Box 166A

VIBRATECH ENGINEERS INCORPORATED

REPORT

TO

Dames & Moore
100 Church Street
New York, New York 10007

Attention: Mr. Tom Tully

DATE

June 30, 1970

SUBJECT

VIBRATION STUDY FOR DAMES & MOORE
Limerick Generating Station Project
Primary Blast - West Face
Pottstown Trap Rock
Sanatoga Quarry
June 24, 1970

COPY NUMBER 2 OF 4

Hazleton, Penna.
June 30, 1970

VIBRATION STUDY
FOR
DAMES & MOORE

Pottstown Trap Rock - Sanatoga Quarry
Primary Blast - West Face
June 24, 1970

PURPOSE

The purpose of this study was to measure the vibration effects from the primary blast on June 24, 1970 at the above named operation and to determine their capacity to cause structural damage and to certify conformance to the Pennsylvania State Law.

THE BLAST

This blast consisted of 14 vertical holes, 6½ inches in diameter, drilled to an average depth of 36 to 59 feet. The spacing and burden of the holes was 15 x 20 feet with an average of 12 feet of stemming material confining the charge in each hole. The total load of 6631 pounds of Dupont Powder Company's HDP-1 Primers, Pourvex Extra, and ANFO "P" explosives was detonated in 14 separate firing periods by means of Millisecond Electric Delay Blasting Caps #1 thru #14. The maximum amount of explosives per delay period was 629 pounds. Time of detonation was 11:03 A.M.

WEATHER CONDITIONS

1. Type of day - Clear
2. Wind direction - From the Southwest
3. Temperature - Approximately 78°F

SEISMOGRAPH STATIONS

For registration of the vibration effects from the subject blast two Vibra-Log 3-Component Seismographs were employed.

Station #1:

Velocity Seismograph #178 (0.2 Range) was placed on the ground about 100 feet west southwest of Stack #A-20, approximately 250 feet west of the blast.

Station #2:

Velocity Seismograph #151 (1.0 Range) was placed on the ground at the Limerick Generating Station Site at Coordinate 3780 east and 6680 north, approximately 2800 feet south southeast of the blast.

THE SEISMOGRAPH RECORD

The seismograph record represents a photograph of the velocity of vibrations of the surface on which the instrument is sitting, at the recording location, in the form of 3 lines. The bottom line (longitudinal) represents horizontal velocity on a line joining the blast and the recording location; the top line (transverse) represents velocity at right angles to this; and the middle line represents vertical velocity. Deviations of these lines from their positions of rest amount to the velocity of the ground magnified by an instrument factor depending on the range used for the seismograph test. In this case the range was set at 0.2 and 1.0 and the velocities were obtained by measuring the deviations of the traces in inches and dividing by the proper calibration factor. Vertical lines on the record indicate the passage of time in 0.02 seconds, with every second being indicated by an accent mark.

RESULTS

Recent studies by the United States Bureau of Mines and other Authorities in the field of blast vibrations and their effects on structures have resulted in a new criteria based on velocity in inches per second. Below is a table of standards based on a velocity criteria.

VELOCITY	PROBABLE DEGREE OF DAMAGE
Below 2.0 inches per second	Recommended safe vibration level.
Above 4.0 inches per second	Threshold - very minor perceptible damage; plaster cracks, etc.
Above 5.5 inches per second	Minor - no apparent weakening of the structure; glass, plaster, masonry damage.
Above 7.5 inches per second	Major - serious structural failure through cracking, distortion or shifting.

The above table is based on the Maximum Velocity on any one component of an instrument measuring motion in three mutually perpendicular planes.

RESULTS CONTINUED

The Commonwealth of Pennsylvania Law states that in blasting operations the "Peak Particle Velocity" of the ground shall not exceed 2.0 inches per second in any one of three mutually perpendicular planes, in the vertical and horizontal directions, at the immediate location of any dwelling house, public building, school, church, commercial or institutional building.

Tabulated below are the measurements resulting from this blast.

SEISMOGRAPH NO. & LOCATION	COMPONENT	MAXIMUM VELOCITY (in/sec)
#178 Quarry Location	Transverse	1.60
	Vertical	1.50
	Longitudinal	1.90
#151 Project Site	Transverse	0.03
	Vertical	0.02
	Longitudinal	0.02

Note: The safety of the recorded vibration effects is further substantiated by the New Jersey and Massachusetts Blasting Codes.

CONCLUSIONS

According to all recognized damage indices, the recorded vibration effects from the subject blast were below that necessary to cause structural damage to even old pre-stressed plaster, normally the weakest material of construction, at the seismograph stations, in the immediate vicinity of the stations, or beyond the seismograph stations in the same general direction and also conformed to the Pennsylvania State Law governing blast vibrations.

Respectfully submitted,

VIBRA-TECH ENGINEERS, INC.

John J. Resetar

John J. Resetar
Field Engineer

Anthony J. Petro

Anthony J. Petro, P. E.
President

BLAST AND SEISMOGRAPHIC REPORT

Client DAMES & MOORE Operation LIMERICK GENERATING STATION (Job Location)

Specific Blast Location WEST FACE of POTTSTOWN TRAP ROCK - SANATOGA QUARRY

Blast No. — Date 6-24-70 Time of Blast 11:03 A.M.

No. of Vertical ~~Horizontal~~ (cross out one) Holes 14 Hole Diameter 6 1/2" Average Depth 56' TO 59'

Average Subgrade Drilling 4' Hole Spacings 15' Burdens 20'

Average Stemming to Top Charge 12' Type and Delay Nos. Used MS 25 TO 500

Decking Information (if any) —

Total Weight of Explosives 6631 Lbs. Average Explosives Load per Hole 475 Lbs.

Make and Type of Explosives DUPONT: POWERFLEX EXTRA 3025#, ANFO "P" 3550#, HDP-1 PRIMERS 56#

Maximum Amount of Explosives Per Firing Period 629 Lbs.

If Supplementary Holes, Snake Holes, etc., were used give information as above.

Weather and Sky Conditions CLEAR Wind from the S.W.

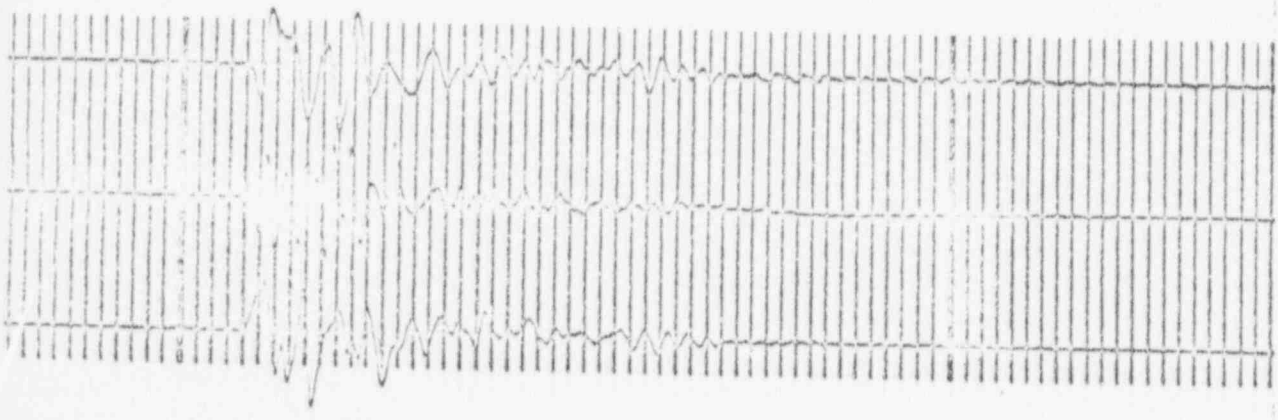
Temperature Approx 78°

Instrument Location ON GROUND AT REAR of SHOT - Approx. 100' WEST SOUTHWEST of STACK #A-20

Instrument Located Approximately 250 Feet WEST (Direction) from the Blast

Remarks if Blast produced any unusual effects

Seismograph No. 178 RANGE ~~Camera No.~~ 0.2 Operated by J. RESETAR



DATE 6-24-70

T = 1.60 IN/SEC

TIME 11:03 A.M.

V = 1.50 IN/SEC

L = 1.90 IN/SEC

RANGE 0.2

VIBRA-TECH ENGINEERS, INC.

by John J. Roberts

A-19

(Use reverse side for rough sketches of plan or profile of shot if indicated)

BLAST AND SEISMOGRAPHIC REPORT

Client DAMES & MOORE Operation LIMERICK GENERATING STATION (Job Location)

Specific Blast Location WEST FACE of POTTSTOWN TRAP ROCK - SANATOGA QUARRY

Blast No. ——— Date 6-24-70 Time of Blast 11:03 A.M.

No. of ~~Vertical~~ Horizontal (cross out one) Holes 14 Hole Diameter 6 1/2" Average Depth 36' TO 59'

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Maximum Amount of Explosives Per Firing Period 629 Lbs.

If Supplementary Holes, Snake Holes, etc., were used give information as above.

Weather and Sky Conditions CLEAR Wind from the S.W.

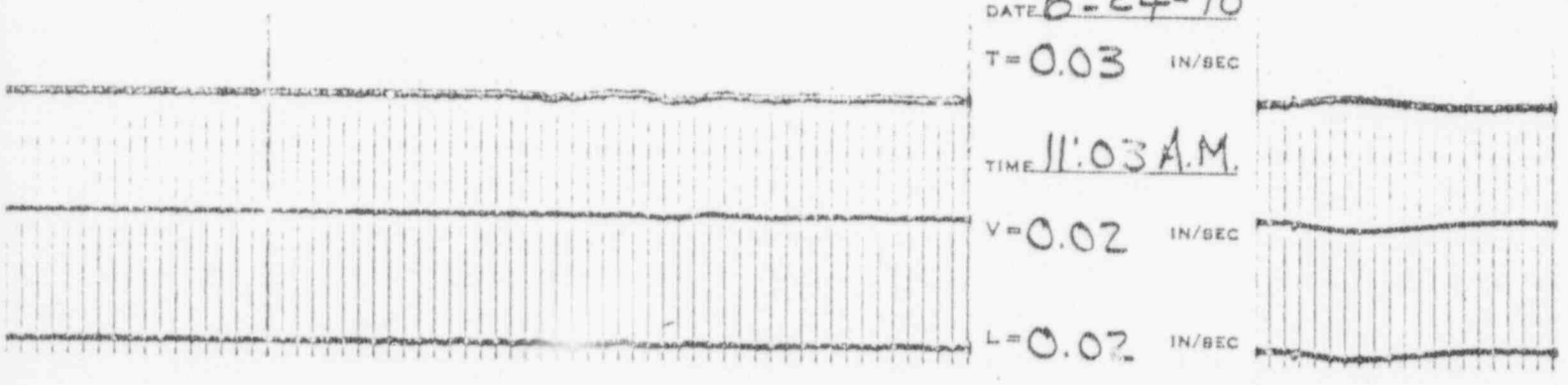
Temperature APPROX 78°

Instrument Location ON GROUND AT ⊃ LIMERICK GENERATING STATION SITE AT COORDINATE 3780 EAST & 6680 N 2TH

Instrument Located Approximately 2800 Feet S.S.E. (Direction) from the Blast

Remarks if Blast produced any unusual effects

Seismograph No. 151 RANGE 1.0 Operated by H. KINTER



RANGE 1.0

VIBRA-TECH ENGINEERS, INC.

by John J. Roberts

A-18

(Use reverse side for rough sketches of plan or profile of shot if indicated)

VME-Nitro Consult Inc.

FSC-115

H. Leinsen? Blasting

December 12, 1979

RECEIVED DEC 17 1979

Mr. J. R. Reiney, Jr.
Bechtel Power Corporation
P. O. Box A - Sanatoga Branch
Pottstown, Penna. 19464

Dear Mr. Reiney:

VME-Nitro Consult has reviewed the photographic tape and data sheets pertaining to a quarry blast on April 8, 1976 at 12:15 PM., the tape is identifiable with the tape print-out submitted with the data sheets. The scale though listed as .25 on the data sheets is not confirmable on the original tape. This indicates the following:

Plane	Particle Velocity
Longitudinal	.28 inches per second
Vertical	.19 " " "
Transverse	.32 " " "
Resultant	.47 " " "

The data sheet indicates that the scaled distance for this shot was: 20.4. For trap rock, the above particle velocities appear moderate to low.

Sincerely,

David W. Glossbrenner S.B.

David W. Glossbrenner
Regional Manager

DWG/sab

IMPORTANT

1. Send original copy back to VME with camera.
2. Send one copy to your home office file.
3. Keep one copy on job for ready reference.
4. Seis range for velocity recorder only.

FIELD TEST DATA FOR SEISMOGRAPH

DALTA PRINTERS, INC., SEASIDE

Recording No. FSC-115-1 Date 4/8/76 Seis. No. VR-D-88 (C-21)

Seis. Position N8820±/E2900± (conc. slab - Weather Tower #1) Seis. Range 0-25

Location of Shot Point Potts town Trap Rock Quarry (527'± north of Weather Tower #1)

Distance 527'± Time Fired 12:15 PM Manufacturer ** Strength **

Total Explosive Charge 7,679# Max. Explosive/Delay 660#

No. Holes 13 Hole Diameter 4¼" Loaded by Elmer Wood Open Face ~~Free~~

Depth of Holes 100'± Height of Bank 80'± No. of Decks — Stemming 4'± to 12'±

Hole No.														
Spacing														
Burden														
Explosive														
Detonator														

Seis Operator Bill Lassing ~~Camera No.~~ Full Seal — T. O.K. —

Remarks ** - DuPont - See attached "Quarry Shot Report" & seismic readout tape (4 enclosures).

FOR V. M. E. USE ONLY

~~Diagram~~

Client Bechtel Power Job Loc. Limerick

Reported by Harry W. Schmoyer Title Fld. Engr.

QUARRY SHOT REPORT

Customer: Pottstown Trap Rock Quarry

Location: Sanatoga

Customer Representative In Charge: Jim Florig

Explo-Tech Representative: Elmer Wood

License No.

License No. 5242A

Shot No. 1

Date 4-8-76

Time 12:15

Row No.	Hole No.	Dia. in.	Horiz. Vert. Angle	Burden Ft.	Spacing Ft.	Face Ft.	Depth Ft.	Water Ft.	Blasting Mtls. Used Lbs. 1	2	3	4	5	6	Tot.	Stem. Ft.	M.S. Delay
1	1	6	V	22	15'	96'	100'		360	104	200	4			668	4	3
										[illegible]	400	2			402	12	4
	2	↓	↓	↓	↓	↓	↓		360	78	200	5			643	4	1
										[illegible]	421	2			427	12	2
	3								360	78	200	4			642	4	5
										[illegible]	425	2			427	12	6
	4								360	78	200	4			642	4	7
										[illegible]	425	2			427	12	8
	5								360	78	200	4			642	4	9
										[illegible]	425	2			427	12	10
	6								360	104	200	4			668	4	11
										[illegible]	400	2			402	12	12
	7								360	104	200	4			668	4	13
										[illegible]	400	2			402	12	14
									[illegible]								
					Totals →				2520	624	4300	45			7677		

6 Toe holes using 180# Toe[illegible]
12 - HDP-1 Primers
12 - Inst Caps

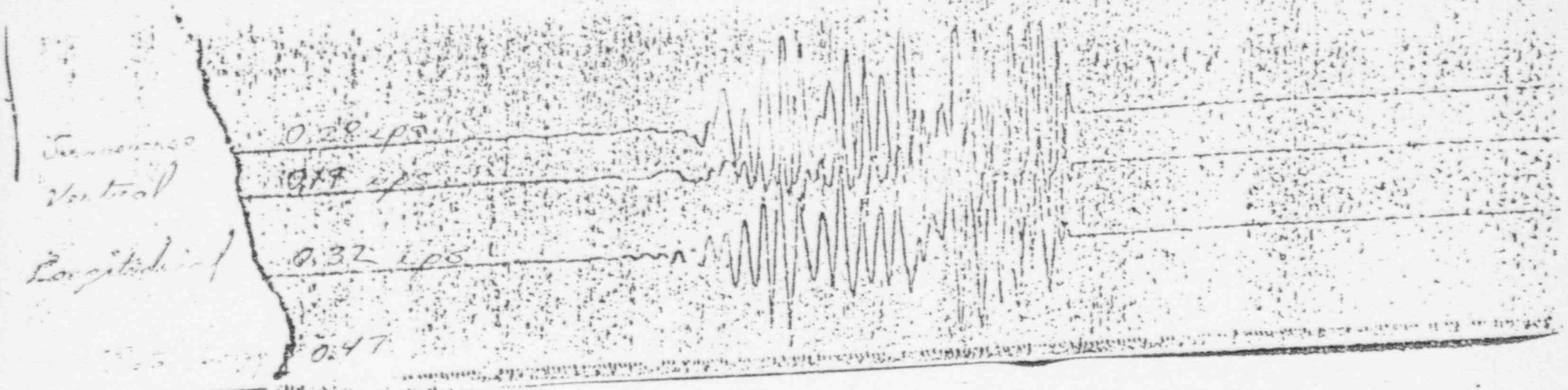
Blasting Mtls. Used:
Mfg.:
(1) Power Extra
(2) [illegible]
(3) [illegible]
(4) HDP-1 Primers
(5)
(6)

Total Lbs Exp 7677
Max Lbs/Delay 668
Max holes/Delay 2
Firing Method E.B. Caps
Circuit Parallel Series
Blast Mach CD-32
Material Shot
Mats Used
Weather Clear
Temp 55 °F
Wind From
Wind Vel.
Tons-~~Yards~~ Stone Shot 1884[illegible]
Tons/Lbs [illegible]

RECORDED DATA

Inst. No.	Cam. No.	Operator	Instrument Location	Closest Bldg. Y	Dist. from Shot	Dist. ft.	Scale Dis Ds	Part Vel L.	V.	T.	Sound Db	Blast psi

Instrument [illegible] Tech Engineers [illegible]



4/8/76 Shot of Pottstown Trap Rock Quarries
Seis. range V.R.-D-48 on conc. slab at PECo Weather Towe
0.125 quarry. Distance = 527' (±) = (VR to shot

Vinocon, inc.
590 ZEREGA AVENUE, BRONX, NEW YORK 10473, Tel. (212) 824-6410, 824-6411
P.O. BOX 312, ARDMORE, PENNSYLVANIA 19003, Tel. (215) VI 8-8540
P.O. BOX 248, VALE ROAD, BROOKFIELD, CONNECTICUT 06804, Tel (203) 775-2670

VIBRATION STUDY

PURPOSE — The purpose of this study was to measure vibrations generated by construction blasting done by Pottstown Trap Rock Quarries, Inc. #1 Quarry Road Douglasville, Pa. at Pottstown Trap Rock Quarries, Inc. on September 4, 1974 as part of a program of controlled blasting on this project.

PROCEDURE — Measurements of vibrations were made at various times and locations as indicated on the enclosed log form and sketches.

INSTRUMENT — Vibrations were recorded on a portable 3-Component Displacement type seismograph Serial No. 136 which records photographically on a time scale the amplitude of motion (in inches) on each of the three components of ground motion (Transverse, Vertical, and Longitudinal).

RESULTS — Permanent records (Seismograms) have been interpreted and tabulated to indicate the Maximum Peak Particle Velocity on each of the three components of ground motion (Transverse, Vertical, and Longitudinal) and the Maximum Possible Resultant Energy Ratio produced by each blast at the Recording station for comparison with the most recent damage criteria established by the U. S. Bureau of Mines and other agencies.

REMARKS — This blast produced vibrations within the allowable limits of Pennsylvania and were considered safe by present standards.

(see Analysis of a Vibration Study - attached)

VINOCON, INC.
BY:

ALFONSO DEIDO JR.
GENERAL MANAGER

Vinocon, inc.
590 ZEREGA AVENUE, BRONX, NEW YORK 10473, Tel. (212) 824-6410, 824-6411
P.O. BOX 312, ARDMORE, PENNSYLVANIA 19003, Tel. (215) VI 8-8540
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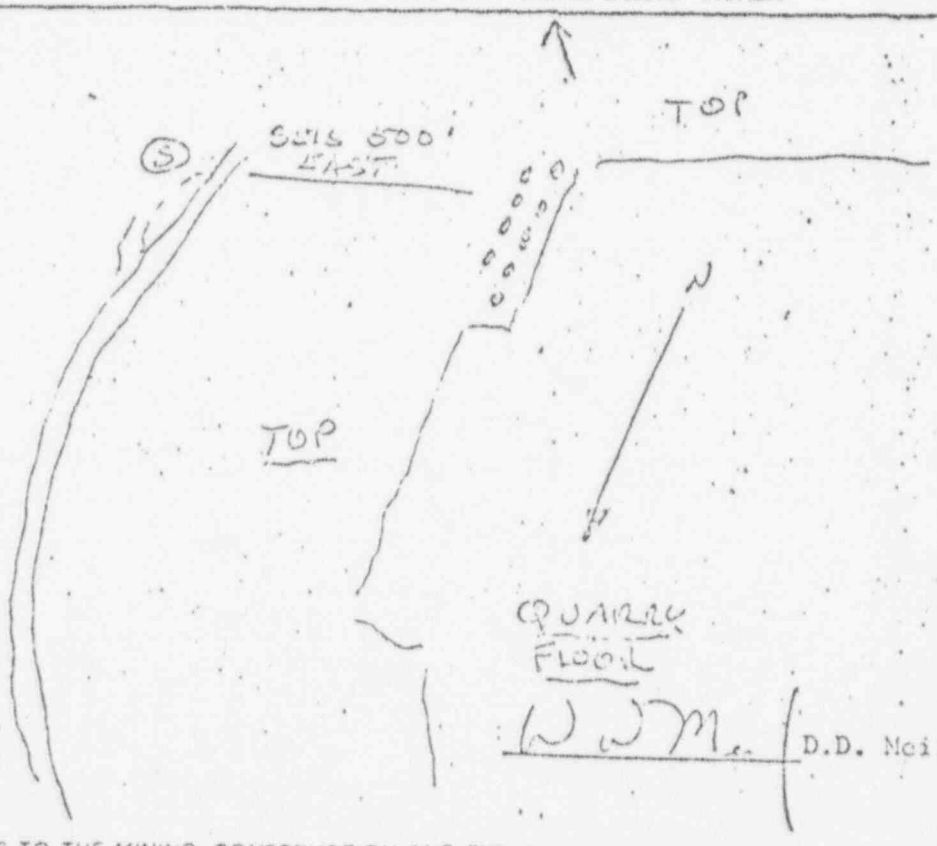
TABULATION OF VIBRATION RECORDINGS

LAST NUMBER / TIME	MAXIMUM VELOCITY ON EACH COMPONENT: TRANSVERSE	VERTICAL	LONGITUDINAL	MAXIMUM DISPLACEMENTS: TOTAL ENERGY RAT
74-8-4-PTR1 / 2:49 PM	0.572 "/sec.	0.670 "/sec.	0.563 "/sec.	0.300

USE SPACE BELOW FOR SKETCH OF BLASTING AREA

74-8-4-PTR1



D.D. Meisel, P.E.