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**MEXICO POLICY & REGULATORY
SUPPORT FOR CLEAN TECHNOLOGIES
PROJECT**

**SCREENING REVIEW OF LOW NOX
BURNERS FOR PEMEX**

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for

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Screening Review of Low NOx Burners for PEMEX

PEMEX is looking for a cost-effective solution to their particulate matter (PM), NOx, and boiler efficiency problems in their refinery boilers. They are currently using Petroferm's PEP-99 additive for improved combustion performance and NOx control but this approach is very expensive and they would like a more cost-effective solution. The approach being considered is to modify their old, inefficient, existing burners with Electric Power Technologies' (EPT) Reduced Emissions and Advanced Combustion Hardware (REACH) technology, which has been shown to provide significant NOx and PM (unburned carbon) emissions reduction as well as improve boiler efficiency and reliability.

This review provides a comparison of the REACH technology with three of the leading low-NOx burner suppliers here in the US. The purpose of the review is to determine whether the REACH technology is best suited for the needs of PEMEX as compared to the low-NOx burner technology currently offered by other burner manufacturers.

Experience

The three US burner manufacturers selected for comparison to REACH were Coen, Forney, and Peabody. All three are recognized leaders in the power industry and all have proven experience with low-NOx burners in this size and type of application. Bechtel has worked with each of the three companies and has had successful experiences with each of them. Each of the companies have a significant number of burner installations worldwide, including some burners currently installed in a few of the boilers at the PEMEX refineries.

REACH technology has proven experience at over 100 gas and oil fired boilers (both utility and industrial boilers) with total installed capacity exceeding 17,000 MW worldwide. One of their most current projects was a successful retrofit of REACH combustion technology at the Manzanillo Power Station in Mexico. At Manzanillo, REACH technology was used to significantly reduce the amount of unburned carbon leaving the boiler; reducing the stack plume opacity; and, has received very favorable reviews from both the owner and operators at Manzanillo. PEMEX officials have also visited the Manzanillo Station and came away with very favorable opinions of the REACH technology.

One interesting fact discovered during this review was that Coen has obtained a license from EPT for the REACH technology and that EPT has supplied their technology to other major burner manufacturers in the past. This points out that the current industry leaders in burner technology recognize the REACH technology as a valuable one and in some cases may be better suited to an application than their own technology.

Design

The low-NOx burner designs that are currently offered by Coen, Forney, and Peabody are all quite similar to one another and each of the manufacturers would recommend the change-out of the entire existing burner assembly. Complete burner replacement could require modifications to the boiler tubes and refractory due to size differences between the old and new burners however a couple of the manufacturers stated that they custom fit their burners to the size required in order to minimize boiler tube and refractory rework. The actual burner design itself is fairly typical among the suppliers, with each differing only slightly in how the oil is atomized and how the air is evenly distributed to ensure efficient and complete combustion and minimize the formation of NOx.

The major design advantage for REACH technology is its ability to retain much of the original burner and only replace a few key components, primarily the oil atomizer and flame stabilizer, for each burner rather than replacing the entire burner assembly. This results in a lower replacement cost and also shortens the time that the plant must be shutdown to perform the burner modifications. The REACH technology uses a patented segmented V-jet atomizer (patented in both US and Mexico) for NOx control which REACH claims produces a superior spray quality when compared to other more commonly used oil atomizer designs. The other major component of the REACH system, the flame stabilizer, is a custom designed compound-curved-vane swirler that enables better combustion performance than conventional diffusers and flat bladed swirlers that are commonly in use today.

Another design benefit of REACH is that it can be retrofitted to wall-fired or tangential-fired boilers at a fraction of the cost of installing new burners. REACH technology could also be incorporated into the design of new low-NOx burners and can be adapted to all of the burners from the leading manufacturers. As mentioned above, Coen already has a license for the REACH technology and the technology has been supplied to several other burner manufacturers in the past.

Cost

Budgetary cost quotations were received from two of the three manufacturers; the third manufacturer, Peabody, failed to respond in time for the review even after repeated requests were made of them. The results are summarized in Table 1 and include material costs only.

Table 1: Relative Cost of Installing REACH Technology at PEMEX (Normalized)

	REACH	Coen	Forney	Peabody
Material Cost	\$225,000	\$360,000	\$510,000	No Response
Normalized Cost	1.0	1.6	2.3	NA

While all the manufacturers have proven, successful experience with Low-NOx burner technology and could meet the emissions and performance requirements, the REACH technology could do it with a significantly smaller capital investment. In addition, the additional time required for complete burner changeout or possible boiler tube and refractory rework is a significant cost factor which must be considered. Finally, the annual operating and maintenance costs of REACH are significantly less than what PEMEX is currently experiencing while using the Petroferm additive.

Additional Considerations

All the manufacturers should be able to meet and guarantee the expected PM and NOx emissions requirements. The expected emission requirements are not overly stringent and within their typical design range.

Bechtel Power has not used the REACH technology in their projects but based on their extensive experience with low-NOx burners, offered several comments and recommendations for things to consider when selecting a burner supplier. These include the ability to meet price, schedule, and workmanship and confirm that the manufacturer can meet the guarantee performance requirements. They also recommend to look for complete compliance with National Fire Protection Association (NFPA) requirements, as a minimum NFPA 8501 and 8502, Single Burner Boiler Operation and Furnace Explosions/Implosions in Multiple Burner Boilers, respectively. All the vendors contacted could meet these requirements

Also, confirm that adequate fuel and atomizing steam are available at the interface to the burner main fuel shutoff valve rack within the required pressure range. Their experience has shown that the greatest concern with burners of this type was with the controls, not the mechanical equipment. Also, as mentioned above, the newer, low-NOx burners from Coen, Forney, or Peabody may not be able to fit within the existing burner opening and boiler modifications may be necessary. In some extreme cases, overfire air ports may need to be added. They pointed out that most burner suppliers have to have a reasonably decent low-NOx burner product in today's very competitive U.S. market.