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"Renewal and Extension of Pumping Machinery for the Metropolitan Water Board." †

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Mr. R. G. Moores observed that, having been intimately associated with Mr. Durham in the work described in the Paper, he wished to congratulate the Author upon the attention given to detail. Emphasis had rightly been placed upon the method adopted for the selection of type of pumping plant for installation based on the annual capital charges and running costs, although reliability, which was also an important point but difficult to assess financially, had not been overlooked.

In connexion with the preparation of estimates for the selection of plant, it might be of interest to mention that the use of graphs [1] of capital costs, fuel-consumption, and running and maintenance costs of the various types considered, were found very useful.

With regard to competitive tenders, he endorsed the Author's remarks on the adjustment of the tender prices to make the offers comparable on the basis of the guaranteed efficiency and fuel- or steam-consumption; but he considered that the statement that the specifications were drawn up in the widest possible terms was to a certain extent misleading. As the principal aim of the specification was to obtain tenders that were competitive and comparable, the extent of the contract was always very clearly defined and as a guide for the contractor such details as the following, which were intended to indicate the Board's minimum requirements, were invariably specified :—

> *For steam reciprocating units,* the ram-speed (maximum); volume of low-pressure cylinder; size of main bearings; and area through pump valves.

† J. Instn Civ. Engrs, vol. 26 (1945–46), p. 432 (Oct. 1946).

[1] F. E. F. Durham, "The Selection and Operation of Pumping Machinery for Waterworks Purposes," Trans. Instn Water Engrs, vol. xxxv. (1930), p. 86.

For oil-engine-driven units, the mean effective brake-pressure and piston-speed.

For boiler plant, the heating-surface ; grate-area ; type of fuel ; and draught conditions.

In addition, clauses regarding duty and efficiency trials, load-factor, hydraulic pressure tests and test of materials, the submission of drawings for approval, the minimum of noise and vibration, platforms for easy maintenance, and compliance with regulations and B.S.I. specifications, were among the important items specified.

With respect to reliability, the fact that firms with wide experience in the manufacture of pumping machinery and boiler plant usually furnished the best efficiencies was appreciated when accepting the most suitable offer based on the financial gain due to high efficiency.

The contractors were made entirely responsible for the manufacture, installation, and maintenance of the whole plant until taken over by the Board and, they were always given a free hand with respect to the choice of valve gears and matters affecting the guaranteed efficiency.

The inclusion in the specification of detailed lay-out drawings of the proposed plant, which invariably accompanied the specification, was invaluable for competitive tendering. The limits of the contract were clearly defined and the suction and delivery mains adjacent to the pumps were planned to provide the best possible lay-out from the point of view of convenience and avoidance of head loss.

It was surprising how few contractors appreciated the important financial value of efficiency and that with the increased use of electrically-driven pumping plant it was becoming still more important. In several recent contracts for electrical plant, although the tenderers were invited to offer high-efficiency plant, only a limited number of the firms had responded. Needless to say, the contractors offering high-efficiency plant were easy winners, except in the cases where low load-factors were specified.

The following features were of interest in connexion with the plant described in the Paper :

1. For starting triple-ram pumps and the like a charging pressure main was provided for feeding each ram-case during the suction strokes through a reflux valve, facilitating easy starting-up against full pressure. That feature, introduced by Hathorn Davey & Co., Ltd., on the Musgrave engine at Lee Bridge, was fitted to the plants at Walton, Kempton Park, and Deptford.
2. Emergency trips were fitted to the steam turbines at Surbiton, Kempton Park, Hammersmith, and Hampton, in case of failure of suction water to the main pumps, lubrication, or vacuum.

3. The electric low-lift pumps at Hampton were provided with the following automatic and hand speed-control gear:

(*a*) Four of the main electric units were required to maintain any pre-set constant discharge with a varying delivery head, due to the rise and fall of the water-level in the balance tank into which they discharged. The speed-control gear was required to be fixed at the pump-house floor and, as the pitot tubes for operating the controls were in the basement, and sometimes at zero pressure, it was arranged to transfer the differential to the higher level by creating a sub-atmospheric pressure in the manometer tubes by two exhausters (one acting as stand-by).

(*b*) Two of the units were provided with clock and water-level control for regulating the required rate of pumping (from maximum and minimum) by means of a cam rotated by the clock mechanism, so as to ensure that the water-level in the balance tank was at the required level for any particular time of the day or night.

The Author, in reply, thanked Mr. Moores for his contribution to the discussion and particularly for drawing attention to the point that reliability of operation was a matter which always received careful consideration.

Perhaps it was unfortunate that the Author had not made it abundantly plain that the extent of the contract was always clearly defined in the Specification and that certain minimum requirements were invariably stated. He was aware of that, and it was only because he regarded it as almost axiomatic that such things should be included in the Specification that he had omitted it from the Paper. What, however, he had really been at some pains to indicate was that by drawing the Specification as widely as possible the advantage of the accumulated knowledge of manufacturers was secured and that manufacturers were not excluded from tendering because apparatus for which patent rights were held, or for which licences to manufacture would be required, had been specified.

He was obliged to Mr. Moores for enumerating the several features which were to be found in some of the installations described. But for the necessity of curtailing the length of the Paper they would have been referred to.