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**Subject: Request for expert comments on the Issue #1- Estimation of savings due to control of de-super heater water spray, uploaded on [www.energymanagertraining.com](http://www.energymanagertraining.com)**

**Dear Sir**

Please refer to your letter dated 31<sup>st</sup> July, 2008 on the above subject forwarding therewith the solutions received on the above issue. Our observations in the matter are as follows:-

1. From the solutions it is broadly seen that most of the solutions have estimated the savings considering attemperation flow as an additional heat input (over and above the steam flow input of 390 TPH) and have accordingly estimated the fuel savings.
2. It is also seen that while doing so most solutions appear to have considered that de-super heater is the final heat transfer point in the boiler and have worked out heat balance in the desuperheater considering that the final steam quality (enthalpy 822.9 kCal/kg) is achieved in the desuperheater. They have also assumed that the fuel input to the boiler remains constant and have thus projected huge savings equivalent to heat energy of saved desuperheater spray and even higher.
3. A comparison of saving projected in various solutions is enclosed at Annexure-1. As may be seen, the projected savings worked out by the solutions vary from Rs. 1 Crores to Rs. 9 Crores per year. The annual coal cost for the station works out to Rs.90 Crores per year and thus the project saving works out 1 % to 10% of the yearly coal cost (or coal consumption) indicating a corresponding improvement in the efficiency. As the turbine side

has assumed to be not affected at all in the solutions, all of this incremental efficiency gain must come through improvement in boiler efficiency.

4. The only component of boiler efficiency (or boiler losses) impacted by fouling of the boiler surface is the dry gas loss component and thus the indicated savings in the solutions must come from improvement (reduction) in the dry gas losses.
5. Assuming a final stack temperature of 140 deg.C at the optimal operational level (considered by the solutions) when the spray would get reduced to 7 tph, an attempt has been made to compute the prevailing stack temperature considering the extent of in-efficiency or degradation projected by various solutions. As may be seen the projected savings indicated by the solutions imply that the present flue gas temperature at stack should be about 154 to 350 deg C (14 to 210 degree higher than the assumed optimal stack temperature of 140 deg C) for the projected savings to occur.
6. Obviously, therefore the approach adopted in the solutions is not correct for the following reasons :
  - Irrespective of the amount of desuperheat spray, the final heat output from the boiler (to the turbine) has remained same in both the cases and it is equivalent to heat input of steam flow of 390 TPH. The injection of de-super heat spray only leads to equalization of heat between the steam and spray water, thus, leading to the desired final quality parameters of the steam. Loss due to mixing would be extremely low due to slight energy loss in mixing process.
  - Desuperheat spray is normally applied before the final superheater to get the desired steam parameters at final superheater outlet. Thus there is heat transfer from flue gases to steam beyond the desuperheat point in the final superheater and the flue gases transfer heat further in economizer, air preheater etc.
  - The necessity of desuperheat spray may arise not only due to fouling or non performance of soot blowers but also due to firing coals which are much different from the design coal.
  - Fouling of the boiler surface does affect the heat transfer, and the same could be improved by soot blowing. But the impact is more in the nature of varying relative heat absorption in the various heat transfer surfaces in the boiler (super-heater economizer, pre-heater etc.) The net impact of fouling on efficiency however would be very minor and depend on the ultimate increase in the flue gas temperature at the exit to the air-preheater.

7. Thus in real situation amount of superheat spray has virtually NO impact on boiler efficiency. There could however be slight deterioration in turbine cycle efficiency ( turbine cycle heat rate) if the water for spray has been tapped from BFP discharge as this water does not undergo completely through the regenerative feed heating chain (as it does not go through HP heaters). If however tapping for superheat spray has been taken after the HP heaters, even this degradation does not occur and the impact of superheat spray is NIL.
8. Assuming that feed water to boiler is taken from HP heaters (though it is not explicitly mentioned in the problem) the impact of incremental spray as per the conditions given in the problem, estimated on the basis of mathematical computation from standard design literature and modeling softwares is estimated to be of the order of 1.5 to 2 kCal/kWh (in unit heat rate) only which work out to saving of Rs. 4 to 6 lacs per year.
9. However soot blowing has advantages of more consistent and uniform boiler temperature regime which is ultimately beneficial from the point of view of operating life of boiler pressure parts though it cannot be quantified exactly in money terms.

**(Sanjay Sharma)**  
**Dy. Director**

**Comparison of Projected Savings by Various Solutions****Given Data**

Unit Size	MW	140
Generation	MW	110
Sp. Coal Consumption	kg/kWh	0.65
GCV of coal	kcal/kg	4600
Operating Hours per year	hrs	7000
Coal Cost	Rs./ton	1800
Unit Heat Rate	kcal/kWh	2990
Coal Cost per unit	Rs./kWh	1.17
Yearly coal cost	Rs. Cr	90.09

<b>Projected savings by different solutions</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
Yearly projected savings	Rs. Cr/yr	0.63	9.44	1.2375	4.1	1.68	1.259		5	4.04
% savings in coal per year	%	0.70%	10.48%	1.37%	4.55%	1.86%	1.40%		5.55%	4.49%
Corresponding reduction in Unit Heat Rate	kcal/kWh	21	313	41	136	56	42		166	134
Implied increase in boiler efficiency or reduction in boiler loss	% Points	0.70%	10.48%	1.37%	4.55%	1.86%	1.40%		5.55%	4.49%
Assuming dry gas loss of 5% in optimal case, prevailing dry gas Loss Corresponding to Savings	%	5.70%	15.48%	6.37%	9.55%	6.86%	6.40%		10.55%	9.49%
Prevailing Flue gas exit Temperature to stack corresponding to this loss	Deg C	154	350	167	231	177	168		251	230
Increase over 140 Deg C	Deg C	14	210	27	91	37	28		111	90

**Remarks**

Solution 5 has indicated a net saving of 65 lacs/yr after accounting for soot blower steam consumption.

Estimated savings for solution 1 has been taken as coal savings for 0.77 MW