LIGNITE
COMBUSTION
AP-42: Section 1.7
Reference Number
5
4/93
Ja

ENVIRONMENTAL HEALTH
AND
ENGINEERING SERVICES
W. Van Heuvelen, Chief

DIVISION
OF
ENVIRONMENTAL ENGINEERING
Gene A. Christianson, P.E., Director
(701) 224-2374

North Dakota State

Department of Health
State Capitol
BISMARCK 58501

State Health Officer

December 13, 1973

Ref. 5
Sec 1.7
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Mr. Tom Lahre
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Dear Mr. Lahre:

As per your recent telephone request to Mr. Gene Christianson of this office, we are sending you copies of stack test reports we have for lignite fired steam generating plants in North Dakota.

If you have any questions after reviewing them, please feel free to contact this office.

Sincerely,

Dana K. Mount

Dana K. Mount, P.E.
Division of Environmental
Engineering, Air Pollution
Control Program

DKM:kl
Encl:

MPC

MINNKOTA POWER COOPERATIVE, INC. Box 1318 Grand Forks, N.D. 58201 Phone (701) 775-4641

July 14, 1971

Mr. Gene A. Christianson
Division of Environmental Engineers
North Dakota State Department of Health
Bismarck, North Dakota 58501

Dear Gene:

The enclosed report of an SO_2 and NO_x test conducted by B&W on our Center unit is for your information. It is merely an additional test to add to the information we have presented you and is not intended to offer any different information or changed conditions from the information already given you.

Very truly yours,

MINNKOTA POWER COOPERATIVE, INC.

Lloyd

Lloyd V. Hillier
System Operations Manager

LVH:nph

Enclosure

MPC
MINNKOTA POWER COOPERATIVE, INC. Box 1318 Grand Forks, N.D. 58201 Phone (701) 775-4641

June 29, 1971

Mr. Gene A. Christianson
Division of Environmental Engineering
State Department of Health
Bismarck, North Dakota 58501

Subject: Stack Emission
Milton R. Young Station
Center, North Dakota

Dear Gene:

This letter and the enclosed prints and reports are pieces of information meant to inform you of our present planning in regard to meeting the existing and future stack emission requirements at our Center plant.

The stack emission test performed by B&W indicates satisfactory performance by the installed dust collector, but it also indicates that the stack emission exceeds the existing requirements of the North Dakota Air Pollution Regulations.

The tests performed by the personnel of the Lignite Research Lab in November, 1970, and again in April, 1971, are good tests for SO_2, SO_3, and NO_x. Their dust loading test was a test of the loading to the dust collector so it is not pertinent in a direct way with the stack emission.

Part. testing before control

The Lignite Lab test for SO_2 indicated 100% of the sulfur in the coal was converting to SO_2, but on later analysis they corrected that number to 92% since there is evidence of some sulfur remaining in the ash. In any event, even 100% sulfur conversion to SO_2 would not exceed the allowable 3 lb. per 10^6 BTU input as set by the North Dakota Air Pollution Regulations.

Our consulting engineers, Sanderson & Porter, were asked to look into the feasibility of an electrostatic precipitator to further improve the stack emission to an acceptable level.

Their letter of June 2 to us makes it clear that at least two manufacturers of precipitators are confident that their equipment can and will take sufficient dust from the stack gases to meet emissions of .1 lb./10^6 BTU of heat input to the boiler.

Sanderson & Porter's letter of June 4, 1971 includes correspondence from the two manufacturers which offer several alternatives to us for the installation of such equipment. It is interesting to note that one of the manufacturers considers that .02 grains/ACFM would result in a visually clear stack, while the other says that .01 grains/ACFM would be required for a clear stack. .02 grains/ACFM would be equivalent to .1 lb./10^6 BTU in our Center unit.

It is our intention to meet stack emission requirements of both State and Federal agencies if it is possible to do so. It is also our understanding that final Federal requirements have not been established, but when they are the State requirements will be changed to meet those standards if they are more stringent than the existing regulations.

We therefore request that we be allowed to wait for such new regulations to be established before we submit a firm plan for installation of additional dust collecting equipment.

The enclosed prints show two proposed methods of precipitator installation. Obviously, both plans are expensive and constructionally difficult to install. Serious, lengthy plant outages are probable for final installation. It is, therefore, quite important to everyone concerned that the final plan is adequate and properly engineered.

The estimated time for engineering, purchase, construction, and installation could take 1 1/2 to 2 years so we recognize the importance of proceeding as quickly as possible.

We will appreciate your advice as to the adequacy of this submittal and will welcome any discussion with you that may seem desirable to meet your requirements and our obligation for presenting you with the proper information.

Very truly yours,

MINNKOTA POWER COOPERATIVE, INC.

Lloyd V. Hillier

Lloyd V. Hillier
System Operations Manager

LVH:nph

Enclosures: Sanderson & Porter letter, June 2, 1971
Sanderson & Porter letter, June 4, 1971
Lignite Research Lab Test Report
B & W Flue Gas Test
Drawing No. SK4038-11-1
Drawing No. SK4038-11-2

DATA FOR MILTON R YOUNG PLANT : Ref C

36% EA

640 ppm NO_x

Carbon	42%
H_2	3
S	.7
H_2O	35
Ash	6
O_2	12
N_2	1.3
	100.0%

① Air Requirement:

$C + O_2 \rightarrow CO_2$

$$\left(\frac{.42\ lb\ C}{lb\ lignite}\right)\left(\frac{1\ lb\ mole\ C}{12\ lb\ C}\right)\left(\frac{1\ lb\ mole\ O_2}{1\ lb\ mole\ C}\right)\left(\frac{32\ lb\ O_2}{1\ lb\ mole\ O_2}\right)\left(\frac{56.4\ SCF}{1\ lb\ O_2}\right) = 63.2 \text{ (SCF air)}$$

Hydrogen: $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$

$$(.03\ lb\ H_2)\left(\frac{1\ lb\ mole\ H_2}{2\ lb\ H_2}\right)\left(\frac{\frac{1}{2}}{1}\right)\left(\frac{32}{1}\right)\left(\frac{56.4}{1}\right) = 13.6$$

Sulfur $S + O_2 \rightarrow SO_2$

$$(.007\ lb\ S)\left(\frac{32}{32}\right)\left(\frac{56.4}{1}\right) = .395$$

Nitrogen $\frac{1}{2}N_2 + \frac{1}{2}O_2 \rightarrow NO$

$$.013\ lb\ N_2\left(\frac{32}{28}\right)\left(\frac{56.4}{1}\right) = .84$$

78.0 SCF air needed for combustion

$.12\ lb\ O_2 \quad \frac{56.4\ SCF}{1\ lb\ O_2} = 6.8\ SCF\ O_2$

$$(6.8\ SCF\ O_2)\left(\frac{1\ SCF\ AIR}{.21\ SCF\ O_2}\right) = 32.4\ SCF\ air$$

− 6.8 SCF O_2 in

71.2 SCF air needed / lb lignite

Products of combustion

CO_2: $(.42\ lb)\left(\frac{44}{12}\right)\left(\frac{379}{44}\right) =$

H_2O (combustion): $(.03)\left(\frac{379}{2}\right) =$

H_2O (fuel) $(.35)\left(\frac{379}{18}\right) =$

SO_2: $(.007)\left(\frac{379}{32}\right) =$

NO: $(.013)\left(\frac{1\ lb\ mole\ N_2}{28}\right)\left(\frac{1\ lb\ mole\ NO}{\frac{1}{2}\ lb\ mole\ N_2}\right)\left(\frac{379}{1}\right) =$

Nitrogen from air: