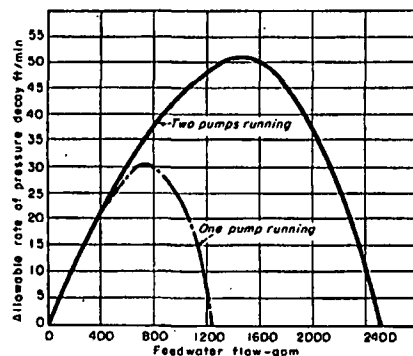


TECHNICAL BRIEFS

Latest engineering developments for busy power men



ALLOWABLE RATE of decay starts at zero at no flow, maximizes at approximately 700 gpm per pump and falls back to zero at 1250 gpm

Transient Conditions in Boiler Feed Pumps Attract Greater Attention

Centrifugal Boiler Feed Pumps Under Transient Operating Conditions. By Igor J. Karasik, Worthington Pump Corp., G. H. Bosworth, Bachtel Corp., and W. D. Elston, Pacific Gas and Electric Corp.

The study of transient conditions in a steam power plant and of their effect on the centrifugal boiler feed pumps assumes the characteristics of a mopping-up operation. For years we have been developing power plants to operate at ever increasing steam pressures and temperatures to improve overall thermal efficiencies. It follows, therefore, that the problems introduced by transient conditions have grown in complexity and severity with time. Yet it has been only recently that much concern—or even interest—has been given to these problems.

The authors' present paper supplements the theories presented earlier with experimental data, develops a simplified method of evaluating the relative safety of a given installation and enlarges the scope of the field covered by including an analysis of problems which may arise in closed feedwater cycles. In addition, problems akin to those presented by transient conditions and arising

from the use of common spare pumps in adjoining units—in either open or closed cycles—are included in the scope of this paper.

These problems for open cycles subdivide into two groups, namely, problems arising from an interruption or reduction in turbine load and problems caused by sudden increases in this load. Here is how the authors approach these problems.

The effect of a sudden drop in electrical load is for the turbine governor to reduce the inlet steam flow so as to maintain the proper relation to the generated power. The consequence of this reduction is a proportionate pressure reduction at all of the successive stages of the turbine, including the bleed stage supplying steam to the direct contact heater.

It is possible during this period that the NPSH (net positive suction head) available for the boiler feed pump may be reduced seriously because of the changing relationship between the decaying boiler pressure, above, and the feedwater temperature at the suction end of the pump. The magnitude and duration of this reduction will vary according to the load drop that is experienced

9 Digests for you on:
PUMPS
FUELS & FIRING
STATION DESIGN
ELECTRICITY

and will depend on a number of factors peculiar to each installation.

The allowable rate of decay starts at zero at no flow (because the residence time is infinite), rises to a maximum somewhere in the vicinity of 700 gpm per pump for the example case the authors pick and falls back to zero at 1250 gpm, where the available NPSH exactly balances the required NPSH. We must remember, however, that operation of boiler feed pumps at abnormally low flows is prevented by automatic controls and that 1250 gpm per pump is greatly in excess of the maximum feedwater flow demand for the unit the authors have under consideration. Thus, if we assume that the minimum permissible flow without recirculation is 125 gpm, the allowable pressure decay rate at low flows will be 10.5 feet per minute, or approximately 4.4 psi per minute. It should be considered that under low load operation a single pump may be running. Under these conditions, the residence time for any flow is effectively doubled and therefore the allowable rate of pressure decay shown on graph is approximately halved. Since such a situation may increase the danger of operation, it follows that, for a rigorous analysis of an installation where more than one pump is installed for normal operation, the allowable rate of pressure decay must be determined for single pump operation as well as for all pumps on the line.

The assumptions concerning the action of the controls involved are subject to wide interpretation. For instance, the action of the feedwater regulator makes it difficult to predict how soon after the load drop the feedwater flow to the boiler will become stabilized with relation to the turbine throttle flow. While the majority of large steam power plant installations are provided with three-element feedwater control, there are variations as to the manner in which those controls are adjusted. In general, the feedwater input is regulated to parallel closely steam output, but the control is sometimes adjusted to vary the boiler water level with the load as a precaution against the effects of "swell" and "shrinkage." Thus, while the water flow will go down with steam flow, the rate of drop may not be quite as fast as that of the steam flow. In addition, the transient condition problems are just as likely to occur in installations

(Continued on page 156)

Johns-Manville Insulations
save industry a billion dollars in fuel every year!



Reduce your fuel costs and build better furnace linings
with JM-3000 INSULATING FIRE BRICK

HERE'S THE ONLY insulating fire brick that withstands a full 3000°F. It's highly efficient both as an exposed refractory lining or as back-up insulation. And JM-3000 is only one of six types of Johns-Manville Insulating Fire Brick made for these applications. All provide long-life insulation. All are lightweight, have low conductivity, high structural strength. These properties permit thinner furnace walls—yet you can achieve important fuel savings and increased production, because JM Insulating Fire Brick assures quick furnace response.

JO-O-COL® Insulating Brick is another outstanding J-M fuel-saver... a high load-bearing brick for back-up insulation behind refractory linings. It comes in three types, for service through 3000°F—making it possible to reduce the necessary thickness of refractory linings as much as one-third.



Save fuel with

J-M Hydraulic Setting Refractories

Johns-Manville refractories meet every need for castable, troweling and gunning applications for temperatures through 3000°F. Firecrete® is used to cast special shapes of all kinds. It is ready for use within 24 hours, has negligible shrinkage and high resistance to spalling. Blerecrete® is used to build and repair furnace linings. When gunned, it adheres readily with a minimum of rebound loss. When slap-troweled, it eliminates laborious ramming and tamping.



Save fuel with J-M Aggregates and Fills

These lightweight insulations are used as fills to conserve heat in irregular spaces where other forms of insulations cannot be economically applied. They are also used as aggregates for mixing with other materials to form insulating refractory concrete.

Send for your free copy! This new booklet IN-115A gives full details about J-M insulating materials for service through 3000°F. To find out how they can help cut your fuel costs, simply mail coupon.

Johns-Manville, Box 60, N.Y. 16, N.Y.
(In Canada, 199 Bay St., Toronto 1, Ont.)
Please send me, without charge,
copy of brochure IN-115A

Name _____
Company _____
Street _____
City & Zone _____ State _____

Johns-Manville
FIRST IN INSULATION