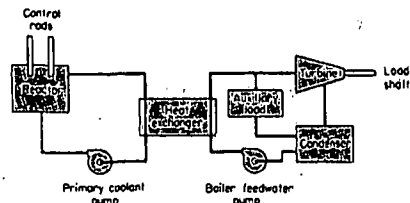


TECHNICAL BRIEFS

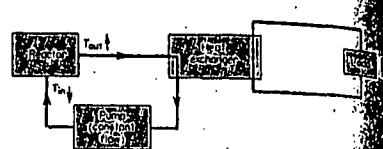
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ELEMENTARY BLOCK diagram of possible nuclear power plant. Reactor is merely source of heat energy. Heat is extracted by coolant, transferred via heat exchanger to turbine system



HEART OF CONTROL for nuclear plant is its primary control operating cycle. Desirable goal is reactor whose overall activity decreases as reactor average temperature increases

Nuclear Power

Nuclear Power Plant Control Considerations. By M A Schultz, Westinghouse Electric Corp.

The development procedure for designing the control system for a nuclear power plant is basically the same procedure as for any other type of power plant but the presence of a nuclear reactor as a component in the system imposes many unusual design problems. This article reviews general plant considerations affecting control system design giving special emphasis to the features of reactor control.

The basic method of approach to control system design consists first of studying the plant operational requirements and the plant control requirements. Following this review a preliminary block diagram of a control system to fulfill these requirements may be attempted. However, after a study of this diagram, it often becomes apparent that the inherent dynamics of the plant and the characteristics and limitations of some of its components are of utmost importance. Modifications are then made to the proposed block diagram. Once the desired operation of the control system is fully understood, the problem of synthesizing the control system can begin.

For the sake of illustration an elementary block diagram of a possible nuclear power plant is shown left, above. Here the reactor is considered merely as a source of heat energy. When this

heat is extracted by passing a coolant through the reactor, the heat energy is then transferred via a heat exchanger to a turbine system, and the output shaft of the turbine can be made to drive many types of working apparatus. The primary coolant considerations are basic for control design, and it may be mentioned in passing that gas, water, and liquid metals have been proposed as reactor coolants.

Start-up and shut-down requirements affect the control system. Here the nuclear reactor plays a prominent part in determining plant performance for nuclear reactors cannot be started up too fast and never can be really shut down. In considering the output of the nuclear reactor there is no such thing as "zero power" involved, right, above.

Even in a brand new cold clean reactor which has been shut down as much as possible an inherent source of neutrons exists which causes a certain amount of nuclear fission to occur. This fission produces minute amounts of power and in the process more neutrons are released. This effect requires that the reactor neutron output be monitored continually to see that the neutron level is kept under control. In practical cases this monitoring means that instrumentation for measuring neutrons must be capable of operating over ranges as wide as 6 to 10 decades and control provisions must be provided over a similar range.

Starting up a reactor from a cold con-

dition means that the reactor can operate over a neutron range of many decades before any appreciable useful power begins to occur at the output. Some arbitrary number of neutron fissions has to be taken as zero power. For example 1% of full load output may be considered to be the equivalent of zero power. Transitions between 1% full power and 100% full power can be made relatively rapidly, but because of the safety aspects involved transitions from a cold start-up must be made quite slowly. *AIEE Paper No. 53-31.*

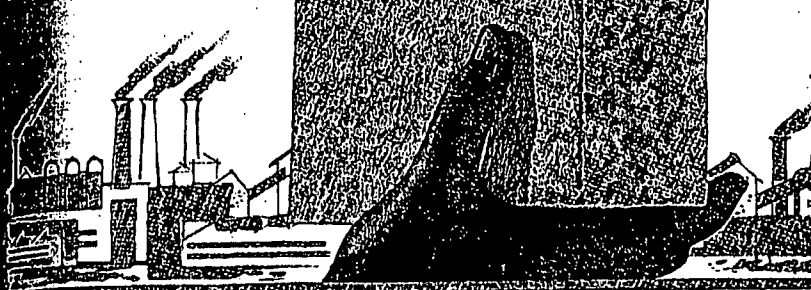
Water Treatment

Conversion of a Two Stage Hot Process Water Softener. By G H Cowdy, Reiss Service Corp and S B Applebaum, Crane Corp.

In 1949 a 16,000 gph two-stage hot lime-soda hot-phosphate softener was installed in the Kendall Square station of the Cambridge Electric Light Co. to treat up to 30% make-up for two 1500 psig boilers evaporating 200,000 lb of water each. In 1951 make-up demands exceeded 20,000 gph at times. A storage tank was considered to supply the peak demands. But conversion to hot lime zeolite proved more economical.

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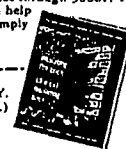
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