IMPROVED INSTRUMENTATION FOR UPGRADING RADWASTE SYSTEMS FOR NUCLEAR POWER PLANTS

Ron Estes

Fluid Components, Inc.
San Marcos, California

ABSTRACT

Utilities today are looking for improved process instrumentation to assist plant operators in radwaste management, ALARA compliance and radiological assessment. A reduction in the total liquid waste a plant has to process has definite pay back advantages. Reduced manrem exposure is something all utilities strive to achieve. New instrumentation applications developed for radwaste systems give the utilities better tools to meet these goals.

BACKGROUND

Low-level liquid radioactive waste emminates from many systems within the nuclear power plant. The cost associated with the processing and disposal of these wastes has dramatically increased over the past few years. As utilities re-examine their plants to ensure that the accumulation of liquid radioactive waste is held to a minimum, it becomes obvious that improved instrumentation will play a key role in the minimization program. The costs for new instrumentation will be returned many times in savings on waste processing.

MEASUREMENT OF LIQUID WASTE ACCUMULATION

- Radioactive Fluid System Valve Stem Packing Leakoff: Flow sensors installed in the leakoff lines will detect packing failures and alert plant personnel to perform maintenance on the valves. This leakage path, if undetected, can result in a substantial quantity of radioactive water which must be processed.
- Radioactive Drain Line Flow: In-line flow sensors installed in drain lines, vent lines or overflow lines will detect and quantify trickle flow in route to the radioactive waste collection system. These flow instruments properly located can pinpoint sources of liquid leakage.
- Sump Level Detection: Point level sensors will detect level rises in potentially radioactive sumps. This can provide early warning of water accumulation.
- Radioactive Spill Sensors: Level sensors will detect 1/16 inch of water accumulation on the floor surface. This can provide immediate detection of radioactive spills in unoccupied compartments.

MEASUREMENT OF RADIOACTIVE RESIN/WATER INTERFACE

- Spent Resin Storage Tank Level Detection: Point level sensors installed in these tanks will detect air/water and resin/water interface. This information will prevent the overfilling of the tank and the possibility of a radioactive spill. Resin transfer operations can be more effectively monitored when the resin level is displayed.

MEASUREMENT OF FLOW THROUGH PLANT EFFLUENT PATHS

° Flow sensors installed in plant vent stacks, off-gas lines, waste gas decay tank effluent, relief lines and turbine exhausts can accurately measure mass flow rates to allow plant operators to calculate radioactive releases of liquid or gases to the environment.

INSTRUMENT DESCRIPTION

The instrumentation which can accomplish all of the above applications has no moving parts, can be calibrated remotely, has a fail-safe design, is maintenance free, is qualified for harsh environments, allows better compliance in ALARA design, and has many years of proven operation. This instrument line is qualified to IEEE-344 and IEEE-323 and is used widely throughout the nuclear industry.

OPERATING PRINCIPLE

The instrumentation operates on the thermal dispersion principal. The design of the sensor utilizes three thermowells, two being brazed together, with the other spaced a few millimeters apart (see Figure 1.) Two matched platinum resistance temperature detectors (RTD's) are installed in two of the thermowells spaced apart. A low wattage heater is installed in the thermowell adjacent to the one RTD. The resistance of each RTD is monitored by state-of-the-art electronics. The heater heats its adjacent RTD approximately 100°F higher than the non-heated RTD in still air. The temperature difference in still water is approximately 20°F.

When used as a flow sensor, the media passing the sensor removes heat from the heated RTD in relation to the reference RTD and the electronics produce a signal change proportional to the rate of flow. In air, gas or steam, the instrument has very wide rangeability. The electronics can produce relay contacts for alarm or control functions as well as analog signals for flow indication or control.

When used as a level or interface sensor between non-missable liquids or gases, the thermal dispersion characteristic of the media establishes the temperature of the heated RTD. This allows the sensor to detect interfaces such as air/water, oil/water, resin/water, etc.

The manufacturer of this instrumentation is Fluid Components, Inc., San Marcos, California. As a supplier of instrumentation for the nuclear industry, FCI is committed to developing instruments which can solve problem areas in the nuclear power plant. Radwaste system improvements, as discussed above, is only one area in which FCI has responded to the industry needs.

FIGURE 1