Commonwealth Edison
72 West Adams Street, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690 - 0767

DCO

May 1, 1989

Mr. A. Bert Davis
Regional Administrator
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: LaSalle County Station Units 1 and 2
Response to Inspection Report Nos.
50-373/89007 and 50-374/89007
NRC Docket Nos. 50-373 and 50-374

References (a): E.G. Greenman letter to Cordell Reed dated March 21, 1989

(b): W.E. Morgan letter to A.B. Davis dated April 5, 1989

Dear Mr. Davis:

This letter is in response to the special inspection conducted by Messrs. S. DuPont, R. Kopriva, D. Butler, R. Mendez, and P. Shemanski of certain activities associated with the March 2, 1989 event at LaSalle County Station Units 1 and 2. Reference (a) required a written response of the findings and conclusions associated with the March 2 event. This was transmitted in Reference (b).

Commonwealth Edison was additionally requested to respond to the unresolved items identified in Sections 5 and 6 of the inspection report. The Commonwealth Edison Company's response to the unresolved items is provided in the Attachment.

If you have any further questions regarding this matter, please direct them to this office.

Very truly yours,

Wayne E Morgan

W. E. Morgan
Nuclear Licensing Administrator

lm

Attachment

cc: NRC Resident Inspector - LSCS
P.C. Shemanski - Project Manager, NRR

IE01

MAY 3 - 1989

0102T

UNRESOLVED ITEM: 373/89007-01
374/89007-01

... The AIT requested records relating to the testing of the OCB and the SAT. The licensee stated that the power factor test (doble test) and the travel test (timing) of the phase B 4-6 OCB had been performed but the results were not documented. The inspector was informed that oil samples from the 4-6 OCB and the Unit 2 SAT were acceptable, although no records were available for review at the site. Additionally, the licensee has not located the power factor testing records for the Unit 2 SAT. The lack of documented test result data associated with large electrical equipment is considered to be an unresolved item.

... The AIT attempted to review records relating to testing of the lightning arrester. The licensee indicated that the lightning arresters were tested by CECo Operating Analysis Department (OAD) but the data was not recorded. In addition, acceptance criteria for testing the lightning arrester was not available. The failed arrester was sent to the manufacturer (General Electric) for analysis to determine the failure mechanism. The licensee has committed to make the results available to the NRC. Since large electrical equipment is routinely tested by CECo OAD and testing data is not recorded or maintained, this is considered to be an unresolved item.

RESPONSE:

- Doble Tests of OCB 4-6 were performed on March 9, 1989, after the defective B phase bushing was replaced, and documented by System Operational Analysis Department (Attachment A).

- Travel Tests (timing) of OCB 4-6 were performed on March 7, 1989, after the defective B phase bushing was replaced and documented by Southern Division Operational Analysis Department (Attachment B).

- Oil samples from OCB 4-6 were tested and the results documented by Southern Division Substation Construction Department (Attachment C).

- Oil samples from Unit 2 SAT were tested on March 3, 1989 and the results documented by System Materials Analysis Department (Attachment D).

- The Unit 2 SAT was not power factor tested during this event. Insulation resistance tests (megger) and transformer turns ratio tests (TTR) were performed on March 3, 1989, and the test results documented by Southern Division Operational Analysis Department (Attachment E). Megger and TTR tests, and not power factor tests, are normally used in the diagnosis of a transformer trip out.

- As per the manufacturer's instruction manual regarding the testing of lighting arresters "These arresters do not require testing ... There is no single field test which will indicate the complete operating characteristics of the arrester." (Attachment F) The replacement lightning arrester and the original lightning arrester were not tested by either Southern Division Operational Analysis Department or System Operational Analysis Department.

0102T

DOBLE INSULATION TESTS

CIRCUIT BREAKER

DOBLE ENGINEERING COMPA
WATERTOWN, MASS.
FORM MH-CB178

COMPANY C.E. DATE 3-9-81

LOCATION OF TESTS Sta. 1 Falls CC AIR TEMP. 40°F OIL TEMP.

CIRCUIT BREAKER Bus Sect. 4-6 WEATHER Sunny % HUM. 60

BREAKER MFR. W.E. TYPE SF6 AGE 17 yrs

BREAKER SERIAL NO. 4-38Y4702 KV 345 AMPS. 2000

DATE LAST INSP. DATE LAST TEST 5-7-80 LAST TEST SHEET NO. 1-85

BUSHING MFR. W.E. BUSHING (TYPE-FORM-DWG NO.) " "

TCF = .90

	BUSH NO.	BUSHING SERIAL NO.	SIDE	PHASE	FEET OF BUS	INS. IN PARALL.	TEST KV	EQUIVALENT 10 KV READINGS: MICROAMPERES METER READING	MICROAMPERES MULTIPLIER	MICROAMPERES MICROAMPERES	WATTS METER READING	WATTS MULTIPLIER	WATTS WATTS	% POWER FACTOR MEASURED	% POWER FACTOR COR. 20°C	COLLAR TEST (WATTS/CURRENT)	INSULATION RATING
CIRCUIT BREAKER OPEN	1	26		A	—		10	23.5	.1	2.35	17.5	.02	.35	1.49	1.34		G
	2	28		A	20	8	10	28	.1	2.80	4.25	.1	.425	1.52	1.37		G
*	3	7		B	—		10	23.5	.1	2.35	18	.02	.36	1.53	1.38		G
	4	20		B	20	8	10	24	.1	2.4	3.75	.1	.375	1.56	1.41		G
	5	22		C	—		10	23.5	.1	2.35	15.5	.02	.31	1.32	1.19		G
	6	21		C	20	8	10	28	.1	2.8	4	.1	.40	1.43	1.29		G
CB CLOSED	TANK 1			A	20	8	10	50.5	.1	5.05	4	.1	.40	.79	.71	-.375	X
	TANK 2			B	20	8	10	46	.1	4.6	19.5	.02	.39	.85	.76	-.345	X
	TANK 3			C	20	8	10	50.5	.1	5.05	18	.02	.36	.71	.64	-.350	X

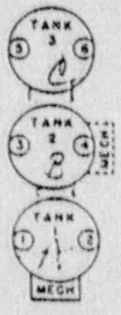
OTHER TESTS

LINE NO.																	
1																	
2																	
3																	
4	7		B	—		10	76	.07	1.52	7.5	.01	.075	.41	.44	404		
5	7		B	—		2	21	1	2.6	7	.2	1.4	.54	.48	6870		
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	

N.P.
P.F. .41 416
7254

ATTACHMENT A

KEY TO BUSHING NO.



REMARKS

* Bushing #3 Ser. no. 7 is a replacement.

KEY TO INSULATION RATING

BUSHINGS-INSULATORS-ETC.	WOOD MEMBERS-OIL-ETC.	WINDINGS
G=GOOD	XG=GOOD	WG=GOOD
D=DETERIORATED	XD=DETERIORATED	WD=DETERIORATED
I=INVESTIGATE	XI=INVESTIGATE	WI=INVESTIGATE
B=BAD (REMOVE OR RECONDITION)	XB=BAD (REMOVE OR RECONDITION)	WB=BAD (REMOVE OR RECONDITION)

3-7-89

RDLR/RDH

LaSalle STA 1 345 KV B-T 4-6

CLOSE/TRIP TIMING TEST

AIR PRESURE 250

CLOSE TIMES

TRIAL	AΦ	BΦ	CΦ
1	270 ms	274 ms	277 ms
2	263	265	273
3	267	270	278
1	262	267	265

TRIP 1 & 2 CLOSE 3

TRIP COIL #1 TIMES

TRIAL	AΦ	BΦ	CΦ
1	33.0 ms	33.4 ms	33.2 ms
2	32.7	33.4	32.9
3	32.9	33.5	33.0

TRIP COIL #2 TIMES

TRIAL	AΦ	BΦ	CΦ
1	33.1 ms	33.3 ms	32.4 ms
2	33.4	33.3	32.5
3			

ATTACHMENT B

TRAVEL TIME

AΦ CLOSE 5 FT/SEC TRIP 15.4'/SEC

BΦ CLOSE 5'/SEC TRIP 16.3'/SEC

CΦ CLOSE 5'/SEC TRIP 16'/SEC

OVER ALL CLOSE CYCLES

AΦ 13.5

BΦ 13.5 CΦ 13.5

SOUTHERN DIVISION

COMMONWEALTH EDISON

3-7-89
ADLR / RDL

Case 7A

Trip 1 15

Trip 2 15A

SOUTHERN DIVISION
OAD
COMMONWEALTH EDISON

TRAVEL TEST ANALYSIS

BT 4-6

9:30PM CΦ CC1 $\frac{1''}{1.5\sim} \times \frac{60\sim}{SEC} \times \frac{1ft}{12''} = 5 \frac{ft}{SEC}$

TC1 $\frac{2.5''}{2\sim} \times \frac{60\sim}{SEC} \times \frac{1ft}{12''} = 18.75 \frac{ft}{SEC}$ 3"-10.5"

$\frac{9''}{2.5\sim} \times$ " " $= 18.0 \frac{ft}{SEC}$ 5"-14"

$\frac{4''}{4.5\sim - 3.25\sim} \times$ " " $= 16.0 \frac{ft}{SEC}$ 1"-5"

9:49PM BΦ CC1 $\frac{1''}{1\sim} \times$ " " $= 5 \frac{ft}{SEC}$

$\frac{4''}{4.8'' - 3.25} \times$ " " $= 12.9 \frac{ft}{SEC}$ 1"-5"

$\frac{4}{4.7 - 3.3} \times$ " " $= 14.3 \frac{ft}{SEC}$ 1.25"-5.25"

$\frac{5.75''}{1.5\sim''} \times \frac{60\sim}{SEC} \times \frac{1ft}{12''} = 19.2 \frac{ft}{SEC}$ 3"-9.75"

AΦ CC1 $\frac{1}{9.6 - 18.6} \times$ " " $= 5 \frac{ft}{SEC}$

TC1 $\frac{4''}{1.3\sim} \times$ " " $= 15.4$ 1.25"-5.25"

STATION _____

CIRCUIT BREAKER NO. _____ TYPE _____

TESTER _____

DATE 3-7-61

FORM CC-5010

TRAVEL 1 SPACE = 1/4 INCH

TIME-CYCLES

0 HIGH	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0 LOW	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32

TEST 1 OF 1

STATION

CIRCUIT BREAKER NO. 4-6 #1

TESTER

DATE 3-7-87

TYPE

FORM CC-50

TRAVEL 1 SPACE = 1/4 INCH

TIME-CYCLES

0 HIGH	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0 LOW 2	4	6	8	10	12	14	16	18	20	22	24	26	28	30

TDK

M2

STATION

CIRCUIT BREAKER NO. H-6 C&I

TYPE WESTINGHOUSE (FPO)

TESTER

DATE 2-7-84

FORM CC-5010

TRAVEL 1 SPACE = 1/4 INCH

TIME-CYCLES

0 HIGH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0 LOW	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30

ATTACHMENT

C

April 11, 198[illegible]

Subject: LaSalle Station AIT Report Unresolved items
50-373/89007-01, 50-374/89007-01

Mr. R. M. Hennigan:

Information regarding Southern Division Substation Construction Activities related to the March 2, 1989 trip of SAT 242 has been received from Mr. K. Faber, Southern Division Substation Construction Superintendent.

Substation Construction personnel tested the insulating oil in all three phases of 345 KV bus tie 4-6 as it was removed from and returned to the circuit breaker. Breakdown values for A, B and C phases respectively were 24 KV, 21 KV and 23 KV on removal; 32 KV, 32 KV and 33 KV on return. These tests were documented and data is on file at the Southern Division Substation Construction office.

R. B. Benvenuti
Gen. Substation Supt.
T & D Construction

RBB/mc

0142m

cc: K. E. Faber

c8778 2-

SYSTEM MATERIALS ANALYSIS DEPARTMENT REPORT
ON
TRANSFORMER OIL SURVEILLANCE

Location LaSalle Sta. Line or Unit # Aux #2 Division Southern

Make G.E. KVA 65,000 Serial # A547385 Benchmark 5/78

Report No.	2					
Sample Date	3-3-89					
Analysis Date	3-3-89					
Atmospheric Data	**Percent By Volume**					
Combustibles	0.10					
CO_2	0-1					
O_2	5.5					
Gas-in-Oil Data	**Parts Per Million By Volume**					
Hydrogen	<50					
Methane	NF					
Ethane	NF					
Ethylene	NF					
Acetylene	NF					
Carbon Monoxide	18					
Carbon Dioxide	465					
Oxygen	<500					
Nitrogen	78,400					
% Total Gas	7.9					
Supplemental Analysis						
Water Content, ppm	—					
Dielectric Strength, kV	45					

ATTACHMENT D

Report No.	2					
Additional Information						
Purged						
Trip-Out	✓					
Benchmark						
Interpretation of Results						
Normal Condition	✓					
Corona Discharge						
Cellulose Involvement						
Arcing						
Overheating (< 150°C)						
Overheating (150-200°C)						
Overheating (200-300°C)						
Conductor Overheating						
Overloaded Joints/ Circulating Currents						

NOTE: If interpretations appear serious, comments will be made below, and appropriate people notified.

Comments:

Reported By:	RLR					
Date:	3-3-89					
Approved By:	EO					
Approved By:						
Approved By:						

Copies to: Division Operating Manager
Division OAD Engineer
Station Manager
28770 SSC-LaSalle
Proc. Superintendent

SEED Manager
SOAD Manager
SSC Supt.

NUCLEAR WORK REQUEST

No. STA L 8 7 9 9 4 WR NUMBER

EQUIPMENT NAME: SAT Transformer U-2 2#2 | UNIT: 2 | LOCATION: Outside Turbine Bldg U-2 | EPN: 2APG1E | SYSTEM: AP

WP EM/WORK REQUEST: 2 SAT Transformer 2#2 Tripped. Investigate cause of Trip and Repair.

ATTACHMENT E

REQUESTED BY: R.A. Novak /DATE: 3/3/89 | TEST REQUIRED: YES ☒ NO ☐ OAD ☒ | BY: OP ☐ TS ☐ MM ☐ EM ☐ IM ☐

DEPT. ASSIGNED: IM ☐ IM EM ☐ OTHER ☒ O.A.D.

SUP. APPR.: M. Dowd 3/3/89 MO DA YR

Verify proper operation

TECH. SPEC REQ: YES ☒ NO ☐ 3.0

PRIORITY: 4

LOAD REDUCTION: YES ☐ NO ☒ | UNIT OUTAGE: SHORT REFUEL ☐ | HOT COLD ☐ | SPECIAL ☐

SAFETY RELATED	REGULATORY RELATED	MODIFICATION	CODE WORK
YES ☐ NO ☒	YES ☐ NO ☒	YES ☐ NO ☒	YES ☐ NO ☒

ASME CLASS ____ IF ALL FOUR NO'S ARE CHECKED "●" APPROVALS / + COMPLETION ARE NOT REQ'D

ENGR. APPR. /DATE: 3-3-89 | FIRE HAZARD REVIEW: ☒ NONE ☐ PROCEDURE ☐ SPECIAL

T. DEPT. APPR. /DATE: Dowd for Dan Lantz 3/3/89 | ALARA ACTION: ☒ NOT APPLICABLE ☐ NOT REQUIRED ☐ REQUIRED

QA ACTION: R Novak /DATE: 3/3/89 | EQ.: YES ☐ NO ☒

QUALITY CLASSIFIED	EQUIPMENT	WORK
	YES ☒ NO ☐	YES ☒ NO ☐

ROUTINE MAINT. ☐

WORK INSTRUCTIONS:

Assist SO.AD in Troubleshooting, Repairing and Testing of the U-2 SAT Transformer as required. Document lifting/Moving Leads on LAP-1200-1 Rev 39 pg. 2 of 2.

WORK ANALYST	CODE	PARTS CHECKED AND FOUND AVAILABLE	PARTS ASSEMBLED IN STOREROOM UNDER THIS W.R. NO.	JOB CODE	W.O. FUNCTION NO.	SUBDIVISION
R.A. Novak	N	☐	☐	C	☐ 5 4 1 8 1 - 2 5 6 7	

INT. / PACS APPR. /DATE: Dowd for Dan Lantz the 3/3/89

REVIEW CECO. QA / /DATE: for Patty Lewis 3/3/89 per

VERIFY /DATE: NA

WORK ASSIGNED TO:

MAINT. FOREMAN	CODE
R Cassity	
MAINT. FOREMAN	CODE
L Dye	

SCHEDULED START DATE: / / MO DA YR

SHIFT AUTHORIZATION TO START WORK: R Miller 0809-PO /DATE

RELEASE / CECO. QA /DATE

FOREMAN COMP. / /DATE

/DATE

APPROVED COMPLETION /DATE

WORK REQUEST PACKAGE COMPLETE

ATTACHED DOCUMENTATION REQUIREMENTS

	YES	NO
Clearance TRAVELER	☐	☐
PROCEDURE	☐	☐
RED TAGS	☐	☐
DOC. CHK. LIST	☐	☐

OTHER

WORK TO BE CONTRACTED

PORTION ☐ ALL ☐ P.O. NO. ____

CONTRACTOR ____

	EST	ACT
CREW SIZE	2	
TOTAL MNHRS	16	

SPECIAL PART NO'S AND TOOLS USED: Crosse - Part # 6H174 SE# 2014437

SERIAL NO. OF ITEM INSTALLED

	+ CALIBRATED TOOL NO.	+ PREVENTIVE MAINTENANCE
1.	5090A	☐
2.	05240 95D	+ CORRECTIVE MAINTENANCE ☑
3.	05271 0L 27340 35D	+ MAINTENANCE CODE ___
4.	05140 95D	+ MAINTENANCE CAUSE ___

WORK PERFORMED

0524005D 05141 05D

See Substantiating attachment yellow sheets and White sheet pgs 1 to 3

SEE ATTACH CAL SHEETS AND DATA FORMS (OAD)

RDH 3/4/89

DR NO.

— STAPLE TAG HERE —

Work Request # L87994
Date 3-3-89

Transformer # 242 S.S.T.
Drawings 1E-2-4000NF

Megger
megger voltage: 2500 VDC
acceptance criteria: 1 megohm/KV + 1 megohm

(X winding)	1. High to ground (low side grounded)	1000 meg ohms
(Y winding)	2. Low to ground (high side grounded)	975 meg ohms
	3. Low to ground (high side grounded)	750 meg ohms

10 min. megger results ✓ attached. Megger QA # 2574085.
0527101

TTR

TTR QA # 27340350

Expected Ratio $\frac{\text{Primary Volts} \times \sqrt{3}}{\text{Secondary Volts} \times \sqrt{3}} = \frac{345 \times \sqrt{3}}{6.9 \times \sqrt{3}} = 50$

$\frac{345 \times \sqrt{3}}{4.16 \times \sqrt{3}} = 82.932$

Windings		Readings	
Red Blk	Red Blk		
1, $H_1 - H_0$ to	$X_1 - X_0$	82.821	4.16 KV
2, $H_2 - H_0$ to	$X_2 - X_0$	82.877	
3, $H_3 - H_0$ to	$X_3 - X_0$	82.88	

Windings		Readings	
Red Blk	Red Blk		
1, $H_1 - H_0$ to	$Y_1 - Y_0$	49.081	6.9 KV
2, $H_2 - H_0$ to	$Y_2 - Y_0$	49.114	
3, $H_3 - H_0$ to	$Y_3 - Y_0$	49.116	

Evaluation

Megger Results ✓ acceptable
TTR Results ✓ acceptable

Joe J. Fowler 3/3/89

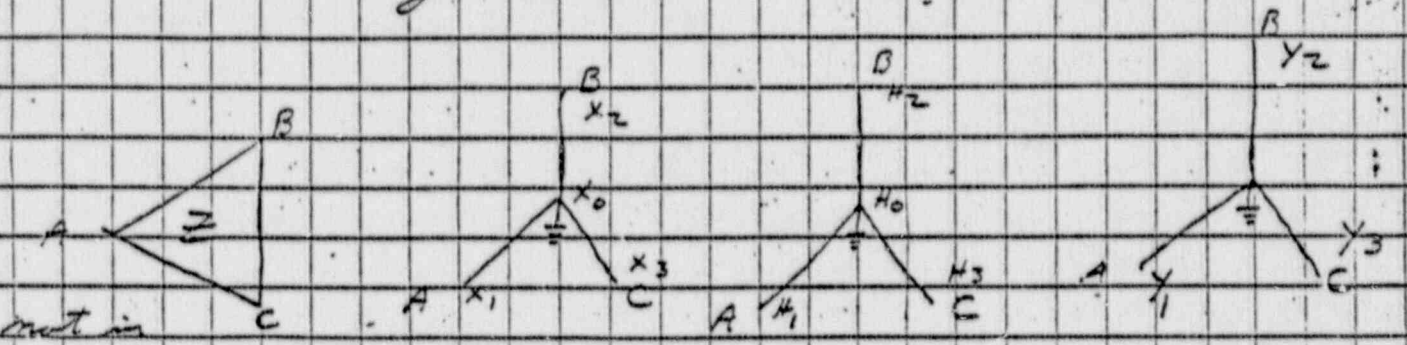
Unit Sub-Station

Megger and TTR test

Transformer Winding Connections

Transformer # 242 5 mVA

Vector Diagram



Not in use

Winding Connections — Readings

	Red		Blk		Red		Blk		
1	H_1	–	H_0	to	Y_1	–	Y_0	49.081	4.16 KV
2	H_2	–	H_0	to	Y_2	–	Y_0	49.114	
3	H_3	–	H_0	to	Y_3	–	Y_0	49.116	
1	H_1	–	H_0	to	X_1	–	X_0	82.821	6.9 KV
2	H_2	–	H_0	to	X_2	–	X_0	82.877	
3	H_3	–	H_0	to	X_3	–	X_0	82.880	

TEN MINUTE MEGGER

WORK REQUEST L 87994

DATE: 3/3/89

EQUIPMENT NAME: SAT HIGH SIDE 242

EQUIPMENT NO.:

MEGGER POINTS: HIGH SIDE TO GRD

DATA

MEGGER VOLTAGE:

MINUTES	READING	MULTIPLIER	MEGOHMS
0.00	50	5	250
0.50	150	↓	750
1.00	175		875
2.00	175		875
3.00	180		900
4.00	180		900
5.00	180		900
6.00	190		950
7.00	200		1000
8.00	200		1000
9.00	200	↓	1000
10.00	200	5	1000

60:30 SEC RATIO: $\frac{575}{250} = 1.16$

POLARIZATION INDEX (10:1 MIN RATIO): $\frac{1000}{875} = 1.14$

MEGGER QA NO. 0527104

EVALUATION: RESULTS: ↓ ACCEPTABLE, ___ NOT ACCEPTABLE

K. Higgins 3/3/89
OAD ENGINEER

ITS

TEN MINUTE MEGGER

WORK REQUEST L87994

DATE: 3 / 3 / 89

EQUIPMENT NAME: SAT 242

EQUIPMENT NO.: Y WINDING (2.3 C 0's TIED)

MEGGER POINTS: Y WINDING TO GROED

DATA

MEGGER VOLTAGE: 2500 VDC

MINUTES	READING	MULTIPLIER	MEGOHMS
0.00	170	5	850
0.50	175		875
1.00	200		1000
2.00	175		875
3.00	125		625
4.00	135		675
5.00	150		750
6.00	150		750
7.00	150		250
8.00	150		750
9.00	150		750
10.00	150	5	750

60:30 SEC RATIO: $\frac{1000}{875} = 1.14$

POLARIZATION INDEX (10:1 MIN RATIO): $\frac{750}{1000}$ .75

MEGGER QA NO. 052408SD

EVALUATION: RESULTS: ↘ ACCEPTABLE, ___ NOT ACCEPTABLE

R. Huggins
OAD ENGINEER

X WINDING & HIGH SIDE GROED

WORK REQUEST 487994

DATE: 3/3/89

EQUIPMENT NAME: SAT 242

EQUIPMENT NO.: X WINGING (A, B, C Ø's TIED)

MEGGER POINTS: X WINGING TO GRD

DATA

MEGGER VOLTAGE: 2500 VDC

MINUTES	READING	MULTIPLIER	MEGOHMS
0.00	150	5	750
0.50	150		750
1.00	160		800
2.00	170		850
3.00	175		875
4.00	180		900
5.00	180		900
6.00	195		975
7.00	195		975
8.00	195		975
9.00	195		975
10.00	195	5	975

60:30 SEC RATIO: $\frac{800}{750} = 1.06$

POLARIZATION INDEX (10:1 MIN RATIO): $\frac{975}{800} = 1.2$

MEGGER QA NO. 052408 SD

EVALUATION: RESULTS: ↘ ACCEPTABLE, ___ NOT ACCEPTABLE

K. Huggins 3/3/89
OAD ENGINEER

Y WINDING & HIGH SIDE GRDED

INSTRUCTIONS

GEK-34167
Supersedes GEK-32269

ALUGARD® II STATION ARRESTERS

MODEL 9L11M-SERIES 3-312 KV

MODEL 9L16B-SERIES ABOVE 312 KV

CAUTION: THE EQUIPMENT COVERED BY THESE INSTRUCTIONS SHOULD BE INSTALLED AND SERVICED ONLY BY COMPETENT PERSONNEL FAMILIAR WITH GOOD SAFETY PRACTICES. THIS INSTRUCTION IS WRITTEN FOR SUCH PERSONNEL AND IS NOT INTENDED AS A SUBSTITUTE FOR ADEQUATE TRAINING AND EXPERIENCE IN SAFE PROCEDURES FOR THIS TYPE OF EQUIPMENT.

The ALUGARD II Station Arrester is of single-phase design, suitable for outdoor service. Three arresters are required for three-phase installations. Smaller, lower-rated models are shipped assembled, while the larger, higher-rated models consist of four to six individual units which must be assembled. The arresters require no testing before being placed in service, and are completely self-supporting.

Each ALUGARD II arrester unit contains a number of THYRITE® valve and alurite gap elements permanently sealed in a porcelain housing provided with pressure-relief construction. Metal end fittings, cemented to the housing, provide a means for bolting the arrester units together or to a foundation.

APPLICATION

Arresters are designed to limit surge voltages to a safe value by discharging the surge current to ground, and to interrupt the power-frequency follow current. The ability to interrupt power-follow current is limited to applications where the power-frequency voltage at the arrester never exceeds the arrester's continuous or short-time rating. In case of doubt concerning application, consult your local General Electric Company representative.

INSTALLATION

INITIAL INSPECTION

ALUGARD II arresters are designed to withstand severe shipping shocks. In addition, each unit is shipped in a carefully designed container. If the crate or carton shows signs of rough handling upon receipt, the porcelain housing should be inspected for chips or cracks. If damage is apparent, the arrester should not be installed. Claims for such damage should be registered immediately with the common carrier.

The model number and continuous voltage rating of each complete arrester are identified on the nameplate which is attached to the lower end fittings. The nameplate information should be checked against the shipping memorandum. If at any time it is necessary to correspond with the General Electric Company, complete nameplate data should be furnished in order to expedite replies.

LOCATION

Install the arrester electrically as close as practicable to the apparatus being protected. Keep line and ground connections short and direct.

FOUNDATION

The footings of all outdoor piers or supports should extend below the frost line and be elevated above the ground line sufficiently to meet personnel safety requirements.

ASSEMBLY

Single-unit Arresters

Each arrester, except those requiring grading rings, is shipped completely assembled. When grading rings are needed, bolt them securely on the line end, before electrical connections are made.

All single-unit ratings can be suspension mounted if the line connection is made to the top of the arrester. The top cap of each standard ALUGARD II unit has provisions for attaching an insulator clevis fitting. Special ALUGARD II arresters rated 258 kV and below can be supplied for rigid suspension mounting from station structural members.

Install the arrester on the foundation, using care to see that it is perpendicular, shimming under one or two feet if necessary. It is important that all three feet rest solidly on the foundation before the foundation bolts are drawn down to avoid unnecessary stresses in the castings. Tighten the bolts firmly. The opening for pressure-relief should be oriented so as to minimize damage to adjacent equipment by incandescent gases in the remote event of arrester failure.

ATTACHMENT F

IMPORTANT: AN ARRESTER MUST CONSIST OF UNITS WITH IDENTICAL SERIAL NUMBERS.

Multi-unit Arresters

It is important that the individual arrester units be erected in the exact order specified on the outline drawing shipped with each arrester. The model number of the arrester unit is given on the unit nameplate which is attached to the bottom end casting. The base unit also bears the larger arrester nameplate.

Install the base unit on the foundation, using care to see that it is perpendicular, shimming under one or two feet if necessary. It is important that all three feet rest solidly on the foundation before the foundation bolts are drawn down to avoid unnecessary stresses in the castings. Tighten the bolts firmly. The opening for pressure-relief should be oriented so as to minimize damage to adjacent equipment by incandescent gases in the remote event of arrester failure.

Select the next unit carefully by reference to the outline drawing and bolt it securely to the base unit. The end fittings are carefully affixed at the factory to assure parallelism, so no further shimming should be required provided it was carefully done when the base unit was installed.

The line terminal cap has a central lifting hole and it may be used, if desired, as an aid to erection by bolting it temporarily to each unit in turn.

Be sure to install the grading rings at the points called for on the outline drawing.

LINE AND GROUND CONNECTIONS

Connect the arrester ground to the apparatus ground and the main station ground, utilizing a reliable common ground network of low resistance.

Connection to the line should be made through a suitable line connector. Line connections should be made in such a manner that no excessive mechanical stress is placed on the arrester. When connecting the arrester to an energized line, it is imperative that a quick, positive, continuous action be made to avoid possible damage to the arrester.

CAUTION: ALWAYS BE CERTAIN THAT THE GROUND CONNECTION IS FIRMLY MADE BEFORE CONNECTING THE ARRESTER TO AN ENERGIZED LINE. IF AN INSULATING UNIT IS USED AT THE GROUND END TO PERMIT USE OF A DISCHARGE COUNTER, THE DISCHARGE COUNTER MUST BE CONNECTED (OR THE INSULATING UNIT SHORTED OUT) BEFORE CONNECTING THE ARRESTER TO AN ENERGIZED LINE.

CLEARANCE

The term "clearance" means the actual distance between any parts of the arrester at line potential and any object at ground potential or other phase potential.

Clearances listed in the appropriate outline print packed with each arrester are the minimum recommended for conventional outdoor substations. Arresters rated 96 kV and below may be enclosed completely using the same clearance values. The values shown are suitable for altitudes up to 3300 feet (1000 meters). At higher altitudes, add 3 percent for each additional 1000 feet of elevation. The arrangement of the foundation plans shown on the outlines can be modified if proper clearances are maintained.

ALTITUDE

3-48 kV models 9L11M arresters can be used from 0-18,000 feet altitude.

60-312 kV arresters can be used from 0-10,000 feet altitude. ALUGARD II arrester sealing would allow these units to be applied to 18,000 feet, but they must be limited to 10,000 feet because reduction of air density increases the possibility of external flashover on these 9L11MHA series arresters.

ALUGARD II arresters, 9L15B series can be used from 0-10,000 feet altitude.

PERIODIC INSPECTION AND MAINTENANCE

Before inspecting or handling, disconnect the arrester from line and, as a safety precaution, ground the line end. *Remove this temporary ground before reconnecting the arrester onto the line.*

ALUGARD II arresters require no special care. They may be hot-washed, subject to the usual care and techniques used in hot-washing insulation to avoid external flashover.

These arresters do not require testing, and no test which applies power voltage in excess of maximum arrester voltage rating should be made without consulting the General Electric Company. There is no single field test which will indicate the complete operating characteristics of the arrester.

PORCELAIN TOP UNITS

Porcelain top arresters with center line terminals are available and are particularly suited for use in metal cubicles. These arresters can be mounted in any position when installed in a reasonably clean and dry indoor location.

DISCHARGE COUNTERS

An insulating base is required when installing a discharge counter with arresters. Both of these are accessories and are described in Handbook Section 9030. Install the discharge counter and insulating base as shown on the outline drawing furnished with the counter.

The following report details the analysis of the lightning arrester which was sent to the manufacturer (General Electric) to determine the failure mechanism.

On Monday, April 10, 1989, Gregg Mathewson of System Electrical Engineering Department witnessed in the teardown of the subject lightning arrester in the GECo factory in Pittsfield, Massachusetts.

On the day of the incident at LaSalle Station visible external evidence was found to indicate that the arrester had failed internally. The area around the top expulsion port was darkened and metalic splatter was found on the porcelain at the area of the top expulsion port. No evidence of external flashover to the base of the arrester was found. It was surmised by all at the site that the arrester failed internally.

However, upon disassembly of the arrester at the factory, no evidence of internal failure was found. The internal spark gaps were all intact. Also, the top and bottom expulsion ports and seals were intact and had not operated.

The factory inspection conclusively indicated that the arrester had not failed internally (Attached).

On Thursday, April 13, 1989, Messrs. L.R. Yule and R.F. Cameron of the System Electrical Engineering Department met with Steve Samolinski from LaSalle Station Technical Staff. The area around the SAT 242 transformer was inspected in an attempt to locate flash marks on grounded objects near the SAT 242 transformer CO lightning arrester. A brass nozzle on the deluge system near the CO arrester showed definite signs of recent flashover burning as viewed through a 50 power telescope.

It is our conclusion that an external CO to ground flashover occurred from the CO arrester top can and grading ring to the grounded deluge system brass nozzle. It is further postulated that conductive debris was blown across this area to cause the flashover. (The air clearance is too great to cause flashover in air for the protective level of this lightning arrester.) Attached is a copy of weather data obtained from LaSalle Station indicating that the wind direction at the 33 foot level was from the East at a speed of approximately 22 MPH the proper direction to support this postulation.

Additionally, the following clarification needs to be made in reference to Page 15 of the AIT report concerning this incident. In the second paragraph of Section 4 of the report, it states that this incident caused a "catastrophic" failure of the lightning arrester. It should be noted that the utility industry generally reserves the word "catastrophic" when applied to arrester failures to indicate the arrester porcelain was shattered and strewn over the area of the incident. This clarification is made so as to identify that there was not a violent failure of the lightning arrester.

L117	DRYWELL HUMIDITY	% RH	GOOD VALUE	22.844
L118	DRYWELL PRESSURE	PSIG	OUT OF SCAN LO	0.000
L122	SUPP POOL WATER TEMP NW	DEGF	GOOD VALUE	57.027
L123	SUPP POOL WATER TEMP SE	DEGF	GOOD VALUE	57.402
L124	SUPP POOL WATER LEVEL	IN.	GOOD VALUE	-1.085
L128	SUPP POOL PRESSURE	PSIG	GOOD VALUE	0.003
C229	TOTAL CONDEN POLISH FLOW	GPM	GOOD VALUE	19765.000
F458	COND DEMIN 1A FLOW	GPM	GOOD VALUE	3387.500
F459	COND DEMIN 1B FLOW	GPM	GOOD VALUE	3196.250
F460	COND DEMIN 1C FLOW	GPM	GOOD VALUE	3336.250
F461	COND DEMIN 1D FLOW	GPM	GOOD VALUE	3376.250
F462	COND DEMIN 1E FLOW	GPM	GOOD VALUE	3280.000
F463	COND DEMIN 1F FLOW	GPM	GOOD VALUE	3188.750
F464	COND DEMIN 1G FLOW	GPM	GOOD VALUE	0.000
C090	HEAT REJ TO COND	MBTU/H	GOOD VALUE	6513.312
C091	CIRC WTR TEMP RISE	DEGF	GOOD VALUE	30.933
C092	COND GRIST TEMP DIF	DEGF	GOOD VALUE	45.307
C093	COND LEAST TEMP DIF	DEGF	GOOD VALUE	14.374
C094	LOG MEAN TEMP DIFF	DEGF	GOOD VALUE	26.944
C095	ACT HT TRANS COEF		GOOD VALUE	254.459
C096	CIRC WTR VELOCITY	FT/SEC	GOOD VALUE	4.770
C097	TH HEAT TRANSFER RATE		GOOD VALUE	363.730
C098	CLEANLINESS FACTOR		GOOD VALUE	0.700
F285	LINE A COND INLET	DEGF	GOOD VALUE	43.069
F286	LINE B COND INLET	DEGF	GOOD VALUE	43.234
F359	LINE A COND OUTLET	DEGF	GOOD VALUE	81.393
F360	LINE A COND OUTLET	DEGF	GOOD VALUE	77.672
F361	LINE A COND OUTLET	DEGF	GOOD VALUE	76.568
F362	LINE A COND OUTLET	DEGF	GOOD VALUE	81.262
F363	LINE B COND OUTLET	DEGF	GOOD VALUE	82.229
F364	LINE B COND OUTLET	DEGF	GOOD VALUE	79.467
F365	LINE B COND OUTLET	DEGF	GOOD VALUE	77.396
F366	LINE B COND OUTLET	DEGF	GOOD VALUE	84.577
C024	DIESEL GEN POWER	MW	GOOD VALUE	0.000
E424	DG 0 KWATTS	KW	GOOD VALUE	0.219
E425	DG 1A KWATTS	KW	GOOD VALUE	-0.219
T235	EHC FLUID	PSIG	GOOD VALUE	1615.625
T236	EHC FLUID	DEGF	GOOD VALUE	117.635
A847	WIND DIRECT AT 375FT	DGREES	GOOD VALUE	442.461
A848	WIND DIRECT AT 200FT	DGREES	GOOD VALUE	448.875
A849	WIND SPEED AT 375FT	M.P.H.	GOOD VALUE	27.844
A850	WIND SPEED AT 200FT	M.P.H.	GOOD VALUE	25.937
A851	DIFF TEMP AT 33FT/375	DEGF/F	GOOD VALUE	-1.894
A852	WIND SPEED AT 33FT	M.P.H.	GOOD VALUE	22.484
A853	WIND DIRECT AT 33FT	DGREES	GOOD VALUE	87.412
A854	TEMP AT 33FT	DEGF	GOOD VALUE	24.260
F289	HTR 16A EXT	PSIG	GOOD VALUE	278.875
F290	HTR 16B EXT	PSIG	GOOD VALUE	277.875
F291	HTR 15A EXT	PSIG	GOOD VALUE	121.062
F292	HTR 15B EXT	PSIG	GOOD VALUE	122.187
F293	HTR 15C EXT	PSIG	GOOD VALUE	121.362
F294	HTR 14A EXT	PSIG	GOOD VALUE	63.719
F295	HTR 14B EXT	PSIG	GOOD VALUE	64.250
F296	HTR 14C EXT	PSIG	GOOD VALUE	65.625
F297	HTR 13A EXT	PSIG	GOOD VALUE	32.625
F298	HTR 13B EXT	PSIG	GOOD VALUE	32.922
F299	HTR 13C EXT	PSIG	GOOD VALUE	33.672

3/2/84

22220

GENERAL ELECTRIC'S FORMAL REPORT ON

THE DISASSEMBLY AND INSPECTION OF

THE 9L11MHA264 ALUGARD STATION ARRESTER

MEMORANDUM

Disassembly and inspection of an Alugard 9L11MHA264 arrester returned from service by Commonwealth Edison Co. S/N 48007, Date Code L76

This report discusses observations and conclusions made during disassembly of the arrester with the customer representative Mr. Gregg Mathewson present on 4/10/89.

Description of the unit, including past history.

The subject arrester was installed on phase C of the unit 2 Sys.Aux. Tr.242 of the LaSalle County Generating Station. In approximately 1984 it was found that the Tr.142 and 242 arresters had been installed and operated since installation without the proper grading rings and at that time corrective action was taken. The lack of a grading ring will result in higher than normal voltage across the upper gaps causing some degradation in the sparkover characteristics, a higher than normal operating temperature of the upper grading rods, and a likelihood of internal corona in the internal upper portion of the arrester at normal operating voltage. On 02-28-89, at 23:02 Hrs the station tripped on differential. Note that the arrester is outside of the differential zone, so an arrester failure should not cause differential tripping. The station record showed that for 18 sec. before tripout there was a ground current indication of >= 200 amps. The record showed a pole disagreement on breaker opening. The event oscillogram shows 4.5 cycles of fault current coincidental with a collapse of the C phase voltage and in addition a half cycle collapse of the B phase voltage just prior to breaker opening. The fault current is listed on the oscillogram as 4875 amps although the available was stated to be 46 Ka. Upon inspection of the station after the event the upper end of this C phase arrester was "smoked up" in the vicinity of the pressure relief port indicating operation of the upper pressure relief port (See attached photo #1). Also noted was a cracked bushing on the breaker. The breaker was repaired, the arrester replaced, and the station was then reenergized successfully. At the time of the event there was reported to be some rain and the temperature was probably about 40F.

Disassembly of the arrester

A visual inspection confirmed extensive "smoking" of the upper end of the housing in the area of the pressure relief port so it was assumed without further investigation that venting had indeed occurred and the arrester was then opened by melting off the lower end casting. The lower gasket was found in the proper position and in excellent condition (Photo # 2) and there was no burning or arc marks of any kind on the lower aluminum sealing plate (Photo # 3). The lower three arrester sections were removed through the bottom end and found to be in generally very good condition with no indication of any failure arc (Photos # 4,5,6). The only deterioration noted was that the nylon washers used to

secure the epoxy glass clamping rods had become brittle from oxidation to the point where they mechanically gave way and released the tension in the stack assemblies. The effect of this was that the stacks tended to fall apart when removed from the housing as seen in the photos; however, there would be no adverse effect in the erect unopened arrester because the compression springs in the assembly act to captivate everything in place. That is, the tie rods only serve the purpose of facilitating arrester assembly and stabilizing the internal parts during shipment. The grading capacitors in this Arrester were Erie units, code 05266, with the brown encapsulant introduced to cure the problem with ozone imbrittelment experienced with some of the earlier red units. As expected they showed no degradation even though there was obviously much ozone present as evidenced by the yellow color of the nylon washers.

The upper end casting was melted off next to facilitate removal of the upper internal unit and to inspect the gasket seal and lead pressure relief diaphram. This gasket was also in excellent shape and the seal had not been violated. That is, the lead pressure relief diaphram had not ruptured or vented in any way. Photo # 7 shows the interior of the upper and lower sealing systems as they were when removed and photos # 8 and 9 are of the inside and outside faces respectively of the disassembled parts of the upper sealing and pressure relief system.

At this point then it was obvious that this arrester had not failed and must not have contributed to the event. The arrester contained 44 gaps and, counting from the bottom, gaps 1, 11, 21, and 44 were removed, tested for sparkover, and dissected. The results of the tests were:

Gap #	R.N. Start	S.O.	Normal S.O.
1	6.0 Kv	13.5-14.5	Approx 14
11	7.5 Kv	9.03-9.15	Approx 9.1
21	7.5 Kv	8.97-9.03	Approx 9.1
44	8.0 Kv	13.6-14.1	Approx 14

The test values are essentially normal, indicating little or no deterioration and this would be expected from the fine appearance of the internal parts. Particularly significant are the results on gaps 11 and 21 which are control gaps and are in as good as new condition. The end plates were then removed from the gaps revealing, as seen in photo # 10, that the electrodes and arc chambers were also like new. In fact a close inspection of these parts indicate that either the arrester never experienced a discharge or, at the worst, any operations it did see were very benign.

Photos # 11 and 12 show details of the arc damage to the upper housing and in particular photo # 11 reveals that although of course a high current arc did contact the housing it did not significantly mark the top petticoat and hence could hardly have originated anywhere near the upper relief vent. There was considerable residue deposited on the housing which appeared to be primarily organic and with numerous splatters of copper. The organic deposit led to speculation that the arc may have involved a loose insulated

lead and Mr Mathewson took some wipes from the surface to see if it could be identified by chemical analysis. Photo # 13 of the upper end fitting shows evidence of small arc marks or splatters but no evidence of a high current arc termination. Photo # 14 is of one of the grading ring mounting ears of the upper end fitting and shows an indication that a heavy current may have flowed between the casting and the grading ring mounting strap. Perhaps the external arc current flowed through the arrester drop lead then to the casting and the grading ring and then off the ring to some adjacent object.

Summary

The arrester had not failed and did not vent and therefore is not considered to be the cause of the event. The internal parts were in excellent condition except for severe oxidation of some organic parts, particularly the nylon tie rod retaining washers. The washers at the upper end were in far worse shape than those at the lower end probably both because operation without a grading ring would cause internal corona in the upper part and thus generate ozone which is a strong oxidizer and also because the upper parts would be the warmest, also enhanced by the lack of a grading ring. It must be emphasized however that in spite of the severe oxidation of some organics the writer does not believe that this had any significant effect on the reliability and viability of the arrester. All of the important parts including the gaps, grading circuits, valve elements, and seals were essentially unaffected. It is the writers recommendation that the lack of grading rings should not be considered as having compromised the reliability of the remaining arresters.

J S Kresge
(consultant)
4/19/89

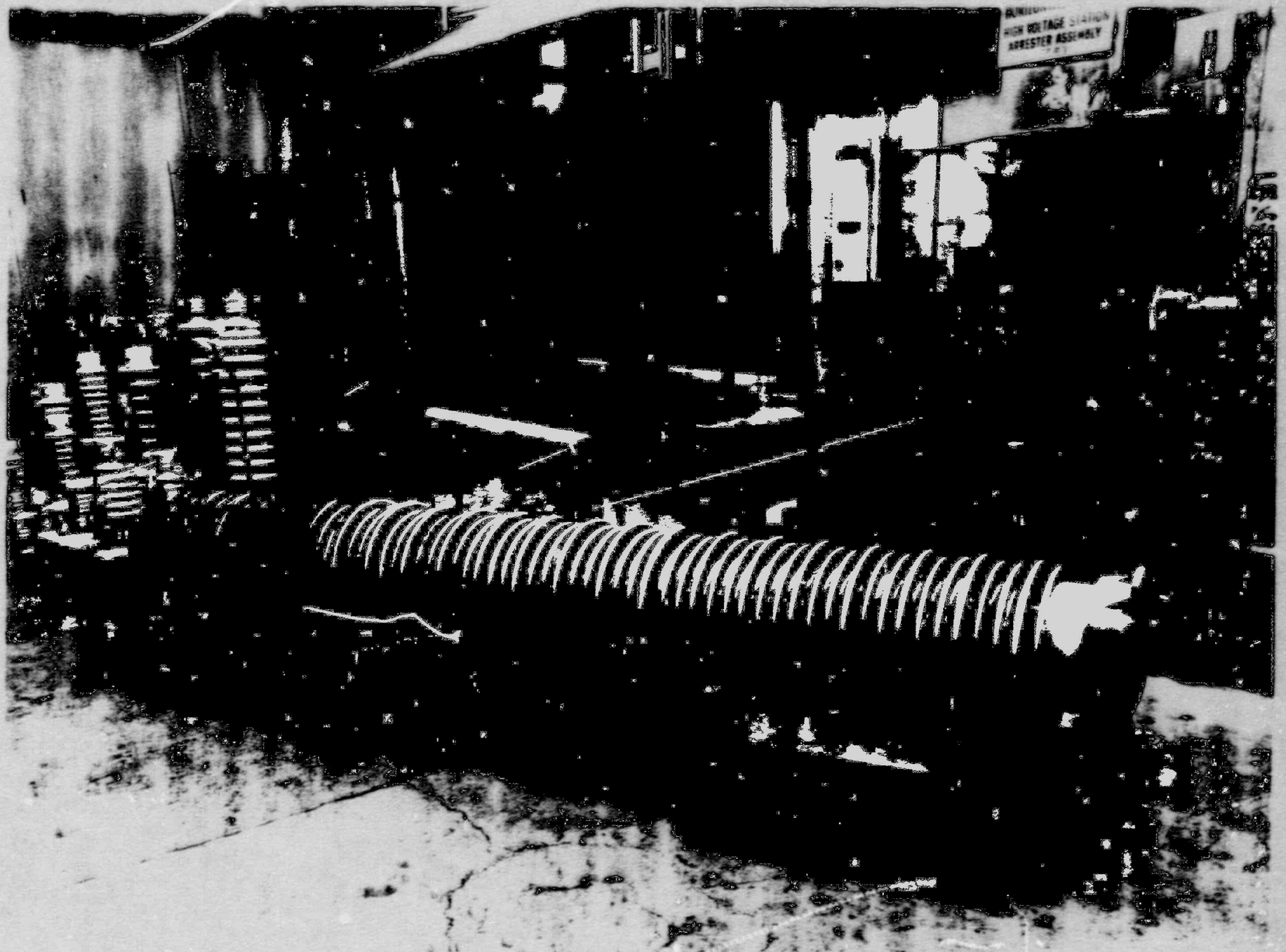


Photo # 1

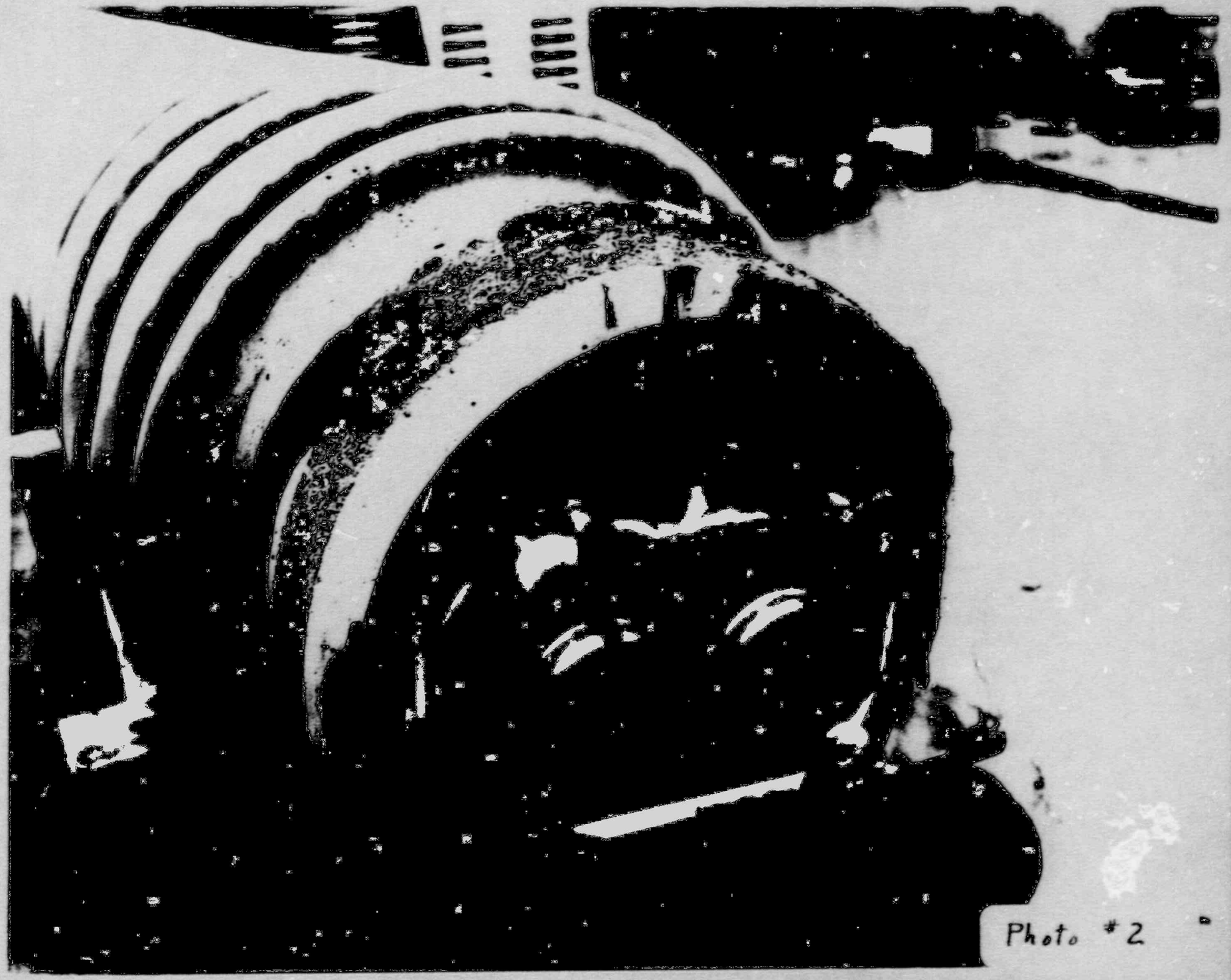


Photo #2

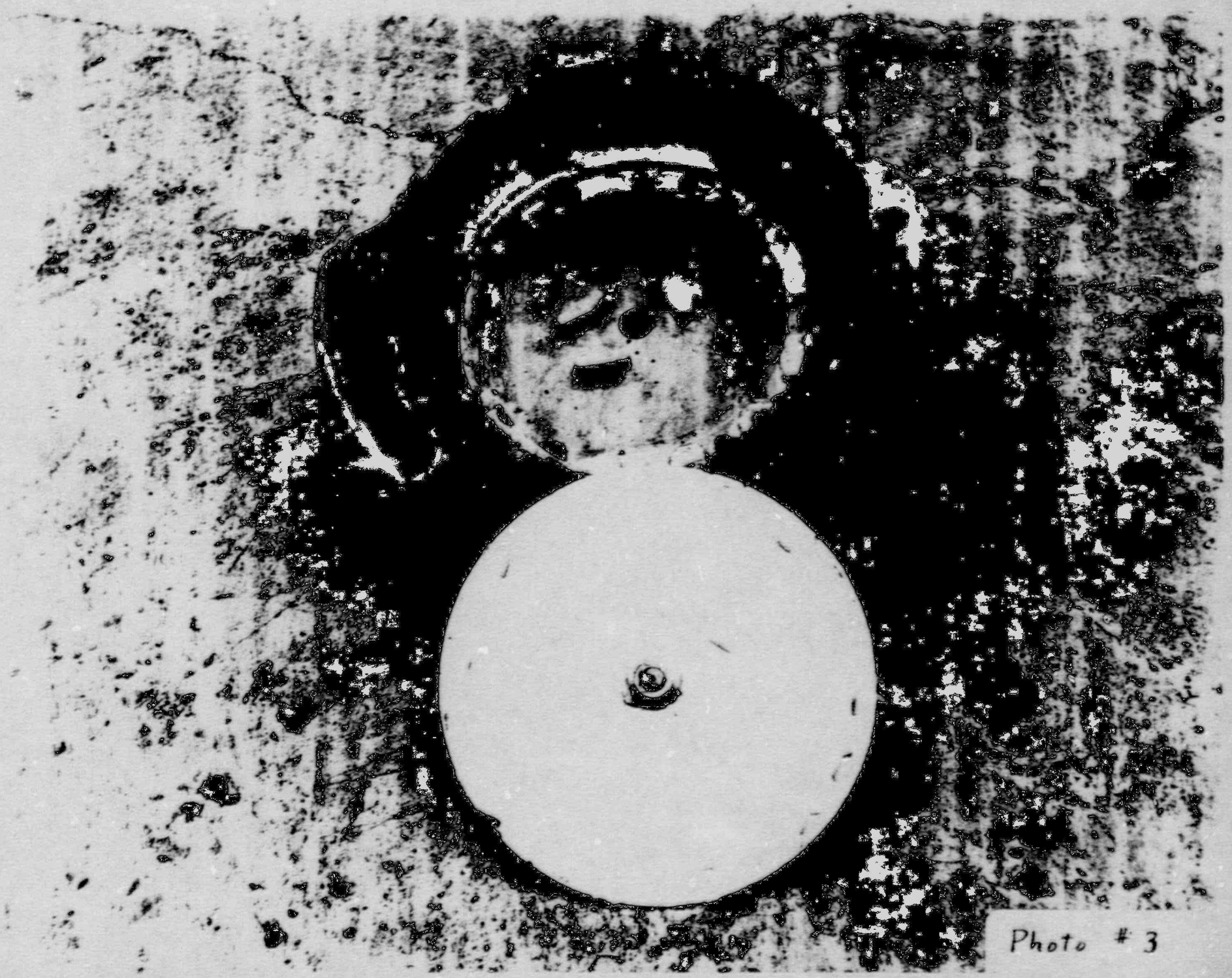


Photo # 3

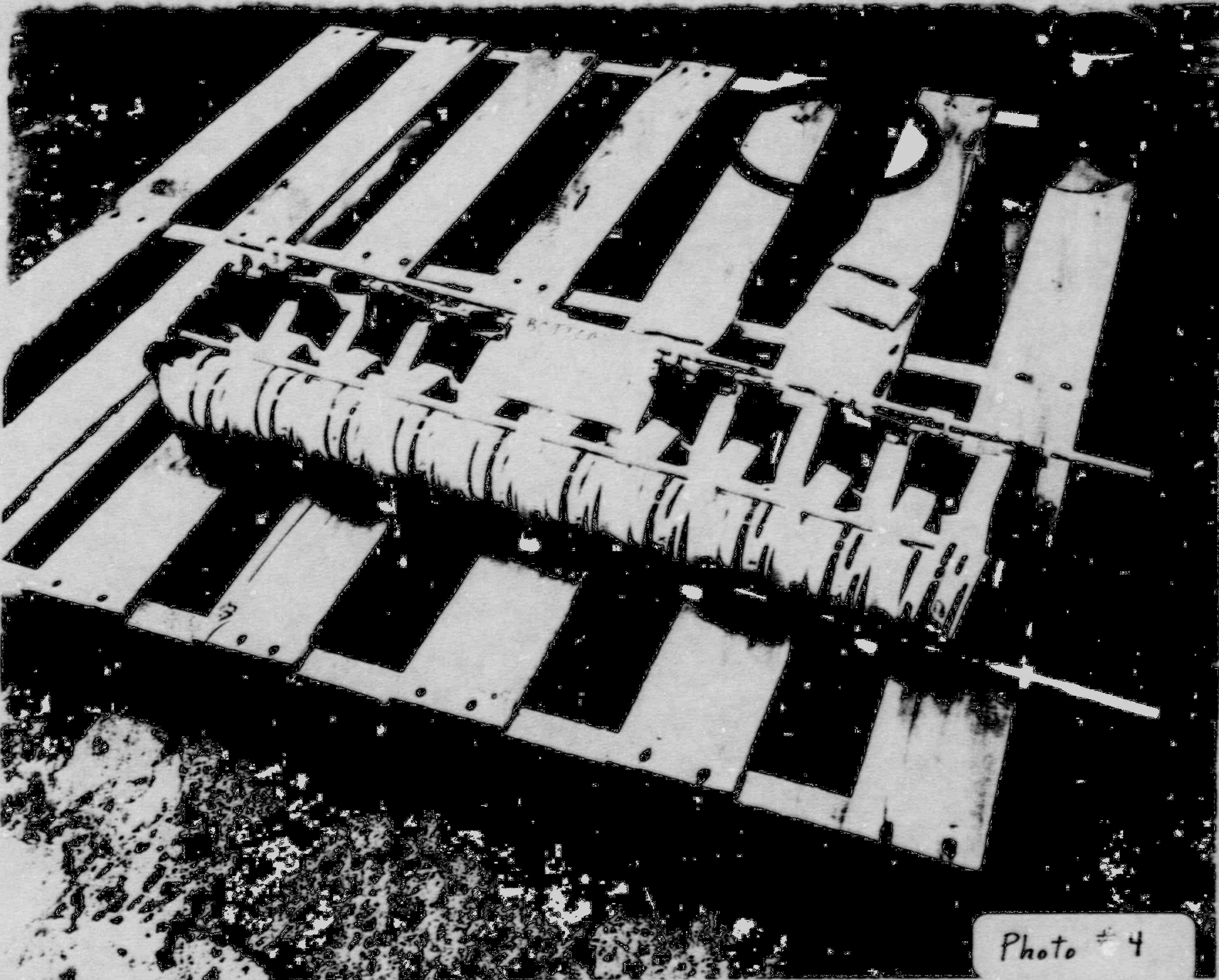


Photo # 4

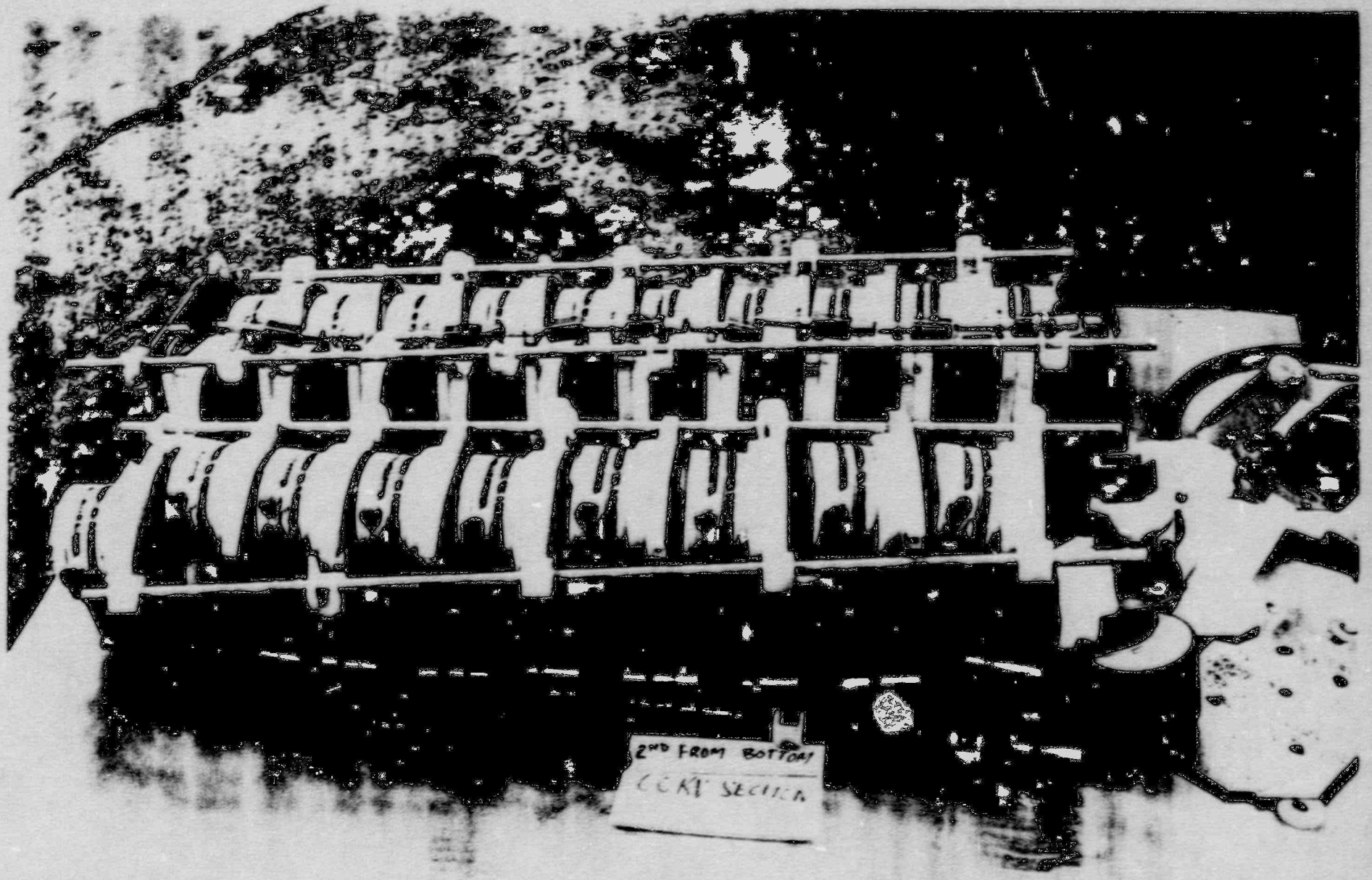


Photo # 5

Photo # 6

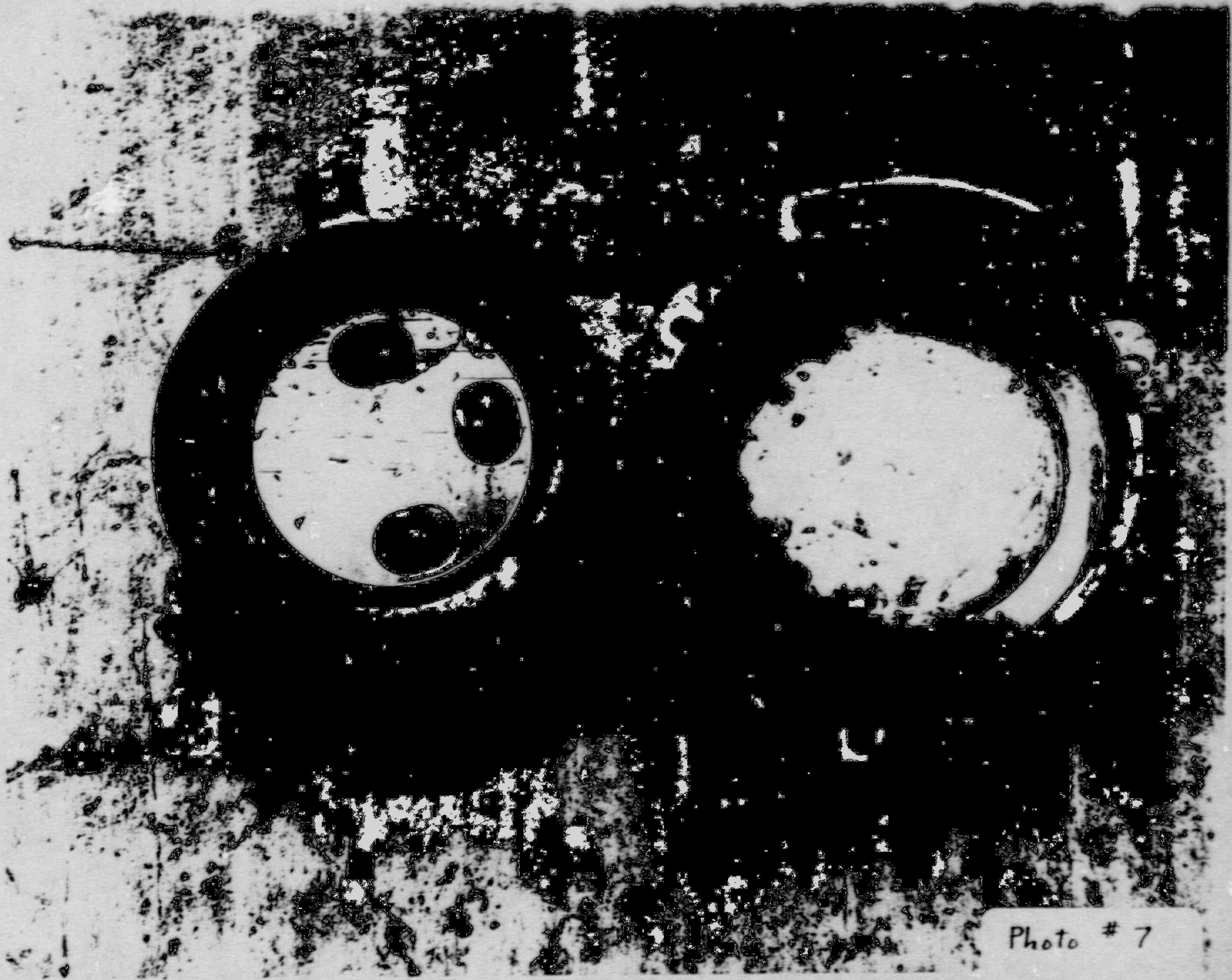


Photo # 7

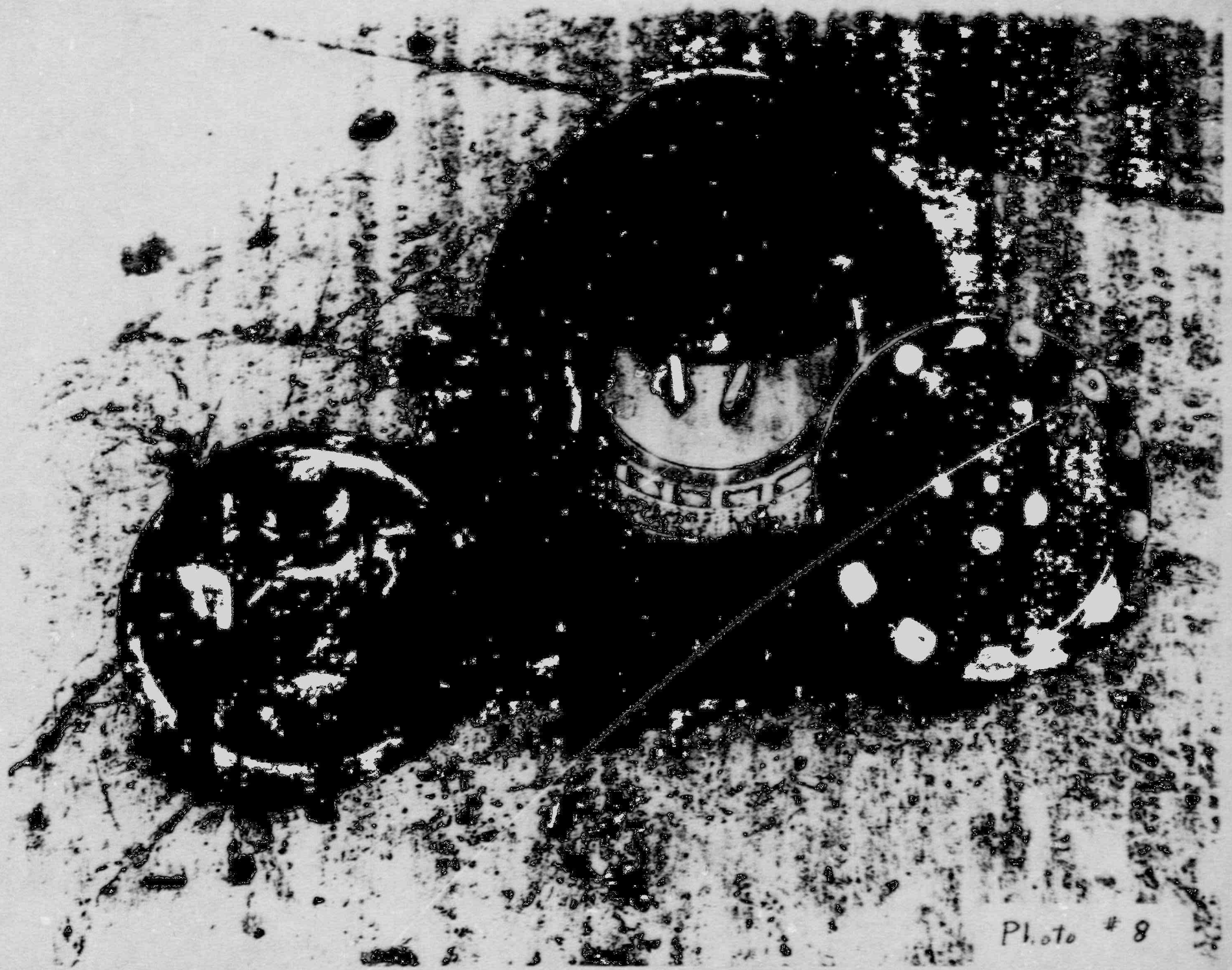


Photo # 8

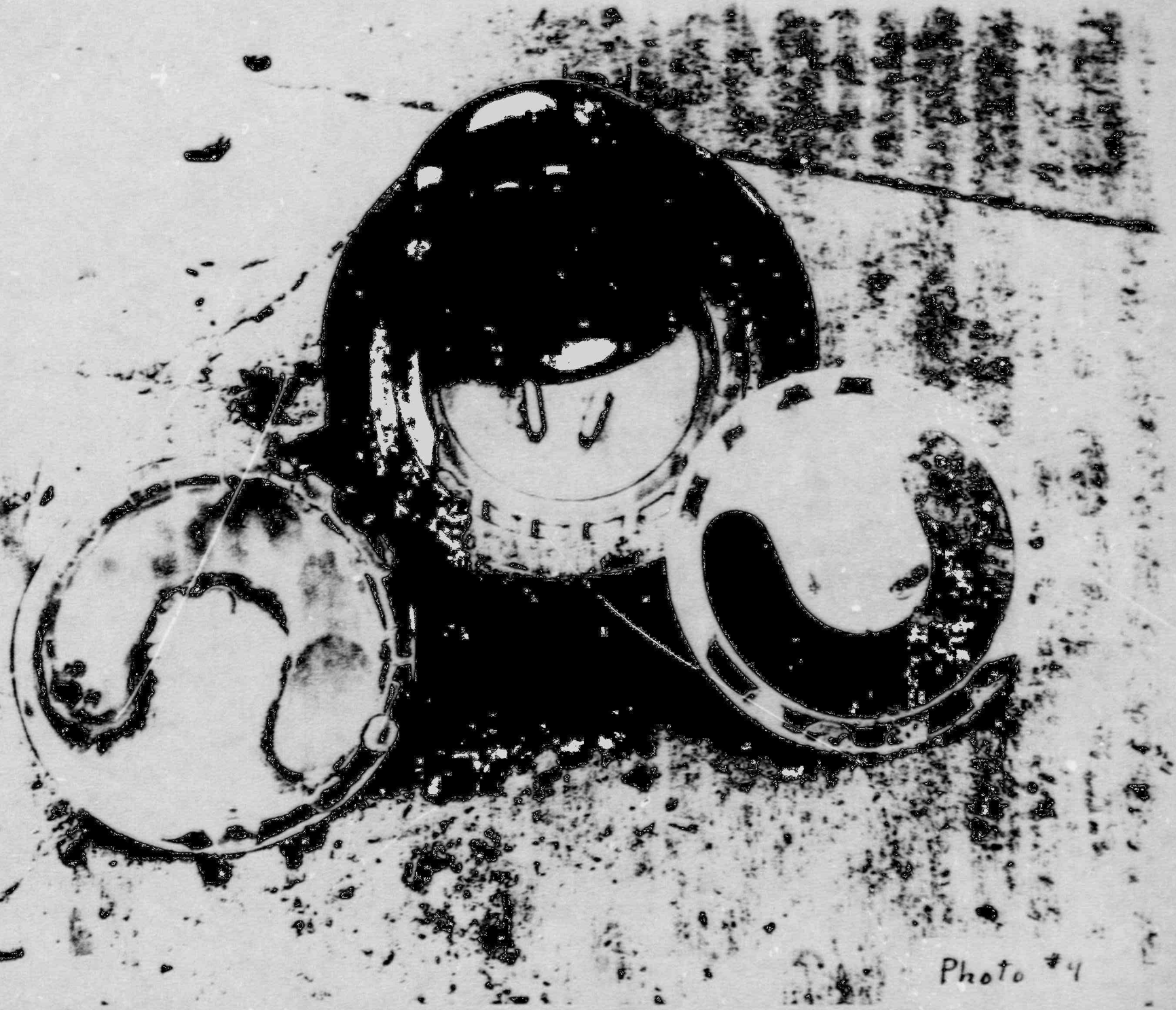


Photo #4

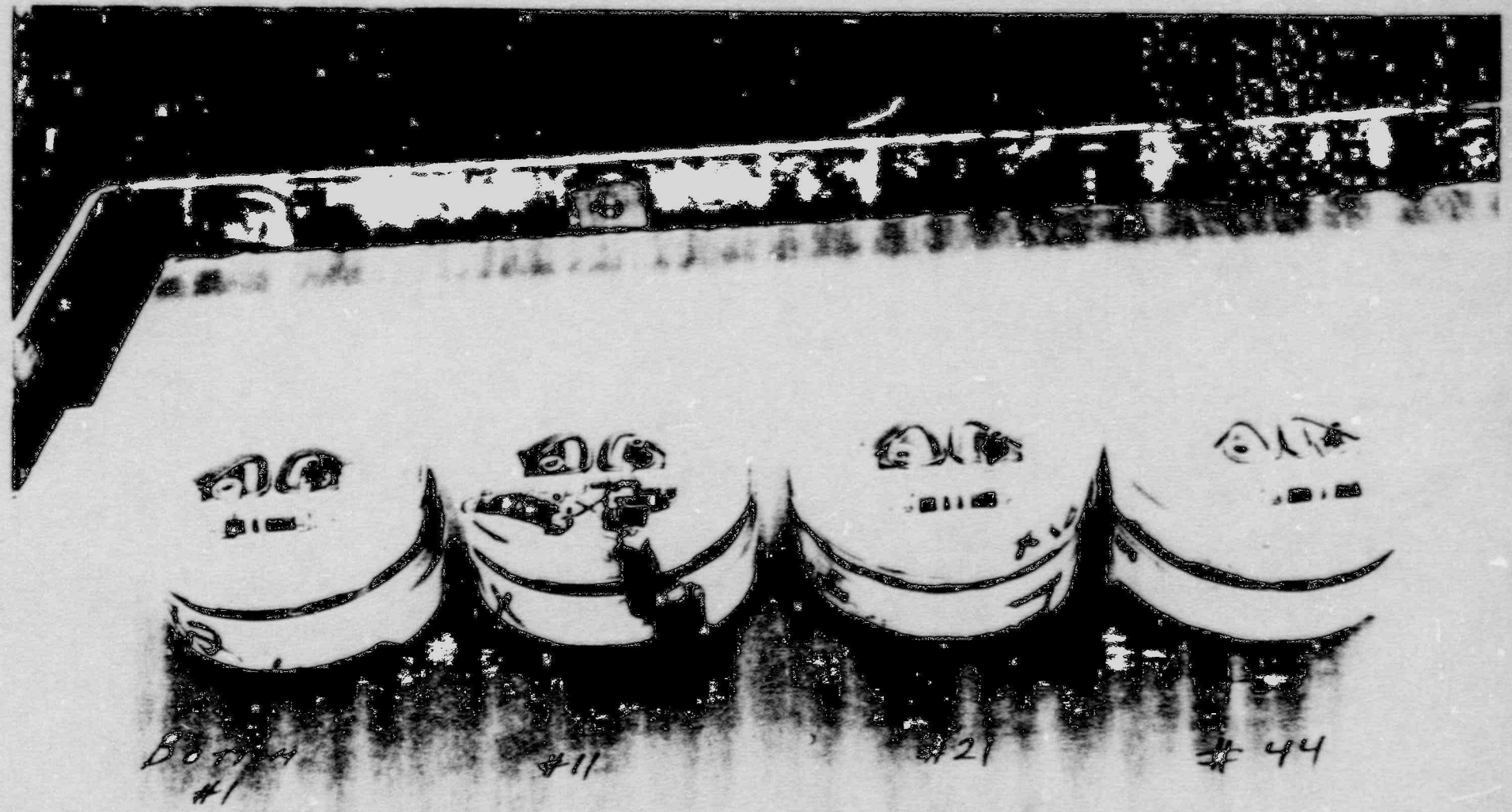


Photo #10

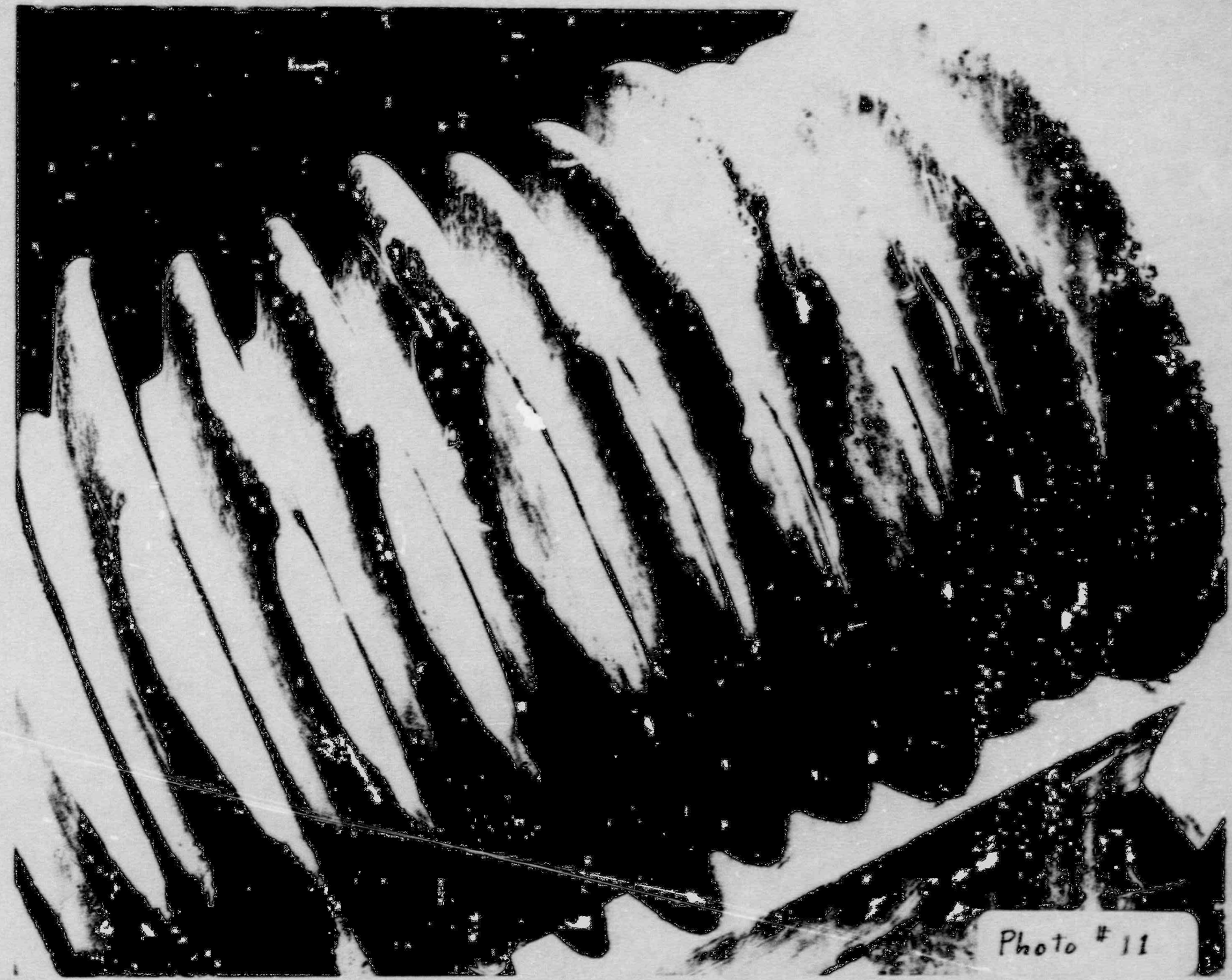


Photo # 11

Photo # 12

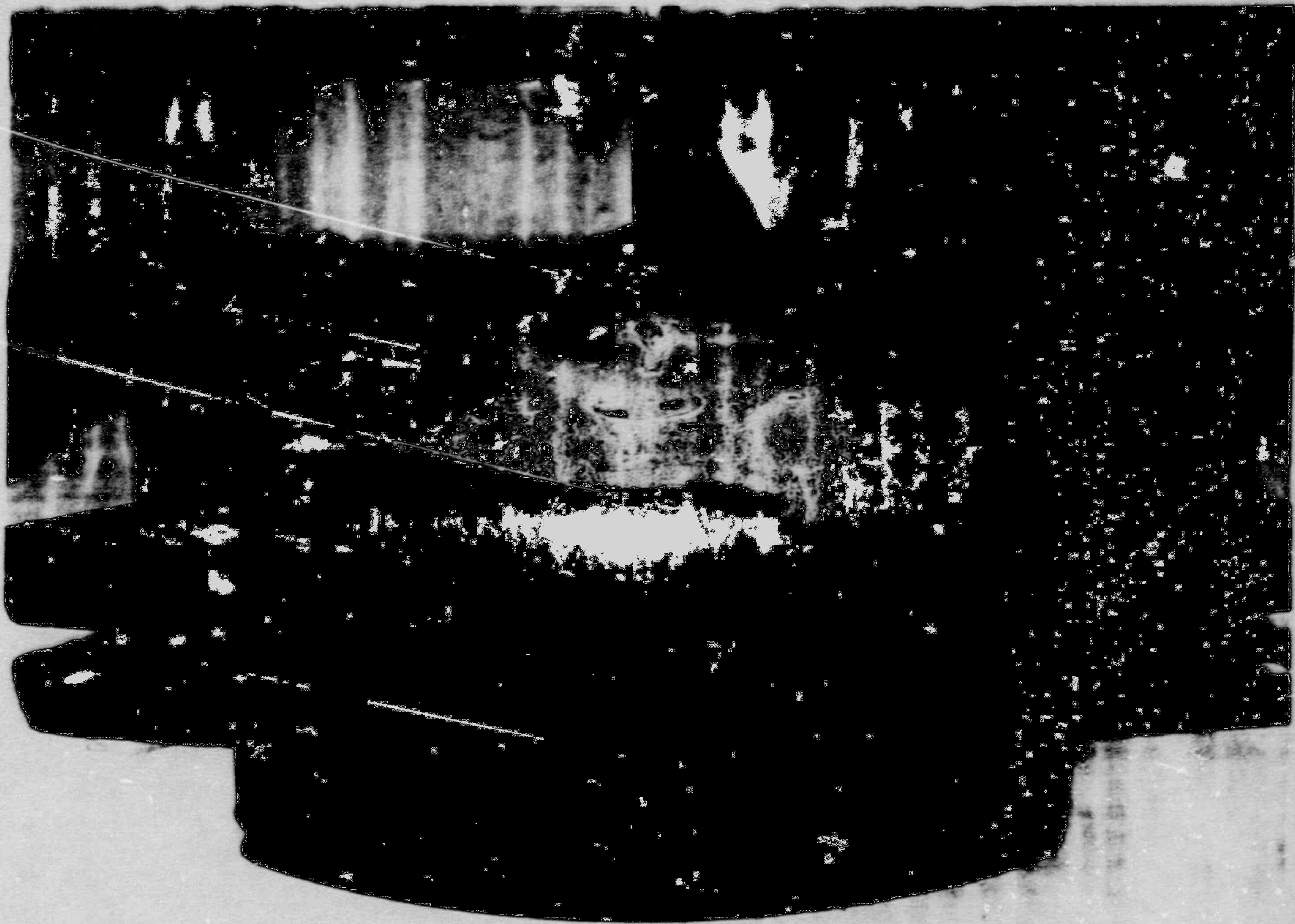
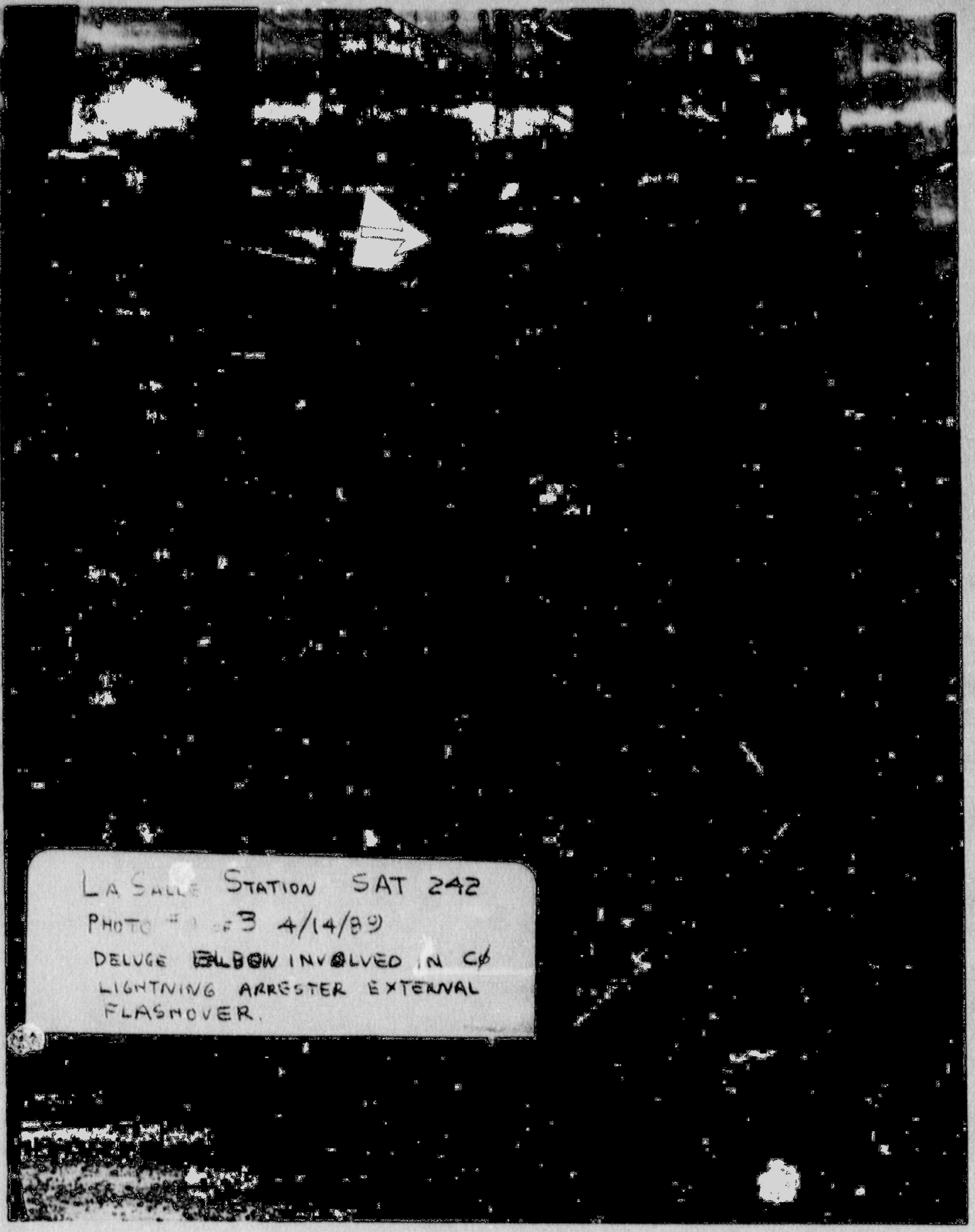
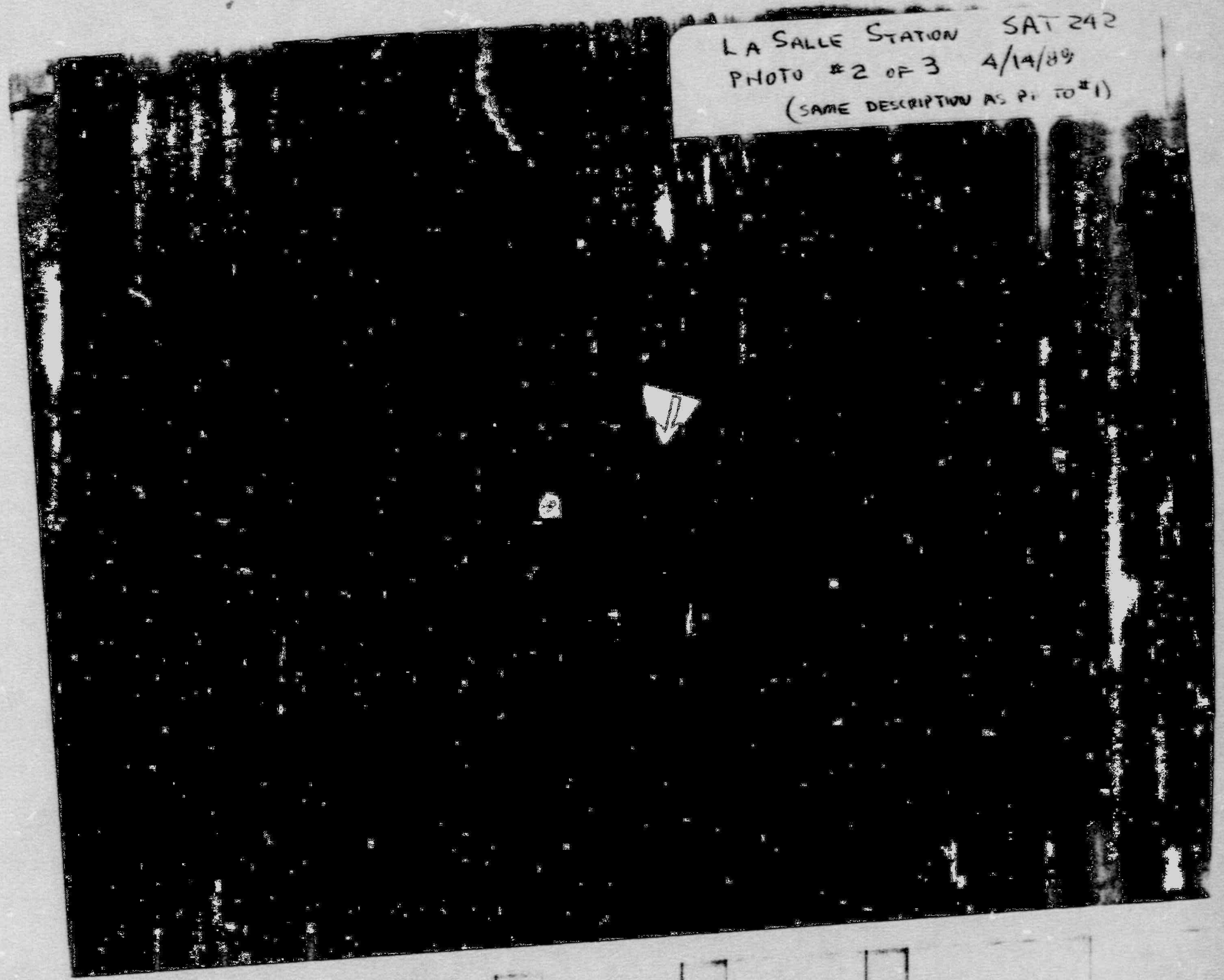
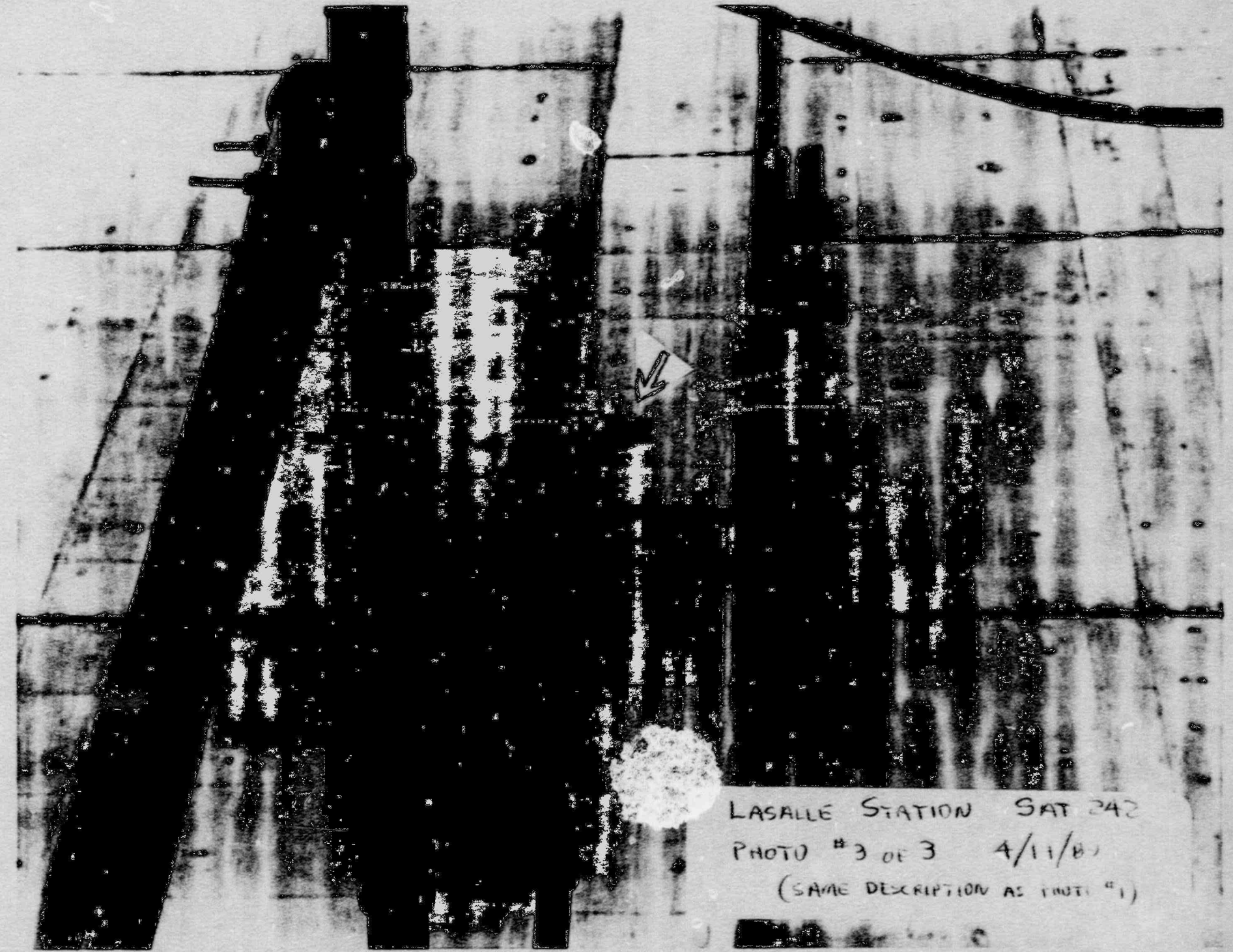


Photo #13

Photo #14


LA SALLE STATION SAT 242
PHOTO # 1 OF 3 4/14/89
DELUGE ELBOW INVOLVED IN CØ
LIGHTNING ARRESTER EXTERNAL
FLASHOVER.


LA SALLE STATION SAT 242
PHOTO #2 OF 3 4/14/89
(SAME DESCRIPTION AS PHOTO #1)



LASALLE STATION SAT 242
PHOTO #3 OF 3 4/11/81
(SAME DESCRIPTION AS PHOTO "1")

UNRESOLVED ITEM: 373/89007-02
374/89007-02

... The AIT discussed with the licensee, the availability of reliable sequence of event information. The licensee had no formal policy to ensure that when one unit's process computer was on alternate power supply for UPS maintenance that the other unit's process computer was not out of service for maintenance or on its alternate power supply. This would also apply to the Hathaways. The licensee has initiated an action item to review the AIT's concern. Review of the licensee's actions is considered an unresolved item.

RESPONSE:

The policy for the Process Computer and Hathaway sequence of events recorders Power Supply (PS) has been revised. The status of each PS will be recorded in the shiftly operator rounds package. If the PS is in bypass, a work request will be initiated or verified to be outstanding to ensure the problem is corrected. PS work requests which require the PS to be placed in bypass will be classified as priority B1. If the work requires the Unit to be placed in a different condition to complete the work (e.g., Unit must be in shutdown), the work will be performed at the next opportunity of sufficient duration. An engraved sign will be placed by the Hathaways power supply breaker requiring that the shift supervisor be notified prior to changing over to the alternate supply.