The following Inquiry is presented as received:

Definition of UNHR = (1/\eta_{Steam Generator}) \times \text{HR Turbine} \times \left[\frac{P_{Gen}}{(P_{Gen} - P_{Aux})}\right]

HR Turbine = \frac{\text{Heat Output from Steam Generator}}{P_{Gen}}

Measurement must be carried out using the following ASME Codes:
- Boiler Efficiency ---> PTC 4.1
- Steam Turbine Unit ---> PTC 6

Question:
For which operating conditions does the Steam Turbine Heat Rate has to be corrected, to be used for calculating the Unit Heat Rate according to the above formula?

In our opinion, the correction of the Efficiency of Steam Generator and the Heat Rate to rated conditions has to be done for those parameters, which are outside the scope of supply (ambient air temperature, barometric pressure, humidity, cooling water temperature, heating value of fuel, power factor, frequency).

In the client opinion, the Steam Turbine Heat Rate should be strictly corrected according to PTC 6 as described in PTC 6 A, Section VI, page 25 to 55.

Is the following interpretation correct?

In our opinion, all parameters, listed under Group 1, are not permitted to correct to specified values (shown on the Heat Balance Diagram), because these components are within the scope of our supply, we are the supplier of steam turbine and balance of plant. For example: The supplier of Steam turbine is responsible for all terminal temperature differences of all heaters, for all pressure losses in all extraction lines, for temperature rise of feed water pump a.s.o.).

In our opinion, parameters, listed under Group 2, which are outside the scope of our supply can be corrected, only?

For example: Guarantee is based on cooling water inlet temperature, therefore Heat Rate must be corrected to rated Cooling Water Inlet temperature.

No correction will be done for LP-Turbine exhaust pressure!

Reheater pressure drop may not be corrected to rated values because Reheater Pressure Drop is an internal value (Subject to the Consortium).

We need your judgment on the above-mentioned subject to clarify the contractual situation with our client. Your early reply would be highly appreciated.
**ANSWER:**

The turbine heat rate (HR Turbine) is not to be corrected according to PTC 6 as described in PTC 6A. The corrections described in Section VI of PTC 6A are for determination of turbine performance, and are not necessarily appropriate for establishing unit heat rate. (Please note that the current version of PTC 6A is 2000).

In the case where one supplier provides the entire power plant, that supplier can properly be held accountable for only the performance of the equipment within his scope of supply (this, however, is to be agreed by the parties in form of a contract or in any other appropriate form).

If above statement is correct, they can expect to have corrections made only for those parameters outside their control. Such parameters include not only those mentioned in the inquiry (ambient air temperature, barometric pressure, humidity, cooling water temperature, heating value of fuel, power factor, system frequency), but also corrections for hydrogen pressure and purity, boiler blowdown (if not isolated), process steam flow (if applicable) and process return or make-up (if applicable).

The corrected fuel energy efficiency of the steam generator is determined as per ASME PTC 4.1, abbreviated efficiency test, and entered directly into the equation for UNHR. UNHR is then corrected to specified conditions applying the corrections mentioned above. [Please note that PTC 4.1-1964 (R1991) – Steam Generating Units, has been superceded by PTC 4-1998 – Fired Steam Generators].

Boiler exit steam conditions are not necessarily the same as turbine inlet conditions. Between the two pieces of equipment are lengths of piping which may introduce changes in both steam pressure and temperature. Such losses, if they differ from any anticipated in the design of the equipment, are, generally, the responsibility of the supplier. Therefore, corrections for deviations in steam turbine inlet steam pressure, temperature, and reheat temperature are improper for the situation described in the inquiry. Proper boiler exit steam pressure and temperatures should be accounted for in the testing of the boiler.

The question raised in the inquiry asks about which Group 2 corrections may properly be applied to the Steam Turbine Heat Rate. The only steam turbine corrections that should even be considered are the ones to account for (a) small differences in measured versus specified power for a test run to be conducted at a specified measured or corrected power level, or (b) small differences between required and actual unit operating setup such as valve point operation of the steam turbine.

PTC 46-1996 – Overall Plant Performance describes the correct use of corrections to determine overall plant-performance parameters in Appendix E. Please refer to equations (5.3.3) and (5.3.4) as well as to Table 5.1 of PTC 46-1996. ASME recommends the use of PTC 46-1996 for determination of overall plant performance.

Please note that ASME does not recommend the application of PTC 6 (current version is 1996) in the determination of performance of the overall integrated plant since PTC 6 is designed to determine performance of the steam turbine isolated from the rest of the plant.

"ASME procedures provide for reconsideration of this interpretation when or if additional information is available which the inquirer believes might affect the interpretation. Further,
persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. As stated in the foreword of our standards, ASME does not "approve", "certify", "rate", or "endorse" any item, construction, proprietary device or activity."