## 7. INSTRUMENTATION AND CONTROLS

Instrumentation and control technology has undergone significant advances in the last 20 years. The control technology has evolved from the analog control with pen recorders, manual/auto station, and alarm panels prevalent 20 years ago to modern distributed control systems (DCS) with CRT-based operator interfaces and new control algorithms based on modern microprocessor technology. DCS control has the capability either to monitor system operation and guide control room operators through adjustments that will optimize the process, or to automate the process, thereby optimizing it. In addition, through sophisticated algorithms, the DCS can correct for off-design conditions. Advances in computing capabilities have allowed designers to model processes closely; thus the computing system is able to determine the most appropriate means of optimizing the system.

Utility owners have begun to replace their current analog control systems for several reasons. Replacement parts are becoming scarce, the benefits of the DCS systems have been proven, and implementation costs have been minimized. However, while utility-designed control systems are very similar to control systems that would be found in market-based facilities, utility control systems tend to contain more instrumentation, as well as more maintenance and diagnostic equipment. Utilities are generally concerned with optimization and efficiency. The utilities will use the abundance of instrumentation for confirmation of operating parameters and maintenance and performance of advanced monitoring during partial load conditions. Utilities will also design DCS systems with redundancy of main components.

The control system of the market-based facility, however, is designed to operate at one specific point, and enough instrumentation is provided to allow the facility to safely and effectively operate at that point. Very little planning is provided to facilitate operation at other loads. Redundancy in the DCS is not provided. The plant is instrumented as little as possible to maintain a safe working facility. Tanks will be provided with a low level alarm and switch that will shut down the forwarding pump, rather than the utility design of a low level alarm and a low-low level switch to shut down the pump. In a market-based design, tanks that are filled from a truck (sodium hypochlorite, sodium bisulfite used in water treatment) are provided with site glass level indicators; high level alarms are not provided. In a utility-based design, this same tank would have a high level indicator, a high-high level indicator, and an automatic shutoff point.

Generally, utility owners are interested in “expert” systems, while owners of market-based plants are not interested in investing in these advanced systems.

The future of control system technology is quickly developing through technological advancements and the changing microprocessor industry. Costs are decreasing due to the improvement in microchip technology and advancements in the manufacturing techniques of microprocessor boards.

The foreseeable future of the control system technology brings with it geographic distribution of intelligence. DCS equipment will become more rugged, or environmentally hardened. The equipment will no longer need a temperature-controlled, clean environment. It will become acceptable to have multiple DCS cabinets located directly inside the plant without requiring special enclosures. The equipment will be capable of operating in atmospheres up to 120°F, and will not give off high levels of heat. The processor boards will be hermetically sealed and located in a separate section of the cabinet from the access door where maintenance and altering set points would occur.

In the next generation of power systems, the majority of equipment, systems, and processes will be automated and controlled through the DCS. With the quantity of equipment and instrumentation that will be controlled through the DCS, dedicated point-to-point connections will equate to an immense wiring system. Work is presently being done to determine the feasibility of replacing the current wiring scheme with a network or field bus. The field bus will communicate digitally with a controller highway, which will communicate with the Operator Interface System. This will eliminate the long runs of cable required by dedicated point-to-point connections. The major concern with this scenario is the ability of various vendor-supplied controls to communicate with the plant control system. In the future, the industry may standardize on one line of products for the Operator Interface System (i.e., Microsoft). This will enable equipment suppliers to standardize a specific control system to interface with a known system.

Also in the future, historical data will be stored in a separate area of the DCS. The operating system will be capable of exporting historical data to a personal computer, where the operator can manipulate the data in a multitude of fashions. In addition, the DCS will be able to compare the current data to historical data to determine loss of efficiency or changes in operating parameters. The DCS will then notify the operator of such changes, and suggest modification to correct the operation. In addition, it will alert the operator that the performance of the piece of equipment is dropping off, and there is a need for maintenance to the equipment to prevent catastrophic failure. The historical data will provide information of what maintenance has been done to that piece of equipment, along with the operating parameters before and after the maintenance was performed.

Another area of improvement in the future of the control system is the instrumentation. Pressure and temperature instrumentation has basically remained the same over the past ten years. With the development of fiber optics, it is feasible that this technology will be incorporated in the instruments, thus improving the accuracy and precision of temperature and/or pressure measurements.

It is feasible that control systems will become so sophisticated that startup could be accomplished by a single pushbutton. This would entail a complicated sequence of controls, expert systems to verify operations before proceeding with the next operation. This philosophy stems from the unmanned combustion turbines. To accomplished unmanned startups, all drain and vent valves would need to be motor-operated. Motor-operated drain and vent valves will add significant cost to the capital plant cost. Therefore, this scenario would apply only to facilities located where it is harmful or expensive to employ human operators.

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