1004.7
Revision 5
03/08/83

IMPORTANT TO SAFETY
NON-ENVIRONMENTAL IMPACT RELATED

THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 EMERGENCY PLAN IMPLEMENTING PROCEDURE 1004.7
OFFSITE/ONSITE DOSE PROJECTIONS

Table of Effective Pages

Page	Revision	Page	Revision	Page	Revision	Page	Revision
1.0	4						
2.0	5						
3.0	3						
4.0	4						
5.0	4						
6.0	4						
7.0	3						
8.0	3						
9.0	3						
10.0	3						
11.0	3						
12.0	3						
13.0	3						
14.0	4						
15.0	4						
16.0	3						
17.0	3						
18.0	4						
19.0	4						
20.0	4						
21.0	4						
22.0	4						
23.0	4						

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THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 EMERGENCY PLAN IMPLEMENTING PROCEDURE 1004.7
OFFSITE/ONSITE DOSE PROJECTIONS

1.0 PURPOSE

The purpose of the procedure is to provide:

a. Techniques and methods for calculating projected doses (whole body, and thyroid dose equivalent which might result from monitored releases of radioactive materials from TMI Unit 1.

b. Techniques and methods for predicting the downstream concentrations of radioactive liquids resulting from a major accidental release of radioactive liquids to the Susquehanna Valley.

c. Contingency methods for estimating projected doses if monitors are out of service or off-scale high.

The Radiological Assessment Coordinator is responsible for implementing this procedure.

2.0 ATTACHMENTS

2.1	Attachment I	Dose Assessment Sheet
2.2	Attachment II	Meteorological Data
2.3	Attachment III	Calculation of the Source Term and Onsite/Offsite Dose Projections
2.4	Attachment IV	Contingency Calculations
2.5	Attachment V	Liquid Release Calculation
2.6	Attachment VI	Protective Action Guides
2.7	Attachment VII	Field Monitoring Nomograph
2.8	Attachment VIII	Computerized Dose Calculations

3.0 EMERGENCY ACTION LEVELS

3.1 As required by an Emergency Plan Implementing Procedure.

3.2 As directed by the Emergency Director or his designee.

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4.0 EMERGENCY ACTIONS

INITIALS

NOTE: The TRS-80 minicomputer may be used in lieu of written hand calculations to determine dose projections. Utilize Attachment VIII "Computerized Dose Calculations" to operate the minicomputer.

NOTE: Perform steps in order: If the release is radioactive materials to the atmosphere, perform Steps 4.1 - 4.5. If release is of radioactive liquids to the Susquehanna River perform Steps 4.6 - 4.8.

NOTE: Refer to EPIP 1004.6, Additional Assistance and Notification, Attachment III (pg. 10.0) for back-up sources of meteorological information.

____4.1 Complete the Meteorological section of the Dose Assessment Sheet by completing Attachment II.

____4.2 Complete the Release section, Source Term and Dose Projection section of the Dose Assessment Sheet by completing forms on Attachment III.

____4.3 Utilize Attachments VI and VII to evaluate Field Monitoring data and recommend Protective Action.

____4.4 Utilize Attachment IV to project dose based upon contingency calculations.

____4.5 Always report dose rate, dose, time used, and basis for the time estimate to the Emergency Director, or his designee.

____4.6 Compile the expected downstream concentrations by performing the steps and completing the forms in Attachment V.

____4.7 Compile the time for the flume to reach downstream users and a 24 hour average concentration by completing the remaining steps in Attachment V.

____4.8 Report results to the Emergency Director or his designee.

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ATTACHMENT I

DOSE ASSESSMENT SHEET

1.0 Meteorological Section

1.1 Time_____
1.2 Date_____
1.3 Wind Direction_____
1.4 Pasquil Stability Class_____

2.0 Release Section

2.1 Release Pathway_____
2.2 Monitor Designation_____

3.0 Source Term Calculation

10^{-6}	x	Meter Reading	x	Meter Conversion Factor	x	Ventilation Flowrate	=	Source Term
		$\left(\frac{\text{cpm or cpm}}{\text{min}}\right)$		$\left(\frac{\frac{\text{uci}}{\text{cc}}}{\frac{\text{cpm or cpm}}{\text{min}}}\right)$		$\left(\frac{\text{cc}}{\text{sec}}\right)$		$\left(\frac{\text{Ci}}{\text{sec}}\right)$
Noble Gas Channel		_____	x	_____	x	_____	=	_____
Radioiodine Channel		_____	x	_____	x	_____	=	_____

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4.0 Onsite/Offsite Dose Projections

	Source Term		Dispersion Factor		$\frac{1}{\text{Wind Speed}}$ mph		Dose Conversion Factor		Estimated Duration		Dose
	$\left(\frac{Ci}{sec}\right)$	:	$\left(\frac{Sec}{m^3}\right)$	:	$\left(\frac{mph}{mph}\right)$	:	$\left(\frac{\frac{mrem}{hour}}{\frac{Ci}{m^3}}\right)$	:	(hours)	: =	mrem
Noble Gas Channel		x		x		x	4E5	x		=	
Radioiodine Channel		x		x		x	3E9	x		=	

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Dose	Distance					
(mrem)	200m	400m	EA	2LPZ	8EPZ	10EPZ
Whole Body						
Thyroid						

ATTACHMENT II

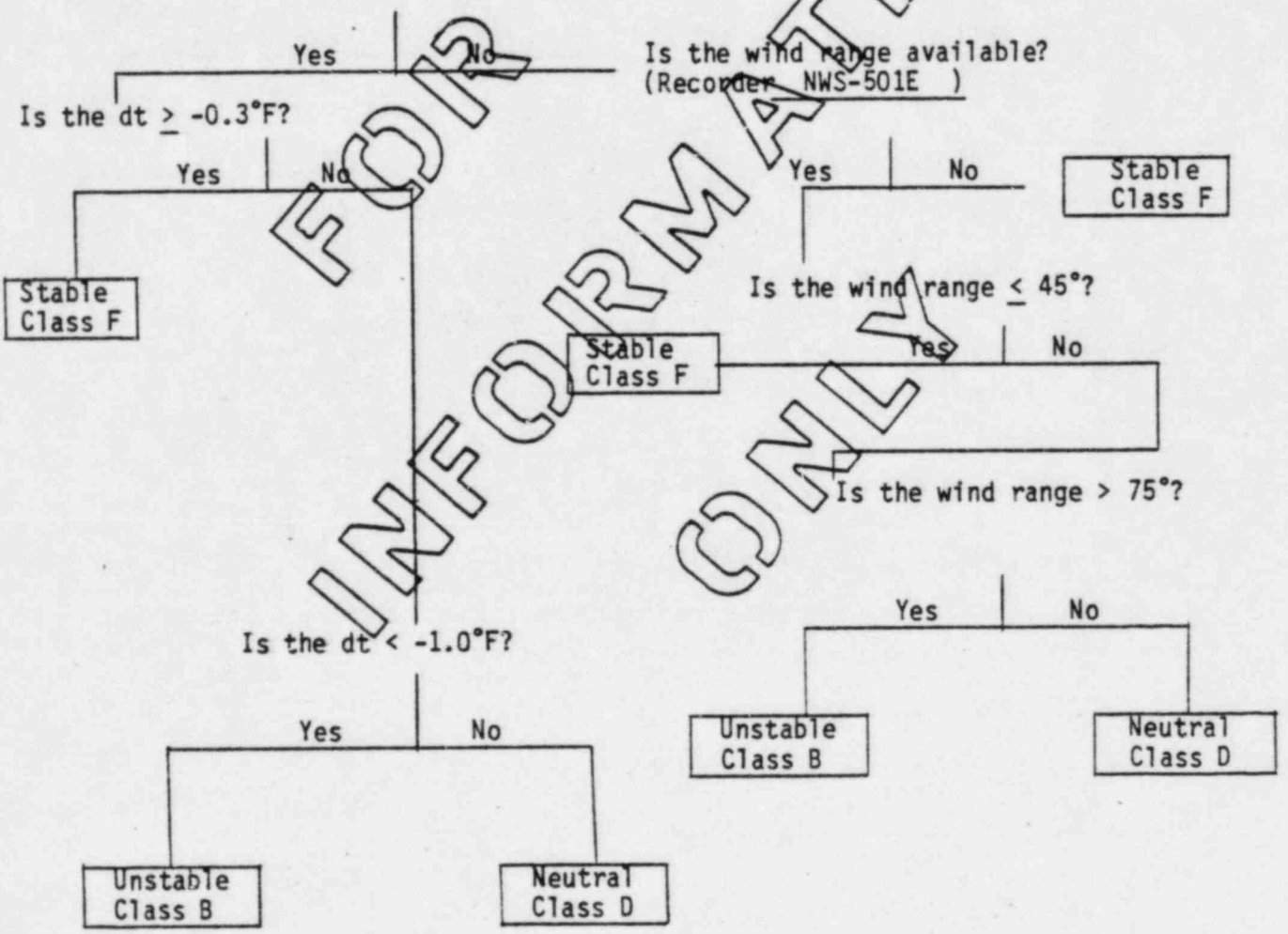
METEOROLOGICAL DATA

1. Record the following information on the Dose Assessment Sheet in the Meteorological section.

   1.1 Time of Day
   1.2 Date

   1.3 Wind Direction (per Recorder NWS-501E in degrees radian)
   1.4 Pasquil Stability Class (per the algorithm described below)

Is the differential temperature (dt) available?
(Recorder NWS-501E)



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2. Determine the dispersion factors that correspond to the correct stability class from Table 1, Dispersion Factors. Record the dispersion factors on the Dose Assessment Sheet, in the Onsite/Offsite Dose Projection section.

Table 1, Dispersion Factors

Pasquil Stability Class	Distance					
	200m	400m	EA	2LPZ	5EPZ	10EPZ
B	7.7 E-4	2.75 E-4	1.1 E-4	2.2 E-6	7.4 E-7	4.7 E-9
D	3.8 E-3	1.35 E-3	5.4 E-4	5.1 E-5	1.3 E-5	5.2 E-6
F	9.1 E-3	3.25 E-3	1.3 E-3	2.0 E-4	7.0 E-5	3.2 E-5

Record the Wind Speed (per recorder NWS-501-E in mph) on the Dose Assessment Sheet in the Onsite/Offsite Dose Projection section.

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ATTACHMENT III

Calculation of the Source Term and Onsite/Offsite Dose Projections

1. Identify the affected atmospheric radiation monitor(s) per the Radiation Monitoring System (RMS) Schematic by comparing the "actual" indicated concentration of radionuclide to the "normal observed" level. If more than one monitor on a Release Pathway is affected then choose the monitor furthest downstream of the release source. If all monitors in a Release Pathway are out-of-service or off-scale then proceed to the Contingency Calculations, Attachment IV.
   Record the monitor designation and Release Pathway on the Dose Assessment Sheet, in the Release section.

2. Record the Noble Gas Channel and Radioiodine Channel readings for the affected monitor on the Dose Assessment Sheet in the Source Term Calculation section.

3. Record on the Dose Assessment Sheet in the Source Term Calculation section, the Meter Conversion Factors that correspond to the affected monitor. The Meter Conversion Factors are listed on Table presented below:

Table 2 Meter Conversion Factors

Monitor Designation	Meter Conversion Factors	
	Noble Gas $\left(\frac{\frac{uci}{cc}}{cpm}\right)$	Radioiodine $\left(\frac{\frac{uci}{cc}}{\frac{cpm}{min}}\right)$
RM-A2	2.52 E-08	8.33 E-10
RM-A4	" "	" "
RM-A5	" "	N/A
RM-A6	" "	8.33 E-10
RM-A8	2.7 E-08	7.7 E-10
RM-A9	2.56 E-08	7.2 E-10

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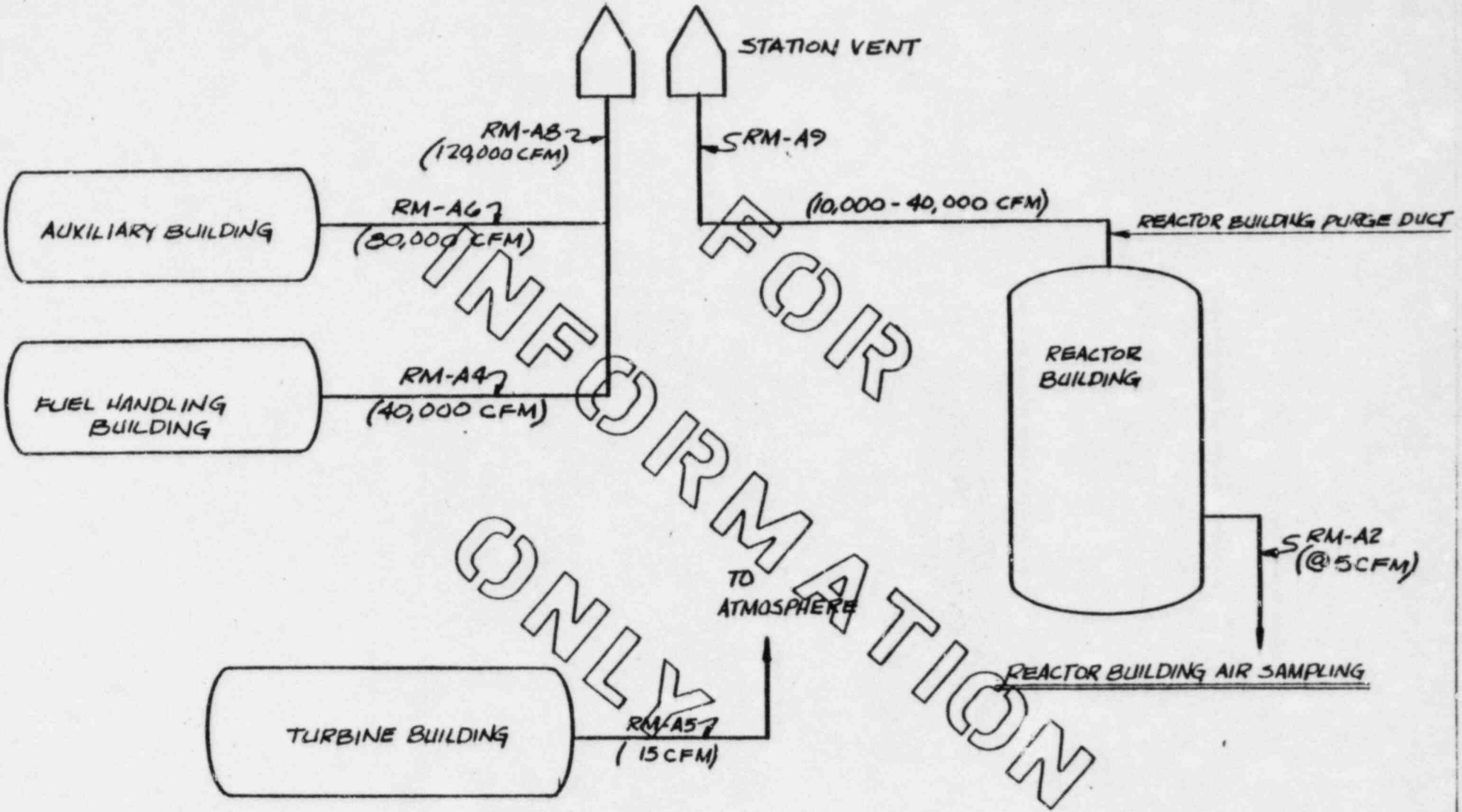

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4. Determine the Ventilation Flowrate for the affected Release Pathway.

TABLE 3 VENTILATION FLOWRATE

Release Pathway	Ventilation Flowrate Recorder
1. Station Vent (RM-A8)	1. FR-151 (CFM)
2. Auxiliary Building (RM-A6)	2. FR-150 " "
3. Fuel Handling Building (RM-A4)	3. FR-149 " "
4. Reactor Building Purge (RM-A9)	4. FR-143 " "

Multiply the Ventilation Flowrate in (CFM) by 472 to obtain the ventilation Flowrate in $\left(\frac{cc}{sec}\right)$.

Record on the Dose Assessment Sheet in the Source Term Calculation section the ventilation flowrate.

5. Calculate the Source Term $\left(\frac{Ci}{sec}\right)$ as indicated by the Dose Assessment Sheet, Attachment I.

6. Calculate the Onsite/Offsite Dose Projections as indicated by the Dose Assessment Sheet, Attachment I.

7. Determine the Emergency Action Level (EAL) utilizing Table 3 and the Exclusion Area Dose Projection.

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TABLE 3 EMERGENCY ACTION LEVELS (EAL)

EAL	Fraction of Lower Limit Protective Action Guide	Whole Body Gamma Exposure at Site Boundary(EA)
Alert	.01	$\geq$ 10 $\frac{\text{mrem}}{\text{hour}}$ < 50 $\frac{\text{mrem}}{\text{hour}}$
Site Emergency	.05	$\geq$ 50 $\frac{\text{mrem}}{\text{hour}}$ < 1 $\frac{\text{Rem}}{\text{hr}}$
General Emergency	1	$\geq$ 1 Rem/hr

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ATTACHMENT IV

Contingency Calculations

1. Utilize Table 1 if the radiation monitors normally used to monitor the containment and/or other plant effluent paths are out of service or off-scale high. The Emergency Director shall select a classification from (I-V). Computations shall be made using the Source Terms identified in Table 1. Transfer the noted Source Terms to the Dose Assessment Sheet, Attachment 1.
2. RM-G8 meter readings, containment pressure indications and Table 2 shall be utilized in lieu of Table 1 (Case I and II) Source Terms when possible. Transfer the Source Term computed utilizing Table 2 to the Dose Assessment Sheet, Attachment 1.

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Contingency Calculations Table 1

Classification	Source Term $\left(\frac{Ci}{sec}\right)$	
	Whole Body	Thyroid
Case I LOCA		
1. Fuel Melting		
2. No Core Cooling	1.0	1.5 E-1
3. 100% Noble gases and 25% iodines in the core released to containment		
4. Containment Maximum Design Leak Rate		
5. FSAR 14.2.2.4		
Case II LOCA		
1. No Fuel Melting	6.5 E-2	1.5 E-3
2. Core cooling maintained		
3. 100% GAP release		
4. Containment Maximum Design Leak Rate		
5. FSAR 14.2.2.3		
Case III		
Case Decay Tank Rupture	25	4.4 E-3
1. Total contents of tank released 90,000 Ci Noble Gas, 16 Ci D.E. I-131		
2. FSAR 14.2.2.5		
Case IV		
Fuel Handling Accident	4.7	7.5 E-4
1. Reactor is S/D for 72 hours		
2. 56 Fuel rods suffer mechanical damage to the cladding with GAP release.		
3. 100% Noble Gas and 10% of the iodine is released to Fuel Handling Building Atmosphere		
4. Charcoal filters on FHB ventilation system absorb 90% of the iodine.		
5. FSAR, 14.2.2.1		
Case V		
Steam Generator Tube Rupture	1.0	9.3 E-4
1. Double-ended rupture of one S/G tube		
2. Radioactivity is released through the turbine bypass to the condenser and then out the condensate vacuum pump exhaust.		
3. The gas to liquid partition factor for iodines is 10^{-4}		

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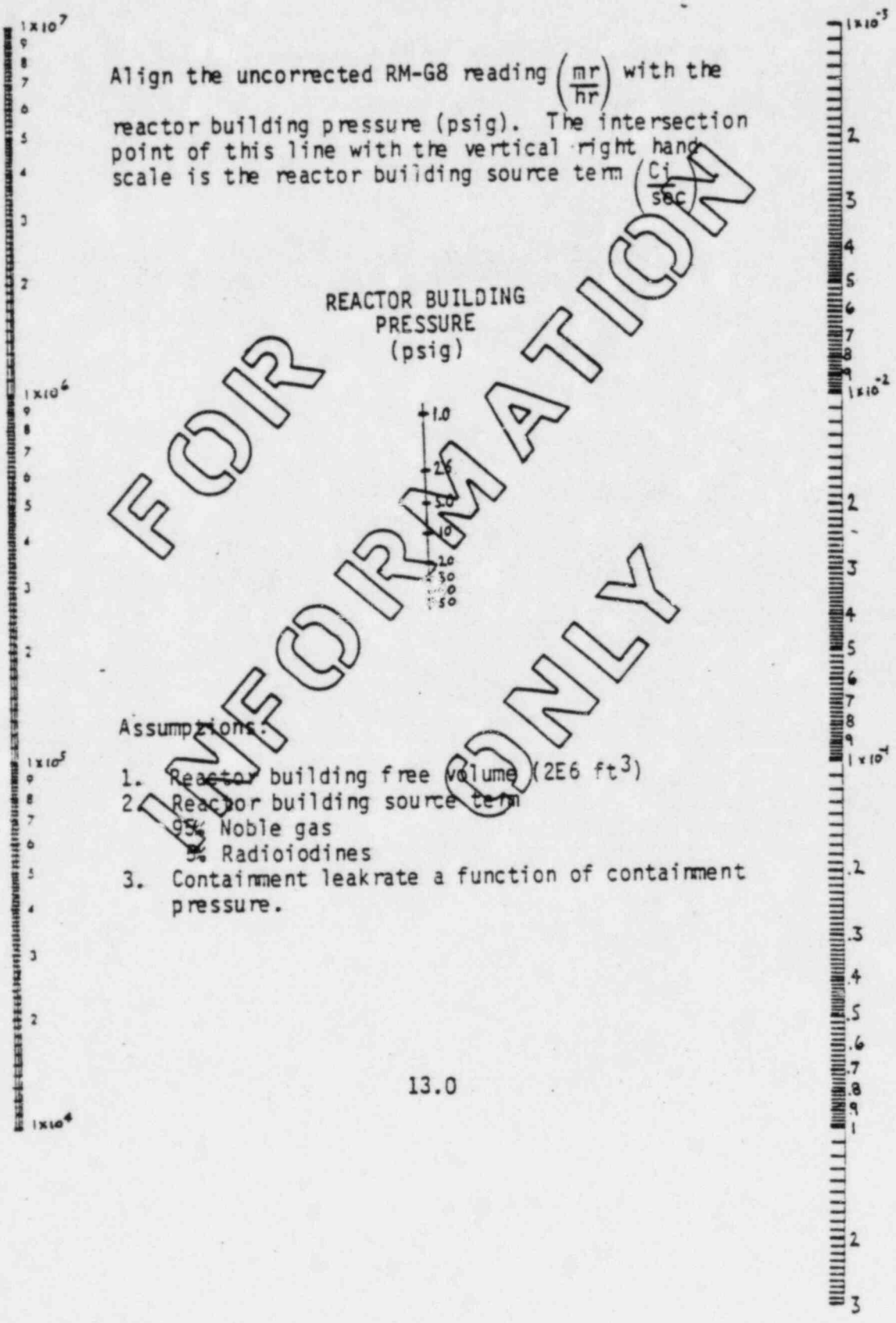
CONTINGENCY CALCULATIONS TABLE 2

REACTOR BUILDING SOURCE TERM NOMOGRAPH

UNCORRECTED RM-G8 READING (mR/hr)

REACTOR BUILDING SOURCE TERM (Ci/sec)



Align the uncorrected RM-G8 reading $\left(\frac{mr}{hr}\right)$ with the reactor building pressure (psig). The intersection point of this line with the vertical right hand scale is the reactor building source term $\left(\frac{Ci}{sec}\right)$

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Assumptions:

1. Reactor building free volume (2E6 ft^3)
2. Reactor building source term
   - 95% Noble gas
   - 5% Radioiodines
3. Containment leakrate a function of containment pressure.

ATTACHMENT V

LIQUID RELEASE CALCULATION

1. Estimate quantity of radioactive liquid released or the release rate of the liquid being released _____ (1a) gallons or _____ (1b) gpm.

2. From recorded information or sample analysis determine the activity level (in uCi/ml) of the released liquid: _____ (2) µCi/ml.

3. Obtain the river level by calling the River Forecast Center in Harrisburg at phone number 782-2256 or 782-3488 and record the reading: _____ (3) ft.

4. Find the river flow corresponding to the river level No. 3 above, in Table I, and record: _____ (4) CFS.

5. Calculate the average and maximum downstream concentrations of radioactive material as follows:

Maximum

$$\underset{(2)}{\quad}\ \frac{\mu Ci}{ml} \times \underset{(1b)}{\quad}\ gpm \times 2.33 \times 10^{-3}\ \frac{cfs}{gpm} \div \underset{(4)}{\quad}\ cfs = \underset{(5)}{\quad}\ \frac{\mu Ci^{**}}{ml}$$

NOTE: ** If the average or maximum downstream concentration is $\geq 1 \times 10^{-6}$ µCi/ml, notify downstream users to curtail intake.

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ATTACHMENT V

Time for Flume to Reach Downstream Users

6.	Downstream Points (Table II)	____	____	____	____	____
7.	Distance to Point in miles (Table II)	____ (9)	____ (9)	____ (9)	____ (9)	____ (9)
8.	River velocity in mph corresponding to river flow from (4) above (Table 1)	____ (10)	____ (10)	____ (10)	____ (10)	____ (10)
9.	Calculate a time in hours for the flume to reach selected point: Step 7 / Step 8	____	____	____	____	____

24 Hour Average Concentration in Unrestricted Areas

10. Record the duration of the release in minutes: ____ min.

11. Calculate a 24 hour average concentration in unrestricted areas:

$$\frac{\quad}{(5a)}\ \frac{\mu Ci}{ml} \times \frac{\quad}{(1)}\ \text{min} \times 6.95 \times 10^{-4} = \frac{\quad}{(1)}\ \frac{\mu Ci}{ml}$$

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ATTACHMENT V

12. Determine the estimated fraction of MPC:*

$$\frac{\text{(13)}}{\frac{\mu Ci}{ml}} \div MPC_{w}^{**} = \frac{\text{(12)}}{\text{Fraction of MPC}}$$

NOTE: * If the ratio obtained in (14) of Attachment is >500, notification of NRC is required with 24 hours per 10CFR20.403. If the ratio obtained is >5,000, immediate notification is required per 10CFR20.403.

NOTE: ** MPC_w is the weighted MPC for the isotopes released. If unknown, use 3×10^{-8} $\mu Ci/ml$.

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ATTACHMENT V

TABLE I

RIVER FLOW VS. RIVER LEVEL

A Gauge Reading Market Street Bridge, Hbg. (Feet)	B River Elevation at TMI (Feet Above Sea Level)	C River Flow (Cubic Feet per Second)	D River Velocity (MPH)
4.3	278.7	20,000	.9
5.3	279.5	40,000	1.4
6.2	280.1	60,000	.7
7.1	280.7	80,000	2.0
8.1	281.3	100,000	2.3
10.4	282.5	150,000	2.6
12.5	283.6	200,000	3.1
14.3	284.9	250,000	3.3
16.1	285.8	300,000	3.5
17.9	287.0	350,000	3.7
19.5	288.1	400,000	3.9
21.2	289.7	450,000	4.1
22.7	291.0	500,000	4.3
24.3	292.6	550,000	4.5
25.6	294.0	600,000	4.7
26.9	295.2	650,000	4.9
28.1	296.1	700,000	5.1
29.3	297.1	750,000	5.3
30.4	298.1	800,000	5.5
31.3	299.2	850,000	5.7
32.0	300.1	900,000	5.9
32.6	301.1	950,000	6.1
33.1	302.0	1,000,000	6.3

NOTE: River elevations 302.0 feet at water intake structure TMI requires initiation of EPIP 1004.2 ALERT.

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ATTACHMENT V

TABLE II

DOWNSTREAM POINTS

Downstream Water Users (6)	Distance To User (miles) (7)
Brunner Island Steam Electric Station	5.0
Wrightsville Water Supply Company	16.25
Borough of Columbia	16.75
City of Lancaster	16.75
Safe Harbor Water and Power Corp.	27.25
Holtwood Reservoir	34.75
Chester Water Authority	43
City of Baltimore	49

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ATTACHMENT VI

Protective Action Guides

Emergency Action Level (EAL)	Actual or Projected Exclusion Area Dose (mrem)	
	Whole Body	Thyroid
1. Unusual Event	≤10	<50
2. Alert	≥10 <50	≥50 <250
3. Site Emergency	≥50 <1000	≥250 <5000
4. General Emergency	≥ 1000	≥5000

Protective Action Guide (PAG'S)	Actual or Projected Exclusion Area Dose (rem)	
	Whole Body	Thyroid
Lower Limit (PAG)	1	5
Upper Limit (PAG)	5	25

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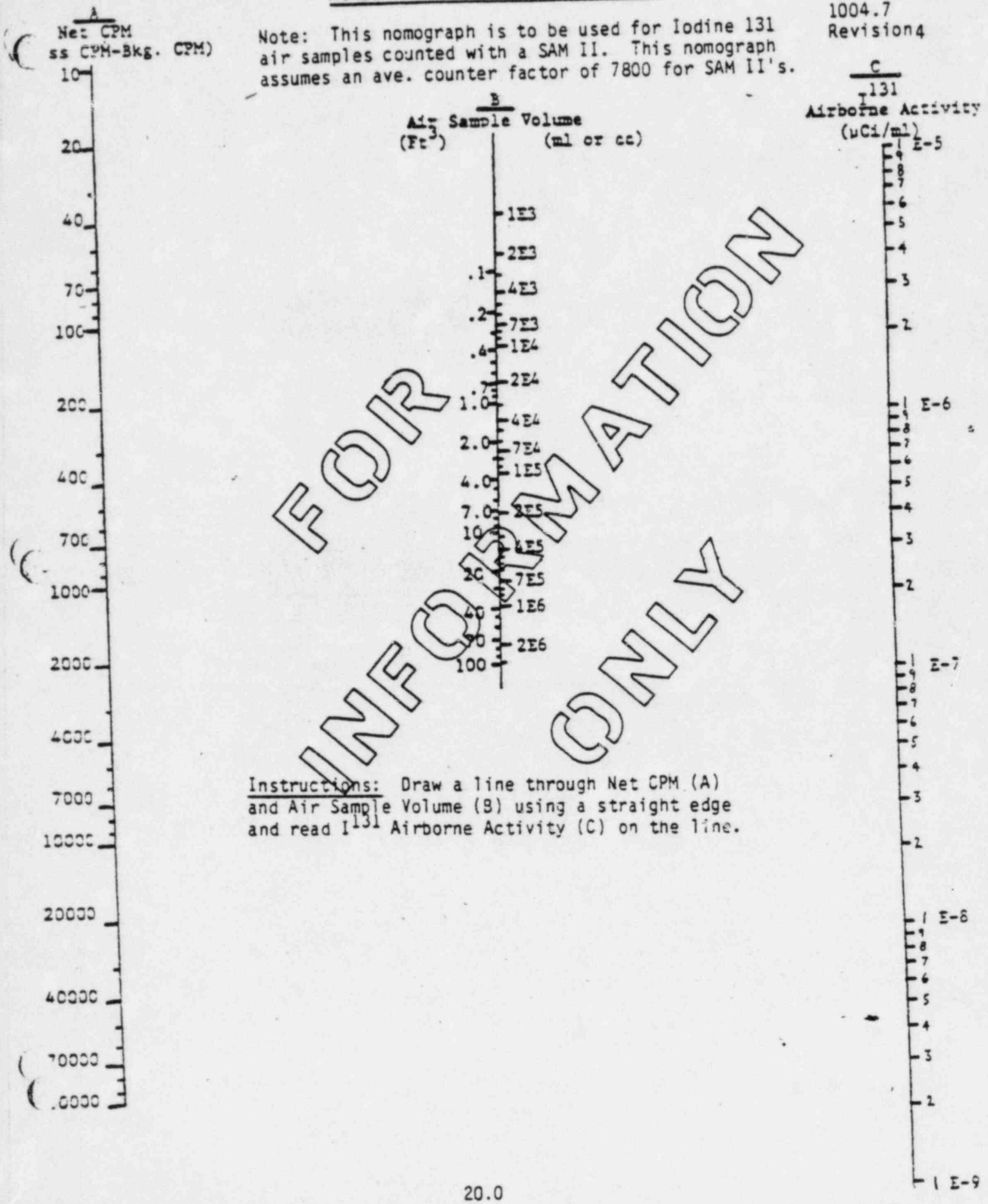
ATTACHMENT VII

AIRBORNE IODINE SAMPLE NOMOGRAPH

1004.7
Revision4

Note: This nomograph is to be used for Iodine 131 air samples counted with a SAM II. This nomograph assumes an ave. counter factor of 7800 for SAM II's.



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Instructions: Draw a line through Net CPM (A) and Air Sample Volume (B) using a straight edge and read I^{131} Airborne Activity (C) on the line.

ATTACHMENT VIII

COMPUTERIZED DOSE CALCULATIONS

1. Ensure computer components are connected as pictured in Attachment 1A.
2. Energize the system components in the following order:
   a. Quick Printer II
   b. Video Display
   c. Keyboard Terminal
3. Computer will respond with the following message:
   MEMORY SIZE -
   Strike the 'ENTER' key
4. Computer will respond with:
   RADIO SHACK LEVEL II BASIC
   READY
   >

NOTE: For liquid release, go to step 6.

5. For airborne release:
   Place cassette labeled 'Program "D" Airborne Dose Calculations' in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to '4'.
6. For liquid release:
   Place cassette labeled 'Program "L" Liquid Release Calculations' in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to '4'.

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ATTACHMENT VIII (cont'd)

7. Enter the following command from the keyboard:

   CLOAD "D" for airborne; CLOAD "L" for liquid and strike the 'ENTER' key. At this time the cassette will begin loading the program into the computer memory. Program loading will take approximately 2 1/2 or 3 minutes. One steady and one blinking star will appear in the upper right corner of the video display to signify program loading is in progress.

NOTE:	If both stars appear, with neither blinking; i.e. both steady, replace cassette with new copy and start over at step 5.

8. When program loading is completed, the computer will respond with:

   READY

   >_

   Depress stop button, rewind the cassette and remove it from the recorder.

9. To begin program execution, enter the following command from the keyboard:

   RUN

   and strike the 'ENTER' key.

10. General notes on program operation:

    a. All responses must be followed by striking the 'ENTER' key.

    b. Numbers in scientific notation should be entered using the following formats:

       $9.2 \times 10^3 = 9.2E3$

       $4.0 \times 10^{-4} = 4E-4$

    c. All responses requiring a yes or no, are to be answered with a Y or N.

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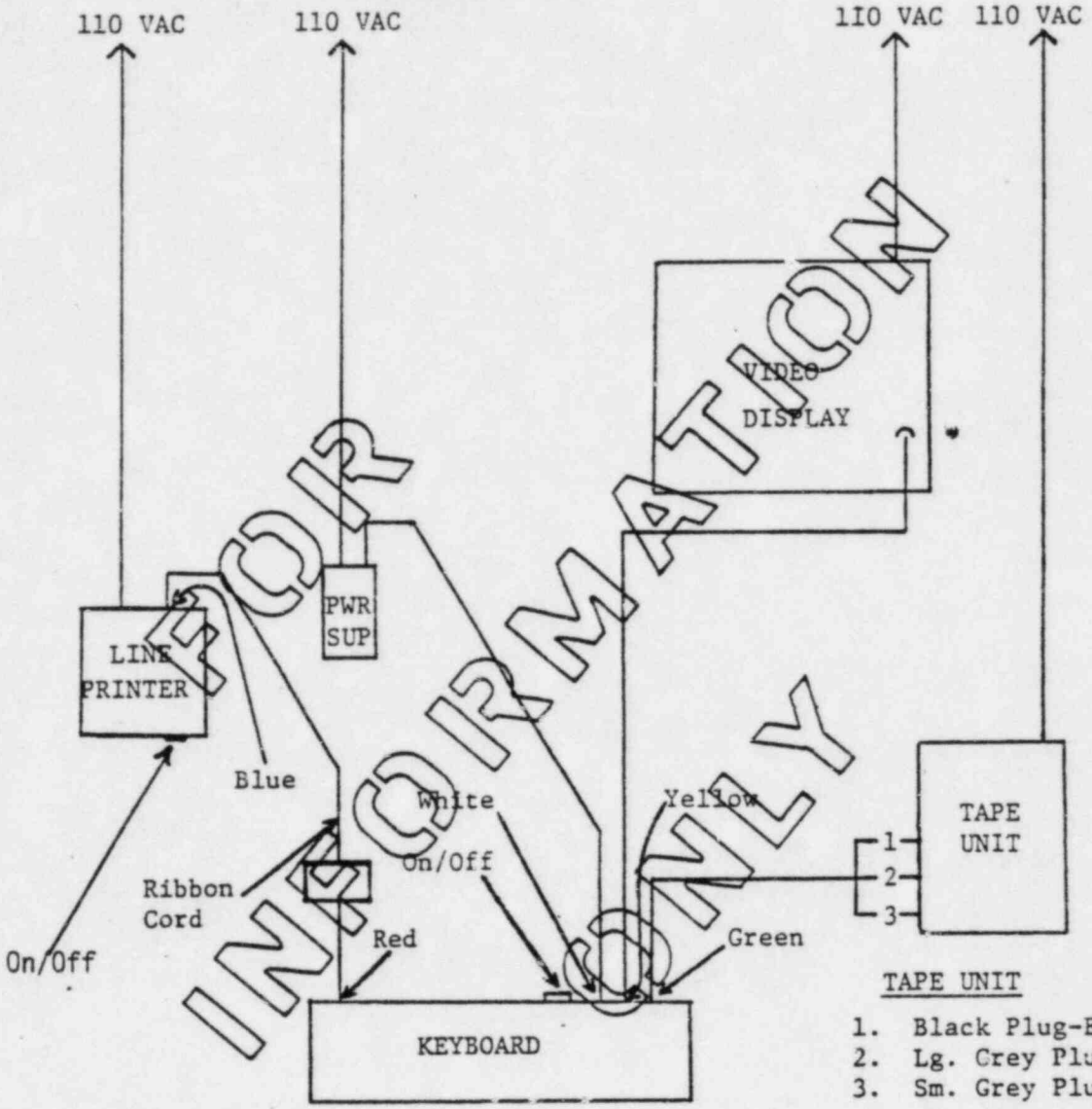
ATTACHMENT VIII

COMPUTER CONNECTIONS
and COLOR CODES



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TAPE UNIT

1. Black Plug-Ear
2. Lg. Grey Plug-Aux
3. Sm. Grey Plug-Mic