Cost-Effective Combustion Improvement, NOx and SOx Reduction Solutions for Coal-Fired Boilers

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In Vietnam and other Asian countries, all coal power plants will have to comply with stringent NOx and SO2 emission limits that have been set by their respective government. NOx and SOx reduction and management experience in the US and Europe suggests that the most cost-effective approach is to first maximise NOx reduction through primary and secondary methods, and SO2 reduction through dry sorbent injection (DSI) technology. Then the need for a downstream SCR or wet FGD may be eliminated or will cost much lower since there is less further reduction to be required.

The paper provides an in-depth discussion of the principal primary and secondary NOx control approaches, including the expected range of NOx reduction level that can be achieved, typical capital cost and operating cost. Such primary and secondary measures are listed as follows:

- Combustion Optimisation and Burner Modifications
- Low NOx burners (LNBs) and existing OFA
- Burner Modification & Advanced OFA
- Selective Non-Catalytic Reduction (SNCR)

Basic combustion optimization with existing plant equipment is the lowest-cost option, but typically only achieves 5%-15% NOx reduction. Combustion optimization plus the installation of primary low NOx combustion technologies such as LNBs, OFA, and advanced OFA systems can achieve 30% and up to 40%, depending on fuel diet, boiler design and combustion optimization & tuning. The associated capital costs of these systems are reasonable with relatively low operating costs. Integrating multiple primary NOx reduction methods, when properly combined, can provide between 40% and 50% NOx reduction at a relatively low cost. SNCR technology is best applied as an add-on to the primary NOx reduction methods previously outlined, which has demonstrated to provide NOx compliance at less than 200 mg/Nm3. It must be stressed that improper design and application of these technologies can also result in serious combustion issues and adversely affect

normal boiler operations, such as reduced combustion efficiency, low load burner operation, potential furnace slagging, etc. In addition, the balancing of fuel distribution across the burner zone, management of fuel quality and PF particle size distribution and minimising uncontrolled air ingress become critical to ensuring the combustion efficiency.

Dry Sorbent Injection (DSI) is a low capital technology that has been widely applied to the power industry in the U.S. and Europe. The sorbent is usually injected before or after air preheater, and the SO2 reduction percentage can be up to 50%-70% when high reactive hydrated lime or milled sodium bicarbonate (SBC) material is used. Compared to wet FGD, DSI technology costs only small fraction and but provides significant flexibility and fits well to the small-to-middle size boilers burning low-to-medium sulphur coals.

The paper offers key learnings and typical performance from extensive and detailed experience gained over many decades on a wide range of coal-fired boiler technology. It is offered to help ensure lessons learned in the past elsewhere can be applied to the Asian Power Industry.