Additional Information for the Proposed Methodology

"Energy Saving by Introduction of High Efficiency Once-through Boiler and Installation of Economizer into Existing Boiler"

1. Survey on boilers in Thailand

According to the interviews with the major boiler suppliers Company A, B and C in Thailand, approximately, 70% of boilers installed in Thailand is fire tube type, 15% is water tube type (inclusive of once-through type), and the remaining 15% are other types such as thermal heat type or biomass type. It was conceived that the share of once-through boiler is still low in Thailand. It was also found out that installation of economizer is not commonly conducted since most customers prefer to have boilers without economizer considering initial high investment cost. In general, heavy oil, coal and natural gas are commonly used as a fuel of boilers in Thailand while the oil fuel boiler has the largest share among the fossil fuel boilers.

2. Reference boiler efficiency (OT)

Oil and gas fire tube boiler is considered in setting the reference boiler efficiency. Coal fired boiler is excluded with a view to securing conservativeness. According to two major manufactures which sell fire tube boilers in Thailand, the latest efficiency of the oil and gas fire tube boilers without economizer is 89% while the common boiler efficiency is 80－85%. Moreover, according to Training manual on senior energy practitioners in the field of heat set by DEDE (Department of Alternative Energy Development and Efficiency), the boiler efficiency in Thailand is stated as 85%. Therefore, the reference boiler efficiency in Thailand is determined to be 89% taking the highest value among those figures.

3. Supplemental information of conservativeness of reference boiler efficiency (OT)

The advantage of once-through boiler (project boiler) is that its high efficiency can be maintained under the low range of operation load. On the other hand, efficiency of oil and gas fired fire tube boiler is low at the smaller operation load range. Figure 1 shows the test result conducted by a boiler manufacturer to compare the efficiency between once-through boiler and fire tube boiler.

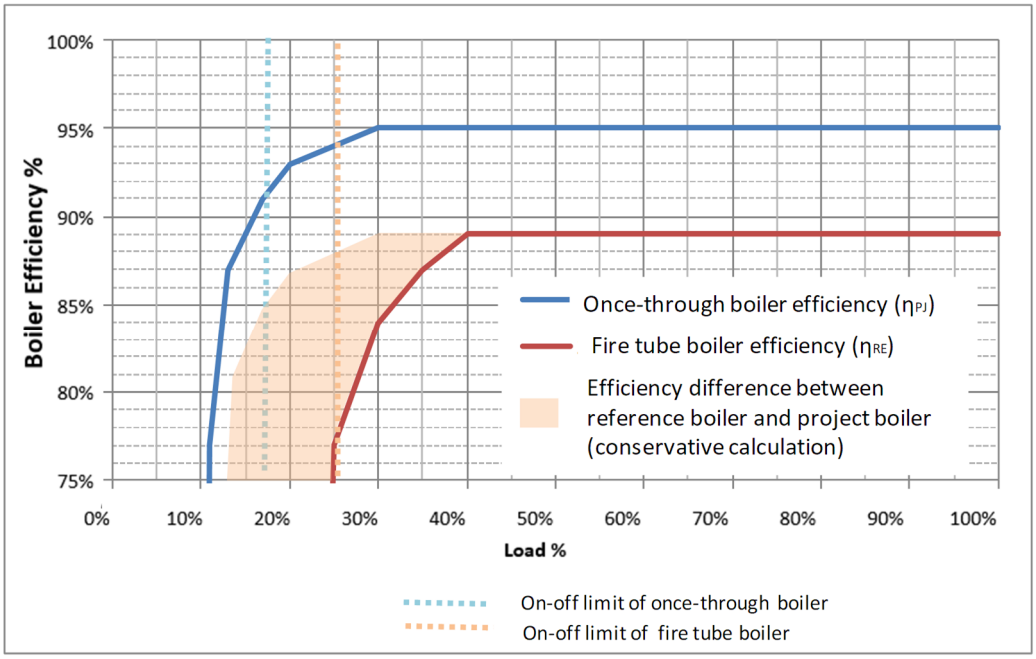

Figure 1: Efficiency comparison between once-through boiler and fire tube boiler at various load range

Source: Based on Japanese boiler manufacturer's test report

As shown in the above figure, when the load rate is small range (e.g. 25-35%), the efficiency of fire tube boiler becomes low (η_{RE}＝77-87%) while efficiency of once-through boiler can be maintained relatively high (94-95%) at the same range.

When the load is less than 25% (on-off limit), fire tube boiler starts switching on and off. At this time, the efficiency decreases rapidly, which cannot be theoretically calculated. The on-off limit of fire tube boiler is generally more than 25%, and the efficiency becomes again lower at smaller load range. Meanwhile, the on-off limit of the once-through boiler is 17%, which means that the boiler keeps good efficiency up in a smaller load range up to 17%.

This means when the boiler is operated at a smaller load range, the efficiency difference between project boiler and reference boiler becomes large, and thus CO_2 emission reduction amount becomes larger. Depending on factory production pattern, it is quite often that boiler load becomes less than 35%. Therefore, the default setting of reference efficiency at 89% is considered to be conservative.

4. Project boiler efficiency (EC)

Economizer is a mechanical device that recovers and transfers heat from boiler exhaust gases to incoming boiler feed water, thus it increases the overall boiler thermal efficiency. The project

boiler efficiency (EC) is the increased efficiency of a boiler obtained through installation of a new economizer. Under this methodology, the project boiler efficiency (EC) is considered only when a new economizer is newly installed to an existing boiler.

The project boiler efficiency (EC) will be set by selecting the lowest value (%) from economizer's specification in each project for conservative estimation of reference emissions.

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