Question 20.4

Topic: Reporting of Hourly Heat Input Rate

Question: How do I determine and report hourly heat input rates for a subtractive stack configuration?

Answer: Determine hourly heat input rates: (1) at the main common stack; (2) at any secondary common stack(s); (3) any common pipe(s) and (4) for *each* individual unit in the subtractive stack configuration (both affected and nonaffected units). Determine the hourly heat input rates as follows:

A. Heat Input Rate Measured at the Main Common Stack Only

When heat input rate is measured only at the main common stack (for qualifying configurations, as described in Section C.(3) of Question 20.2 or in Section B.(3) of Question 20.3), apportion the hourly heat input rate at the common stack to each of the units in the subtractive stack configuration (both affected and nonaffected units) using Equation F-21a or F-21b in Appendix F to Part 75 (see Table 20-3), for each stack operating hour (each hour in which effluent gases discharge through the main common stack). The summation term in the denominator of these equations must include *all* unit loads (for both the affected and nonaffected units).

Table 20-3: Hourly Heat Input Rate Apportionment and Summation Formulas

Equation Code	Formula	Where
F-21a	$$HI_i = HI_{CS}\left(\frac{{}^tCS}{t_i}\right)\left[\frac{MW_i\, t_i}{sum from\, i=1?n\, MW_i\, t_i}\right]$$	HI_i = Heat input rate for a unit (mmBtu/hr) HI_{CS} = Heat input rate at the common stack or pipe (mmBtu/hr) MW_i = Gross electrical output for a unit (MWe) t_i = Operating time at a particular unit (hour or fraction of an hour) t_{CS} = Operating time at common stack (hour or fraction of an hour) n = Total number of units using the common stack or pipe i = Designation of a particular unit
F-21b	$$HI_i = HI_{CS}\left(\frac{{}^tCS}{t_i}\right)\left[\frac{SF_i\, t_i}{\sum\limits_{i=1}^{n} SF_i\, t_i}\right]$$	HI_i = Heat input rate for a unit (mmBtu/hr) HI_{CS} = Heat input rate at the common stack or pipe (mmBtu/hr) SF_i = Gross steam load for a unit (klb/hr) t_i = Operating time at a particular unit (hour or fraction of an hour) t_{CS} = Operating time at common stack (hour or fraction of an hour) n = Total number of units using the common stack or pipe i = Designation of a particular unit
F-25	$$HI_{CS} = \frac{\sum\limits_{all-units} HI_u t_u}{t_{CS}}$$	HI_{CS} = Heat input rate at the common stack (mmBtu/hr) I_u = Heat input rate for a unit (mmBtu/hr) t_u = Operating time at a particular unit (hour or fraction of an hour) t_{CS} = Operating time at common stack (hour or fraction of an hour)

B. Heat Input Rate Measured at the Main Common Stack and the Nonaffected Unit(s)

When heat input rate is monitored or measured at both the main common stack and at the nonaffected unit(s), determine the heat input rate for each unit in the subtractive stack configuration as follows:

Scenario #1: For hours in which *both* affected and nonaffected units are operating and the total heat input in mmBtu measured at the main common stack is greater than the total heat input of the nonaffected unit(s):

(i) For the affected units:

(A) Use Equation SS-3a (see Table 20-4) to obtain the total hourly heat input for the affected units. The term on the left side of the minus sign in Equation SS-3a is the hourly total heat input at the main common stack (mmBtu), and is the product of the measured heat input rate and the stack operating time. The term on the right hand side of the minus sign is the total hourly heat input for the nonaffected units, and is the sum of the products of the measured heat input rates and the unit operating times for all of the nonaffected units.

(B) If any nonaffected units are monitored as a group at a single location, then, for those units, replace the term $HI_{nonaff} t_{nonaff}$ in Equation SS-3a with the term $HI_{CS^*} t_{CS^*}$, where HI_{CS^*} is the hourly heat input rate measured at the nonaffected units' monitoring location (designated as a secondary common stack) and t_{CS^*} is the stack operating time at the secondary common stack.

(C) For each hour in which Scenario # 1 applies, calculate the individual affected unit heat rates using Equation SS-3b (see Table 20-4). Note that the summation term in the denominator of Equation SS-3b includes *only* the affected unit hourly loads.

(ii) For the nonaffected units:

(A) If the nonaffected units are individually monitored for heat input rate, report the measured hourly heat input rate value(s). This includes gas and oil-fired units using Appendix D procedures to determine heat input rate.

(B) If, for a group of nonaffected units, heat input rate is monitored at a single location (designated as a secondary common stack) using a flow monitor and a diluent CEM, apportion the heat input rate measured at the secondary common stack to the individual

Table 20-4: Hourly Heat Input Formulas for Affected Units

Equation Code	Formula	Where
SS-3a	$$HItot_{aff-hr} = HI_{CS}t_{CS} - \sum_{all-nonaff} HI_{nonaff}t_{nonaff}$$	$HItot_{aff-hr}$ = Total hourly heat input for the affected units (mmBtu) HI_{CS} = Hourly heat input rate at the common stack (mmBtu/hr) HI_{nonaff} = Hourly heat input rate for a particular nonaffected unit (mmBtu/hr) t_{CS} = Operating time for the common stack (hr) t_{nonaff} = Operating time for a particular nonaffected unit (hr)
SS-3b	$$HI_{aff} = \frac{1}{t_i} \times HItot_{aff-hr} \times \left(\frac{L_i t_i}{\sum_{all-aff} L_i t_i} \right)$$	HI_{aff} = Hourly heat input rate for a particular affected unit (mmBtu/hr) $HItot_{aff-hr}$ = Total hourly heat input for all affected units (mmBtu) t_i = Operating time for a particular affected unit (hr) L_i = Hourly unit load for an affected unit in the subtractive stack configuration (MW or klb of steam per hour)

Scenario #2: For any hour in which both nonaffected unit(s) and affected unit(s) are operating and the total heat input at the main common stack is less than or equal to the total heat input for the nonaffected unit(s), causing

Equation SS-3a to give a negative or zero total heat input value for the affected units, follow these procedures:

(i) Invalidate the result obtained from Equation SS-3a;

(ii) Consider the heat input rate measured at the main common stack to be correct;

(iii) Disregard all heat input rate(s) measured at the nonaffected unit(s); and

(iv) Apportion the heat input rate measured at the main common stack to all units (affected and nonaffected) in the subtractive stack configuration, using Equation F-21a or F-21b.

Scenario # 3: For any hour in which *only* affected units are operating,

(i) For the affected units:

(A) Set the summation term in Equation SS-3a equal to zero, so that the total heat input for the affected units equals the heat input measured at the main common stack.

(B) Then, use Equation SS-3b to determine the hourly heat input rate for each affected unit.

(ii) For the nonaffected units:

Assign a heat input rate value of zero to each nonaffected unit.

Scenario #4: For any hour in which *only* nonaffected units are exhausting to the common stack,

(i) For the affected units:

Assign a heat input rate value of zero to each affected unit.

(ii) For the nonaffected units:

(A) Invalidate all measured heat input rates for the nonaffected units;

(B) Consider the heat input rate measured at the main common stack to be correct; and

(C) Apportion the heat input rate measured at the main common stack to the nonaffected units, using Equation F-21a or F-21b.

References: Appendix F

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