ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: RECORD OF CHANGES AND REVISIONS | FORM NO. 1000.06A

OFFSITE DOSE PROJECTIONS - POCKET COMPUTER METHOD | REV. # 8 | PC #

OFFSITE DOSE PROJECTIONS - POCKET COMPUTER METHOD
1904.02 REV. 0

UN-Controlled Copy # 104

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APPROVED BY:

(General Manager)

APPROVAL DATE
7/30/82

REQUIRED EFFECTIVE DATE:

1.0 PURPOSE

The purpose of this procedure is to provide an initial estimate of the radiological conditions at the ANO Exclusion Area Boundary, provide information to determine the Emergency Action Level, define the offsite area(s) potentially affected by an airborne radiological release, provide an estimate of the whole body and child thyroid dose rates and refine projections based on available field monitoring data, using a hand-held computer to perform the necessary calculations.

2.0 SCOPE

2.1 This procedure is applicable to airborne radioactive releases from ANO, Units One and Two as indicated by the ventilation system stack monitors (i.e. the SPING monitors of the GERM System).

2.2 If the monitors are off scale, refer to 1904.03, "Auxiliary Building Ventilation Exhaust Emergency Radiation Monitor".

2.3 This procedure does not take into account effects caused by precipitation.

2.4 To use the LFE Trapelo or Westinghouse effluent monitors, (original normal range monitors) refer to procedure 1904.04 "Estimating Airborne Release Rates".

3.0 REFERENCES

3.1 References Used in Procedure Preparation:

3.1.1 Arkansas Nuclear One Emergency Plan

3.1.2 "Manual for Protective Actions, Appendix D", Environmental Protection Agency

3.1.3 "Workbook of Atmospheric Dispersion Estimates", U.S. Department of Health, Education and Welfare

3.1.4 Memoranda Numbers CL-1460, CL-1571, CL-1735, and CL-2115 (By A. L. Smith)

3.1.5 Radio Shack TRS-80 Pocket Computer User's Manual

3.1.6 Radio Shack Minisette-9 Owner's Manual

3.2 References Used in Conjunction with this Procedure:

3.2.1 1903.10, "Emergency Action Level Response"

3.2.2 1903.43, "Duties of the Emergency Radiation Team"

3.2.3 1904.03, "Auxiliary Building Ventilation Exhaust Emergency Radiation Monitor"

3.2.4 1904.04, "Estimating Airborne Release Rates"

3.2.5 1904.05, "Atmospheric Stability Class Determination"

3.3 Related ANO References:

None

4.0 DEFINITIONS

4.1 σΘ (sigma theta) - The standard deviation (net change) of the horizontal wind direction over time.

4.2 Δt (delta t) - The vertical temperature differential between the upper and lower temperature sensors on the meteorological tower (in degrees Centigrade).

4.3 X/Q - The ratio of the concentration of radioactive material (at a specific location) to the release rate (at the origin) in units of μCi/cc/Ci/sec which is equivalent to units of secs/m^3.

4.4 [] - Brackets represent a labeled computer button.

4.5 Abbreviations

4.5.1 C.T. = Child Thyroid Dose Rate

4.5.2 W.B. = Whole Body Dose Rate

4.5.3 OK = "Non-radiologic 1" Incident

4.5.4 U.E. = Unusual Event

4.5.5 S.E. = Site Emergency

4.5.6 G.E. = General Emergency

4.5.7 DEF = Define Mode

4.5.8 PRO = Program Mode

4.5.9 RES = Reserve Mode

5.0 RESPONSIBILITIES

5.1 The Shift Operations Supervisor is responsible for determining if an unplanned gaseous release to the environment is indicated by symptoms such as high stack monitor readings, area radiation monitor alarms or other indications.

5.2 The Duty Emergency Coordinator, or his designee, is responsible for performing the magnitude of release calculations.

5.3 The Shift Operations Supervisor/Duty Emergency Coordinator is responsible for notifying appropriate groups per 1903.10, "Emergency Action Level Response".

5.4 The Offsite Radiological Monitoring Section of the Emergency Radiation Team is responsible for measuring offsite radiological hazards per 1903.43, "Duties of the Emergency Radiation Team".

6.0 LIMITS AND PRECAUTIONS

6.1 This procedure provides an initial projection of the radiological conditions; field monitoring is necessary to determine the actual conditions.

6.2 Actual terrain and weather conditions will generally limit the accuracy of the projected doses at a specific location.

6.3 The diffusion overlays used in this procedure represent long-term average conditions for a ground level release.

6.4 When performing manual or programmed calculations, the computer should be in the RUN Mode.

7.0 DETERMINATION OF EXISTING METEOROLOGICAL CONDITIONS

7.1 Site meteorological data may be obtained at the TSC, ECC, or other locations by utilizing the "R MONIT" command from GERMS (chromatics) terminal. Station No. 1 (40' elevation sensor) should be used, if possible, for readings other than $\sigma\theta$ (indicated as wind direction variability), which may be obtained from station No. 2. [The recorders indicated on form 1904.02A may also be used from control room locations.]

7.2 If the on-site meteorological system is out of service, limited meteorological data may be obtained from the following sources.

A. National Weather Service (Meteorologist-in-Charge) [771-0971 or • •]

B. KARV Radio (968-1184)

C. MSS Dispatcher (4882) - Request data for Arkansas Zone five.

D. The stability category may be calculated from causative factors (see procedure 1904.05, "Atmospheric Stability Class Determination").

7.3 Complete Form 1904.02A to record the current meteorological conditions.

8.0 DETERMINATION OF THE AIRBORNE RELEASE PATHS

NOTE: If the GERMS detectors are out of service for a normal release path which is discharging substantial amounts of radioactive material, refer to procedure 1904.04 "Estimating Airborne Release Rates".

8.1 Normal Release Paths:

Record the radioactive release data as indicated on the Eberline CT2 for each of the release points that are in service on Form 1904.02C.

8.1.1 At the Eberline Control Terminal (CT), insert the key into the "keyboard" switch and activate the control terminal.

8.1.2 Set the History Format select knob to "Release Rate."

8.1.3 For each of the channels to be interrogated, depress the [Hist. Min] pushbutton then enter the 2-digit monitor ID number and then the two digit channel ID. Then depress the [ENTER] pushbutton. A printout of the 23 previous 10-minute averages plus the current value will appear.

8.1.4 Depress the [PRINT] then the [.FILE] and then the [ENTER] pushbuttons.

NOTE: If the direct connected flow instrument is out of service, the CT-2 will ask the operator to supply the discharge flow rate in cc/min. To obtain the flow rate in CFM, refer to the appropriate analog flow recorder. To convert CFM to cc/min., multiply the recorder flow rate (in CFM) by 2.83E4. Then enter the result on the CT-2 (to enter a number in ex-potential notation, such as 5.26E3, use the following key sequence: depress [+] then 5.26 then [+] 03 and then the [ENTER] pushbutton).

8.1.5 For each channel interrogated, record the next-to-last value listed onto the proper line of Form 1904.02C. Record the noble-gas data from the lowest numbered channel which gives valid, on-scale data (i.e., data is not valid if "failed high" alarm [or similar alarm] is indicated).

8.2 Contaminated Steam Releases:

If contaminated steam releases are occurring:

8.2.1 Record the radiation levels in the main steam headers and either the number of safeties/atmospheric dumps open or the pounds/hour of steam being exhausted on Form 1904.02B.

8.2.2 For the initial release, assume 14 safeties open for ANO-1, 10 for ANO-2. For follow-up determinations, assume 2 safeties open unless verified to be more or less.

8.2.3 Complete form 1904.02B and transfer the release rates in Ci/sec to the "Steam Releases" line of 1904.02C.

8.3 Unmonitored Release Paths:

8.3.1 If a release is occurring from an unmonitored location and field monitoring data is not available, refer to procedure 1904.04 "Estimating Airborne Release Rates", and enter the estimated release rates on Form 1904.02C as "Other Releases".

8.3.2 If field monitoring data is available, complete sections 9.0, 10.0, and 12.0 using assumed initial release rates of 1.0 Ci/sec. for both iodines and noble gases. The scale factors determined in section 12.0 can then be used with the assumed release rates to produce relatively accurate offsite dose projections by repeating procedure sections 9.0 and 10.0.

9.0 DETERMINATION OF DOSE RATES AND MAXIMUM PERMISSIBLE CONCENTRATION

9.1 Obtain the computer, overlays and map from the appropriate emergency kit:

9.1.1 Control Room

9.1.2 Technical Support Center

9.1.3 Emergency Control Center

9.2 Complete Form 1904.02D to determine the following information:

9.2.1 Whole body dose rate at the indicated distances.

9.2.2 Child thyroid dose rate at the indicated distances.

9.2.3 The ratio of the projected to the maximum permissible concentration of Xe-133 at the site boundary, assuming "annual average" meteorology.

9.3 If an Emergency Action Level is NOT indicated, return to Section 7.0. New data should be taken as specified by the Duty Emergency Coordinator or the Dose Assessment Supervisor.

10.0 PLUME DEFINITION

NOTE: The attachments contained in this procedure are provided for ILLUSTRATION ONLY. The correctly scaled overlays and maps are located in the emergency kits.

10.1 Select the overlay (Attachments 1-7) which corresponds to the existing atmospheric stability category (Form 1904.02A, Line 5.0).

10.2 Place the selected overlay on the ANO area map (Attachment 8) with the origin directly over the ANO site center and align the plume centerline with the downwind direction.

10.3 Locate the plume boundary line (from Form 1904.02D Line 5.1.3) on the overlay. Any sub-sectors which are contained (or partially contained) with the plume boundary line should be designated as affected. Record this information on line 7.0 of Form 1904.02D.

10.3.1 Account for the uncertainty in the local wind near Mt. Nebo/ Spring Mountain:

A. If the plume centerline lies in sector 10 and the plume boundary extends beyond 6 miles, the affected area should also include sectors 9, 10 and 11 (from sub-sector G to the projected extent of the plume).

B. If the plume centerline lies in sector 11 and the plume boundary extends beyond 6 miles, the affected area should also include sectors 10, 11 and 12 (from sub-sector G to the projected extent of the plume).

11.0 NOTIFICATIONS

11.1 Provide radiological release information to appropriate groups per 1903.10, "Emergency Action Level Response".

11.2 The Emergency Radiation Team shall be dispatched to obtain field radiological data whenever an Emergency Action Level has been declared based on offsite radiological releases. If the Emergency Radiation Team is dispatched, refer to Section 12.0.

11.3 Return to Section 7.0 of this procedure. New data should be taken as specified by the Duty Emergency Coordinator/Dose Assessment Supervisor.

12.0 VERIFICATION OF PROJECTED DOSE RATES BY FIELD MEASUREMENT

12.1 Whenever an Emergency Action Level has been declared due to offsite radiological releases, the Duty Emergency Coordinator/Offsite Monitoring Supervisor shall, based on wind direction, dispatch offsite radiological monitoring teams to sample the plume to determine the magnitude and extent of the radiation fields.

12.1.1 Radiation surveys at specific locations should include a direct exposure rate measurement (mR/hr) and an air sample to determine iodine concentration (μCi/cc).

12.1.2 As the survey teams approach assigned survey locations, continuous measurements should be taken to identify the location of the highest radiation level for a particular downwind distance.

12.2 Scale Factor Determination

12.2.1 Accurate scale factors may be calculated only by comparing measured plume centerline conditions with projected plume centerline conditions for corresponding time periods and downwind distances.

12.2.2 When field monitoring data becomes available for a plume centerline location, complete Form 1904.02E to calculate whole body and child thyroid dose rate scale factors.

12.3 Return to section 7.0 of this procedure. New data should be taken as specified by the Duty Emergency Coordinator/Dose Assessment Supervisor.

13.0 ATTACHMENTS AND FORMS

13.1 Form 1904.02A - Current Meteorology Summary

13.2 Form 1904.02B - Contaminated Steam Release Rates

13.3 Form 1904.02C - Airborne Release Rate Work Sheet

13.4 Form 1904.02D - EAL/Offsite Dose Projection Work Sheet

13.5 Form 1904.02E - Scale Factor Work Sheet

13.6 Attachment 1 - Diffusion Overlay (Atmospheric Stability Category A)

13.7 Attachment 2 - Diffusion Overlay (Atmospheric Stability Category B)

13.8 Attachment 3 - Diffusion Overlay (Atmospheric Stability Category C)

13.9 Attachment 4 - Diffusion Overlay (Atmospheric Stability Category D)

13.10 Attachment 5 - Diffusion Overlay (Atmospheric Stability Category E)

13.11 Attachment 6 - Diffusion Overlay (Atmospheric Stability Category F)

13.12 Attachment 7 - Diffusion Overlay (Atmospheric Stability Category G)

13.13 Attachment 8 - Area Map

13.14 Attachment 9 - Keyboard Layout

13.15 Attachment 10 - Battery Replacement

13.16 Attachment 11 - Program Loading/Verification

13.17 Attachment 12 - Program Listing

13.18 Attachment 13 - Memory Contents

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Arkansas Nuclear One

TITLE: CURRENT METEOROLOGY SUMMARY
FORM NO. 1904.02A
REV. # 0 PC #

1.0 Record the date and time at which this data was measured _____ / _____
Date Time

2.0 Record the 10-minute average wind speed (Chromatics terminal or WSR 9300) if less than 1 MPH, enter "1": _____ MPH

3.0 Record the 10-minute average wind direction (Chromatics terminal or WDk 9300) _____ Degrees

4.0 Record the $\sigma\theta$ (Chromatics terminal or AAR 9300). If this is not available, record the Δt (AAR 9300 or Chromatics terminal).

$\sigma\theta$ _____ degrees or Δt _____ °C

5.0 Determine from the following table the atmospheric stability category corresponding to the value determined in Step 4.0 above and record the category below:

Atmospheric Stability Category	$\sigma\theta$	Δt
A	>22.5°	<-0.87°
B	17.5° to 22.5°	-0.87° to -0.78°
C	12.5° to 17.5°	-0.78° to -0.69°
D	7.5° to 12.5°	-0.69° to -0.23°
E	3.8° to 7.5°	-0.23° to +0.69°
F	2.1° to 3.8°	+0.69° to +1.8°
G	<2.1°	>1.8°

Atmospheric Stability Category = _____

Performed By _____ / _____
Initials Time

Reviewed By _____

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TITLE: CONTAMINATED STEAM RELEASE RATES | FORM NO. 1904.02B

REV. # 0 PC #

NOTE: Complete only the sections of the table below which correspond to headers currently discharging contaminated steam.

1.0 If the number of open safeties is used as the criteria for steam flow, complete the first table below.

Col 1	Col 2	Col 3	Col 4[a]	Col 5	Col 6[b]	Col 7	Col 8[c]	Col 9	Col 10[d]
Unit/Hdr	Rad. Monitor Number	MR/hr Reading	No. Open Safeties	Lb/Hr Per Safety	Steam Flow (Lb/Hr)	Monitor Calib. Factors	Q-GAS Ci/Sec	Q-I/Q-G Ratio	Q-Iodine (Ci/Sec)
ANO-1/A	RI-2682			8.0E 5		2.23E-8		7.2E-3	
ANO-1/B	RI-2681			8.0E 5		2.23E-8		7.2E-3	
ANO-2/A	2RI-1007			1.5E 6		2.46E-8		1.1E-5	
ANO-2/B	2RI-1057			1.5E 6		2.46E-8		1.1E-5	
TOTALS	XXXXXXXX	XXXXXXX	XXXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	

2.0 If the makeup flow rate is used as the criteria for steam flow, complete the following table:

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6[b]	Col 7	Col 8[c]	Col 9	Col 10[d]
Unit/Hdr	Rad. Monitor Number	MR/hr Reading	GPM Makeup Flow	Lb/Hr Per GPM	Steam Flow (Lb/Hr)	Monitor Calib. Factors	Q-GAS Ci/Sec	Q-I/Q-G Ratio	Q-Iodine (Ci/Sec)
ANO-1/A	RI-2682			500		2.23E-8		7.2E-3	
ANO-1/B	RI-2681			500		2.23E-8		7.2E-3	
ANO-2/A	2RI-1007			500		2.46E-8		1.1E-5	
ANO-2/B	2RI-1057			500		2.46E-8		1.1E-5	
TOTALS	XXXXXXXX	XXXXXXX	XXXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	

a Initially, assume: 14 (total) for ANO-1 (1.1E7 lb./hr.)
10 (total) for ANO-2 (1.5E7 lb./hr.)
Thereafter, assume: 2 (total) for ANO-1 (1.6E6 lb./hr.)
2 (total) for ANO-2 (3.0E6 lb./hr.)

(Unless verified to be otherwise.)

b Column 6 = Column 4 x Column 5

c Column 8 = Column 3 x Column 6 x Column 7

d Column 10 = Column 8 x Column 9

Performed By _____ / _____
Initials Time

Reviewed By _____

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TITLE: AIRBORNE RELEASE RATE WORKSHEET | FORM NO. 1904.02C

REV. # 0 PC #

Monitor Number	Unit/ Designation	Release Rates (μCi/min.) Iodine (Chan. 03)	Noble Gases (Circle Chan.)	
001	1/Cont. Purge		05 07 09	
002	1/Radwaste		05 07 09	
003	1/Fuel Hd.		05 07 09	
004	1/Pen. & H_2 PRG		05 07 09	
005	2/Cont. Purge		05 07 09	
006	2/Radwaste		05 07 09	
007	2/Fuel Hd.		05 07 09	
008	2/Pen. & H_2 PRG		05 07 09	
009	PASS Bldg.		05 07 09	
010	2/Aux. Bldg. Ext.		05 07 09	
GERMS Totals (μCi/min.)			XXXXXXXXXXXXXXXX	

Multiply the corresponding iodine or noble gas GERMS total (μCi/min.) by 1.9E-8 Ci/sec./μCi/min. to obtain GERMS total Ci/sec.

GERMS Totals (Ci/sec.) [μCi/min. * 1.9E-8]	*	XXXXXXXXXXXXXXXX	*
Steam Releases (Ci/sec.) Totals from 1904.02B Columns 8 & 10 respectively		XXXXXXXXXXXXXXXX	
Other Releases (Ci/sec.)		XXXXXXXXXXXXXXXX	
Other Releases (Ci/sec.)		XXXXXXXXXXXXXXXX	
Other Releases (Ci/sec.)		XXXXXXXXXXXXXXXX	
Other Releases (Ci/sec.)		XXXXXXXXXXXXXXXX	
Site Totals (Ci/sec.)		XXXXXXXXXXXXXXXX	

Performed By _____ / _____
Initials Time

Reviewed By _____

ARKANSAS POWER & LIGHT COMPANY
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TITLE: EAL/OFFSITE DOSE PROJECTION WORKSHEET | FORM NO. 1904.02D

REV. # 0 PC #

INSTRUCTIONS

1.0 Press the [ON] button.

1.1 If a dot is not visible in the upper right hand corner of the display, replace the batteries per Attachment 10 - Battery Replacement.

2.0 Press the [MODE] button repeatedly, as necessary, until the word "RUN" is indicated in the upper portion of the display.

NOTE: At least one test case contained in Attachment 11 - Program Loading/Verification should be performed prior to initial use.

_____
Initials

3.0 Type RUN (followed by [ENTER])

4.0 Type the appropriate responses, as indicated (followed by [ENTER]) to each question as it is displayed.

4.1 Wind Direction (From) - 1904.02A, Line 3.0

4.2 Windspeed (MPH) - 1904.02A, Line 2.0

4.3 Stability Class A-G - 1904.02A, Line 5.0

4.4 Q-GAS (Noble Gas in Ci/sec.) - 1904.02C "Totals"

4.5 Q-Iodine (Ci/sec.) - 1904.02C "Totals"

4.6 Whole Body Scale Factor - 1904.02E, Column 4a (or 1.0, in the absence of usable field data.)

4.7 Child Thyroid Scale Factor - 1904.02E, Column 4b (or 1.0, in the absence of usable field data.)

5.0 When the computer prints an answer, the following actions should be taken:

5.1 Record the answer in the appropriate column below; then press [ENTER] to display the next answer (through Line 5.1.5E).

5.1.1	Emergency Action Level	OK U.E. Alert S.E. G.E.
5.1.2	Downwind Direction	Degrees
5.1.3	Plume Outer Boundary X/Q	Sec/m^3

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TITLE: EAL/OFFSITE DOSE PROJECTION WORKSHEET FORM NO. 1904.02D
REV. # 0 PC #

5.1.4 Projected MPC Factor (Annual Average Meteorology) _____

5.1.5 Projected Dose Rates (Real-Time Meteorology)

	DOWNWIND DISTANCE (MILES) OR LOCATION	WHOLE BODY (mR/hr)	CHILD THYROID (mR/hr)
A.	0.65		
B.	1.0		
C.	2.0		
D.	5.0		
E.	10.0		
F.	OTHER: (LIST)		

5.2 To facilitate review, record the program input variables as they are displayed on the calculator:

5.2.1 Wind Direction (From) _____ (Deg.)

5.2.2 Windspeed _____ (MPH)

5.2.3 Stability Class _____

5.2.4 Q-GAS _____ (Ci/sec.)

5.2.5 Q-Iodine _____ (Ci/sec.)

5.2.6 Whole Body Factor _____

5.2.7 Child Thyroid Factor _____

6.0 The dose rates at any field location (5.1.5F) may be estimated by the following method.

6.1 Interpolate the X/Q value from the appropriate overlay for the desired location.

6.2 Type the value obtained in Step 6.1 followed by pressing the [SHIFT] B [ENTER] keys. The computer will display the projected whole body dose rate (mR/hr) for that location.

6.3 Press [SHIFT] X [ENTER]. The computer will then display the projected child thyroid dose rate for the same location.

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TITLE: EAL/OFFSITE DOSE PROJECTION WORKSHEET | FORM NO. 1904.02D

REV. # 0 PC #

NOTE: Data may be reviewed by the following:

OTHER RESERVE KEY FUNCTIONS

Key Sequence	Function	Purpose
[SHIFT] V [ENTER]	Run 390	Review Output Variables
[SHIFT] A [ENTER]	Run 560	Review Input Variables

7.0 AFFECTED SUB-SECTORS (From step 10.4 of this procedure):

_____

Performed By _____ / _____
Initials Time

Reviewed By _____

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TITLE: SCALE FACTOR WORKSHEET — FORM NO. 1904.02E

REV. # 0 — PC #

1.0 Record the following raw data:

1.1 Measurement Time _____

1.2 Measurement Location (sub-sector) _____

1.3 Downwind Distance _____ (mi)

1.4 Measured Whole Body Dose Rate (record in column 1, line a) below)

1.5 Measured Radioiodine Concentration _____ (μCi/cc)

2.0 Multiply line 1.5 by 5.6E8 (mr/hr per μCi/cc) to convert the radioiodine concentration to the equivalent child thyroid dose commitment rate (record in column 1, line b) below).

3.0 Project the radiological conditions for the measurement location:

3.1 X/Q at measurement location (from stability class overlay) = _____ (sec/m^3)

3.2 Type the value obtained in step 3.1 followed by pressing the [SHIFT] B [ENTER] keys. The computer will display the projected whole body dose rate (mR/hr) for that location. Record in column 2a below.

3.3 Press [SHIFT] X [ENTER]. The computer will then display the projected child thyroid dose rate for the same location. Record this value in column 2b below.

3.4 Transcribe the previous scale factors used for these dose rate projections from form 1904.02D steps 5.2.6 and 5.2.7 to column 3 below.

4.0 Calculate the current scale factors:

Column 4 = (column 1 ÷ column 2) x column 3

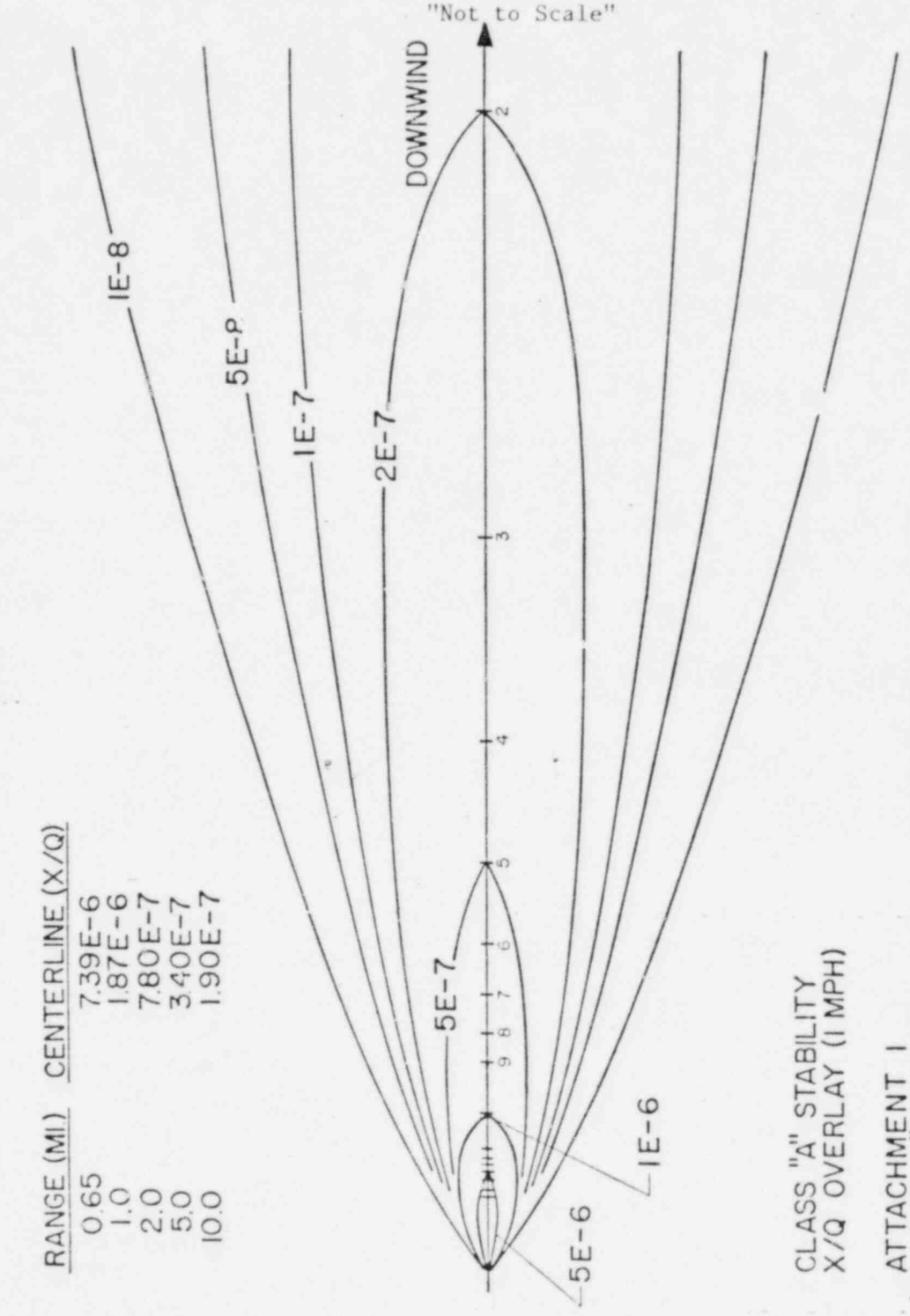
	Column 1 Measured mR/hr	Column 2 Projected mR/hr	Column 3 Previous Scale Factors	Column 4 Current Scale Factors
a) Whole Body				(WB)
b) Child Thyroid				(CT)

Performed By _____ / _____
Initials Time

Reviewed By _____

ATTACHMENT 1

"Not to Scale"



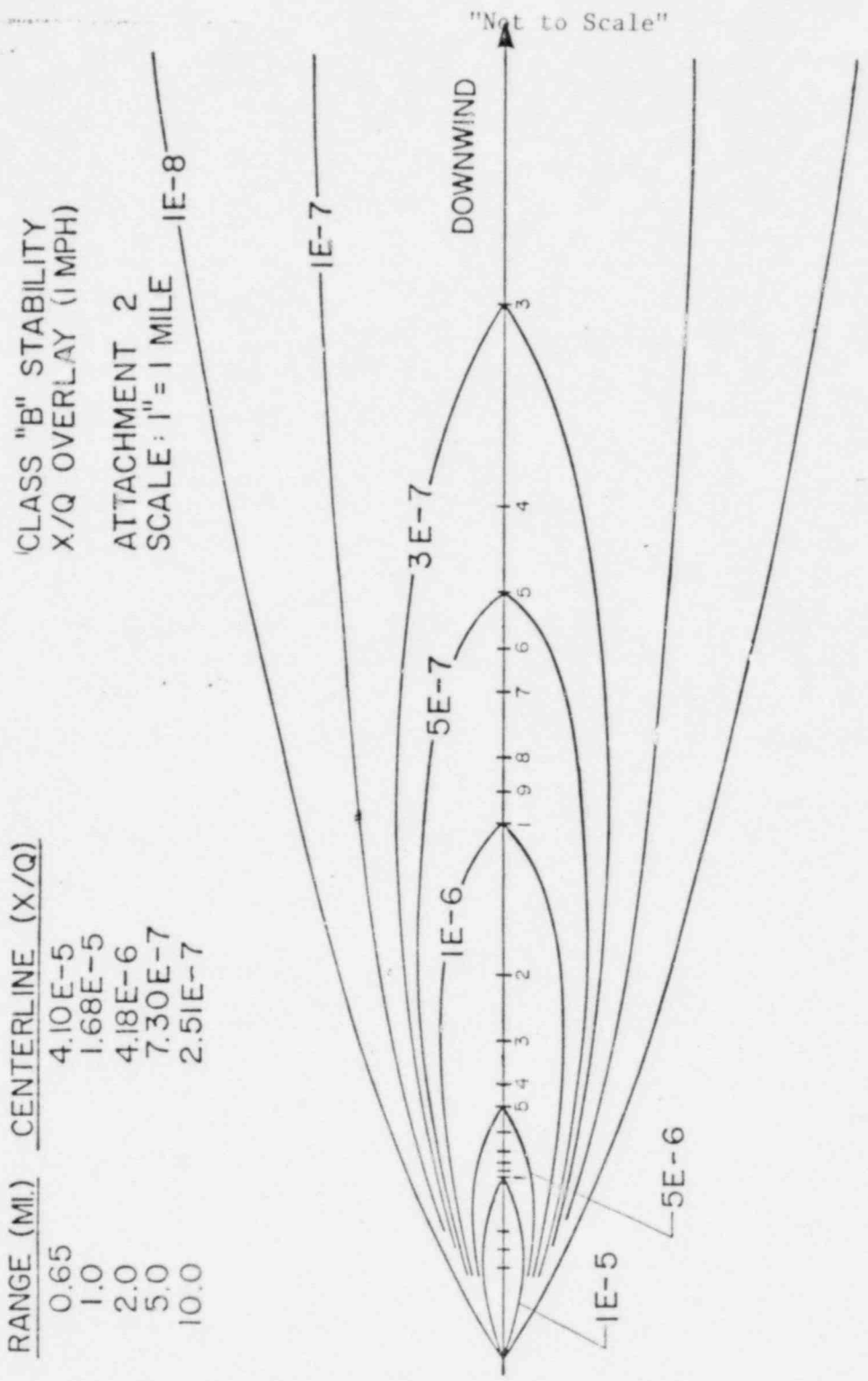
RANGE (MI)	CENTERLINE (X/Q)
0.65	7.39E-6
1.0	1.87E-6
2.0	7.80E-7
5.0	3.40E-7
10.0	1.90E-7

CLASS "A" STABILITY
X/Q OVERLAY (1 MPH)

ATTACHMENT 1
SCALE: 1" = 1 MILE

ATTACHMENT 2

"Not to Scale"



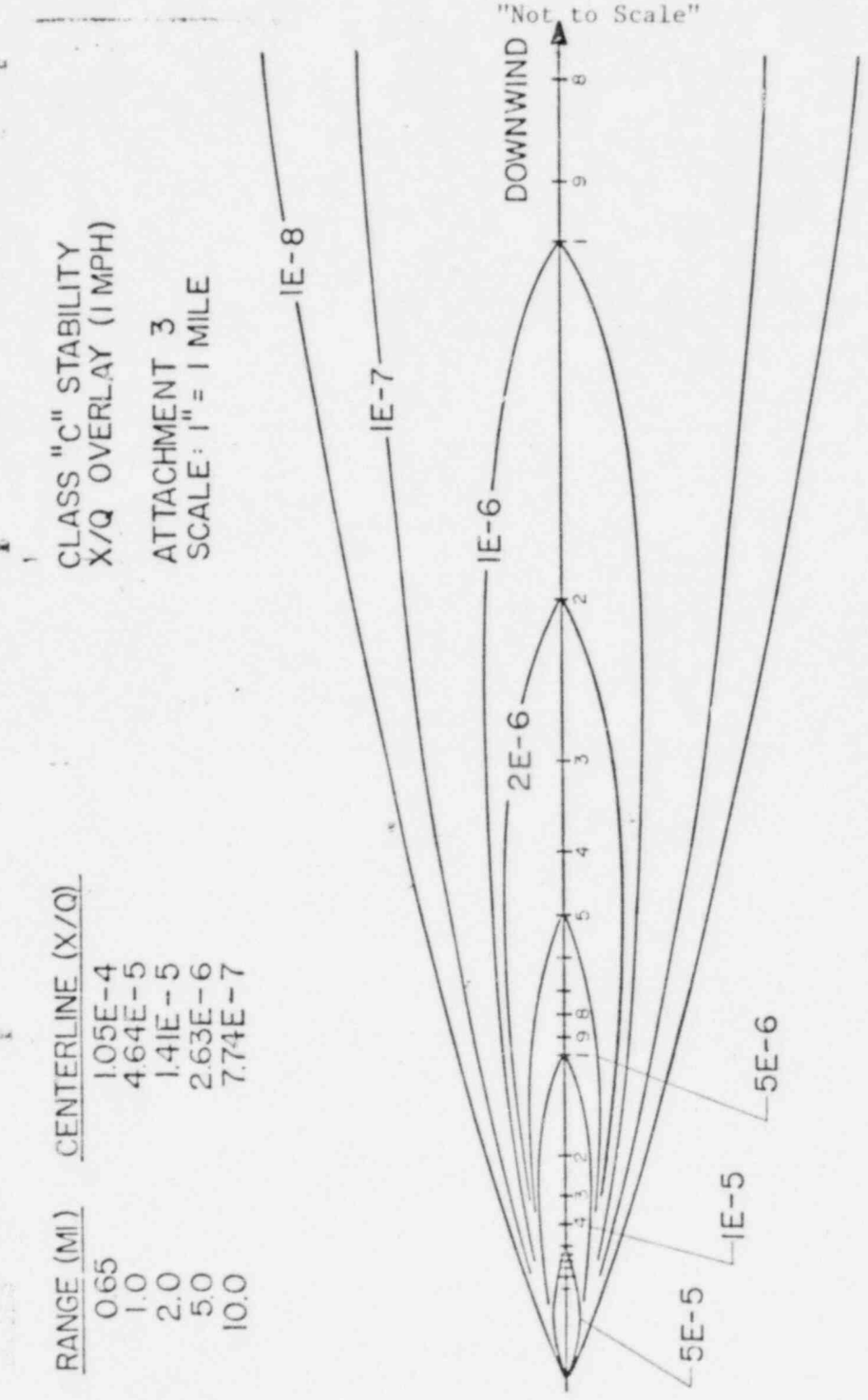
ATTACHMENT 2
SCALE: 1" = 1 MILE

CLASS "B" STABILITY
X/Q OVERLAY (1 MPH)

RANGE (MI.)	CENTERLINE (X/Q)
0.65	4.10E-5
1.0	1.68E-5
2.0	4.18E-6
5.0	7.30E-7
10.0	2.51E-7

ATTACHMENT 3

"Not to Scale"



CLASS "C" STABILITY
X/Q OVERLAY (1 MPH)

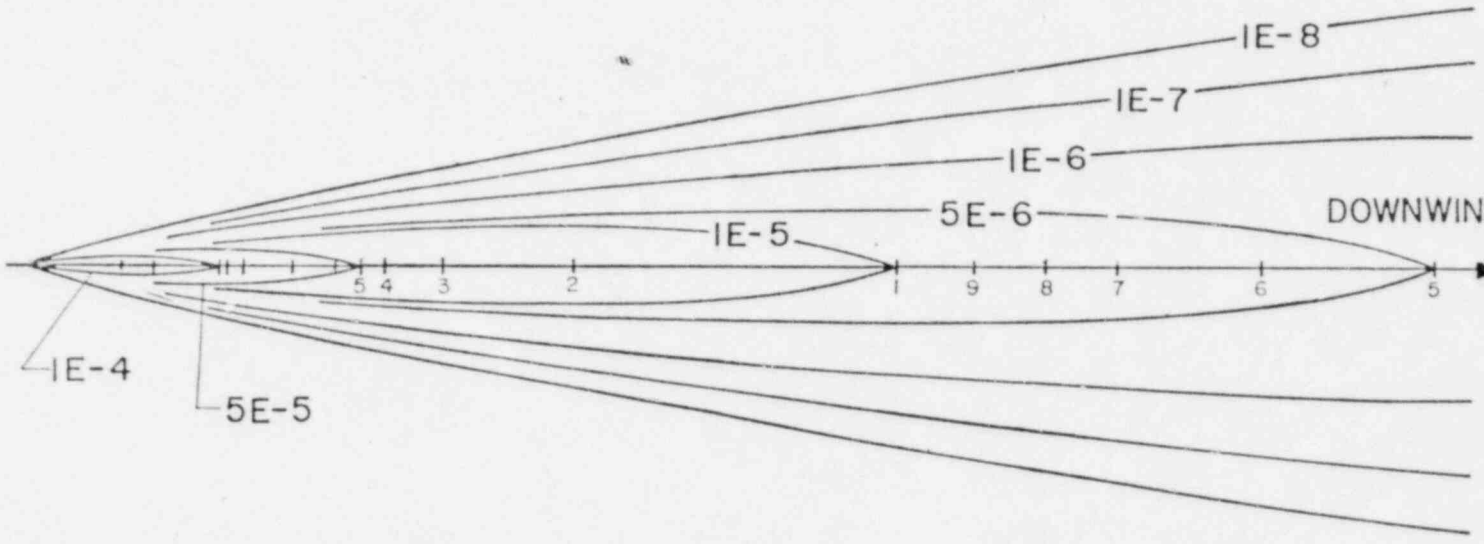
ATTACHMENT 3
SCALE: 1" = 1 MILE

RANGE (MI)	CENTERLINE (X/Q)
0.65	1.05E-4
1.0	4.64E-5
2.0	1.41E-5
5.0	2.63E-6
10.0	7.74E-7

RANGE (MI.)	CENTERLINE (X/Q)
0.65	2.87E-4
1.0	1.38E-4
2.0	6.64E-5
5.0	1.31E-5
10.0	4.83E-6

CLASS "D" STABILITY
X/Q OVERLAY (1 MPH)

ATTACHMENT 4
SCALE: 1" = 1 MILE



"Not to Scale"

ATTACHMENT 4

ARKANSAS NUCLEAR ONE

PLANT MANUAL SECTION: OFFSITE DOSE PROJECTIONS

PROCEDUREWORK PLAN TITLE: OFFSITE DOSE PROJECTIONS - POCKET COMPUTER METHOD

NO: 1904.02

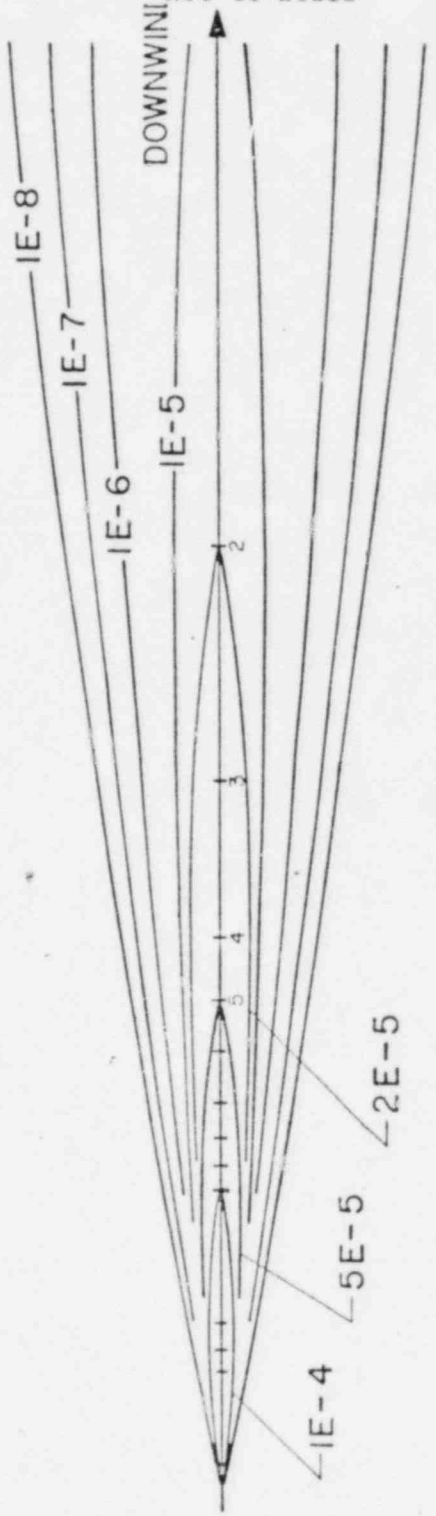
PAGE 19 of 37

REVISION 0 DATE 06/30/82

CHANGE DATE

ATTACHMENT 5

"Not to Scale"



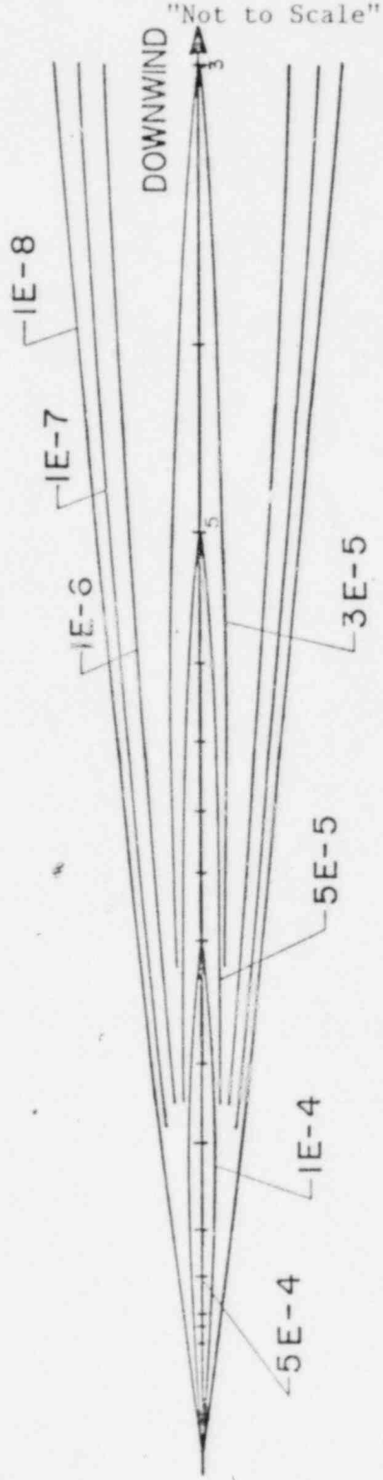
CLASS "E" STABILITY
X/Q OVERLAY (1 MPH)

ATTACHMENT 5
SCALE: 1" = 1 MILE

RANGE (MI.)	CENTERLINE (X/Q)
0.65	4.84E-4
1.0	2.62E-4
2.0	1.02E-4
5.0	2.92E-5
10.0	1.14E-5

ATTACHMENT 6

"Not to Scale"



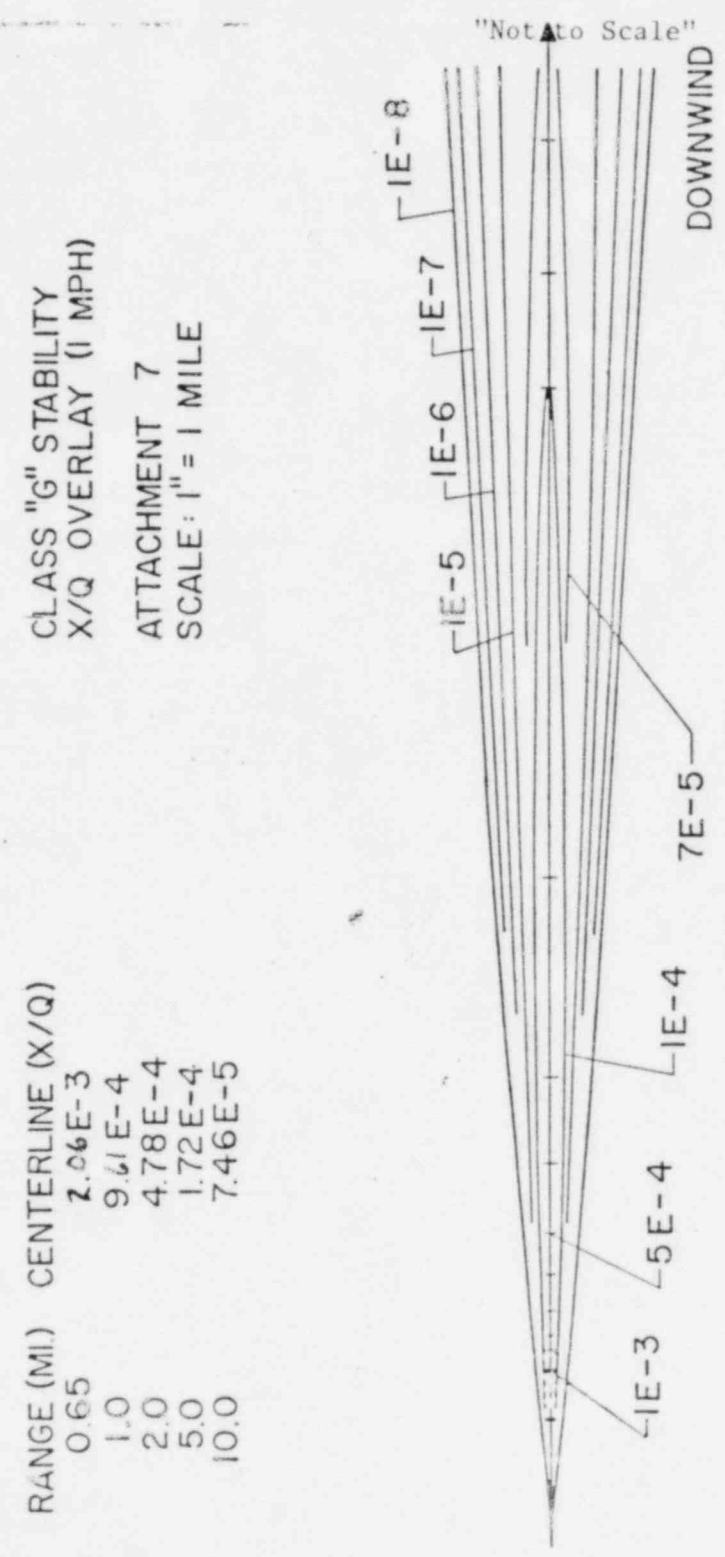
CLASS "F" STABILITY
X/Q OVERLAY (1 MPH)

ATTACHMENT 6
SCALE: 1" = 1 MILE

RANGE (MI.)	CENTERLINE (X/Q)
0.65	8.37E-4
1.0	5.01E-4
2.0	2.22E-4
5.0	7.23E-5
10.0	3.05E-5

ATTACHMENT 7

"Not to Scale"



CLASS "G" STABILITY
X/Q OVERLAY (1 MPH)

ATTACHMENT 7
SCALE: 1" = 1 MILE

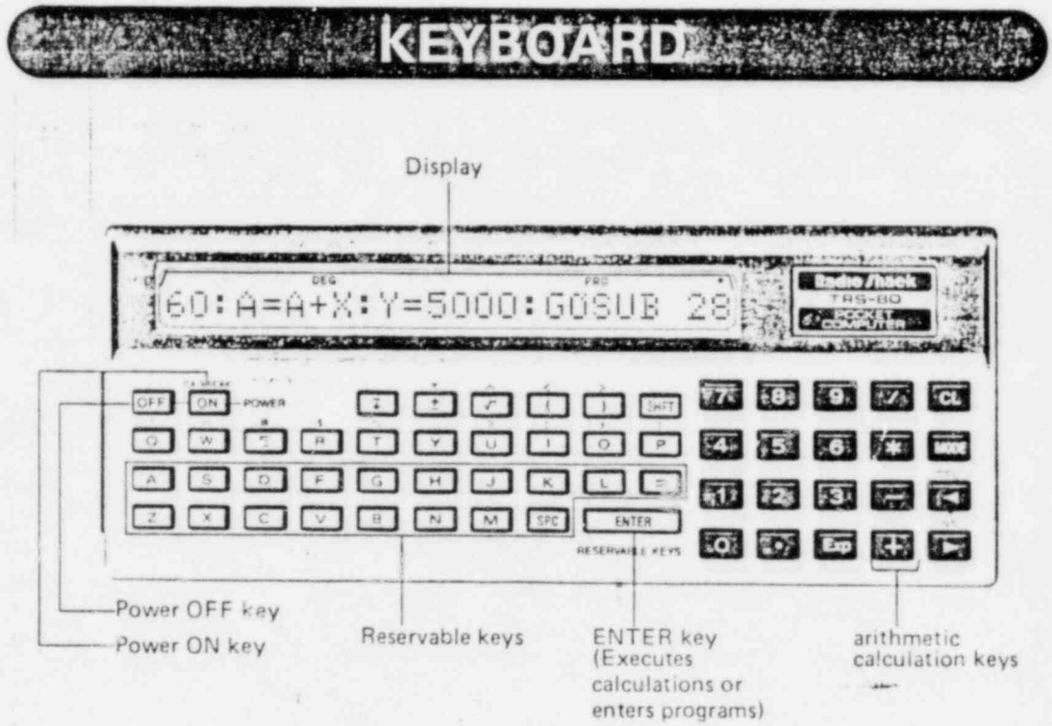
RANGE (MI.)	CENTERLINE (X/Q)
0.65	2.06E-3
1.0	9.61E-4
2.0	4.78E-4
5.0	1.72E-4
10.0	7.46E-5

ATTACHMENT 8

AREA MAP

ATTACHMENT 9

KEYBOARD LAYOUT



ATTACHMENT 10 Page 1 of 2

BATTERY REPLACEMENT

1.0 COMPUTER

NOTE: This computer uses Type 675 batteries; mercury batteries should be used when possible.

1.1 Press the [OFF] button.

NOTE: Two (2) types of screws hold the back cover in place.

1.2 Remove the screws from the back cover.

NOTE: Use a dry cloth to wipe off the surface of the new batteries before installing.

1.3 Replace the batteries, placing the "+" side up.

1.4 Hook the tabs on the back cover into the slots on the computer.

1.5 Push the back cover in slightly while replacing the screws.

NOTE: Do not use a pencil.

1.6 Using a hard, pointed object, carefully push the Reset switch on the back cover to clear the computer.

1.7 Press the [OFF] and then [ON] button to clear the computer.

NOTE: When the batteries are correctly installed "> DEG (MODE) ." will be displayed.

2.0 CASSETTE INTERFACE

NOTE: This device uses Type AA batteries; alkaline batteries should be used when possible.

2.1 Remove the sliding door located on the underside of the interface.

2.2 Replace the batteries as indicated on the interface.

3.0 CASSETTE TAPE RECORDER

NOTE: An optional AC adapter may be used, as necessary, if battery replacement is not feasible.

a) Press down on the battery compartment cover (on the back) and remove.

b) Replace the batteries as indicated on the recorder.

c) Replace the battery cover.

ATTACHMENT 11 Page 1 of 5

PROGRAM LOADING/VERIFICATION

1.0 CONNECTING THE POCKET COMPUTER TO THE CASSETTE INTERFACE

NOTE: Before attaching or removing the Computer from the Interface, be sure to turn off the Computer with the [OFF] key. If the computer is connected or disconnected with power ON, all keys may become inoperative. In this case, press the ALL RESET switch on the back of the Computer. This will clear the entire Computer (including programs stored in memory).

1.1 Press the [OFF] button.

1.2 Remove the cover from the left side of the Computer. It may be snapped into place on the bottom of the Cassette Interface, if desired.

1.3 Fit the projecting parts on the Cassette Interface in the grooves of the Computer.

NOTE: If parts do not mate properly, do not force them. Carefully shift the Computer left or right to be sure the mating surfaces are correctly aligned.

1.4 Slide the Computer carefully to fit securely onto the Cassette Interface.

2.0 CONNECTING THE CASSETTE INTERFACE TO A TAPE RECORDER

2.1 Connect red plug into the MIC jack on the Cassette Recorder.

2.2 Connect gray plug into the EAR phone jack on the Recorder.

3.0 LOADING A PROGRAM FROM A MAGNETIC TAPE

3.1 Load tape in the tape recorder.

3.2 Rewind the tape completely; connect the black plug into the REMOTE jack on the Recorder.

3.3 Press the [ON] button.

3.4 Press the [MODE] button repeatedly, as necessary, until the word "Run" is indicated in the upper portion of the display.

3.5 Push the PLAY button on the tape recorder.

3.6 Set the VOLUME control to approximately 3/4 of its full scale value.

3.7 Set Tone to maximum treble (if this option is available).

3.8 Type NEW [ENTER].

3.9 Press the [MODE] button repeatedly until the word "RESERVE" is indicated in the upper portion of the display.

3.10 Type NEW [ENTER].

3.11 Press the [MODE] button repeatedly until the word "RUN" is indicated in the upper portion of the display.

NOTE: When the program has been transferred, the Computer will automatically stop the tape motion and display the PROMPT (>) symbol.

3.12 Type CLOAD "PRO/ING" [ENTER]

3.12.1 If an error occurs (error code "5" is displayed), start over from the beginning. If the error continues, adjust volume up or down slightly and repeat steps 3.1 to 3.12.

3.12.2 If the error code is not displayed but tape motion continues, transferring is improper. Press [ON] key to stop the tape. Repeat steps 3.1 to 3.12.

3.12.3 If the error remains or the tape continues to run after several attempts to correct the problem, try cleaning or demagnetizing the Recorder's tape head.

3.13 Type INPUT "MEM/ING" [ENTER].

3.14 Press the [MODE] button until the word "RESERVE" appears in the upper portion of the display.

3.15 Type CLOAD "RES/ING" [ENTER].

3.16 Stop the recorder.

3.17 Press the [MODE] button repeatedly, as necessary, until the word "RUN" appears in the upper portion of the display.

NOTE: The following methods may be used to indicate that the program has been loaded correctly. The first method causes the Computer to automatically search for the specified file name and compare the contents on tape with the contents in memory. The second method checks the general program operation by inputing given initial data and manually comparing the output data to the calculated results.

4.0 PROGRAM TESTS

4.1 Comparison Method.

4.1.1 Disconnect the black plug from the REMote jack and completely rewind the tape.

4.1.2 Reconnect the black plug to the REMote jack.

4.1.3 Press the PLAY button of the recorder.

4.1.4 Type CLOAD? "PRO/ING" [ENTER]

A. If the programs are verified as being identical, the prompt symbol (>) will be displayed.

B. If the programs differ, execution will be interrupted and an Error Code 5 will be displayed. If this occurs, you may try again to either reload or re-verify the programs. A slight adjustment in the recorder volume level may improve the transfer.

NOTE: Ensure that the computer is turned OFF prior to removing it from the interface.

C. Upon completion, the computer may be removed from the interface, as appropriate.

4.2 Test Cases

4.2.1 Using the general operational method described in Sections 3.0 to 6.0 of 1904.02D, enter the appropriate input data from at least one of the following test cases. Compare the output data with the indicated results.

ATTACHMENT 11 Page 4 of 5

TEST CASE #	1	2	3	4	5
INPUT:					
Wind Direction	17	215	100	360	180
Wind Speed	4.5	3	18	6	1.5
Stability Class	A	C	D	E	G
Q-Gas	5E-3	0.15	1.9	6.8	20
Q-Iodine	6E-6	5E-4	4E-3	5E-3	6E-3
WB Scale Factor	0.9	1.1	0.6	0.99	1.9
CT Scale Factor	0.7	1.5	0.3	0.88	1.7
RESULTS:		Unusual		Site	General
EAL	O.K.	Event	Alert	Emergency	Emergency
Downwind Dir.	197	35	280	180	0
X/Q: Plume Bdy.	3.68E-4	8.70E-6	9.65E-6	6.09E-7	4.93E-8
.65 mi Avg. MPC	5.98E-2	2.19E 0	1.51E 1	8.95E 1	5.05E 2
.65 mi WB	1.00E-3	6.02E-1	1.48E 0	3.96E 1	2.08E 3
.65 mi CT	3.86E-3	1.47E 1	1.07E 1	1.98E 2	7.84E 3
1 mi WB	2.53E-4	2.66E-1	7.14E-1	2.14E 1	9.74E 2
1 mi CT	9.77E-4	6.49E 0	5.15E 0	1.07E 2	3.65E 3
2 mi WB	1.05E-4	8.09E-2	3.43E-1	8.36E 0	4.84E 2
2 mi CT	4.07E-4	1.97E 0	2.47E 0	4.18E 1	1.82E 3
5 mi WB	4.61E-5	1.51E-2	6.78E-2	2.39E 0	1.74E 2
5 mi CT	1.77E-4	3.68E-1	4.89E-1	1.19E 1	6.54E 2
10 mi WB	2.57E-5	4.44E-3	2.50E-2	9.34E-1	7.56E 1
10 mi CT	9.93E-5	1.08E-1	1.80E-1	4.68E 0	2.84E 2
INPUT:					
Local X/Q	1E-7	1.9E-7	3.9E-7	1.2E-6	8.08E-9
RESULTS:					
Local WB	~1.22E-5	~0.0012	~1.21E-3	~0.102	~1.56E-2
Local CT	~3.66E-5	~0.0399	~4.37E-3	~0.455	~0.0523

A. If the data compares favorably, then the overall program is operating properly.

B. If the data does not compare, you may try to reload or reverify the program. A slight adjustment in the recorder volume level may improve the transfer.

NOTE: Ensure that the computer is turned OFF prior to removing it from the interface.

C. Upon completion, the computer may be removed from the interface, as appropriate.

ATTACHMENT 12 Page 1 of 2

PROGRAM LISTING

```
110  Input "Wind Direction (From)?"; C
120  Input "Windspeed (MPH)?"; D
122  Input "Stability Class (A-G)?"; Y$
123  B = 1: IF Y$ = "A" GOTO 140
124  B = 2: IF Y$ = "B" GOTO 140
125  B = 3: IF Y$ = "C" GOTO 140
126  B = 4: IF Y$ = "D" GOTO 140
127  B = 5: IF Y$ = "E" GOTO 140
128  B = 6: IF Y$ = "F" GOTO 140
129  B = 7: IF Y$ = "G" GOTO 140
130  GOTO 122
140  Input "Q-Gas (Ci/Sec)?"; E
150  Input "Q-Iodine (Ci/Sec)?"; G
170  Input "WB Scale Factor?"; F
180  Input "CT Scale Factor?"; A
200  H = C - 180
210  IF H<0 Let H = C + 180
215  K = E * 13.3 * F
225  X = A (B + 32)
230  M = A * G * 5.6E8 * X/D
245  L = 1.74E5 * E * F * A (B + 25) * X/D
294  IF ((M< = 500) * (L< = 250)) GOTO 298
296  Print "General Emergency": GOTO 314
298  IF ((M< = 150) * (L< = 50)) GOTO 302
300  Print "Site Emergency": GOTO 314
302  IF (K< = 10) GOTO 306
304  Print "Alert": GOTO 314
306  IF (K< = 1) GOTO 310
308  Print "Unusual Event": GOTO 314
310  Print "O.K."
314  W = X * .05/L
316  FOR N = 1 TO 4
318  A (14 + N) = A (7 * N + B + 32) * L/X
320  A (18 + N) = A (7 * N + B + 32) * M/X
330  Next N
390  Print Using; "Downwind Direction ="; H
400  Using "#.## ^^"
405  Print "X/Q: Plume Bdy ="; W
430  Print ".65 mi Avg. MPC ="; K
440  Print ".65 mi WB ="; L
450  Print ".65 mi CT="; M
478  Print "1 mi WB ="; O
480  Print "1 mi CT ="; S
490  Print "2 mi WB ="; P
500  Print "2 mi CT ="; T
```

ATTACHMENT 12 Page 2 of 2

PROGRAM LISTING

```
510  Print "5 mi WB ="; Q
520  Print "5 mi CT ="; U
530  Print "10 mi WB ="; R
540  Print "10 mi CT ="; V
560  Print Using; "Wind Direction (From) ="; C
570  Print "Windspeed ="; D
580  Print "Stability ="; Y$
590  Using "#.## ^^"
600  Print "Q-Gas ="; E
610  Print "Q-Iodine ="; G
620  Print "WB Factor ="; F
630  Print "CT Factor ="; A
999  END
```

ATTACHMENT 13

MEMORY CONTENTS

Memory Location	Variable Name	Description	Value
1	A	Child Thyroid Scale Factor	(NOTE: The memory contents of locations 1-25 depend upon program input.)
2	B	Stability Class No.	
3	C	Wind Direction	
4	D	Wind Speed	
5	E	Q-Gas	
6	F	Whole Body Scale Factor	
7	G	Q-Iodine	
8	H	Downwind Direction	
9	I	Not Used	
10	J	Not Used	
11	K	Line 10a) 0.65 MPC (ANN)	
12	L	" 10e) " W.B. (REAL)	
13	M	" 10c) " C.T. (REAL)	
14	N	Loop Counter	
15	O	1 mi W.B.	
16	P	2 mi W.B.	
17	Q	5 mi W.B.	
18	R	10 mi W.B.	
19	S	1 mi C.T.	
20	T	2 mi C.T.	
21	U	5 mi C.T.	
22	V	10 mi C.T.	

ATTACHMENT 13 Page 2 of 4

MEMORY CONTENTS

Memory Location	Variable Name	Description		Value
23	W	X/Q for .05 MR/hr		
24	X	Current 1 MPH X/Q @ 0.65 mi		
25	Y$	Literal Stability Class		
26		Fin. Plume C.F.	(A)	0.78
27		" " "	(B)	0.72
28		" " "	(C)	0.60
29		" " "	(D)	0.47
30		" " "	(E)	0.42
31		" " "	(F)	0.35
32		" " "	(G)	0.23
33		0.65 mi X/Q	(A)	7.39E-6
34		" " "	(B)	4.10E-5
35		" " "	(C)	1.05E-4
36		" " "	(D)	2.87E-4
37		" " "	(E)	4.84E-4
38		" " "	(F)	8.37E-4
39		" " "	(G)	2.06E-3
40		1.0 mi X/Q	(A)	1.87E-6
41		" " "	(B)	1.68E-5
42		" " "	(C)	4.64E-5

ATTACHMENT 13

MEMORY CONTENTS

Location	Description		Value
43	1.0 mi X/Q	(D)	1.38E-4
44	" " "	(E)	2.62E-4
45	" " "	(F)	5.01E-4
46	" " "	(G)	9.61E-4
47	2.0 mi X/Q	(A)	7.80E-7
48	" " "	(B)	4.18E-6
49	" " "	(C)	1.41E-5
50	" " "	(D)	6.64E-4
51	" " "	(E)	1.02E-4
52	" " "	(F)	2.22E-4
53	" " "	(G)	4.78E-4
54	5.0 mi X/Q	(A)	3.40E-7
55	" " "	(B)	7.30E-7
56	" " "	(C)	2.63E-6
57	" " "	(D)	1.31E-5
58	" " "	(E)	2.92E-5
59	" " "	(F)	7.23E-5
60	" " "	(G)	1.72E-4
61	10.0 mi X/Q	(A)	1.90E-7
62	" " "	(B)	2.51E-7
63	" " "	(C)	7.74E-7
64	" " "	(D)	4.83E-6

ATTACHMENT 13

MEMORY CONTENTS

Memory Location	Description		Value
65	10.0 mi X/Q	(E)	1.14E-5
66	" " "	(F)	3.05E-5
67	" " "	(G)	7.46E-5

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: RECORD OF CHANGES AND REVISIONS | FORM NO 1000.06A

OFFSITE DOSE PROJECTIONS | REV. # 8 | PC #

ESTIMATING AIRBORNE RELEASE RATES
1904.04 REV. 0

PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#
1	0													
2	0													
3	0													
4	0													
5	0													
6	0													
7	0													
8	0													
9	0													
10	0													
11	0													
12	0													

APPROVED BY:

(General Manager)

APPROVAL DATE
7/30/82

REQUIRED EFFECTIVE DATE:

1.0 PURPOSE

The purpose of this procedure is to provide radioactive release rate estimates for release points which do not have functioning GERMS SPING detector systems.

2.0 SCOPE

This procedure is applicable to airborne radioactive releases monitored by the original normal-range detectors and emergency-range hydrogen purge detectors, as well as containment leakage, and other "unmonitored" releases. Refer to 1904.03, "Auxiliary Building Ventilation Emergency Radiation Monitor" if the original normal-range detectors are off-scale high.

3.0 REFERENCES

3.1 References used in procedure preparation:

3.1.1 "Meteorology and Atomic Energy," Slade

3.1.2 "Manual for Protective Actions," Environmental Protection Agency

3.1.3 Memorandum Number CL-2126 (A. Smith to File)

3.1.4 Detector Calibration Curves (Supplied by ANO Radiochemistry and I&C)

3.1.5 ANO-1 and ANO-2 Integrated Leak Rate Test Reports, Bechtel Power Corp.

3.1.6 AIMS System Manual, Document No. AIMS-M-20, Applied Physical Technology

3.2 References used in conjunction with this procedure:

3.2.1 1904.02, "Offsite Dose Projections, Pocket Computer Method"

3.2.2 1904.03, "Auxiliary Building Ventilation Exhaust Emergency Radiation Monitor"

4.0 LIMITS AND PRECAUTIONS

4.1 The radiological release rate data source selected should be the best available. Data sources are listed below in order of preference:

4.1.1 GERMS SPING detectors (Procedure 1904.02, "Offsite Dose Projections - Pocket Computer Method")

4.1.2 LFE/Trapelo or Westinghouse normal-range monitors

4.1.3 Auxiliary Building Ventilation Emergency Radiation Monitor (Procedure 1904.03)

4.1.4 Portable instrumentation and grab sample analyses

4.2 If release rates are calculated using different detector types at different release points, care must be taken to account for each release path once and only once. See Figure 1.

5.0 ANO-1 NORMAL RANGE (LFE/TRAPELO) MONITORS

5.1 Record the date and time of the monitor readings on Form 1904.04A.

5.2 Record on Form 1904.04A the net counts per minute and the corresponding flow rate for each release path to be accounted for via normal range monitors.

5.3 Complete Form 1904.04A to estimate the total gaseous and iodine release rates for the selected release paths.

5.4 Copy the results to a line on Form 1904.02C marked "other releases".

6.0 ANO-2 NORMAL RANGE (WESTINGHOUSE) MONITORS

6.1 Record the date and time of the monitor readings on Form 1904.04B.

6.2 Record on Form 1904.04B, the net counts per minute and the corresponding flow rate for each release path to be accounted for via normal range monitors.

6.3 Complete Form 1904.04B to estimate the total gaseous and iodine release rates for the selected channels.

6.4 Copy the results to a line marked "other releases" on Form 1904.02C.

7.0 ANO-1/ANO-2 CONTAINMENT LEAKAGE

7.1 Request Radiochemistry to analyze the atmosphere of the affected containment building for total iodine concentration (μCi/cc I-131 dose-equivalent) and total noble gas concentration (μCi/cc as Xe-133). Record the results on Form 1904.04C.

NOTE: PASS/AIMS minimum detectable concentrations are approximately 1E-4 μCi/cc for all radionuclides.

7.2 Complete Form 1904.04C to estimate the iodine and noble gas release rate from this source. Copy the results to a line marked "other releases" on Form 1904.02C.

8.0 ANO-1 HIGH-RANGE HYDROGEN PURGE MONITOR

8.1 To account for the release of radionuclides in the ANO-1 hydrogen purge using the high-range monitors, complete Form 1904.04D.

8.2 Copy the results from Section 3.0 to a line marked "other releases" on Form 1904.02C.

9.0 "UNMONITORED" RELEASES MEASURED INDOORS

9.1 Instruct the Health Physics or Radiochemistry staff to obtain air samples in the affected area and analyze for radioiodines and noble gases. Record the results on Form 1904.04E in units of μCi/cc.

9.2 Determine the area ventilation discharge flow from Heating & Ventilation drawings, direct measurement, or other means. Record the discharge flow on Form 1904.04E.

9.3 Complete Form 1904.04E to estimate the iodine and noble gas release from this source.

9.4 Copy the results to a line marked "other releases" on Form 1904.02C.

10.0 "UNMONITORED" RELEASES MEASURED OUTDOORS

10.1 Direct Health Physics to determine the approximate plume width in feet and the maximum radiation readings in mR/hr at a convenient downwind distance using a survey meter which is primarily sensitive to gamma radiation. An air iodine sample should also be taken along the plume centerline.

10.2 The effect of direct radiation ("shine") from the source can be subtracted by measuring the "background" radiation an equivalent distance upwind from the source.

10.3 Determine the current windspeed from the control room recorders, the GERMS chromatics terminals, or other source as described in Section 7.2 of 1904.02, "Offsite Dose Projection - Pocket Computer Method."

10.4 Complete Form 1904.04F to estimate the iodine and noble gas release rates from this source.

10.5 Copy the results to a line marked "other releases" on Form 1904.02C.

11.0 ATTACHMENTS AND FORMS

11.1 Form 1904.04A - "ANO-1 Normal Range Monitors"

11.2 Form 1904.04B - "ANO-2 Normal Range Monitors"

11.3 Form 1904.04C - "Containment Atmosphere Leakage"

11.4 Form 1904.04D - "ANO-1 High Range Hydrogen Purge Monitor"

11.5 Form 1904.04E - ""Unmonitored" Releases Measured Indoors"

11.6 Form 1904.04F - ""Unmonitored" Releases Measured Outdoors"

11.7 Figure 1 - "Airborne Release Monitors at ANO"

11.8 Figure 2 - "Hydrogen Purge Monitor Coversion Factors"

11.9 Figure 3 - "Finite Plume Multiplication Factor"

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: ANO-1 NORMAL RANGE MONITORS | FORM NO. 1904.04A

REV. # 0 PC #

PART 1 - TOTAL GASEOUS RELEASE RATE Date _____ Time _____

LINE	RELEASE PATH & MONITOR/FLOW INDICATION NUMBER	COLUMN 1 MONITOR READING (CPM)	COLUMN 2 VENTILATION SYSTEM FLOW RATE (CFM)	COLUMN 3 MONITOR CALIBRATION CONVERSION FACTOR	COLUMN 4 (1) Q_{gas} (Ci/Sec)
1	Stack (RE-7400; FR-8001)			2.05E-11	
2	Penetration Room (RI-2120; FI-2120)			1.23E-12	
3	Penetration Room (RI-2130; FI-2130)			1.23E-12	
4	Hydrogen Purge (RI-7441; FI-7441)			9.28E-12	
5	Hydrogen Purge (RI-7442; FI-7442)			9.28E-12	
6	Total Normal Range Noble Gas Release Rate	XXXXXXXXX	XXXXXXXXXXXXX	XXXXXXXXXXXXX	(2)

PART 2 - TOTAL IODINE RELEASE RATE

Plant Condition	Iodine/Noble Gas Ratio (3)
Waste Gas Tank Rupture	4.1E-5
Steam Generator Tube Rupture (to Condenser)	4.5E-5
Fuel Handling Accident	1.4E-3
Large-Break LOCA	5.3E-2
Rod Ejection Accident	6.8E-1
None of the Above	7.8E-3

Circle the applicable iodine/noble gas ratio tabulated above. Multiply this value times line 6 to obtain the estimated iodine release rate for the selected flow paths:

Total Iodine Release Rate (Ci/Sec) _____

PART 3 - NOTES

1. Determination of Gaseous Release Rate (Q_{gas}) = Column 1 x Column 2 x Column 3.
2. Total normal range gaseous release rate, Q_{gas} = sum of values in Column 4.

Performed By _____ / _____
Initial Time

Reviewed By _____

3. I/NG ratios may also be determined via grab samples & laboratory analyses by multiplying the iodine concentration in µCi/cc by the vent flow rate (CFM) and by 4.71E-4 m^3/sec-CFM.

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: ANO-2 NORMAL RANGE MONITORS | FORM NO. 1904.04B

REV. # 0 PC #

PART 1 - TOTAL GASEOUS RELEASE RATE Date _____ Time _____

LINE	RELEASE PATH & MONITOR/FLOW INDICATION NUMBER	COLUMN 1 MONITOR READING (CPM)	COLUMN 2 VENTILATION SYSTEM FLOW RATE (CFM)	COLUMN 3 MONITOR CALIBRATION CONVERSION FACTOR	COLUMN 4 (1) Q_{gas} (Ci/Sec)
1	Aux. Bldg. Ext. (2RITS-7828; 2FR-7828)			1.9E-9	
2	Containment Purge (2RITS-8233; 2FR-8315)			5.2E-10	
3	Fuel Handling Area (2RITS-8540; 2FR-8315)			5.0E-10	
4	Rad Waste Area (2RITS-8542; 2FR-8315)			3.9E-10	
5	Hydrogen Purge (2RITS-6231; 2FI-8277-1)			3.6E-10	
6	Penetration Rm (2RITS-8845-1; 2FIS-8827-1)			5.7E-10	
7	Penetration Rm (2RITS-8846-2; 2FIS-8828-2)			3.9E-10	
8	Total Normal Range Noble Gas Release Rate	XXXXXXXXX	XXXXXXXXXXXXX	XXXXXXXXXXXXX	(2)

PART 2 - TOTAL IODINE RELEASE RATE

Plant Condition	Iodine/Noble Gas Ratio (3)
Waste Gas Tank Rupture	2.2E-7
Steam Generator Tube Rupture (To Condenser)	1.1E-4
Fuel Handling Accident	6.9E-3
Large-Break LOCA	1.9E-2
Small LOCA (Outside Containment)	5.8E-2
None of the Above	2.9E-3

Circle the applicable iodine/noble gas ratio tabulated above. Multiply this value times line 8 to obtain the estimated iodine release rate for the selected flow paths:

Total Iodine Release Rate (Ci/Sec) _____

PART 3 - NOTES

1. Determination of Gaseous Release Rate (Q_{gas}) = Column 1 x Column 2 x Column 3.

2. Total normal range gaseous release rate, Q_{gas} = sum of values in Column 4.

Performed By _____ / _____
Initial Time

Reviewed By _____

3. I/NG ratios may also be determined from grab samples (laboratory analyses) by multiplying the iodine concentration in μCi/cc by the vent flow rate (CFM) and by 4.71E-4 m^3/sec-CFM.

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: CONTAINMENT ATMOSPHERE LEAKAGE | FORM NO. 1904.04C

REV. # 0 PC #

1.0 Circle the affected unit: ANO-1 / ANO-2

2.0 Record containment sample time: _____ date: _____

3.0 Record the containment leak rate: _____ (m^3/sec)*

4.0 Record the containment iodine concentration:
_____ (μCi/cc I-131 D.E.)

5.0 Record the containment noble gas concentration:
_____ (μCi/cc as Xe-133)

6.0 Estimate the iodine leakage rate:
Q-iodine = line 3.0 x line 4.0 = _____ (Ci/Sec)

7.0 Estimate the noble gas leakage rate:
Q-gas = line 3.0 x line 5.0 = _____ (Ci/Sec)

* NOTE: Integrated containment leak rate for ANO-1 was 2.38E-4 m^3/sec as of 2/21/81. Integrated containment leak rate for ANO-2 was 1.63E-4 m^3/sec as of 5/31/81.

Performed By: _____ / _____
Initial Time

Reviewed By: _____

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: ANO-1 HIGH RANGE HYDROGEN PURGE MONITOR | FORM NO. 1904.04D

REV. # 0 PC #

1.0 Record the date and time of monitor reading: _____ / _____
Date Time

2.0 Complete the following table for each purge system which is currently operating:

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
	Radiation Monitor	Flow Monitor	Radiation Reading (mR/hr)	Vent Flow (CFM)	Conversion Factor	($\frac{Ci/ft^3}{\mu Ci/cc}$)	Q-gas (Ci/Sec)
a)	RI-7441A	FI-7441			(1)	4.72E-4	(2)
b)	RI-7442A	FI-7442			(1)	4.72E-4	(2)
c)	TOTAL	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	

3.0 Circle the Iodine/Noble gas ratio below corresponding with the time in hours since reactor shutdown. Multiply line 2.0-c by this value to obtain the estimated Q-Iodine (Ci/Sec)(3):

Hours Since Shutdown	0 hr	2 hr	4 hr	6 hr	12 hr
I/N.G. Ratio	0.49	0.37	0.33	0.29	0.24

_____ x _____ = _____
I/N.G. Ratio Line 2.0-c Q-Iodine (Ci/Sec)

NOTES:

(1) $\frac{\mu Ci/cc}{mR/hr}$ (See Figure 2)

(2) Q-gas = Column 3 x Column 4 x Column 5 x Column 6.

(3) The I/NG ratio may also be obtained from PASS/AIMS or laboratory analyses.

Performed By: _____ / _____
Initial Time

Reviewed By: _____

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: "UNMONITORED" RELEASES MEASURED INDOORS

FORM NO. 1904.04E

REV. # 0 PC #

1.0 Source location: _____

2.0 Measurement time & date: _____ / _____
Time Date

3.0 Area noble gas concentration _____ (μCi/cc as Xe-133)

4.0 Area airborne radioiodine concentration _____ (μCi/cc as I-131)

5.0 Area total ventilation discharge flow _____ (CFM)

6.0 Estimate Q-gas for this source:

_____ (μCi/cc) x _____ (CFM) x 4.71E-4 $\frac{m^3/sec}{CFM}$
Line 3.0 Line 5.0

= _____ (Ci/Sec)
Q-gas

7.0 Estimate Q-Iodine for this source:

_____ (μCi/cc) x _____ (CFM) x 4.71E-4 $\frac{m^3/sec}{CFM}$
Line 4.0 Line 5.0

= _____ (Ci/Sec)
Q-Iodine

Performed By: _____ / _____
Initial Time

Reviewed By: _____

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: "UNMONITORED" RELEASES MEASURED OUTDOORS — FORM NO. 1904.04F

REV. # 0 PC #

1.0 Source location: _____

2.0 Measurement time & date: _____ / _____ (Time / Date)

3.0 Distance from source: _____ (ft)

4.0 Plume width at this distance: _____ (ft)

NOTE: One mile = 5280 feet.

5.0 Maximum gamma dose rate at this distance: _____ (mR/hr)

6.0 Maximum iodine concentration at this distance: _____ (μCi/cc as I-131)

7.0 Gamma dose rate at the equivalent upwind distance: _____ (mR/hr)

8.0 Current windspeed: _____ mph

9.0 Based on the plume width line 4.0, read and record the finite plume correction factor from Figure 3 for a plume of this width: _____

10.0 Estimate Q-gas for this source:

$$(\underset{\text{Line 4.0}}{\quad}\text{(ft)})^2 \times (\underset{\text{Line 5.0}}{\quad}\text{(mR/hr)} - \underset{\text{Line 7.0}}{\quad}\text{(mR/hr)}) \times \underset{\text{Line 8.0}}{\quad}\text{(mph)} \times \underset{\text{Line 9.0}}{\quad} = \underset{\text{Q-gas}}{\quad}\text{(Ci/Sec)}$$

11.0 Estimate Q-Iodine for this source:

$$(\underset{\text{Line 4.0}}{\quad}\text{(ft)})^2 \times 8.16\text{E-}3 \times \underset{\text{Line 6.0}}{\quad}\text{(μCi/cc)} \times \underset{\text{Line 8.0}}{\quad}\text{(mph)} = \underset{\text{Q-Iodine}}{\quad}\text{(Ci/Sec)}$$

Performed By: _____ / _____ (Initial / Date)

Reviewed By: _____

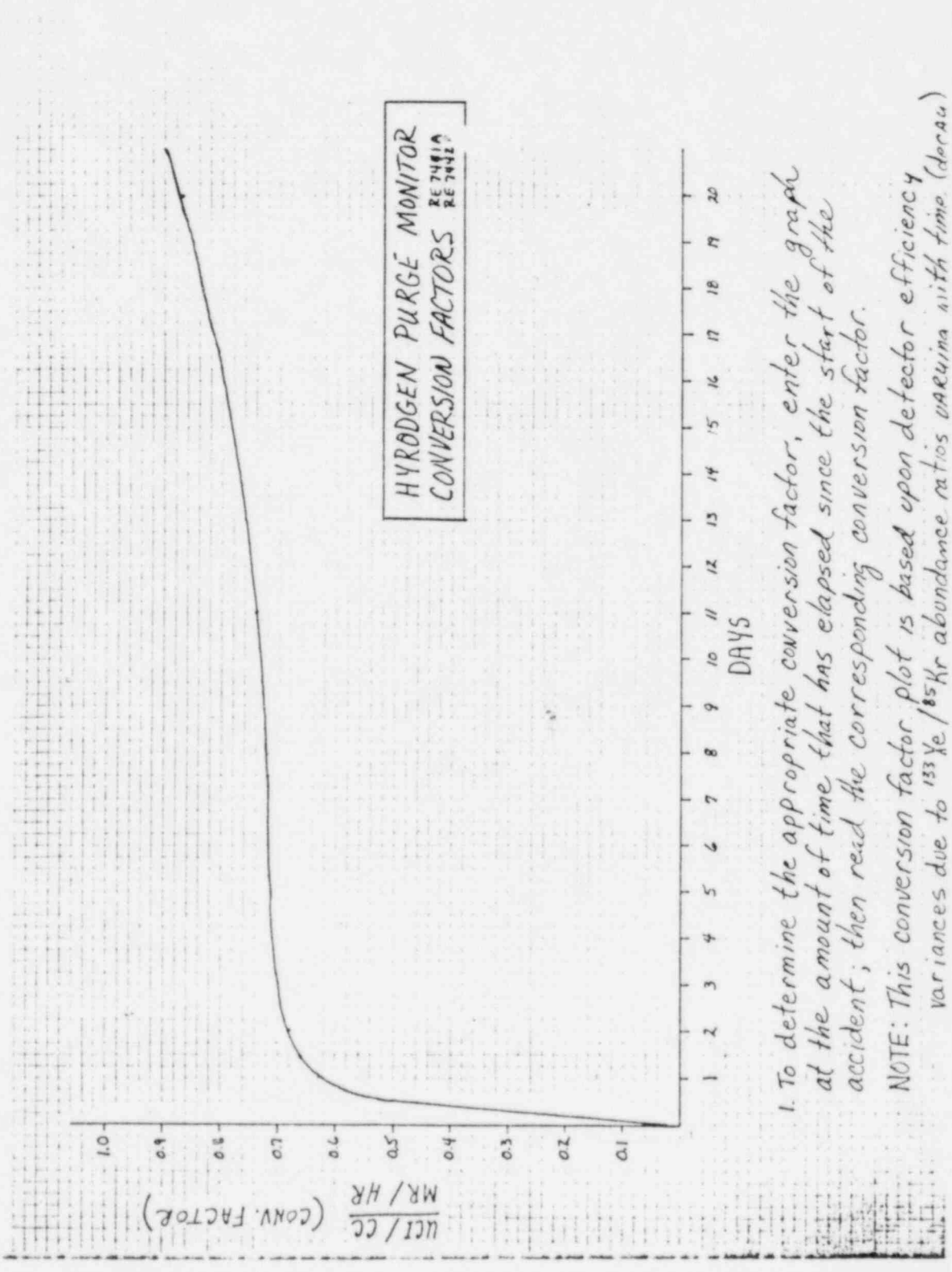
FIGURE 1

AIRBORNE RELEASE MONITORS AT ANO

AIRBORNE RELEASE PATH	SPING DESIGNATION MONITOR NUMBER	EMERGENCY RANGE MONITOR DESIGNATION	NORMAL RANGE MONITOR DESIGNATION	FLOW INSTRUMENT
ANO-1 Cont. Purge	Rx-9820/Monitor 1	*		
ANO-1 Radwaste	Rx-9825/Monitor 2	Model RMS II (See 1904.03)	RE-7400	FR-8001
ANO-1 Fuel Hd.	Rx-9830/Monitor 3	None		
ANO-1 H_2 Purge "A"	Rx-9835/Monitor 4	RI-7441A	RI-7441	FI-7441
ANO-1 H_2 Purge "B"		RI-7442A	RI-7442	FI-7442
ANO-1 Pen. Vent "A"		None	RI-2120	FI-2120
ANO-1 Pen. Vent "B"		None	RI-2130	FI-2130
PASS Bldg.	2Rx-9840/Monitor 9	None	None	None
ANO-2 Cont. Purge	2Rx-9820/Monitor 5	*	2RITS-8233	2FR-8315
ANO-2 Radwaste	2Rx-9825/Monitor 6	Model RMS II (See 1904.03)	2RITS-8542	2FR-8315
ANO-2 Fuel Hd.	2Rx-9830/Monitor 7	None	2RITS-8540	2FR-8315
ANO-2 H_2 Purge	2Rx-9835/Monitor 8	None	2RITS-8231-1	2FI-8277-1
ANO-2 Pen. Vent "A"		None	2RITS-8845-1	2FIS-8827-1
ANO-2 Pen. Vent "B"		None	2RITS-8846-2	2FIS-8828-2
ANO-2 Aux Bldg Ext	2Rx-9845/Monitor 10	None	2RITS-7828	2FR-7828

* Indirect, based upon containment leak rate & PASS/AIMS remote sample and analysis. (See Section 7.0 of this procedure.)

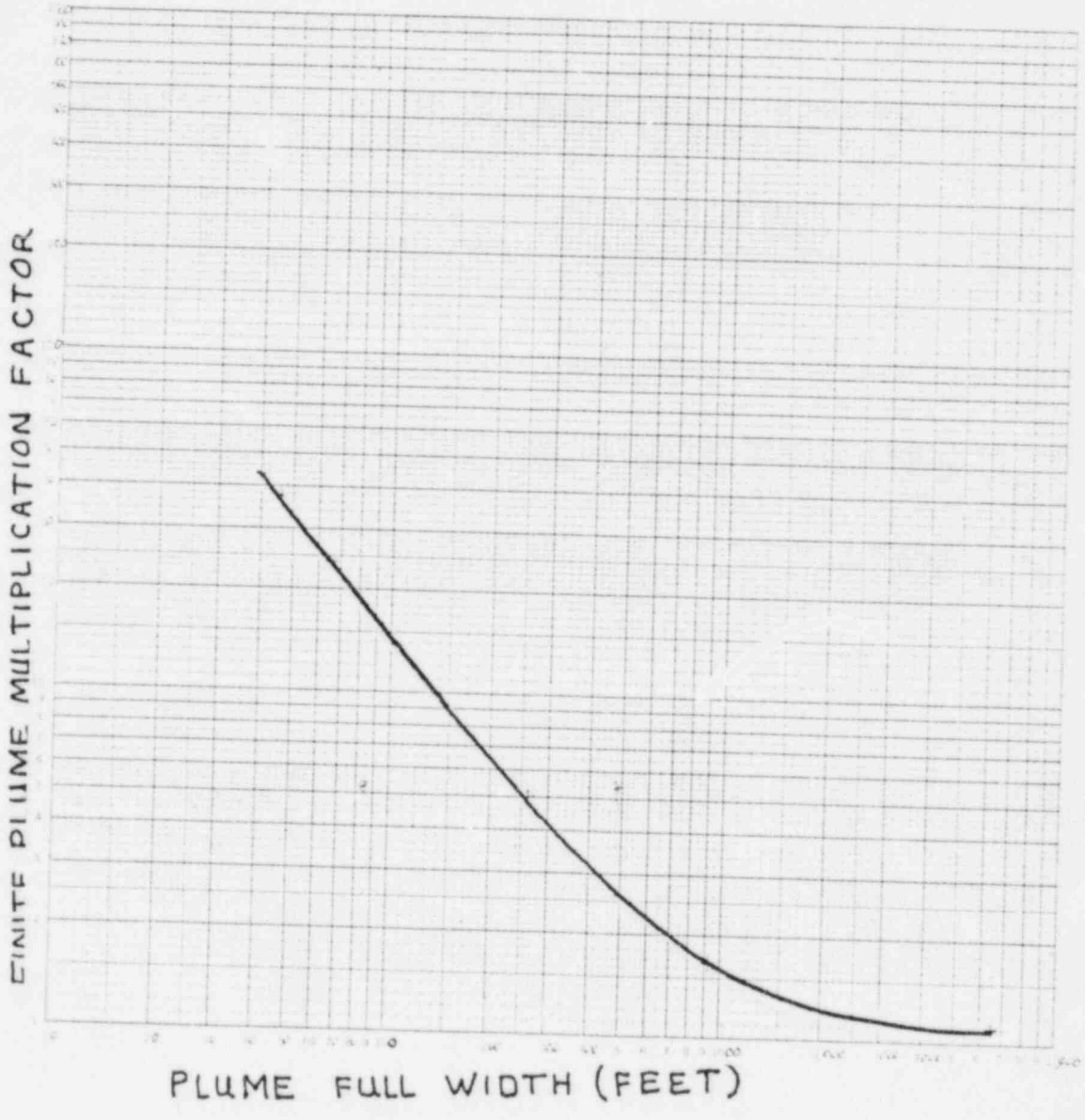
FIGURE 2



1. To determine the appropriate conversion factor, enter the graph at the amount of time that has elapsed since the start of the accident; then read the corresponding conversion factor.

NOTE: This conversion factor plot is based upon detector efficiency variances due to ^{133}Xe/^{85}Kr abundance ratios during with time (decay)

FIGURE 3



ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: RECORD OF CHANGES AND REVISIONS | FORM NO 1000.06A

OFFSITE DOSE PROJECTIONS | REV. # 8 | PC #

ATMOSPHERIC STABILITY CLASS DETERMINATION
1904.05 REV. 0

UN-Controlled Copy # 104

PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#	PAGE	REV	PC#
1	0													
2	0													
3	0													
4	0													
5	0													
6	0													
7	0													
8	0													

APPROVED BY:

(General Manager)

APPROVAL DATE
7/31/82

REQUIRED EFFECTIVE DATE:

1.0 PURPOSE

The purpose of this procedure is to allow determination of the atmospheric stability category based upon the position of the sun, the wind speed, and cloud conditions.

2.0 SCOPE

2.1 This procedure should be used when $\sigma\theta$ and ΔT information from the onsite meteorological tower are unavailable or are known to be inaccurate.

2.2 This procedure may be used to check stability class projections made from the onsite meteorological tower.

3.0 REFERENCES

3.1 References Used in Procedure Preparation

3.1.1 Personal Communication from Lee Harrison of the National Weather Service in North Little Rock, Arkansas (Lee Harrison to J. Tim Pugh, 3/26/82)

3.1.2 U.S. Department of Transportation/Federal Highway Administration, Region 15, Demonstration Project No. 38

3.1.3 Smithsonian Meteorological Tables, List, Sixth Revised Edition

3.1.4 "A Diffusion Model for an Urban Area", D.B. Turner, 1964, Journal of Applied Meteorology, February 1964, p. 91

3.2 References Used in Conjunction with this Procedure

None

3.3 Related ANO References

3.3.1 1904.02, "Offsite Dose Projections, Pocket Computer Method"

4.0 DEFINITIONS

4.1 Total Cloud Cover - Fractional portion of the sky obscured by clouds, expressed in tenths (including clouds at all altitudes).

4.2 Ceiling - Height above the surface (in feet) of the bottom of the lowest layer of clouds, smoke, etc., which contributes to obscuring the sky.

4.3 Solar Declination - The angle of the sun north (+) or south (-) of the equator.

4.4 Solar Angle - The compound angle of the sun above the horizon.

4.5 Insolation Class - The relative strength of sunlight falling at a location, based upon the solar angle and assuming clear skies.

4.6 Net Radiation Index - A measure of the net heat gain (+) or loss (-) by the earth's surface, based upon the insolation class and cloud conditions.

4.7 Nighttime - The period from one hour before sunset to one hour after sunrise.

5.0 CALCULATION OF THE SOLAR ANGLE

5.1 For nighttime conditions, the solar angle need not be calculated and the user can proceed directly to Section 6.0.

5.2 Enter the current standard (i.e. not daylight) time on Form 1904.05A line 1.1 in 24-hour format (i.e. 18:00 is equivalent to 6 p.m.)

5.3 Complete Form 1904.05A to compute the solar angle.

6.0 DETERMINATION OF THE NET RADIATION INDEX AND STABILITY CLASS

6.1 Obtain the wind speed from the Corps of Engineers and the ceiling height (in feet) for the Russellville area from the National Weather Service.

6.1.1 The Corps of Engineers ph. 968-5008

6.1.2 The National Weather Service in North Little Rock, ph. 771-0971 or • •

NOTE: To convert from knots (nautical miles per hour) to MPH (statute miles per hour), multiply the wind speed in knots by 1.15. The ceiling height can be estimated, if necessary.

6.2 The fractional cloud cover may be estimated by onsite or offsite personnel having a clear view of the sky.

6.3 Complete Form 1904.05B to calculate the net radiation index and the atmospheric stability class.

7.0 ATTACHMENTS AND FORMS

7.1 Form 1904.05A - "Calculation of the Solar Angle"

7.2 Table A-1 - "Stability Class Determination (Causative Factors)"

7.3 Form 1904.05B - "Determining the Net Radiation Index"

7.4 Table B-1 - "Stability Class Determination (Causative Factors)

ARKANSAS POWER & LIGHT COMPANY
Arkansas Nuclear One

TITLE: CALCULATION OF THE SOLAR ANGLE
FORM NO. 1904.05A
REV. # 0 PC #

NOTE: This form should only be completed for daytime hours (i.e. one hour after sunrise to one hour before sunset).

1.0 Convert the present time (Central Standard Time) to the number of hours past midnight:

1.1 Enter the present time (Central Standard Time) as hours and minutes past midnight (i.e., Military Time): _____hours _____minutes.

1.2 Convert the minutes to fractional hours by dividing the number of minutes indicated in Step 1.1 by 60:

_____minutes/60 min/hour = _____hours

1.3 Add the number of hours indicated in Step 1.1 and the fractional hours indicated in Step 1.2 to obtain the total number of hours past midnight:

_____ hours + _____ fractional hours = _____ hours past midnight

2.0 Subtract 12 hours from the number of hours past midnight obtained in Step 1.3 to obtain the (positive or negative) hours past noon:

_____ hours past midnight - 12 hours = _____ hours past noon

3.0 Multiply the hours past noon (positive or negative) obtained in Step 2.0 by 15 deg./hour to obtain the hour angle (θ):

θ = _____ hours past noon * 15 deg./hr. = _____ degrees

4.0 From Table A-1, obtain the solar declination (δ) for the date nearest the present:

δ = _____ degrees

5.0 Compute the solar angle (a) using the following formula:

$a = ASN ((0.578 * \sin \delta) + (0.816 * \cos \delta * \cos \theta))$ = _____ degrees

NOTE: The TRS-80 should be used for this calculation. With the TRS-80 in the RUN mode, type in the expression as above using values from 3.0 and 4.0 above. Be sure to enter all parenthesis. The notation ASN is equivalent to $\sin^{-1}$.

PERFORMED BY: _____ / _____
Initials Time

REVIEWED BY: _____

TABLE A-1

STABILITY CLASS DETERMINATION
(CAUSATIVE FACTORS)

Date	Declination (Degrees)	Date	Declination (Degrees)	Date	Declination (Degrees)
Jan. 1	-23.07	May 1	14.83	Sep. 1	8.58
5	-22.70	5	16.03	5	7.12
9	-22.22	9	17.15	9	5.62
13	-21.62	13	18.18	13	4.10
17	-20.90	17	19.15	17	2.57
21	-20.08	21	20.03	21	1.02
25	-19.15	25	20.82	25	-0.53
29	-18.13	29	21.50	29	-2.10
Feb. 1	-17.32	June 1	21.95	Oct. 1	-2.88
5	-16.17	5	22.47	5	-4.43
9	-14.92	9	22.87	9	-5.97
13	-13.62	13	23.17	13	-7.48
17	-12.25	17	23.37	17	-8.97
21	-10.83	21	23.45	21	-10.42
25	-9.38	25	23.42	25	-11.83
		29	23.28	29	-13.20
Mar. 1	-7.88	July 1	23.17	Nov. 1	-14.18
5	-6.35	5	22.87	5	-15.45
9	-4.80	9	22.47	9	-16.63
13	-3.23	13	21.95	13	-17.75
17	-1.65	17	21.35	17	-18.80
21	-0.08	21	20.63	21	-19.75
25	1.50	25	19.83	25	-20.60
29	3.07	29	18.95	29	-21.35
Apr. 1	4.23	Aug. 1	18.23	Dec. 1	-21.68
5	5.77	5	17.20	5	-22.27
9	7.28	9	16.10	9	-22.75
13	8.77	13	14.92	13	-23.10
17	10.20	17	13.68	17	-23.33
21	11.35	21	12.38	21	-23.43
25	12.93	25	11.03	25	-23.42
29	14.22	29	09.65	29	-23.28

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Arkansas Nuclear One

TITLE: DETERMINING THE NET RADIATION INDEX
FORM NO. 1904.05B
REV. # 0 PC #

1.0 Based upon information available (National Weather Services, Corps of Engineers) or direct observation, enter the following information:

1.1 Ceiling Height _____ ft.

1.2 Fractional Cloud Cover _____ (in tenths)

2.0 For Overcast:

If the fractional cloud cover is 10/10 and the ceiling is less than 7000 feet, enter net radiation index equal to 0 on line 5.0 (whether day or night).

3.0 For Nighttime:

3.1 If total cloud cover $\leq$4/10, enter net radiation index equal to -2 on line 5.0.

3.2 If total cloud cover >4/10, enter net radiation index equal to -1 on line 5.0.

4.0 For Daytime:

4.1 Select the insolation class number as a function of the solar angle (Form 1904.05A, line 5.0) from the table below:

SOLAR ANGLE (a)	INSOLATION	INSOLATION CLASS NUMBER
$a > 60°$	Strong	4
$35° < a \leq 60°$	Moderate	3
$15° < a \leq 35°$	Slight	2
$a \leq 15°$	Weak	1

Insolation Class Number _____

ARKANSAS POWER & LIGHT COMPANY
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TITLE: DETERMINING THE NET RADIATION INDEX | FORM NO. 1904.05B
REV. # 0 PC #

4.2 If total cloud cover <5/10, enter a net radiation index on line 5.0 numerically equal to the insolation class number on line 4.1.

4.3 If cloud cover >5/10, modify the insolation class number on line 4.1 by following these six steps:

NOTE: Keep a running total on the lines along the right margin.

4.3.1 Ceiling <7000 ft., subtract 2. _____

4.3.2 Ceiling >7000 ft. but <16000 ft., subtract 1. _____

4.3.3 Total cloud cover equal 10/10, subtract 1. (This will only apply to ceilings >7000 ft.) _____

4.3.4 If insolation class number has not been modified by Steps 4.3.1, 4.3.2, or 4.3.3 above, enter a net radiation index on line 5.0 numerically equal to the insolation class number on line 4.1.

4.3.5 If modified insolation class number is less than 1, let it equal 1. _____

4.3.6 Enter a net radiation index on line 5.0 corresponding to the modified insolation class number on line 4.3.5.

5.0 Net Radiation Index _____

6.0 Enter the wind speed from the Corps of Engineers.

Wind Speed = _____ mph

7.0 Apply the wind speed and net radiation index listed above to Table B-1 to obtain the atmospheric stability class and record here:

Atmospheric Stability Class = _____

Performed By _____ / _____
Initials Time

Reviewed By: _____

TABLE B-1

STABILITY CLASS DETERMINATION
(CAUSATIVE FACTORS)

STABILITY CLASS AS A FUNCTION OF NET RADIATION AND WIND SPEED

Wind Speed (MPH)	Net Radiation Index						
	4	3	2	1	0	-1	-2
0 - 2.3	A	A	B	C	D	F	G
2.3 - 4.6	A	B	B	C	D	F	G
4.6 - 6.9	A	B	C	D	D	E	F
6.9 - 8.1	B	B	C	D	D	E	F
8.1 - 9.2	B	B	C	D	D	D	E
9.2 - 11.5	B	C	C	D	D	D	E
11.5 - 12.7	C	C	D	D	D	D	D
12.7 - 13.8	C	C	D	D	D	D	D
>13.8	C	D	D	D	D	D	D