LESSON PLAN

PART I
COVER SHEET

LESSON TITLE: NORAD Nuclear Detonation (NUDET) Plotting/Fallout Prediction

TRAINING METHOD: Demonstration - Performance

REFERENCES: North American Defense Regulation 55-39, Nuclear, Biological, Chemical Warning and Reporting System
AFM 51-40, Air Navigation

AIDS AND HANDOUTS:
- A latitude/longitude map
- A protractor
- A pencil
- A ruler marked in centimeters
- Graph paper or plastic sheeting
- A compass or string to draw circles

Attachment 1. Effective Downwind Speed/Downwind Distance Charts

Attachment 2. Location of GZ and Wind Direction

Attachment 3. Construction of Left and Right Radial Lines

Attachment 4. Construction of Cloud Radius, Zone I and Zone II

Attachment 5. Construction of Tangent Lines and Time of Arrival Arcs

Attachment 6. Fallout Prediction Plot with Winds Less than 8 km/hr

Attachment 7. Map Scale Conversion Chart

LESSON OBJECTIVE: Given an explanation, the necessary materials, and a demonstration on NUDET plotting, the student must properly perform all of the task steps listed. Additionally, given a lecture on plotting/predictions for NUDETs, the student during the final course exam, must correctly answer questions demonstrating mastery all of the samples of behavior listed below:

TASK STEPS:
1. Plot two locations on a latitude/longitude map.
2. Construct a fallout prediction plot.
3. Construct a fallout prediction plot for winds less than 8 km/hr.

SAMPLES OF BEHAVIOR:
1. State the purpose of NUDET plotting.
2. State the difference between Zone I and Zone II fallout areas.

ORGANIZATIONAL PATTERN: Sequential

SUGGESTED COURSE(S) OF INSTRUCTION: Disaster Preparedness Support Team

STRATEGY: NUDET plotting procedures using NORAD Regulation 55-39 are covered in this training package. Main points that are not covered in the samples of behavior are evaluated during the student performance of the task.

LESSON OUTLINE:

MAIN POINT 1. PURPOSE OF NUDET PLOTTING

MAIN POINT 2. LATITUDE AND LONGITUDE SYSTEMS
- A. Latitude
- B. Longitude
- C. Minutes and Seconds
- D. Coordinates
- E. Plotting Coordinates

MAIN POINT 3. EFFECTIVE DOWNWIND FALLOUT MESSAGE

MAIN POINT 4. FALLOUT AREA ZONES
- A. Zone I
- B. Zone II
- C. Outside the Predicted Zones

MAIN POINT 5. FALLOUT PREDICTION
- A. Required Information
- B. Downwind Distance

MAIN POINT 6. SPECIAL CASES
- A. Overlapping Plots
- B. Low Winds

PART II
TEACHING PLAN
INTRODUCTION

ATTENTION: A nuclear weapon has detonated 90 miles north of your base. Will you receive any fallout?

MOTIVATION: Plotting a nuclear detonation (NUDET) using NORAD procedures gives you a fairly accurate estimate of when to expect fallout arrival. This will enable your base to prepare for its arrival.

OVERVIEW: During this lesson, we will cover:

⇒ the purpose of NUDET plotting

⇒ latitude/longitude system

⇒ effective downwind fallout message

⇒ fallout area zones

⇒ fallout prediction using NORAD procedures

⇒ fallout prediction using low wind speeds

TRANSITION: Let’s begin by discussing the purpose of NUDET plotting.

BODY

MAIN POINT 1. PURPOSE OF NUDET PLOTTING

The purpose of NUDET plotting and fallout prediction is to enable commanders at all levels to assess the impact of nuclear attacks. NORAD NUDET plotting procedures are covered in NORAD Regulation 55-39.

MAIN POINT 2. LATITUDE AND LONGITUDE SYSTEM

The position referencing system used for NORAD NUDET plotting and reporting is latitude and longitude. These are imaginary lines on the earth's surface.

INSTRUCTOR'S NOTE: Refer to RTP E8 (Finding and Plotting Locations on a Map) for more information on using maps.

A. LATITUDE

A. Latitude lines run parallel to the equator and are identified as north and south of the equator. The equator is zero degrees latitude and the imaginary lines are numbered 0-90 degrees both north and south of the equator.

B. LONGITUDE

B. Longitude lines run north and south between the poles. The prime meridian, which runs through Greenwich, England, is zero degrees longitude. Additional lines are numbered 0-180 degrees both east and west of the prime meridian.

C. MINUTES AND SECONDS

C. Each degree of latitude and longitude is divided into 60 minutes; each minute is divided into 60 seconds.

D. COORDINATES

D. Coordinates always include the latitude expressed as north or south, if not zero; and longitude expressed as east or west, if not zero. Minutes and seconds are added to the latitude and longitude to the degree of accuracy desired. When used, minutes and seconds are always given as two digits. For example:

35N 111W is Arizona in degrees
3512N 11139W is Flagstaff AZ in degrees and minutes.

351245N 1113926W is a particular point within the city of Flagstaff as expressed in degrees, minutes, and seconds.

E. PLOTTING COORDINATES

E. When plotting latitude and longitude coordinates in North America, first read up the map to the latitude and then read left to the longitude.

INSTRUCTOR'S NOTE: Pass out maps to the students and have them plot the location of a set of coordinates you've chosen in advance. Ensure they are able to plot coordinates before proceeding to the next point.

TRANSITION:	Now that you know how to find locations on the map, let's go on to the weather data message used for fallout prediction.
MAIN POINT 3. EFFECTIVE DOWNWIND FALLOUT MESSAGE	Effective downwind fallout messages (EDM) are transmitted twice daily by US Air Force Global Weather Central to NORAD Headquarters, the Canadian Federal Warning Center, each NORAD region or sector, and each Canadian Provincial Warning Center. EDMs are given in a six digit format. Three digits are used for wind direction and three digits are used for wind speed. For example, 090020 represents winds blowing towards 90 degrees at a speed of 020 knots. They are used at locations throughout the continental United States, Canada, and Alaska. To make a reliable radioactive fallout prediction, you need an EDM and the location of the nuclear detonation.
MAIN POINT 4: FALLOUT AREA ZONES	The predicted fallout area is divided into two zones; Zone I and Zone II.
A. ZONE I	A. Zone I is the area of immediate concern. In Zone I, exposed, unprotected people may receive 150 centigrays of radiation or greater in four hours or less after the arrival of fallout.

B. ZONE II

B. Zone II is the area of secondary hazard. The total dose of radiation received by exposed, unprotected people is not expected to reach 150 centigrays within a period of four hours after the arrival of fallout. However, people may receive a total dose of 50 centigrays or greater within the first 24 hours after the arrival of fallout.

C. OUTSIDE THE PREDICTED ZONES

C. Outside the two predicted zones, exposed, unprotected people may receive a total dose of 50 centigrays in the first 24 hours after the arrival of fallout.

MAIN POINT 5. FALLOUT PREDICTION

To determine where the zones are, we must develop a fallout prediction plot.

A. REQUIRED INFORMATION

A. To make a fallout prediction plot, you need:

⇒ a current EDM

⇒ the location of the nuclear detonation (we'll refer to this point as ground zero)

⇒ the time of detonation

⇒ yield of the weapon used (assume a 1-megaton yield for all surface bursts unless the yield is known to be 0.5 MT or less)

⇒ the Zone I downwind distance

⇒ a map

B. DOWNWIND DISTANCE

B. Determine the downwind distance of Zone I by matching the effective downwind speed to the downwind distance on the chart in NR 55-39, Figure 4-1 or 4-2 (Attachment 1, in Part IV)

INSTRUCTOR'S NOTE: Use Attachment 1, in Part IV, to show the student how to determine Zone I downwind distance for both a 1 MT and a 0.5 MT burst. In this lesson we will use a wind speed of 20 knots and a wind direction of 90 degrees.

C. FALLOUT PREDICTION PLOT

C. Follow these procedures to make a fallout prediction plot:

PLOT GZ

(1) Plot ground zero (GZ) on the map and draw a line from GZ on the map to correspond with the downwind direction, in degrees, as obtained from the EDM.

INSTRUCTOR'S NOTE: Use Attachment 2, in Part IV, to show the student the location of GZ and the wind direction.

DRAW 20 DEGREE RADIALS

(2) Draw two radial lines from GZ; one 20 degrees to the right and the other 20 degrees to the left of the downwind direction line.

INSTRUCTOR'S NOTE: Use Attachment 3, in Part IV, to show the student the 20 degree radial lines.

DRAW CLOUD RADIUS AROUND GZ

(3) Using GZ as the center, draw a 10 nautical mile radius around GZ. Use the map scale to draw the circle to the appropriate size. The size of the radius is equivalent to the radius of a stabilized nuclear cloud for a 1 MT burst.

ZONE I

(4) Between the right and left radial lines, locate the downwind distance of 102 nautical miles from GZ and strike an arc between the radial lines. This is the downwind distance for Zone I.

ZONE II

(5) Double the Zone I distance and strike a second arc to denote Zone II.

INSTRUCTOR'S NOTE: Use Attachment 4, in Part IV, to show the student the GZ circle and radial lines.

TANGENT LINES

(6) Draw two lines originating at the points where the left and right radial lines intersect with the Zone I arc and tangent to the cloud radius circle.

DETERMINE ARRIVAL TIME

(7) Next, we need to determine where the fallout will be at one and two hours after the detonation. To do this, use the following equation:

$$\text{Time of arrival (hours)} = \frac{\text{Distance from GZ (NM)}}{\text{Effective Wind Speed (kt)}}$$

DRAW ARRIVAL TIME ARCS

(8) From GZ, plot the distance fallout will travel in one hour and strike an arc between the left and right radial lines using a dashed line. Repeat for the distance in a two hour period.

INSTRUCTOR'S NOTE: Use Attachment 5, in Part IV, to show the student a completed plot with the tangent lines and time of arrival arcs.

MAIN POINT 6. SPECIAL CASES

There may be situations which require modification of the basic procedures in plotting downwind hazards.

A. OVERLAPPING PLOTS

A. In situations where there are multiple bursts, you may discover that zones from separate plots overlap. In situations where overlapping occurs, the greater hazard of the two determines the zone. For example, Zone I overlaps Zone II of separate plots. The area where the overlap exists will be considered as Zone I.

B. LOW WINDS

B. An occasion may arise when the effective wind speed is 8 km/hr or less. For such cases, fallout may occur at almost any location around GZ. Therefore, we denote the fallout hazard area as a circle.

(1) To prepare a fallout prediction under these circumstances, plot GZ and draw a circle with a radius of 48 nautical miles. This is Zone I.

(2) Double the distance and draw a second circle to denote Zone II.

INSTRUCTOR'S NOTE: Use Attachment 6, in Part IV, to show the student a completed fallout plot for wind speeds of 8 km/hr.

CONCLUSION

SUMMARY: In summary, we've covered:

⇒ the purpose of NUDET plotting.

⇒ the latitude/longitude system.

⇒ effective downwind fallout messages.

⇒ fallout area zones.

⇒ fallout prediction.

⇒ special cases.

REMOTIVATION: It is hoped this information will never be used beyond training. However, should it be necessary, you are equipped to play a vital role in the survival of personnel on your installation.

CLOSURE: This concludes this lesson.

TRANSITION: (Develop locally to transition to the next topic.)

PART III
EVALUATION
STUDENT PERFORMANCE STANDARDS

A. Given coordinates and a map by the instructor, the student must plot two locations using longitude and latitude.

INSTRUCTOR'S NOTE: For GZ use a reference point on the student's map.

B. Construct a fallout prediction plot using the following information, attachments, and instruments:

1. Direction and speed of winds: 100016

2. Weapon yield is unknown

3. Effective Downwind Speed/Downwind Distance Chart (Attachment 1)

4. The students need a protractor, pencil, ruler marked in centimeters, compass or string to draw arcs, and appropriate scale map.

C. Construct a fallout prediction plot for winds of less than 8 km/hr using the following information, attachments, and instruments:

1. Winds are 090006

2. Weapon yield is unknown

3. Effective Downwind Speed/Downwind Distance Chart (Attachment 1)

4. The students need a protractor, pencil, ruler marked in centimeters, compass or string to draw arcs, and appropriate scale map.

TEST ITEMS

1. LESSON OBJECTIVE: State the purpose of NUDET plotting.

QUESTION: (TRUE or FALSE)

The purpose of NUDET plotting and fallout prediction is to enable commanders at all levels to assess the impact of nuclear attacks.

a. True
b. False

KEY: a

REFERENCE: Main Point 1

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2. LESSON OBJECTIVE: State the difference between Zone I and Zone II fallout areas.

QUESTION: (Multiple Choice)

Which of the following statements is FALSE?

a. Zone I is the area of immediate concern where exposed, unprotected people may receive 150 centigrays of radiation or greater in four hours or less after the arrival of fallout.

b. Zone II is the area of immediate concern where exposed, unprotected people may receive 150 centigrays of radiation or greater in four hours or less after the arrival of fallout.

c. Zone II is the area of secondary hazard where exposed, unprotected personnel may receive a total radiation dose of 50 centigrays or greater in the first 24 hours after arrival of fallout.

d. Outside the two predicted zones, exposed, unprotected people may receive a total dose of 50 centigrays in the first 24 hours after the arrival of fallout.

KEY: b

REFERENCE: Main Point 4

PART IV
RELATED MATERIALS

Attachment 1. Effective Downwind Speed/Downwind Distance Charts
Attachment 2. Location of GZ and Wind Direction
Attachment 3. Construction of Left and Right Radial Lines
Attachment 4. Construction of Cloud Radius, Zone I and Zone II
Attachment 5. Construction of Tangent Lines and Time of Arrival Arcs
Attachment 6. Fallout Prediction Plot with Winds Less than 8 km/hr
Attachment 7. Map Scale Conversion Chart

RTP E8 - Finding and Plotting Locations on a Map

Effective Downwind Speed/Downwind Distance Chart

1 - Megaton Burst Characteristics
CLOUD TOP HEIGHT - 71,000 ft (21,640 M)
CLOUD BOTTOM HEIGHT - 44,000 ft (13,410 M)
CLOUD RADIUS - 9.5 NM (18km)
TIME OF FALL - 3.5 hours
RATE OF FALL - 210 ft per minute
FIREBALL - 5700 ft at mean sea level

EDS	DD	EDS	DD	EDS	DD	EDS	DD
4	48	29	125	53	168	77	203
5	51	30	127	54	170	78	204
6	56	31	129	55	172	79	206
7	59	32	130	56	174	80	208
8	63	33	132	57	175	81	208
9	70	34	134	58	176	82	209
10	73	35	137	59	179	83	211
11	76	36	139	60	180	84	213
12	79	37	141	61	181	85	214
13	82	38	142	62	182	86	214
14	88	39	143	63	184	87	217
15	90	40	145	64	185	88	218
16	93	41	148	65	187	89	219
17	96	42	150	66	188	90	221
18	97	43	152	67	190	91	221
19	100	44	153	68	191	92	222
20	102	45	155	69	193	93	224
21	107	46	156	70	194	94	225
22	109	47	159	71	195	95	227
23	111	48	161	72	196	96	228
24	113	49	162	73	198	97	228
25	115	50	163	74	199	98	229
26	117	51	165	75	201	99	232
27	121	52	167	76	202	100	233
28	122						

NOTE: All distances are in nautical miles and speeds in knots

EDS - Effective Downwind Speed
DD - Downwind Distance

Attachment 1 -Effective Downwind Speed/Downwind Distance Charts

Location of GZ and Wind Direction
for a Nuclear Fallout Prediction

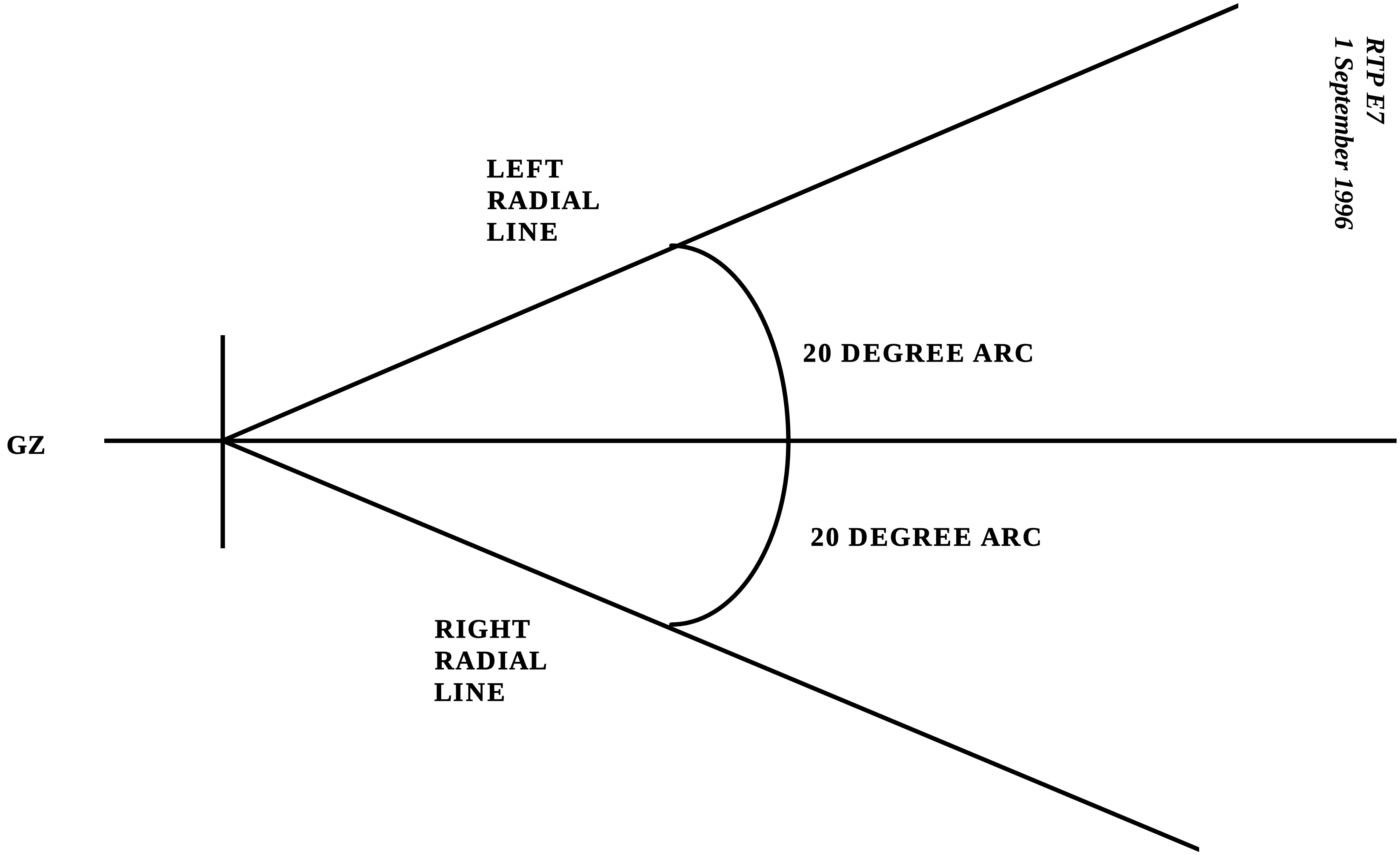
GZ

WIND DIRECTION (DEGREES TRUE)

Attachment 2 - Location of GZ and Wind Direction

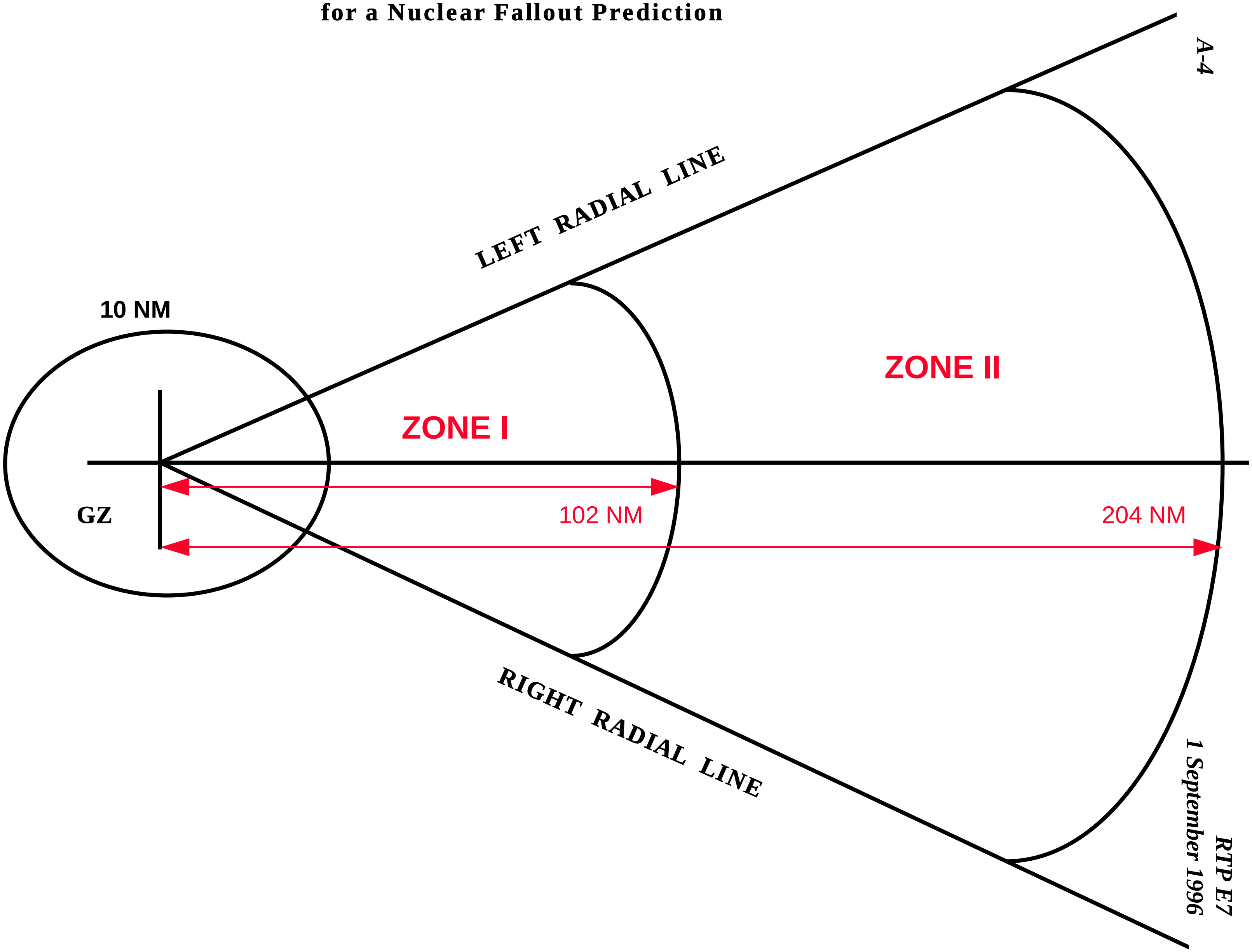
Attachment 3 - Construction of Left and Right Radial Lines

Construction of Left and Right Radial Lines
for a Nuclear Fallout Prediction



NOT TO SCALE

Construction of Cloud Radius, Zone I and Zone II
for a Nuclear Fallout Prediction

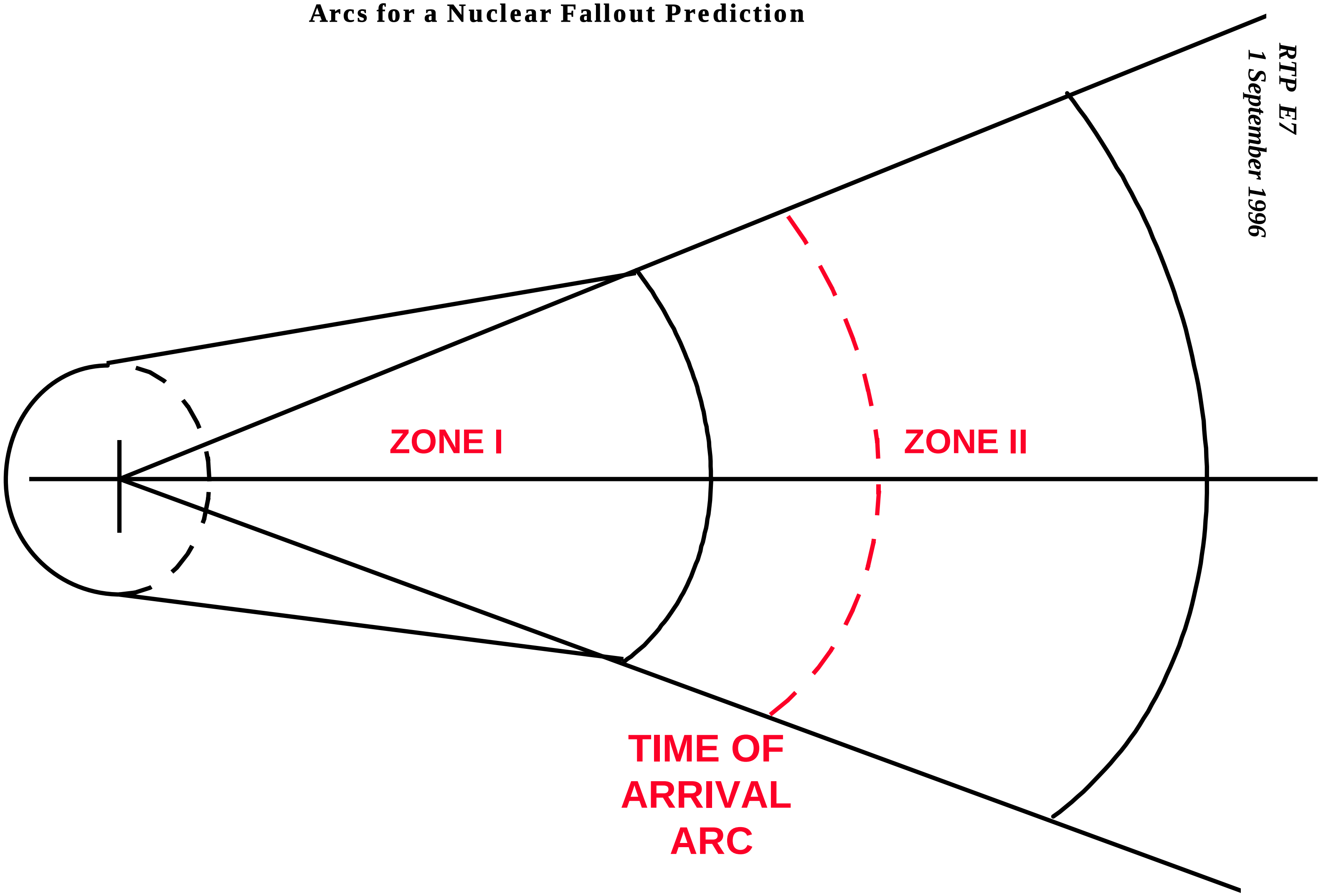


NOT TO SCALE

Attachment 4 - Construction of Cloud Radius, Zone I and Zone II

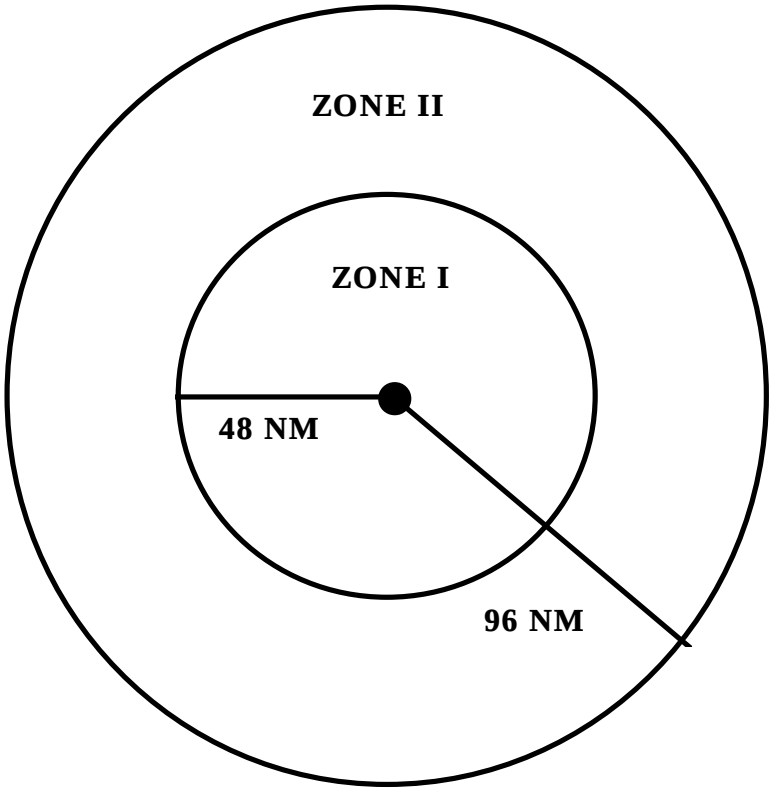
Attachment 5 - Construction of Tangent Lines and Time of Arrival Lines

Construction of Tangent Lines and Time of Arrival Arcs for a Nuclear Fallout Prediction



NOT TO SCALE

Fallout Prediction Plot with Winds Less than 8 km/hr



NOT TO SCALE

Attachment 6 - Fallout Prediction Plot with Winds Less Than 8 kmph

MAP SCALE CONVERSION CHART

At map scale 1:50,000 1 cm = 0.5 km and 1 km = 2.0 cm

At map scale 1:100,000 1 cm = 1.0 km and 1 km = 1.0 cm

At map scale 1:250,000 1 cm = 2.5 km and 1 km = 0.4 cm

At map scale 1:500,000 1 cm = 5.0 km and 1 km = 0.2 cm

Attachment 7 - Map Scale Conversion Chrt

TRAINING PACKAGE COMMENT REPORT

RTP #	RTP DATE

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