

October 17, 2022

Ryan Bares  
Robert Wood  
Utah Division of Air Quality  
P.O. Box 144820  
Salt Lake City, Utah 84114-4829Submitted by email to [rbares@utah.gov](mailto:rbares@utah.gov) and [rwood@utah.gov](mailto:rwood@utah.gov):

**Re: Comments on the Utah Division of Air Quality's Advance Notice of Rulemaking for Natural Gas-Fired Boilers, Steam Generators, and Process Heaters; R307-315 & R307-316**

Dear Mr. Bares and Mr. Wood,

Kennecott Utah Copper LLC (KUC) appreciates that the Utah Division of Air Quality (UDAQ) has provided stakeholders with an Advanced Notice of Proposed Rulemaking for Natural Gas-Fired Boilers, Steam Generators, and Process Heaters (Boiler Rule). Furthermore, KUC appreciates the time that UDAQ took to discuss the potential impacts of the proposed rules with UDAQ in a September 26, 2022, conference call. As discussed on the call, KUC is submitting the following comments on the proposed Boiler Rule.

**Comment 1:**

The proposed rules<sup>1</sup> states that, "A person that commences construction, modification, or reconstruction of a boiler or boiler burner shall install a burner that is certified to meet a NOx emission rate of 9 parts per million by volume..."<sup>2</sup> KUC requests that UDAQ include an exclusion to the rule for either superheated steam boilers that are designed for extreme steam conditions or provide an off ramp to the Rules' applicability for boilers that undergo boiler-specific determinations made as part of a permitting application, i.e. boilers that are subject to best available control technology (BACT) determinations.

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<sup>1</sup> In the Advanced Notice of Proposed Rulemaking, UDAQ published two rules, those being R307-315, which would apply to boilers with a rated heat input between 2.0 and 5.0 MMBtu/hr, and R307-316, which would apply to boilers with a heat input rating above 5.0 MMBtu/hr. While these are separate rules, the text of the rules, emission standards, and other requirements appears to be the same for both rules. Out of convenience, KUC's comments cite to R307-316. However, these comments apply with equal force and applicability to the proposed R307-315.

<sup>2</sup> Proposed R307-316-4(1).

The need for such an off-ramp to the rule is illustrated by the KUC Smelter. The KUC Smelter operates two large, superheated steam boilers, referred to as the Holman and Rentech boilers in KUC's Approval Order.<sup>3</sup> These boilers are designed for "extreme steam conditions." The normal operating steam temperature and pressure for these boilers is 755 degrees Fahrenheit and 855 pounds per square inch gauge (psig) compared to 250 psig for saturated industrial boilers. At such operating conditions, the manufacturers can only guarantee a NOx emission rate of 15 parts per million by volume (ppmv). Such boilers are technically unable to meet a NOx emission rate of 9 ppmv.

During the permitting of the Rentech boiler in 2019, KUC demonstrated in a technical analysis that meeting the 9 ppm NOx emission rate is not technically feasible, a determination that UDAQ agreed with as part of the new source review process.<sup>4</sup> KUC therefore requests that superheated steam boilers designed for "extreme steam conditions" be exempt from the proposed Boiler Rule. In the event that UDAQ provided such an exemption to the proposed Boiler Rule, KUC would anticipate continuing to meet Notice of Intent requirements for future boiler/burner replacement projects, including a robust best available control technology (BACT) analysis.

In the alternative, KUC requests that UDAQ include provisions in the Boiler Rule that allows for owners and operators that complete a source-specific BACT analysis for their boilers to be exempt from the Boiler Rule. Adding such an off ramp from the Boiler Rule would strike the right balance between UDAQ adopting a rule of general applicability for State Implementation Planning purposes that sets an emission standard for most boilers against the need to provide sources – particularly those operating boilers with unique characteristics, such as those operating with extreme steam conditions – regulatory flexibility that allows for boiler-specific considerations. Furthermore, such an off ramp from the Boiler Rule would not create a regulatory exemption or uncertainty because any source using the provision would be subject to a source-specific BACT analysis that would evaluate the technical and economic feasibility of a BACT analysis as well as subject the source and modification to the full suite of requirements, review, and public comment of UDAQ's new source review program.

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<sup>3</sup> Approval Order DAQE-AN1034600060-21; Condition II.B.2 (Holman Boiler and Rentech Boiler NOx Requirements).

<sup>4</sup> Aux Boiler White Paper; Assessment of Ultra-Low NOx Technology for Superheated Steam Boiler Application, prepared by J+KombusTech Inc., March 28, 2019, attached hereto ("Ultra-low NOx applications of superheated boilers achieving 9 ppm NOx do not currently exist. Saturated steam boilers typically achieve 9 ppm NOx utilizing high levels of FGR. However, this pushes the high-heat combustion area to a different area of the boiler which will not accommodate the needs of the superheated tube bank. These factors and others ... result in unreliable combustion of the boiler and unreliable boiler performance will affect the Acid Plant performance which is required for propose SO2 emission control for furnace operation.")

## Comment 2:

The proposed Boiler Rule states that, “A person that commences construction, modification, or reconstruction of a boiler or boiler burner shall install a burner that is certified to meet a NOx emission rate of 9 parts per million by volume (ppmv) or less at 3% volume stack gas oxygen on a dry basis averaged over a period of 15 consecutive minutes.”<sup>5</sup>

KUC intends to comply with this requirement for saturated boilers through manufacturers’ specification sheets and emission guarantees. But vendor-provided emission guarantees do not include averaging periods for small boilers, rendering KUC’s compliance with the averaging requirement infeasible. As commonly known, stack testing small boilers and heaters would be cost prohibitive and inconsistent with the spirit of the proposed rules, R307-315 and R307-316.

Given these facts, KUC requests that UDAQ remove the listed averaging period from its compliance requirements in this Boiler Rule. If UDAQ proceeds with the proposed rule, KUC requests that R307-315-4(1) and R307-316-4(1) read (with deleted language in red strikeout):

A person that commences construction, modification, or reconstruction of a boiler or boiler burner shall install a burner that is certified to meet a NOx emission rate of 9 parts per million by volume (ppmv) or less at 3% volume stack gas oxygen on a dry basis ~~averaged over a period of 15 consecutive minutes~~.

## Comment 3:

The proposed Boiler Rule states that, “Persons subject to this rule shall be in compliance with this rule by May 1, 2023.” KUC requests clarification and definitions around the applicability of this timeline. We recommend that this timeline be connected to a permitting activity or milestone to assist with the permitting of future boiler/burner projects.

## Comment 4:

As currently drafted in the Advanced Notice of Rulemaking, the Boiler Rule’s title suggests that the Rule applies to Natural Gas-Fired Boilers, Steam Generators, and Process Heaters. However, the text of the Boiler Rule only proposes conditions and standards for boilers, and relies on the regulatory definition of the term “boiler” found in 40 CFR 63.11237 to define what constitutes a boiler under the Rule; there is no conditions or provisions for steam generators or process heaters in the text of the proposed Boiler Rule. Given that the rule text demonstrates an intent by UDAQ to regulate boilers only, for clarity in implementation KUC requests that UDAQ revise the title of the proposed Boiler Rule as applying “NOx

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<sup>5</sup> R307-416-4(1).



Emission Limits for Natural Gas-Fired Boilers” and delete the references to steam generators and process heaters.

KUC appreciates the opportunity to comment on the proposed Boiler Rule and looks forward to additional discussions on the rule in the future.

Sincerely,

Jenny Esker Evans  
Principal Advisor, Air Quality Permitting and Compliance

**Attachment  
Rentech Boiler Technical Analysis**

# J+KOMBUSTECH INC.

Date: March 28<sup>th</sup>, 2019

## Rio Tinto Kennecott Utah Smelter

Aux Boiler White Paper

Assessment of Ultra-Low NOx Technology for  
Superheated Steam Boiler Application

### Prepared For:

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# J+KOMBUSTECH INC.

## Aux Boiler Specification

The Kennecott Utah Copper (KUC) Smelter Aux Boiler, also referred to as the Foster-Wheeler boiler, is a “**Special Case SuperHeated Steam Water Tube Boiler**” and it is a “Critical” piece of equipment for normal operation of the KUC Smelter. It requires a boiler designed for “extreme steam conditions” with both high pressure and high temperature superheated steam utilizing an integral steam superheater tube bank inside the boiler.

The existing 1995 vintage Foster Wheeler Aux Boiler is fitted with a Todd burner utilizing FGR which is designed for less than 40.0 ppm NOx (0.05 lb/MM Btu). The normal Aux boiler operating pressure required to be delivered to the Smelter Acid Plant compressor is 853 psig (with a boiler pressure nominal design rating of 1,000 psig). The normal operating steam temperature is 755 deg F and the design steam flow rate is 130,000 lbs/hr.

This is in contrast to saturated steam boilers which are more typical in industrial settings and operate at less than 250 psig. Achieving boiler performance and lower emission standards has been demonstrated for saturated steam boilers, but for this project, no existing superheated steam boilers were identified with ultra-low NOx emission standards.

## Investigation for Replacement Boiler

### Packaged Boiler Companies Short List

Bids from four boiler companies were evaluated for this project:

- WOOD Foster Wheeler,
- RENTECH,
- Cleaver Brooks,
- Nationwide Boiler (with B&W)

### Burner / Combustion System Companies

The bids included combustion technology from three (3) burner manufacturers: COEN, ZEECO and NATCOM. We requested Fives North American and they declined to quote.

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## **Evaluation of Existing Superheated Steam Boiler Projects**

At this time, we are unaware of any combustion technology that meets a 9.0 ppm NOx emissions rating for superheated steam. None of the boiler / burner manufacturers solicited were able to provide a reference list with a superheated steam boiler of this type with either 9.0 ppm or 15.0 ppm NOx emissions combustion technology installed.

While combustion technology does exist for 9.0 ppm NOx emissions from the three (3) burner companies listed for saturated steam boilers, there were no examples for this specific boiler application. The reference projects provided by the boiler / burner companies for Low NOx applications were saturated steam boilers (without a superheater) or lower pressure and lower temperature steam conditions than what the Smelter Aux Boiler requires.

## **Justification for 15.0 ppm NOx as Ultra-Low NOx Combustion Technology for the Aux Boiler**

Saturated steam boilers are an easier boiler application to achieve Ultra Low NOx emissions than superheated steam boilers. The basis for this difference is provided in the sections below.

### *Flue Gas Recirculation Impacts to Superheated Steam Boilers*

The combustion technology from the solicited burner companies utilizes high flue gas recirculation (FGR) rates as part of their technology solution according to the burner and boiler manufacturers. COEN and NATCOM both either clearly state that the FGR rates will approach 30% FGR and ZEECO indicates being able to achieve 9.0 ppm with lower than 30% FGR and likely in the 20% FGR range.

With a superheated steam boiler, the flame pattern and heat flux required at the superheater tube banks are critical to the performance of the boiler and achieving the superheated steam temperature while maintaining the steam pressure required for the process by ensuring high steam quality standards (no water carryover). When utilizing high FGR rates of greater than 15% the flame combustion envelope is highly diluted with FGR and resultant flame temperature is lowered substantially to impede the formation of thermal NOx.

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The problem with high FGR rates is that the flame envelope and resultant heat flux from the flame to the boiler tubes in the radiant section of the boiler is reduced and more heat transfer is done in the convective section of the boiler. However, with a superheater tube bank that is integral to the production of high pressure/high temperature steam, the heat transfer is highly dependent on the burner flame pattern and its temperature. Both of these aspects are compromised when high FGR rates are utilized and hence the superheater performance is affected and steam quality could be compromised.

The inability to achieve the superheated steam performance standards required from of this boiler would render the boiler non-functional and unreliable. Unreliable operation of the boiler will result in unreliable operation of the Acid Plant which results in SO<sub>2</sub> exceedances and incidents because the furnace offgas must be directed to the Main Stack to protect workers when the Acid Plant unexpectedly trips offline.

## Boiler Operating Flue Gas Oxygen Level and Boiler Efficiency Considerations

Achieving 15.0 ppm NO<sub>x</sub> should be achieved with no greater than 2% to 3% nominal O<sub>2</sub> level in the flue gas and < 20% FGR. Higher oxygen levels mean increased excess air (XS) and decrease overall boiler efficiency.

Lower NO<sub>x</sub> levels of 9.0 ppm generally require increasing the flue gas oxygen operating level to as much as or greater than 5.0% O<sub>2</sub> (30% XSair) along with the increased FGR flow rates (IE: 2% O<sub>2</sub> is 10% XSair). Operating with higher XSair (higher O<sub>2</sub>) and increased FGR will require a much larger combustion air fan for the added volume of FGR and added volume of combustion air and possibly a larger physical size boiler, economizer with more convective heat transfer surface area to attempt to keep the thermal efficiency in check.

Higher oxygen levels and FGR rates will lower the fuel efficiency of the boiler resulting in burning more fuel per pound of steam produced to achieve 9.0 ppm NO<sub>x</sub> than should be required if operating at 15.0 ppm NO<sub>x</sub>. The fuel usage and overall energy efficiency will generally increase and this could be as high as 3.0% or 4.0% increase in energy consumption depending on the final operating flue gas exhaust temperature at full production rates.

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Considering all costs and assuming about 50% utilization of the boiler, this could be an operating cost impact in the \$150,000.00 to \$200,000.00 range per annum for a superheated boiler.

The combustion air fan motor connected Horse Power with a 15.0 ppm burner and 20% FGR will be in the 600 HP range. With a 9.0 ppm burner we should expect the HP to increase to as high as 700 HP. Hence more electric power consumed to achieve the lower NOx emissions and the overall boiler energy efficiency negatively impacted.

## Summary

Ultra-low NOx applications of superheated boilers achieving 9 ppm NOx do not currently exist. Saturated steam boilers typically achieve 9 ppm NOx utilizing high levels of FGR. However, this pushes the high-heat combustion area to a different area of the boiler which will not accommodate the needs of the superheated tube bank. These factors and others discussed above result in unreliable combustion of the boiler and unreliable boiler performance will affect the Acid Plant performance which is required for proper SO2 emission control for furnace operation.

Despite the fact that none of the boiler and burner manufacturers have a reference for a similar superheated boiler with 15.0 ppm NOx emissions, we believe this NOx technology should be as low as they can reasonably achieve and we can accept with burner technology for superheated specifications required for the Aux Boiler, keeping in mind that the Smelter has an extremely unique boiler case configuration requiring superheated, high pressure and high temperature steam as part of critical plant operation for the Acid Plant and SO2 emissions control.

Because the Aux Boiler application is a **“Special Case SuperHeated Steam Water Tube Boiler”** and it is a **“Critical”** piece of equipment for normal operation of the KUC Smelter:

- We are recommending that the Aux Boiler burner / combustion system technology have a target NOx emission rate of 15.0 ppm corrected to 3% O2

## End of Report