NUS-4792

RESULTS OF THE ATMOSPHERIC TRACER STUDY WITHIN THE BUILDING COMPLEX AT THE PERRY NUCLEAR POWER PLANT

Prepared for
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

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1.0 INTRODUCTION

In September 1985, NUS conducted an atmospheric tracer study within the Building Complex of the Perry Nuclear Power Plant (PNPP). This report provides the results of the field program.

The description of the site is presented in Section 2. The field program description is discussed in Section 3. The field data are presented in Section 4. Analyses of the data are described in Section 5, and Section 6 contains the conclusions. References are described in Section 7, and a glossary is provided in Section 8. An executive summary appears in Section 9.

The purpose of the study was to characterize the atmospheric dispersion between specific release points and ventilator system intakes within the Building Complex at the PNPP. The tracer study was conducted for The Cleveland Electric Illuminating Company under contract to NUS Corporation. NUS Corporation subcontracted to Tracer Technologies of Escondido, California, for the release and measurement of tracer materials.

In the remainder of this section, the following are described:

- Objectives
- Existing Dispersion Estimates

1.1 Objectives

The atmospheric tracer study was conducted to characterize the atmospheric dispersion within the Building Complex at PNPP. The atmospheric dispersion is represented by normalized concentrations, Chi/Q. Of concern is the value for a one-hour average for use in evaluating accident scenarios. This value (applicable for 0 to 8 hours) is used to determine the dose received through the air pathway between the containment buildings and the Control Room as it affects the habitability of the Control Room.

The primary objective was to demonstrate by measurement that a reduction in Chi/Qs would be appropriate relative to those estimated based on the generic

Murphy and Campe (1974) methodology. The Chi/Qs correspond to the atmospheric dispersion at the ventilation intakes for the Control Complex, which supply air to the region around the Control Room.

1.2 Existing Dispersion Estimates

The "existing" dispersion estimates were those determined prior to this study. These estimates were calculated using the NRC-accepted methodology of Murphy and Campe (1974), "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19." Section B.1.b of the methodology was determined to be applicable to the Perry Control Room.

The existing dispersion estimates were determined in 1985 (Mitchell, 1985) and were based on the seven-year meteorological data set and the generic Murphy and Campe (1974) methodology:

> The revised control room Chi/Qs for CEI/PNPP are presented below. The methodology employed was Murphy and Campe's "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19." The seven-year meteorological data base, described in the 1983 Annual Report (NUS-4536), was used: 5/1/72-4/30/74, 9/1/77-8/31/82. The Chi/Q values represented the worst case of those comprised of the combinations of Units 1 and 2 control room air intakes and Units 1 and 2 containments and vents. The containments and vents were treated as diffuse area sources in accordance with the Murphy and Campe methodology. The controlling case was the combination of the Unit 1 control room receptor and Unit 2 containment source. An occupancy factor of one (1) was assumed throughout the duration of the accident for the purpose of these calculations.

Chi/Q (s/m^3) For Time After Accident			
0-8 hrs	8-24 hrs	1-4 days	4-30 days
3.5E-3	2.1E-3	1.1E-3	2.3E-4

Note: 3.5E-3 = 3.5×10^{-3}

Supplemental information on the application of the methodology was considered. Based on the geometry of the plant layout, a determination was made of the wind direction sectors that could potentially affect a receptor

for a given source. The following cases (consistent with Murphy & Campe) were examined:

Case 1: Unit 1 Containment to Unit 1 Control Room, sectors NNE-E;
Case 3: Unit 1 Containment to Unit 2 Control Room, sectors N-ENE;
Case 5: Unit 2 Containment to Unit 1 Control Room, sectors ENE-SE;
Case 7: Unit 2 Containment to Unit 2 Control Room, sectors NE-ESE.

Cases 2, 4, 6 and 8 were the same configurations as above except that the stack vent, rather than the containment, was the source. No credit for momentum or buoyancy was included. These were treated as point rather than diffuse-area sources. However, as presented in Murphy and Campe, the point-source methodology was not applicable to the Perry site geometry. Therefore, only cases 1, 3, 5 and 7 were used in further evaluation.

Cumulative wind speed probability distributions were determined for the combined sectors of interest for each case. The speed distributions were based on the seven-year Perry meteorological data base Joint Frequency Distribution (JFD) (5/1/72-4/30/74; 9/1/77-8/31/82) that is presented in Table 1-1. The speed distributions were combined into a cumulative frequency distribution beginning with the lowest speeds. The point of the lowest five percent of the wind speeds was identified: 95 percent of the speed occurrences were above the 5th percentile. The 5th percentile wind speeds were selected for input to the following equation (equation 6 from Murphy and Campe):

$$Chi/Q = \frac{1}{U[\pi\sigma_y\sigma_z + a/(k+2)]}$$

where:

Chi/Q = 0 to 8 hr relative concentration at the plume centerline (s/m^3)

$$k = \frac{3}{(s/d)^{1.4}}$$

s = distance between containment surface and receptor location (approximately 60 m for Perry)

d = diameter of containment (approximately 41.5 m for Perry)

a = projected area of containment building (=1780m^2 for Perry)

U = 5th percentile wind speed at a height of 10 meters (m/sec)

σ_y = standard deviation of the plume concentration in the horizontal crosswind direction (m)

σ_z = standard deviation of the plume concentration in the vertical crosswind direction (m)

The σ_y and σ_z were selected to represent 5th percentile dispersion conditions -- based on the assumption of stability class F (moderately stable) conditions (specified by Murphy and Campe) and the controlling 5th percentile wind speeds (in the range of 0.5 to 1.0 m/s, depending on the case examined) as prescribed by the methodology.

Thus, using the Murphy & Campe formulation, the controlling meteorological conditions for control room dispersion calculations are wind direction sectors N through SE, 10-m wind speeds of about 0.5 to 1.0 m/s, and delta T (60m-10m) stability class of F.

Stability class refers to the description of atmospheric turbulence based upon measurements of temperature differential (delta T) over a vertical distance on the meteorological tower based on USNRC, 1972:

A = Very unstable
B = Moderately unstable
C = Slightly unstable
D = Neutral
E = Slightly stable

F = Moderately stable

G = Very stable

The Chi/Qs applicable throughout the course of the accident scenario were determined in accordance with Murphy and Campe. Wind speed and wind direction factors were determined from the seven-year JFD on the basis of observations in the sectors that could result in an exposure. The resulting factors were applied to the 0-8 hour Chi/Q to obtain values for time periods out to 30 days. The factors were as follows:

Time Period	Wind Speed Factor	Wind Direction Factor	Combined Factor
0-8 hrs	1.00	1.00	1.00
8-24 hrs	0.73	0.80	0.58
1-4 days	0.51	0.61	0.31
4-30 days	0.31	0.21	0.07

The literature indicated that the Murphy and Campe methodology may provide results that are overly conservative for a given application by a factor of 10 to 100 (Hosker, 1982). Thus, the present study was conducted to determine site-specific estimates for Perry.

Table 1-1. Seven-Year Joint Frequency Distribution
(Sheet 1 of 5)

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

May 1, 1972 - April 30, 1974
and
September 1, 1977 - August 31, 1982

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	2
0.35- 0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.51- 0.75	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	4
0.76- 1.00	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	4
1.01- 1.50	1	1	0	1	2	1	1	1	0	1	1	0	0	2	2	3	17
1.51- 2.00	3	7	2	1	3	1	2	1	1	1	0	1	3	3	8	4	41
2.01- 3.00	62	26	8	4	5	6	3	6	8	4	3	13	23	35	41	53	297
3.01- 5.00	120	131	64	21	16	14	24	26	35	33	40	41	148	146	127	103	1089
5.01- 7.00	15	23	68	9	1	6	7	19	12	17	21	54	130	32	15	14	443
7.01-10.00	1	0	16	2	0	0	1	2	4	4	6	28	37	4	4	1	110
10.01-13.00	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	5
13.00-	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
TOTAL	202	189	158	38	28	31	38	57	60	60	72	137	343	223	198	178	2014

STABILITY CLASS B

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
0.35- 0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.51- 0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0.76- 1.00	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	3
1.01- 1.50	2	2	1	1	2	2	1	0	0	1	0	0	2	0	2	3	19
1.51- 2.00	3	6	2	2	3	2	3	3	0	0	1	0	0	7	3	4	39
2.01- 3.00	30	29	8	7	9	10	7	7	7	5	3	5	19	29	42	30	247
3.01- 5.00	61	85	58	16	11	15	37	27	28	40	29	63	140	120	68	60	858
5.01- 7.00	13	10	42	10	3	4	13	11	16	29	19	41	131	37	23	18	420
7.01-10.00	0	3	11	2	0	0	8	1	5	10	7	33	43	10	6	0	139
10.01-13.00	0	0	0	0	0	0	1	1	0	0	0	1	2	1	0	0	6
13.00-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	109	135	122	39	28	33	71	50	57	85	59	143	337	204	144	116	1732

Table 1-1. Seven-Year Joint Frequency Distribution
(Sheet 2 of 5)

STABILITY CLASS C

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

May 1, 1972 - April 30, 1974
and
September 1, 1977 - August 31, 1982

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
0.35- 0.50	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3
0.51- 0.75	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3
0.76- 1.00	1	0	0	0	1	0	0	2	1	0	1	1	0	2	0	0	9
1.01- 1.50	2	2	0	1	4	1	3	1	0	2	0	0	4	4	2	8	34
1.51- 2.00	4	6	3	3	5	5	2	2	3	3	1	4	1	7	6	14	69
2.01- 3.00	52	17	21	10	17	12	14	21	22	16	14	20	40	56	58	45	435
3.01- 5.00	82	86	98	22	17	24	29	38	53	45	42	84	187	158	127	81	1173
5.01- 7.00	8	12	41	18	2	3	13	18	39	37	22	72	111	60	25	11	492
7.01-10.00	1	2	9	2	0	0	5	2	5	11	23	49	41	21	8	2	181
10.01-13.00	0	0	0	0	0	0	0	0	2	0	0	5	0	2	0	0	9
>13.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	152	126	172	56	46	45	66	85	125	115	104	235	384	310	226	161	2408

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	36
0.35- 0.50	5	5	4	7	5	4	5	4	5	1	9	4	4	2	3	2	69
0.51- 0.75	5	5	10	11	9	4	9	5	8	7	10	8	9	1	3	3	107
0.76- 1.00	15	16	18	32	24	11	7	6	6	9	21	10	20	12	8	11	226
1.01- 1.50	49	54	54	79	76	41	33	33	31	37	60	35	48	46	37	51	764
1.51- 2.00	73	95	96	115	92	67	46	50	68	56	72	85	79	96	76	72	1238
2.01- 3.00	311	310	338	354	326	186	176	209	301	315	303	299	411	384	392	298	4917
3.01- 5.00	634	476	728	572	290	280	370	390	631	854	876	898	1253	1000	790	604	10646
5.01- 7.00	194	99	234	250	31	74	274	243	345	491	705	950	1012	701	700	311	6614
7.01-10.00	43	29	81	87	5	31	140	97	91	132	279	652	546	454	366	123	3156
10.01-13.00	6	1	5	13	0	2	10	6	10	11	33	152	105	45	44	5	448
>13.00	0	0	0	0	0	0	0	0	0	6	1	5	5	2	0	0	26
TOTAL	1335	1090	1568	1520	858	700	1070	1013	1496	1923	2369	3098	3492	2750	2419	1480	28247

Table 1-1. Seven-Year Joint Frequency Distribution
(Sheet 3 of 5)

STABILITY CLASS E

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

May 1, 1972 - April 30, 1974
and
September 1, 1977 - August 31, 1982

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	66
0.35- 0.50	4	7	10	6	10	9	7	7	6	12	11	5	5	4	8	9	120
0.51- 0.75	14	14	19	21	23	16	28	17	22	10	14	11	9	10	9	8	245
0.76- 1.00	17	14	21	31	40	33	27	17	34	21	20	15	19	14	13	6	342
1.01- 1.50	28	39	68	92	108	90	83	64	84	68	75	58	50	32	28	29	996
1.51- 2.00	39	59	85	121	179	117	125	121	141	161	120	91	78	38	31	27	1533
2.01- 3.00	122	120	124	208	296	225	291	414	618	672	445	205	142	112	77	118	4189
3.01- 5.00	153	95	90	132	91	164	369	467	1019	723	461	364	201	154	118	166	4767
5.01- 7.00	22	23	19	10	4	33	165	198	327	220	182	189	105	45	42	47	1631
7.01-10.00	3	1	5	3	0	12	68	61	60	79	55	91	48	24	10	4	524
10.01-13.00	0	0	0	0	0	0	9	2	5	10	9	9	8	1	1	3	57
>13.00	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4
TOTAL	402	372	441	624	751	699	1172	1368	2316	1976	1392	1042	665	434	337	417	14474

STABILITY CLASS F

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	63
0.35- 0.50	2	4	7	16	21	14	20	14	16	10	4	1	7	4	3	3	140
0.51- 0.75	11	10	12	15	34	26	25	31	28	21	11	9	7	2	3	1	246
0.76- 1.00	4	3	10	35	74	49	46	43	48	27	20	12	11	5	2	0	389
1.01- 1.50	2	6	20	58	141	119	72	53	91	63	43	18	8	5	1	9	709
1.51- 2.00	11	6	12	46	110	111	102	72	97	116	58	19	8	5	7	3	783
2.01- 3.00	10	4	14	42	106	186	149	257	318	256	92	16	4	4	5	5	1468
3.01- 5.00	7	6	8	16	9	34	32	48	98	38	26	1	1	3	5	2	334
5.01- 7.00	0	0	0	0	0	0	0	1	4	0	0	3	1	0	1	0	10
7.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-13.00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
>13.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	47	39	77	228	495	539	446	519	700	531	254	80	47	28	27	23	4143

Table 1-1. Seven-Year Joint Frequency Distribution
(Sheet 4 of 5)

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

May 1, 1972 - April 30, 1974
and
September 1, 1977 - August 31, 1982

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	163
0.35- 0.50	2	3	8	13	47	67	76	63	43	15	12	5	3	3	1	1	362
0.51- 0.75	3	6	9	19	88	148	167	127	113	32	6	7	3	2	3	2	735
0.76- 1.00	4	3	14	19	108	187	182	144	129	52	20	4	5	2	1	1	875
1.01- 1.50	2	5	12	46	203	243	194	195	139	64	24	7	7	0	1	3	1145
1.51- 2.00	2	3	6	25	84	114	121	132	114	30	10	4	2	1	1	2	651
2.01- 3.00	4	1	2	30	58	80	91	197	200	46	14	4	0	1	0	2	730
3.01- 5.00	1	1	0	4	2	5	5	31	26	2	0	0	1	0	0	0	78
5.01- 7.00	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3
7.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-13.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.00+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	19	22	51	156	590	844	836	889	764	242	86	31	21	9	7	12	4742

STABILITY CLASS ALL

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (M/S)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	330
0.35- 0.50	14	20	23	42	83	94	108	88	70	38	37	15	19	13	15	15	694
0.51- 0.75	34	35	50	66	154	196	229	181	171	71	41	35	29	15	19	15	1341
0.76- 1.00	41	37	63	118	248	281	263	213	219	109	82	42	55	35	24	18	1848
1.01- 1.50	86	109	155	278	536	497	387	347	345	236	203	118	119	89	73	106	3684
1.51- 2.00	135	182	206	313	476	417	401	381	424	367	262	204	171	157	132	126	4354
2.01- 3.00	591	507	515	655	817	705	731	1111	1474	1318	874	559	639	621	615	551	12283
3.01- 5.00	1058	880	1046	783	436	536	866	1027	1890	1735	1474	1451	1931	1581	1235	1016	18945
5.01- 7.00	253	167	404	297	41	120	472	490	743	795	949	1309	1490	875	816	402	9613
7.01-10.00	48	35	122	96	5	42	222	163	165	236	370	853	715	513	394	130	4110
10.01-13.00	6	1	5	13	0	2	20	10	17	21	43	169	116	50	45	8	526
13.00+	0	0	0	0	0	0	0	0	0	6	1	11	5	0	0	0	32
TOTAL	2266	1973	2589	2661	2796	2891	3699	4011	5518	4932	4336	4766	5289	3958	3358	2387	57760

Table 1-1. Seven-Year Joint Frequency Distribution
(Sheet 5 of 5)

STABILITY BASED ON: DELTA T BETWEEN 60.0 AND 10.0 METERS
WIND MEASURED AT: 10.0 METERS
WIND THRESHOLD AT: 0.75 MPH

May 1, 1972 - April 30, 1974
and
September 1, 1977 - August 31, 1982

TOTAL NUMBER OF OBSERVATIONS: 61344

TOTAL NUMBER OF VALID OBSERVATIONS: 57760

TOTAL NUMBER OF MISSING OBSERVATIONS: 3584

PERCENT DATA RECOVERY FOR THIS PERIOD: 94.2 %

MEAN WIND SPEED FOR THIS PERIOD: 3.7 M/S

TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
3.49	3.00	4.17	48.90	25.06	7.17	8.21

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	202	189	158	38	28	31	38	57	60	60	72	137	343	223	198	179	2
B	179	135	122	39	28	33	71	50	57	85	59	143	337	204	144	116	0
C	152	126	172	56	46	45	66	85	125	115	104	235	384	310	226	161	0
D	1335	1090	1568	1520	858	700	1070	1043	1496	1923	2369	3098	3492	2750	2419	1480	36
E	402	372	441	624	751	699	1172	1368	2316	1976	1392	1042	665	434	337	417	66
F	47	39	77	228	495	539	446	519	700	531	254	80	47	28	27	23	63
G	19	22	51	156	590	844	836	889	764	242	86	31	21	9	7	12	163
TOTAL	2266	1573	2589	2661	2796	2891	3699	4011	5518	4932	4336	4766	5289	3958	3358	2387	330

2.0 SITE DESCRIPTION

The Perry Nuclear Power Plant (PNPP) is located approximately 45 miles northeast of Cleveland, Ohio, on the shore of Lake Erie. The 10-mile radius of the PNPP is of low relief, of mixed use, and largely open, including fields, forests, agricultural and nursery activities, and buildings and towns. Additional discussion of regional topography can be found in the FSAR (1980), Section 2.3.2.3.

Figure 2-1 depicts the site plan on a topographic map, reproduced from FSAR Figure 2.3-15. The shoreline is oriented approximately northeast-southwest, with Lake Erie to the north. While the site boundary extends over a mile inland, the Building Complex is centered on the north side of the site.

The plot plan of the Building Complex is shown in Figure 2-2, reproduced from Figure 1.2-2 of the FSAR (1985). Near the center of the figure are the reactor buildings for Units 1 and 2 and the Control Complex. These are located in the midst of many other adjoining and separate buildings. The locations of the tall, natural-draft cooling towers to the northeast are also depicted.

A close-up of the Building Complex within the vicinity of the reactor buildings is shown in Figure 2-3. This figure, reproduced from Figure 1.2-10 from the FSAR (1985), is an overhead view of the roof level. The containment vent stack for both units is located slightly outside (plant west) the region between the reactor buildings. The air intakes to the Control Complex are shown farther to the west. They are within approximately 60 m of the containments on the west face of the Control Complex. (Figure 3-2 depicts some of those details more clearly.)

A side view of this region is provided in Figure 2-4, Section C-C, reproduced from Figure 1.2-13 of the FSAR (1985). The vent stack is separate from the reactor building, but reaches almost as high (to 750 ft.). The air intakes for the Control Complex are not shown but are located about 200 feet to the left (plant west), halfway up the exposed face (of the Control

Complex) that faces away from the reactor buildings (note the approximate location of these as illustrated in Figure 3-3).

These air intakes are the only direct air pathway to the Control Complex for any airborne releases from the reactor buildings and stack vent. The Control Room is contained entirely within the Control Complex.

Thus, for the study, tracers were released from the containments and stack and sampled at the intakes. Refer to Section 3.2 for study details.

APPENDIX E

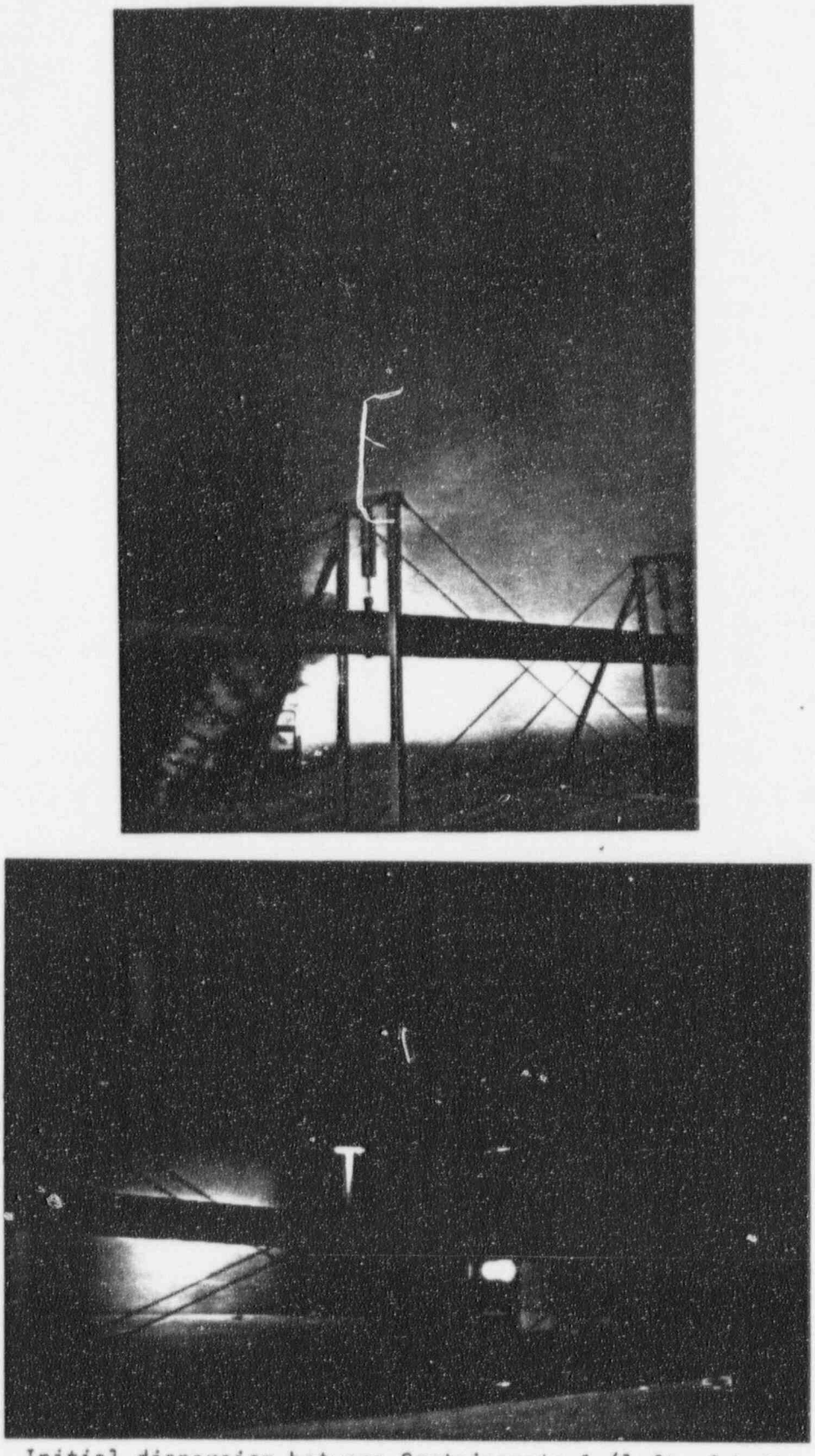
PHOTOGRAPHS OF SMOKE RELEASES

Building Complex Tracer Study

September 1985

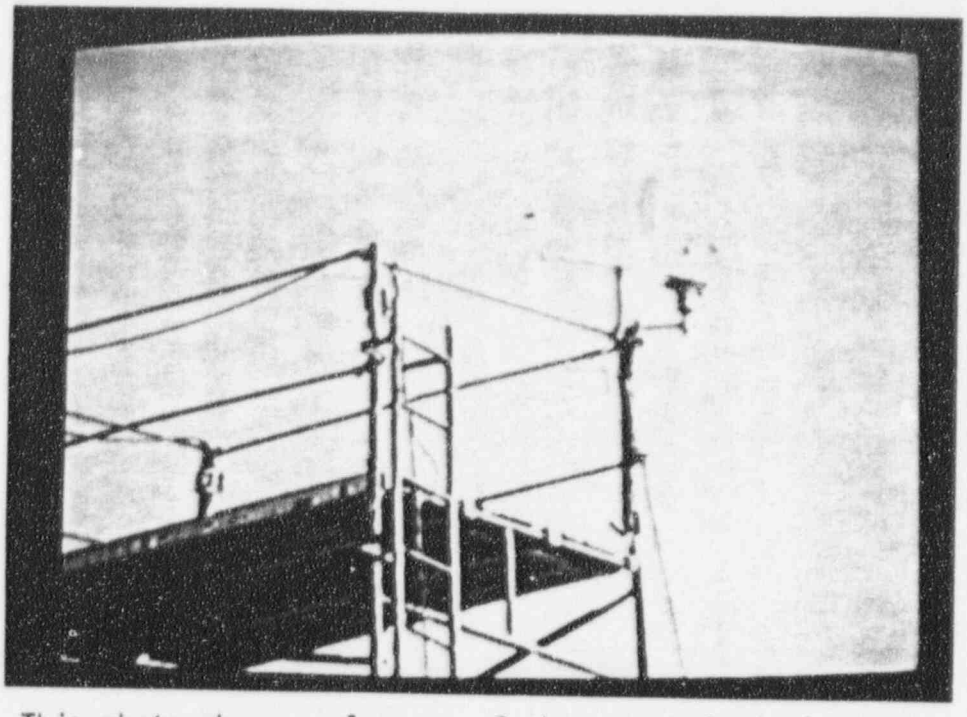
Perry Nuclear Power Plant

Photos have been selected from still and video records of smoke releases in order to illustrate dispersion in the Building Complex.

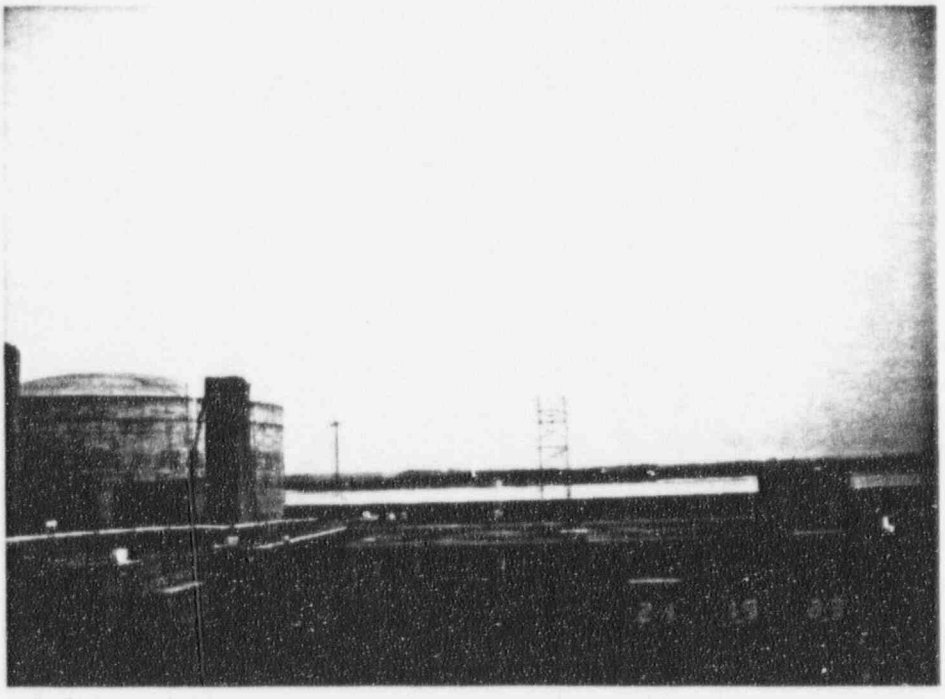


Initial dispersion between Containments 1 (left of both pictures) and 2 (right of both pictures), with smoke rising up the lee of the containment toward the other during Test 1.

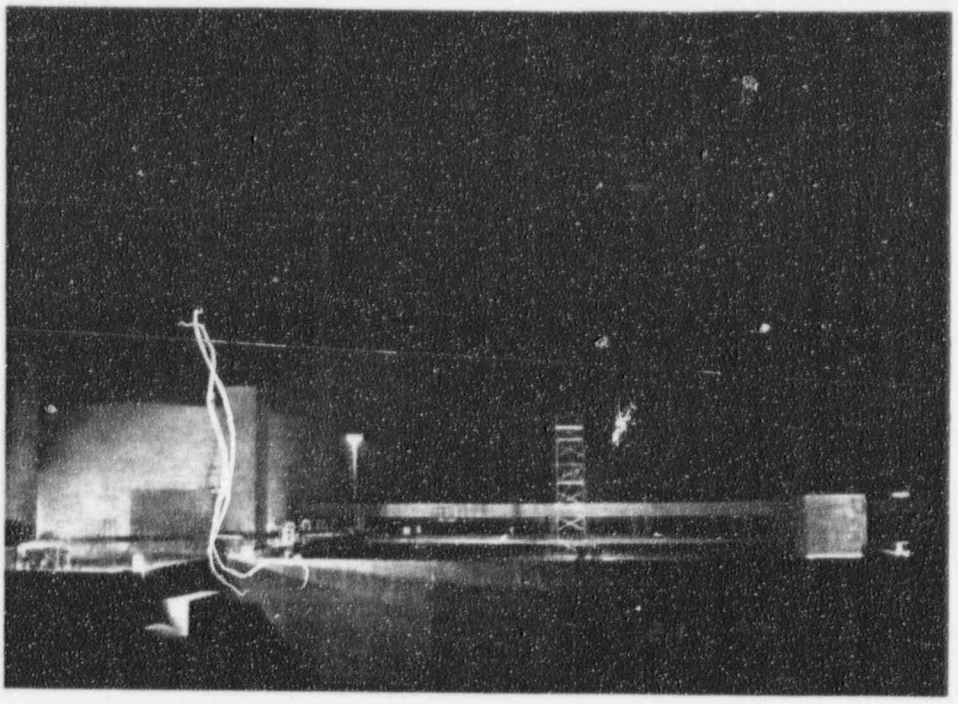
WD = SE WS = 1.9 m/s SC = F



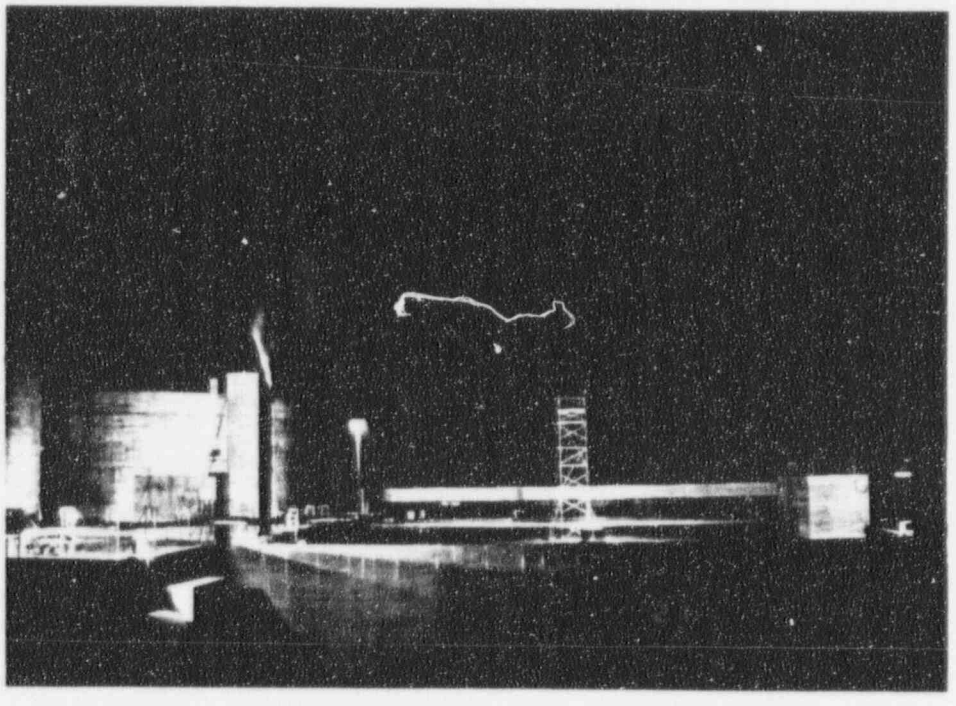
This photo shows a close-up of the meteorological tower on the roof of the Control Complex.



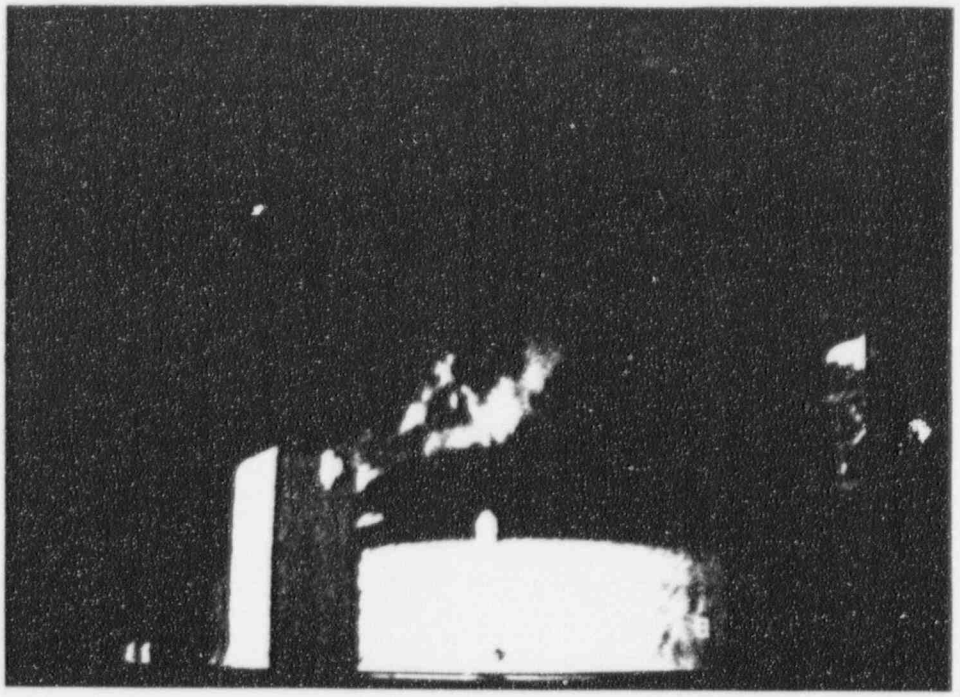
Release from stack during a brief period of very light wind speeds during Test 8.
WD = ENE WS = 1.6 m/s SC = E



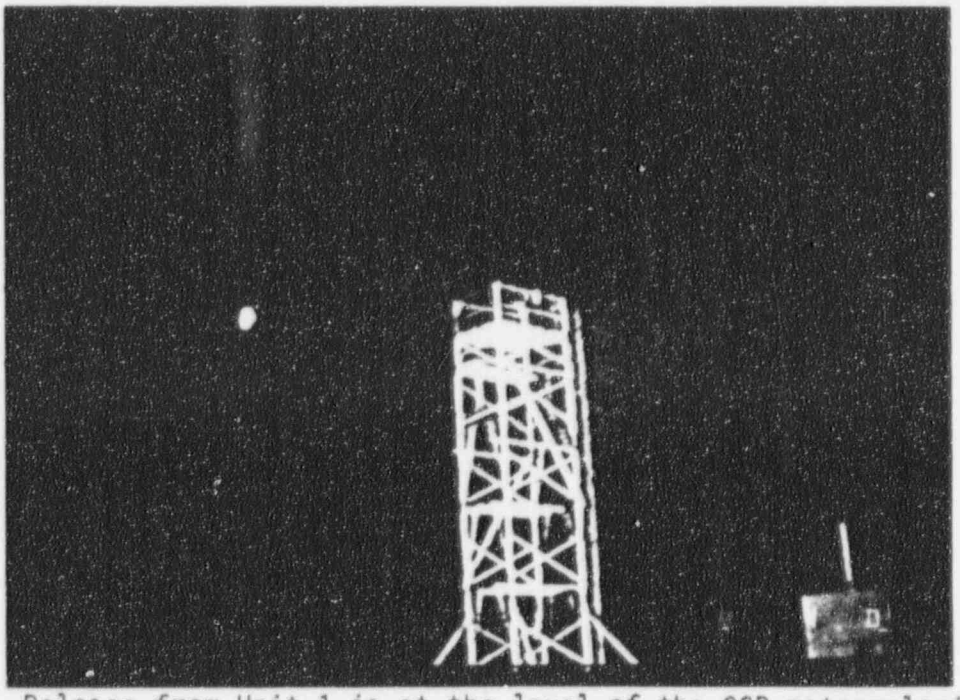
Containment release mixed between containments moves up and over the Control Complex during Test 9.
WD = ENE WS = 2.0 m/s SC = E



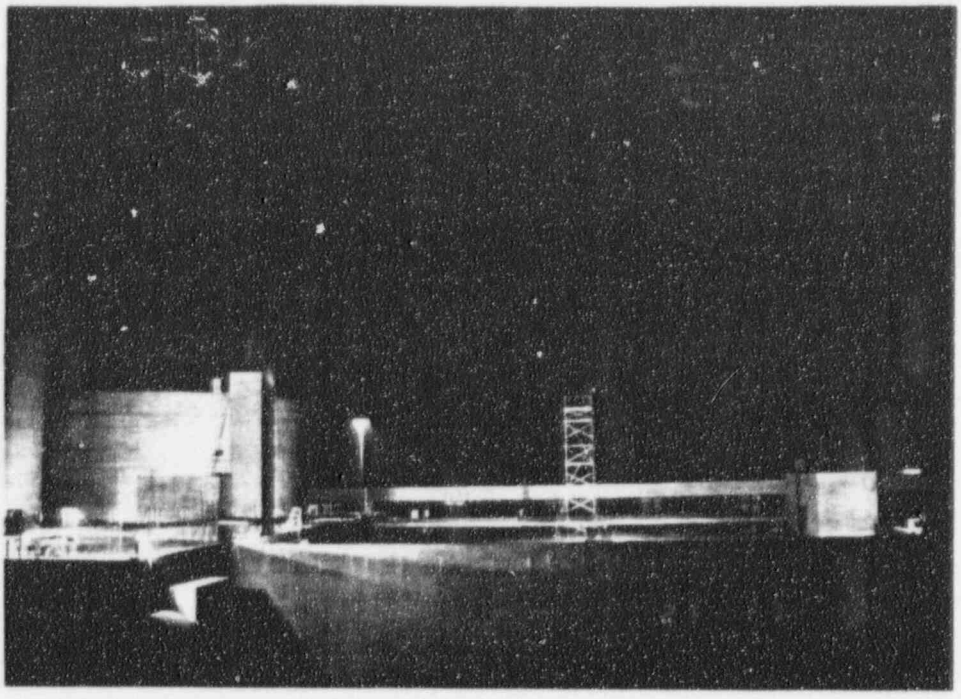
Stack release remains mostly above the Control Complex and penthouse during Test 9.
WD = ENE WS = 2.0 m/s SC = E



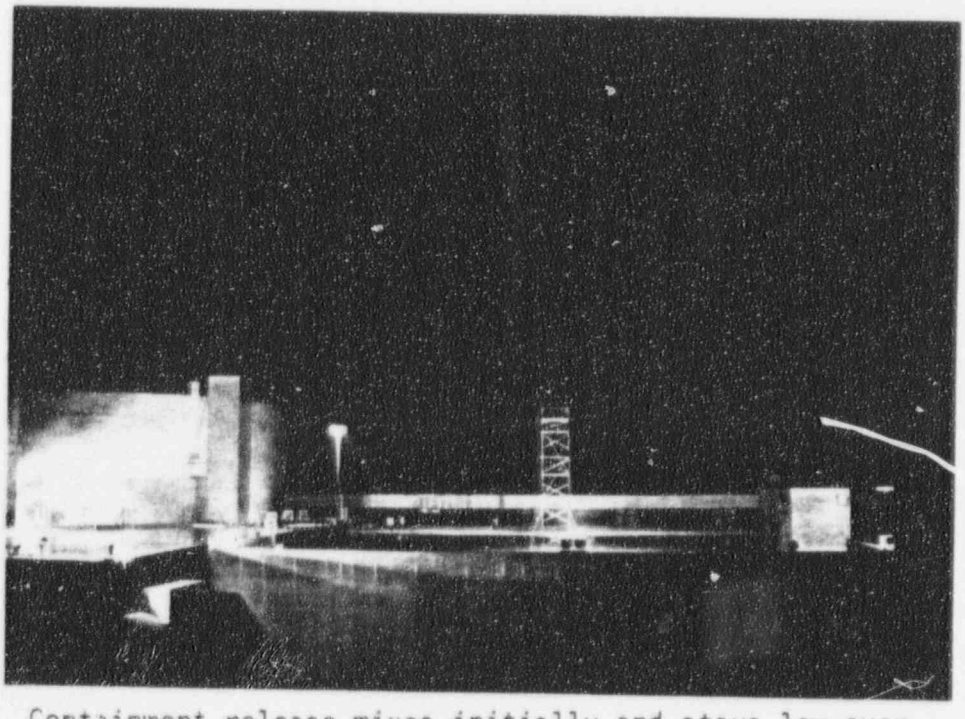
This photo shows a close-up of the stack release during Test 9.
WD = ENE WS = 2.0 m/s SC = E



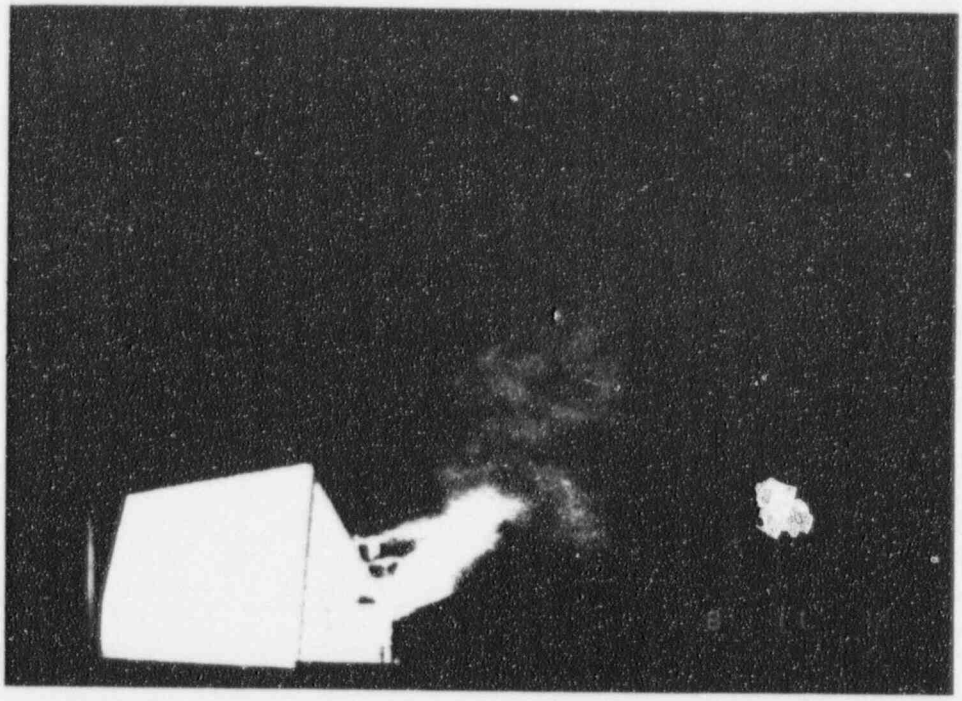
Release from Unit 1 is at the level of the CCR meteorological tower during Test 9.
WD = ENE WS = 2.0 m/s SC = E



Stack release bends over smoothly and down toward the penthouse during Test 10.
WD = ESE WS = 2.0 m/s SC = E

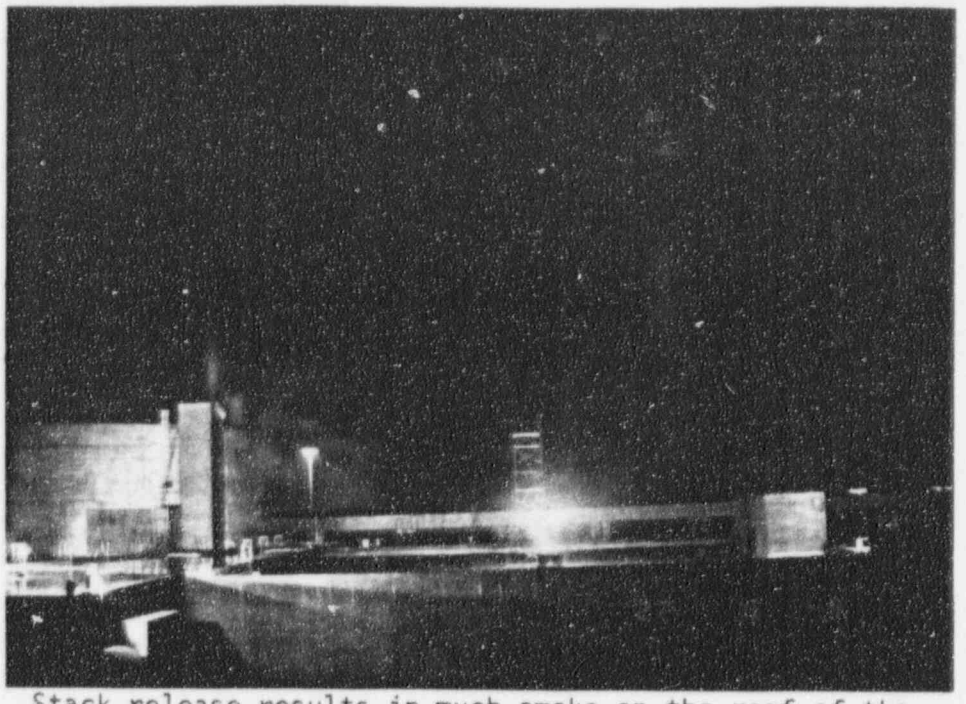


Containment release mixes initially and stays low over the roof of the Control Complex during Test 10.
WD = ESE WS = 2.0 m/s SC = E

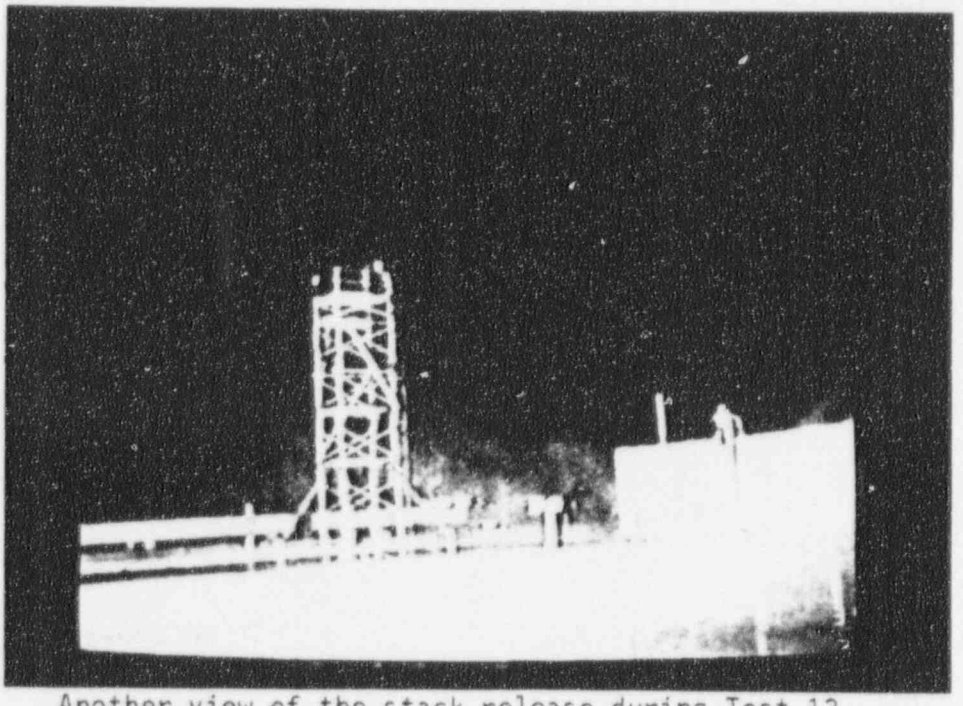


These two photos show initial dispersion from stack releases during Test 10.

WD = ESE WS = 2.0 m/s SC = E



Stack release results in much smoke on the roof of the Control Complex during Test 13.
WD = E WS = 1.7 m/s SC = F

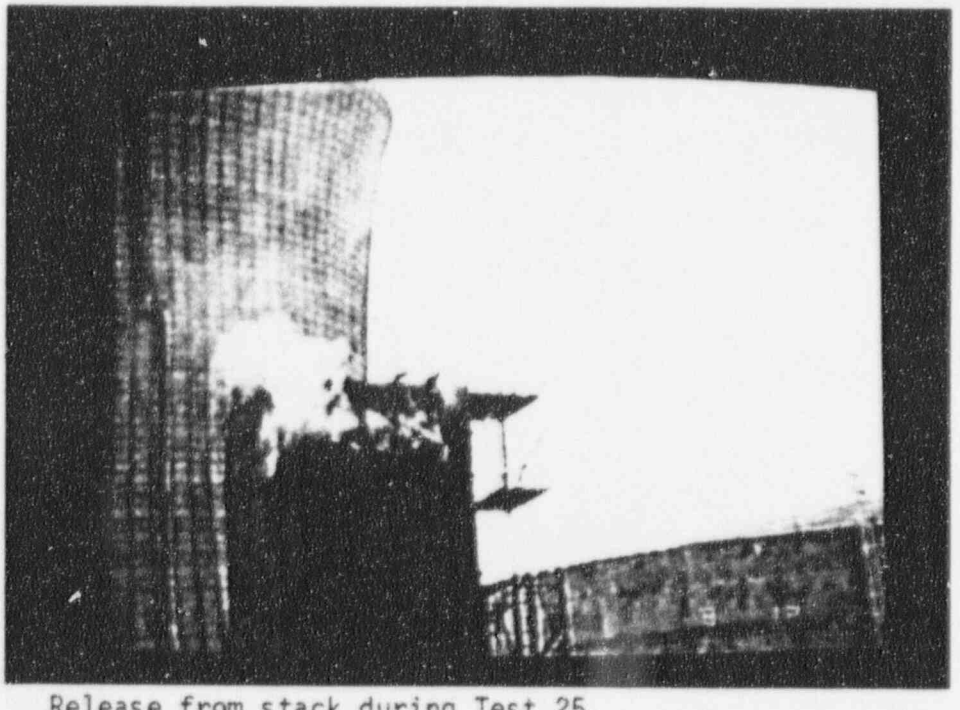


Another view of the stack release during Test 13.
WD = E WS = 1.7 m/s SC = F

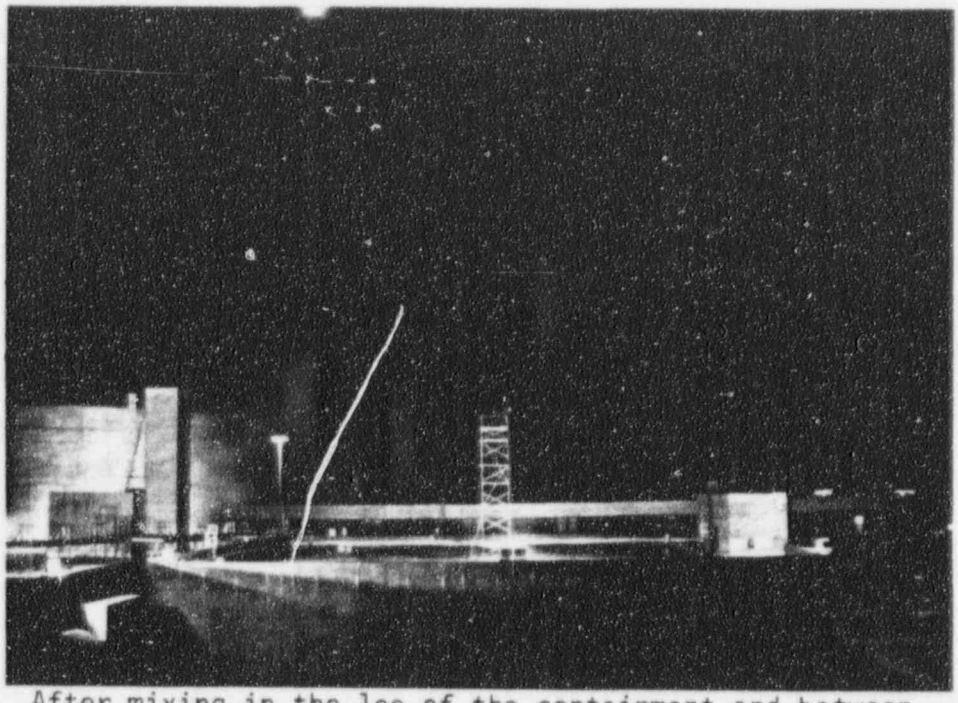
Stack release does typical looping during Test 21.
WD = ENE WS = 3.5 m/s SC = B

Stack release continues looping off the wes end of the Control Complex during Test 21.
WD = ENE WS = 3.5 m/s SC =

Stack release moves steadily upward during Test 23.
WD = NE WS = 4.6 m/s SC = C



Release from stack during Test 25.
WD = ENE WS = 3.5 m/s SC = E



After mixing in the lee of the containment and between containments, smoke remains mostly below the spring line of the containment during Test 27.

WD = E WS = 2.2 m/s SC = E