Anthracite Coal Combustion
AP-42 Sect. Chap 4
Reference Ref 4

AP42 Section 1.2
4/93
Reference 12

REPORT ON PARTICULATE EMISSION[illegible]

BOILERS NOS. 1 & 3 AT PENNHURST CENTER

SPRING CITY, PENNSYLVANIA

PR July 25th Latest To Rick

JANUARY 23 and 25, 1980

TRC ENVIRONMENTAL CONSULTANTS, INC.

TRC PROJECT NO.1222-E80-00
EPA CONTRACT NO. 68-01-4145, Task 70
LEIGH GAMMIE
PROJECT MANAGER
PREPARED BY:
BENJAMIN F. BROWN
ENVIRONMENTAL SCIENTIST
MAY 1, 1980

125 SILAS DEANE HIGHWAY
WETHERSFIELD
CONNECTICUT 06109
(203) 563-1431

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1.0 INTRODUCTION

The particulate compliance status for sources at nine Commonwealth of Pennsylvania-owned facilities has been questioned with regard to applicable SIP air pollution regulations. Because the Pennsylvania Department of Environmental Resources cannot effect enforcement measures against the facilities, EPA Region III elected to initiate an investigatory action to determine the current particulate compliance status of the sources at those facilities and to document any violations of the applicable SIP regulations.

The measurement of the particulate emissions from the facility sources was contracted by EPA Region III to TRC Environmental Consultants, Inc. of Wethersfield, Connecticut. During the week of January 21, 1980, TRC tested at Pennhurst Center in Spring City, Pennsylvania, the first of nine facilities designated for testing. The effluent combustion gases from Boilers Nos. 1 and 3 were tested for particulate concentration in the chimney through which they discharge. Environmental Scientist Benjamin F. Brown and Associate Environmental Engineer Edward D. Astle from TRC conducted the testing.

Mr. Keith Owens, P.E., from the Pennsylvania State University Department of Architectural Engineering represented the Department of Public Welfare for the testing and served as liaison between TRC and Pennhurst Center.

Air Pollution Control Engineers Richard L. Ruhl and Thomas H. Jones, Jr., from the Region I - Norristown Office of the DER conducted visible emission observations during the particulate testing.

Utility Plant Operator Barry Gardner was responsible for recording the boiler operating data and the coal consumption weights during the testing.

This report presents the particulate test results for the Pennhurst source and all relevant testing information and data.

2.0 RESULTS AND CONCLUSION

The three test average particulate emission rate was 0.21 lb/MMBTU. The test results indicate that the combined particulate emission discharged from Pennhurst Center Boilers Nos. 1 and 3 do not exceed the particulate emission limit of 0.40 lb/MMBTU(1). The emission rate was determined by the F-Factor method instead of the coal usage because the scales were considered to be inaccurate.

A summary of the testing results is presented in Table 2-1. Appendix A contains the computer summary of the particulate test results. The particulate test computer inputs are in Appendix B.

The methodology for the sampling and analysis which was used for the testing is detailed in Section 4.0.

TRC believes the results to be representative of normal operation for these boilers and recommends that EPA Region III consider this source to be in compliance with the aforementioned particulate limit.

An interpretation of the limit by the Pennsylvania DER appears in Appendix L.

(1) Section II, Chapter 123, Title 25 PA Code, Rules, Regulations, Environmental Resources.

[illegible]

[illegible]

SPRING CITY, PENNSYLVANIA

TEST NO.	TEST DATE	TEST TIME	STEAM LOAD Lbs/Hr BOILER NO.1	BOILER NO.3	SOURCE TOTAL	MAX. SOURCE AVG. 78-79 HEAT. SEASON(2)	TOTAL HEAT INPUT (MMBTU/HR) BASED ON "Q" FACTOR	PARTICULATE EMISSIONS EMISSION STANDARD LB/HR	EMISSION STANDARD LB/MMBTU(1)	LB/ MMBTU	LB/HR	GR/ DSCF(4)	SAMPLE VOLUME (DSCF)	ISO-KINETIC RATE, %	SOLUBLE PARTICULATE MG(3)
1-1	23 Jan 1980	1111 Hrs to 1428 Hrs	14,100	13,700	27,800	32,284[2]	44.8	17.92	0.40	0.30	12.22	0.05	26.62	90.60	11.4
1-2															
1-3	25 Jan	1009 Hrs to 1158 Hrs	16,000	16,600	32,600	32,284[2]	48.0	19.20	0.40	0.18	8.36	0.04	36.82	98.40	9.6
1-4	25 Jan	1247 Hrs to 1429 Hrs	16,400	15,700	32,100	32,284[2]	50.0	20.0	0.40	0.16	7.80	0.03	38.45	97.30	19.8
Average					30,822	32,384[2]	47.6	19.4	0.40	0.21	9.46	0.04			

-3-

(1)Paragraph (a) Section II, Combustion Units, Chapter 123, Title 25 PA Code, Rules and Regulations, Environmental Resources.
"No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter, at any time, from any combustion unit in excess of:

1) The rate of 0.4 pounds per million BTU of heat input, when the heat input to the combustion unit in millions of BTU's per hour is greater than 2.5 but less than 50.
2) The rate determined by the formula: $A = 3.6E^{-0.56}$ where: A = Allowable emission in pounds per million BTU of heat input, and E = Heat input to the combustion unit in millions of BTU's per hour; when E is equal to or greater than 50 but less than 600.
3) The rate of 0.1 pounds per million BTU of heat input when the heat input to the combustion unit in millions of BTU's per hour is equal to or greater than 600."

(2)Produced with two of facility's four boilers; all rated @ 25,875 lbs of steam/hr - continuous.

(3)Residue after evaporation of condensate catch after filtration through 0.22μ filter.

(4)Standard conditions: 68°F, 29.92 inches Hg.

OPERATION DESCRIPTION

Pennhurst Center has four Keeler water-tube Boilers Nos. 1, 2, 3, and 4, which produce steam for hot-water heating, space heating, cooling, and food preparation. During peak load demand periods, two of the four boilers operate with the other two on standby. During the 1978-79 heating season, two of the four boilers produced a maximum continuous load which averaged 32,384 lbs. of steam/hr. All four boilers are rated at 34,500 lbs. of steam/hr. maximum with a heat input of 49 MMBTR/hr. and 28,875 lbs. of steam/hr. continuous with a heat input of 37 MMBTU/hr. They all burn Buckwheat No. 3 anthracite coal which is fed into Boilers Nos. 1 and 3 on Coxe traveling grate stokers.

The effluent combustion gases from all four boilers flow into a common breeching and exhaust to the atmosphere through a 165' chimney.

TESTING LOCATION, METHODOLOGY AND ANALYSES

Location

Figure 4-1 illustrates the location of the sampling ports which were installed for the testing. The table at the bottom of the figure presents the traverse point intervals from the inside wall of the stack to the sampling point.

Testing Methodology and Analyses

Particulate

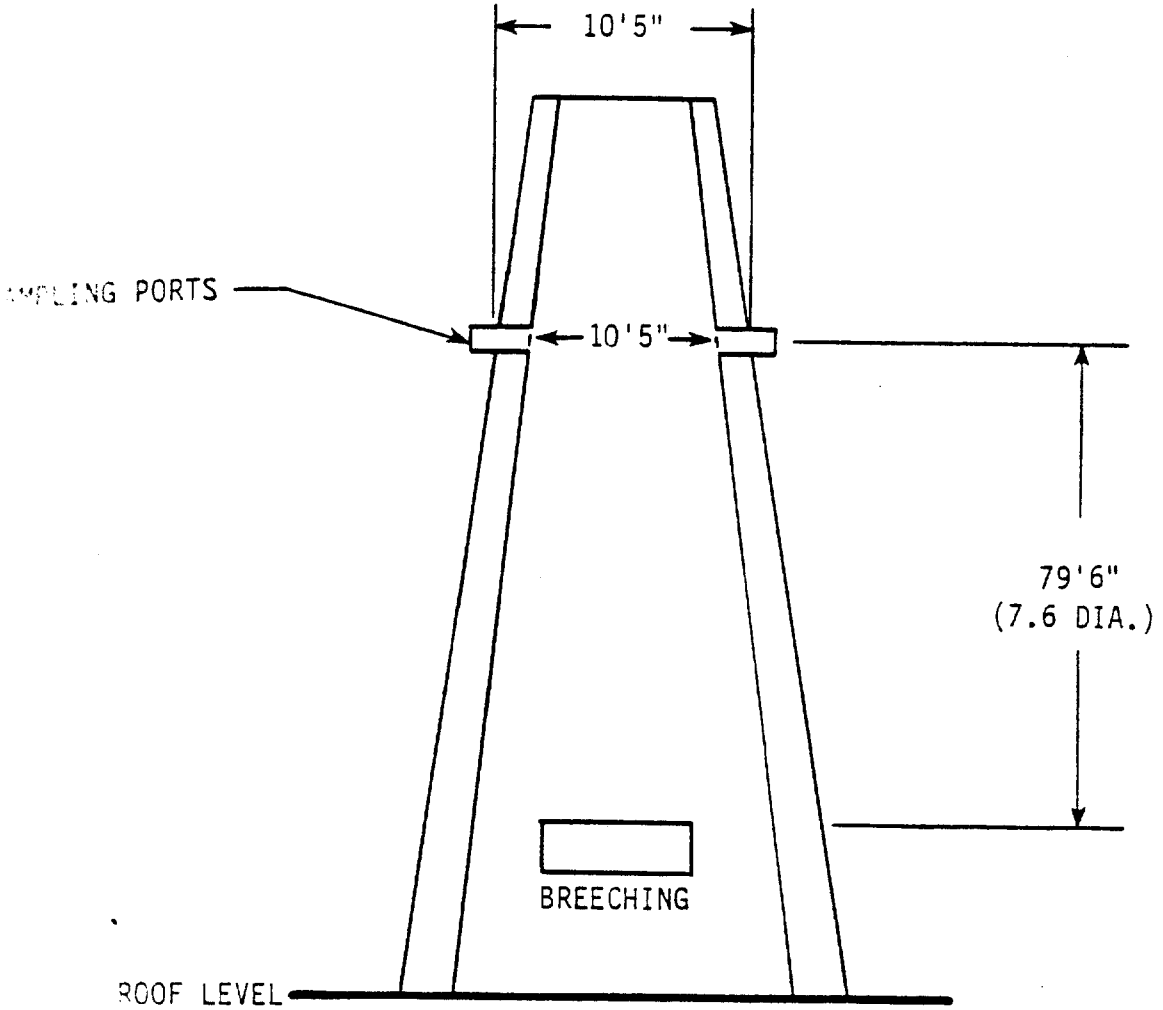
The following procedures were followed to assure the quality of the tests and data collected:

1. Complete sampling train calibrations were performed before testing commenced. The inside diameter of each nozzle was measured to the nearest 0.0001 inch with a micrometer. The probe pitot tubes were calibrated against a reference standard pitot tube in a 20" ID wind tunnel capable of velocities ranging from 0 to 100 fps. The dry gas meters, with their respective orifices attached, were calibrated against a wet test meter (1 cubic foot per revolution) while pressure differentials across the orifices were recorded for the corresponding gas volumes drawn through the dry gas meters. The chromelalumel thermocouples and indicators were calibrated electronically. The calibration data is contained in Appendix C.

2. Acetone blanks were analyzed prior to the field use and only acetone with low blank values ($\leq$ 0.001 percent) was used.

3. All filters were permanently numbered. The filter numbers and tare weights were recorded in a bound notebook kept in the custody of the chemistry laboratory supervisor.

4. Each filter was placed in a filter holder and sealed to prevent any contamination. The sealed filter holder was clearly labeled with the filter number. The sealed filter holders were placed in a fiberglass transport case. The fiberglass transport case was in the custody of the field team leader for the duration of the field program. When a filter was used in the field, its filter number was recorded on the field data sheet. At the conclusion of the sample run, the filter holder was sealed and returned to the fiberglass, foam-lined transport case. The case also contained clean, numbered, glass probe-wash sample bottles and plastic silica gel bottles. When they were used, their bottle numbers were recorded on the field data sheets. The bottles were sealed and returned to the fiberglass case.



TRAVERSE POINTS	
POINT NO.	*DISTANCE (INCHES)
1	5.5
2	18.3
3	37.0
4	88.0
5	106.8
6 -	119.5

*FROM THE INSIDE WALL

FIGURE 4-1: SAMPLING PORT LOCATIONS - PENNHURST CENTER, SPRING CITY, PENNSYLVANIA

5. Back at TRC, the filters were removed from their sealed holders and placed in sealed petri dishes. The sealed petri dishes containing the filters, the sealed glass bottles containing the probe wash, and front-end glassware washes, the impinger catch containers, and the silica gel bottles were submitted to the lab supervisor.

6. All lab weighings and calculations were recorded in bound notebooks which are in the custody of the lab supervisor. The lab results were checked by the lab supervisor and submitted to the program manager on the lab reporting form (see Appendix D).

Particulate sampling was accomplished by using the EPA collection train, Method #5, described in the August 18, 1977 edition of the Federal Register: It is shown schematically in Figure 4-2 and consists of a nozzle, probe, filter, four impingers, vacumm pump, dry gas meter, and an orifice flow meter.

The nozzle (1) was attached to a stainless steel glasslined probe (2) that was wrapped with nichrome heating wire and jacketed. Controlling the temperature at ~250°F prevented condensation of the sampled gas. Following the probe, the gas stream inpacted on a 4-1/2" Reeve Angel Type 934AH filter attached to a fritted-glass disk in a Pyrex glass holder (3). A heated box enclosed the whole filter assembly to maintain filter temperatures at 250°F ± 25°F to prevent condensation of water and SO_3. An ice bath containing four impingers (5) was attached to the end of the filter holder (6). All condensible material in the sample stream was collected here. The first two impingers contained distilled water, the third was dry and the fourth contained silica gel to remove any remaining moisture. Leaving the fourth impinger, the sample stream flowed through flexible tubing (6), a vacuum gauge (7), needle valve (8), a leakless vacuum pump (9), in parallel with a bypass valve (10), and a dry gas meter (11). A calibrated orifice and inclined manometer (12) completed the sampling train. The stack velocity pressure was measured using a pitot tube and inclined manometer (13)

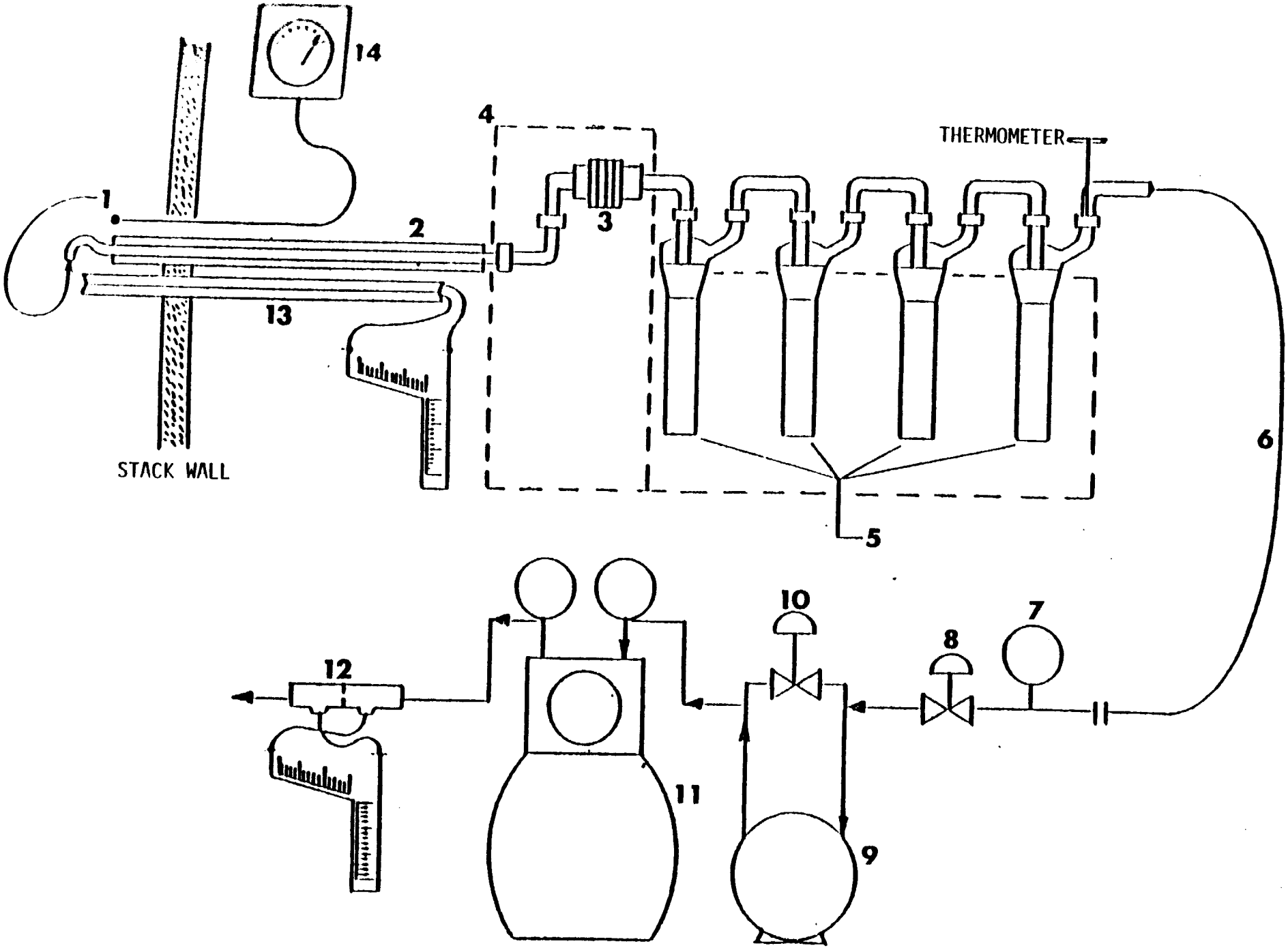


FIGURE 4-2: MODIFIED EPA PARTICULATE SAMPLING TRAIN
AUGUST 18,1977, FEDERAL REGISTER

and stack temperature was monitored by a thermocouple attached to the pitot and connected to a potentiometer (14).

A nomograph was used to quickly determine the orifice pressure drop required for the measured pitot velocity pressures and stack temperatures in order to maintain isokinetic sampling conditions. The sampling flow was adjusted by means of the bypass valve.

Test data recorded included test time, sampling duration at each traverse point, pitot pressure, stack temperature, meter volume, meter inlet-outlet temperature and orifice pressure drop. The field data sheets are included in Appendix E.

At the end of each test, four sample containers were used as follows to transport the samples back to TRC:

Container #1 - to transport the filter.

Container #2 - to transport the acetone wash of probe and front half of filter holder.

Container #3 - to transport the catch from the first and second impingers.

Container #4 - to transport the silica gel from the fourth impinger.

At TRC's laboratory, the sample analyses were performed in the following manner:

Container #1 - The filter, and any loose particulate matter from the sample container was transferred to a tared glass weighing dish, desiccated and dried to a constant weight. Results were reported to the nearest 0.1 mg.

Container #2 - The acetone washings were transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. They were desiccated and dried to a constant weight. Results were reported to the nearest 0.1 mg.

Container #3 - The impinger condensate was filtered through a tared, 0.22 μm membrane filter. The filter was transferred to a tared glass weighing dish and desiccated to a constant weight. The results were reported to the nearest 0.1 mg. This was called insoluble particulate and its weight was added to the front end catch to obtain the total particulate catch.

An aliquot of the impinger condensate was evaporated in a tared glass weighing dish and desiccated to a constant weight. The results were reported to the nearest 0.1 mg. This value was designated as soluble particulate.

Container #4 - Silica gel was weighed to the nearest 0.5 g. the weight of the moisture entrapped in the silica gel, along with the volume of moisture which was condensed in the impingers, was used to calculate the moisture content of the flue gas.

The lab data was transferred to coding forms and keypunched along with the field data. The field data sheet also served as a coding form. The keypunched cards were run through our inhouse Univac 90/30 computer which is programmed to perform the U.S. EPA Reference Method Calculations.

The program calculated the emission rates in lb/hr, grain loading in grains per standard cubic foot, lb/MMBTU and the volume flow in the duct stack. The emission rates in lb/MMBTU are calculated by the F-Factor stoichiometric method. The Federal Registers of October 6, 1976 (for the F-factor method) and August 18, 1977 are the references for the formulas used in performing the required calculations. An example emissions calculation is shown in Appendix F.

4.2.2 Flue Gases

Grab samples were taken and measured for CO_2, O_2 and N_2 (by difference) during each test. An Orsat and/or portable Teledyne Analyzer, Model #320P-4, were used for the sampling and measurements. The average results are in Appendix G.

4.2.3 Coal

During the test series coal samples were composited from each boiler in a drum. A representative 10-pound sample of that drum composite was obtained for analysis. Five pounds of that sample were sent to an outside laboratory and analyzed by ASTM methods for the following constituents:

moisture
ash
heating value
sulfur
carbon
hydrogen
nitrogen
oxygen

The coal analysis is reported in Appendix H.

5.0 DISCUSSION

This first series of tests, in the series of nine, served not only to measure the source emissions at Pennhurst Center but to "shakedown" the program techniques and procedures. Certain circumstances and occurrences which developed during this series necessitated occasional variations, both temporary and permanent from the original scope. The following discussion will explain the nature of and the reason for those variations.

Test Number 1-2 was never completed. During that test, the filter particulate accumulation reduced the sampling train flow to a subisokinetic rate. Due to the imminent sunset and the hazard that the test crew would have faced descending from the testing platform in darkness, the test was cancelled.

In Test Number 1-1 the required 30.0 DSCF samples volume was not reached. A sample volume at 26.62 DSCF was drawn for Test Number 1-1. This occurred because a nozzle of less than optimum ID (0.379") was chosen, based upon preliminary velocity data taken from the previous day. Unfortunately, velocity averages on the test day were significantly lower than those measured on the preceding day. When the observed test volumes of the initial traverse points were extrapolated for the planned test duration, it became apparent that the required volume would be inadequate. Each point on the first traverse was resampled for another five minutes. The points on the second traverse were sampled for ten minutes each to increase the sample volume. Tests Numbers 1-3 and 1-4 were performed with a nozzle with an ID of (0.503"). This allowed the required volume to be sampled in a reasonable amount of time.

Another slight variation in the test procedure was the sampling of the flue gases by grab methods only, instead of the planned integrated sampling

system. The pump which served the integrated system failed and could not be repaired in the field. Sufficient grab samples were taken and analyzed with a Fyrite (for CO_2 and O_2) and a portable Teledyne Analyzer, Model #320P-4 (for O_2) to provide accurate combustion gas data similar to what would have been obtained from a composite sample.

Originally, four test ports were to have been used for testing. This was based upon the difficulty anticipated in moving the sampling unit with a probe long enough to accomodate a full ID traverse. However, once on location, the crew discovered that a sampling unit with a probe of sufficient length was not such an unmanageable system. This discovery allowed the scaffolding plans for the remaining eight locations to be modified so that only three, instead of the five sites, would require the four-port configuration.

The stack ID at the testing location was measured as 10'5". This was 6" greater than the 9'11" calculated from the engineering blueprints. The ports were located 79'6" (7.6 diameters) above (downstream) the breeching.

TRC feels that these occurrences, circumstances, and variations did not affect the integrity of the emissions data.

Concurrent with the emissions tests, personnel from the DER monitored the opacity from the stack. The visible emissions observations records are in Appendix I.

The boilers were monitored for steam load and for coal usage during the sampling period. The Boiler Field Data sheets are contained in Appendix J.

A sample calculation for the Heat Input using the F-Factor is shown in Appendix K.

APPENDICES

Pennhurst

Test No. 1-1

Velocity - 7.8 fps
Volume - 26,200 DSCFM
Gr/DSCF - 0.055
lbs/hr - 11.90 lbs/hr

41.9 MBTU/hr

Test No 1-3 *

Velocity - 8.2 fps
Volume - 26,300 DSCFM
Gr/DSCF - 0.036
lbs/hr - 8.30

1st pt 5 min; 2nd pt 9 min
orifice offset 7 min. per point

Test No. 1-4

Velocity - 8.75 fps
Volume - (26,800)
Gr/DSCF - 0.032
lbs/hr - 7.90

44.8 MBTU/hr

APPENDIX A

COMPUTER SUMMARY OF THE PARTICULATE TEST RESULTS OF JANUARY 23, 1980 AND JANUARY 25, 1980

TEST DATA -- EPA METHOD #5 -- TEST NO 1-1
TRC PROJECT 1222-E8C

PENNHURST
UNITS 1 AND 3 STACK
JANUARY 23 1980 11:11 TO 14:29

TOTAL SAMPLING TIME, MINUTES	120.
AVERAGE SQUARE ROOT VELOCITY HEAD, IN H2O EXP .5	~~2.115~~
AVERAGE ORIFICE PRESSURE DROP, IN H2O	~~0.178~~
AVERAGE METER TEMPERATURE, DEG F	~~62.8~~
AVERAGE DUCT STATIC PRESSURE, IN H2O	~~0.00~~
AVERAGE DUCT TEMPERATURE	312.
TOTAL SAMPLE VOLUME, DACF	35.9[illegible]
TOTAL SAMPLE VOLUME, DSCF	~~25.452~~ 26.166
MOISTURE CONTENT OF DUCT GAS, PERCENT	~~2.11~~
DUCT VOLUMETRIC FLOW, ACFM	40545.
DUCT VOLUMETRIC FLOW, DSCFM	26641.
AVERAGE DUCT VELOCITY, FPM	476.
EXCESS AIR, PERCENT	257.6
AVERAGE DUCT GAS DENSITY, LBS/ACF	~~0.050~~
ISOKINETIC FACTOR, PERCENT	90.6
F FACTOR, DSCF/MM BTU	9968.320

EMISSION DATA

	GR/ ACF	GR/ DSCF
PARTICULATE PROBE	0.012	0.018
PARTICULATE FILTER	0.023	0.035
TOTAL DRY PARTICULATE	0.034	0.052
Condensible Particulate	0.001	0.001
TOTAL PARTICULATE	0.036	0.054

	LBS/ HR	LBS/ MMBTU
PARTICULATE PROBE	3.997	0.037
PARTICULATE FILTER	7.961	0.192
TOTAL DRY PARTICULATE	11.958	0.289
Condensible Particulate	0.265	0.006
TOTAL PARTICULATE	12.223	0.295

TEST DATA -- EPA METHOD #5 -- TEST NO 1-3
TRC PROJECT 1222-E8C

PENNHURST
UNITS 1 AND 3 STACK
JANUARY 25 1980 10:09 TO 11:5[illegible]

TOTAL SAMPLING TIME, MINUTES	64.
AVERAGE SQUARE ROOT VELOCITY HEAD, IN H2O EXP .5	0.121
AVERAGE ORIFICE PRESSURE DROP, IN H2O	0.655
AVERAGE METER TEMPERATURE, DEG F	35.4
AVERAGE DUCT STATIC PRESSURE, IN H2O	-0.36
AVERAGE DUCT TEMPERATURE	338.
TOTAL SAMPLE VOLUME, DACF	35.36
TOTAL SAMPLE VOLUME, DSCF	36.80
MOISTURE CONTENT OF DUCT GAS, PERCENT	2.57
DUCT VOLUMETRIC FLOW, ACFM	42771.
DUCT VOLUMETRIC FLOW, DSCFM	27526.
AVERAGE DUCT VELOCITY, FPM	502.
EXCESS AIR, PERCENT	245.3
AVERAGE DUCT GAS DENSITY, LBS/ACF	0.050
ISOKINETIC FACTOR, PERCENT	98.4
F FACTOR, DSCF/MM BTU	9963.320

EMISSION DATA

	GR/ ACF	GR/ DSCF
PARTICULATE PROBE	0.009	0.014
PARTICULATE FILTER	0.013	0.021
TOTAL DRY PARTICULATE	0.022	0.035
Condensible Particulate	0.001	0.001
TOTAL PARTICULATE	0.023	0.035

	LBS/ HR	LBS/ MMBTU
PARTICULATE PROBE	3.292	0.070
PARTICULATE FILTER	4.866	0.104
TOTAL DRY PARTICULATE	8.158	0.174
Condensible Particulate	0.198	0.004
TOTAL PARTICULATE	8.356	0.178

TEST DATA -- EPA METHOD #5 -- TEST NO 1-4
TRC PROJECT 1222-E8C

PENNHURST

UNITS 1 AND 3 STACK

JANUARY 25 1980 12:47 TO 14:2?

TOTAL SAMPLING TIME, MINUTES	84.
AVERAGE SQUARE ROOT VELOCITY HEAD, IN H2O EXP .5	0.127
AVERAGE ORIFICE PRESSURE DROP, IN H2O	0.731
AVERAGE METER TEMPERATURE, DEG F	37.6
AVERAGE DUCT STATIC PRESSURE, IN H2O	0.36
AVERAGE DUCT TEMPERATURE	322.
TOTAL SAMPLE VOLUME, DACF	37.98
TOTAL SAMPLE VOLUME, DSCF	33.45
MOISTURE CONTENT OF DUCT GAS, PERCENT	2.32 0.37
DUCT VOLUMETRIC FLOW, ACFM	44710.
DUCT VOLUMETRIC FLOW, DSCFM	29067.
AVERAGE DUCT VELOCITY, FPM	525.
EXCESS AIR, PERCENT	249.6
AVERAGE DUCT GAS DENSITY, LBS/ACF	0.050
ISOKINETIC FACTOR, PERCENT	97.3
F FACTOR, DSCF/MM BTU	9968.320

EMISSION DATA

	GR/ ACF	GR/ DSCF
FRONT HALF PROBE	0.009	0.013
FRONT HALF FILTER	0.011	0.017
TOTAL DRY PARTICULATE	0.020	0.030
Condensible Particulate	0.001	0.001
TOTAL PARTICULATE	0.020	0.031

	LBS/ HR	LBS/ MMBTU
FRONT HALF PROBE	3.330	0.068
FRONT HALF FILTER	4.267	0.087
TOTAL DRY PARTICULATE	7.597	0.155
Condensible Particulate	0.200	0.004
TOTAL PARTICULATE	7.797	0.159

APPENDIX H

COAL ANALYSES

Gilbert/Commonwealth engineers and consultants

GILBERT ASSOCIATES, INC., P. O. Box 1498, Reading, PA 19603/Tel. 215 775-2600

CERTIFICATE OF ANALYSIS

LABORATORY NO: 122915 RECEIVED: 1/31/80 REPORTED: 2/14/80

CLIENT: TRC - The Research Corp of New England, 125 Silas Deane Highway
Wethersfield, CT 06109

SAMPLE DESCRIPTION: Analyses of coal - Sample #1
Project #1222-E80-00
PO #6082

- - - - - -

		AS RECEIVED	DRY BASIS
Moisture	%	8.50	
Ash	%	12.3	13.4
Heating value	Btu/lb	11931	13039
Sulfur	% S	0.91	0.99
Carbon	% C	72.7	79.5
Hydrogen	% H	2.27* 3.22**	2.48
Nitrogen	% N	0.76	0.83
Oxygen	% O	2.58* 10.1**	2.82

* The hydrogen and oxygen values reported do not include the hydrogen and oxygen from the moisture.

** The hydrogen and oxygen values reported do include the hydrogen and oxygen from the moisture.

Respectfully submitted,

J. K. Kieffer, Supervisor
Laboratory Services

MAH
cc: L. A. Gammie
W. Wade

APPENDIX J

BOILER OPERATION DATA

[illegible] 203 663-1431
[illegible] CONNECTICUT 06109
Environmental Consultants To Management

BOILER FIELD DATA

CLIENT EPA Region III (Pennhurst) LOCATION Spring City Penna

BOILER NO. 1 MANUFACTURER Keeler DATE 4/23/80

CAPACITY (Full Load) _____ lbs/hr PRESSURE _____ PSI TEMPERATURE _____ °

FUEL TYPE Anthracite FUEL SAMPLE TAKEN [X] YES [ ] NO TIME _____

Saturated

TIME	STEAM LOAD lbs/hr	INTEGRATOR (x 400)	~~FEED WATER FLOW lbs/hr [GPM]~~	STEAM TEMP °F	STEAM PRESSURE PSIG	~~TEMP °F~~	FUEL (Coal) ~~FLOW METER READINGS~~ Wgts
AM 9:30	15,000	50103			145		9:30 AM - Hopper Level
10:00	13,500	50122			145		10:00 1430
10:30	12,500	50141			145		10:35 1520
11:00	13,000	50158			145		11:40 1475
11:30	14,500	50176			145		12:08 PM 1490
12:00	13,500	50194			145		12:50 1480
PM 12:30	14,500	50211			145		1:35 1490
1:00	15,000	50230			145		2:30 1480
1:30	13,500	50247			145		3:15 1480
2:00	14,000	50 266			145		4:15 1495
2:30	15,000	50 284			145		4:50 1480
3:00	14,500	50302			145		5:27 290 7 hr 57 min
3:30	15,000	50320			145		15,210
4:00	14,500	50339			146		Coal Hopper 10 : 7.95 hrs
4:30	15,000	50357			145		15,110
5:00	16,000	50375			145		
5:28	16,000	50394			145		1900 lbs/hr
							22.7×10⁶ BTU/hr input
							19.2
							41.9 MBTU/hr

744.0

135 SILAS DEANE HIGHWAY, WETHERSFIELD, CONNECTICUT 06109 203 563-1431

Environmental Consultants To Management

BOILER FIELD DATA

CLIENT Kennhurst - EPA Region III LOCATION Peanhurst Center

BOILER NO. 3 MANUFACTURER Keeler DATE 1/22/80

CAPACITY (Full Load) _____ lbs/hr PRESSURE _____ PSI TEMPERATURE _____ °

FUEL TYPE Anthracite FUEL SAMPLE TAKEN [X] YES [ ] NO TIME _____

TIME	STEAM LOAD lbs/hr	INTEGRATOR (x 400)	~~FEED WATER FLOW lbs/hr [GPM]~~	STEAM TEMP °F (saturated)	STEAM PRESSURE PSIG	~~TEMP °F~~	FUEL (Coal) FLOW METER READINGS (Wgts)
AM 9:30	15,000	39852			145		9:35 AM Hopper Level
10:00	14,000	39870			145		10:00 1415
10:30	14,500	39887			145		10:30 1410
11:00	14,500	39906			145		11:20 1400
11:30	13,500	39922			145		12:25 PM 1430
12:00	13,000	39939			145		1:40 1440
PM 12:30	13,000	39956			145		2:25 1385
1:00	13,000	39973			145		3:40 1410
1:30	14,000	39991			145		4:00 1430
2:00	15,000	40009			145		4:45 1400
2:30	12,500	40027			145		5:33 240 Tho 68 min 4.97
3:00	13,500	40043			145		15,960
3:30	13,500	40060			145		Less empty 10c 16140 lbs
4:00	14,500	40077			145		12,860
4:30	15,000	40097			145		19.2 Btu/lbs
5:00	14,000	40114			145		
5:30	15,000	40133			145		

744.0

195 E. LAS CASAS HIGHWAY, WETHERSFIELD, CONNECTICUT 06109
Environmental Consultants To Management
203 563-1431

BOILER FIELD DATA

CLIENT Pennwalt Corp.

BOILER NO. 1 MANUFACTURER E Keeler Company LOCATION Spring City, Pa

CAPACITY (Full Load) _____ lbs/hr PRESSURE _____ PSI DATE 11/25/80

FUEL TYPE Anthracite FUEL SAMPLE TAKEN ☒ YES ☐ NO TEMPERATURE _____ °F

SAT. TIME _____

TIME	STEAM LOAD lbs/hr	INTEGRATOR (x 400)	~~FEED WATER FLOW~~ lbs/hr [GPM]	STEAM TEMP °F	STEAM PRESSURE PSIG	TEMP °F	FUEL - COAL FLOW METER READINGS
AM 9:00	12,000	51955			145		9:00 Hopper Level
9:30	14,500	51973			145		9:50 1530
10:00	15,000	51990			145		10:40 1535
10:30	14,500	52011			145		11:08 1555
11:00	15,500	52032			145		11:40 1550
11:30	16,500	52061			145		12:30 1560
12:00	16,400	52090			145		1:10 1550
12:30	16,400	52111			145		2:00 1550
1:00	16,400	52111			145		2:56 — Level Hopper
1:30	16,400	52132			145		10,830
2:00	16,400	52152			145		Sample - 25
2:30	16,400	52172			145		10,805
2:48	15,000	52184			145		

63 hr
5.88 hr

21.9 x 8 BTU/hr
22.9
4.8 MBTU/hr

1830 #/hr

744.0

378 B LAS CEANE HIGHWAY, WETHERSFIELD, CONNECTICUT 06109
Environmental Consultants To Management
203 563-1431

BOILER FIELD DATA

CLIENT Community Center

LOCATION Spring City, PA

BOILER NO. 3

MANUFACTURER E Keeler Company

CAPACITY (Full Load) _____ lbs/hr

PRESSURE _____ PSI

DATE 4/25/

FUEL TYPE Anthracite

FUEL SAMPLE TAKEN [X] YES [ ] NO

TEMPERATURE _____ °

TIME _____

S17.

	TIME	STEAM LOAD lbs/hr	INTEGRATOR (x 400)	~~FEED WATER FLOW lbs/hr [GPM]~~	STEAM TEMP °F	STEAM PRESSURE PSI G	FUEL TEMP °F	FUEL FLOW METER READINGS
AM	8:55	20,000	41835			145		8:55 Hopper Level
	9:30	18,000	41652			145		9:50 1475
	10:00	17,500	41864			145		1440
	10:30	16,500	41907			145		10:45 1430
	11:00	16,500	41928			145		11:40 1480
	11:30	16,500	41948			145		12:30 1430
	12:00	16,000	41960			145		1:00 1425
	12:30	16,500	41989			145		1:15 1420
	1:00	16,500	42010			145		2:00 1400
	1:30	15,000	42029			145		2:54 — Hopper Level
	2:00	15,000	42048			145		11,500
	2:30	15,500	42066			145		Sample 25
	2:50	13,000	42081			145		11,475 22.9 MBTU/ton

744.0

APPENDIX K

EXAMPLE HEAT INPUT CALCULATION (TEST NO. 1-3)

PENNHURST TOTAL HEAT INPUT CALCULATION

Test 1-3

Heating Value = 11931 BTU/lb

Heat Input (F-Factor Method)

(E = Total Source Heat input in millions of BTU's per hour)

$$E = \frac{\frac{\text{DSCF}}{\text{min.}} \times \frac{60 \text{ min.}}{\text{Hr.}} \times \frac{100}{100 + \text{Excess Air}}}{\text{F-Factor}}$$

$$E = \frac{\frac{27526 \text{ DSCF}}{\text{Min.}} \times \frac{60 \text{ min.}}{\text{Hr.}} \times \frac{100}{345.3}}{\frac{9968.32 \text{ DSCF}}{\text{MMBTU}}} = 47.98 \frac{\text{MMBTU}}{\text{Hr.}}$$

Allowable Emission = 0.4 lbs/MMBTU.(1)

Average Steam Load = 16,000 lbs/hr - Boiler #1
16,000 lbs/hr - Boiler #3

(1) Section II, Chapter 123, Title 25 PA Code, Rules, Regulations, Environmental Resources.

APPENDIX L

DER INTERPRETATION OF PA 123.11

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 2063
Harrisburg, Pennsylvania 17120

April 10, 1980

Research Corporation
of New England
125 Silas Deane Highway
Wethersfield, Connecticut 06169

Attention: Mr. Lee Gammie

Gentlemen:

This will confirm my telephone discussion with Messrs. Ben Brown and Lee Gammie on April 8, 1980 regarding Pennsylvania's allowable particulate matter emission standards for combustion units, Section 123.11. The allowable emission rate contained in Section 123.11 applies to each individual combustion unit (boiler), based upon the actual heat input to that unit during a given period of time.

If a stack test is conducted on two or more combustion units having a common stack, the allowable emission rate for this situation would be calculated by determining the heat input for each of the combustion units individually and comparing the individual heat input to Section 123.11. If, for example, a stack test was conducted on three combustion units with a common stack each with an actual heat input of less than 50 million BTU's per hour, the allowable emission rate would be 0.4 pounds per million BTU's for each unit. The allowable emission rate to be compared with the measured emission rate would in that case be 0.4 pounds per million BTU's.

If two combustion units were tested with a common stack one having an actual heat input of 40 million BTU's per hour and the other having a heat input of 70 million BTU's per hour the allowable emission rate from the stack in pounds per million BTU's would be 0.357 pounds per million BTU's. This number would be obtained in the following manner.

$$\frac{40{,}000{,}000 \text{ BTU}}{\text{hr}} \left| \frac{.4 \text{ lb}}{10^6 \text{ BTU}} \right. = 16 \text{ lb/hr}$$

$$A = 3.6E^{-0.56}$$

$$A = 3.6(70)^{-0.56}$$

$$A = 0.333$$

$$\frac{70{,}000{,}000 \text{ BTU}}{\text{hr}} \Big| \frac{.333 \text{ lb}}{10^6 \text{ BTU}} = 23.3 \text{ lb/hr}$$

$$\frac{16 + 23.3}{(40 \times 10^6) + (70 \times 10^6)} = \frac{39.3 \text{ lb}}{110 \times 10^6 \text{ BTU}} = 0.357 \text{ lb}/10^6 \text{ BTU}$$

The procedure outlined in this letter should be used in determining the allowable emission rate for reporting in the stack tests of tests conducted by TRC at the various State facilities.

If you have further questions regarding this matter please contact me at (717) 787-4325.

Very truly yours,

James R. Benson
Chief, Abatement Monitoring and
Emission Inventory Section
Division of Abatement and Compliance
Bureau of Air Quality Control

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 2063
Harrisburg, Pennsylvania 17120
August 27, 1982

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Attention: Mr. William H. Lamison, II
Environmental Engineer
Source Analysis Section, AMTB

Gentlemen:

As requested in your letter dated August 3, 1982, and as clarified by telephone with Mr. Lamison on August 23, 1982, enclosed are photocopies of stack test reports for tests conducted on anthracite coal-fired boilers. These reports include both Department and consultant tests. The majority of the 52 stack tests mentioned in my March 19, correspondence were conducted on bituminous-fired boilers.

Thank you for the opportunity to provide this data for inclusion in the development of emission factors for AP-42.

If you have any questions regarding these reports, please contact me at (717) 787-4324.

Very truly yours,

JAMES R. BENSON, Chief
Abatement Monitoring and
Emission Inventory Section
Division of Abatement and Compliance
Bureau of Air Quality Control

List of Stack Test Reports
Sent to EPA - August 29, 1982

Firm	Test Date	Boiler I.D.	Tested By
Ashland State General Hospital	03/16/77	#3 & #4	DER
Armstrong World Industries	11/13/74	"C"	Armstrong
	02/02/82	"C"	Armstrong
	02/02/82	"C"	Armstrong
	02/02/82	"C"	DER
Magee Carpet Co.	09/18/79	#4	Spotts, Stevens & McCoy
Norristown State Hospital	01/29/80	#3	DER
	01/29/80	#4	DER
	01/29/80	#3 & #4	TRC
	01/30/80	#3	DER
	01/30/80	#4	DER
	01/30/80	#3 & #4	TRC
Pennhurst Center	01/23/80	#1 & #3	TRC
	01/25/80	#1 & #3	TRC
	01/25/80	#1 & #3	TRC
Tobyhanna Army Depot	05/01-03/79	#2	Dept. of Army
	07/16-20/79	#2	Dept. of Army
West Chester State	11/23/76	#3	Roy Weston
	11/23/76	#3	Roy Weston
	11/24/76	#4	Roy Weston
	11/24/76	#4	Roy Weston
	04/04/77	#3	Roy Weston
	04/04/77	#3	Roy Weston
	04/05/77	#3	Roy Weston
	04/06/77	#4	Roy Weston
	04/06/77	#4	Roy Weston
	04/07/77	#4	Roy Weston

Firm	Test Date	Boiler I.D.	Tested By
Wilkes-Barre Stream Heat	04/25/75	#6	Gannett Fleming
	02/19/76	#5	DER
	01/04/78	#5	DER
	10/10/79	#6	DER
	10/10/79	#6	DER
	10/10/79	#6	DER
	11/06/80	#5	Roy Weston
	11/06/80	#5	Roy Weston
	11/06/80	#5	Roy Weston
	11/07/80	#6	Roy Weston
	11/07/80	#6	Roy Weston
	11/07/80	#6	Roy Weston