Appendix A – Examples of Implementation of Alternative NOx Standard

Example 1: Establish Mass Emission Limit for Alternate NOx Compliance Plan

Assumptions:

Data for Pre-1994 Heaters Subject to 9-10-301 (for simplicity, all are assumed to operate at a consistent NOx emission factor and to operate at 100% capacity on each of the 10 baseline days, and all are still in service and subject to Reg. 9-10 at the time of application for the alternate compliance plan):

Heater	Rated Heat Input (MM BTU/hr)	Emission Factor (lb NOx/MM BTU)	Daily Fuel Use (MM BTU)	NOx Emissions (lb)
#1	50	0.080	1200	96
#2	100	0.050	2400	120
#3	150	0.040	3600	144
#4	150	0.040	3600	144
#5	250	0.009	6000	54
Weighted Average (lb NOx/MM BTU)		**0.033**		
Total (MM BTU)			**16800**	
Total (lb)				**558**

Calculations

The NOx mass emission limit is: **558 lb/day**.

Future Implementation of 9-10-308.3:

If Heater #2 was later replaced (after the alternate compliance plan was approved), the NOx emission limit would become:

(558 – 120) lb NOx/day = 438 lb NOx/day

If Heater #5 was later replaced (after the alternate compliance plan was approved), the NOx emission limit would become:

(558 – 54) lb NOx/day = 504 lb NOx/day

Example 2: Establishing Mass Emission Limit for Alternate NOx Compliance Plan (IERC used to comply with 9-10-301)

Assumptions:

The only difference from Example 1 is the higher NOx emission factor at Heater #5 during the 10 baseline days, which makes the daily average NOx emission rate exceed the limit in 9-10-301. The refinery complies under the current rule by the use of Interchangeable Emission Reduction Credits.

Heater	Rated Heat Input (MM BTU/hr)	Emission Factor (lb NOx/MM BTU)	Daily Fuel Use (MM BTU)	NOx Emissions (lb)	Difference between actual daily emissions and emissions @ 0.033 lb NOx/MM BTU (lb)
#1	50	0.08	1200	96	
#2	100	0.05	2400	120	
#3	150	0.04	3600	144	
#4	150	0.04	3600	144	
#5	250	0.025	6000	150	
Total (MM BTU)			**16800**		
Total (lb)				**654**	**96**

Calculations

The proposed amendments require that the difference between actual emissions during the baseline period and allowed NOx emissions (daily average of 0.033 lb / MM BTU) be addressed at the time the NOx mass emission limit is set. The difference here is:

(654 – 558) lb NOx/day = **96 lb NOx/day**.

The refinery has 3 options to comply:

1) Continue to apply IERC under Reg. 2-9.

2) Mitigate the reduction by surrendering NOx ERC at a 1.15 to 1 ratio. The maximum mitigation that can occur is up to the actual emission level, which results in a daily NOx mass limit of 654 lb NOx/day, and requires the following ERC:

(96 lb NOx /day)(365 day)(1.15) = 40,296 lb NOx = 20.15 tons NOx ERC

3) Improve NOx emissions controls and/or reduce heater use to reduce emissions to no more than 558 lb NOx/day.

Example 3: Application to Modify or Remove Heater #5

Assumptions:

At the time of the application to use the alternative standard, the refinery had already submitted an application for an Authority to Construct that includes modifying heater #5 or removing this heater from service (either circumstance removes the heater from the pre-1994 population). The data from Example 1 is changed to reduce the rated heat input of Heater #5 to zero to show the effect on the overall NOx emission rate:

Heater	Rated Heat Input (MM BTU/hr)	Emission Factor (lb NOx/MM BTU)	Daily Fuel Use (MM BTU)	NOx Emissions (lb)
#1	50	0.08	1200	96
#2	100	0.05	2400	120
#3	150	0.04	3600	144
#4	150	0.04	3600	144
#5	0	0.009	0	0
Total (MM BTU)			**10800**	
Total (lb)				**504**

Calculations

Because Heater #5 has a lower-than-average NOx emission rate, removing this heater would raise the weighted-average NOx emission rate at the remaining heaters, even though total NOx emissions are reduced, and the resulting emission rate would exceed the limit in 9-10-301. If the refinery remained subject to 9-10-301, it would have to mitigate the resulting increase in NOx emission rate. The proposed amendments require that in this specific situation, the baseline NOx emission limit (558 lb NOx/day from Example 1) be reduced to a level that would comply with 9-10-301:

(10800 MM BTU)(0.033 lb NOx/MM BTU) = **356 lb NOx/day**.

The allowable emissions are calculated only for the heaters that would remain subject to 9-10-301. The amount is the difference between the NOx emissions allowed (356 lb NOx/day) and the current emissions (504 lb NOx/day):

504 lb NOx/day – 356 lb NOx/day = **148 lb NOx/day**.

Example 3 (continued)

The refinery has 3 options to comply:

1) Apply IERC under Reg. 2-9.

2) Surrender NOx ERC at a 1.15 to 1 ratio to mitigate the difference. ERC can be surrendered up to the actual emission level from Example 1, which results in a daily NOx mass limit of 558 lb NOx/day. The following amount of ERC would be required:

(148 lb NOx /day)(365 day)(1.15) = 62,123 lb NOx = 31.06 tons NOx ERC

3) Improve NOx emissions controls and/or reduce heater use to reduce emissions to no more than 360 lb NOx/day.

Note: The adjustment in Example 3 is independent of the adjustment in Example 2. If the circumstances in both examples occurred, then both adjustments would be made, and both sets of mitigation options could be used.