SPECTRUM SYSTEMS, INC.

3410 WEST 9 MILE ROAD PENSACOLA, FLORIDA 32526 (904) 944-3392

January 30, 1991

RECEIVED

FEB 06 1991

ENV. PERMITTING

Mrs. Elsa Bishop
Florida Power & Light Company
5500 Village Boulevard
West Palm Beach, FL 33407

RE: Opacity Monitor Audit

Dear Mrs. Bishop:

With respect to our earlier conversation concerning the Sanford Plant Stack #4 Opacity Monitor, I am writing to clarify our audit results. As you are aware, our engineer Reggie Davis performed a standard field audit of the transmissometer and control unit on January 24, 1991. The instrument was challenged with standard neutral density filters having a traceability chain to the National Bureau of Standards.

Initial "as found" data was collected prior to any adjustment and cleaning procedures being performed. As you will note in the attached table, all readings are well within the allowed ± 3% tolerance. A replacement internal span grating was installed to allow daily checks of the instrument to be performed as near as possible to the upper opacity limit of the generating unit.

Final cleaning and alignment of the stack and control room mounted equipment along with a complete calibration check and adjustment of the system provided acceptable accuracy from zero to one hundred percent opacity as checked at eight points along the scale. As found data and after cal data were in very good agreement up to about eighty percent opacity. The high end roll-off of the system was due to an adjustment on the control unit optical density printed circuit board. This roll-off is not linear and occurs at a very well defined point on the opacity scale as amplifier saturation is reached.

There is absolutely no doubt that the system was and is well within tolerance from zero to at least eighty one percent opacity and most likely to ninety one percent opacity. This statement is based on hard field data extracted from the Spectrum service report dated 1-24-91 and my own ten years of experience with this exact type of opacity monitor.

To elaborate on double pass opacity monitors, I must point out that "opacity" as defined in EPA Method 9 is a single pass parameter. The Lear Siegler RM41 is an opacity calculator using the double pass transmittance algorithm. In order to compute opacity, the system must take the logarithm of the two pass transmittance, multiply by the as installed optical path length ratio and compute the antilogarithm to produce a single pass path corrected

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transmittance. This value is then subtracted from the number one and converted to percentage for final output. As engineers insist on doing, all these gyrations are used to produce linear relationships on which to perform extrapolation or interpolation. Once all parameters are compared, one will clearly see that an asymptotatical approach to the theoretical end point is the only means of solving a zero to one hundred percent sweep of an "opacity calculator". Referring to the enclosed excerpt from the Lear Siegler RM41 Manual, and in particular to the opacity/optical density chart on pages 2-3, one may observe a full scale OD of 2.0 representing 99% opacity. This is the full scale definition of an RM41 at a path length without taper. The FP&L Sanford Stack is slightly tapered, yielding an even steeper curve at 100% opacity. This explanation is directed at pointing out the extreme non-linearity of any "opacity calculator" on the market today. Amplifier saturation may occur at any point along the asymptote near the coordinates of 100% opacity and 2.0 optical density, due to only a slight calibration error.

This summary should explain why instrument accuracy is not compromised throughout its range when top end roll-off is experienced. A second common error for full scale deflection is the use of a dark, but reflective, material as a light block. If any reflected energy is impinged on the system detector, the conversions at this extreme function slope will show errors that appear to be excessive and unexpected.

If I may be of further assistance with this matter, please feel free to call me direct at 1-904-944-3392.

Respectfully,

Chuck W. McDonald

Chuck W. McDonald
Vice-President, Operations

CWM/vc

Enclosure

cc: H. Gordon Jones, President
Spectrum Systems, Inc.

R. Davis, Field Service Engineer
Spectrum Systems, Inc.

M. Halpin
FP&L

B. Allen
FP&L

PRELIMINARY FINDINGS
(AS FOUND DATA)
UNIT #4 OPACITY MONITOR
JANUARY 24, 1991

CALIBRATION FILTER VALUES PATH ADJUSTED % OPACITY	MONITOR/RECORDER INDICATION % OPACITY
0.0%	0.0%
9.6%	10.0%
17.0%	17.0%
34.6%	37.0%
48.8%	51.0%
80.4%	81.0%
100.0% Using Opaque Material	92.0%

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OPACITY CALIBRATION ERROR TEST

Service Engineer: Reginald Davis
Date: 1/24/91
Monitor Pathlength, L1:
Emission Outlet Pathlength, L2:
Clearpath Distance: 40' 9"
OPLR: 0.4339

Source Name: FP&L
Unit No.: # 4
Location: Sanford, FL
Model: LSI RM41
Serial Number: 38880

NEUTRAL DENSITY FILTERS

RANGE	DOUBLE PASS OPTICAL DENSITY	% OPACITY	PATH ADJUSTED OPACITY
LOW	0.1012	0.11	9.61%
MID	0.6707	0.538	48.81%
HIGH	1.6300	(00.8)	80.37%

Run Number	Calibration Filter Value Path-Adjusted % Opacity	Instrument Reading (Opacity), percent	Arithmetic Difference (Opacity), percent Low	Mid	High
1-Low	9.61%	9.00%	-0.61%	--------	--------
2-Mid	48.81%	50.00%	--------	1.19%	--------
3-High	80.37%	81.90%	--------	--------	1.53%
4-Low	9.61%	9.10%	-0.51%	--------	--------
5-Mid	48.81%	50.00%	--------	1.19%	--------
6-High	80.37%	81.90%	--------	--------	1.53%
7-Low	9.61%	9.00%	-0.61%	--------	--------
8-Mid	48.81%	50.00%	--------	1.19%	--------
9-High	80.37%	82.00%	--------	--------	1.63%
10-Low	9.61%	9.70%	0.09%	--------	--------
11-Mid	48.81%	50.10%	--------	1.29%	--------
12-High	80.37%	81.00%	--------	--------	0.63%
13-Low	9.61%	9.90%	0.29%	--------	--------
14-Mid	48.81%	50.10%	--------	1.29%	--------
15-High	80.37%	82.00%	--------	--------	1.63%
		Arithmetic Mean	-0.27%	1.23%	1.39%
		Confidence Coefficient	0.53%	0.07%	0.53%
		Calibration Error	0.80%	1.30%	1.92%

As a result, readings taken with the RM41 correspond to the visual measurement made by trained observers under ideal conditions. It is also important that the optics exclude the infrared portion of the spectrum, a predominating output of ordinary tungsten filament light sources, which is attenuated by water in the gas phase. Water vapor is not an opacity limiting component in emissions and, because of a narrow spectrum response, an insensitivity to the absorption spectra of water is achieved with the RM41.

Figure 2-2 illustrates the characteristic light attenuation of a polydisperse aerosol as a function of particle size and light wavelength. The attenuation of 1000 nanometer light falls off significantly at particle size of about 0.8 to 0.6 micron, while 550 nanometer light is attenuated by particulate matter as small as 0.3 to 0.2 micron. Light with a mean wavelength of 1000 nanometers is typical of an unfiltered incandescent light measurement system. The specially filtered RM41 optical system provides a necessary representative photopic spectrum that can resolve sub-micron particulate matter.

2.2 TRANSMITTANCE MEASUREMENT PRINCIPLE

The RM41 transmissometer projects a controlled beam of visible light through a smoke or dust channel of interest. Particles in the gas stream cause the light beam to be scattered and absorbed as a function of the type and size of the particles and the wavelength of the impinging light rays. A passive reflector on the opposite side of the channel returns the beam again through the channel to a photocell detector on the source side where it is measured. The measurement value is compared with a reference value previously determined with no smoke in the light path and the resulting ratio is an optical transmittance value for the measurement path. This ratio is subsequently converted to units of optical denstiy and stack exit opacity.

For a system installation it is necessary to establish the intensity level of the measurement beam in a clear stack, or zero opacity condition. This reference level then becomes the base for measuring the density of smoke contained in the measurement path. An optical transmittance measurement equals the ratio of intensities of the measurement beam with and without the attenuating medium (smoke). As a result, the transmittance of an optical path is always less than one but greater than zero. It is normally expressed as a percentage. Because the RM41 transmittance measurement is made with the beam traversing the smoke path twice (once in each direction), the resulting transmittance is a double-pass transmittance measurement. By passing through the smoke twice, sensitivity to low opacity levels is substantially increased, the calibration procedure is simplified, and the alignment requirements are made less stringent in comparison with double-ended transmissometers that employ a light source on one side of the stack, and a detector on the other side. The relationship between single-pass and double-pass transmittance is defined as follows:

$$T_2 = T_1^2 \quad \text{, where} \qquad (1)$$

T_1 is the single-pass transmittance
T_2 is the double-pass transmittance
and $0 \leq T_1$ & $T_2 \leq 1$

Opacity is a complementary function of transmittance. It is a measure of the opaqueness of the optical medium whereas tranmittance is a measure of its transparency. As a result:

$$OP_1 = 1 - T_1 \text{ and} \qquad (2)$$
$$OP_2 = 1 - T_2 \quad \text{, where}$$

OP_1 and OP_2 are single-pass and double-pass opacity values, respectively.

The measurement of smoke density or opacity is sometimes referred to in Ringelmann numbers. By definition, Ringelmann No. 1 is equivalent to 20% opacity, with the opacity increasing 20% for each Ringelmann number up to 5. The opacity in the Ringelmann definition is a single-pass value—a value that would be read by a human observer.

2.3 RELATIONSHIP OF TRANSMITTANCE, OPTICAL DENSITY, AND OPACITY

The relationship of opacity or transmittance to optical density can be seen from the following equations:

From equation (2), (3)

$$OP = 1 - T \quad \text{, where}$$
$$0 \leq T \leq 1$$

Similarly, optical density OD is defined as:

$$OD = \log_{10}(1/T) \text{ or} \qquad (4)$$

$$OD = -\log_{10} T \qquad (5)$$

Rearranging equation (3) and substituting in (5) gives:

$$OD = -\log_{10}(1-OP) \quad \text{, where} \qquad (6)$$
$$0 \leq OP \leq 1$$

Solving for opacity in terms of density yields:

$$OP = 1 - 10^{-OD} \qquad (7)$$
$$0 \leq OD \leq \infty$$

The corresponding relationship of opacity, transmittance, and optical density is shown graphically in Figure 2-3. The "Transmittance to Optical Density Conversion Tables" in the Appendix provide more accurate conversion data.

The appearance of a smoke plume is directly affected by the path length (the amount of smoke sighted-through). Because a transmissometer is rarely mounted at the stack exit, a system is designed to provide measurements corrected for stack exit conditions. This allows the instrument to be installed at a more convenient location even though the depth of the effluent at the measurement site is different than the depth of the plume at the stack exit. If the measurements at the measurement site are noted by a subscript $_M$, and stack exit measurements noted by subscript $_E$, the following relationships are obtained:

$$OP_M = 1 - T_M \quad (8)$$
$$OD_M = -\log_{10} T_M \quad (9)$$

And similarly,

$$OP_E = 1 - T_E \quad (10)$$
$$OD_E = -\log_{10} T_E \quad (11)$$

Now, if L_1 is used to represent the effluent depth at the measurement site and L_2 represents the effluent depth at the stack exit, it can be shown that:

$$OD_E = \frac{L_E}{L_M} OD_M \quad (12)$$

The ratio L_E/L_M is frequently expressed as the Optical Path Length Ratio, or OPLR.

2.4 DERIVATION OF STACK EXIT OPACITY

It must be recalled that the RM41 uses a folded-beam measurement technique; i.e., the measurement beam passes through the stack medium twice. Since the optical density values are directly proportional to path length, the indicated optical density is twice the actual one-way value. Thus, the foregoing equation (12) must be modified as follows:

$$OD_E = \left(\frac{L_E}{2L_M}\right) OD_M \quad \text{, where} \quad (13)$$

OD_E = Optical density at the stack exit
L_E = Effluent depth at the stack exit
OD_M = optical density indicated by a double-pass transmissometer at the measurement site
L_M = Effluent depth at the measurement site.

For double-pass transmissometer systems,
$OPLR = L_E/2L_M$.
As a result, the stack exit opacity can be obtained from the measurement value of optical density by:

$$OP_E = 1 - 10^{-L_E\, OD_M/2L_M} \quad (14)$$

OP_E = opacity at stack exit

Or, in terms of the double-pass OPLR factor,

$$OP_E = 1 - 10^{-OPLR \cdot OD_M} \quad (15)$$

$= 1 - \text{inv} \log(-OPLR \cdot OD)$

In the preceding equations the opacity and transmittance are expressed as fractional numbers equal to or less than one. 100% transmittance (1.0) is equivalent to 0% opacity or zero optical density. Opacity and optical density are logarithmically related such that "0" optical density = "0" opacity; "1" optical density = 0.9 opacity; "2" optical density = 0.99 opacity, etc., as shown in Figure 2-3.

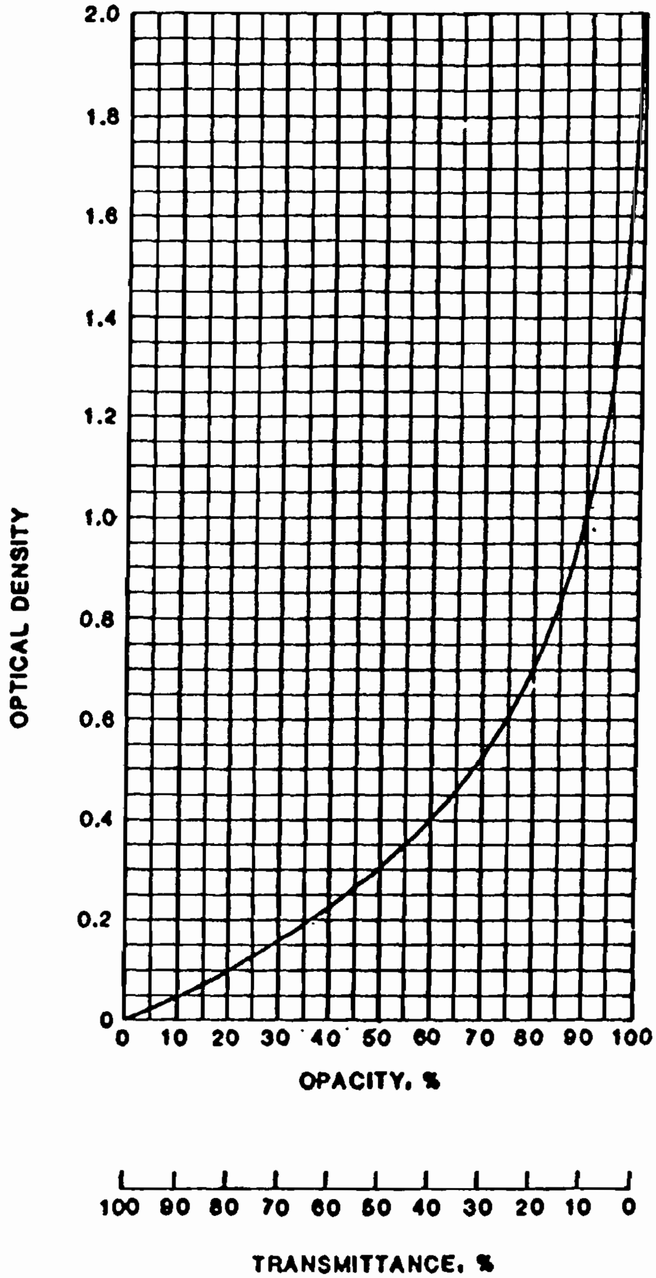

Figure 2-3: Relationship of opacity Transmittance and Optical Density

FPL

Inter-Office Correspondence

To: R. N. Allen Date: February 7, 1991

From: R. F. Messer Department: PRS-EDO

Subject: PARTICULATE TEST DATA-ORIMULSION
SANFORD UNIT NO. 4

A particulate emission test was run on Sanford Unit No. 4 on January 18, 1991 by the Power Resources Technical Support Group. EPA Methods one through four and seventeen were used for sampling and analysis. Unit load during the test averaged 364 MW, and the unit was fired with Orimulsion.

The average particulate emission rate for the three runs was 0.26 pounds per million BTU. The particulate emission standard for Sanford Unit No. 4 is 0.30 pounds per million BTU. A summary of the pertinent data is attached.

Be advised, the average stack temperature for the three test runs was slightly above (17.9 degrees Farenheit) the normal maximum level seen when using EPA Method 17. However, in my professional opinion, no bias was introduced and no compromise of the test results occurred.

If you have any questions, please contact me at the Eastern Division Office, Extension 2480.

R. F. Messer

AJV

Copies:

- D. W. Knutson
- R. F. Messer (w/o attach.)
- R. R. Righter (w/o attach.)
- R. T. Ruhlman
- M. A. Smith (w/o attach.)
- M. J. Taylor (w/o attach.)
- W. J. Waylett (w/o attach.)
- File

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Form 1008 (Stocked) Rev. 2/89

STACK TEST REPORT

CHECKLIST

PER F.A.C. CHAPTER 17-2.700(7)(C) 1.-21

1. Type:Steam Generator
2. Location: Volusia Co., Fla.
3. Designation:Existing
4. Facility Name: Sanford Power Plant
5. Owned and Operated by Florida Power & Light Company
6. Type and amount of fuels:Not applicable (F factor)
7. Means,raw data and computations of fuels:Not applicable
8. Air pollution control devices:Dust collectors
9. Duct/stack sketch:Included
10. Date,time,and duration of run:Included
11. Method:EPA One through four,and seventeen.
12. Number and location of sampling points:Included
13. Readings and sample time:Included
14. Sampling equipment:R.A.C. and custom designed/manufactured.
15. Equipment calibration data:Included
16. Filter data:Included
17. Chemical solutions:Reagent grade acetone
18. Pollutants collected:Included
19. Test crew:Included
20. Measured and calculated data:Included
21. Relation of data to emission rate:Included
22. Applicable standard and maximum emission rate:Included
23. Certification:Included

CERTIFICATION OF VALIDITY

Particulate Test Report
Plant: Sanford
Unit No.: 4
Test date: January 18, 1991

I hereby certify the information and data provided in the stack test report for tests conducted at the above facility on the above date are true and correct, to the best of my knowledge.

R. R. Righter, REP

Emission Test Analyst

FLORIDA POWER AND LIGHT COMPANY
POWER RESOURCES TEST SECTION
6001 VILLAGE BLVD.
WEST PALM BEACH, FLORIDA 33407

PARTICULATE EMISSION TEST

PLANT: SANFORD
UNIT: 4
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	01/18/91	01/18/91	01/18/91
GROSS LOAD (MW)	365	363	363
START TIME (24-HR CLOCK)	1045	1200	1335
END TIME (24-HR CLOCK)	1153	1307	1442
VOL DRY GAS SAMPLED METER COND (DCF)	41.689	41.541	42.015
BAROMETRIC PRESSURE (IN. HG)	30.28	30.28	30.28
AVG ORIFICE PRESSURE DROP (IN. H2O)	1.698	1.643	1.680
AVG GAS METER TEMP (F)	77.2	91.4	94.3
GAS METER CALIBRATION FACTOR	1.0697	1.0697	1.0697
VOL GAS SAMPLED STD COND (DSCF)	44.523	43.217	43.485
TOTAL WATER COLLECTED (G)	152.2	134.2	159.4
VOL WATER COLLECTED STD COND (SCF)	7.18	6.33	7.52
MOISTURE IN STACK GAS (% VOL)	13.88	12.77	14.74
MOLE FRACTION DRY GAS	0.861	0.872	0.853
CO2 VOL PERCENT DRY	11.40	11.80	11.00
O2 VOL PERCENT DRY	5.60	5.60	6.20
N2 VOL PERCENT DRY	83.00	82.60	82.80
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.05	30.11	30.01
MOL. WT. WET STACK GAS (LB/LB-MOLE)	28.38	28.57	28.24
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-2.00	-2.00	-2.00
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.13	30.13	30.13
AVERAGE SQUARE ROOT VELOCITY HEAD	0.972	0.959	0.969
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	386.5	391.9	400.4
STACK GAS VELOCITY STACK COND (FT/SEC)	69.45	68.51	69.97
CROSS SECTION STACK AREA (SQ FT)	359.7	359.7	359.7
STACK GAS FLOW RATE STD COND (DSCFM)	810883.9	805087.7	795783.5
STACK GAS FLOW RATE STACK COND (ACFM)	1498981.8	1478714.8	1510230.0
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	96.62	94.46	96.16
PARTICULATE COLLECTED (MG)	388.7	409.1	415.8
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190.00	9190.00	9190.00
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.1347	0.1461	0.1475
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.242	0.262	0.275

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.26

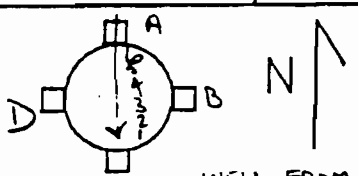
NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

Plant & Unit: PSN - 4
Type of Test: S.S.
Method: 1 THRU 4 & 17
Run Number: 1
Date: 1-18-91
Sampling Location: STACK
Operators: MIRINO, BALE, WEBB

Reference: 1.76
Bar. Pressure (in.Hg): 30.28
Static Pressure (H20): -2.0
Meter Box #: 2790
Ini. Pitot Leak Check: 0.00 @ 7" H_2O
Ini. Leak Rate (cfm): 0.000 @ 15" Hg

Filter #: 63
Nozzle #: 1N
Nozzle Diam.(in.): 0.250
~H@: 1.5802 YI: 1.0697
Pitot #: 2 Cp: 0.84
Thermocouple #: 2N
SHH: A Imp. Set: A

Point #	Clock Time	Sample Time	Dry Gas Meter 309.938	Velocity Head (in.H20)	Orifice ~H (in.H20)	Dry Gas Meter Temp.(F) Inlet	Dry Gas Meter Temp.(F) Outlet	Vacuum (In Hg)	Stack Temp.	Impinger Temp.
A- 1	1045	2.5	311.6	.78	1.37	61	—	5	385	—
2		5.0	313.2	.78	1.37	62	—	5	386	55
3		7.5	314.7	.76	1.33	64	—	5	386	—
4		10.0	316.3	.80	1.41	67	—	5	387	—
5		12.5	317.9	.80	1.41	69	—	5	386	—
6	1100	15.0	319.458	.78	1.37	71	—	5	385	50
B- 1	1102	2.5	321.2	1.00	1.76	71	—	6	385	—
2		5.0	323.0	1.00	1.76	73	—	6	385	—
3		7.5	325.0	1.25	2.20	75	—	7.5	387	—
4		10.0	327.0	1.40	2.46	77	—	8	390	—
5		12.5	329.3	1.40	2.46	78	—	8.5	390	54
6	1117	15.0	331.303	1.35	2.38	81	—	8.5	390	—
Average			41.689	0.972	1.698	77.2	—	Highest 9.0	386.5	—



VIEW FROM TOP OF STACK

Plant & Unit PSN- 4
Type of Test S.S
Method 1 THRU 4 & 17
Run Number 1
Date 1-18-91
Sampling Location STACK
Operators MIRINO BALE, WEBB

Reference 1.76
Bar. Pressure (in.Hg) 30.20
Static Pressure (H20) -2.0
Meter Box # 2790
Fin. Pitot Leak Check 0.00 @ 6" H_2O
Fin. Leak Rate (cfm) 0.000 @ 10" Hg

Filter # 63
Nozzle # 1N
Nozzle Diam.(in.) 0.250
~H@ 1.5802 Yi 1.0697
Pitot # 2 Cp 0.84
Thermocouple # 2N
SHH A Imp. Set A

Point #	Clock Time	Sample Time	Dry Gas Meter 331.303	Velocity Head (in.H2O)	Orifice ~H (in.H2O)	Dry Gas Meter Temp.(F) Inlet	Outlet	Vacuum (in Hg)	Stack Temp.	Impinger Temp.
C- 1	1120	2.5	332.2	1.10	1.94	79	—	7	385	—
2		5.0	335.1	1.20	2.11	80	—	7.5	385	—
3		7.5	337.0	1.15	2.02	82	—	8	386	—
4		10.0	339.0	1.20	2.11	82	—	8	386	—
5		12.5	340.8	1.20	2.11	84	—	8.5	386	—
6	1135	15.0	342.891	1.25	2.20	85	—	9	387	56
D- 1	1138	2.5	344.5	.78	1.37	83	—	6.5	384	—
2		5.0	346.1	.80	1.41	84	—	7.5	384	—
3		7.5	347.6	.68	1.20	85	—	7.5	387	—
4		10.0	348.9	.62	1.09	86	—	7.5	387	58
5		12.5	350.3	.57	1.00	86	—	7	388	—
6	1153	15.0	351.627	.51	0.90	87	—	6	388	—
Average										

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DRY MOLECULAR WEIGHT AND EMISSION RATE CORRECTION FACTOR DETERMINATION

PLANT PSN 4 (ORI)
DATE 1-17-91
SAMPLING TIME (24HR CLOCK) 1045 - 1153
SAMPLING LOCATION Stack
SAMPLE TYPE Integrated Bag
ANALYTICAL METHOD Method 3
AMBIENT TEMPERATURE [illegible] F
OPERATOR [illegible]

COMMENTS : Run 1 SS OR I.

RUN / GAS	1 ACTUAL READING	1 NET	2 ACTUAL READING	2 NET	3 ACTUAL READING	3 NET	AVERAGE NET VOLUME	F_o (TEST) = $\frac{20.9 - \%O_2}{\% CO_2}$
CO_2	11.2		11.4		11.4		[illegible]	F_o (TEST) = $\frac{20.9 - 5.6}{11.4}$ = 1.342
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL O_2 READING)	[illegible]	5.6	17.0	[illegible]	[illegible]	[illegible]	5.6	Fuel Type / Fo (calc.) Residual Fuel Oil 1.290 Natural Gas 1.716
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	—	—	—	—	—	—	—	EPA ACCEPTABLE RANGE Residual Fuel Oil 1.210 – 1.370 Natural Gas 1.600 – 1.836

SYSTEM LEAK CHECK OK

INITIAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL) 15ml / 15ml BUBBLER CO_2

FINAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL) 12ml / 12ml BUBBLER O_2

Sampling Location Stack — MOISTURE — Sampling Location —

Sample Box A — Sample Box —

	Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 1	Impinger 2	Impinger 3	Impinger 4	Weighed By
Final Weight (g)	703.1	530.6	490.3	846.4	—	—	—	—	L.C. Weir
Initial Weight (g)	570.8	524.3	488.7	834.3	—	—	—	—	L.C. Weir
Net Weight (g)	132.3	6.3	1.5	12.1	—	—	—	—	L.C. Weir
Total				152.2				—	

Total Impinger Wash (g) 152.2

Filter Weights				Weighed By	Probe Wash				Weighed By
Filter #	62	—			Beaker #	13	—	BLANK	
Sampling Location	Stack	—			Sampling Location	STACK		—	
Final Weight (g)	[illegible]	—		[illegible] Bair	Final Weight (g)	73.1093	—	64.7870	[illegible]
Initial Weight (g)	[illegible]	—			Initial Weight (g)	73.1051	—	64.7870	
Difference (g)	[illegible]	—			Difference (g)	0.0042	—	0.0000	
Particulate Catch (mg)	384.5	—			Particulate Catch (mg)	4.2	—	0	

— Side Total Catch (mg) —   — Side Total Catch (mg) —

Total Particulate Catch (mg) 388.7 mg

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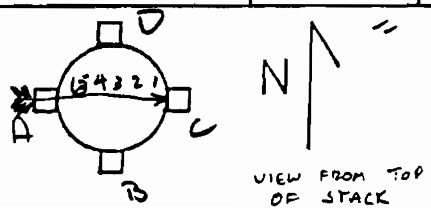
Plant & Unit: PSN - 4
Type of Test: S.S.
Method: 1 THRU 4 & 17
Run Number: 2
Date: 1-18-91
Sampling Location: STACK
Operators: MIRINO, BALE, WEBB

Reference: 1.76
Bar. Pressure (in.Hg): 30.28
Static Pressure (H20): -2.0
Meter Box #: 2790
Ini. Pitot Leak Check: 0.0 @ 7" H2O
Ini. Leak Rate (cfm): 0.000 @ 15" Hg

Filter #: 64
Nozzle #: 2N
Nozzle Diam.(in.): 0.250
~H@: 1.5802 Yi: 1.0697
Pitot #: 2 Cp: 0.84
Thermocouple #: 2N
SHH: 3 Imp. Set: B

Point #	Clock Time	Sample Time	Dry Gas Meter	Velocity Head (In.H20)	Orifice ~H (In.H20)	Dry Gas Meter Temp.(F) Inlet	Dry Gas Meter Temp.(F) Outlet	Vacuum (In Hg)	Stack Temp.	Impinger Temp.
			351.920							
A- 1	1200	2.5	353.6	.80	1.41	84	—	4	387	—
2		5.0	355.2	.76	1.34	85	—	4	387	—
3		7.5	356.7	.68	1.20	86	—	4	389	—
4		10.0	358.1	.71	1.25	87	—	4	389	—
5		12.5	359.5	.60	1.06	88	—	4	389	—
6	1215	15.0	360.873	.57	1.00	89	—	4	390	56
B- 1	1217	2.5	362.7	1.05	1.85	87	—	6	389	—
2		5.0	364.7	1.20	2.11	89	—	6	389	—
3		7.5	366.7	1.25	2.20	90	—	7	390	—
4		10.0	368.6	1.05	1.85	92	—	7	391	—
5		12.5	370.4	1.10	1.94	92	—	7	391	56
6	1232	15.0	372.241	.95	1.67	93	—	6.5	390	—
Average			41.541	0.959	1.643	91.4	—	Highest, 10	391.9	—



Plant & Unit PSN- 4
Type of Test S.S.
Method 1 THRU 4 & 17
Run Number 2
Date 1-18-91
Sampling Location STACK
Operators MIRINO BALE, WEBB

Reference 1.76
Bar. Pressure (in.Hg) 30.28
Static Pressure (H2O) -2.0
Meter Box # 2790
Fin. Pitot Leak Check 0.00@7" H_2O
Fin. Leak Rate (cfm) 0.000@11" Hg

Filter # 64
Nozzle # 2N
Nozzle Diam.(in.) 0.250
~H@ 1.5802 Y 1.0697
Pitot # 2 Cp 0.84
Thermocouple # 2N
SHH B Imp. Set B

Point #	Clock Time	Sample Time	Dry Gas Meter 372.241	Velocity Head (in.H2O)	Orifice ~H (in.H2O)	Dry Gas Meter Temp.(F) Inlet	Outlet	Vacuum (in Hg)	Stack Temp.	Impinger Temp.
C- 1	1235	2.5	373.9	.90	1.58	91	—	7	393	—
2		5.0	375.8	1.05	1.85	92	—	7	393	—
3		7.5	377.7	1.10	1.94	93	—	7.5	395	—
4		10.0	379.8	1.25	2.20	94	—	9	396	52
5		12.5	381.8	1.30	2 29	95	—	9.5	397	—
6	1250	15.0	383.927	1.40	2.46	96	—	10	397	—
D- 1	1252	2.5	385.5	.79	1.39	94	—	6	392	—
2		5.0	387.1	.77	1.36	94	—	6.5	392	49
3		7.5	388.7	.77	1.36	95	—	6.5	394	—
4		10.0	390.2	.77	1.36	95	—	7	395	—
5		12.5	391.8	.80	1.41	96	—	7	395	—
6	1307	15.0	393.461	.77	1.36	96	—	7	395	—
Average										

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DRY MOLECULAR WEIGHT AND EMISSION RATE CORRECTION FACTOR DETERMINATION

PLANT [illegible]
DATE 1-18-91
SAMPLING TIME (24HR CLOCK) 1230-1307
SAMPLING LOCATION Stack
SAMPLE TYPE Integrated Bag
ANALYTICAL METHOD Method 3
AMBIENT TEMPERATURE [illegible] F
OPERATOR [illegible]

COMMENTS : [illegible]

RUN / GAS	1 ACTUAL READING	1 NET	2 ACTUAL READING	2 NET	3 ACTUAL READING	3 NET	AVERAGE NET VOLUME	Fo (TEST) = (20.9 − %O_2) / % CO_2
CO_2	11.7		11.8		11.?		11.8	Fo (TEST) = (20.9 − 5.6) / 11.8 = 1.297
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL O_2 READING)	17.?	5.?	17.4	5.6	[illegible]	5.6	5.?	Fuel Type / Fo (calc.): Residual Fuel Oil 1.290; Natural Gas 1.716
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	—	—	—	—	—	—	—	EPA ACCEPTABLE RANGE: Residual Fuel Oil 1.210 − 1.370; Natural Gas 1.600 − 1.836

SYSTEM LEAK CHECK OK

INITIAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL) [illegible] BUBBLER CO_2

FINAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL) [illegible] BUBBLER [illegible]

Sampling Location Stack — MOISTURE — Sampling Location —
Sample Box B — Sample Box —

	Impinger Number 1	2	3	4	Impinger Number 1	2	3	4	Weighed By
Final Weight (g)	[illegible]	517.6	488.9	865.8	—	—	—	—	[illegible]
Initial Weight (g)	[illegible]	515.5	488.9	854.7	—	—	—	—	[illegible]
Net Weight (g)	121.0	2.1	0.0	11.1	—	—	—	—	[illegible]
			Total	134.2			Total	—	

Total Impinger Wash (g) 134.2

Filter Weights

Filter #	24	—	—	Weighed By
Sampling Location	Stack	—	—	
Final Weight (g)	[illegible]	—	—	H. [illegible]
Initial Weight (g)	[illegible]	—	—	[illegible]
Difference (g)	[illegible]	—	—	H. [illegible]
Particulate Catch (mg)	[illegible]	—	—	[illegible]

Probe Wash

Beaker #	14	—	—	Weighed By
Sampling Location	Stack	—	—	
Final Weight (g)	[illegible]	—	—	H. [illegible]
Initial Weight (g)	[illegible]	—	—	
Difference (g)	0.0027	—	—	H. [illegible]
Particulate Catch (mg)	2.7	—	—	H. [illegible]

— Side Total Catch (mg) — — Side Total Catch (mg) —

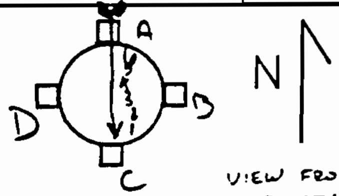
Total Particulate Catch (mg) 409.1

Plant & Unit PSN – 4
Type of Test S. S.
Method 1 THRU 4 & 17
Run Number 3
Date 1-18-91
Sampling Location STACK
Operators MIRINO BALE, WEBB

Reference 1.76
Bar. Pressure (in.Hg) 30.28
Static Pressure (H2O) -2.0
Meter Box # 2790
Ini. Pitot Leak Check 000 @ 6.5" H_2O
Ini. Leak Rate (cfm) 0.000 @ 15" Hg

Filter # 65
Nozzle # 3N
Nozzle Diam.(in.) 0.250
ΔH@ 1.5802 Yi 1.0697
Pitot # 2 Cp 0.84
Thermocouple # 2N
SHH C Imp. Set C

Point #	Clock Time	Sample Time	Dry Gas Meter 393.798	Velocity Head (in.H20)	Orifice ΔH (in.H20)	Dry Gas Meter Temp.(F) Inlet	Dry Gas Meter Temp.(F) Outlet	Vacuum (in Hg)	Stack Temp.	Impinger Temp.
A– 1	1335	2.5	395.3	.77	1.36	83	–	5.5	396	–
2		5.0	396.9	.77	1.36	83	–	6	396	53
3		7.5	398.6	.80	1.41	85	–	6	401	–
4		10.0	400.2	.80	1.41	87	–	6	404	–
5		12.5	401.9	.87	1.53	90	–	7	402	–
6	1350	15.0	403.532	.84	1.48	92	–	7	401	–
B– 1	1352	2.5	405.3	1.05	1.85	92	–	7	400	–
2		5.0	407.1	1.10	1.94	93	–	7	400	–
3		7.5	409.0	1.05	1.85	94	–	7.5	402	–
4		10.0	411.0	1.20	2.11	95	–	9	404	55
5		12.5	413.1	1.40	2.46	97	–	10	402	–
6	1407	15.0	415.233	1.40	2.46	98	–	11	402	–
Average			42.015	0.969	1.680	94.3	–	max. 11.0	400.4	–



VIEW FROM TOP OF STACK

Plant & Unit PSN- 4
Type of Test S.S.
Method 1 THRU 4 & 17
Run Number 3
Date 1-18-91
Sampling Location STACK
Operators MIRINO BALE, WEBB

Reference 1.76
Bar. Pressure (in.Hg) 30.28
Static Pressure (H20) -2.0
Meter Box # 2790
Fin. Pitot Leak Check 0.00 @ 7.5" H2O
Fin. Leak Rate (cfm) 0.000 @ 11" Hg

Filter # 65
Nozzle # 3N
Nozzle Diam.(in.) 0.250
~H@ 1.5802 Y 1.0697
Pitot # 2 Cp 0.84
Thermocouple # 2N
SHH C Imp. Set C

Point #	Clock Time	Sample Time	Dry Gas Meter 415.233	Velocity Head (in.H2O)	Orifice ~H (in.H2O)	Dry Gas Meter Temp.(F) Inlet	Outlet	Vacuum (in Hg)	Stack Temp.	Impinger Temp.
C- 1	1410	2.5	417.0	1.10	1.94	96	—	9	400	—
2		5.0	419.0	1.20	2.11	97	—	10	400	—
3		7.5	421.0	1.25	2.20	98	—	10.5	400	—
4		10.0	423.1	1.20	2.11	98	—	11	401	50
5		12.5	425.0	1.05	1.85	99	—	10.5	400	—
6	1425	15.0	426.847	0.95	1.67	99	—	10	398	—
D- 1	1427	2.5	428.4	.80	1.41	97	—	8	398	—
2		5.0	430.0	.77	1.36	98	—	8	399	56
3		7.5	431.6	.64	1.13	98	—	8	401	—
4		10.0	433.0	.64	1.13	98	—	8	402	—
5		12.5	434.4	.64	1.13	98	—	8	400	—
6	1442	15.0	435.813	.60	1.06	98	—	8	400	—
Average										

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DRY MOLECULAR WEIGHT AND EMISSION RATE CORRECTION FACTOR DETERMINATION

PLANT: PSN 4 (ORI)
DATE: 1-18-91
SAMPLING TIME (24HR CLOCK): 1335 - 1442
SAMPLING LOCATION: Stack
SAMPLE TYPE: Integrated Bag
ANALYTICAL METHOD: Method 3
AMBIENT TEMPERATURE: 70 °F
OPERATOR: Righter

COMMENTS: Run 3 SS (ORI)

RUN 3 / GAS	1 ACTUAL READING	1 NET	2 ACTUAL READING	2 NET	3 ACTUAL READING	3 NET	AVERAGE NET VOLUME	Fo (TEST) = (20.9 − %O_2) / %CO_2
CO_2	11.0		11.0		11.0		11.0	Fo (TEST) = (20.9 − 6.2) / 11.0 = 1.336
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL O_2 READING)	17.2	6.2	17.2	6.2	17.2	6.2	6.2	Fuel Type / Fo (calc.): Residual Fuel Oil 1.290; Natural Gas 1.716
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	—	—	—	—	—	—	—	EPA ACCEPTABLE RANGE: Residual Fuel Oil 1.210 − 1.370; Natural Gas 1.600 − 1.836

SYSTEM LEAK CHECK: OK

INITIAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL): 15ml / 15ml BUBBLER: CO_2

FINAL ORSAT ANALYZER LEAK CHECK (FLUID LEVEL): 12ml / 12ml BUBBLER: O_2

MOISTURE

Sampling Location: Stack — Sample Box: 2

Sampling Location: — Sample Box: —

	Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 1	Impinger 2	Impinger 3	Impinger 4	Weighed By
Final Weight (g)	704.1	599.8	454.[illegible]	[illegible]	—	—	—	—	L C Webb
Initial Weight (g)	560.6	594.7	453.[illegible]	[illegible].9	—	—	—	—	[illegible]
Net Weight (g)	143.5	5.1	0.7	10.1	—	—	—	—	L C Webb
Total				159.4				—	

Total Impinger Wash (g): 159.4

Filter Weights

Filter #	65	—	Weighed By
Sampling Location	STACK	—	
Final Weight (g)	[illegible]	—	[illegible]
Initial Weight (g)	[illegible]	—	
Difference (g)	[illegible]	—	[illegible]
Particulate Catch (mg)	411.3	—	[illegible]

Probe Wash

Beaker #	15	—	Weighed By
Sampling Location	STACK	—	
Final Weight (g)	[illegible]	—	[illegible]
Initial Weight (g)	70.43[illegible]	—	"
Difference (g)	0.0045	—	[illegible]
Particulate Catch (mg)	4.5	—	[illegible]

— Side Total Catch (mg) —   — Side Total Catch (mg) —

Total Particulate Catch (mg): 415.8

POSTTEST
METER BOX CALIBRATION CHECK
(English Units)

Standard Meter No.: 954282

Date: 01/22/91

Pretest Y: 1.0697

Bar.Press.,Pb,in.Hg: 30.14

Std. Meter Coeff.: 0.9900

Orifice Manometer Setting H in. H2O	Gas Volume Std Test Meter Vw ft^3	Gas Volume Dry Gas Meter Vd ft^3	Temperature Std Test Meter Tw ^oF	Temperature Meter Outlet Td ^oF	Time O min	Vacuum Setting in.	Yi^a
1.67	7.484	7.277	60.0	87.0	10.0	11.0	1.0775
1.67	7.433	7.221	61.0	88.0	10.0	11.0	1.0783
1.67	7.453	7.263	63.0	90.0	10.0	11.0	1.0748
						Average	1.0768
						Corrected	1.0661
						% Diff. Pretest Y	0.34

a; $$Yi = \frac{(Vw)(Pb)(Td+460)}{(Vd)(Pb+(H/13.6))(Tw+460)}$$

Vw = Gas volume passing through the wet test meter, cu. ft..

Vd = Gas volume passing through the dry gas meter, cu. ft..

Tw = Temp. of the gas in the wet test meter, F.

Tdi = Temp. of the inlet gas of the dry gas meter, F.

Tdo = Temp. of the outlet of the dry gas meter, F.

Td = Average temp. of the gas in the dry gas meter, F.

H = Pressure differential across orifice, in. water.

Yi = Ratio of accuracy of wet test meter to dry gas meter for each r

Y = Average Yi for all three runs; tolerance = pretest Y +/-0.05Y.

Pb = Barometeric pressure, in. Hg.

O = Time of calibration run, min..

Meter Box Number: 279

Calibrated by: J. Mirino

PARTICULATE TEST SAMPLE PROCESSING PROCEDURES

Plant: Sanford

Unit No. 4

Test Date(s): January 18, 1991

Particulate Stack Test Crew for this test:

R. R. Righter (Test Coordinator)

H. J. Bale

S. C. Webb

J. A. Mirino

Filters Processed Initially by: H. J. Bale

Finally by: H. J. Bale

Probe/Nozzle Washes Collected by: H. J. Bale

Processed by: H. J. Bale

Filter Processing Procedure

1.Pre-test:

A. Please note:At all times filters are handled with clean disposable gloves.
B. Filters are examined under a strong light for irregularities,flaws,and pinhole leaks.
C. Filters are permanently marked.
D. Oven dried at 105 degrees C for two hours.
E. Dessicated for at least two hours.
F. Weighed to the nearest 0.1 mg.
G. Re-dessicated for at least another six hours.
H. Re-weighed until a constant weight is achieved.(Less than 0.5 mg change from previous weight.)

2.Post-test:

A. Filter is transferred to a clean shipping container.
B. A blank filter is handled in an identical manner.
C. In the laboratory,filters are oven dried at 105 degrees C for three hours.
D. Dessicated for at least two hours.
E. Reweighed to a constant weight as above.

Nozzle And Filter Inlet Wash Procedure

1. Pre-test:

   A. Only reagent grade acetone in glass containers is used.

2. Post-test:

   A. Both the nozzle and filter inlet are brushed and rinsed several times,to remove all particulate deposited.
   B. Rinsings are stored in a clean non-reactive container.
   C. Said containers are appropriately labeled,and the level of fluid is marked.
   D. In the laboratory,the individual washes (along with a blank acetone sample of similar volume) are transferred to clean tared beakers.
   E. The wash is evaporated at ambient temperature.
   F. The beakers are dessicated hours.
   G. The beakers are weighed to a constant weight.

Data reduction (prior to computer calculation) by: J. A. Mirino

Computer Program Run by: S. C. Webb

THERMOCOUPLE POSTTEST
CALIBRATION CHECK

Standard: National Bureau of Standards Thermocouple

Reference: Q.A. sec 3.1.2

Procedure: Test thermocouple and NBS thermocouple are wrapped in heating mat. The temperature is controlled by the curren flow into the mat, and is stablized at a point within 10 of the average stack temperature during the test.

Tolerance: +/- 1.5% of actual absolute temperature

Test site: PSN 4
Test date: 01/18/91
Avg. stack temp.: 392.9

Checked date: 01/22/91
Checked by: S. C. Webb

THERMO #	LENGTH ft	REF TEMP. F	MEASURED TEMP F	TOLERANCE % R
2n	15	393	391	0.23

FLORIDA POWER & LIGHT COMPANY
POWER RESOURCES CENTRAL LABORATORY

STATE OF FLORIDA LABORATORY CERTIFICATION NUMBERS
DRINKING WATER CERTIFICATION NUMBER: 56275
ENVIRONMENTAL CHEMISTRY CERTIFICATION NUMBER: E56078

SANFORD #4 (ORIMULSION) PLANT
ANALYSES OF FUEL OIL FIRED
JANAURY 1991

DATE SAMPLE RECEIVED AT LABORATORY	1-18-91		
API GRAVITY	8.8	ASH, % BY WEIGHT	0.21
DENSITY, LB/GAL	8.406	PARTICULATE EQUIVALENT, LB/MBTU	0.16
DENSITY, LB/BBL	353.070	VANADIUM IN ASH AS V2O5, % BY WEIGHT	27
DENSITY, TONS/BBL	0.177	VANADIUM IN OIL AS V2O5, PPM	589
HEAT OF COMBUSTION, BTU/LB	12732	VANADIUM IN OIL AS V, PPM	329
HEAT OF COMBUSTION, MBTU/BBL	4495	VISCOSITY @ SHEAR RATE OF 139.1(1/S),@ 30C,CPS	335
HEAT OF COMBUSTION, BTU/GAL	107031	ASPHALTENES, % BY WEIGHT	7.1
HEAT OF COMBUSTION, MBTU/TON	8991	MAGNESIUM IN OIL AS MG, PPM	373
HEAT OF COMBUSTION, MEGAJOULES/KG	29.594	SODIUM IN OIL AS NA, PPM	78
WATER, % BY VOLUME	30.00	NICKEL IN OIL AS NI, PPM	66
SEDIMENT, % BY WEIGHT	0.30	IRON IN OIL AS FE, PPM	9
SULFUR, % BY WEIGHT	2.7		
SULFUR DIOXIDE EQUIVALENT, LB/MBTU	4.24		

COPIES TO: J. W. DICKEY -PRG/EDO
M. GROSSWALD -PRG/EDO
J. STANTON-PRG/EDO
PLANT MANAGERS
PLANT RESULTS DEPT

D. W. KNUTSON - PRS/EDO
K. WASHINGTON - PRS/EDO
W. WAYLETT- PRS/EDO
BOB RIGHTER - PSN/PLT
ROGER MESSER - PRS/EDO

BILL PARKES - FR/GO
R. LIPPMAN - FR/GO
E. CALLANDER - FR/GO
R.N. ALLEN - JEN/NP
M. TAYLOR - PCU/PLT
E. BISHOP - JEN/NP

ANALYZED BY :

CERTIFIED BY :

DATE: 1-28-91

91-PSN-6

AIR POLLUTION CONTROL DEVICES
Orimulsion

Dust Collectors:

Run 1		Inlet	Outlet	^p
	A	5.5	0.6	4.9
	B	5.6	0.7	4.9
Run 2		Inlet	Outlet	^p
	A	5.5	0.6	4.9
	B	5.6	0.7	4.9
Run 3		Inlet	Outlet	^p
	A	5.8	0.7	5.1
	B	5.9	0.8	5.1

Normal Operating: 4.0 to 6.0 inch pressure drop.

Gas Recirculation: N/A

Run 1		Amps	% Flow
	A		
	B		
Run 2		Amps	% Flow
	A		
	B		
Run 3		Amps	% Flow
	A		
	B		

Normal Operating:

General Conditions:

Date Jan. 18, 1991

Tech. S. C. Webb

SAMPLE NOZZLE CALIBRATION

Reference: EPA Method 5

Procedure: Measure the inner diameter of the sampling nozzle to the nearest 0.001 inch.Repeat,until three measurements are made (using different diameters).

Tolerances:The difference between the high and low values should not exceed 0.004 in.

Nozzle Number	Diam.1 (in.)	Diam.2 (in.)	Diam.3 (in.)	Greatest Difference	Average Diameter
1N	0.250	0.249	0.250	0.001	0.250
2N	0.250	0.250	0.250	0.000	0.250
3N	0.249	0.251	0.250	0.002	0.250
4N	0.249	0.250	0.250	0.001	0.250
5N	0.251	0.250	0.250	0.001	0.250
6N	0.251	0.250	0.250	0.001	0.250

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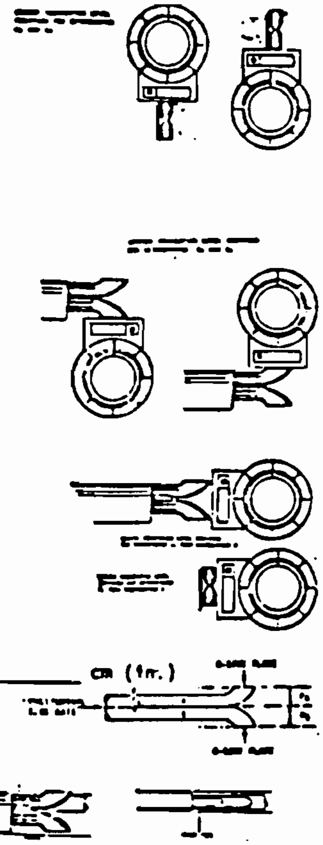
TYPE "S" PITOT TUBE

Inspection (Calibration)

FORM

Parameter	Measurement	Specification	Example	Measurement Instrument
Impact α_1 =	______	(< 10°)		Degree indicating level
Static α_2 =	______	(< 10°)		Degree Indicating level
Static β_1 =	______	(< 5°)		Degree Indicating level
Impact β_2 =	______	(< 5°)		Degree Indicating level
γ =	______	°		Degree Indicating level
θ =	______	°		Degree Indicating level



$P_A + P_B = A$

P_A = ______ cm (in.); P_B = ______ cm (in.) Ruler

A = ______ cm (in.)

D_T = ______ cm (in.) Micrometer

$Z = A \sin \gamma$ = ______ cm (in.); limit is < .32 cm (< 1/8 in. .125)

$W = A \sin \theta$ = ______ cm in; limit < .08 cm (< 1/32 in .03125)

Calibration Required yes ______ no ______

Pitot No	α1	α2	ß1	ß2	γ	θ	PA	PB	A	DT	Z	W	Calibration
~~10~~2	3	1	4	0	3	1	0.4575	0.4575	0.715	0.385	0.048	0.016	S. C. Webb

Pitot Tube Assembly Level

Pitot No	Yes	No
2	✓	

Date: Jan. 15, 1991

Calibrated By: S. C. Webb

Pitot Tube Opening Damaged

Pitot No	Yes	No
2		✓

Date Jan. 18, 1991
Tech. JLW

BAROMETER CALIBRATION

Laboratory Mercury Column Barometer 30.28 inches Hg.

Aneroid Field Barometer 30.28 inches Hg.

0.00 difference

Is aneroid barometer within 0.1 in of mercury column barometer?

✓ YES _______ NO (Adjustment required)

METER BOX CALIBRATION DATA
(English Units)

Standard Meter No. : 954282

Date: 01/09/91

Meter Box Number: 2790

Bar.Press.,Pb,in.Hg: 30.19

Calibrated by: S. Webb

Orifice Manometer Setting H in. H2O	Gas Volume Std Test Meter Vw ft^3	Gas Volume Dry Gas Meter Vd ft^3	Temperature Std Test Meter Tw ^oF	Temperature Dry Gas Meter Td ^oF	Time O min	Yi^a	$H@i^b$
0.5	6.278	5.978	71.0	93.0	15	1.0807	1.5118
1.0	8.823	8.504	68.0	95.0	15	1.0763	1.5082
2.0	8.052	7.909	68.0	99.0	10	1.0612	1.5981
3.0	9.863	9.589	68.0	99.0	10	1.0695	1.5977
4.0	11.291	10.972	67.5	99.0	10	1.0684	1.6224
5.0	12.601	12.187	68.0	95.0	10	1.0623	1.6431
					Average	1.0697	1.5802

a; $$Yi = \frac{(Vw)(Pb)(Td+460)}{(Vd)(Pb+(H/13.6))(Tw+460)}$$

Std Test Meter Cal 0.9893

b; $$H@i = \frac{0.0317(H)}{(Pb)(Td+460)}[(Tw+460)(O)/Vw]$$

Quality Assurance Handbook M8-2.3A (front side)

STANDARD METER CALIBRATION DATA
(English Units)

Date: 07/11/90

Bar Press 30.10

Wet Test Meter # 11AN4

Standard Dry Gas Meter # [illegible]

Calibrated by: S. C. Webb

Approx. Manometer Flow Rate (cfm)	Gas Volume: Wet Test Meter V_w (ft^3)	Gas Volume: Std Gas Meter V_d (ft^3)	Temperature: Wet Test Meter T_s (°F)	Temperature: Std Gas Meter Inlet T_{di} (°F)	Temperature: Std Gas Meter Outlet T_{do} (°F)	Temperature: Average T_d (°F)	Time Θ (min)	Std Gas Meter Pressure ΔP (in. Hg)	Flow Rate Q (cfm)	Meter Coeff. Y_{ds}	Avg Meter Coeff. Y_{ads}
	3.811	3.804	73.0	74.0	72.0	73.0	10.0	0.60	0.380	1.0004	
0.40	3.849	3.843	73.0	74.0	72.0	73.0	10.0	0.60	0.384	1.0001	
	3.863	3.864	73.0	74.0	72.0	73.0	10.0	0.60	0.385	0.9983	0.9996
	6.127	6.134	73.0	74.0	72.0	73.0	10.0	1.10	0.611	0.9962	
0.60	6.114	6.127	73.0	74.0	72.0	73.0	10.0	1.10	0.609	0.9952	
	6.123	6.139	73.0	74.0	70.0	72.0	10.0	1.10	0.610	0.9929	0.9947
	4.207	4.224	73.0	74.0	72.0	73.0	5.0	2.00	0.839	0.9911	
0.90	4.209	4.237	73.0	74.0	72.0	73.0	5.0	2.00	0.839	0.9886	
	4.229	4.249	73.0	74.0	72.0	73.0	5.0	2.00	0.843	0.9905	0.9900
	5.065	5.103	73.0	74.0	72.0	73.0	5.0	2.50	1.010	0.9865	
1.00	5.110	5.166	73.0	74.0	72.0	73.0	5.0	2.50	1.019	0.9832	
	5.080	5.125	73.0	74.0	72.0	73.0	5.0	2.50	1.013	0.9852	0.9850
	6.121	6.260	73.0	74.0	72.0	73.0	5.0	3.50	1.220	0.9695	
1.20	6.172	6.264	73.0	74.0	72.0	73.0	5.0	3.50	1.230	0.9770	
	6.180	6.281	73.0	74.0	72.0	73.0	5.0	3.50	1.232	0.9756	0.9740
									Average		0.9887

$$Q = 17.65 \times \frac{V_w}{\theta} \times \frac{P_b}{(T_s + 460)}$$

$$Y_{ds} = \frac{V_w}{V_d} \times \frac{(T_d + 460)}{(T_s + 460)} \times \frac{P_b}{(P_b + (\Delta P/13.6))}$$

THERMOCOUPLE CALIBRATION DATA

STANDARD: National Bureau of Standards Thermocouple

REFERENCE: EPA Method 2.

PROCEDURE: Thermocouple and NBS thermocouple are inserted into a thermostatically controlled fluidised bath. Temperature is allowed to stabalize at approximately 300 F. Potentiometer and thermocouple readings are compared.

Tolerence: + or - 1.5% of actual absolute temperature.

Therm. Number	Length (ft)	Ref. Temp. (F)	Measured Temp. (F)	Tolerance Obtained (%)
1	15	290.0	288.0	0.267
2	15	290.0	288.0	0.267
3	15	290.0	289.0	0.133
4	15	290.0	285.0	0.667
5	15	290.0	285.0	0.667
6	15	290.0	287.0	0.400
14	10	290.0	290.0	0.000

Calibrated by: R. R. Righter
Date: 01/02/91

SAMPLE HEAD HOOK-UP THERMOMETERS
CALIBRATION PROCEDURES

Quarterly (two point calibration)

1. Place ASTM thermometer and sample head hook-up thermometer in ice bath, allow time for both to equilibrate. Compare and record readings after they have stabilized.

2. Remove both the ASTM thermometer and sample head hook-up thermometer. Dry off thoroughly and place in a room with constant temperature and humidity. Allow a period of stabilization and record readings.

Acceptance Standard: The test thermometer (sample head hook up) shall be acceptable if both temperatures are within + or - 2 F of the ASTM standard thermometer.

Note: If the thermometer is not within the tolerances, discard and calibrate one which will be satisfactory.

Termo. I.D. No.	Dial Range	Location	Reference Temp. (F) 1	Reference Temp. (F) 2	Observed Temp. (F) 1	Observed Temp. (F) 2	Diff. (F) 1	Diff. (F) 2
A	0-220	SHH-A	32.0	72.0	30.0	70.0	2.0	2.0
B	0-220	SHH-B	32.0	72.0	30.0	72.0	2.0	0.0
C	0-220	SHH-C	32.0	72.0	30.0	70.0	2.0	2.0
D	0-220	SHH-D	32.0	72.0	32.0	72.0	0.0	0.0
E	0-220	SHH-E	32.0	72.0	30.0	70.0	2.0	2.0
F	0-220	SHH-F	32.0	72.0	32.0	72.0	0.0	0.0

Calibrated by: S.C. Webb
Date: 01/02/91

DRY GAS METER THERMOCOUPLE
CALIBRATION PROCEDURES

Annually (two point calibration)

1. Place ASTM thermometer and dry gas meter thermocouple in a hot water bath with temperature between 100 F - 125 F, allow time for both to equilibrate. Compare and record readings after they have stabilized.

2. Remove both the ASTM thermometer and dry gas meter thermocouple.Dry Off thoroughly and place in a room with constant temperature and humidity. Allow a period of stabilization and record readings.

Acceptance Standard: The test thermocouple (dry gas meter) shall be acceptable if both temperatures are within + or - 5.4 F of the ASTM standard thermometer.

Note: If the thermocouple is not within the toleranances, discard and calibrate one which will be satisfactory.

Termo. I.D. No.	Location	Reference Temp. (F) 1	Reference Temp. (F) 2	Observed Temp. (F) 1	Observed Temp. (F) 2	Diff. (F) 1	Diff. (F) 2
7	Meter Box # 2790	119.0	66.0	119.0	66.0	0.0	0.0
8	Meter Box # 2790	119.0	66.0	119.0	66.0	0.0	0.0
9	Meter Box # 1151	118.0	66.0	118.0	66.0	0.0	0.0
10	Meter Box # 1151	118.0	66.0	118.0	66.0	0.0	0.0

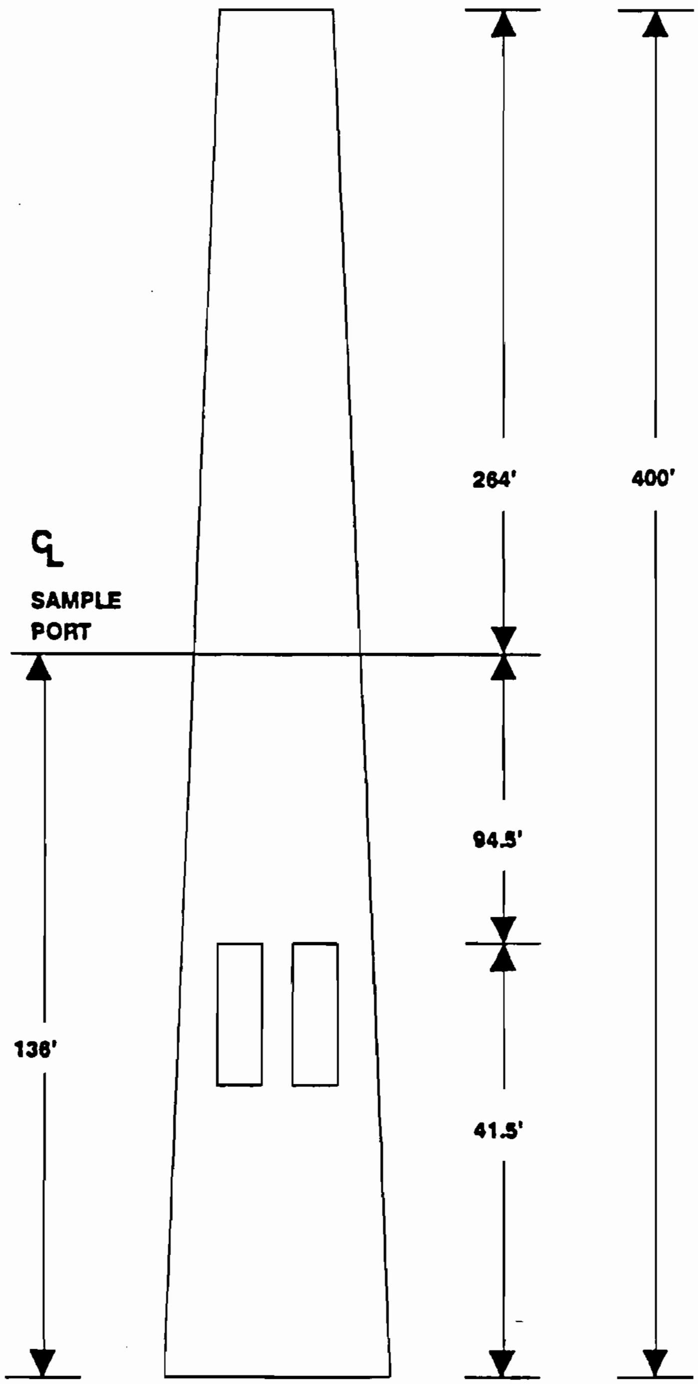
Calibrated by: S.C. Webb
Date: 01/02/91

FLORIDA POWER & LIGHT CO.
PSN UNIT No. 4

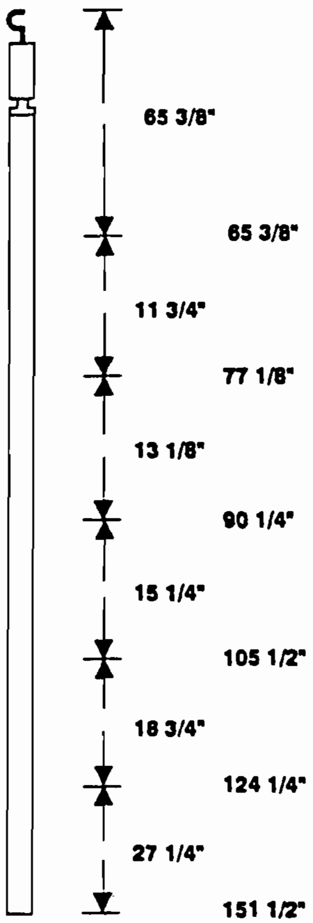
STACK SPECIFICATIONS

SAMPLING DIAMETER: 256.8 in.
SAMPLING AREA: 359.7 sq. ft.
SAMPLING PORT DEPTH: 60.0 in.
No. OF PORTS: 4
No. OF POINTS PER TRAVERSE: 6
TOTAL No. OF POINTS : 24
SAMPLING TIME PER POINT: 2.5 min.
TOTAL SAMPLING TIME: 60.0 min.
NOTE: DRAWING IS NOT TO SCALE

STACK DIAGRAM



PROBE DIAGRAM



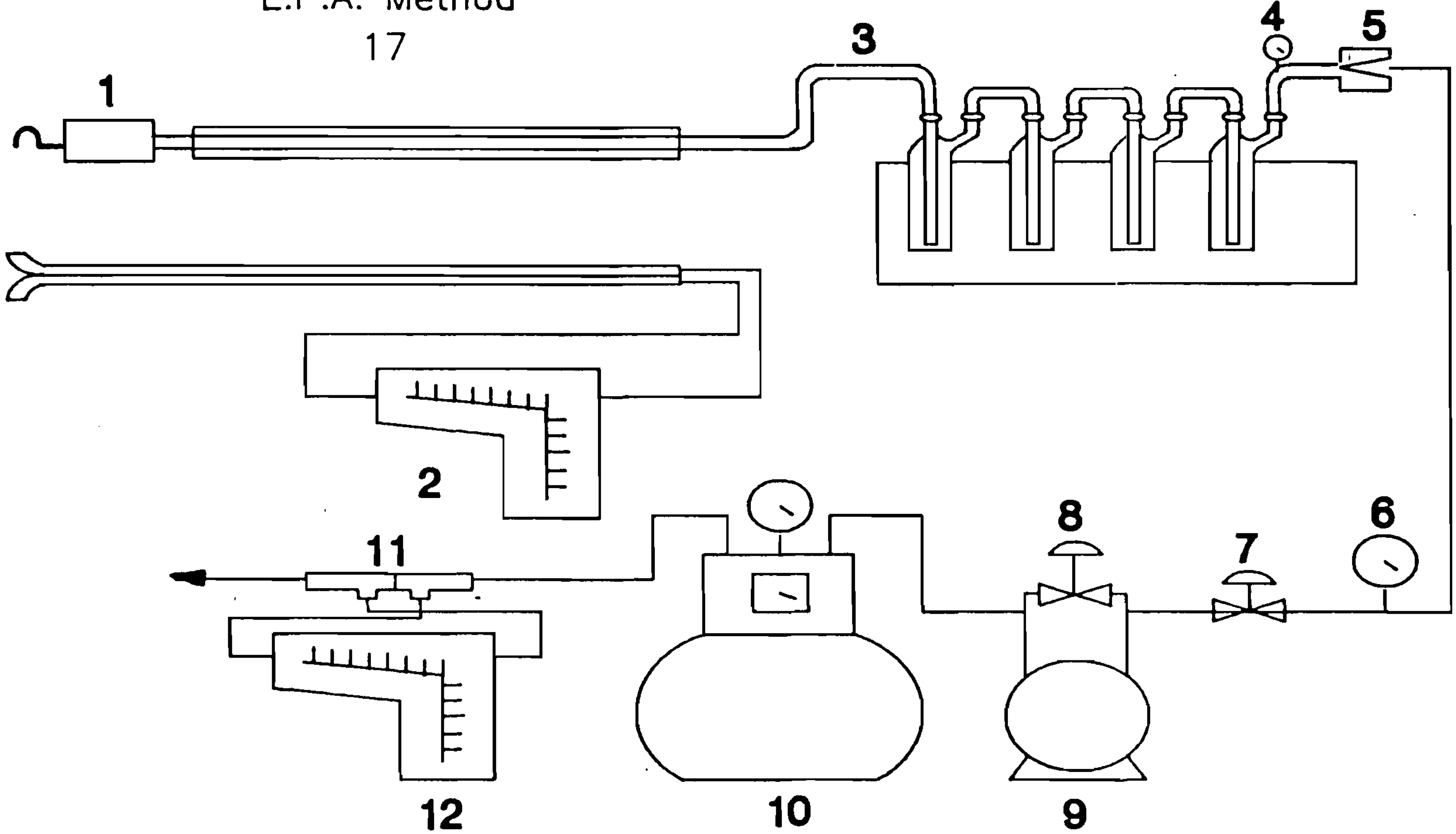
FILE: STACKSN4

R. A. C.

Stacksampler Train

E.P.A. Method

17



1. In – Stack Filter Holder
2. Pitot Manometer
3. Flexible Sample Line
4. Exit Thermometer
5. Check Valve
6. Vacuum Gauge
7. Main Valve
8. By – Pass Valve
9. Vacuum Pump
10. Dry Gas Meter
11. Orifice
12. Orifice Meter

VARIABLES USED IN STACK TEST CALCULATIONS

Vm_{std}	Volume of gas sampled at standard conditions.	DSCF
Y	Dry gas meter calibration factor	
Vm	Volume of dry gas sampled at meter conditions	DCF
Pb	Barometric pressure	in.Hg
Pm	Average orifice pressure drop	in.H20
Tm	Average gas meter temperature	deg.F
Vw_{gas}	Volume of water vapor collected at standard conditions	SCF
Ww	Weight of water collected in impingers	grams
%M	Percent moisture in stack gas	% Volume
Md	Mole fraction of dry gas	
MWd	Molecular weight of stack gas,dry basis	lb/lb-mole
%CO2	Percent carbon dioxide in dry stack gas	% Volume
%O2	Percent oxygen in dry stack gas	% Volume
%N2	Percent nitrogen in dry stack gas	% Volume
MW	Molecular weight of stack gas,wet basis	lb/lb-mole
Psa	Stack gas static pressure	in.Hg abs.
Psg	Stack gas static pressure	in.H20 gauge
E	Elevation difference between sampling point and barometer location	ft.
Cp	Pitot tube coefficient	
Vs	Stack gas velocity at stack conditions	fps
Ps	Stack gas velocity head	in.H20
Ts	Average stack gas temperature	deg.F
Qs	Dry stack gas volumetric flow rate at standard conditions	DSCFM

Qa	Stack gas volumetric flow rate at stack conditions	ACFM
As	Cross sectional area of stack at sampling location	sq. ft.
%I	Percent isokinetic	%
Tt	Net time of test	min.
Dn	Sampling nozzle diameter	in.
F	Combustion gas production rate	SCF/MM BTU
%Gas	Percent of total heat imput derived from natural gas	%
Eg	Particulate emission rate	grains/SCF
Mt	Total particulate collected	mg
Eb	Particulate emission rate	lb/MM BTU

STACK TEST CALCULATIONS

1.Volume of dry gas sampled at standard conditions, DSCF

$$Vm_{std} = 17.64\ Vm * Y * \frac{Pb + (Pm/13.6)}{Tm + 460}$$

2.Volume of water vapor at standard conditions, SCF

$$Vw_{gas} = 0.04715 * Ww$$

3.Percent moisture in stack gas

$$\%M = 100 * Vw_{gas} / (Vm_{std} + Vw_{gas})$$

4.Mole fraction dry gas

$$Md = (100 - \%M) / 100$$

5.Percent nitrogen in dry stack gas,% Vol.

$$\%N2 = 100 - \%CO2 - \%O2$$

6.Molecular weight of dry stack gas,lb/lb - mole

$$MWd = (\%CO2 * 0.44) + (\%O2 * 0.32) + (\%N2 * 0.28)$$

7.Molecular weight of wet stack gas,lb/lb - mole

$$MW = MWd * Md - 18 * (1-Md)$$

8.Stack gas static pressure, in. Hg abs.

$$Psa = (Psg / 13.6) + Pb - 0.001 * E$$

9.Stack gas velocity at stack conditions, fps

$$Vs = 85.49 * Cp * \{(Ps)^{1/2} avg\} * \{(Ts + 460)avg/Psa * MW\}^{1/2}$$

10.Stack gas volumetric flow rate at standard conditions,DSCFM

$$Qs = (1058.82 * Vs * As * Md * Psa) / (Ts + 460)$$

11.Stack gas volumetric flow rate at stack conditions,ACFM

$$Qa = 0.05667 * Qs * (Ts + 460) / (Psa * Md)$$

12. Percent isokinetic

$$\%I = \frac{17.326 * (Ts + 460) * Vm_{std}}{Vs * Tt * Psa * Md * (Dn)^2}$$

13. Combustion gas production rate, SCF/MMBTU

$$F = 8740 * (\%Gas/100) + 9220 * \{1 - (\% Gas/100)\}$$

14. Particulate emission rate, grains/SCF

$$Eg = 0.01543 * (Mt / Vm_{std})$$

15. Particulate emission rate, lb/MMBTU

$$Eb = F * Eg/7000 * \{20.9/(20.9 - \%O2)\}$$

Please note: Standard conditions are defined as 68 degrees F, and atmospheric pressure of 29.92 in. Hg

CALCULATIONS FOR RUN 1

1. Volume of dry gas sampled at standard conditions, DSCF

$$V_{m_{std}} = 17.64 * 41.689 * 1.0697 * \frac{30.28 + (1.698 / 13.6)}{77.2 + 460}$$

2. Volume of water vapor at standard conditions, SCF

$$V_{m_{gas}} = 0.04715 * 152.2$$

3. Percent moisture in stack gas

$$\% M = 100 * 7.18 / (44.523 + 7.18)$$

4. Mole fraction dry gas

$$Md = (100 - 13.88) / 100$$

5. Percent nitrogen in dry stack gas, lb/lb-mole

$$\% N2 = 100 - 11.40 - 5.60$$

6. Molecular weight of dry stack gas, lb/lb-mole

$$MWd = (11.40 * 0.44) + (5.60 * 0.32) + (83.00 * 0.28)$$

7. Molecular weight of wet stack gas, lb/lb-mole

$$MW = (30.05 * 0.861) + [18 * (1 - 0.861)]$$

8. Stack gas static pressure, in. Hg abs.

$$Psa = (-2.00 * 13.6) + 30.28 - (0.001 * 0.00)$$

9. Stack gas velocity at standard conditions, fps

$$Vs = 85.49 * 0.84 * (0.972)^{1/2} * \left| \frac{(386.5 + 460)}{(30.13 * 28.37)} \right|^{1/2}$$

10. Stack gas volumetric flow rate at stack conditions, DSCFM

$$Qs = \frac{(1058.82 * 69.45 * 359.70 * 0.861 * 30.13)}{(386.5 + 460)}$$

11. Stack gas volumetric flow rate at stack conditions, ACFM

$$Qa = 0.5667 * 810883.9 * (386.5 + 460) / (30.13 * 0.861)$$

12. Percent isokinetic

$$\%I = \frac{17.326 * 44.523 * (386.5 + 460)}{69.45 * 60 * 30.13 * 0.861 * (0.25)^2}$$

13. Combustion gas production rate, SCF/MMBTU

$$F = 8710 *(0.0 / 100) + 9190 *[1-(0.0 / 100)]$$

14. Particulate emission rate, grains/SCF

$$Eg = 0.01543 *(388.7 / 44.523)$$

15. Particulate emission rate, lbs/MMBTU

$$Eb = 9284 *(0.1347 / 7000)*[20.9 / (20.9 - 5.60)]$$

FPL

Inter-Office Correspondence

To: W.J. Waylett, PRG/EDO

Date: February 14, 1991

From: K.R. Olen

Department: JRD/EDO

Subject: **ORIMULSION: Calculated f-Factor for Emission Measurements**

Because of the high water content in Orimulsion, e.g., 30%, difficulties have been experienced in determining an accurate and reliable Ultimate Analysis. To overcome this problem new techniques are being developed by the PRS Laboratory for use both in-house and with outside analytical laboratories. Until the analytical chemists establish confidence in the use of these new techniques, an estimated f-Factor will have to be used for emissions measurements.

Since fuel carbon and hydrogen contents normally dominate the f-Factor calculation, and the C/H ratio for Orimulsion is about the same as that generally determined for residual oil, i.e., approximately 8, I suggest that for the foreseeable future the accepted f-Factor for residual oil, namely 9190, be used for Orimulsion until an accurate number can be calculated.

Further support for this suggestion is found in calculating a f-Factor for the midpoint composition per the BITOR fuel specification for Orimulsion:

Carbon, %	58.45
Hydrogen, %	7.25
Sulphur, %	2.65
Nitrogen, %	0.46
Oxygen, %	0.40

Heat Content, Btu/lb 12,898

Using these data the calculated f-Factor is 9088, hence the temporary use of the accepted residual oil f-Factor may prove to be somewhat conservative.

K.R. Olen

KRO/t

EXHIBIT 6

Form 1008 (Stocked) Rev. 5/89

ENTROPY
ENVIRONMENTALISTS, INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
FAX 919-787-8442 919-781-3550

February 5, 1991

Ms. Elsa Bishop
Florida Power and Light Company
P. O. Box 078768
West Palm Beach, FL 33407-0768

Dear Ms. Bishop:

In response to your questions concerning the ability of the Method 5 or Method 17 standard filters to collect particulate matter of very small diameters, please be advised that the collection efficiency of standard EPM 2000 Whatman filters for particles of 0.3 micrometers and greater is 99.997 percent. The collection efficiency of particles even as small as 0.01 micrometers is about 99.5 percent. Thus we are confident that the vast majority of particulate matter, even that of very small size, is effectively captured if the procedures for either Method 5 or Method 17 are properly conducted.

To my knowledge this is the most efficient filter to use.

We hope this information is of service.

Sincerely,

Walter S. Smith
President

WSS/pjj

cc: Bob Allen

EXHIBIT
7

EXHIBIT 8

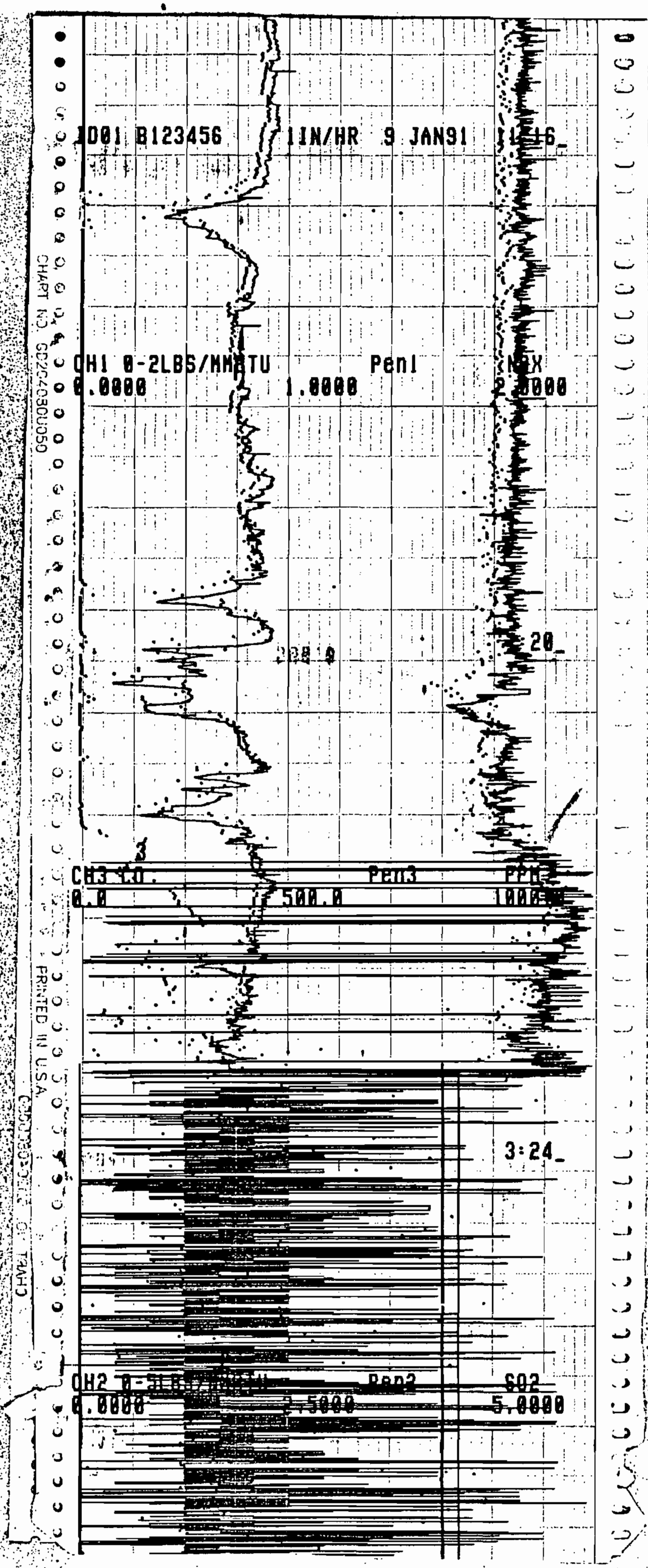
SULFUR DIOXIDE CONTINUOUS EMISSIONS MONITOR STRIP CHART READINGS*

SANFORD UNIT NO. 4

JANUARY 9 - FEBRUARY 10, 1991

*These readings are based on a more conservative f-Factor of 9284 and therefore are higher than if the readings had been based on an f-Factor of 9190.

wn:exh8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2.0000
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Pen3
PPM
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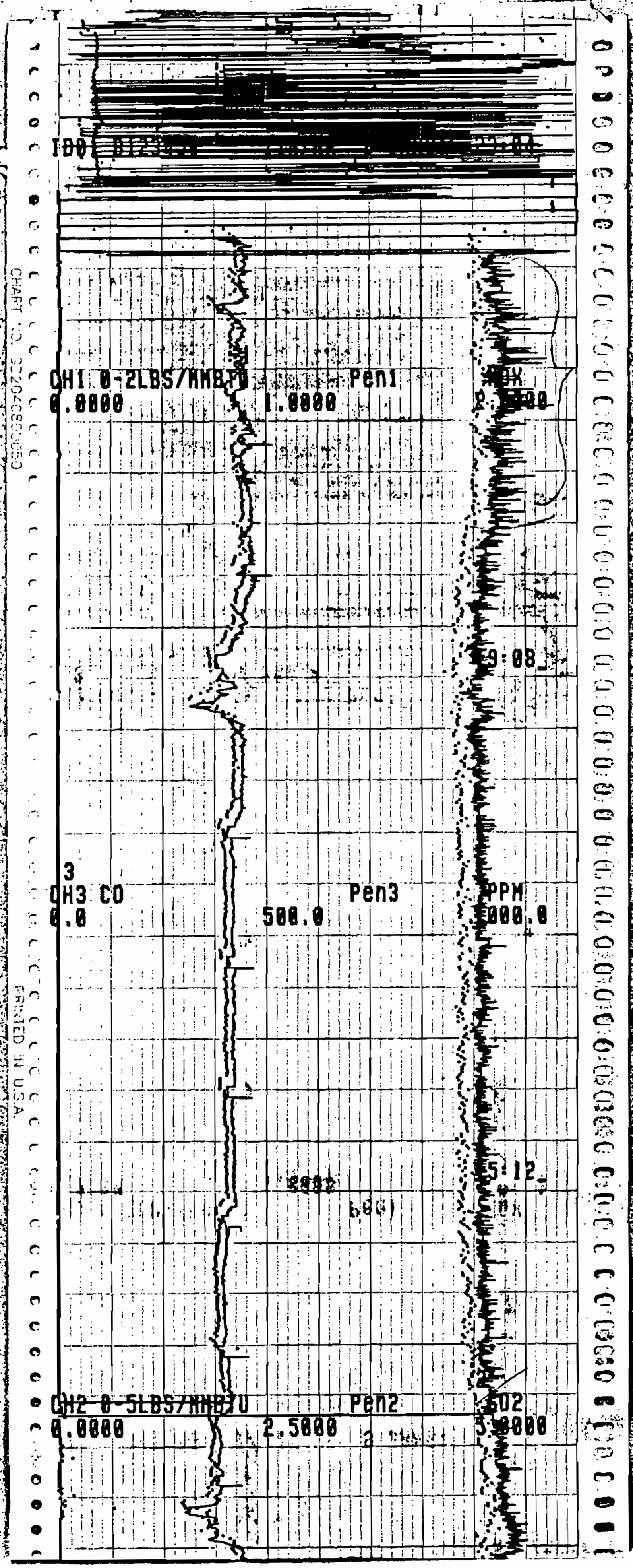

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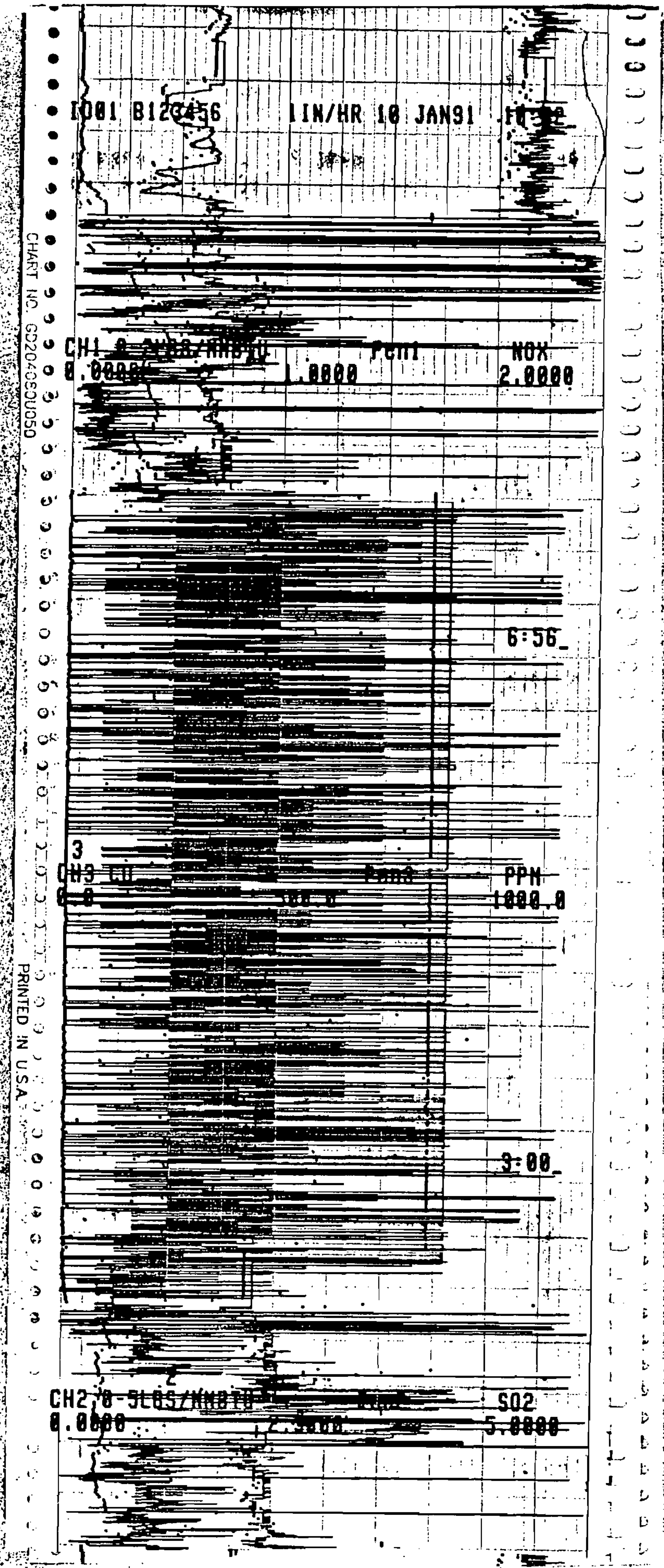

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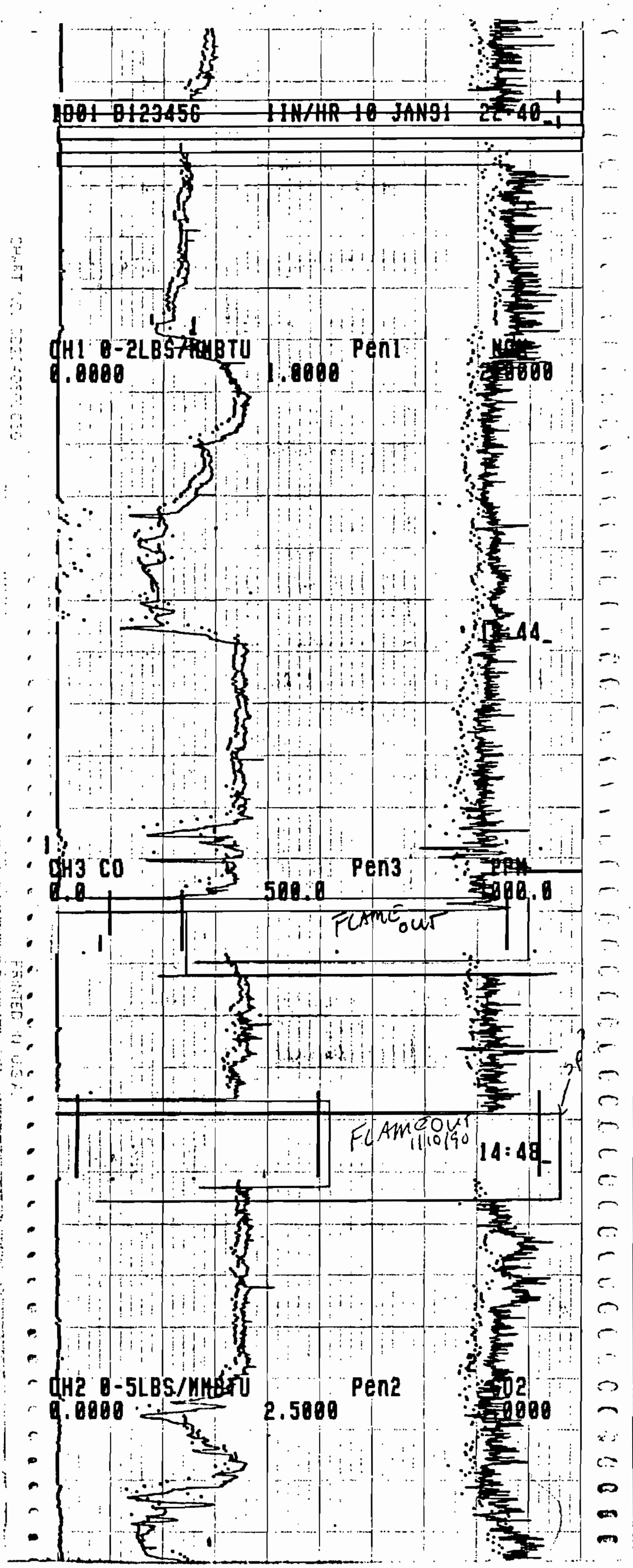

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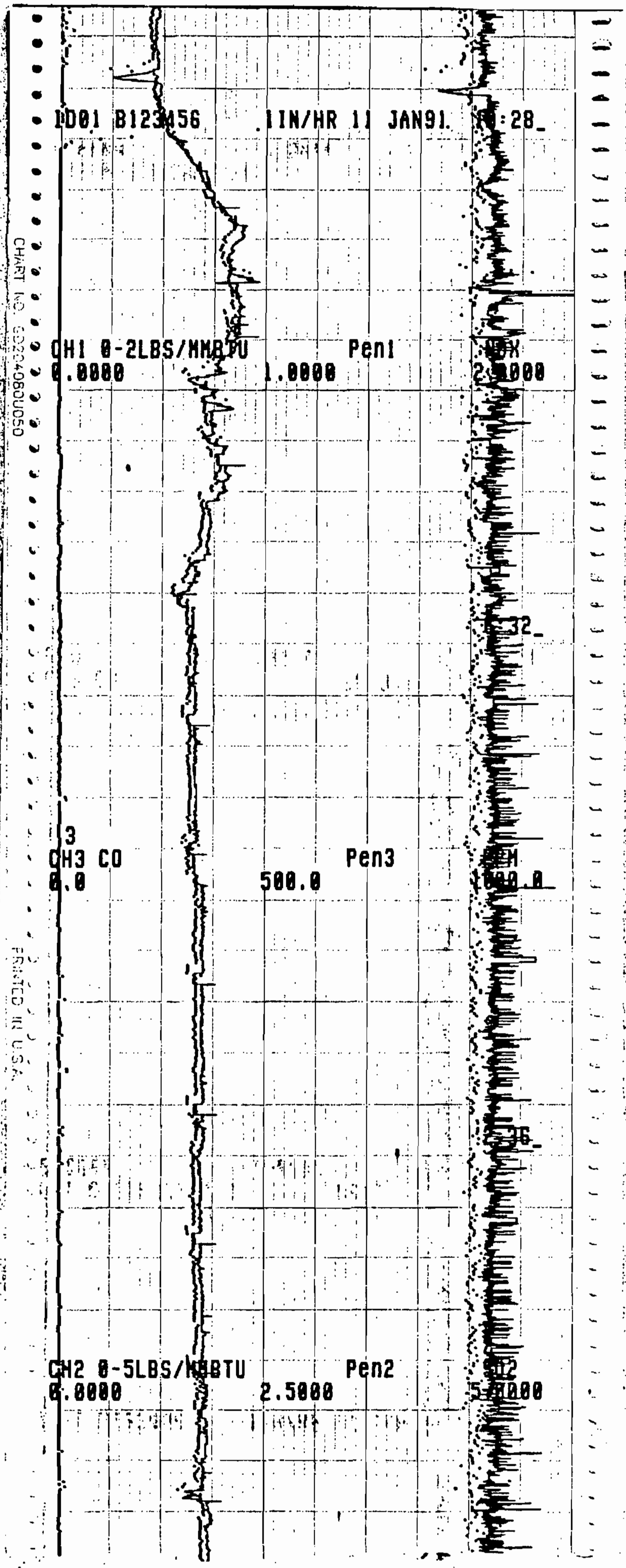

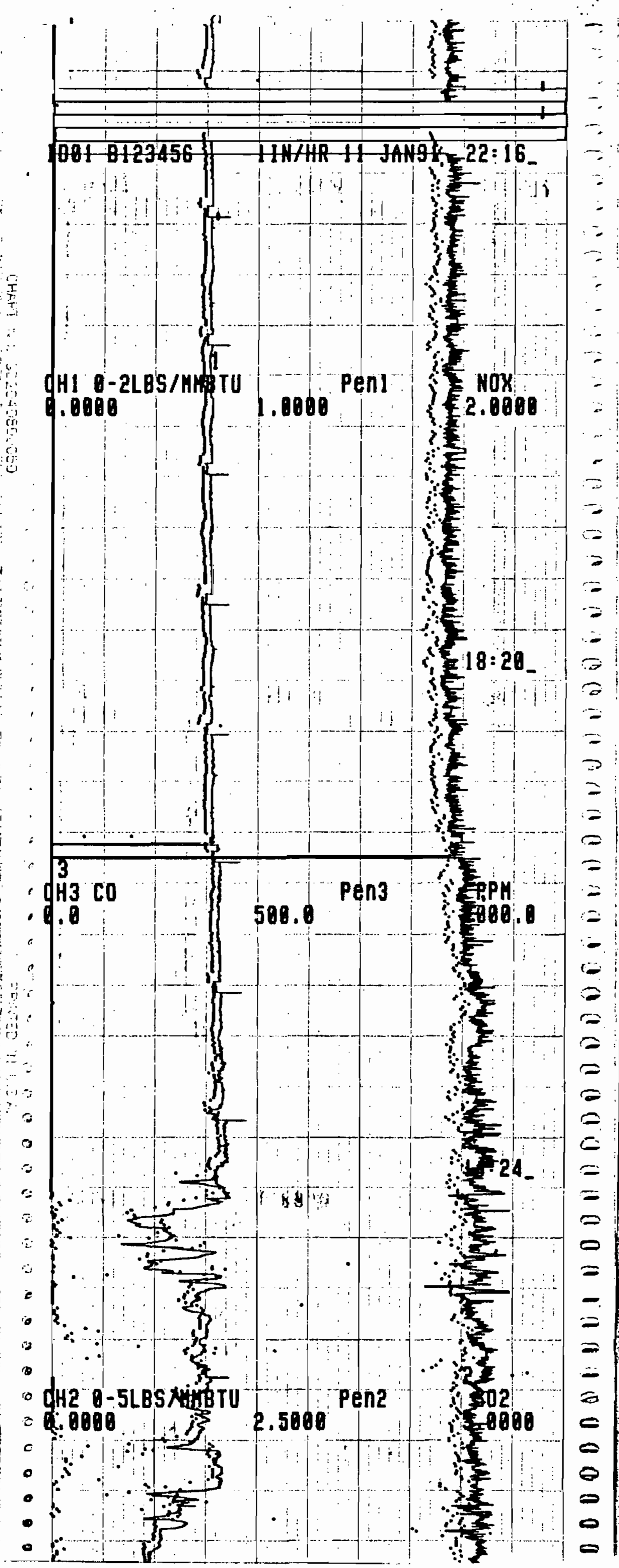
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1IN/HR 11 JAN91
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1.0000
2.0000
18:20_
CH3 CO
Pen3
RPM
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1000.0
CH2 0-5LBS/MMBTU
Pen2
SO2
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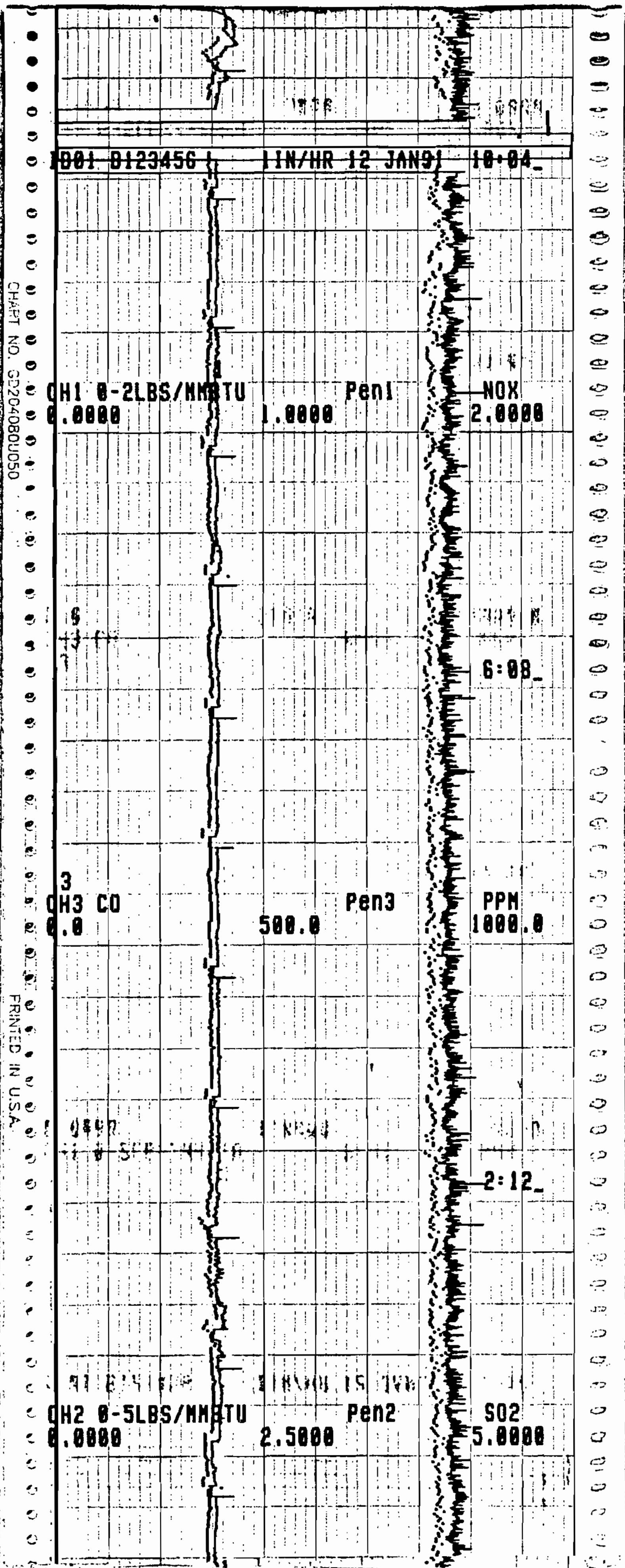
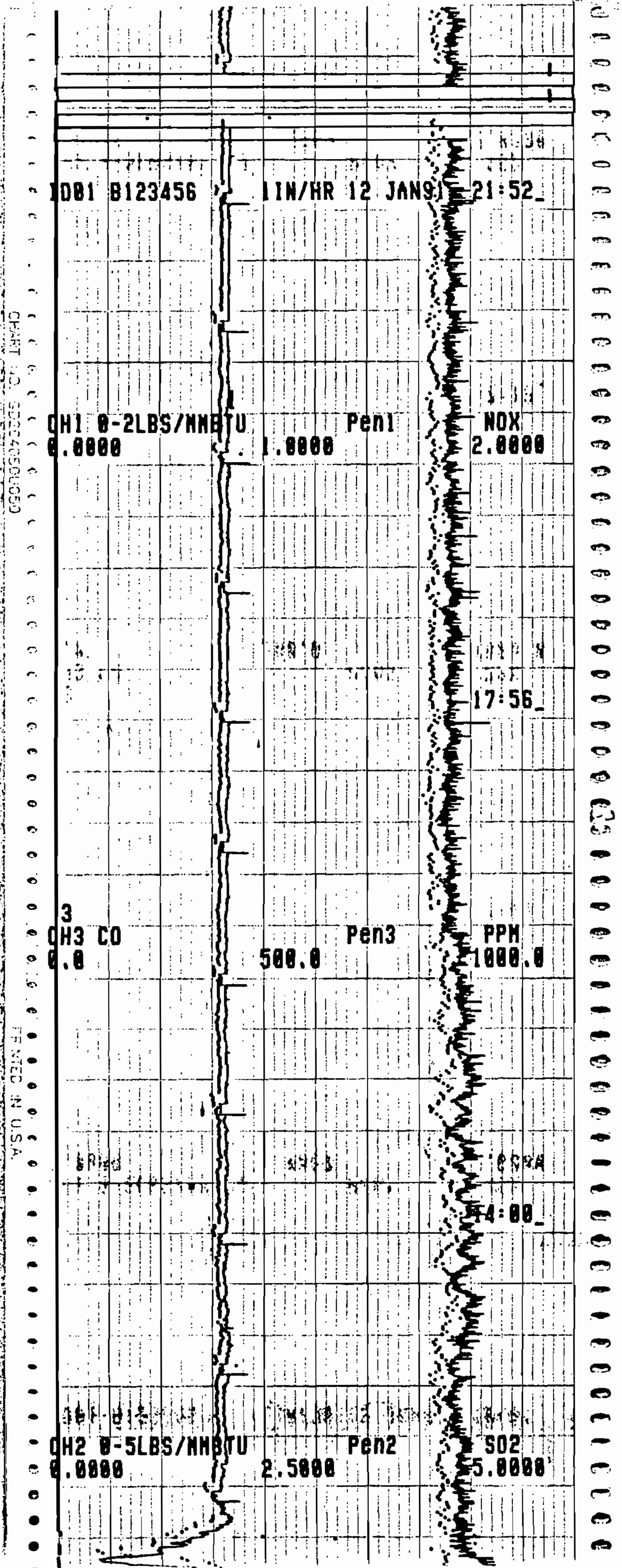
2.5000

Best Available Copy

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Pen3
PPM
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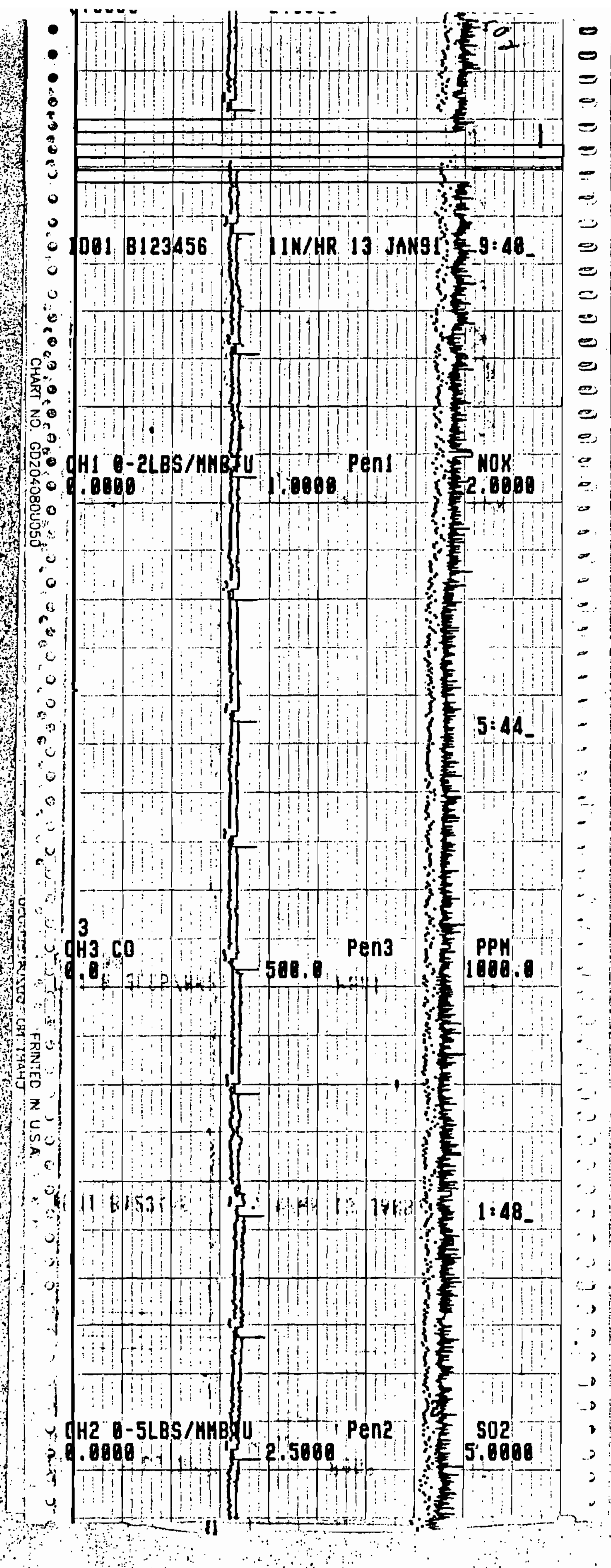
5.0000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Pen3
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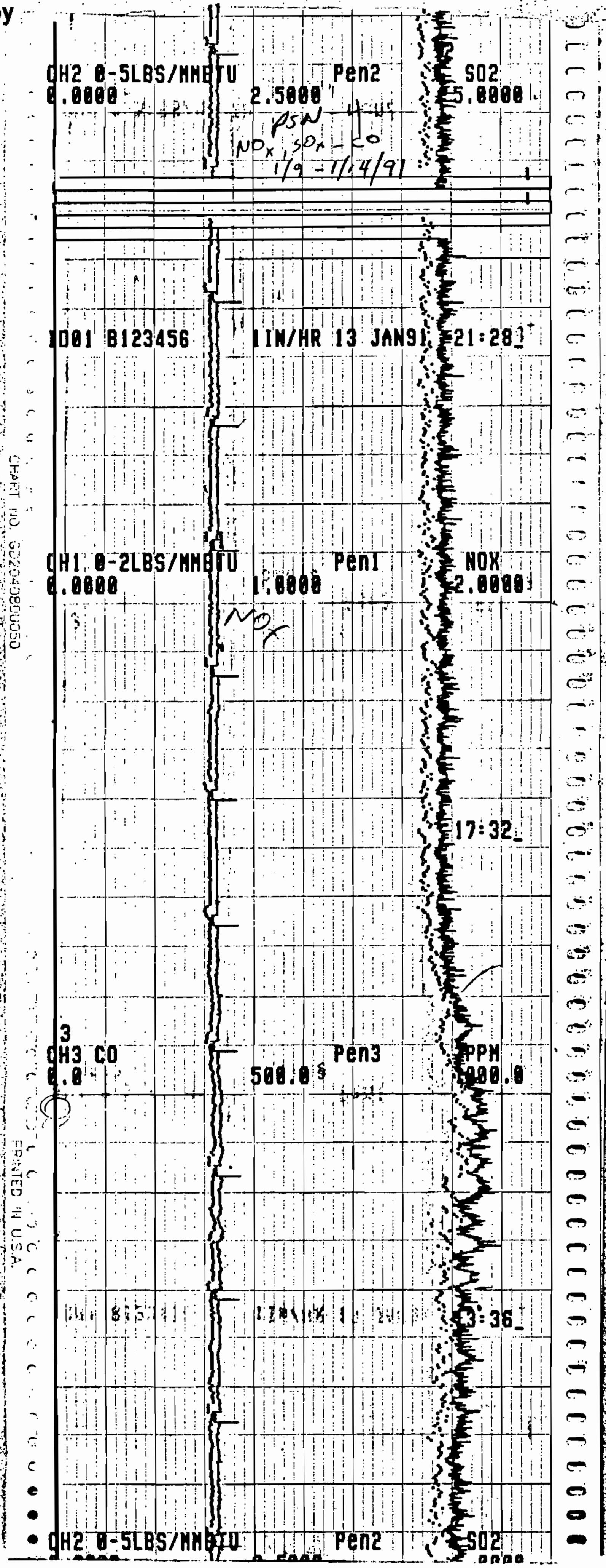

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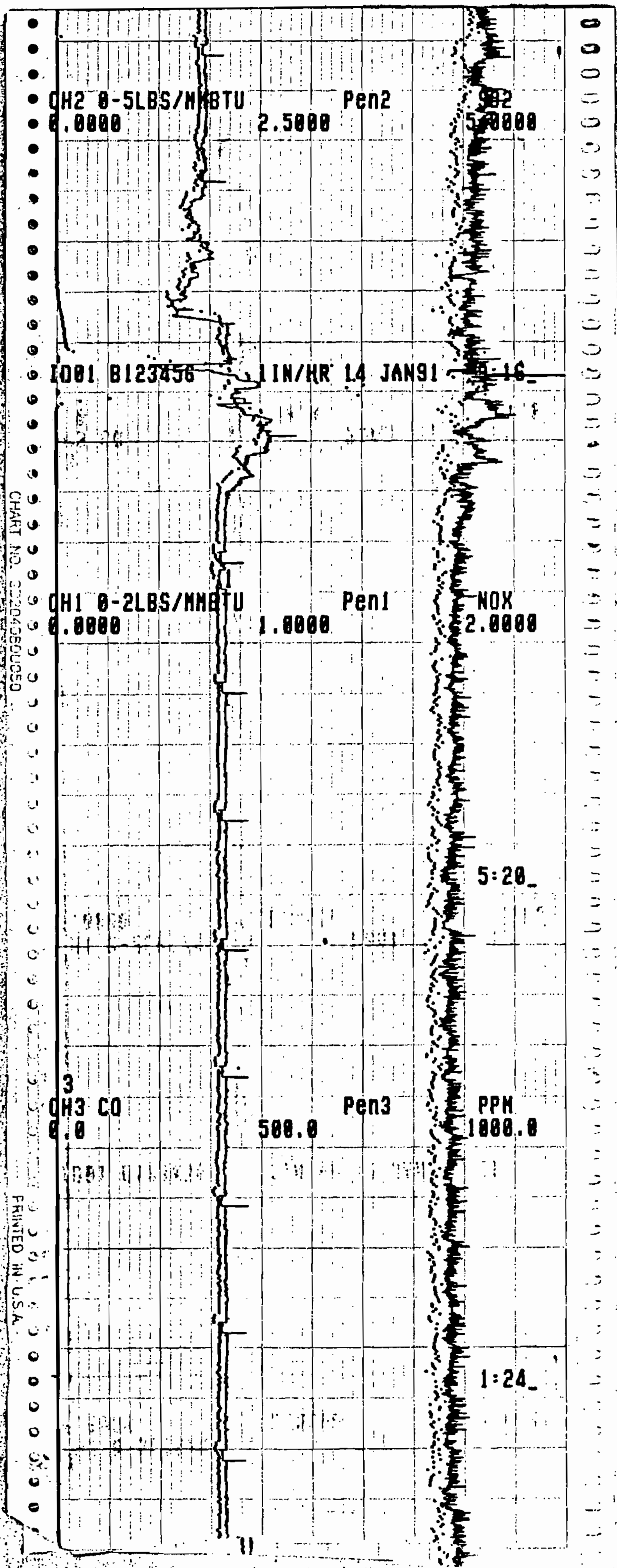

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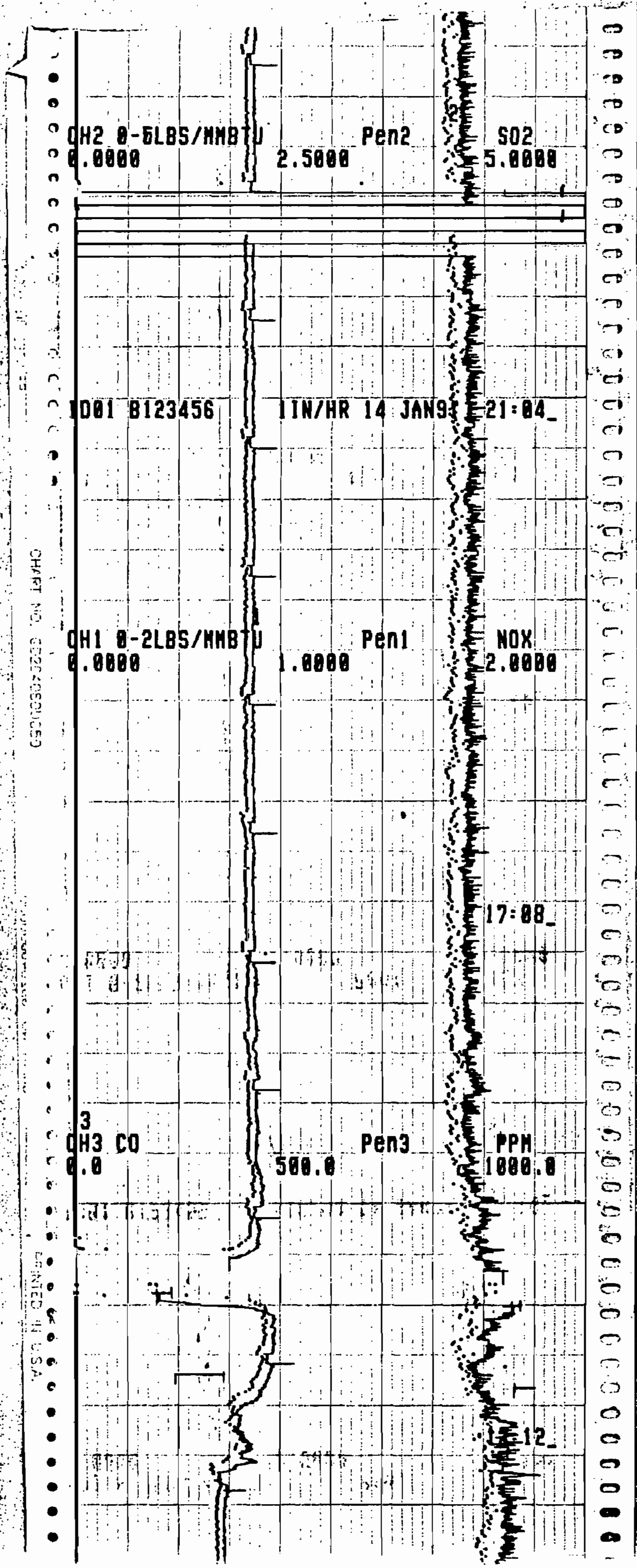

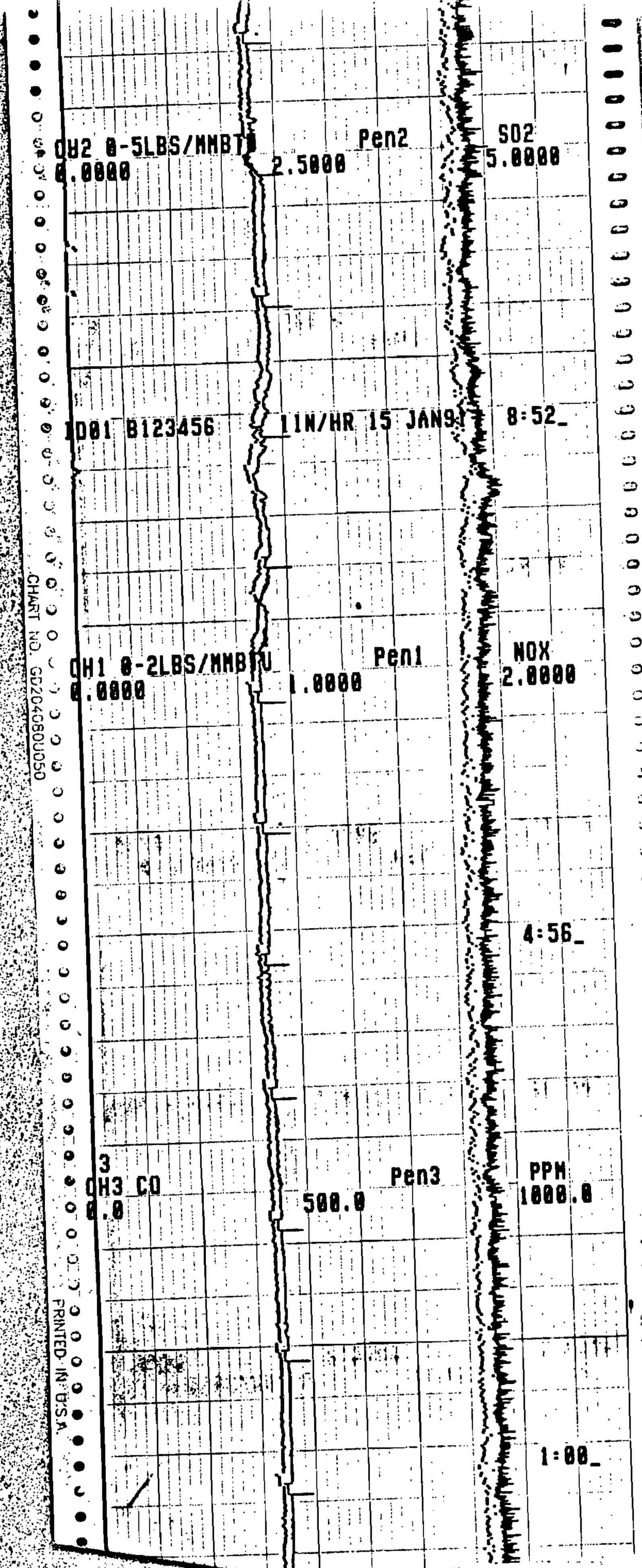
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2.5000
Pen2
SO2
5.0000
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1.0000
Pen1
NOX
2.0000
4:56_
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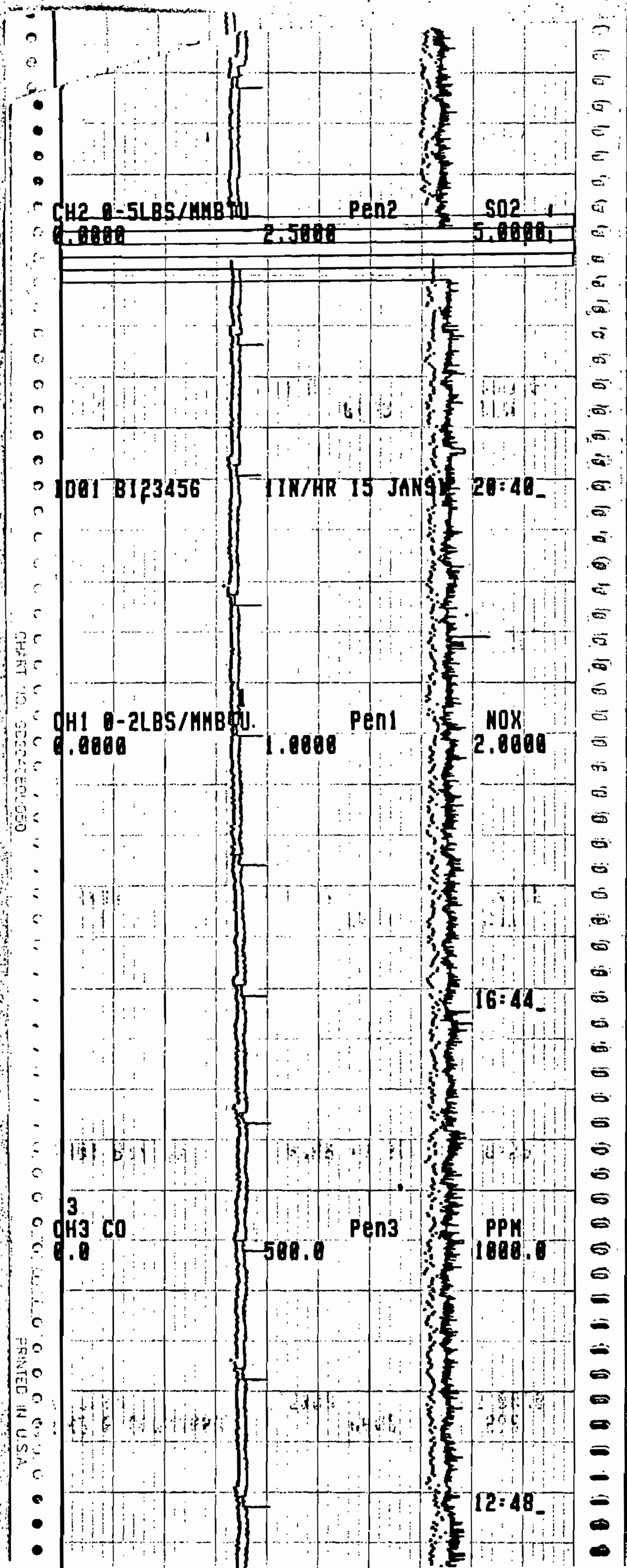
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SO2
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CH1 0-2LBS/MMBTU
Pen1
NOX
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1.0000
2.0000
16:44
3
CH3 CO
Pen3
PPM
0.0
500.0
1000.0
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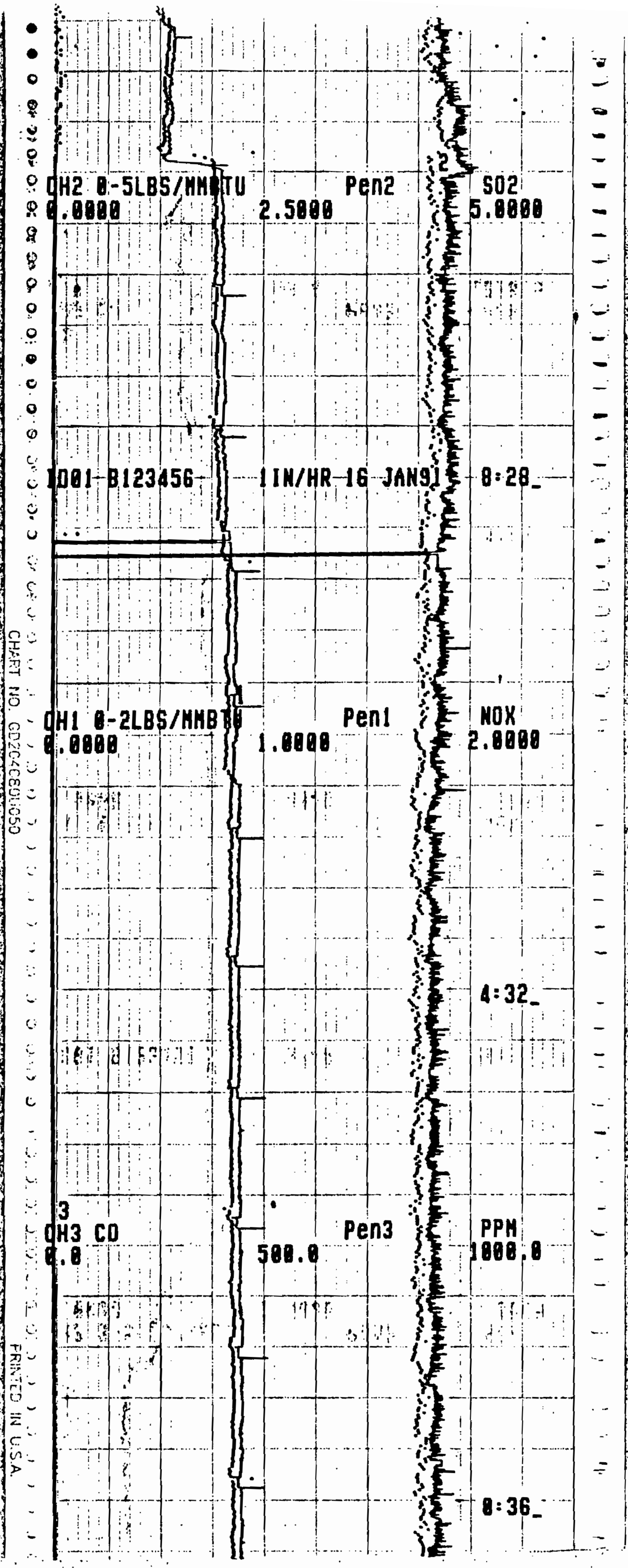
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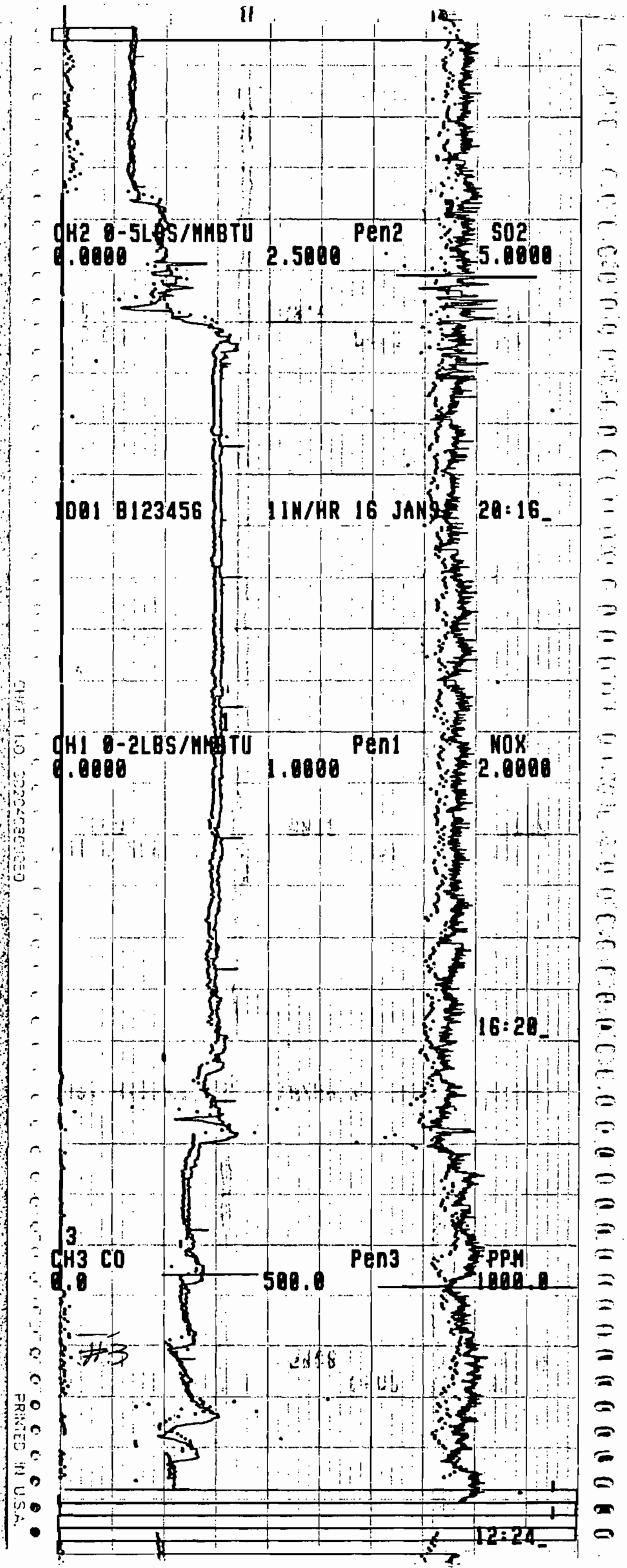

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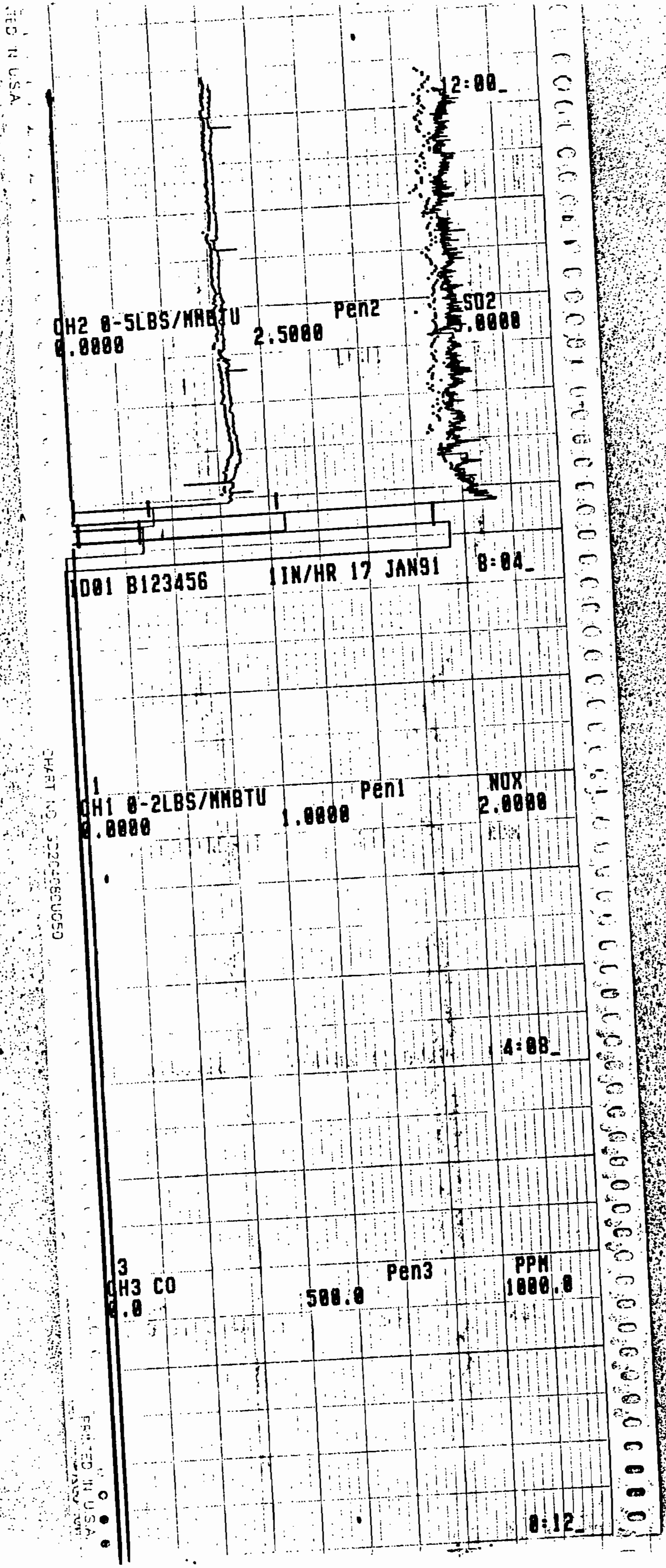

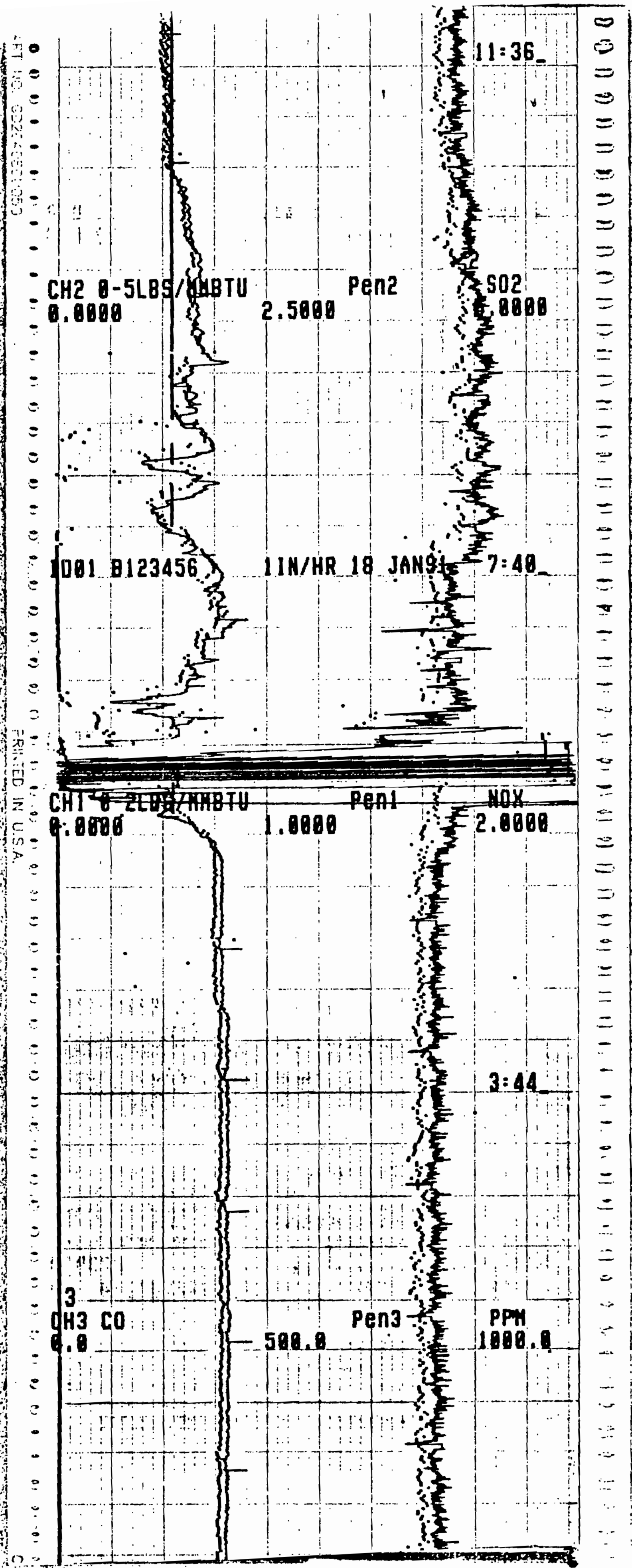
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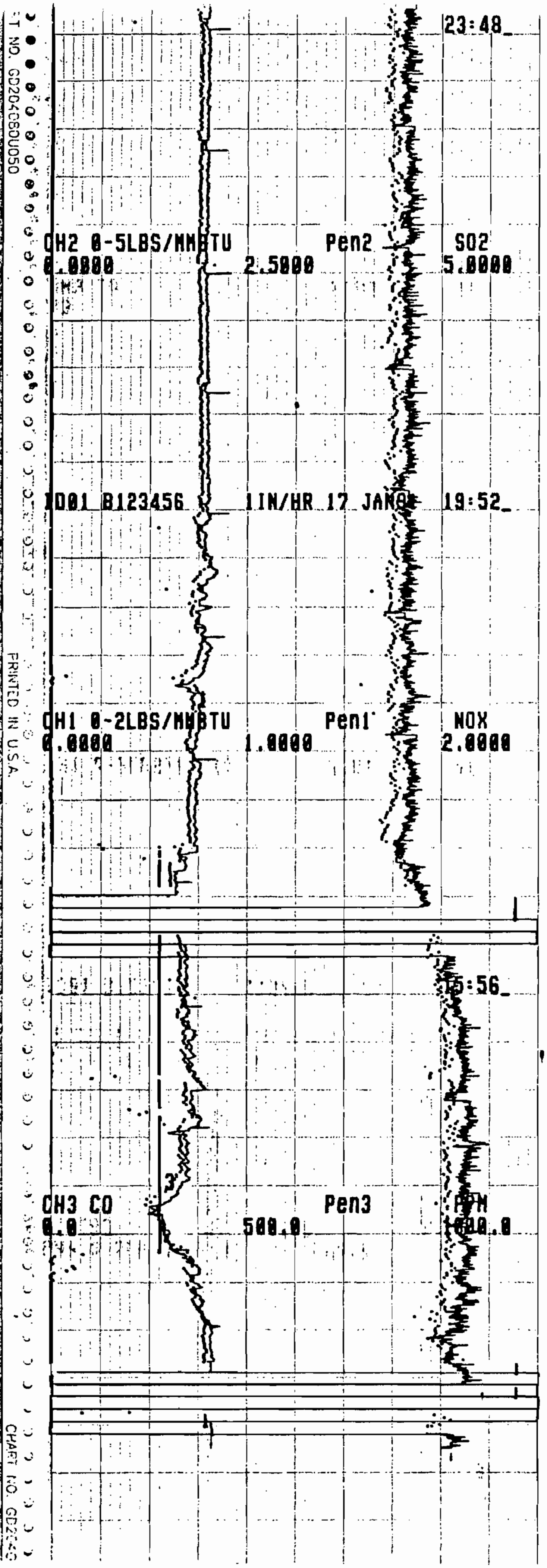

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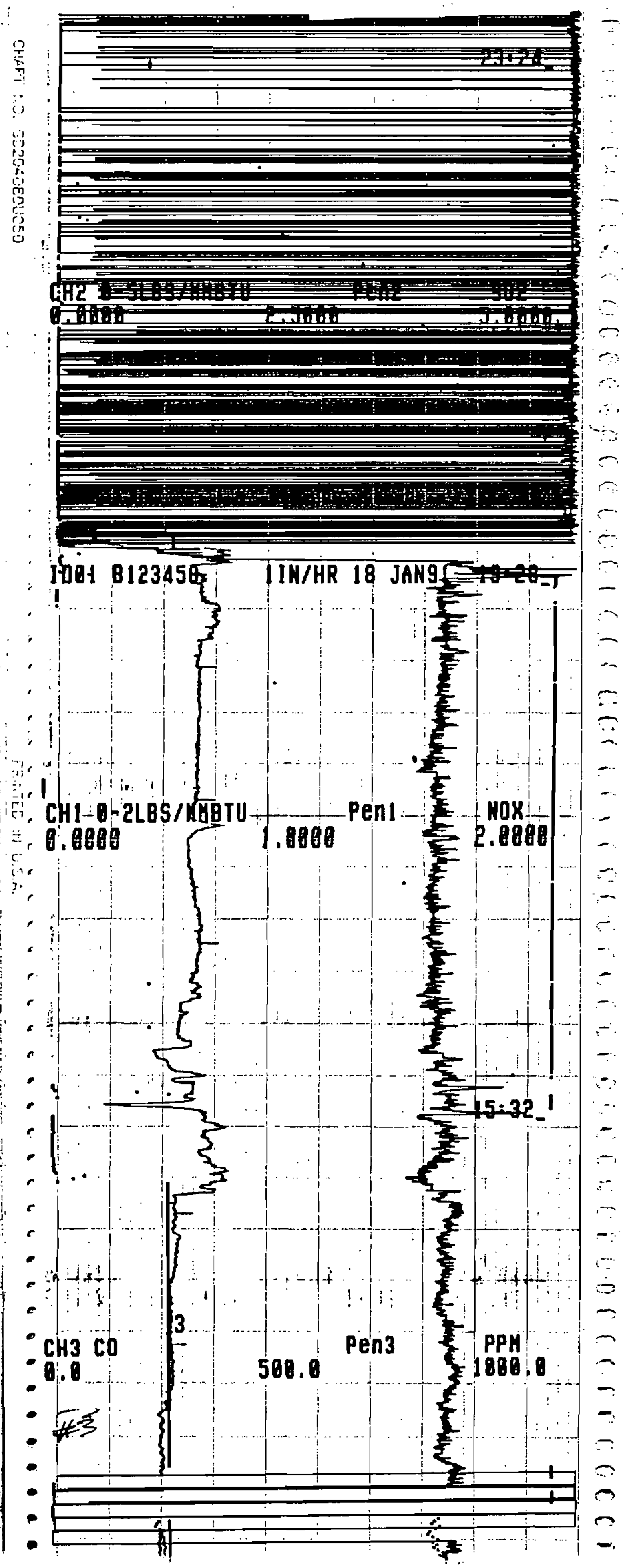

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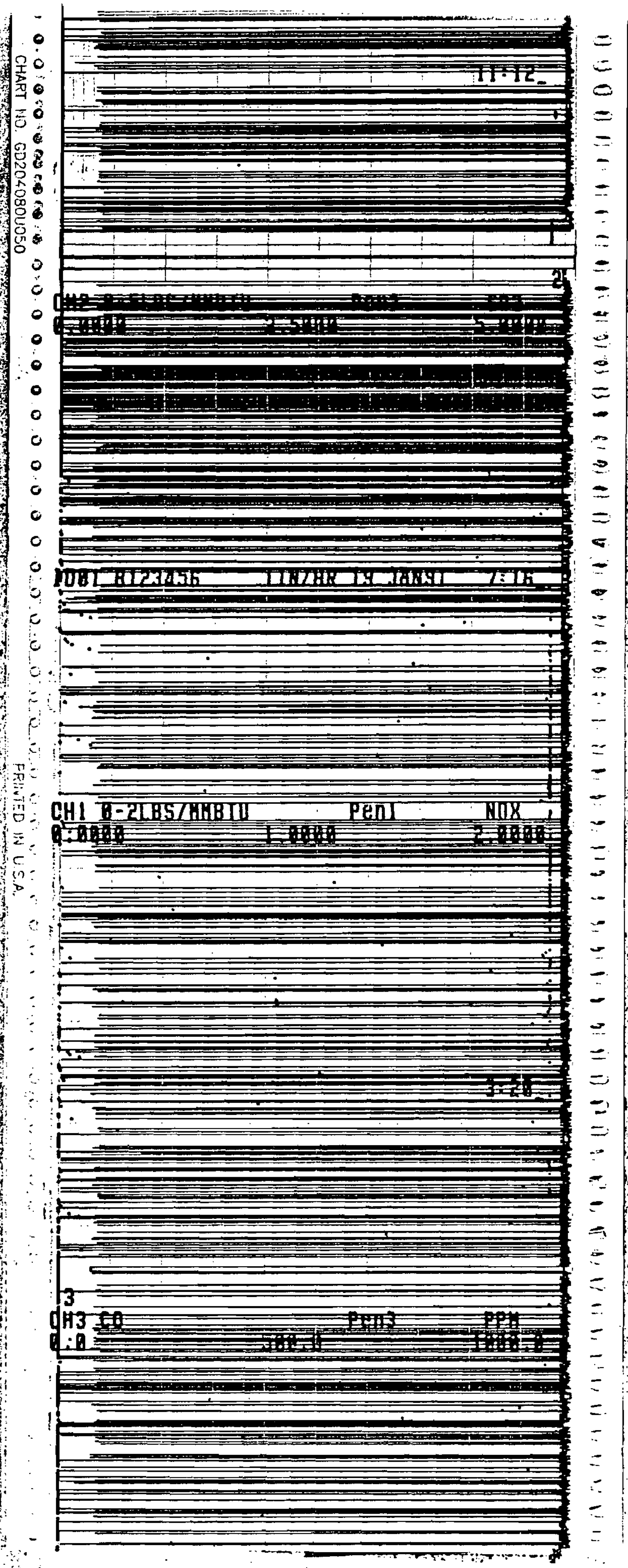

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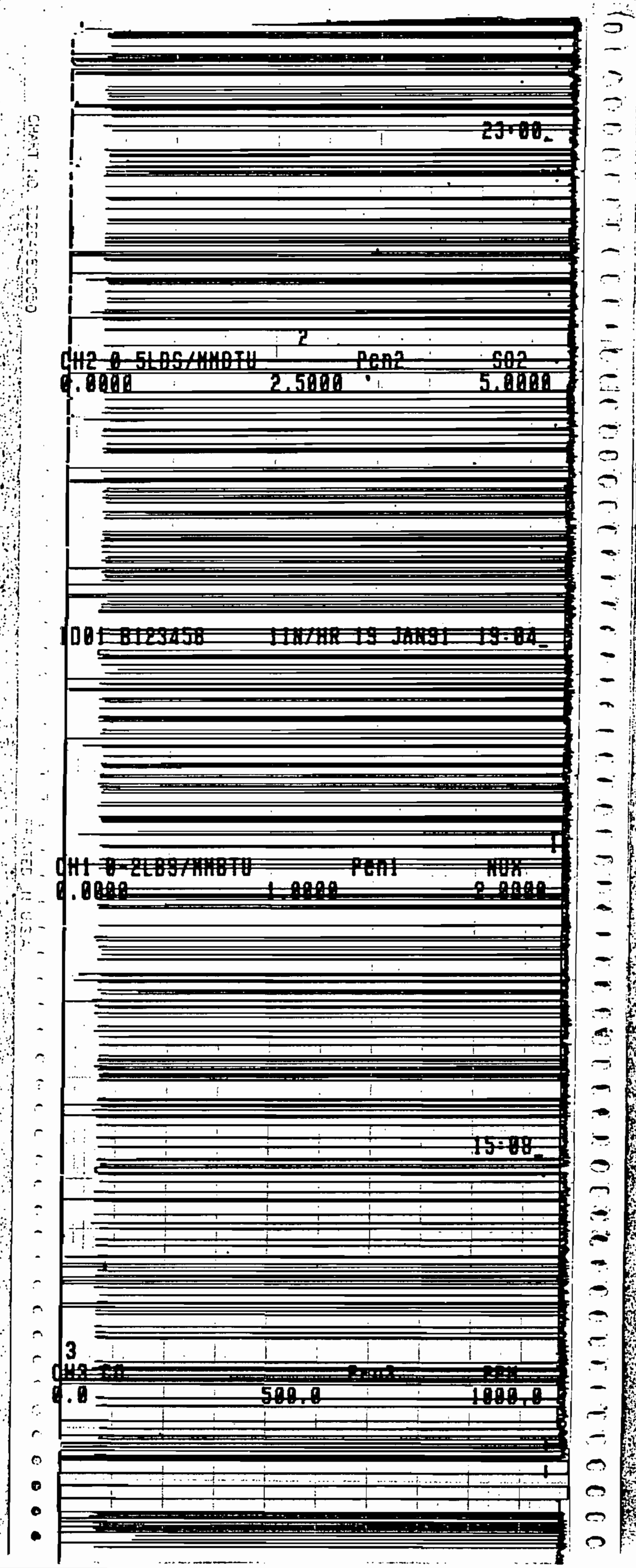

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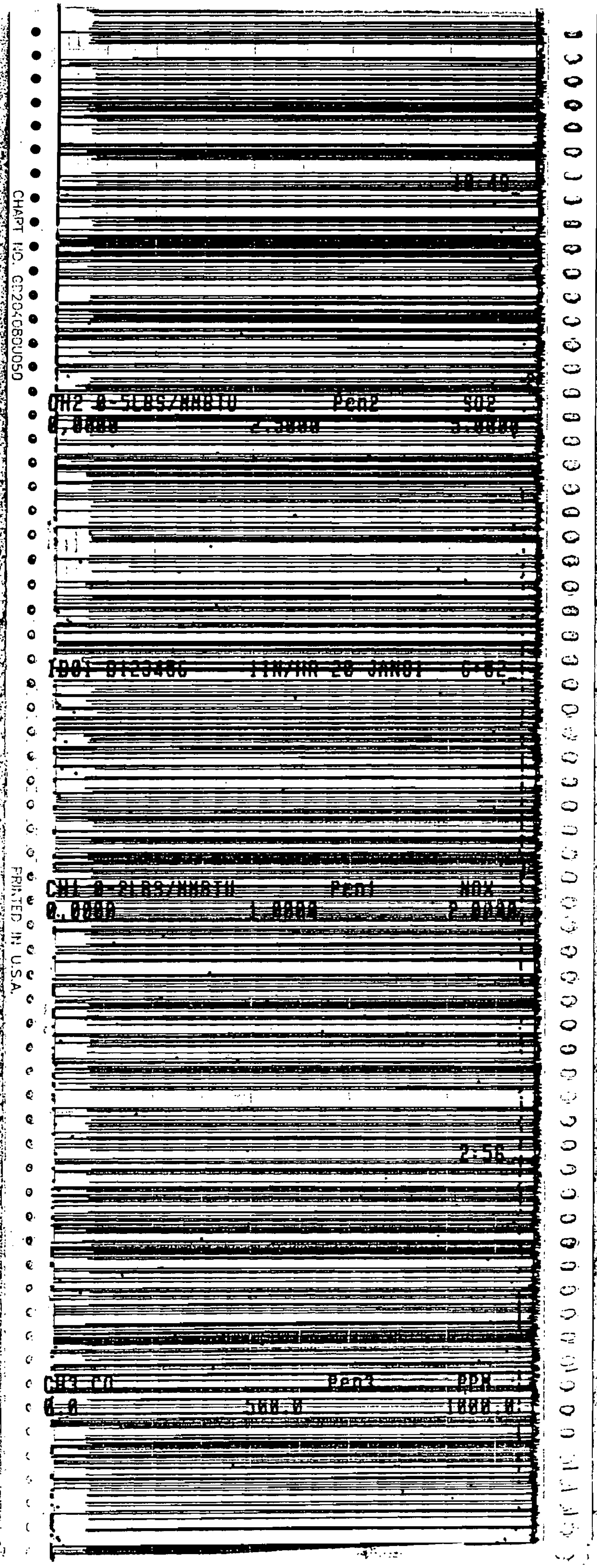

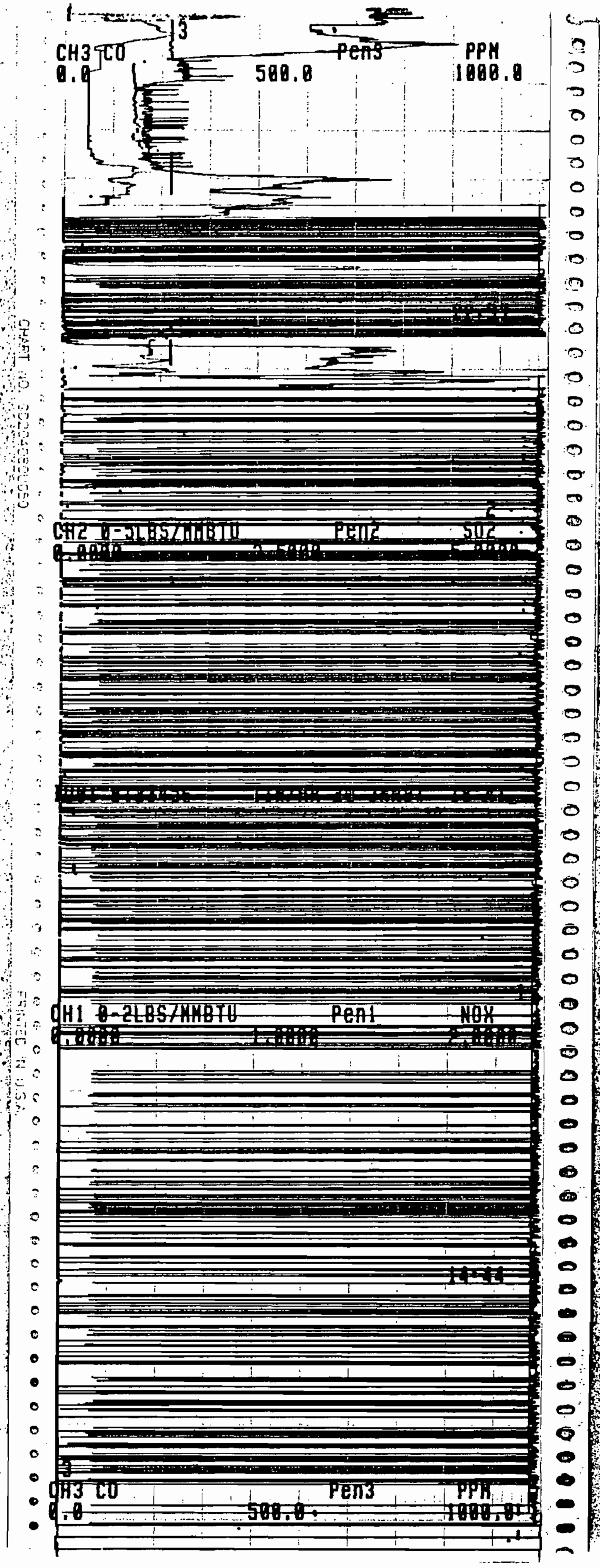
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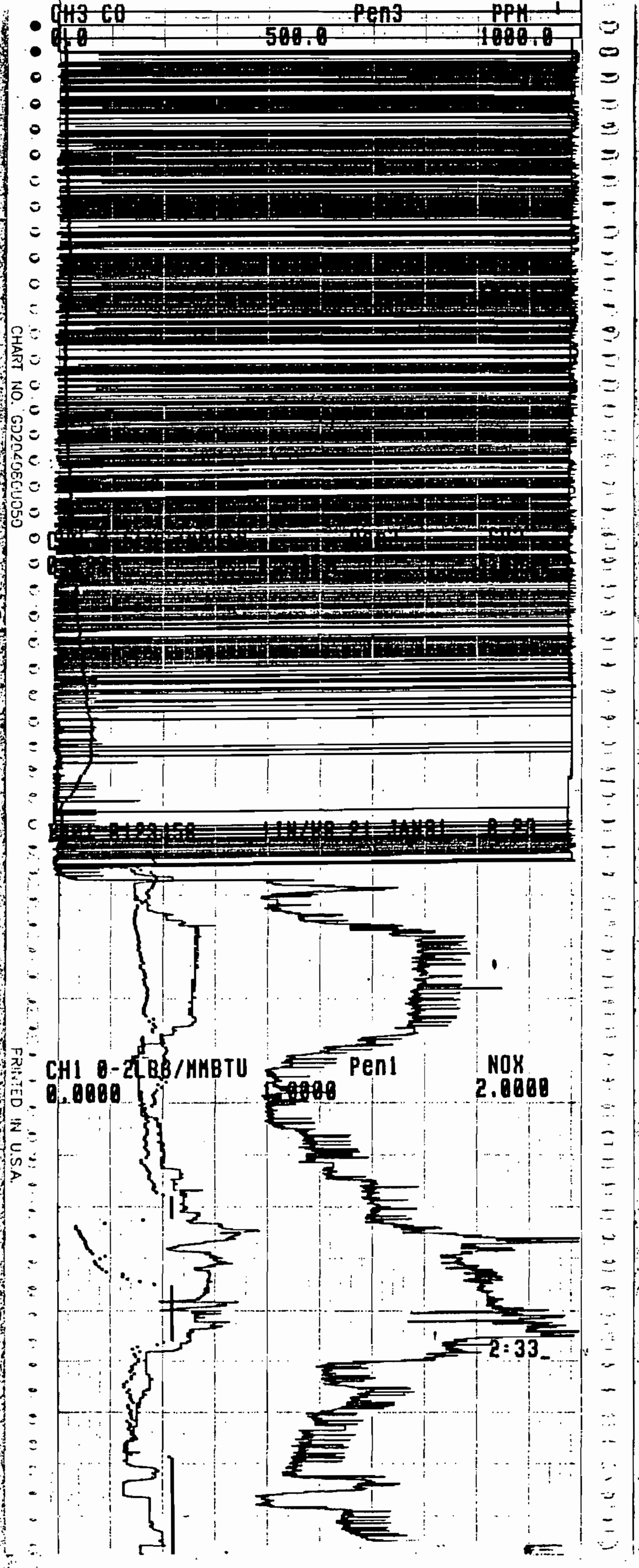
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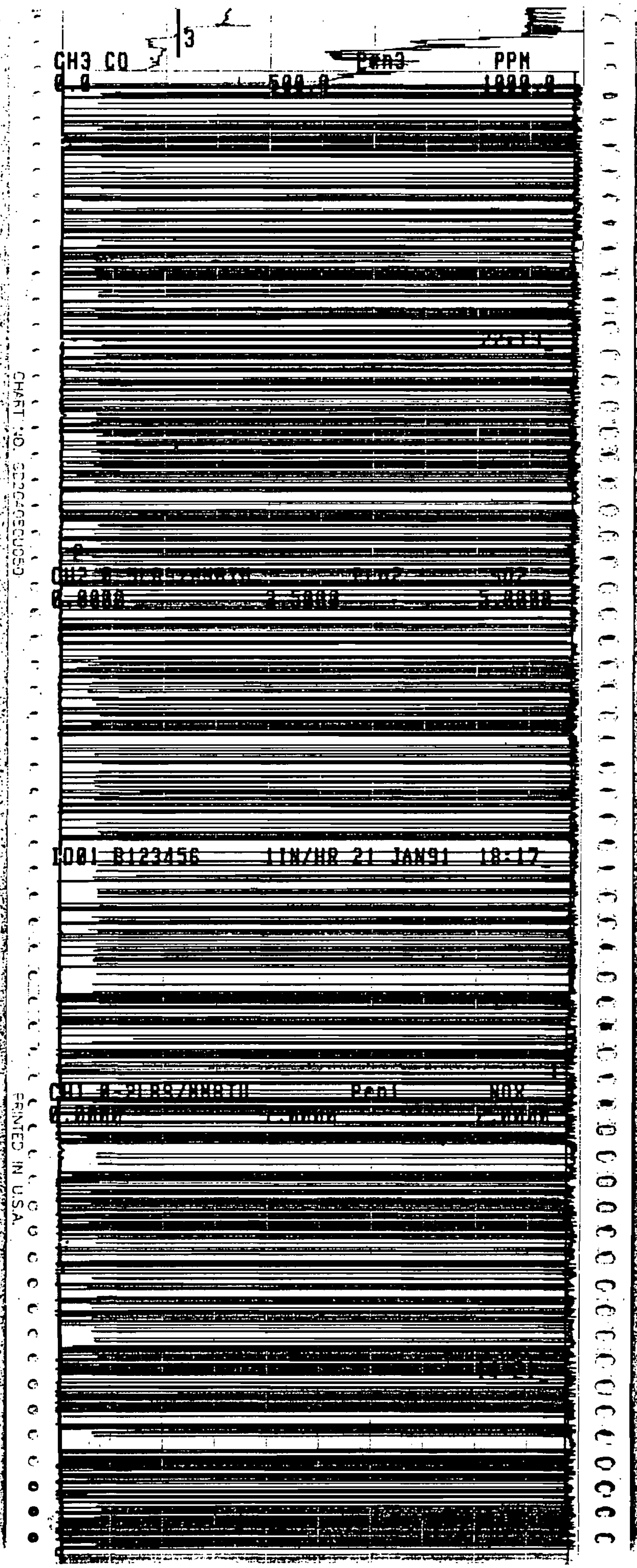
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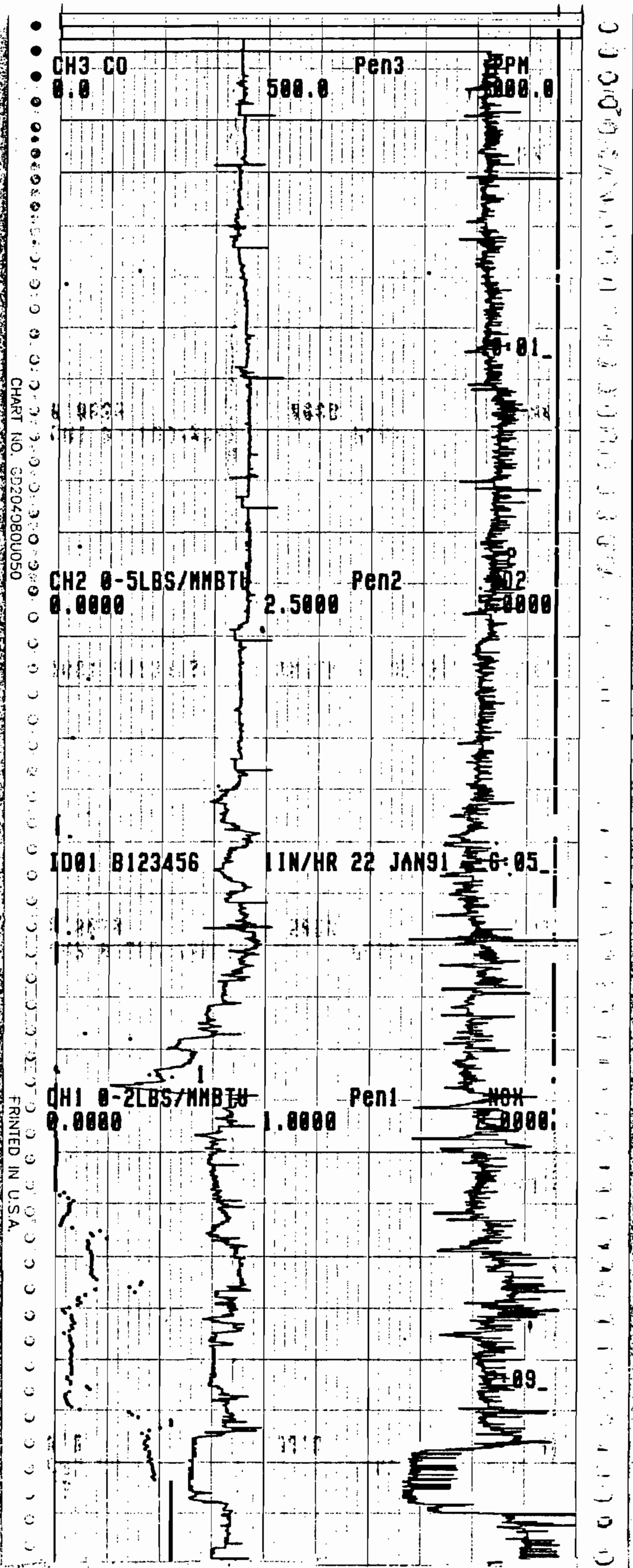
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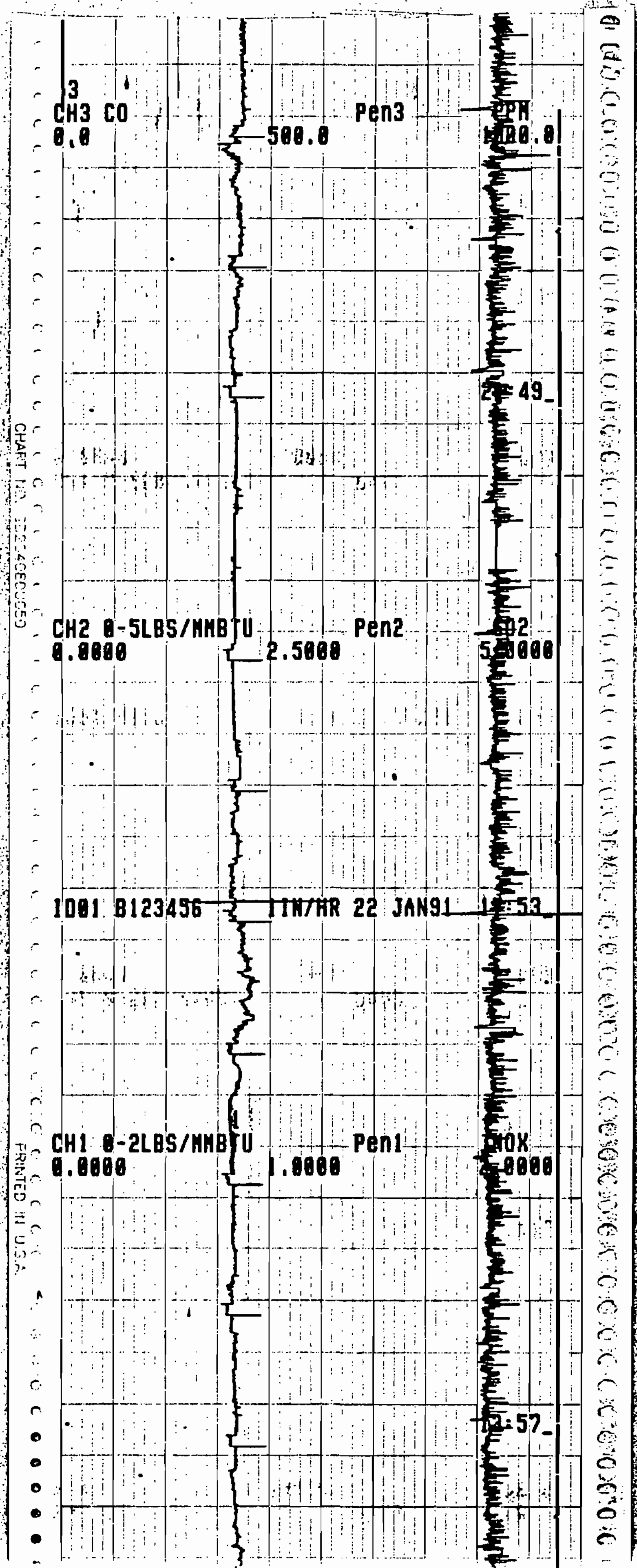

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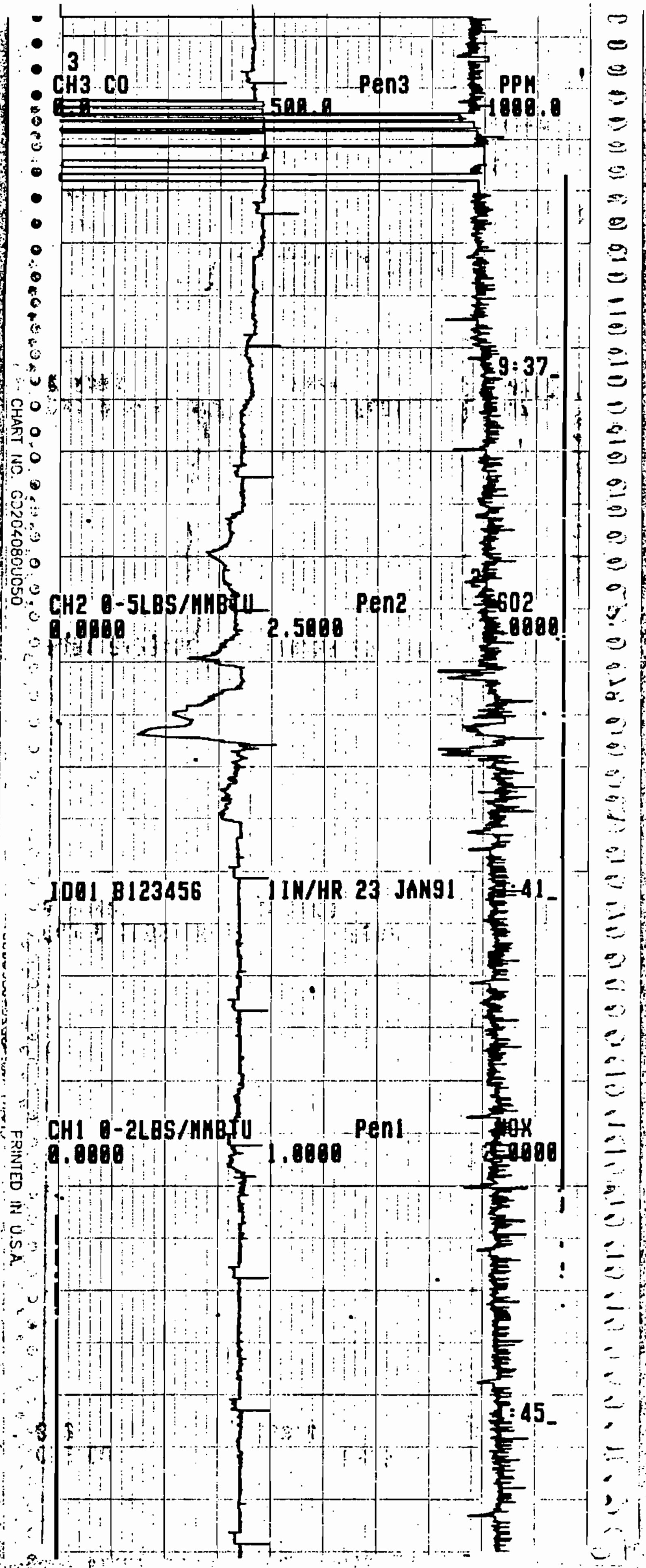

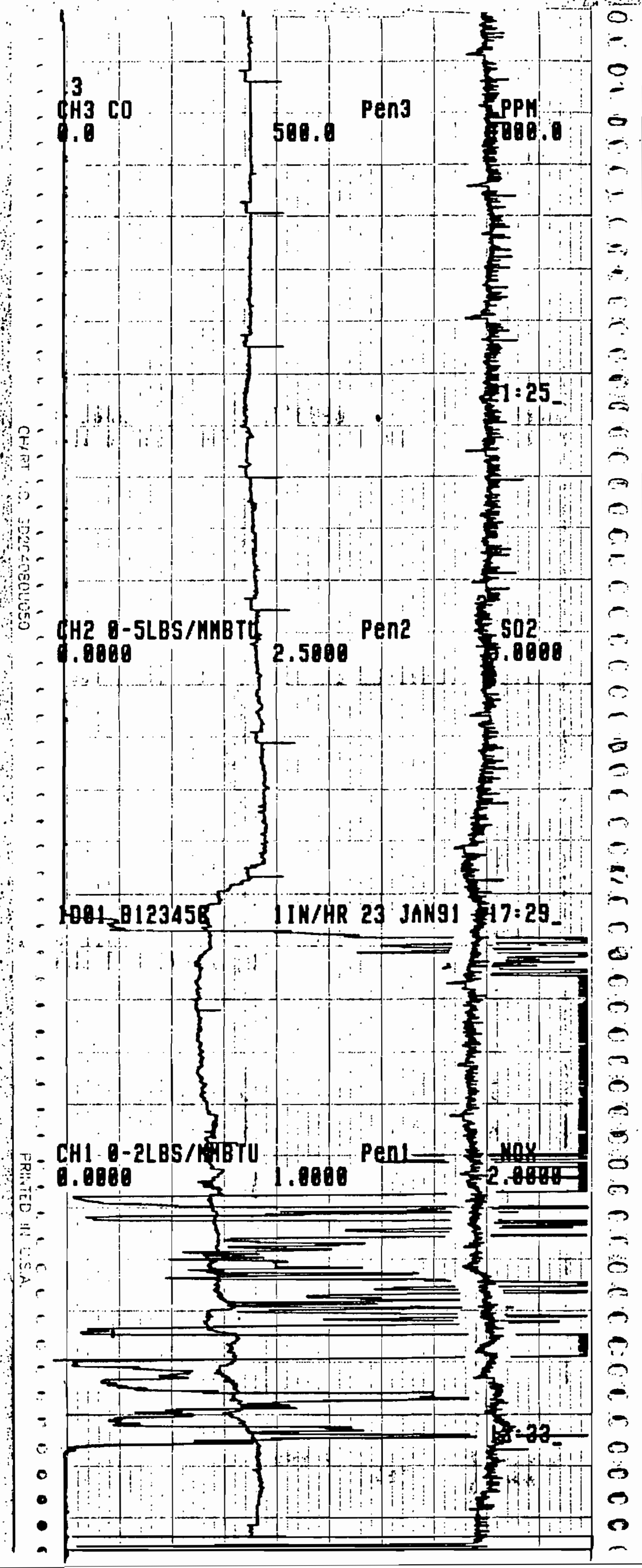

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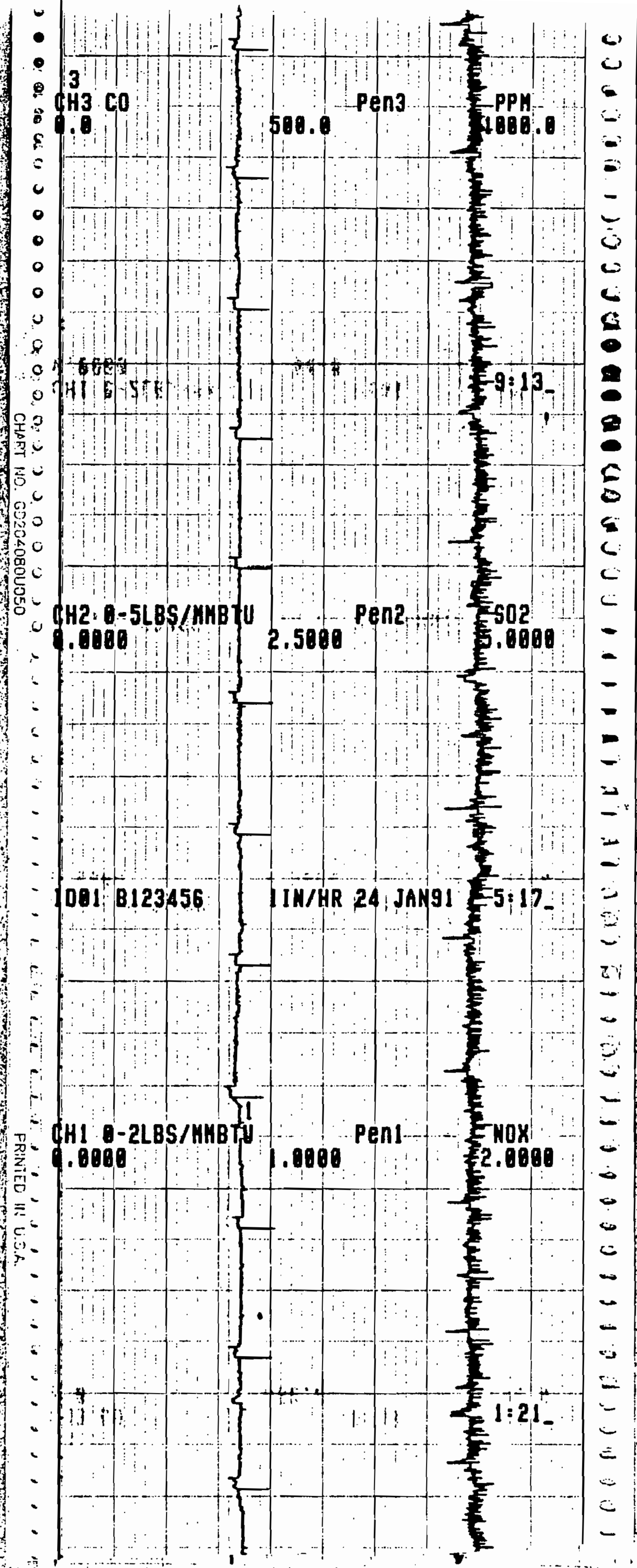
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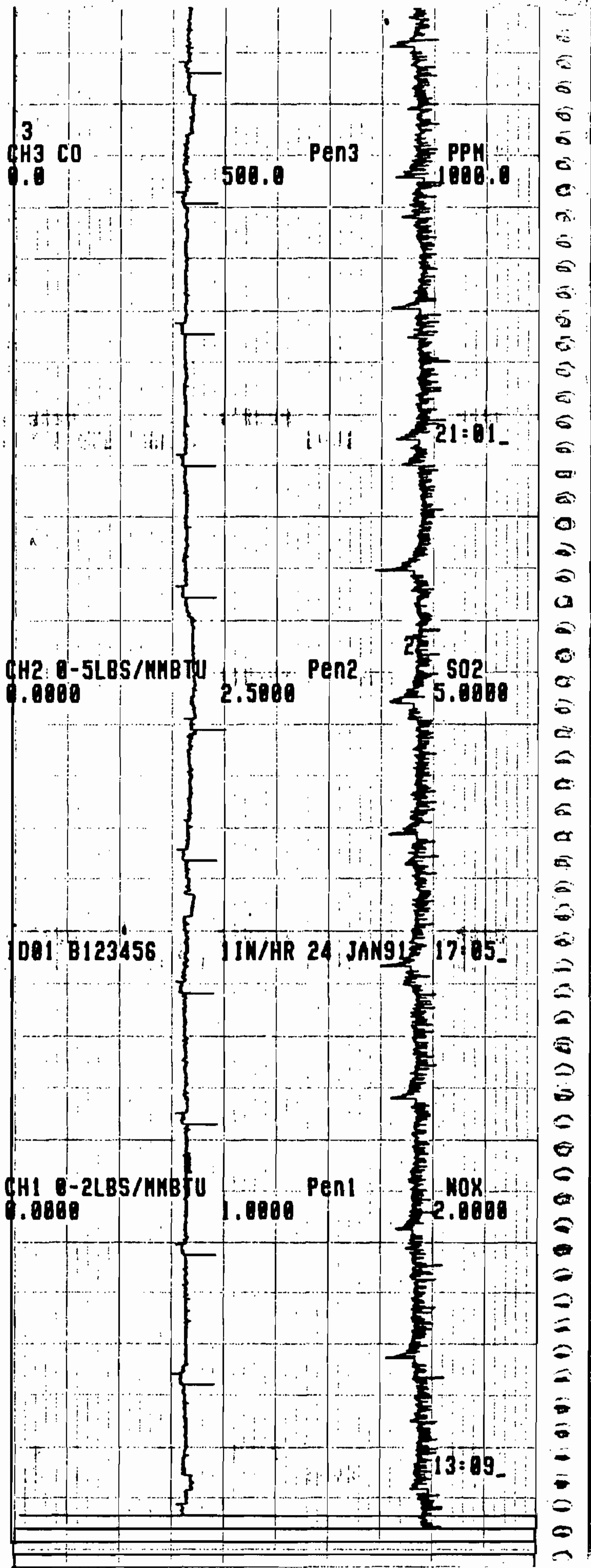
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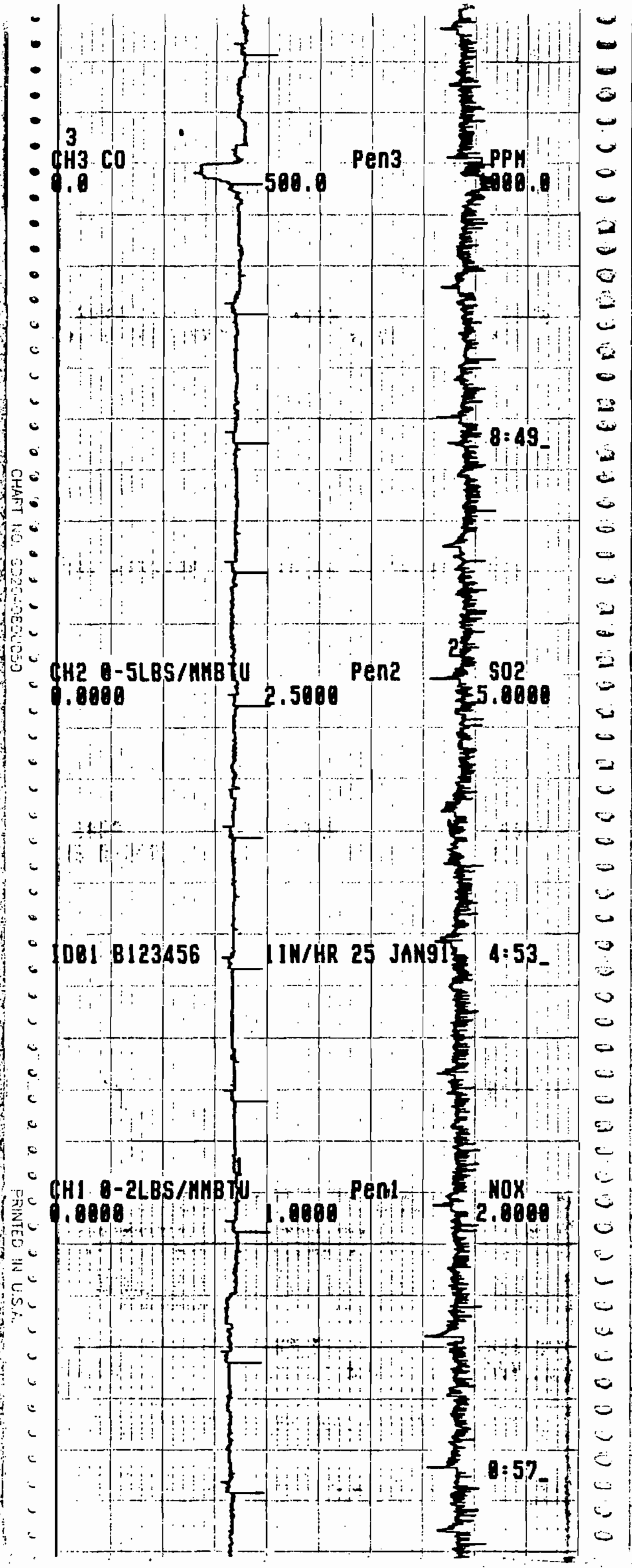
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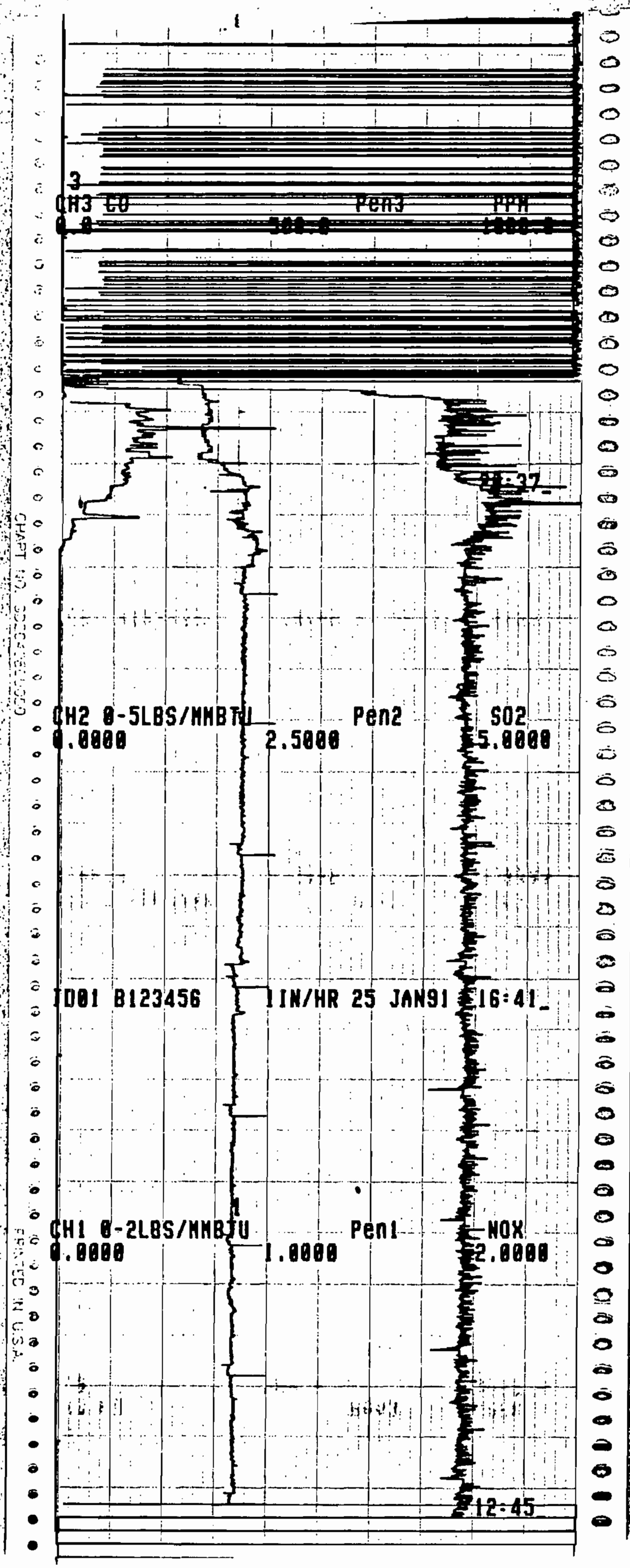
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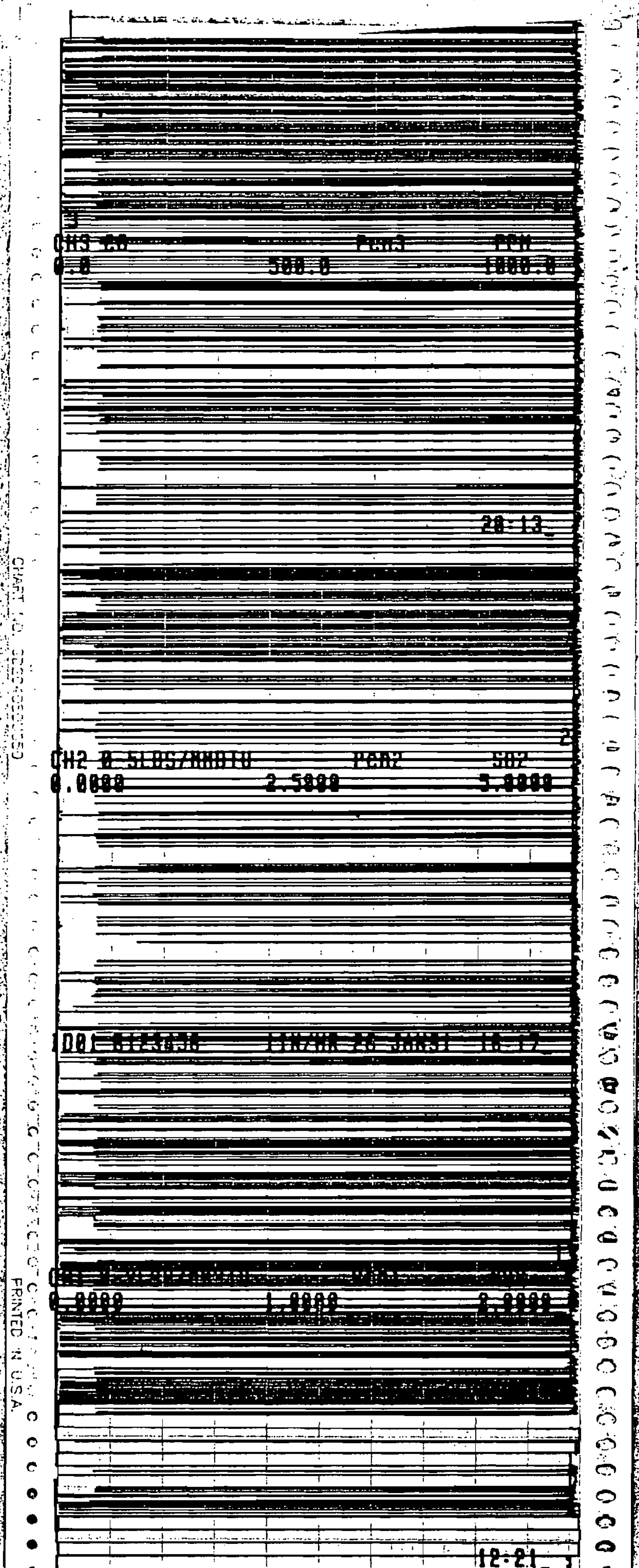
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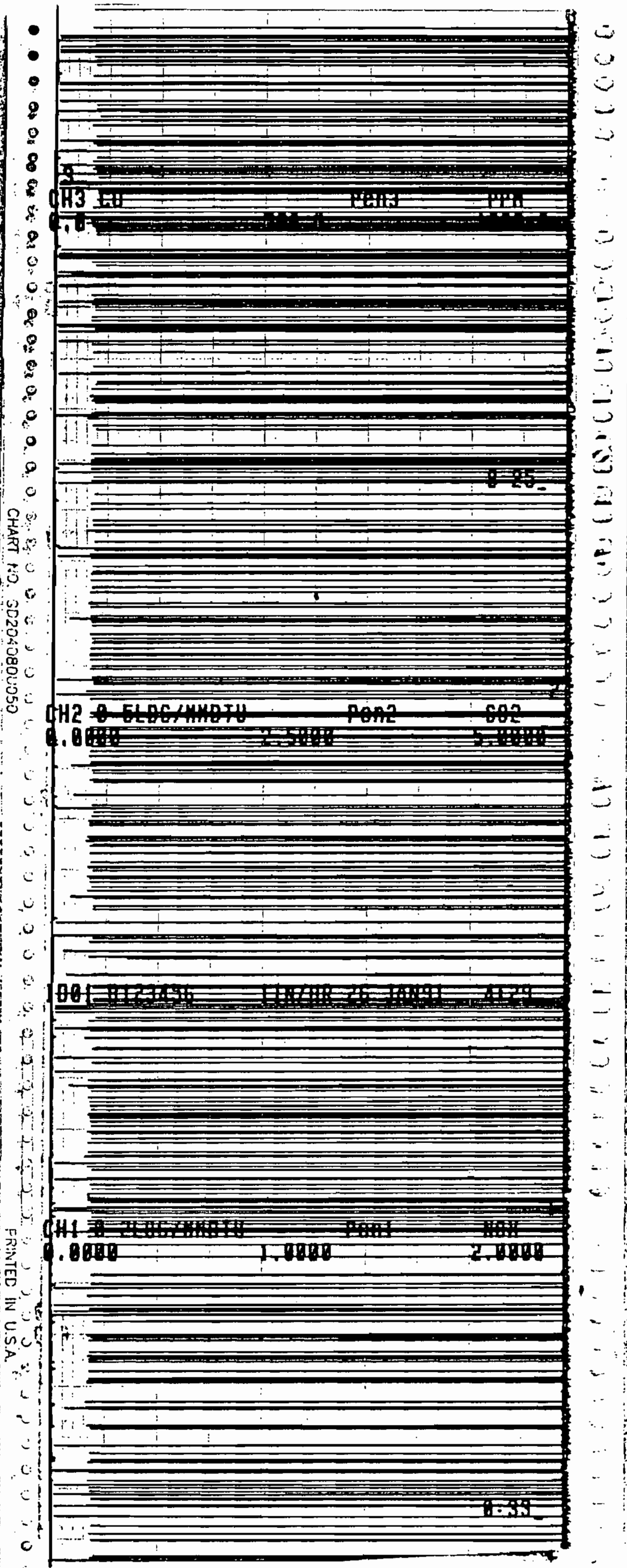
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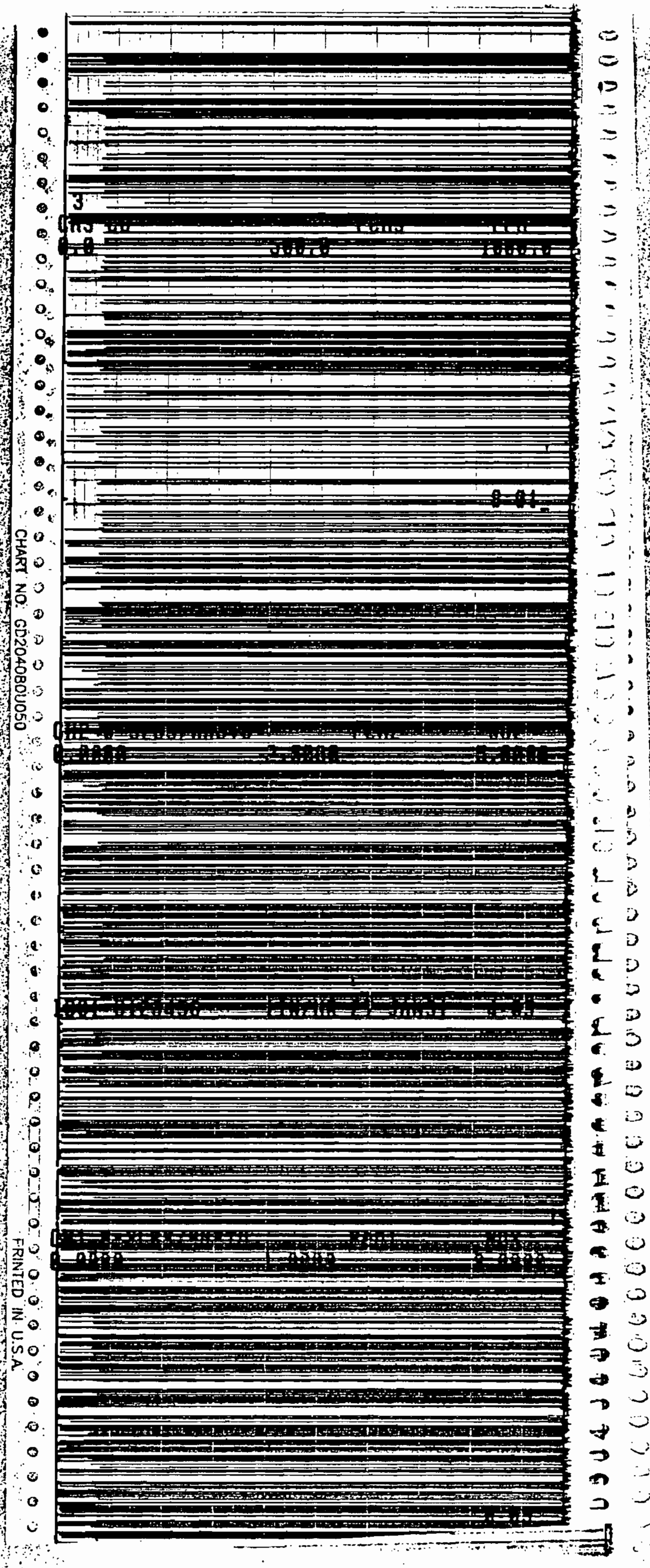

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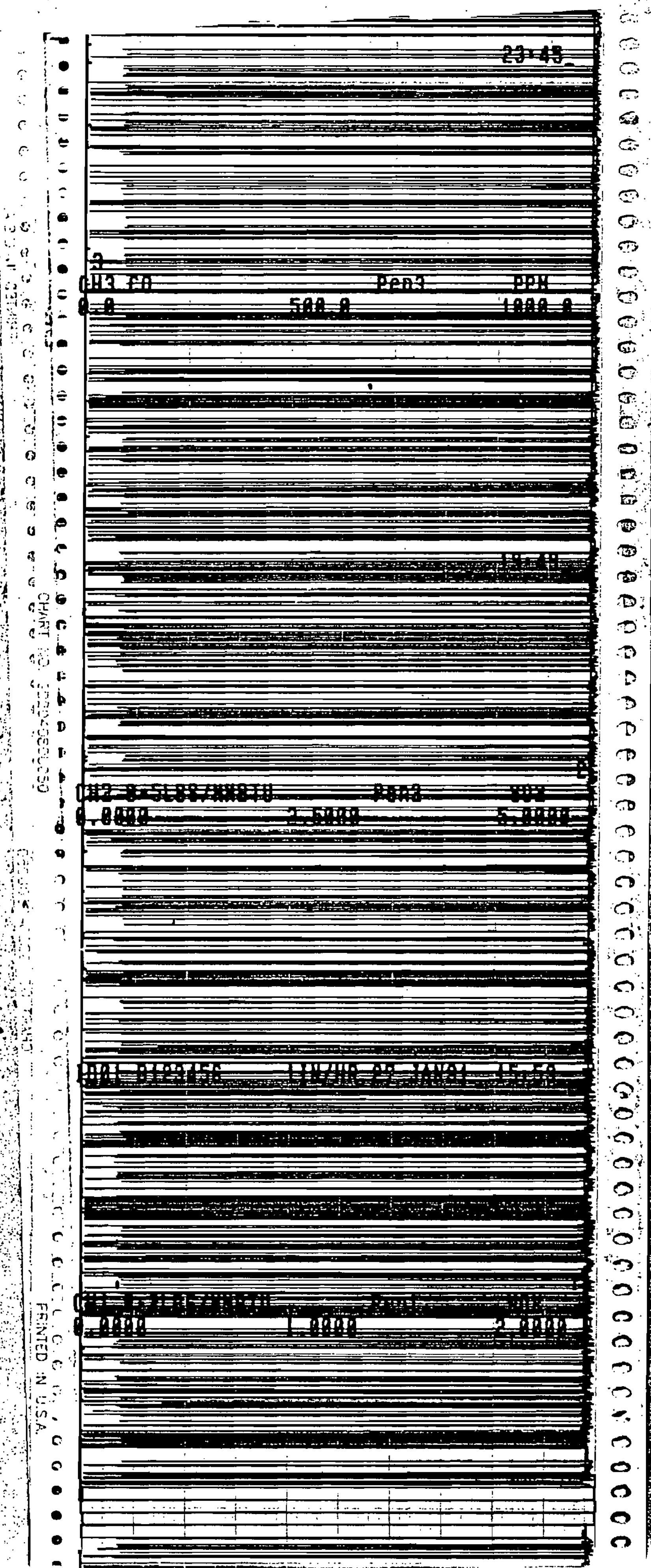

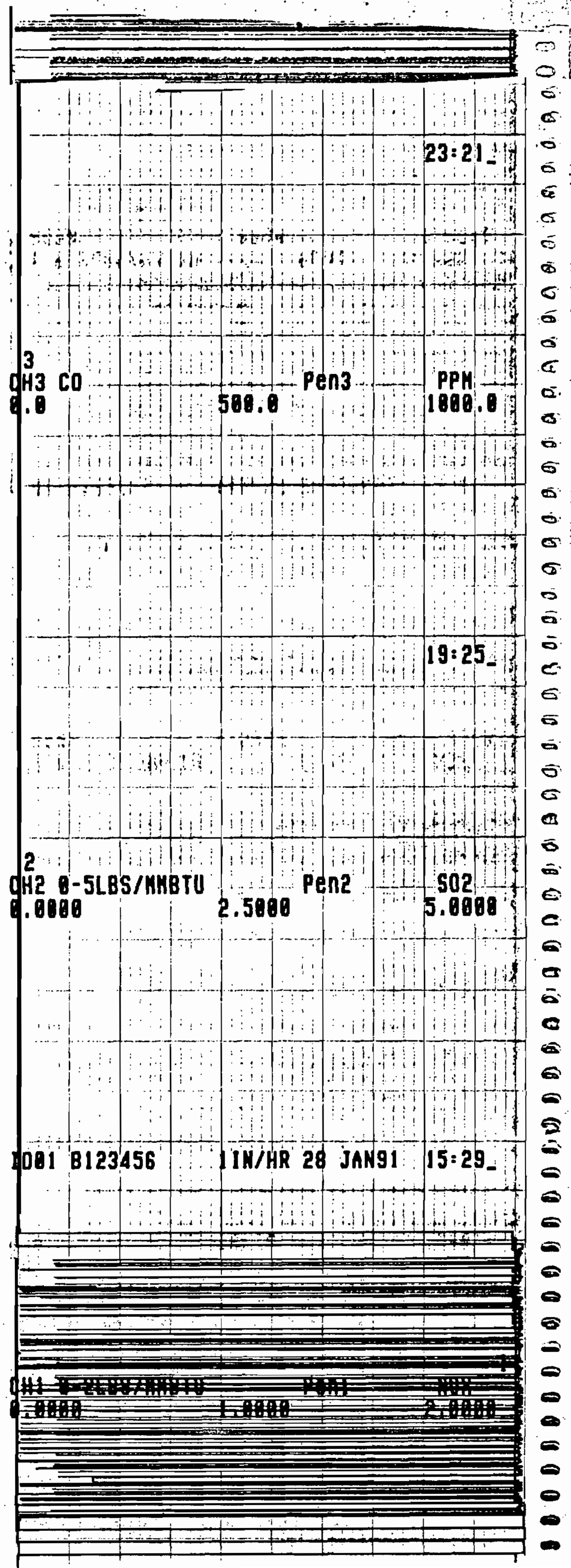
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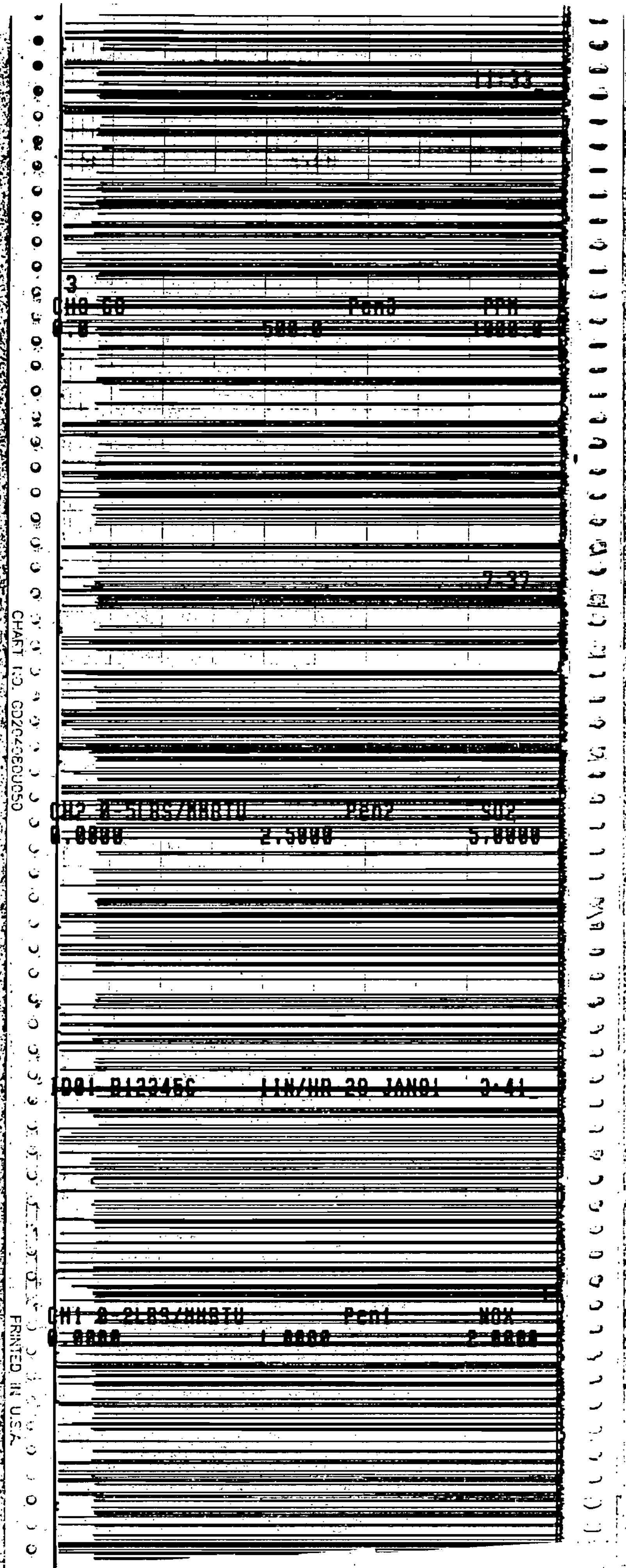
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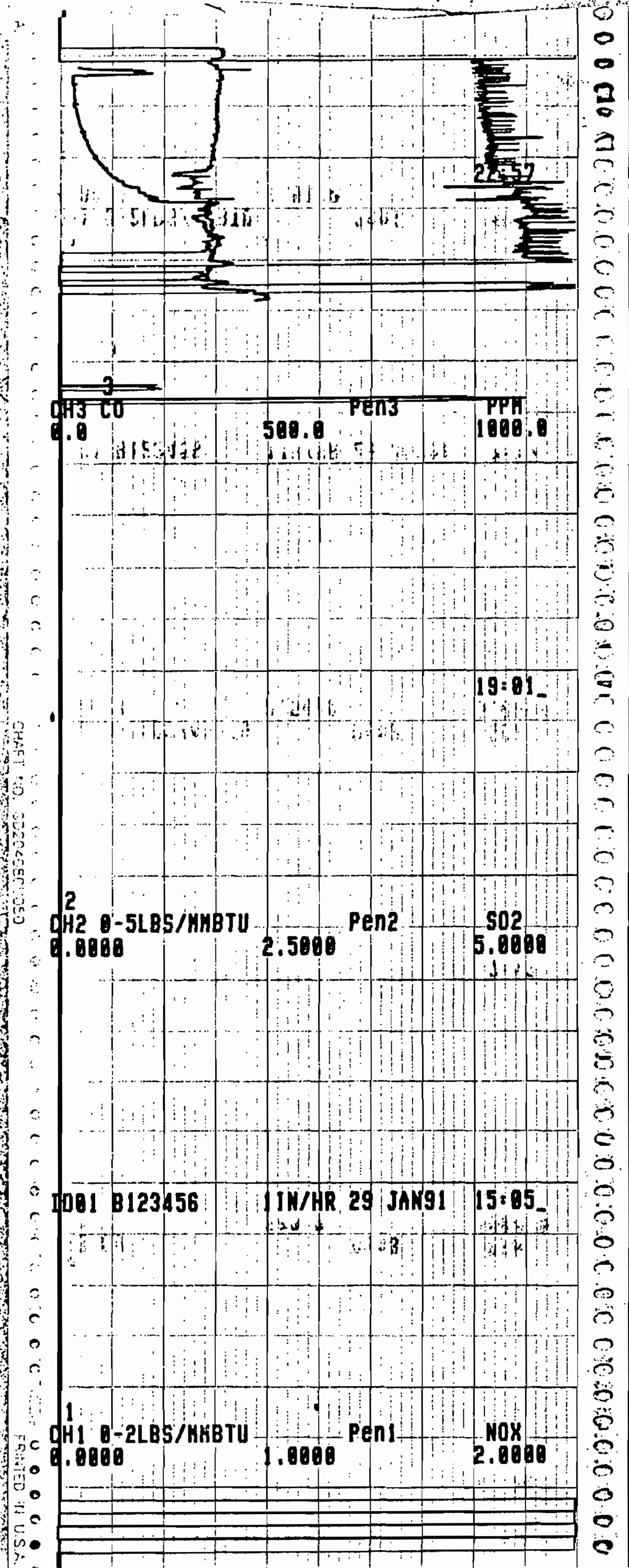
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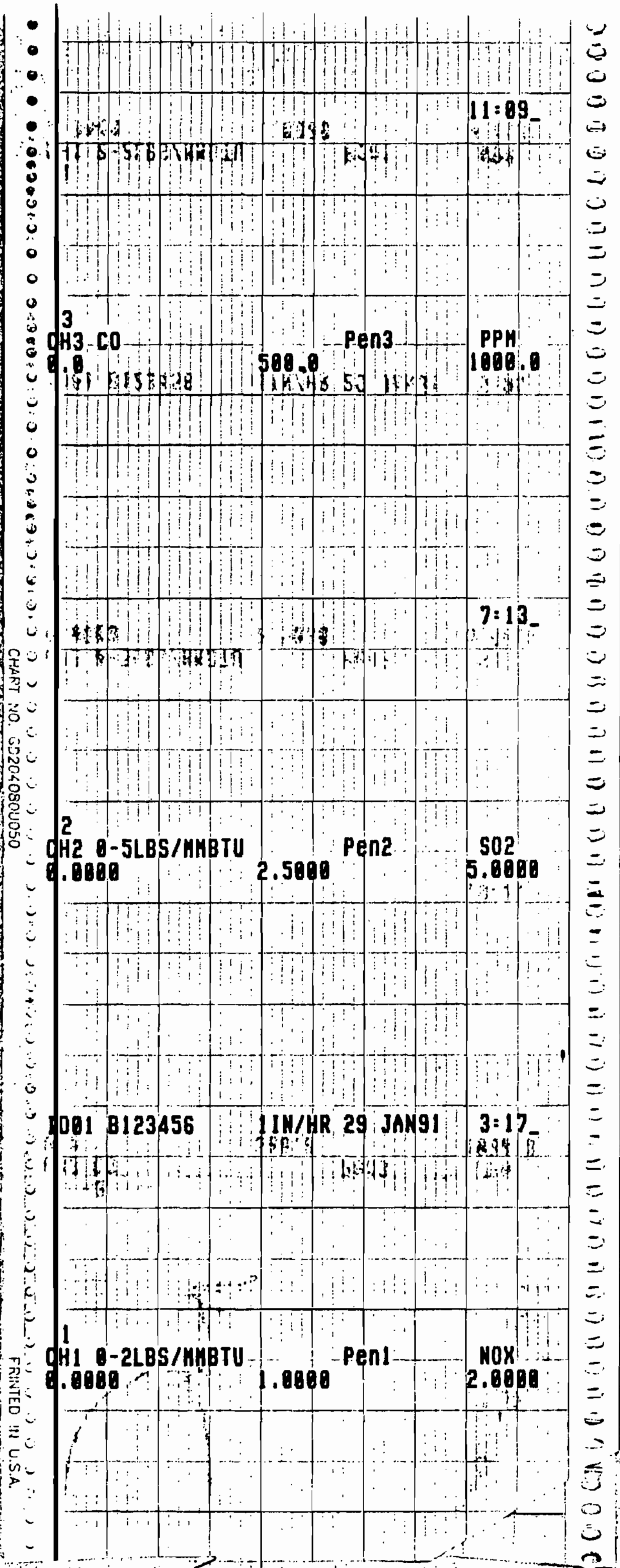
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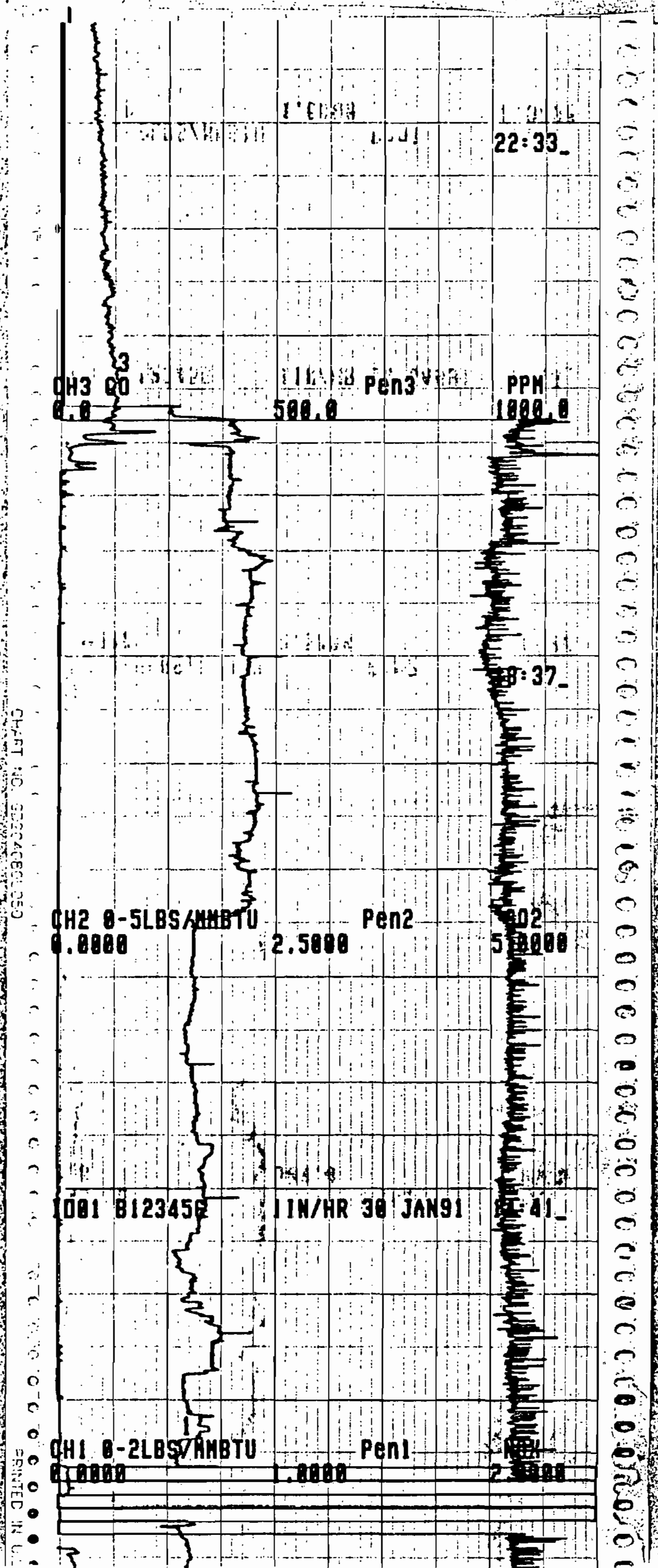
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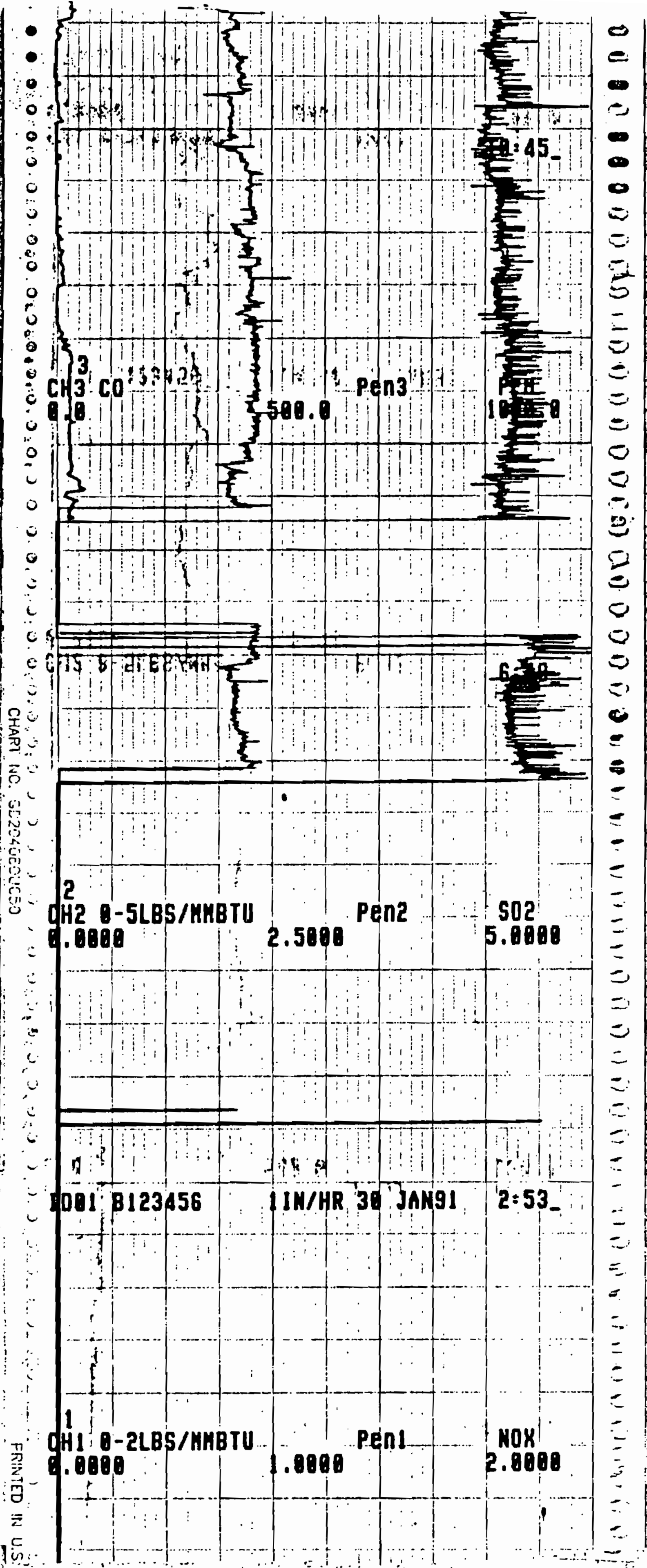

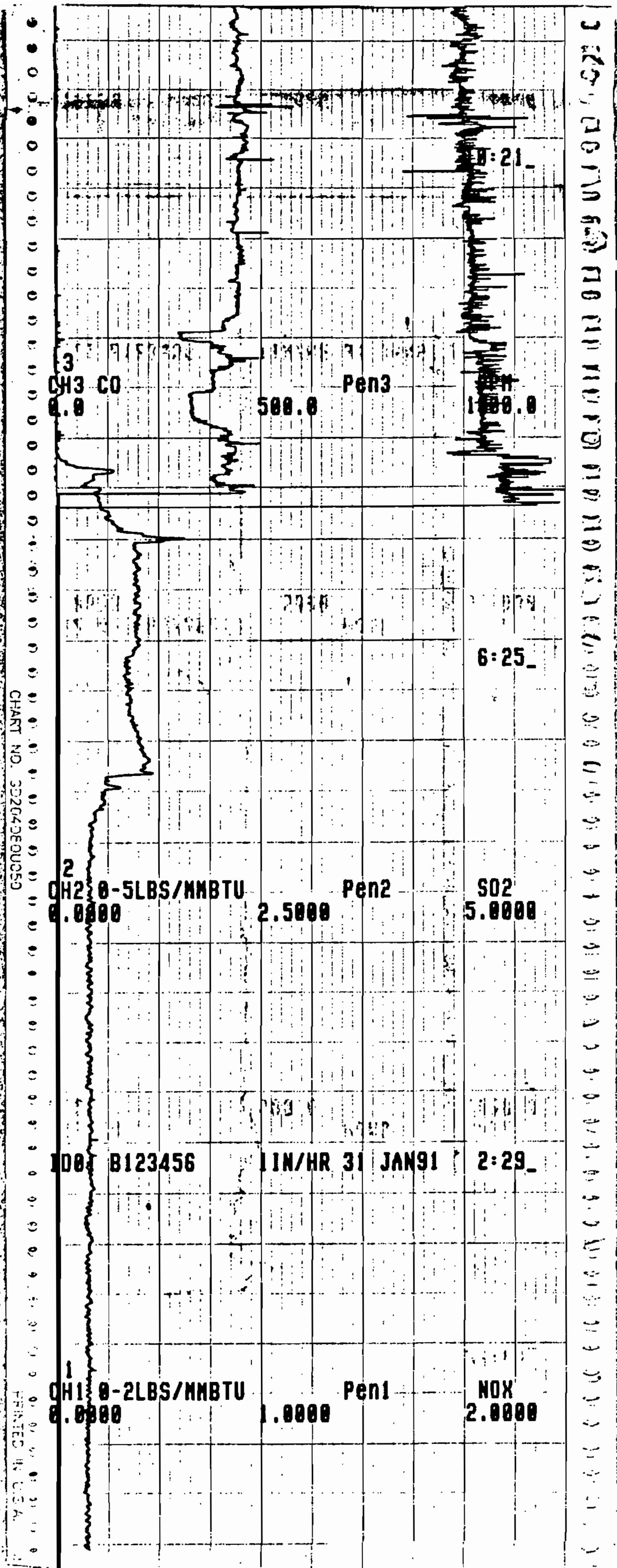
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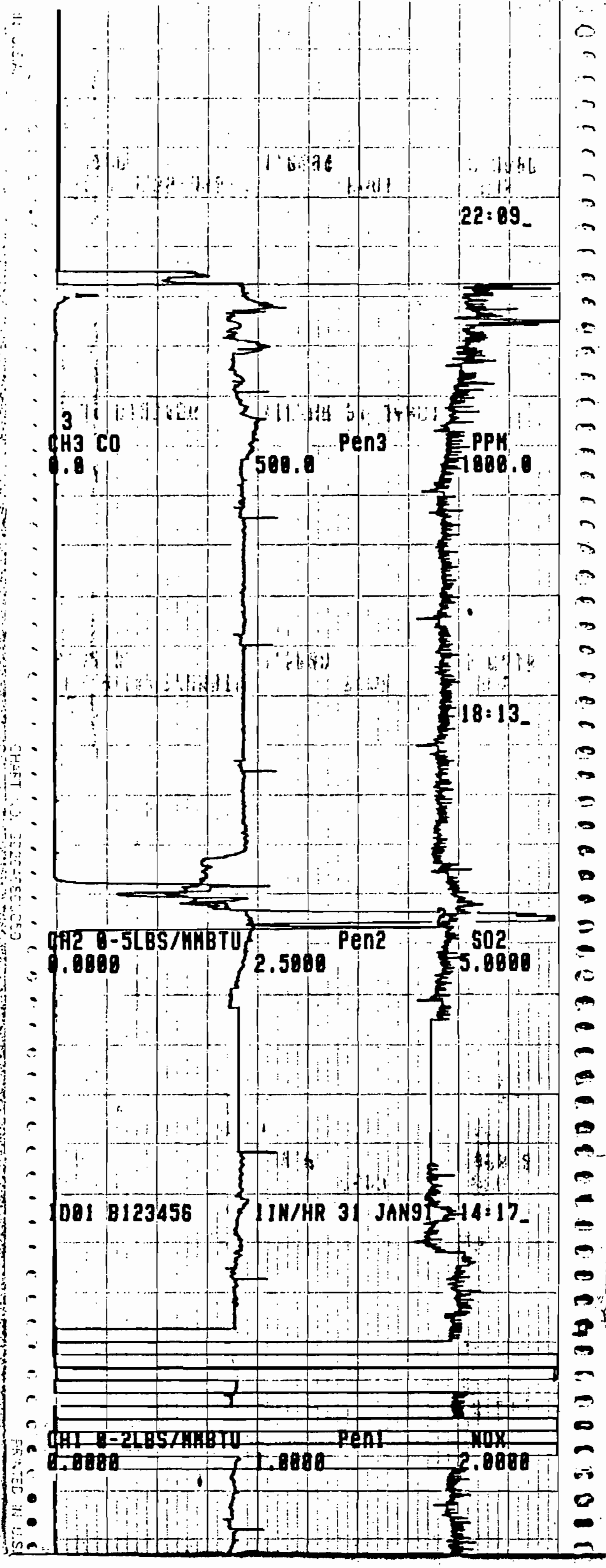

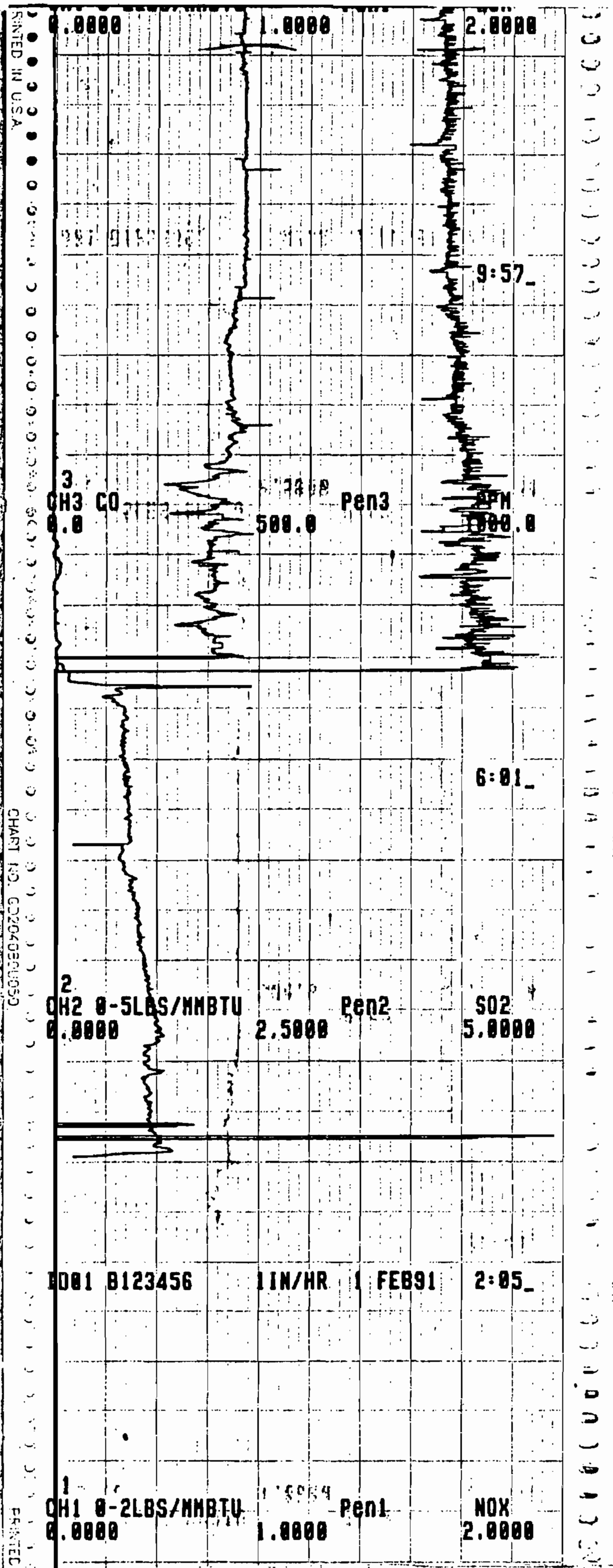
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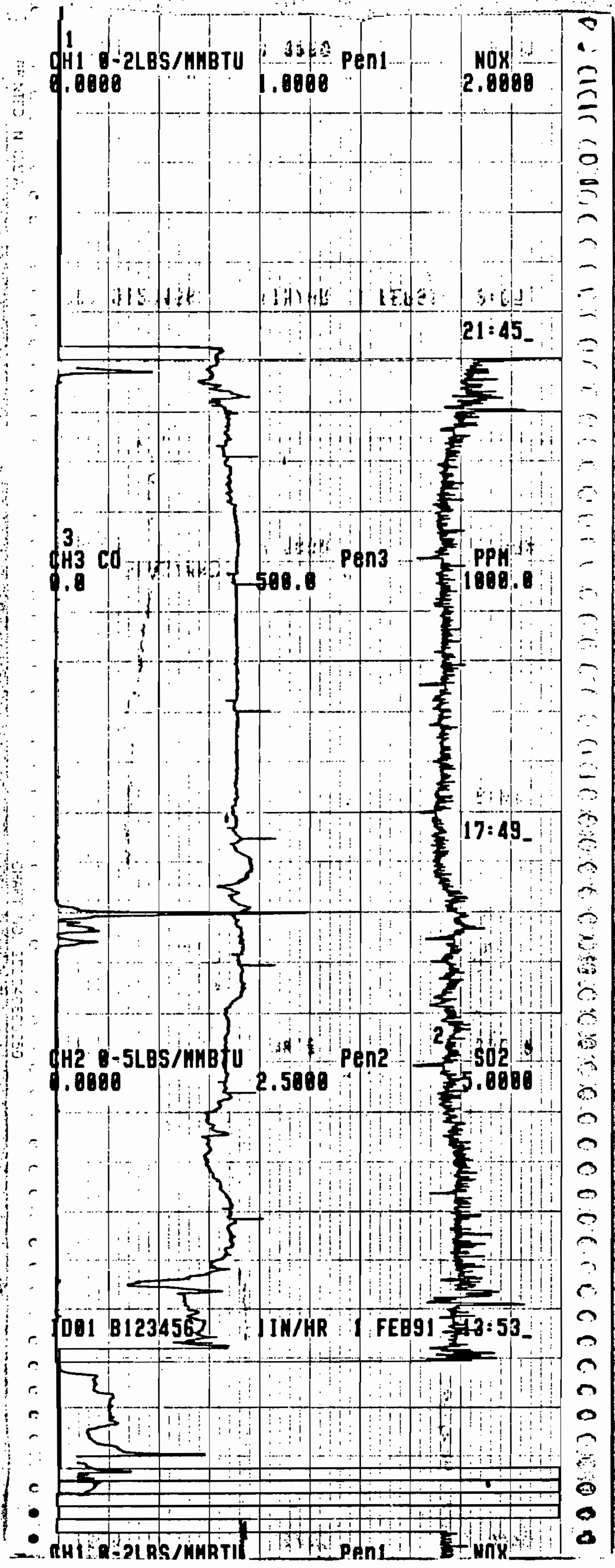

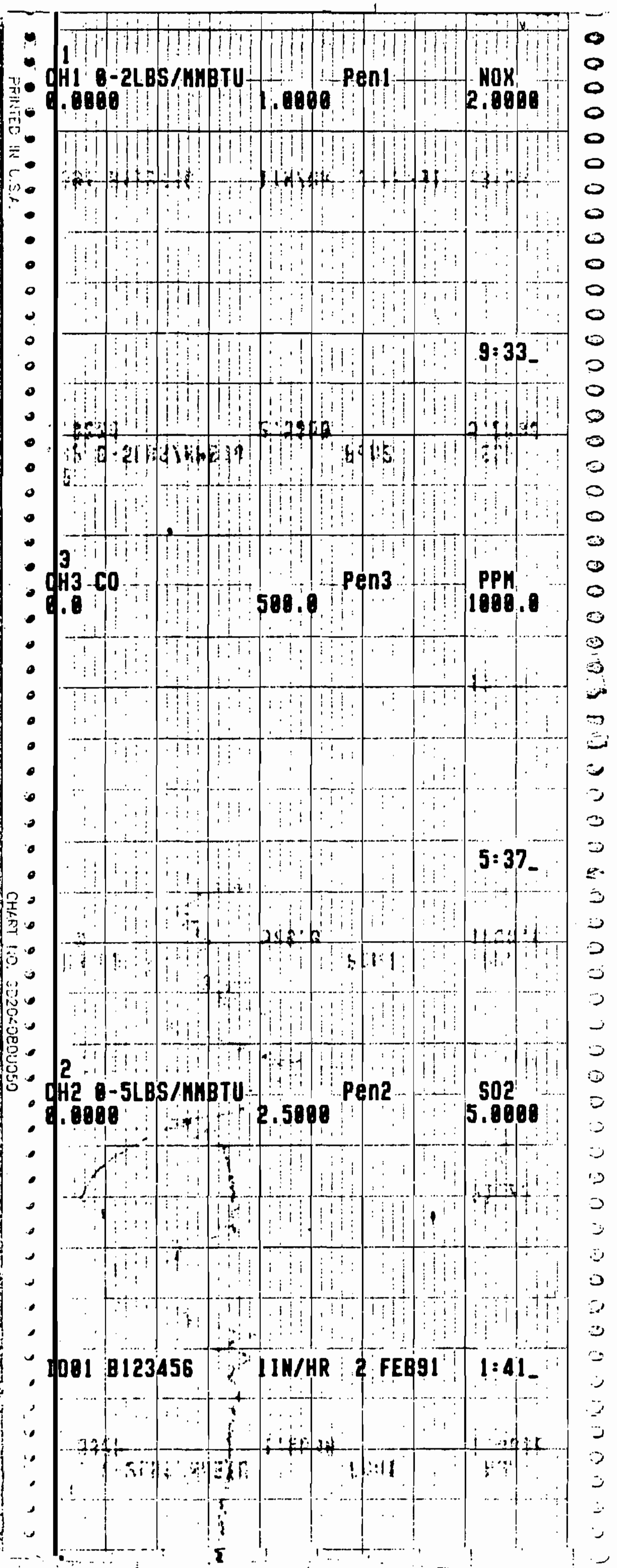

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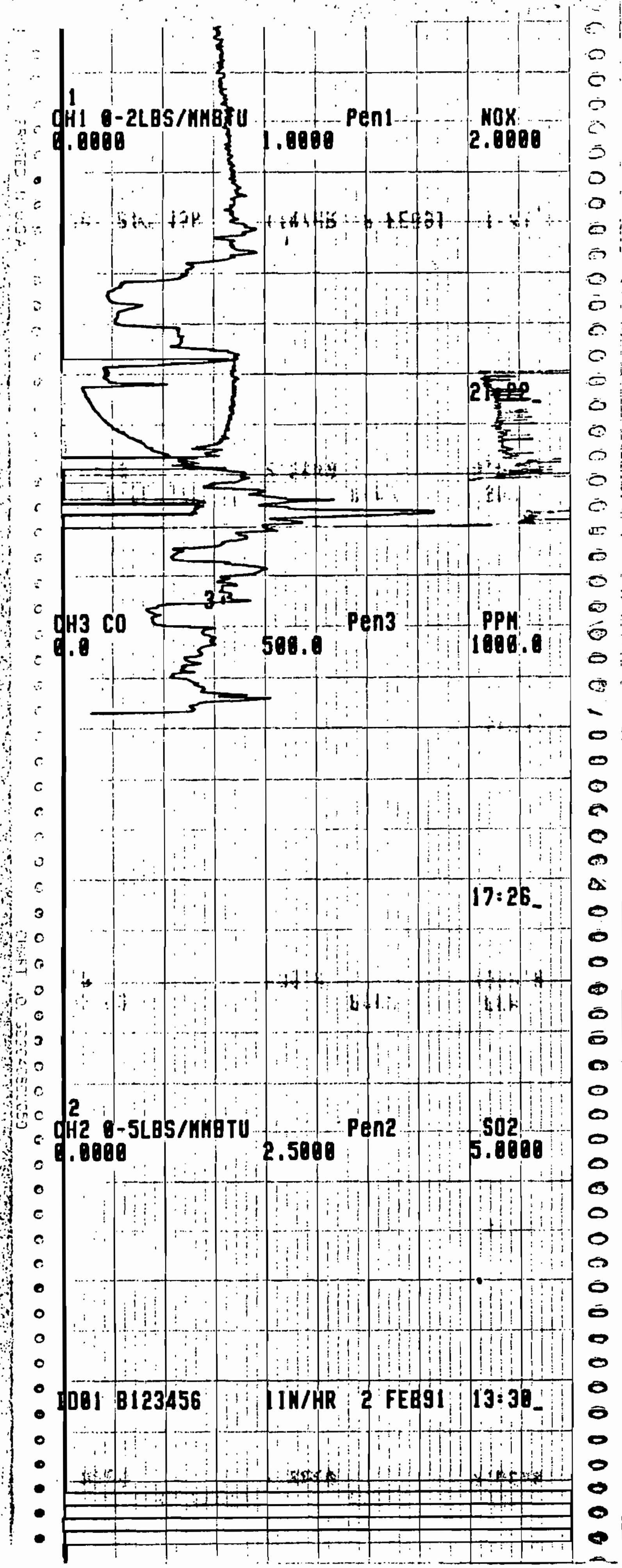
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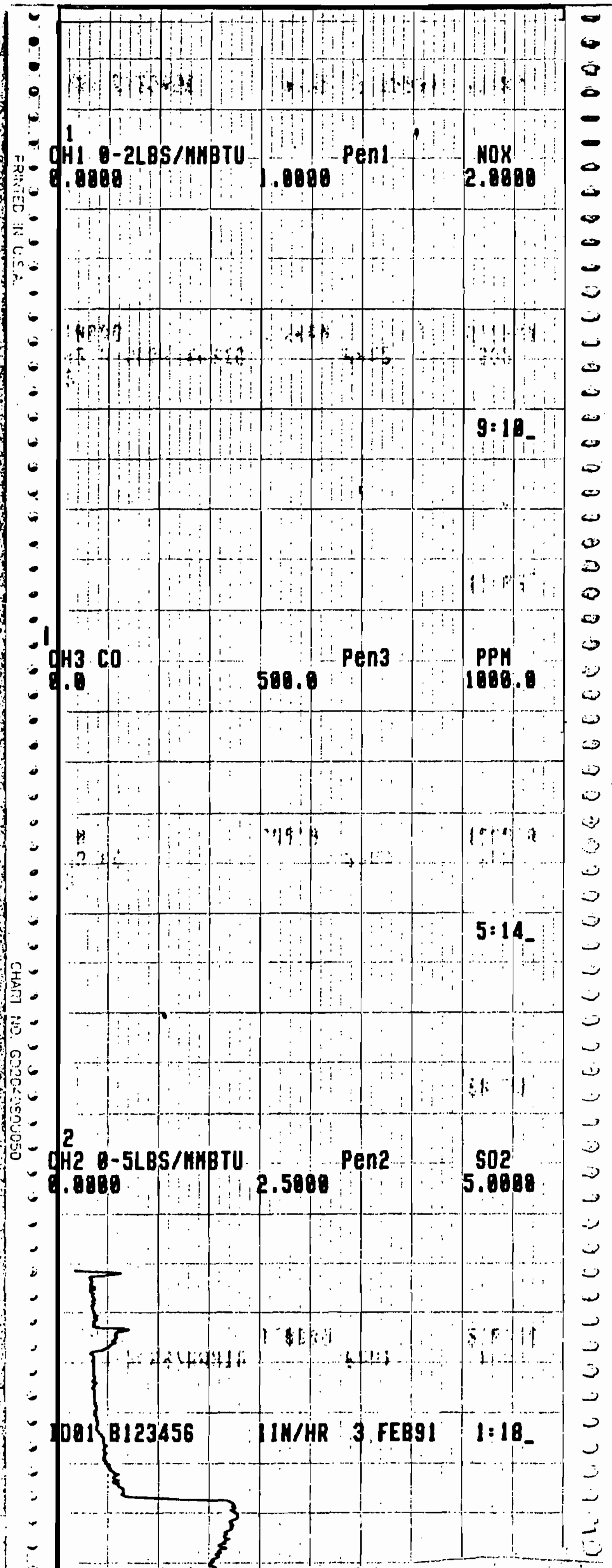

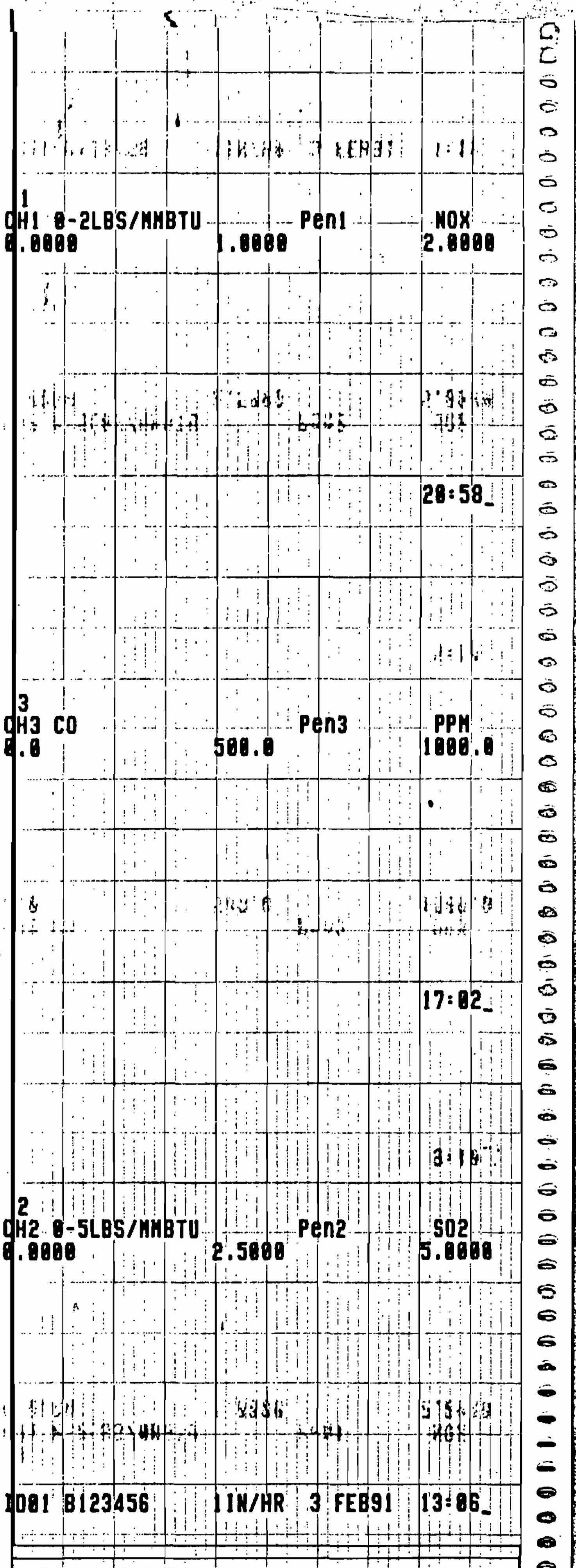
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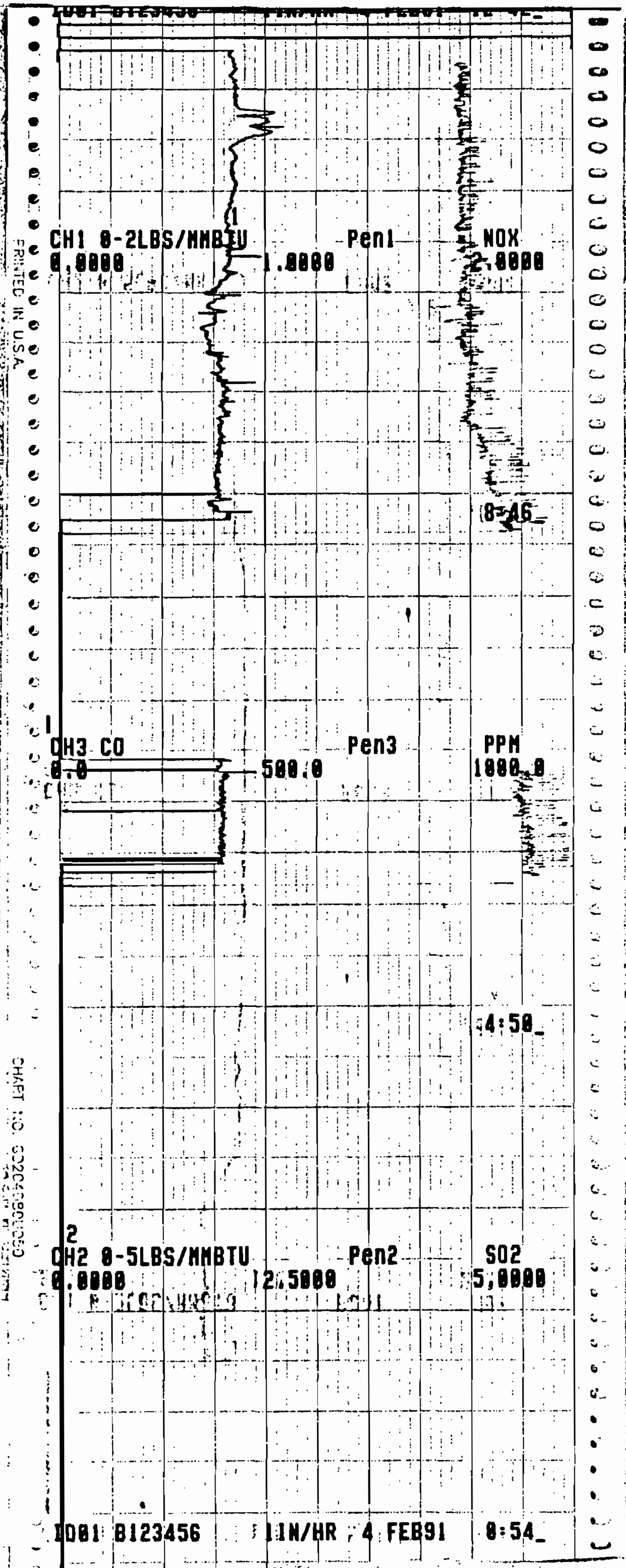
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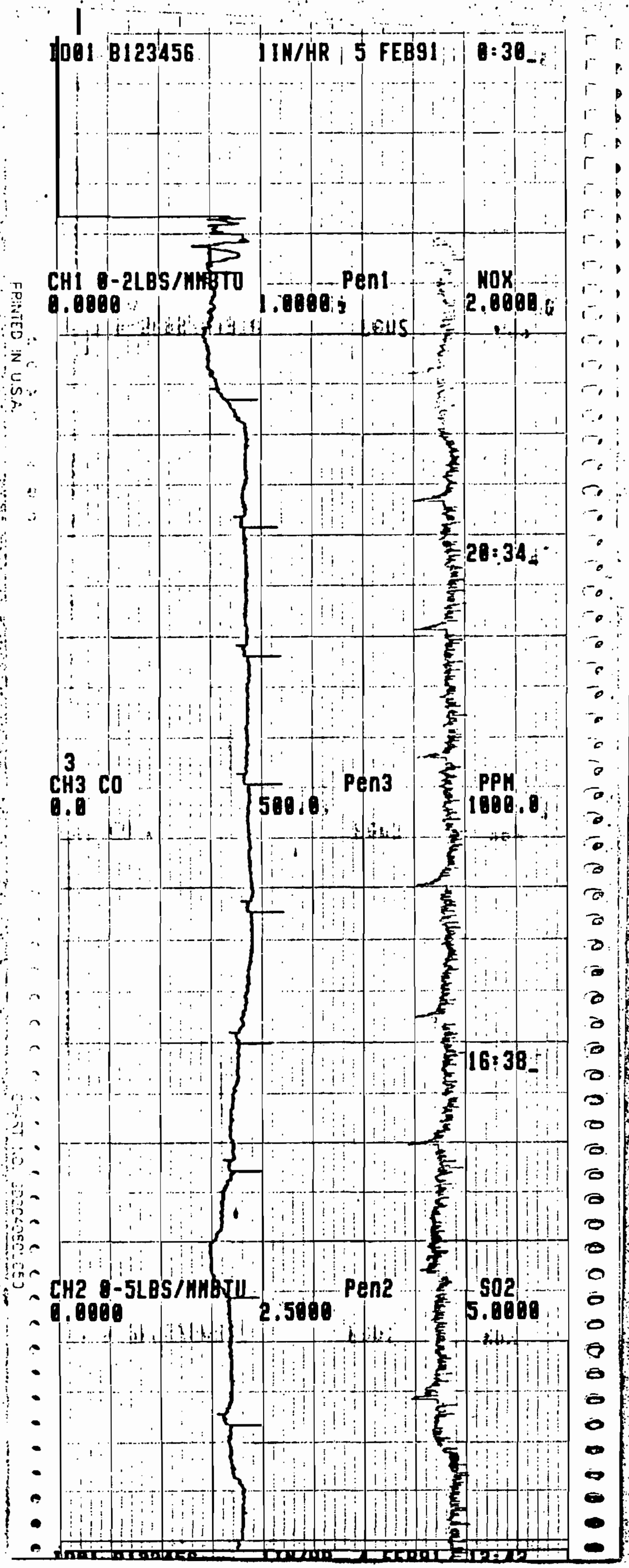

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PPM
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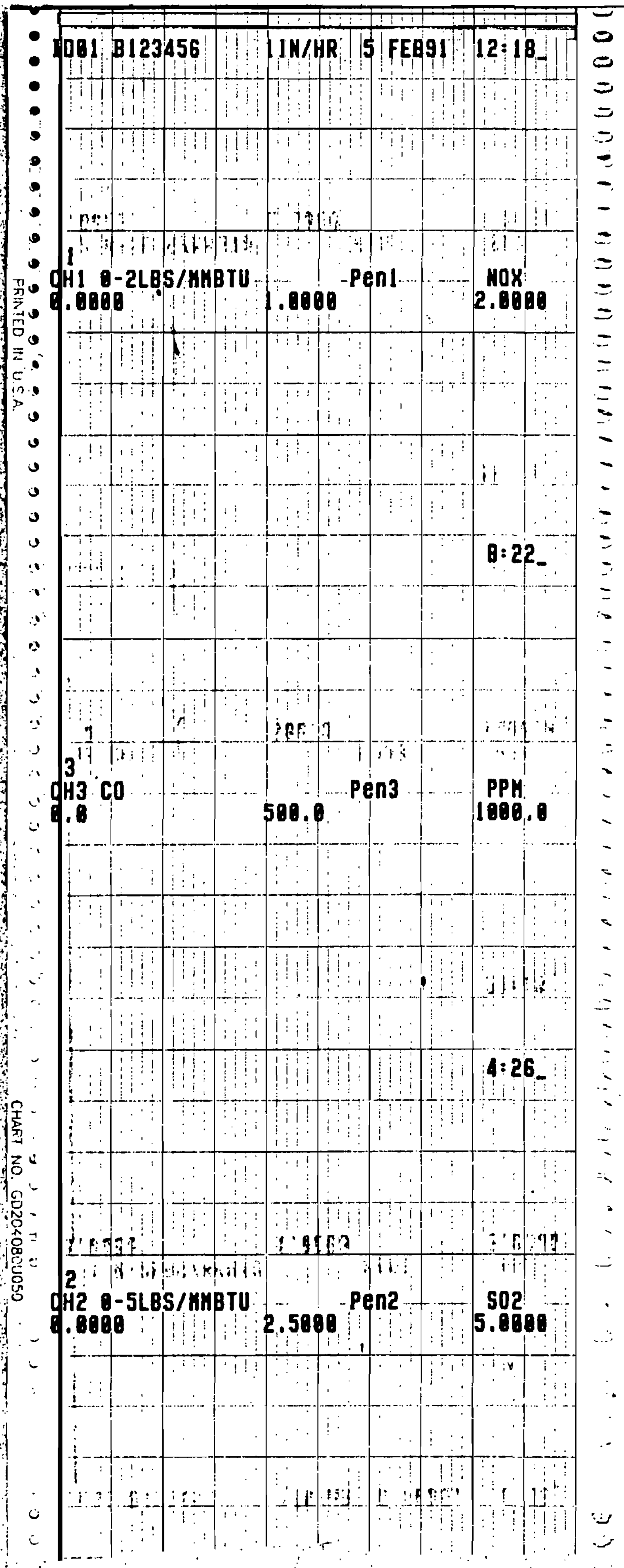

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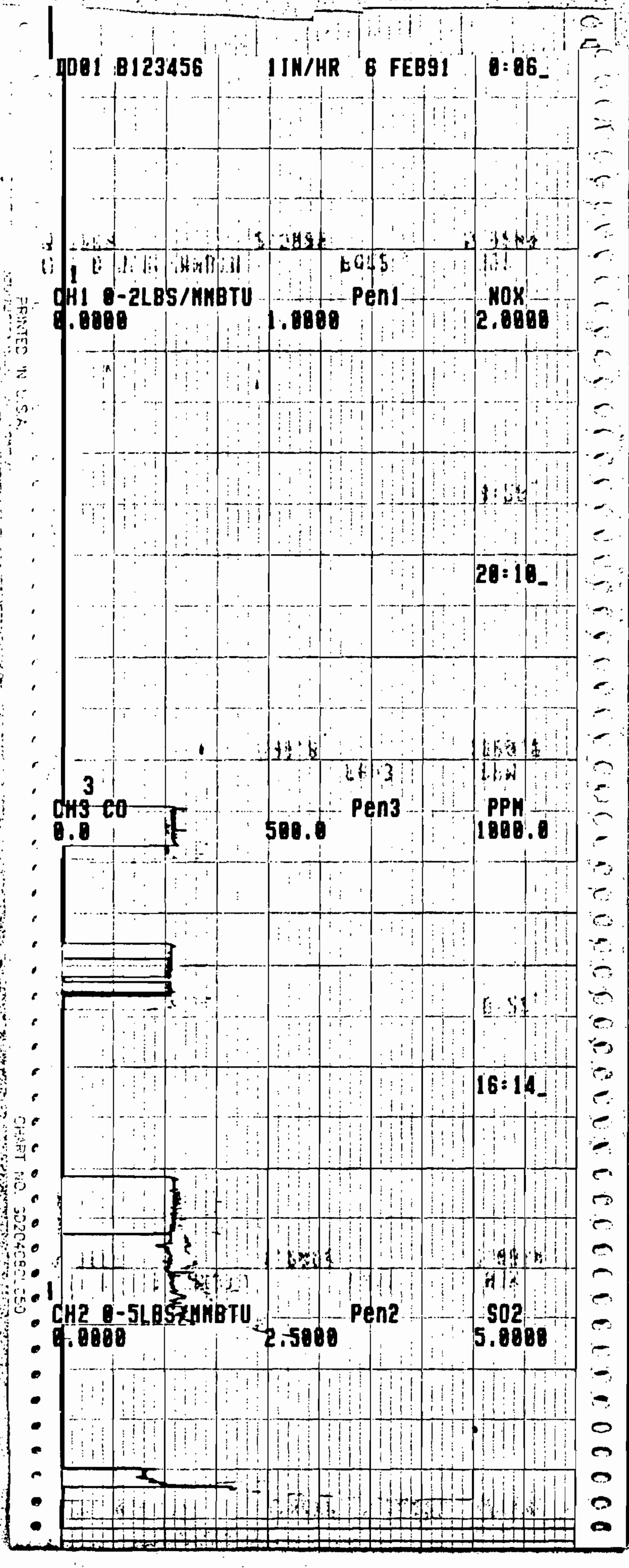

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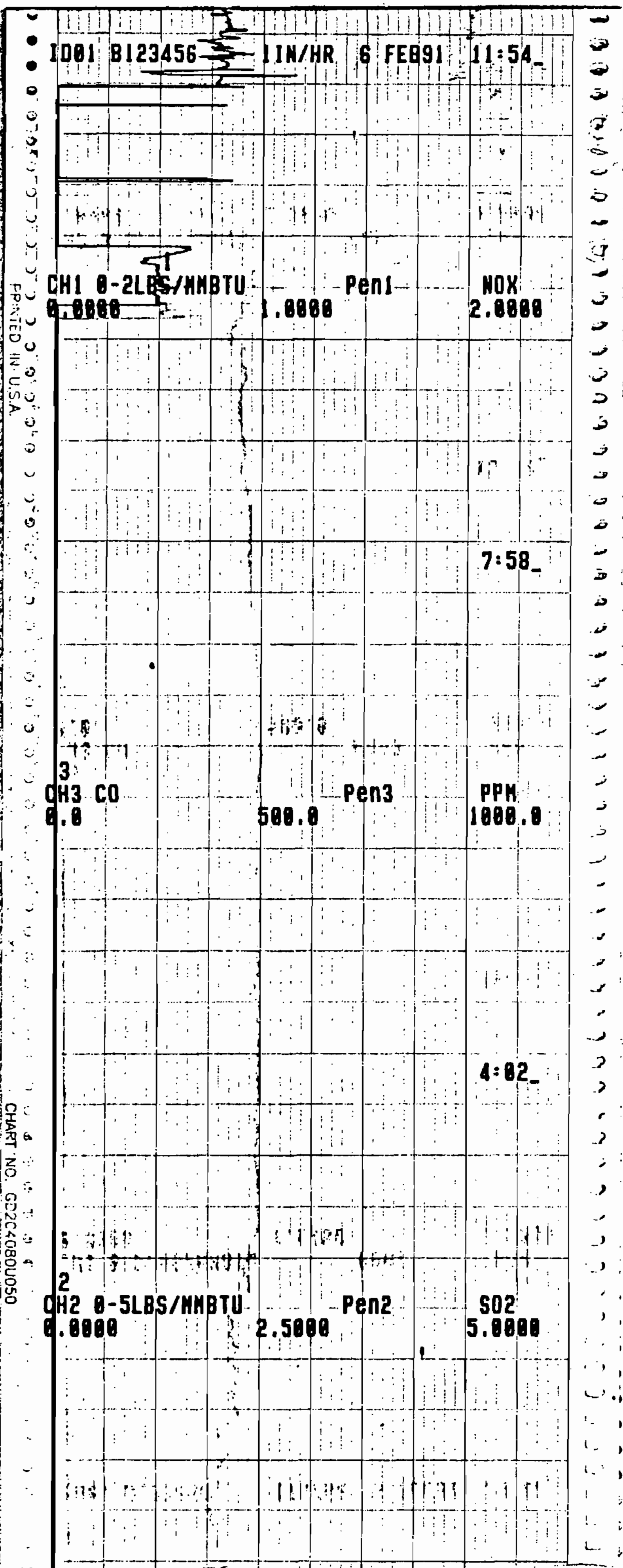

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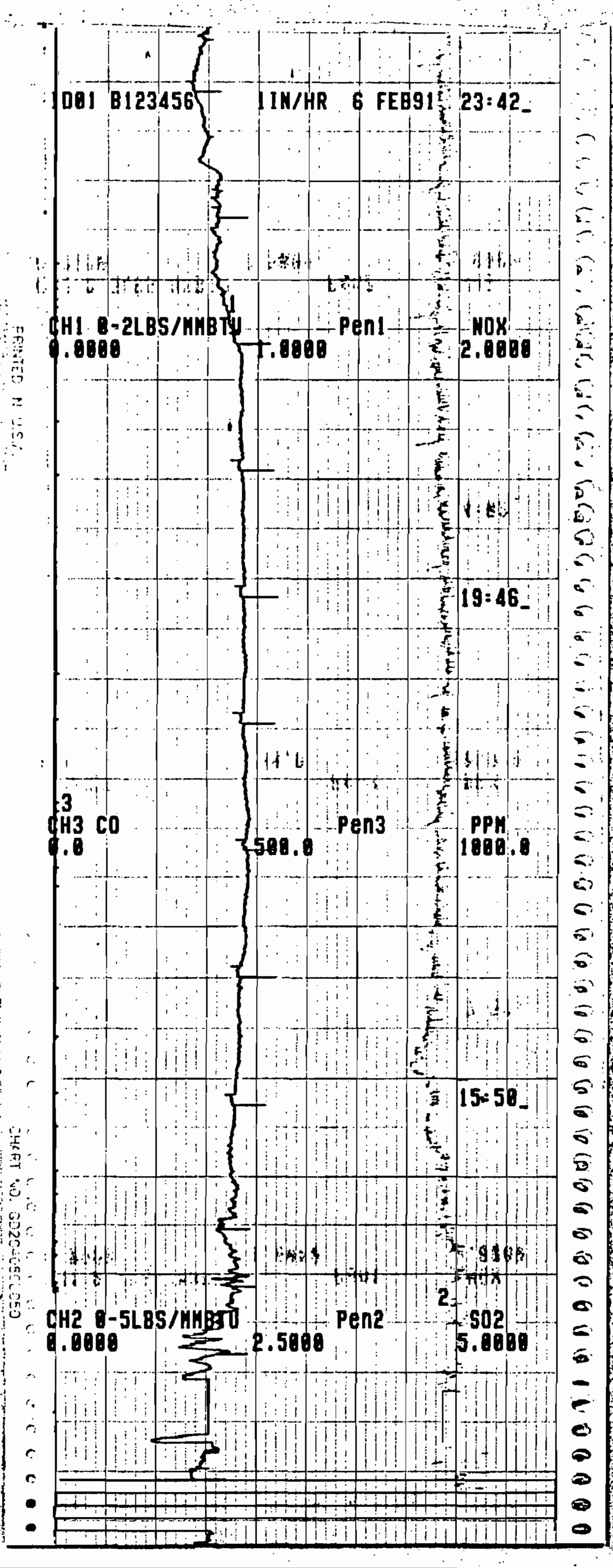

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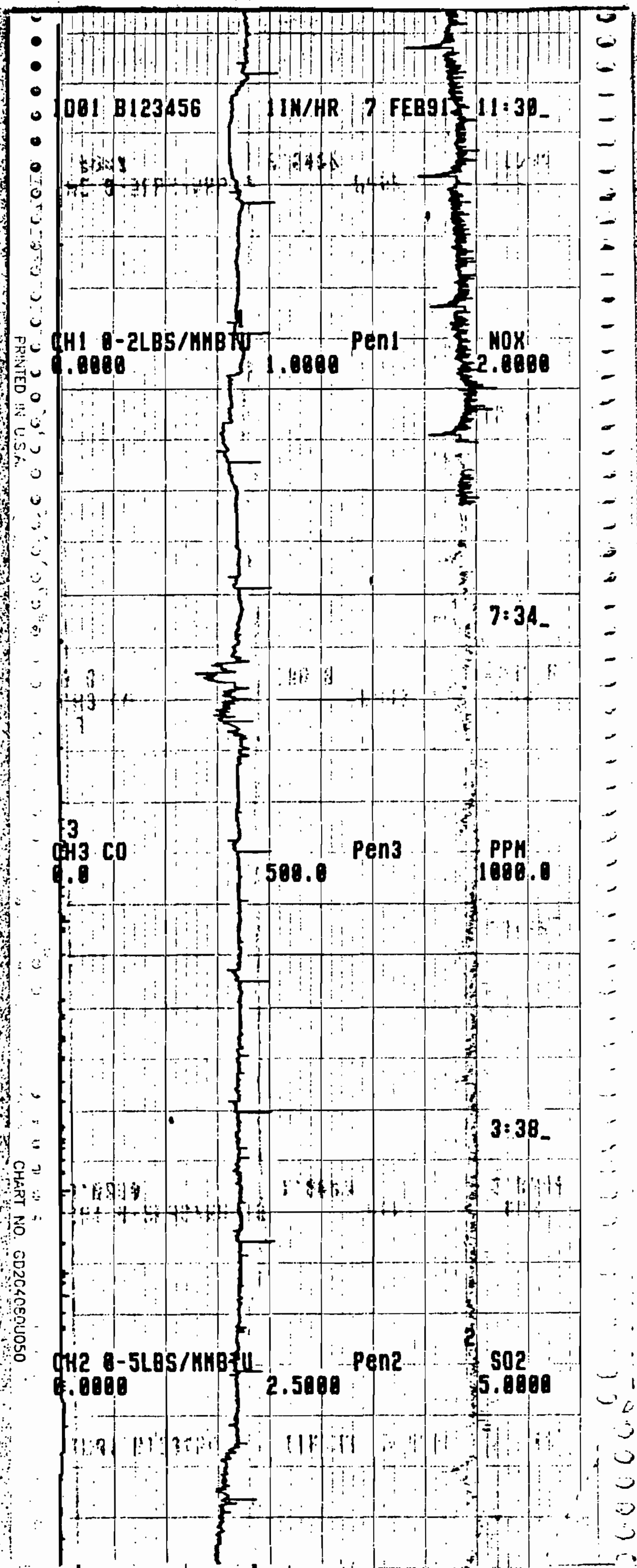

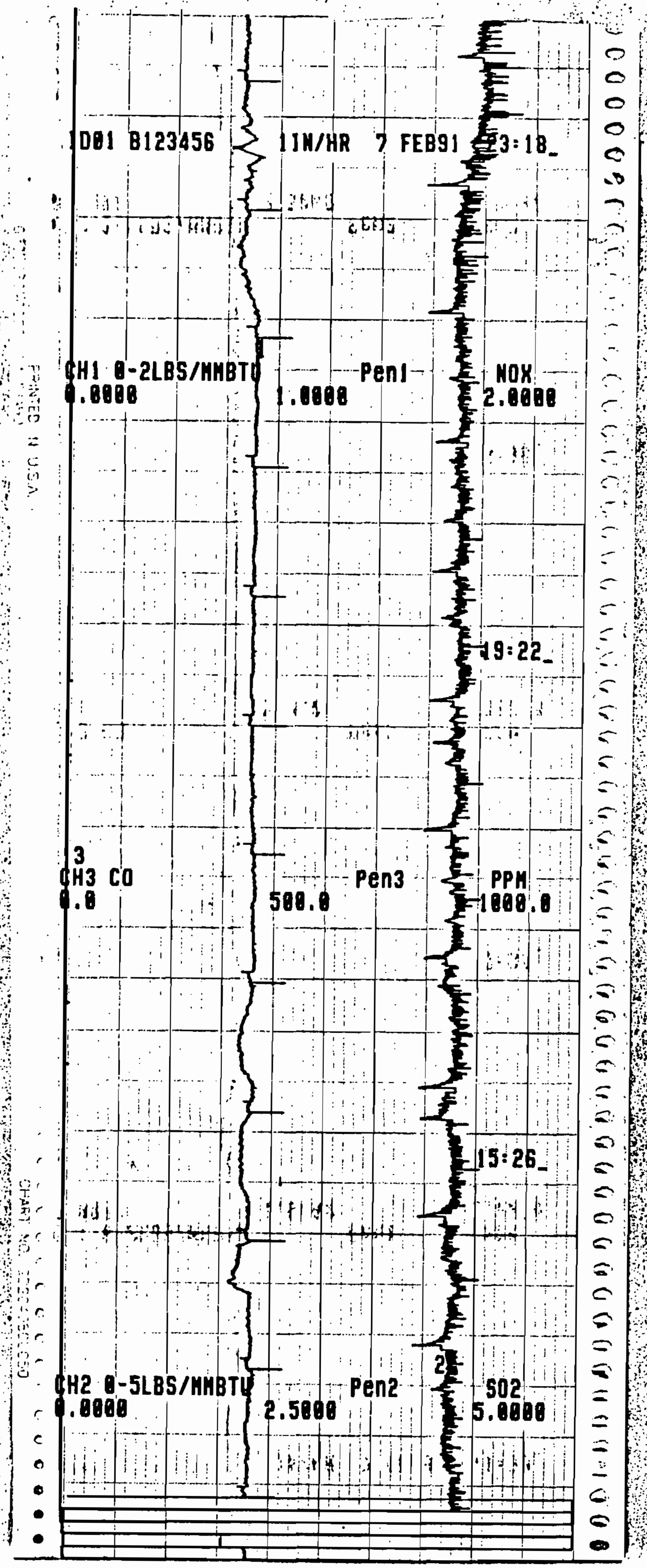

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1.0000
2.0000
19:22_
3
CH3 CO
Pen3
PPM
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500.0
1000.0
15:26_
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Pen2
SO2
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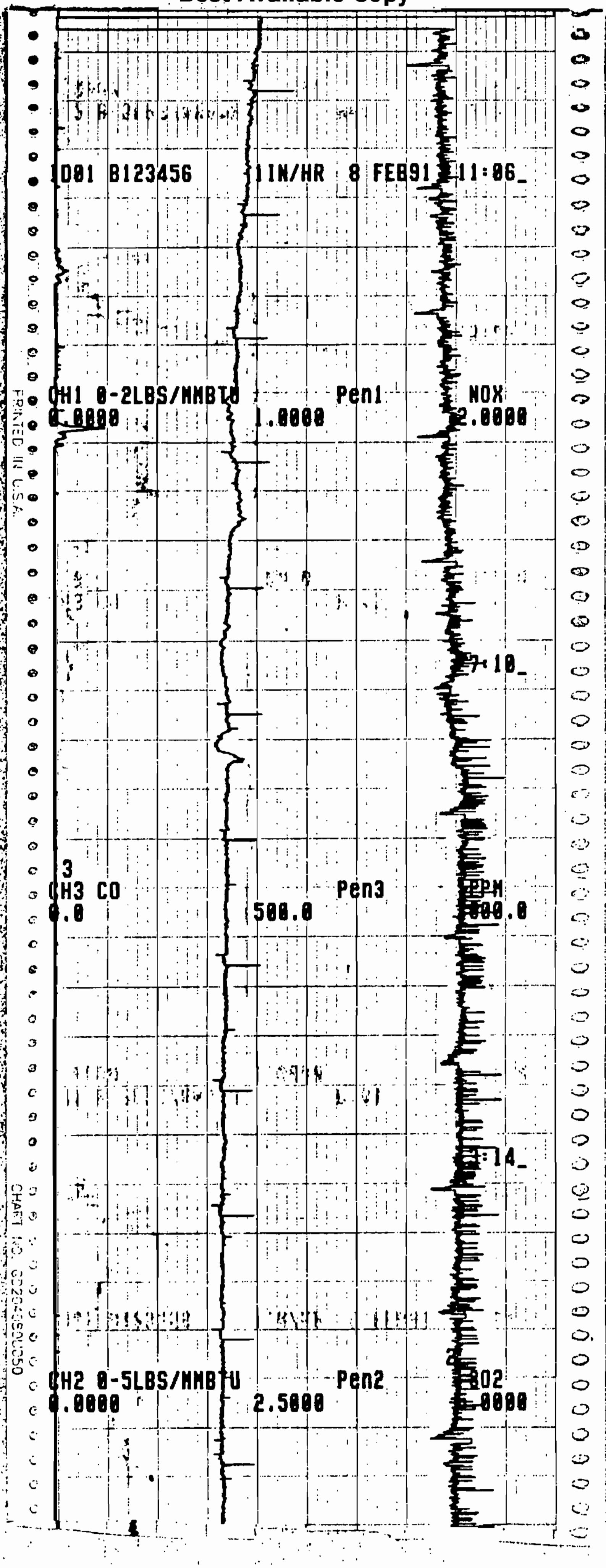
5.0000
PRINTED IN USA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PRINTED IN U.S.A.
7:10_
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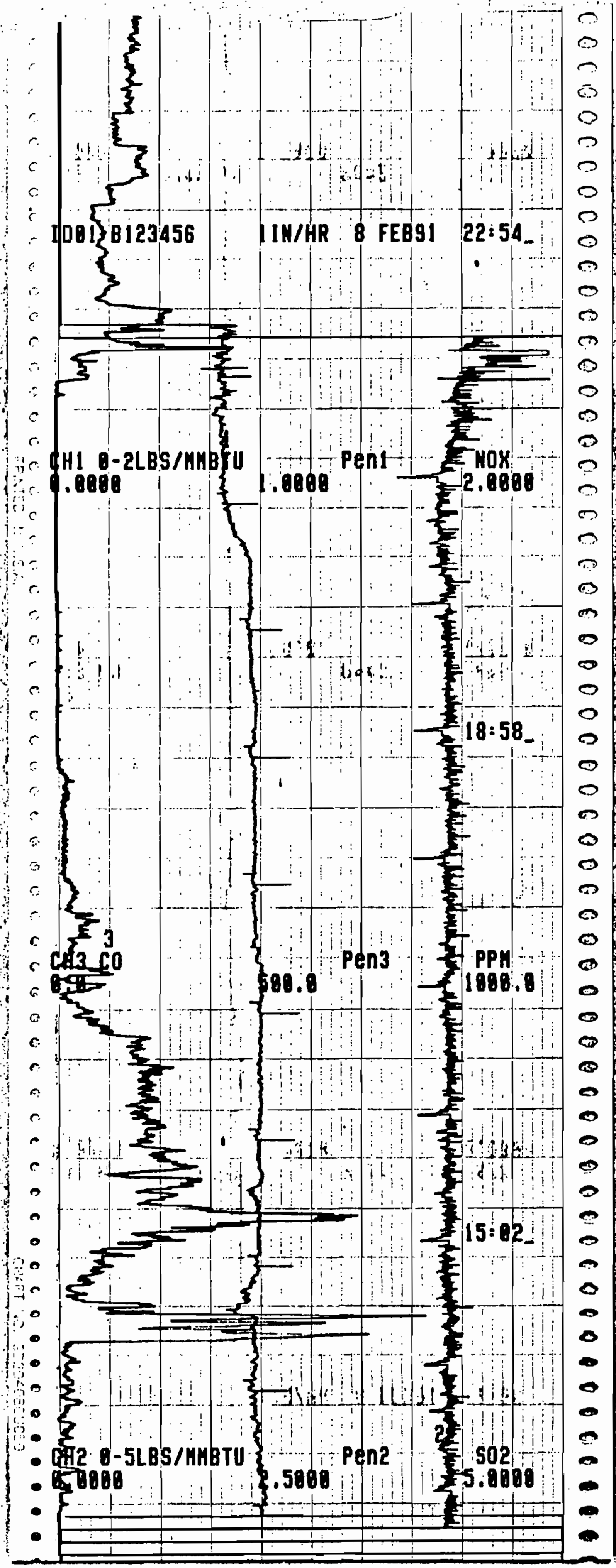
Best Available Copy



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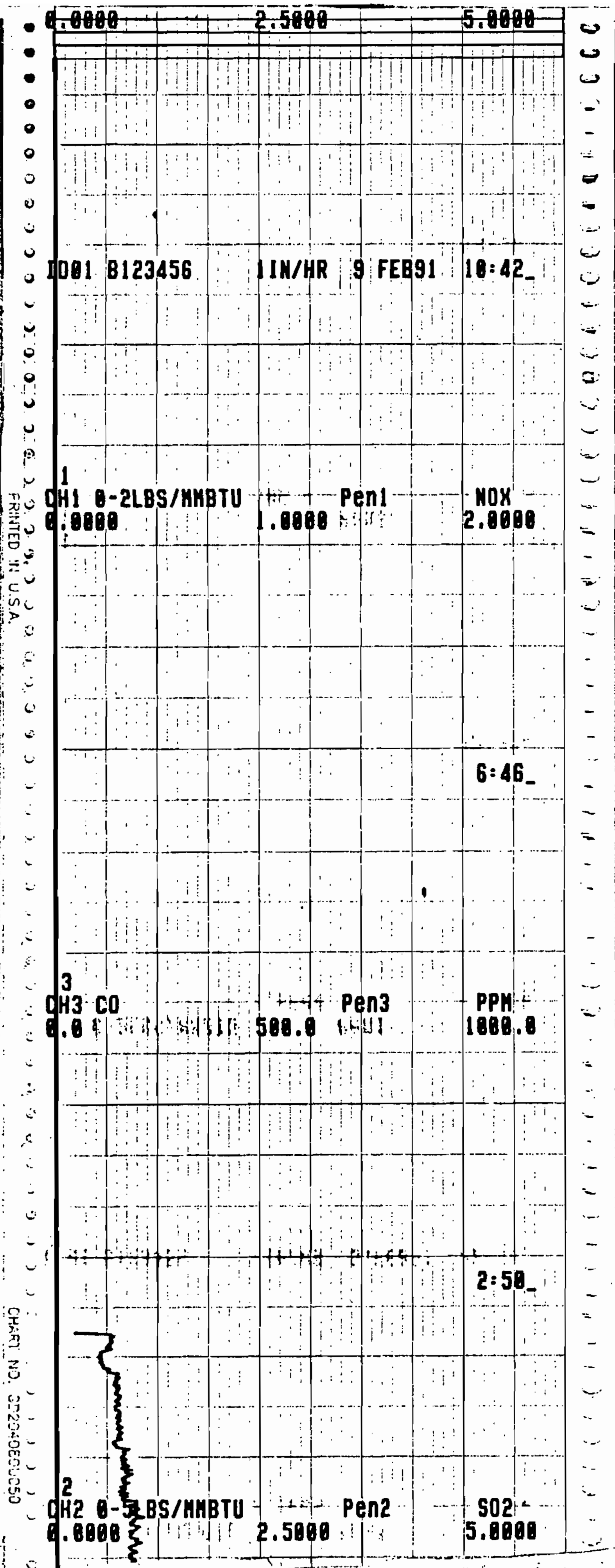

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18:34_

3
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14:38_

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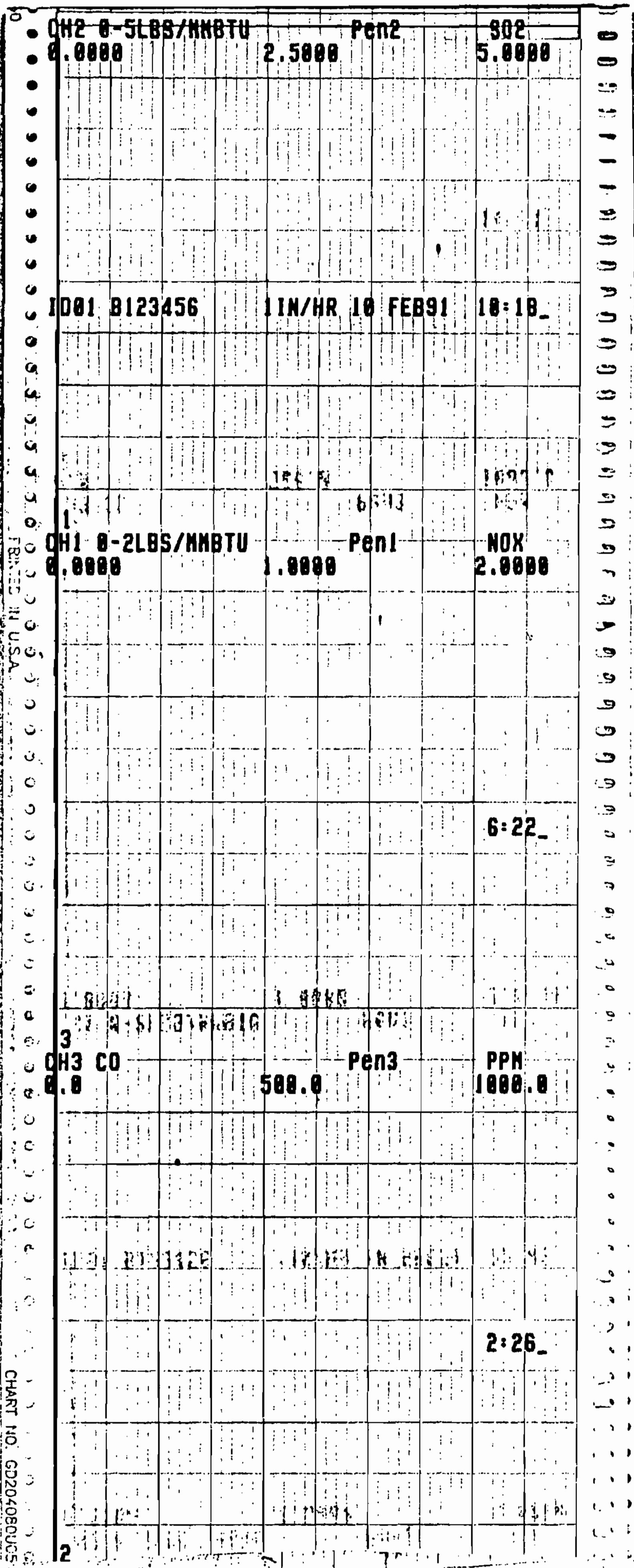
CHART NO.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SO2
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Pen1
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PPM
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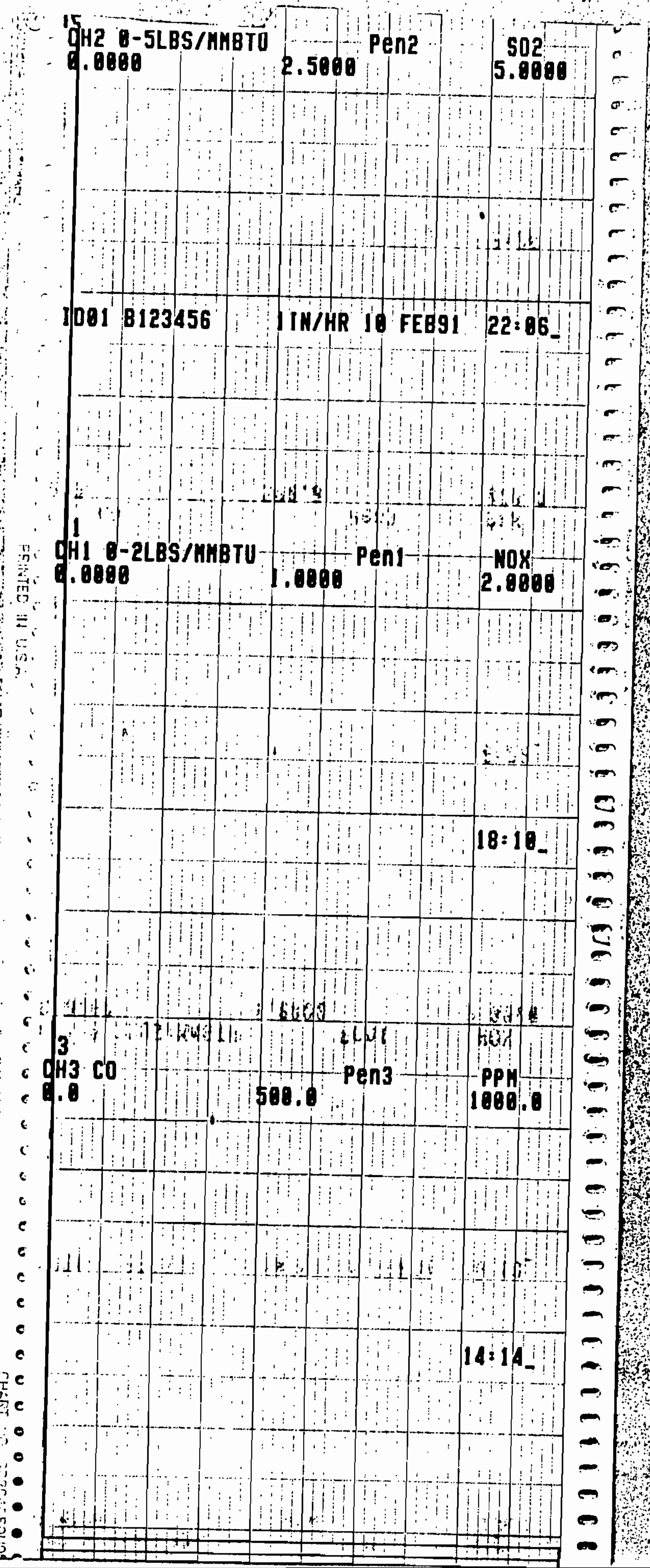
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Pen1
NOX
2.0000
18:10_
CH3 CO
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500.0
Pen3
PPM
1000.0
14:14_
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Environmental
Science &
Engineering, Inc.
A CILCORP Company

Summary of EPA Method 6C SO2 Test Results
02/11/91
FP&L - Sanford Plant
ORIMULSION PROJECT

Run #	SO2 (ppmV)	Oxygen (%V)	SO2 (lb/MMBtu)
1	1339.5	9.17	3.68
2	1348.5	9.15	3.7
3	1380.5	9.00	3.74
4	1335.4	9.05	3.63
5	1359.5	9.00	3.68

Emission rates are based on an F-factor of 9284.

EXHIBIT
9
PENGAD - Bayonne, N.J.

BEST AVAILABLE COPY

As Loaded

FUEL ANALYSIS
TANKER NO. 1
"AS LOADED"

		GROSS	NET
US BBLS AT 60 OF	:	199,912	199,912
LONG TONS	:	31,468.15	31,468.15
METRIC TONS	:	31,967.93	31,967.93

C- QUALITY REPORT:

A.P.I. : 8.7 (SUBMITTED BY LAGOVEN).

QUALITY REPORT BASED ON SHORE TANK AND SHIP'S FINAL

TEST	METHOD	TK 27300S	SHIP'S FINAL	FIRST IN
WATER CONTENT, WT PCT	ASTM D-95	30.0	30.0 ✓	
MEDIAN DROPLET SIZE UM	MALVERN	20.8	22.1 ?	23.5
DROPLETS G.T. 100 UM	MALVERN	0.70	0.70	-
DROPLETS G.T. 150 UM	SIEVE TEST	1.0	1.3?	-
SPAN	MALVERN	2.6	2.6	2.9
APPARENT VISCOSITY, MPAS.	ROTATIONAL VISC.			
10 C - 20 SEC.-1		1278	1268	-
30 C - 20 SEC.-1		510	566	540
50 C - 100 SEC.-1		204	201	-
70 C - 100 SEC.-1		114	108	-
GROSS CALORIFIC VAL. MJ/KG (*)	ASTM D2382	29.6	--	-
NET CALORIFIC VAL. MJ/KG (*)	ASTM D2382	27.4	--	-
SULPHUR, PCT W/W (*)	ASTM D1552	2.5 ✓	--	-
ASH, PCT W/W (*)	ASTM D482	0.14 ✓	--	-
VANADIUM, PPM (*)	ATOMIC ABS.	302 ✓	--	-
SODIUM, PPM (*)	ATOMIC ABS.	74 ✓	--	-
MAGNESIUM, PPM (*)	ATOMIC ABS.	392 ✓	--	-
FLASH POINT, OC (*)	ASTM D-56	113	--	-
POUR POINT, OC (*)	ASTM D-97	0	--	-

Mega joules
Kilogram

NOTE: (*) ANALYSIS PERFORMED AT INTEVEP LABORATORIES AND WITNESSED BY SAYBOLT.

SO2/PE MMBtu

D- QUANTITY DELIVERED BY SHORE TANKS:

TK.	US BBLS GROSS	US BBLS NET
27300S	199,912	199,912

E- SHIP FIGURES:

TOTAL OBSVD	:	203,021
LESS O.B.Q. LOT	:	83
LESS FREE WATER	:	0
GROSS OBSERVED VOL	:	202,938
GROSS STND VOL	:	201,090

ORIMULSION ... RECEIVED ... FROM ... FILES

EXHIBIT
10

POWER RESOURCES CENTRAL LABORATORY
FLORIDA POWER AND LIGHT COMPANY
STATE OF FLORIDA LABORATORY CERTIFICATION NUMBERS:
DRINKING WATER CERTIFICATION NUMBER: 56275
ENVIRONMENTAL CHEMISTRY CERTIFICATION NUMBER: E56078

FUEL ANALYSIS
TANKER NO. 1
"AS RECEIVED"

REPORT OF LABORATORY ANALYSIS

ORIMULSION
VESSEL: FRONT FALCON

DATE COLL'D: 01-01-91 DATE REC'D: 01-02-91 DATE REPORTED: 01-07-91

	ANALYTICAL METHOD	RESULT
DENSITY @60F, g/cm3	(ASTM D-4052)	1.0050*
DENSITY @60F, lbs/BBL		352.261*
BTU/LB	(ASTM D-240)	12710*
MBTU/BBL		4474*
% SULFUR	(ASTM D-1552)	2.7*
VISCOSITY @ 30.5C, mPAS SHEAR RATE = 139.1	(ASTM D-4684)	347*
% WATER	(ASTM D-95)	30*
% SEDIMENT	(ASTM D-473)	0.27
% ASH	(ASTM D-482)	0.18
% ASPHALTENES	(IP-143)	6.5
VANADIUM (MG/KG)		328
SODIUM (MG/KG)		36
MAGNESIUM (MG/KG)		522
NICKEL (MG/KG)		63
IRON (MG/KG)		11
POUR POINT, F		34
FLASH POINT, F		>200
SO2 (LBS/MILLION BTU)		4.2

COMMENTS: * WITNESSED BY THOMAS HOPE FOR CALEB BRETT.
SEE ATTTACHED SPECIFICATION LIMITS.

COPIES TO:
J. ALCANTARA, PSN/PLT
R. ALLEN, JEN/NP
G. BISHOP, JEN/NP
D. CHRISTIAN, JPE/EDO
M. HALPIN, PSN/PLT
D. KNUTSON, PRS/EDO
R. LIPPMAN, FR/GO
M. MILLARES, JPE/EDO
J. NORMAN, PRS/EDO
K. OLEN, JRD/NP
J. POSE, FR/GO
R. RUHLMAN, PSN/PLT
B. STEWART, PSN/PLT
G. TABOR, FR/GO
R. YOUNG, PSN/PLT

ANALYZED BY: Harrison J. Uzice
CERTIFIED BY: H. McDonnell
DATE: 1/7/91

US BBLS AT 60 OF	:	199,912	199,912
LONG TONS	:	31,462.15	31,462.15
METRIC TONS	:	31,967.93	31,967.93

FUEL ANALYSIS
TANKER NO. 2
"AS LOADED"

C- QUALITY REPORT:

Best Available Copy

A.P.I. : 8.9 (SUBMITTED BY LAGOVEN).

QUALITY REPORT BASED ON SHORE TANK AND SHIP'S FINAL

TEST	METHOD	TK 273005	SHIP'S FINAL	FIRST IN
WATER CONTENT, WT PCT	ASTM D-95	30.0	30.0	
MEDIAM DROPLET SIZE UM	MALVERN	20.8	22.1	23.5
DROPLETS G.T. 100 UM	MALVERN	0.70	0.70	-
DROPLETS G.T. 150 UM	SIEVE TEST	1.0	1.3	-
SPAN	MALVERN	2.6	2.6	2.9
APPARENT VISCOSITY, MPAS.	ROTATIONAL VISC.			
10 C - 20 SEC.-1		1278	1265	-
30 C - 20 SEC.-1		510	566	540
50 C - 100 SEC.-1		204	201	-
70 C - 100 SEC.-1		114	108	-
GROSS CALORIFIC VAL. MJ/KG (+)	ASTM D2382	29.6 } 12722 BTU/Lb	--	-
NET CALORIFIC VAL. MJ/KG (+)	ASTM D2382	27.4 } 11776 BTU/Lb	--	-
SULPHUR, PCT W/W (+)	ASTM D1552	2.5	--	-
ASH. PCT W/W (+)	ASTM D482	0.14	--	-
VANADIUM, PPM (+)	ATOMIC ABS.	302 ⎤	--	-
SODIUM, PPM (+)	ATOMIC ABS.	74 ⎬ Mg/V=1.3	--	-
MAGNESIUM, PPM (+)	ATOMIC ABS.	392 ⎦	--	-
FLASH POINT, OC. (+)	ASTM D-56	113	--	-
POUR POINT, OC (+)	ASTM D-97	0	--	-

NOTE: (+) ANALYSIS PERFORMED AT INTEVEP LABORATORIES AND WITNESSED BY SAYBOLT.

D- QUANTITY DELIVERED BY SHORE TANKS:

TK.	US BBLS GROSS	US BBLS NET
273005	199,912	199,912

E- SHIP FIGURES:

TOTAL OBSVD	:	203,021
LESS O.B.Q. LOT	:	83
LESS FREE WATER	:	0
GROSS OBSERVED VOL	:	202,938
GROSS STND. VOL	:	201,090
LONG TONS	:	31,647.54
METRIC TONS	:	32,156.30

FUEL ANALYSIS
TANKER NO. 2
"AS RECEIVED"

POWER RESOURCES CENTRAL LABORATORY
FLORIDA POWER AND LIGHT COMPANY
STATE OF FLORIDA LABORATORY CERTIFICATION NUMBERS:
DRINKING WATER CERTIFICATION NUMBER: 56275
ENVIRONMENTAL CHEMISTRY CERTIFICATION NUMBER: E56078

REPORT OF LABORATORY ANALYSIS

ORIMULSION
VESSEL: FRONT EAGLE

DATE COLL'D: 01-30-91 DATE REC'D: 01-31-91 DATE REPORTED: 01-31-91

	ANALYTICAL METHOD	RESULT
DENSITY @60F, g/cm3	(ASTM D-4052)	1.0070*
DENSITY @60F, lbs/BBL		352.922*
BTU/LB	(ASTM D-240)	12599*
MBTU/TON		25198*
% SULFUR	(ASTM D-1552)	2.8*
VISCOSITY @ 30.2C, mPAS SHEAR RATE = 139.1	(ASTM D-4684)	441*
% WATER	(ASTM D-95)	31*
SO2 (LBS/MILLION BTU)		4.4

COMMENTS: * WITNESSED BY THOMAS HOPE FOR CALEB BRETT.
THE REMAINDER OFF THE ANALYSES WILL FOLLOW.

COPIES TO: G. TABOR, FR/GD

ANALYZED BY: Wayson J. Urica

CERTIFIED BY: K. M. O'Donnell

DATE: 2/11/91

FUEL ANALYSIS
"AS FIRED"

RECEIVED
FEB 06 1991
ENV. PERMITTING

FLORIDA POWER & LIGHT COMPANY
POWER RESOURCES CENTRAL LABORATORY

STATE OF FLORIDA LABORATORY CERTIFICATION NUMBERS
DRINKING WATER CERTIFICATION NUMBER: 56275
ENVIRONMENTAL CHEMISTRY CERTIFICATION NUMBER: E56078

SANFORD #4 (ORIMULSION) PLANT
ANALYSES OF FUEL OIL FIRED
JANAURY 1991

DATE SAMPLE RECEIVED AT LABORATORY	1-18-91		
API GRAVITY	8.8	ASH, % BY WEIGHT	0.21
DENSITY, LB/GAL	8.406	PARTICULATE EQUIVALENT, LB/MBTU	0.16
DENSITY, LB/BBL	353.070	VANADIUM IN ASH AS V205, % BY WEIGHT	27
DENSITY, TONS/BBL	0.176535	VANADIUM IN OIL AS V205, PPM	589
HEAT OF COMBUSTION, BTU/LB	12732	VANADIUM IN OIL AS V, PPM	329
HEAT OF COMBUSTION, MBTU/BBL	4495	VISCOSITY @ SHEAR RATE OF 139.1(1/S),@ 30C,CPS	335
HEAT OF COMBUSTION, BTU/GAL	107031	ASPHALTENES, % BY WEIGHT	7.1
HEAT OF COMBUSTION, MBTU/TON	25464	MAGNESIUM IN OIL AS MG, PPM	373
HEAT OF COMBUSTION, MEGAJOULES/KG	29.594	SODIUM IN OIL AS NA, PPM	78
WATER, % BY VOLUME	30.00	NICKEL IN OIL AS NI, PPM	66
SEDIMENT, % BY WEIGHT	0.30	IRON IN OIL AS FE, PPM	9
SULFUR, % BY WEIGHT	2.7		
SULFUR DIOXIDE EQUIVALENT, LB/MBTU	4.24		

COPIES TO: J. W. DICKEY -PRG/EDO
M. GROSSWALD -PRG/EDO
J. STANTON-PRG/EDO
PLANT MANAGERS
PLANT RESULTS DEPT

D. W. KNUTSON - PRS/EDO
K. WASHINGTON - PRS/EDO
W. WAYLETT- PRS/EDO
BOB RIGHTER - PSN/PLT
ROGER MESSER - PRS/EDO

BILL PARKES - FR/GO
R. LIPPMAN - FR/GO
E. CALLANDER - FR/GO
R.N. ALLEN - JEN/NP
M. TAYLOR - PCU/PLT
E. BISHOP - JEN/NP

ANALYZED BY : T. Harrison / J. Ozice

CERTIFIED BY : K. M. O'Donnell

DATE: 1-28-91

91-PSN-6

FPL

Inter-Office Correspondence

To: M.A. Smith, JEN

Date: 2/14/91

From: M.P. Halpin/J.C. Alcantara

Department: PSN/PLT

Subject: **FPL SANFORD PLANT**
ORIMULSION PROJECT-SULFUR CONVERSION

Attached please find our best estimate of the fuel sulfur input versus output based on best available data.

The following summarizes the key points:

1) All pertinent tests where actual data has been obtained were at 70% of unit output (280 MWG) and at 3.5-4.5% excess oxygen.

2) Three assumptions were made:

   a) 3% of fuel ash remains in boiler as "bottom ash" which has a sulfur content of 9%. This is actual data (3-5%) from Dalhousie, but no actual data currently exists for Sanford.

   b) 80ppm of SO_3 is being generated at this operating point. This is based upon a known data point of 60ppm of $2O_3$ (at 2% excess oxygen) at Dalhousie.

   c) Fuel sulfur measurement reproducibility is $\pm$ .13% sulfur (ASTM D-1552 methodology) based upon orimulsion quality manual.

3) Actual data obtained at this unit operating point is:

   a) 3.675 lb so_2/MBTU being generated (EPA method 6C)

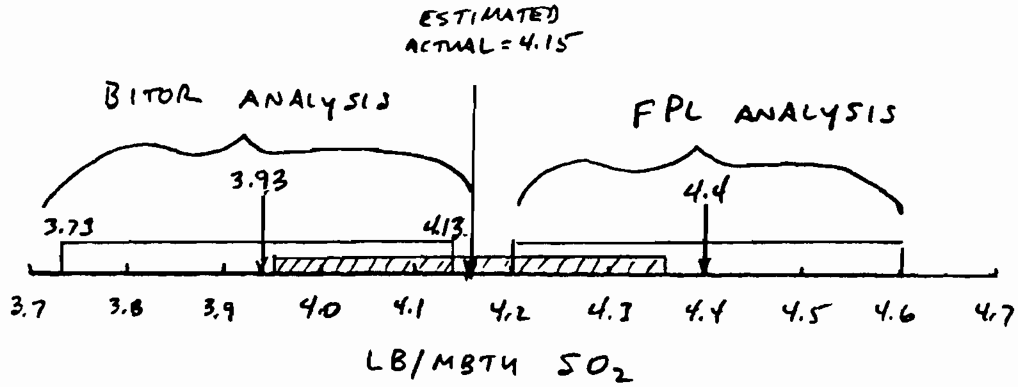
   b) .254 lb SO_2/MBTU sulfate in particulates (EPA method 17 and subsequent analysis of filter deposits)

   c) FPL fuel sulfur analysis was 2.8 and BITOR fuel sulfur analysis was 2.5.

4) Actual SO_2 estimated from sulfur balance is 4.15 lb/MBTU. This equates to 2.61% sulfur.

EXHIBIT
11

FPL SANFORD PLANT
ORIMULSION PROJECT-SULFUR CONVERSION
PAGE -2



KEY: ▭ BOX REPRESENTS REPRODUCIBILITY RANGE

SO_2 IN FLUE GAS	SO_3 IN FLUE GAS	SO_4 IN PARTICULATE MATTER	SO_4 IN BOTTOM ASH	ESTIMATED EQUIVALENT TOTAL	ESTIMATED TOTAL INCL. REPRODUCIBILITY RANGE	FPL ANALYSIS INCLUDING REPRODUCIBILITY RANGE	BITOR ANALYSIS IN REPRODUCIBI RANGE
3.675	0.140	0.254	0.077	4.15	3.95-4.35	4.2-4.6	3.73-4.1

TOTAL EQUIVALENT SO_2 IN LB/MBTU

Please note that it is our estimate that under a "worst case" scenario of maximum conversion to SO_2 in flue gas, approximately .185 lb/MBTU of sulfur in fuel will remain in bottom ash, particulate matter and SO_3. Therefore, we believe that the ability to meet the permitted SO_2 value of 4.3 lb/MBTU is not endangered until the fuel SO_2 calculation is greater than or equal to 4.5 lb/MBTU (approximately 2.81% sulfur).

M.P. Halpin
Ops. Supt.

J.C. Alcantara
Tech. Consultant

MPH/t

SANFORD ORIMULSION PROJECT

SULFUR BALANCE

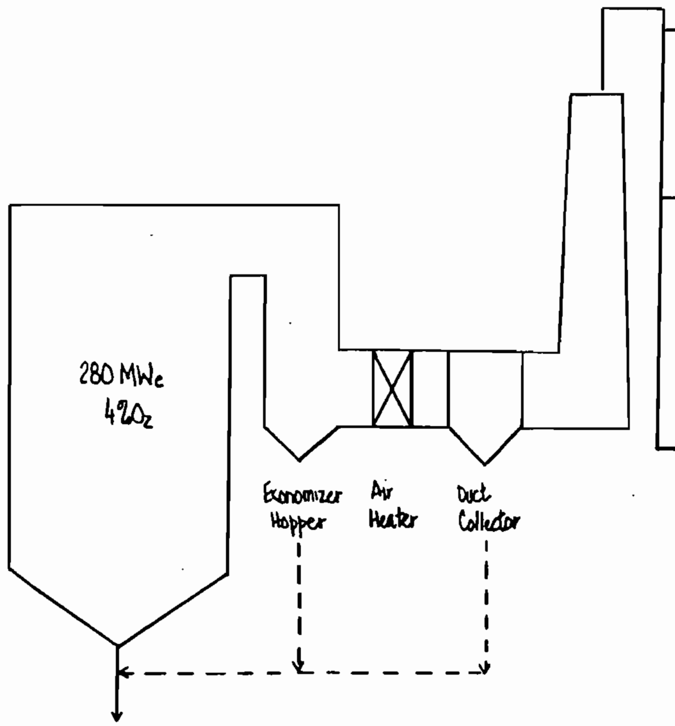
UNIT CONDITIONS

70% Load - 280 MWe
4% Excess O_2

Orimulsion Analyses

1st. Shipment
Sulfur = 2.7 %wt
HHV = 12710 BTU/Lb
Ash = 0.18 %wt
Lb SO_2/MBTU = 4.2

2nd. Shipment
Sulfur = 2.8 %wt
HHV = 12599 BTU/Lb
Ash = 0.18 %wt
Lb SO_2/MBTU = 4.4



SO_2 Emission

$$\frac{Lb\ SO_2}{MBTU} = \frac{1359\ ppm\ SO_2}{} \Big| \frac{20.9}{20.9 - 9.11\%O_2} \Big| \frac{9190}{} \Big| \frac{1.66 \times 10^{-7}}{} = \underline{\underline{3.675}}$$

- ppm SO_2 as measured by EPA's Method 6-C
- F factor included in EPA's Equation
- Conversion Factor
- % O_2 as measured at the Stack

SO_3 Emission

Assumption: A. 80 ppm SO_3 when Unit is operated at high excess O_2 (4%)

$$\frac{Lb\ SO_2}{MBTU} = \frac{80\ Mole\ SO_3}{10^6\ Mole\ Flue\ Gas\ (wet)} \Big| \frac{1\ Mole\ SO_2}{1\ Mole\ SO_3} \Big| \frac{64\ Lb\ SO_2}{Mole\ SO_2} \Big| \frac{1.12\ Mole\ Flue\ Gas\ Wet}{Mole\ Flue\ Gas\ Dry} \Big| \frac{Mole\ Flue\ Gas\ Dry}{379\ SCF\ Dry} \Big| \frac{9190\ Dry\ SCF}{MBTU} = \underline{\underline{0.140}}$$

- Stack moisture from Test #59
- Ideal gas at 60°F & 1 atm
- F factor included in EPA's Equation

Sulfates ($SO_4^=$) in Particulate Emission

Assumption: A. Similar Particulate Emission (0.509 Lb/MBTU) and Sulfates Composition (74.9%) as Diagnostic Stack Test #59

$$\frac{Lb\ SO_2}{MBTU} = \frac{0.509\ Lb\ Particulates}{MBTU} \Big| \frac{0.749\ Lb\ SO_4^=}{Lb\ Particulates} \Big| \frac{Mole\ SO_4^=}{96\ Lb\ SO_4^=} \Big| \frac{1\ Mole\ SO_2}{1\ Mole\ SO_4^=} \Big| \frac{64\ Lb\ SO_2}{1\ Mole\ SO_2} = \underline{\underline{0.254}}$$

Bottom Ash - Assumptions: A. 3% Bottom Ash of Ash in Fuel
B. 9% Sulfur Content in Bottom Ash
} Conservative assumptions based upon the Canadian test experience

$S + O_2 \rightarrow SO_2$

$$\frac{Lb\ SO_2}{MBTU} = \frac{0.18\ Lb\ Ash}{Lb\ Fuel} \Big| \frac{0.03\ Lb\ Bottom\ Ash}{Lb\ Fuel\ Ash} \Big| \frac{0.09\ Lb\ S}{Lb\ Bottom\ Ash} \Big| \frac{Mole\ S}{32\ Lb\ S} \Big| \frac{1\ Mole\ SO_2}{1\ Mole\ S} \Big| \frac{64\ Lb\ SO_2}{Mole\ SO_2} \Big| \frac{Lb\ Fuel}{0.012599\ MBTU} = \underline{\underline{0.077}}$$

Rev. 1 / 14-Feb-91