plugs. Pressure devices on pulsating services will have pulsation dampers.

3.3 TEMPERATURE INSTRUMENTS

In general, temperature instruments will have scales with temperature units in degrees Fahrenheit. Exceptions to this are electrical machinery Resistence Temperature Detectors (RTDs) and transformer winding temperatures that will be in degrees Celsius.

Dial thermometers will be bimetallic actuated, every-angle type with 4-1 /2- or 5-inch-in-diameter (minimum) dials and white faces with black scale markings. Dial thermometers will be suitable for the plant atmospheres.

Temperature elements and dial thermometers will be protected by thermowells, except when measuring flue gas or air temperatures at atmospheric pressure. Temperature test points will have thermowells and caps or plugs.

RTDs will be either 100 ohm platinum or 10 ohm copper, ungrounded, three-wire circuits. The element will be spring-loaded, mounted in a thermowell, and connected to a cast iron head assembly.

Thermocouples will be single-element, grounded, spring-loaded, Chromel-Constantan (ANSI Type E) for general service. Thermocouple heads will be the cast type with an internal grounding screw.

3.4 LEVEL INSTRUMENTS

Reflex-glass or magnetic level gauges will be used. Level gauges for high-pressure service will have suitable personnel protection.

Gauge glasses used in conjunction with level instruments will cover a range that matches the range covered by the instrument. Level gauges will be selected so that the normal vessel level is approximately at gauge center.

3.5 FLOW INSTRUMENTS

Flow transmitters will be the differential pressure type with the range matching the primary element. In general, linear scales and charts will be used for flow indication and recording.

In general, airflow measurements will be temperature-compensated.

3.6 CONTROL VALVES

Control valves in throttling service will generally be the globe-body cage type with body materials, pressure rating, and valve trims suitable for the service involved. Other style valve bodies (e.g., butterfly, eccentric disk) may also be used when suitable for the intended service.

Valves will be designed to fail in a safe position.

Control valve body size will not be more than two sizes smaller than the line size, unless the smaller size is specifically reviewed for stresses in the piping.

Control valves in 600-class service and below will be flanged where economical. Where flanged valves are used, minimum flange rating will be ANSI 300 Class.

Severe service valves will be defined as valves requiring anti-cavitation trim, low noise trim, or flashing service, with differential pressures greater than 100 psid.

In general, control valves will be specified for a noise level no greater than 90 decibels ‘A’ scale (dBA) when measured 3 feet downstream and 3 feet away from the pipe surface.

Valve actuators will use positioners with the highest pressure, smallest size actuator and will be the pneumatic-spring diaphragm or piston type. Actuators will be sized to shut off against at least 110 percent of the maximum shutoff pressure and designed to function with instrument supply air pressure ranging from 60 to 125 psig.

Handwheels will be furnished only on those valves that can be manually set and controlled during system operation (to maintain plant operation) and do not have manual bypasses.

Control valve accessories, excluding controllers, will be mounted on the valve actuator unless severe vibration is expected.

Solenoid valves supplied with the control valves will have Class H coils. The coil enclosure will normally be a minimum of NEMA 4, but will be suitable for the area of installation.

Terminations for solenoid valves will typically be by pigtail wires.

Valve position switches (with input to the DCS for display) will be provided for motor operated valves (MOVs) and open/close pneumatic valves. Automatic combined recirculation flow control (modulating) and check valves (provided by the pump manufacturer) will be used for pump minimum-flow recirculation control.

3.7 INSTRUMENT TUBING AND INSTALLATION

Tubing used to connect instruments to the process line will be 3/8- or 1/2-inch-outside diameter copper or stainless steel as necessary for the process conditions.

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use and will be standardized as much as practical throughout the plant.

Differential pressure (flow) instruments will be fitted with three-valve manifolds; two-valve manifolds will be specified for other instruments, as appropriate.

Instrument installation will be designed to correctly sense the process variable. Taps on process lines will be located so that sensing lines do not trap air in liquid service or liquid in gas service. Taps on process lines will be fitted with a shutoff (root or gauge valve) close to the process line. Root and gauge valves will be main-line class valves.

Instrument tubing will be supported in both horizontal and vertical runs as necessary.

Expansion loops will be provided in tubing runs subject to high temperatures. The instrument tubing support design will allow for movement of the main process line.

3.8 PRESSURE AND TEMPERATURE SWITCHES

Field-mounted pressure and temperature switches will have either NEMA Type 4 housings or housings suitable for the environment.

In general, switches will be applied such that the actuation point is within the center one-third of the instrument range.

3.9 FIELD-MOUNTED INSTRUMENTS

Field-mounted instruments will be of a design suitable for the environment in which they are located. They will be mounted in areas accessible for maintenance and relatively free of vibration and will not block walkways or prevent maintenance of other equipment.

Field-mounted instruments will be grouped on racks where practical. Supports for individual instruments will be prefabricated, off-the-shelf, 2-inch pipe stands. Instrument racks and individual supports will be mounted to concrete floors, to platforms, or on support steel in locations not subject to excessive vibration.

Individual field instrument sensing lines will be sloped or pitched in such a manner and be of such length, routing, and configuration that signal response is not adversely affected.

Local control loops will generally use a locally mounted indicating controller (flow, pressure, temperature, etc.).

Liquid level controllers will generally be the non-indicating, displacement type with external cages.

3.10 INSTRUMENT AIR SYSTEM

Branch headers will have a shutoff valve at the takeoff from the main header. The branch headers will be sized for the air usage of the instruments served, but they will be no smaller than 3/8 inch. Each instrument air user will have a shutoff valve and filter at the instrument.