

# THE CASE OF MISSING STEAM

An enthusiastic Factory Manager; who recently followed a 2 weeks Course in "ENERGY MANAGEMENT" tried his hand in an "Energy Audit" in his factory. He could not account for 15% of the steam (which amounted to 4 tonnes/hour). He tried hard. He spend hours in checking and rechecking his figures. It did not balance. As a faithful employe he reported the matter to the Proprietor! The problem started thereafter.!

Here is the story as told by the factory Manager —

"The factory established in the late seventies and involved in producing basic inorganic chemicals, had provided all the necessary instruments in the steam system network. The two water-tube, coal fired Boilers are designed to produce steam at 32 kg/cm<sup>2</sup>, and at a temperature of 2700°C with a maximum continuous rating of 25 tonnes/hr. each. As per the design, the steam network consists of headers working at three different pressures, viz., High Pressure (30 kg/cm<sup>2</sup>g), Medium Pressure (10 kg/cm<sup>2</sup>g), and Low Pressure (1.5 kg/cm<sup>2</sup>g) with the individual let down and desuperheating stations (see fig. 1).

About 50% of the boiler steam produced is consumed at location A which is designed to operate at a pressure of 28 kg/cm<sup>2</sup>g. Nearly 10% of the steam generated is used at location B, which is designed to operate at a pressure of 10 kg/cm<sup>2</sup>g. A small amount

of medium pressure steam is also used for some miscellaneous purposes. Rest of the steam is converted into Low Pressure steam (1.5 kg/cm<sup>2</sup>g) and used mainly at locations C, D and at some other miscellaneous places. The condition of pressure and flow at the various consumption points is given in table 1.

TABLE 1

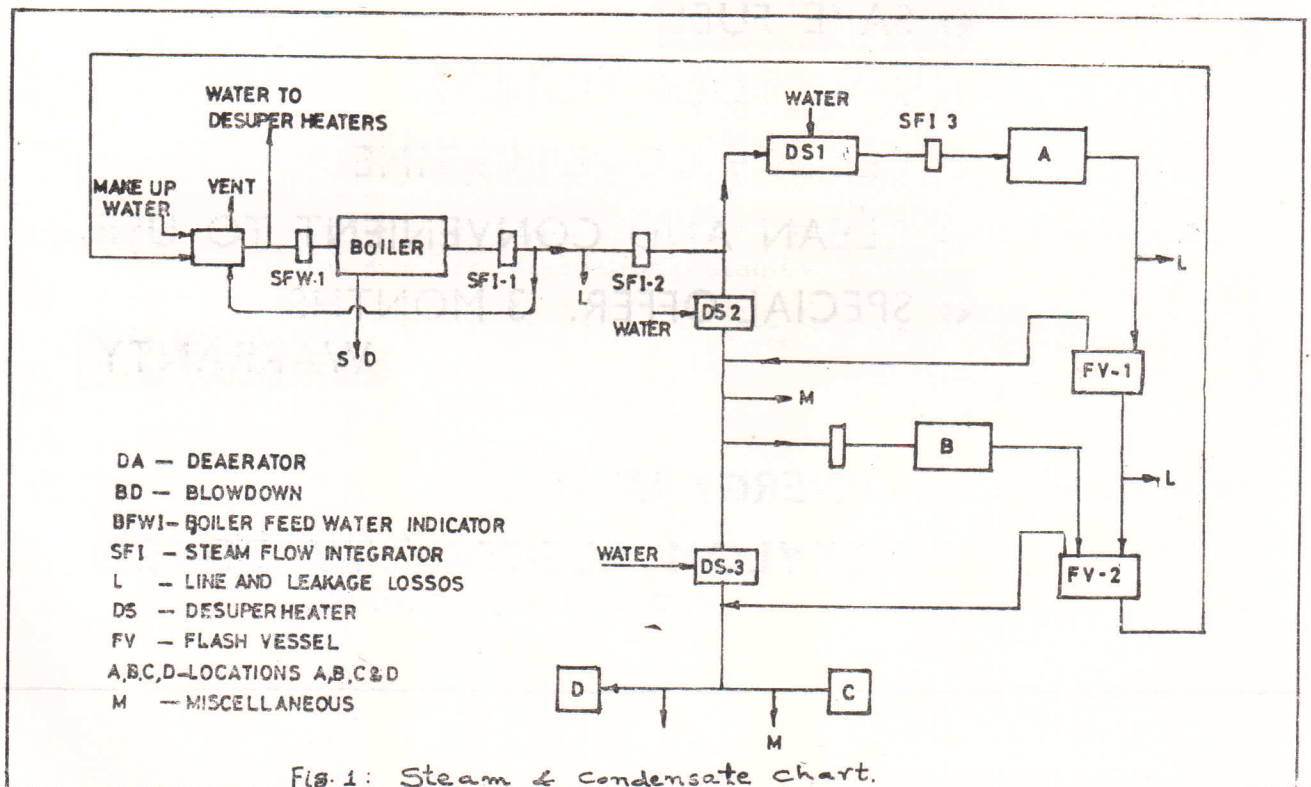
Preliminary Plant Steam Balance

| Department | Steam Pressure<br>kg./cm <sup>2</sup> g. | Steam Consumption<br>tonnes/hr. |
|------------|--|---------------------------------|
| A          | 28                                       | 10                              |
| B          | 10                                       | 2                               |
| C          | 1.5                                      | 5.5                             |
| D          | 1.5                                      | 1.5                             |

Flash steam is recovered from the steam condensates at locations A and B. Condensate after flash steam recovery is pumped back to the deaerator and this constitutes nearly 50% of the feed water to the boiler.

Steam conditions and flow rates are indicated and recorded at the boiler battery limit (SFI — 1) and also at the inlet to the plant (SFI — 2). Steam flow meters are provided at all the utilisation points. These steam flow meters were designed and calibrated for the designed plant steam parameters.

FIG. 1



**Problem :**

Though, the boiler's designed pressure is 32kg/cm<sup>2</sup>g, because of some operational and management misgivings, steam is produced at a pressure of 26 to 29 kg/cm<sup>2</sup>g. After pressure reduction in a PRV and de-superheating at DS — 1, steam is at a pressure of 28 of kg/cm<sup>2</sup>g.

Since the steam flow meters at the boiler house, SFI — 1; entry to the plant, SFI — 2; and entry to the location A, SFI — 3, were calibrated for pressures of 31 kg/cm<sup>2</sup>g. 30 kg/cm<sup>2</sup>g, and 28 kg/cm<sup>2</sup>g respectively, a correction factor was introduced to remedy the steam flow values obtained. At the other utilisation points (locations B, C and D) correction factors are not employed because they are operated close to the designed conditions. In spite of these modifications, it was not possible to account for nearly 15% of the steam produced, and this amounted to nearly 4 tonnes/hr."

Now; put on your thinking caps. Has the young man made any mistake in the methodology or in his working. If so what it is? How will you approach to solve the case of the missing steam.?

(Adopted from an article from "ACTIVE CONSERVATION TECHNIQUES" — a monthly bulletin of Petroleum Conservation Research Association — New Delhi.)

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