Pico Power Project

Appendix 10-E
Control Engineering Design Criteria

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APPENDIX 10E

CONTROL ENGINEERING DESIGN CRITERIA

10 E1 INTRODUCTION

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and installation for 10F.1 instrumentation and controls for the Facility. More specific project information will be developed prior to construction of PPP to support detailed design, engineering, material procurement specifications, and construction specifications as required by the California Energy Commission.

10 E2 CODES AND STANDARDS

Design specifications for all work performed will be in accordance with the laws and regulations of the federal government and the State of California. A summary of general codes and industry standards applicable to design and construction follows.

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

10 E3 CONTROL SYSTEMS DESIGN CRITERIA

10 E3.1 General Plant Control Philosophy

The two combustion turbine generators and the steam turbine generator include their own microprocessor based control systems with local and remote operator workstations, installed on the turbine-generator control panels and in the remote main control room, respectively. The gas turbine control panels are installed in an electrical control enclosure, adjacent to the gas turbine generators, and the steam turbine generator control panels is installed in the remote main control room.

Several of the larger packaged subsystems associated with the PPP include their own PLC based dedicated control systems. For larger systems that have dedicated control systems the Distributed Control System (DCS) will function mainly as a monitor, using network data links to collect, display, and archive operating data.

The DCS system will function as the top-level supervisor and controller for the PPP. The intent is for the plant operator to be able to completely run the entire plant from the DCS operator station, located in the remote main control room, without the need to interface to other local 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. Furthermore, SVP's off-site dispatch center shall be able to monitor and control certain outputs of all three generators.

For the Heat Recovery Steam Generator (HRSG), the DCS will directly control level, flow, and temperature loops based on data from transmitters and other field devices. The DCS will also control motors and monitor motor status.

10 E3.2 Pressure Instruments

Pressure instruments will have linear scales with units of measurement in pounds per square inch gauge.

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 corrosion resistant and weatherproof.

Steam pressure sensing transmitters or gauges mounted above the steam line will be protected by a loop seal or siphon.

Pressure test points will have isolation valves and caps or plugs. Pressure devices on pulsating services will have pulsation dampers. Pressure devices subject to shock during equipment starts, stops, or transient conditions will be installed on an isolated gauge panel.

10 E3.3 Temperature Instruments

Temperature instruments will have scales with temperature units in degrees Fahrenheit. Exceptions to this are electrical machinery RTDs and transformer winding temperatures, which may be in degrees Celsius.

Dial thermometers will have 4½ or 5-inch diameter (minimum) dials and white faces with black scale markings, and will be every-angle type and bimetal actuated. Dial thermometers will be corrosion resistant and weatherproof.

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

RTDs will be either 100ohm platinum or 10ohm copper, ungrounded, three-wire circuits ($R_{100}/R_0=1.385$). The element will be spring-loaded, mounted in a thermowell, and connected to a head assembly.

Thermocouples will be single-element, grounded, spring-loaded, Chromel-Constantan (ANSI Type E) for general service. Chromel-Alumel (ANSI Type K) may be used for flue gas temperature measurement and high temperature applications (exceeding 1100°F). Thermocouple heads will be the cast type with an internal grounding screw.

10 E3.4 Level Instruments

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

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

A remote water level indicating system will be provided for each HRSG drum as required by the ASME Boiled Code.

10 E3.5 Flow Instruments

Flow transmitters will be the differential pressure types with the range matching the primary element. In general, linear scales and trend displays will be used for flow indication.

The flow element for HP and IP feedwater flow to each HRSG will be laboratory calibrated venturi flow nozzles or low-loss flow tubes.

Feedwater flow meters will be temperature compensated when the water temperature is greater than 250°F. Critical steam flow meters will be temperature and pressure compensated. Airflow measurements will be temperature compensated.

10 E3.6 Control Valves

Control valves in throttling service will generally be the globe-body cage types 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 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.

Critical service valves will be defined as ANSI 900 Class and higher valves in sizes larger than 2 inches.

Severe service valves will be defined as valves requiring anticavitation 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 dBA when measured 3 feet downstream and 3 feet away from the pipe surface.

Valve actuators will use positioners and 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 air pressure.

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 will typically be by pigtail wires.

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

10 E3.7 Instrument Tubing and Installation

Tubing used to connect instruments to the process line will be 3/8-inch outside diameter copper or stainless steel as necessary for the process conditions. Half-inch O.D. tubing may be used when deemed necessary by the Contractor.

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use so that equipment 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.

10 E3.8 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.

10 E3.9 Field-Mounted Instruments

Field-mounted instruments will be of a design suitable for the area 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. Freeze protection will be provided as required.

Field-mounted instruments may be grouped on racks when practical. Supports for individual instruments will be prefabricated, off-the-shelf, 2-inch pipestand. 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 (pressure, temperature, flow, etc.).

Liquid level controllers will generally be the nonindicating, displacement type with external cages.

10 E3.10 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 will be no smaller than 3/8 inch. Each instrument air user will have a shutoff valve and filter at the instrument.

10 E3.11 General Instrument Requirements

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

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

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