Radiological Plotting

Topic 6.1

ENABLING OBJECTIVES:

- ***USE*** radiological procedures when given time and intensity following: Construct a log-log plot, select Ta, Tp and Tc, estimate future intensities, estimate dose, and calculate dosage

ENABLING OBJECTIVES:

- ***COMPUTE*** safe stay times when given transmission factors, intensities and stay times

- ***COMPUTE*** safe stay times when given nomograms and associated equipment, intensity at R=1 HR and entry time

Log-Log Plotting Technique

Most accurate for computing and predicting a radiological situation

Weapons testing experience has demonstrated the log-log plot of radiation intensity versus time detonation permitted the following

Analysis of radiological event

Determination of countermeasures

Log-Log Plotting Technique

NTTP 3-20.31(series) and Tycom Repair Manual both stipulate that log-log plots will be maintained

Assumption of log-log plot

No defensive measures taken

wind and speed not considered

Log-Log Plotting Technique

Log-log plot is a graphical presentation of a radiological event showing

- Time of arrival (ta)
- Time of peak intensity (tp)
- Time of fallout cessation (tc)
- Intensities for each of the times above, and intermediate times

Log-Log Plotting Technique

Terms used in log-log plotting (these are general terms and are used in any radiological situation)

Ta	-Time of arrival
Tp	-Time of peak intensity
Tc	-Time of fallout cessation
I	-Intensity at any time

Log-Log Plotting Technique

Terms used in log-log plotting (these are general terms and are used in any radiological situation)

Pi	Peak Intensity
Te	Time of Entry
Ts	Stay time
Et	Exit time

Log-Log Plotting Technique

Terms used in log-log plotting (these are general terms and are used in any radiological situation)

Remember:

all “T” = Time

all “I” = Intensity at any time

D = Dose

Dbu- Build up dose (Ta - Tp)

Dtr- Transitional dose (Tc-Tp)

Basic dose formula

Log-Log Plotting Technique

Numerical values are assigned to shields. The amount of radiation transmitted through a shields is related to the intensity entering the shield and is expressed as a ratio. The ratio is called the The transition factor (TF)

TF= Transition factors is the shielding from outside the skin of the ship to inside a compartment. Every compartment on board ship has a TF presented by a red dot. If compartment does not have a TF then see the CBR Bill

Log-Log Plotting Technique

Four general areas of the plot:

- Initial Period
- Build-up Period
- Transitional Period
- Decay Periods

- Initial Period, Build-up Period and Transitional Period are part of the Emergency Phase. The Decay Periods are part of the Operation Recovery and Final Recovery Phase.

Log-Log Plotting Technique

- Initial period

    Prior to Ta

    Usually can not be plotted

    Usually occurs during bracing for shock

    First minute after blast

Log-Log Plotting Technique

- Build-up period (Dbu)

Starts at Ta

Radiation builds up from Ta-Tp

Explanation of log-log paper

- Log-log paper is based on the powers of 10 (ten)

- Each cycle of the paper is labeled with consecutive powers of the ten, both horizontally and vertically

  - The horizontal axis is the time in minutes or hours after detonation.
    (We will use minutes)

  - The vertical axis is the radiation intensity in R/HR

Log-Log Plotting Technique

- Transitional period
  - Starts at Tp
  - Rapid decrease of radiation intensity
  - Ends at Tc

Log-Log Plotting Technique

- Decay period

  - Tc to any future date

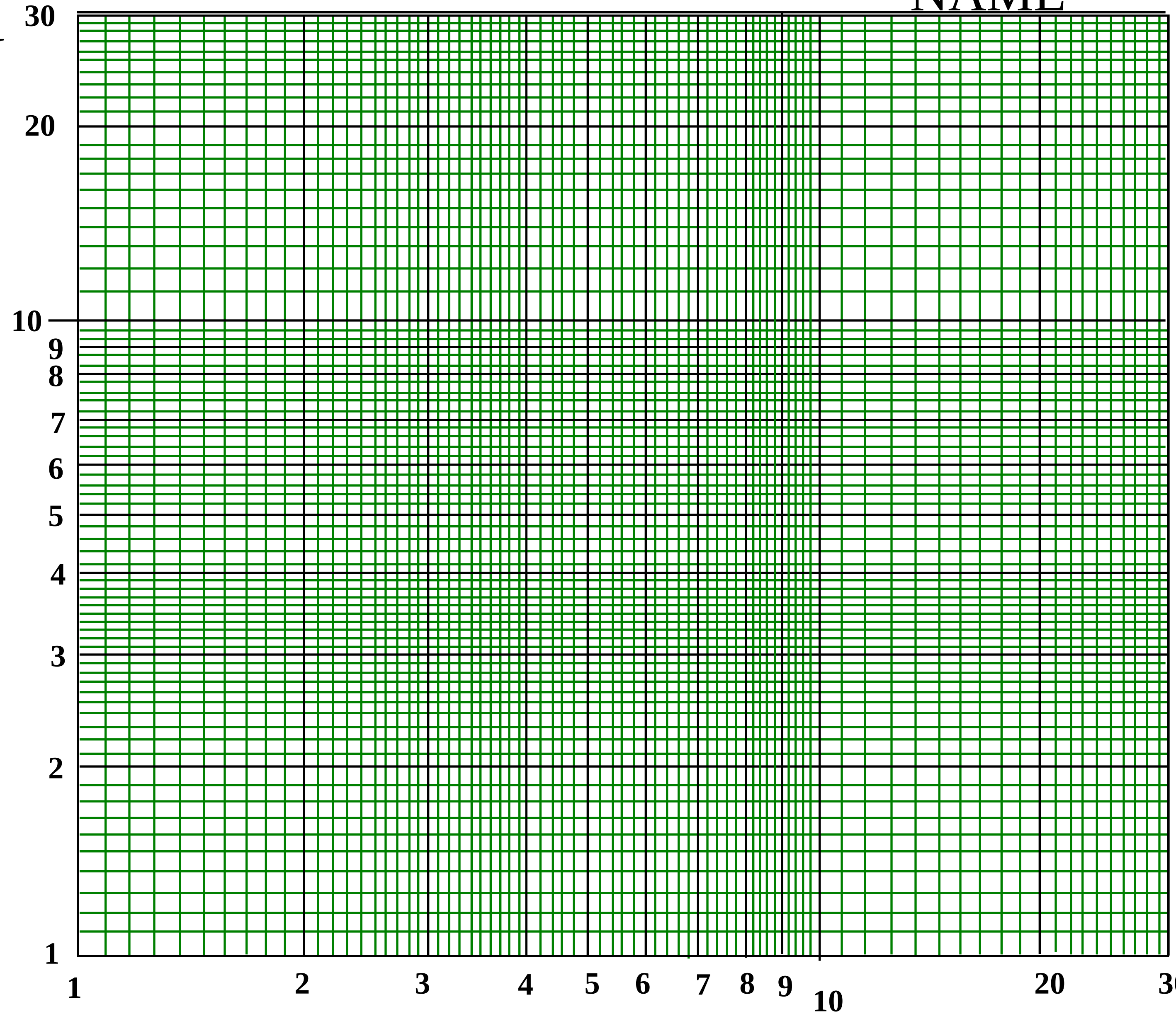
  - Radiation decreased on fixed slop (usually considered standard -1.2 decay slope)

  - Can be figured out mathematically or using nomograms

NAME

BRIDGE ONLY

INTENSITY IN R / HR



TIME IN MINUTES

FORMULA

$$\frac{I_1 + I_2}{2} \times \frac{T_2 - T_1}{60} = \text{ANSWER}$$

ETP **Close in Burst** **TA X 4** **MPE= 150 R**

Distant Burst **TA X 2**

RADIOLOGICAL DOSE RECORDING SHEET												
	TF: 0.5		TF:0.5		TF:		TF:		TF: 0.2		TF: 0.15	
Time:	AN/PDR 65 Topside		AN/PDQ-1 Bridge		AN/PDQ-1 DCC		AN/PDQ-1 Repair 2		AN/PDQ-1 Repair 3		AN/PDQ-1 Deep shelter	
Min/Hrs	Int.	Dose	Int.	Dose	Int.	Dose	Int.	Dose	Int.	Dose	Int.	Dose
H+												
H+												
H+												
H+												

Log-log prediction Plot

- Two types of burst

  - Close in detonation- If (Ta) occurs within 30 minutes (fudge factor of 4)

  - Distant detonation- All other detonations (fudge factor of 2)

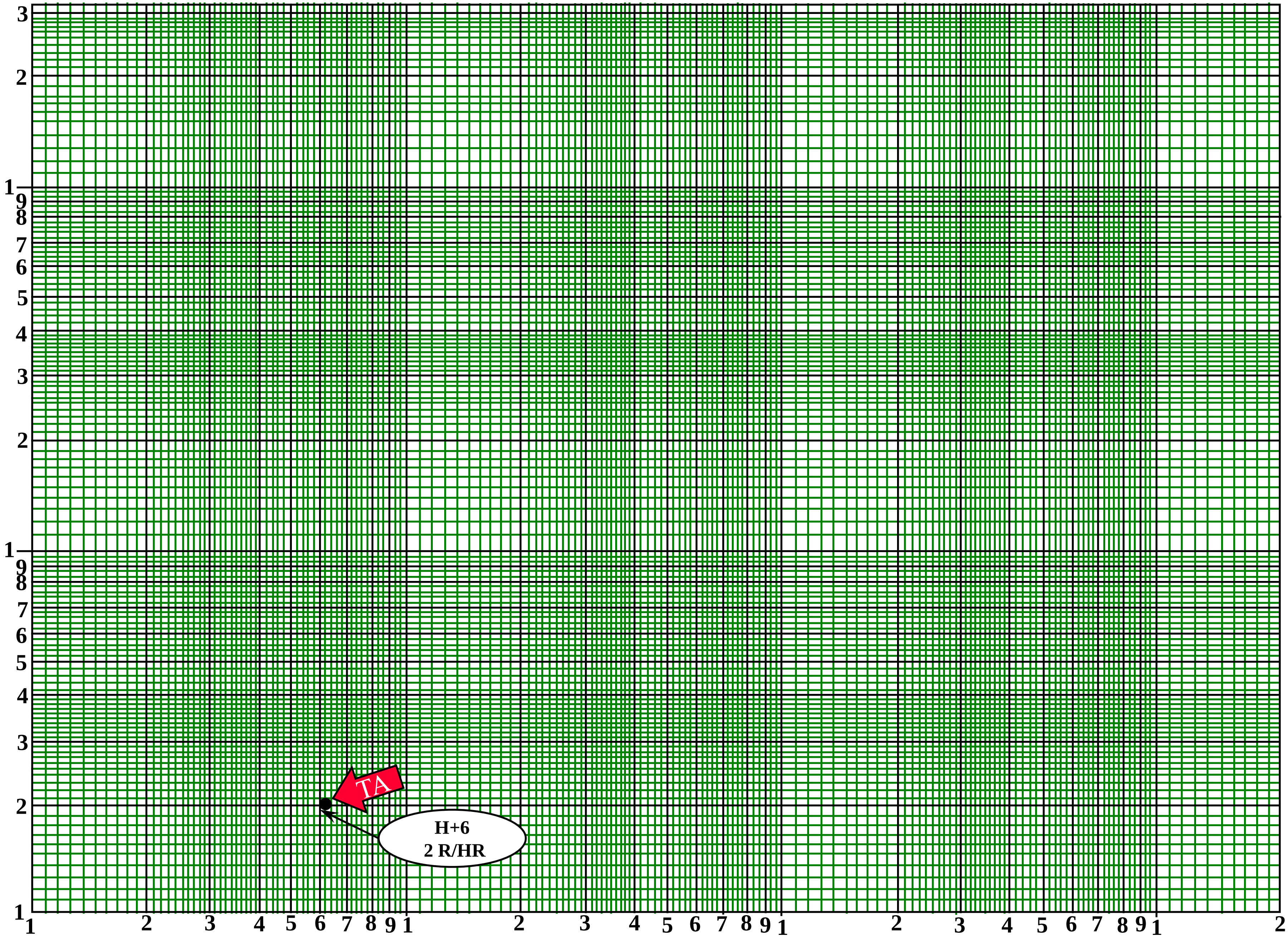
All our exercises will be <u>Close In</u>

Class Assignment sheet.

Question #1.

- When is Ta?

H+6


TA
H+6
2 R/HR

TA H+ 6 TP H + ______ TC H + ______ MPE = 150 R

EST TP ______ EST PI N=

	OUTSIDE INT	OUTSIDE DOSE	BRIDGE INT (TF=0.5)	BRIDGE DOSE	DCC INT (TF= 0.5)	DCC DOSE	REP-2 INT (TF=)	REP-2 DOSE	REP-3 INT (TF= 0.2)	REP-3 DOSE	REP-5 INT (TF=)	REP-5 DOSE	DEEP SHEL INT (TF= 0.15)	DEEP SHEL DOSE
Ta H+ 6			2											
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT

QUESTION #2

- WHAT IS ESTIMATED TIME OF PEAK INTENSITY?

(SEE BOTTOM OF DOSE RECORDING SHEET AND DETERMINE IF BURST WAS CLOSE IN OR DISTANT)

4 x TA = CLOSE IN BURST (30 MINUTES OR LESS)

2 x TA = DISTANT BURST (MORE THAN 30 MINUTES)

To estimate PI for the BRIDGE, (MULTIPLY)

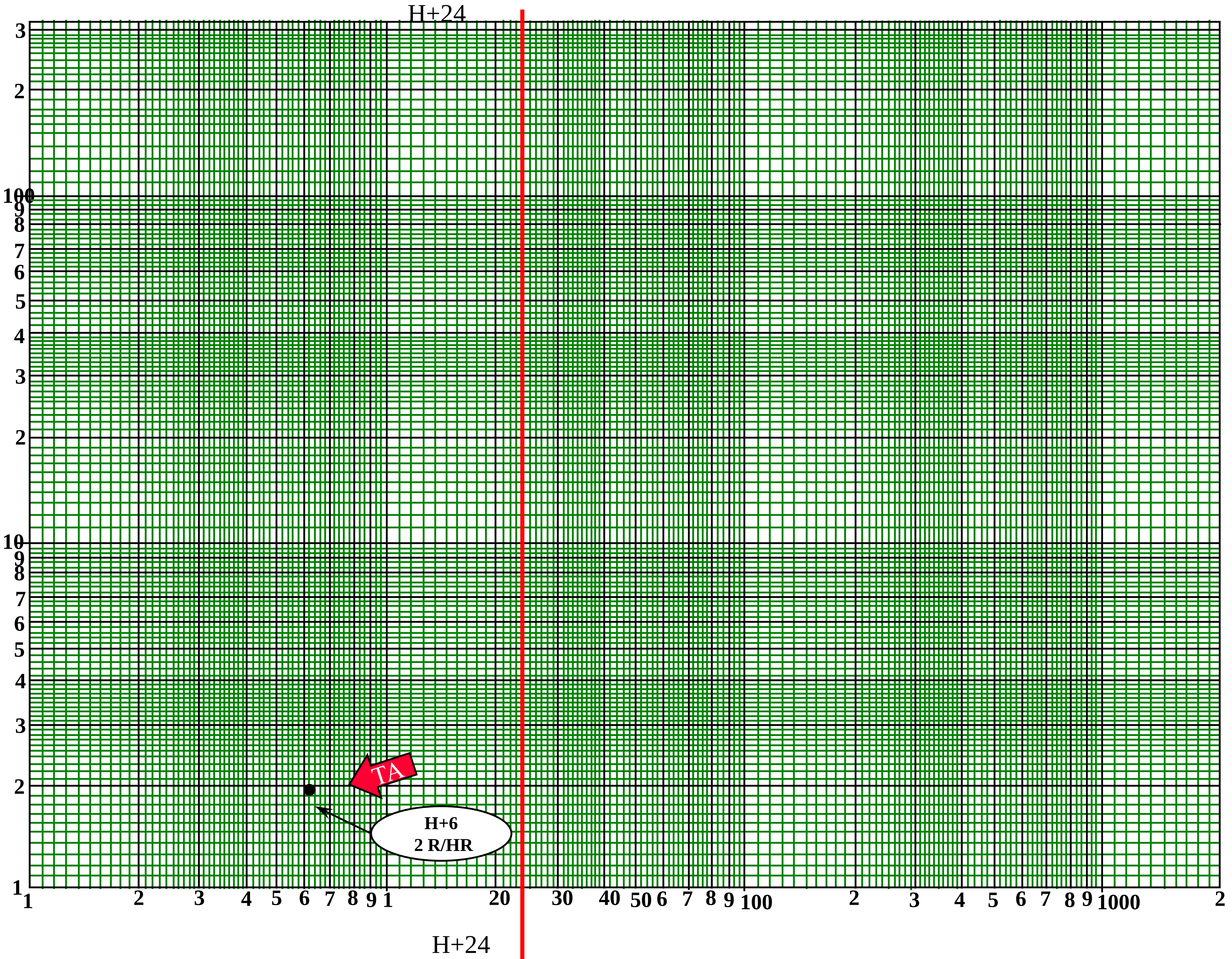
4 X H+6 = 24 min. (H+24)
This will be the estimated time for PI on the BRIDGE

QUESTION #2 Continued

- WHAT IS ESTIMATED TIME OF PEAK INTENSITY?

On LOG-LOG Paper,

PLOT a vertical line from top to bottom at H+24


H+24
3
2
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
TA
H+6
2 R/HR
1 2 3 4 5 6 7 8 9 1 20 30 40 50 6 7 8 9 100 2 3 4 5 6 7 8 9 1000 2
H+24

Question #3

- WHAT IS THE ESTIMATED BRIDGE PEAK INTENSITY?

Note: A Second reading must be taken to determine.

At H+9 you receive 12 R/HR and record on DOSE recording Sheet and PLOT on LOG.

TA H+ 6 TP H + ______ TC H + ______ MPE = 150 R

EST TP 24 EST PI N=

Ta

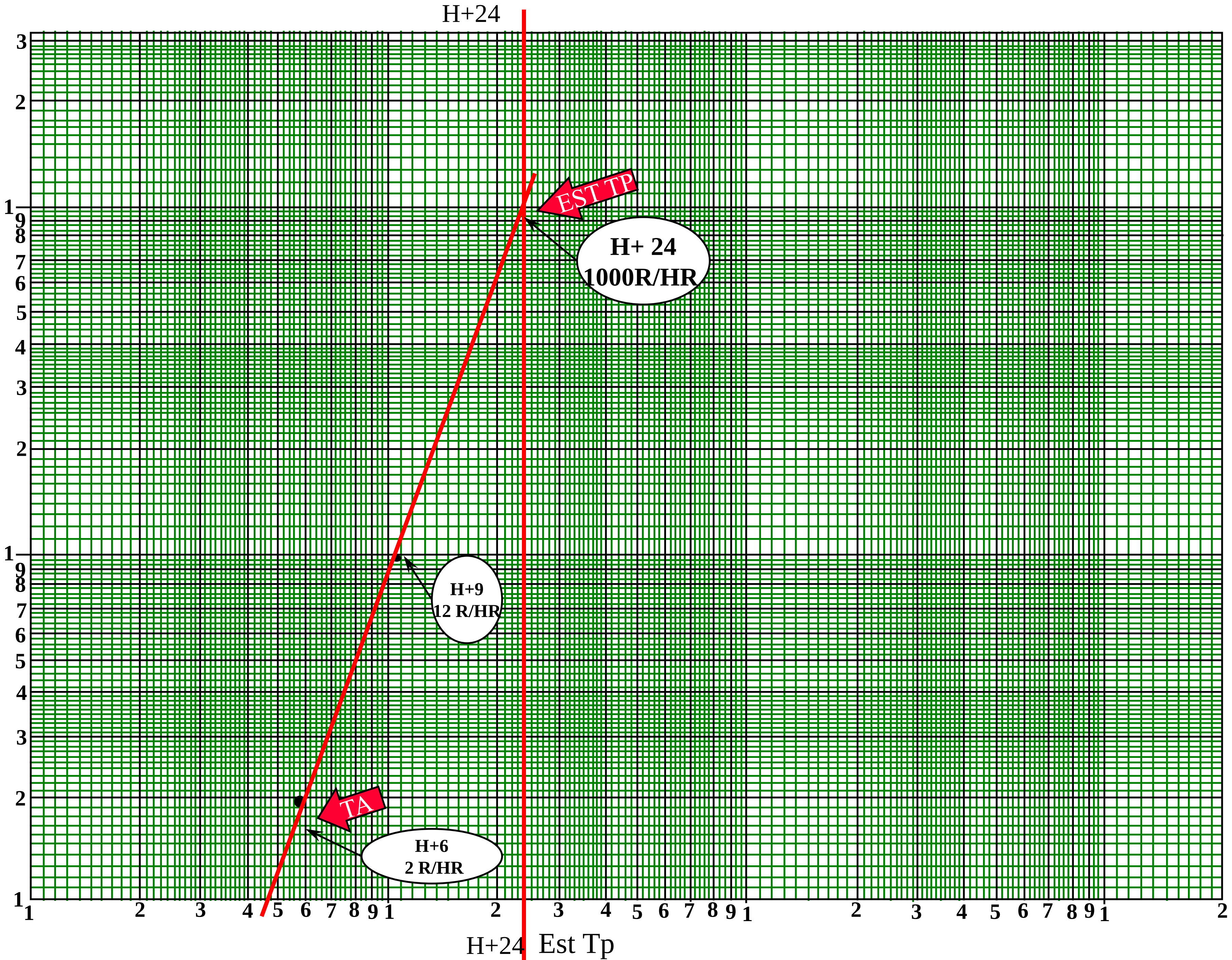
	OUTSIDE INT	OUTSIDE DOSE	BRIDGE INT	BRIDGE DOSE	DCC INT	DCC DOSE	REP-2 INT	REP-2 DOSE	REP-3 INT	REP-3 DOSE	REP-5 INT	REP-5 DOSE	DEEP SHEL INT	DEEP SHEL DOSE
			TF=0.5		TF= 0.1		TF=		TF= 0.2		TF=		TF= 0.15	
H+ 6			2											
H+ 9			12											
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT



H+24
EST TP
H+ 24
1000R/HR
H+9
12 R/HR
TA
H+6
2 R/HR
H+24
Est Tp

TA H+ 6 TP H + ______ TC H + ______ MPE = 150 R

EST TP 24 EST PI 1000 R/HR N=

Ta

			TF=0.5		TF= 0.1		TF=		TF= 0.2		TF=		TF= 0.15	
	OUTSIDE		BRIDGE		DCC		REP-2		REP-3		REP-5		DEEP SHEL	
	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
H+ 6			2											
H+ 9			12											
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN

DIVIDE OUT

#4 WHAT IS THE ESTIMATED DBU FOR BRIDGE, TOPSIDE AND DCC PERSONNEL?

For the bridge

$$\frac{I_1 + I_2}{2} \times \frac{T_2 - T_1}{60}$$

$$\frac{2 + 1000}{2} = \frac{1002}{2} = 501 \quad \frac{24-6}{60} = \frac{18}{60} = 0.3$$

501 X 0.3 = 150.30 R BRIDGE

To get the topside Dbu you need to use the transition factors.

Tf= Multiply In
Divide Out

DCC	D/S	REP 3	BRIDGE
0.1	0.15	0.2	0.5

150.30
Bridge

300.60
Topside

30.06 x DCC

Question #5

- What is the dose received by personnel on the Bridge from H+6 to H+9?

$$\frac{\overset{I_1}{2} + \overset{I_2}{12}}{2} \times \frac{\overset{T_2}{9} - \overset{T_1}{6}}{60} = 7 \times .05 = .35\ R$$

TA H+ 6 TP H + ______ TC H + ______ MPE = 150 R

EST TP 24 EST PI 1000 R/HR **N=**

.05	OUTSIDE		BRIDGE (TF=0.5)		DCC (TF= 0.1)		REP-2 (TF=)		REP-3 (TF= 0.2)		REP-5 (TF=)		DEEP SHEL (TF= 0.15)	
	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
H+ 6			2											
H+ 9			12	.35										
H+ 12			40	1.30 1.65										
H+ 15			80	3.00 4.65										
H+ 18			200	7.00 11.65										
H+ 21			350	13.75 25.40										
H+ 24	**1200**		600	23.75 **49.15**					**240**					
H+ 27	**840**		420	25.50 74.65					**168**					
H+ 30	600		300	18.00 92.65					**120**					
H+														
H+														
H+														

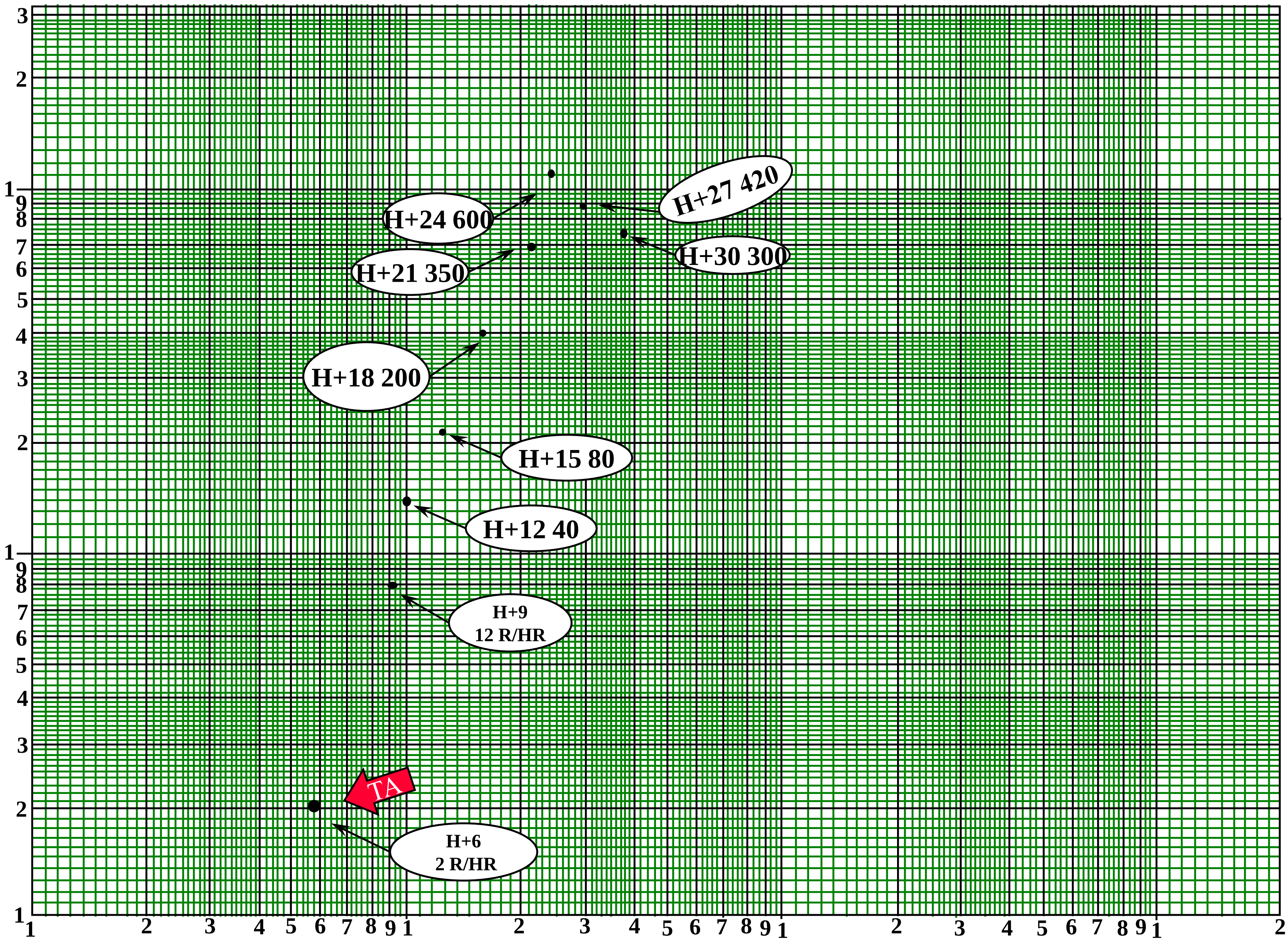
CLOSE IN 4 X TA

DISTANT 2 X TA

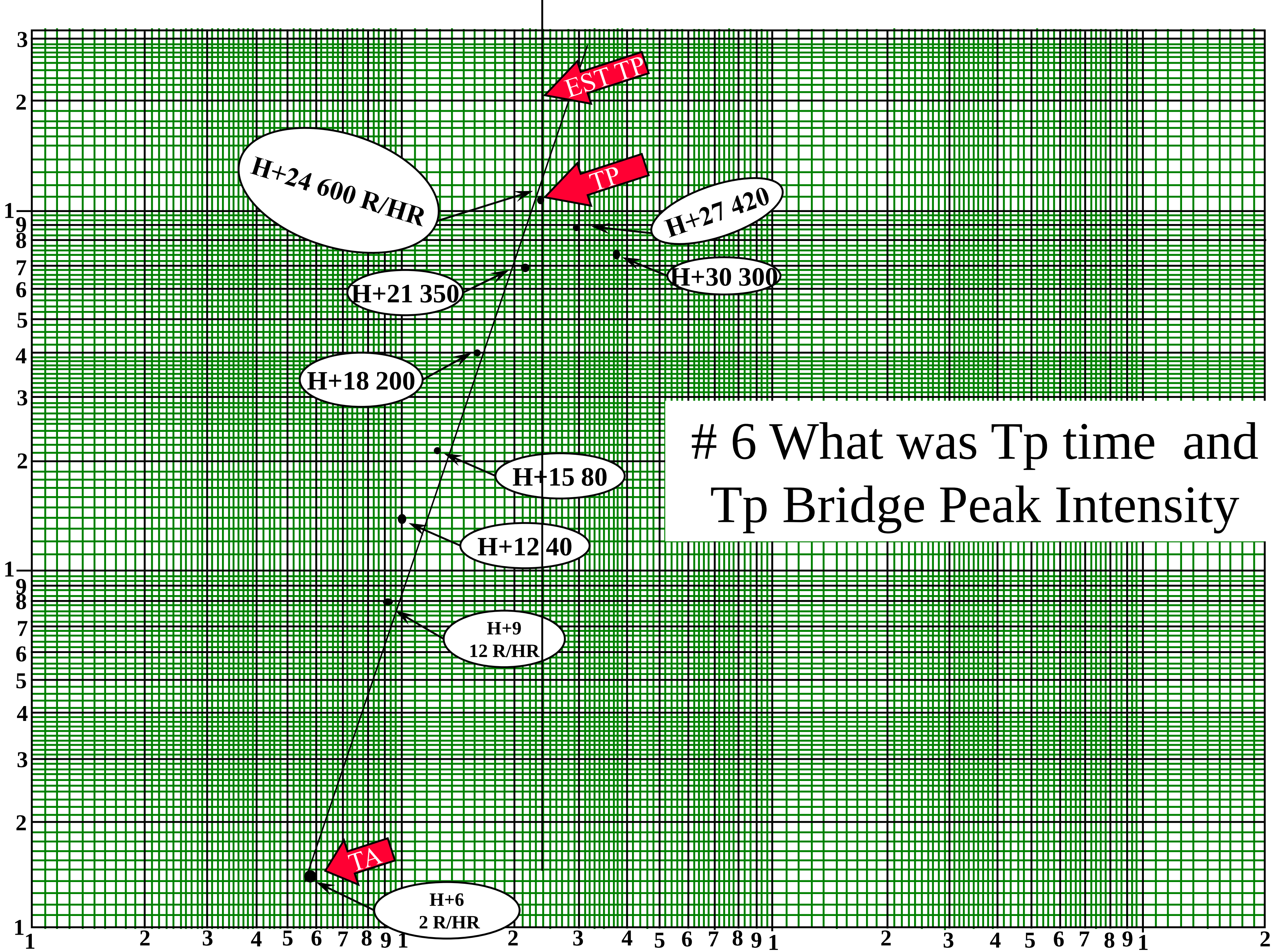
$$DOSE = \frac{(I_1 + I_2)}{\mathbf{2}} \times \frac{(T_2 - T_1)}{60}$$

TF =
MULTIPLY IN

DIVIDE OUT


H+6
2 R/HR
TA
H+9
12 R/HR
H+12 40
H+15 80
H+18 200
H+21 350
H+24 600
H+27 420
H+30 300

6 What was Tp time and Tp Bridge Peak Intensity



TA H+ 6 TP H + 24 TC H + ______ MPE = 150 R

EST TP 24 EST PI 1000 R/HR N=

	OUTSIDE INT	OUTSIDE DOSE	BRIDGE (TF=0.5) INT	BRIDGE (TF=0.5) DOSE	DCC (TF= 0.1) INT	DCC (TF= 0.1) DOSE	REP-2 (TF=) INT	REP-2 (TF=) DOSE	REP-3 (TF= 0.2) INT	REP-3 (TF= 0.2) DOSE	REP-5 (TF=) INT	REP-5 (TF=) DOSE	DEEP SHEL (TF= 0.15) INT	DEEP SHEL (TF= 0.15) DOSE
H+ 6			2											
H+ 9			12	.35										
H+ 12			40	1.30 / 1.65										
H+ 15			80	3.00 / 4.65										
H+ 18			200	7.00 / 11.65										
H+ 21			350	13.75 / 25.40										
H+ 24	1200		600	23.75 / 49.15 ← Dbu					240					
H+ 27	840		420	25.50 / 74.65					168					
H+ 30	600		300	18.00 / 92.65					120					
H+														
H+														
H+														
H+														

.05 — Ta (H+6) ↑ Dbu ↓ Tp (H+24)

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT

#7 What was the Dbu for Bridge, Topside, and DCC personnel

To get the topside Dbu you need to use the transition factors.

Tf= Multiply in
Divide out

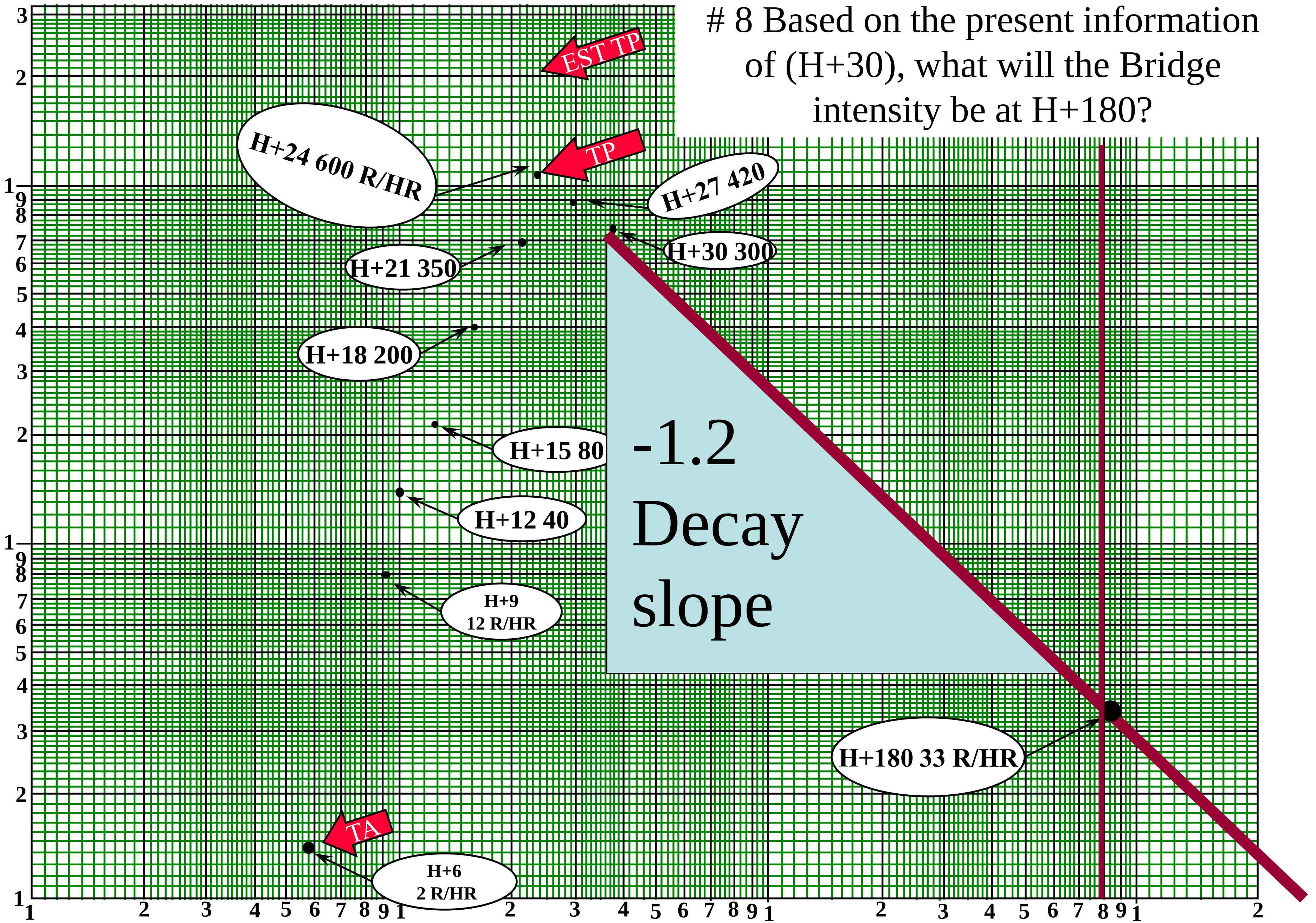
DCC	D/S	REP 3	BRIDGE
0.1	0.15	0.2	0.5

49.15 R
Bridge

98.30 R
Topside

9.83 R x DCC

8 Based on the present information of (H+30), what will the Bridge intensity be at H+180?



TA H+ 6 TP H + 24 TC H + ______ MPE = 150 R

EST TP 24 EST PI 1000 R/HR **N=**

		OUTSIDE		BRIDGE		DCC		REP-2		REP-3		REP-5		DEEP SHEL	
		.05		TF=0.5		TF= 0.1		TF=		TF= 0.2		TF=		TF= 0.15	
		INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
Ta	H+ 6			2											
↑	H+ 9			12	.35										
Dbu	H+ 12			40	1.30 1.65										
	H+ 15			80	3.00 4.65										
	H+ 18			200	7.00 11.65										
↓	H+ 21			350	13.75 25.40										
Tp	H+ 24	1200		600	23.75 49.15	← Dbu				240					
	H+ 27	840		420	25.50 74.65					168					
	H+ 30	600		300	18.00 92.65					120					
	H+ 33			200	12.56 105.15										
	H+ 36			170	9.25 114.40										
	H+ 39			130	7.50 121.90										
	H+ 42			100	5.75 127.65										

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT

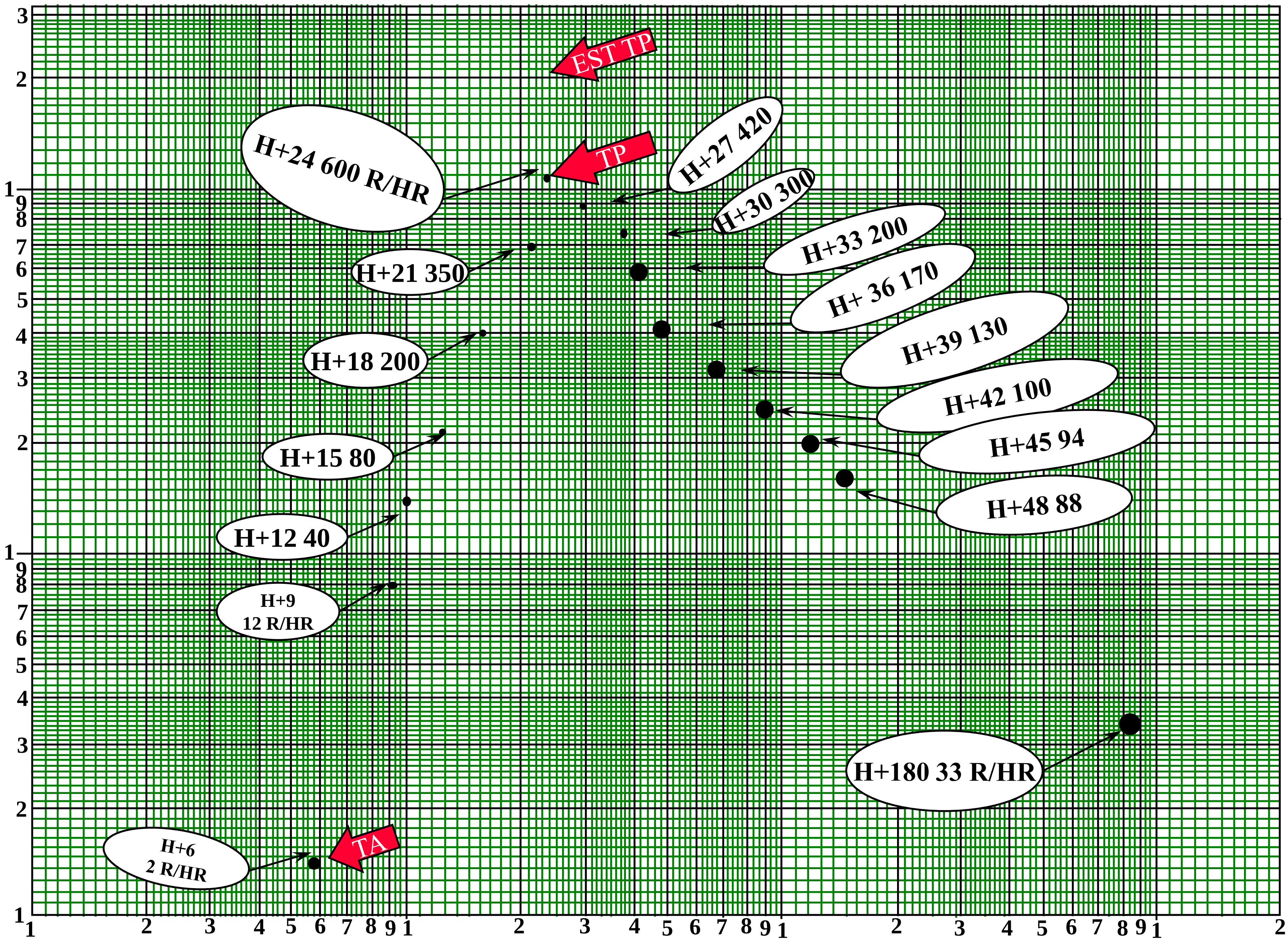
.05			TF=0.5		TF= 0.1		TF=		TF= 0.2		TF=		TF= 0.15	
	OUTSIDE		BRIDGE		DCC		REP-2		REP-3		REP-5		DEEP SHEL	
	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
H+ 42			100	5.75 127.65										
H+ 45			94	4.85 132.50										
H+ 48			88	4.55 137.05										
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														

CLOSE IN 4 x TA

DISTANT 2 x TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

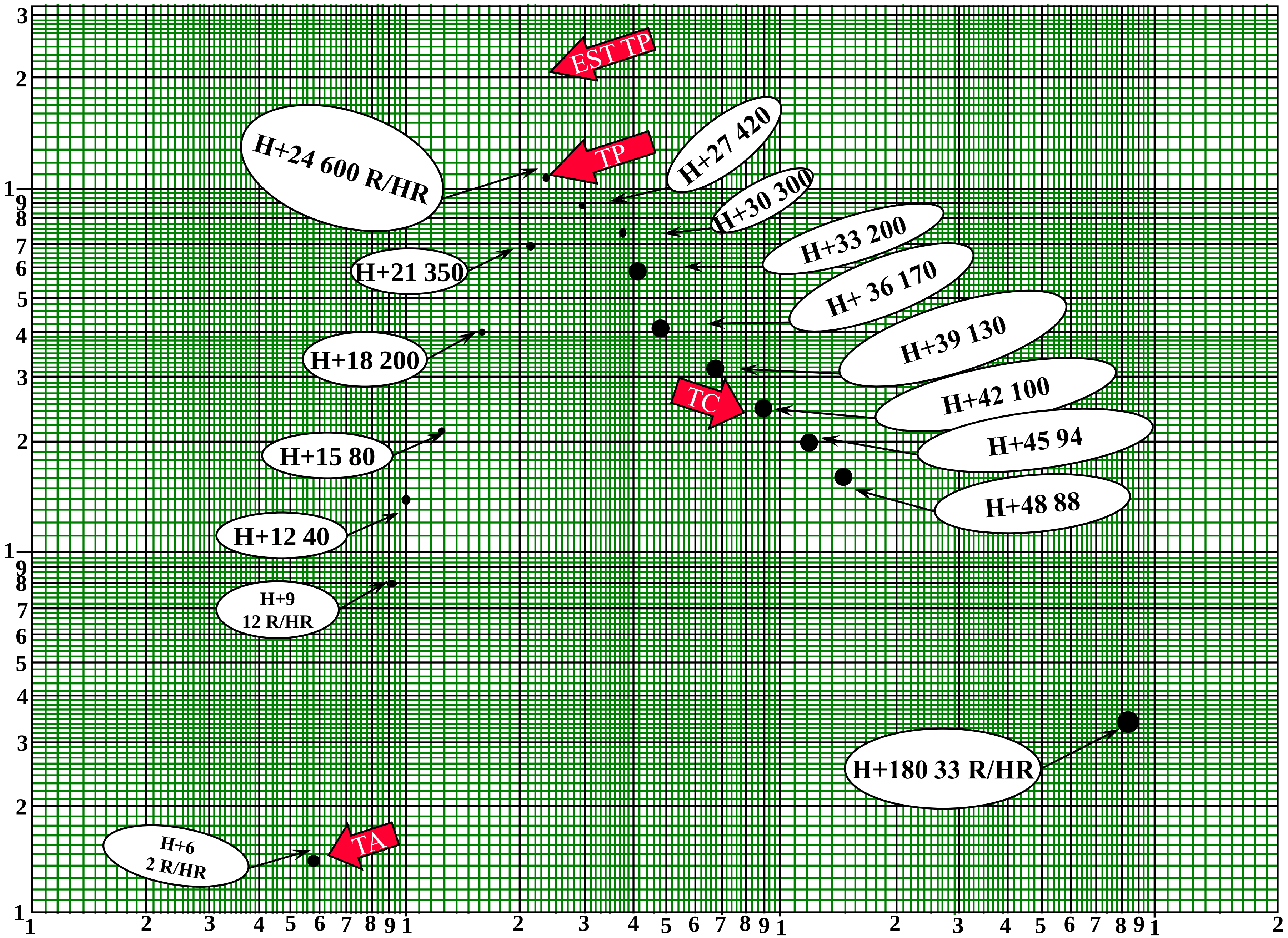
TF: MULTIPLY IN
DIVIDE OUT


EST TP
TP
TA
H+6
2 R/HR
H+9
12 R/HR
H+12 40
H+15 80
H+18 200
H+21 350
H+24 600 R/HR
H+27 420
H+30 300
H+33 200
H+ 36 170
H+39 130
H+42 100
H+45 94
H+48 88
H+180 33 R/HR

Question #9

- What was Tc time and Tc Bridge intensity?

H+ 42   100 R/HR



EST TP
TP
TC
TA
H+6 2 R/HR
H+9 12 R/HR
H+12 40
H+15 80
H+18 200
H+21 350
H+24 600 R/HR
H+27 420
H+30 300
H+33 200
H+ 36 170
H+39 130
H+42 100
H+45 94
H+48 88
H+180 33 R/HR

TA H+ 6 TP H + 24 TC H + 42

EST TP 24 EST PI 1000 R/HR N= MPE = 150 R

.05

		OUTSIDE		BRIDGE (TF=0.5)		DCC (TF= 0.1)		REP-2 (TF=)		REP-3 (TF= 0.2)		REP-5 (TF=)		DEEP SHEL (TF= 0.15)	
		INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
Ta	H+ 6			2											
Dbu ↓	H+ 9			12	.35										
	H+ 12			40	1.30 1.65										
	H+ 15			80	3.00 4.65										
	H+ 18			200	7.00 11.65										
	H+ 21			350	13.75 25.40										
Tp	H+ 24	1200		600	23.75 49.15 ← Dbu					240					
Dtr ↓	H+ 27	840		420	25.50 74.65					168					
	H+ 30	600		300	18.00 92.65					120					
	H+ 33			200	12.50 105.15										
	H+ 36			170	9.25 114.40										
	H+ 39			130	7.50 121.90										
Tc	H+ 42			100	5.75 127.65										

CLOSE IN 4 X TA

DISTANT 2 X TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT

#10 Calculate the Dtr (TRANSITIONAL DOSE) for Topside, Bridge and DCC personnel

To get the topside Dtr you need to use the transition factors.

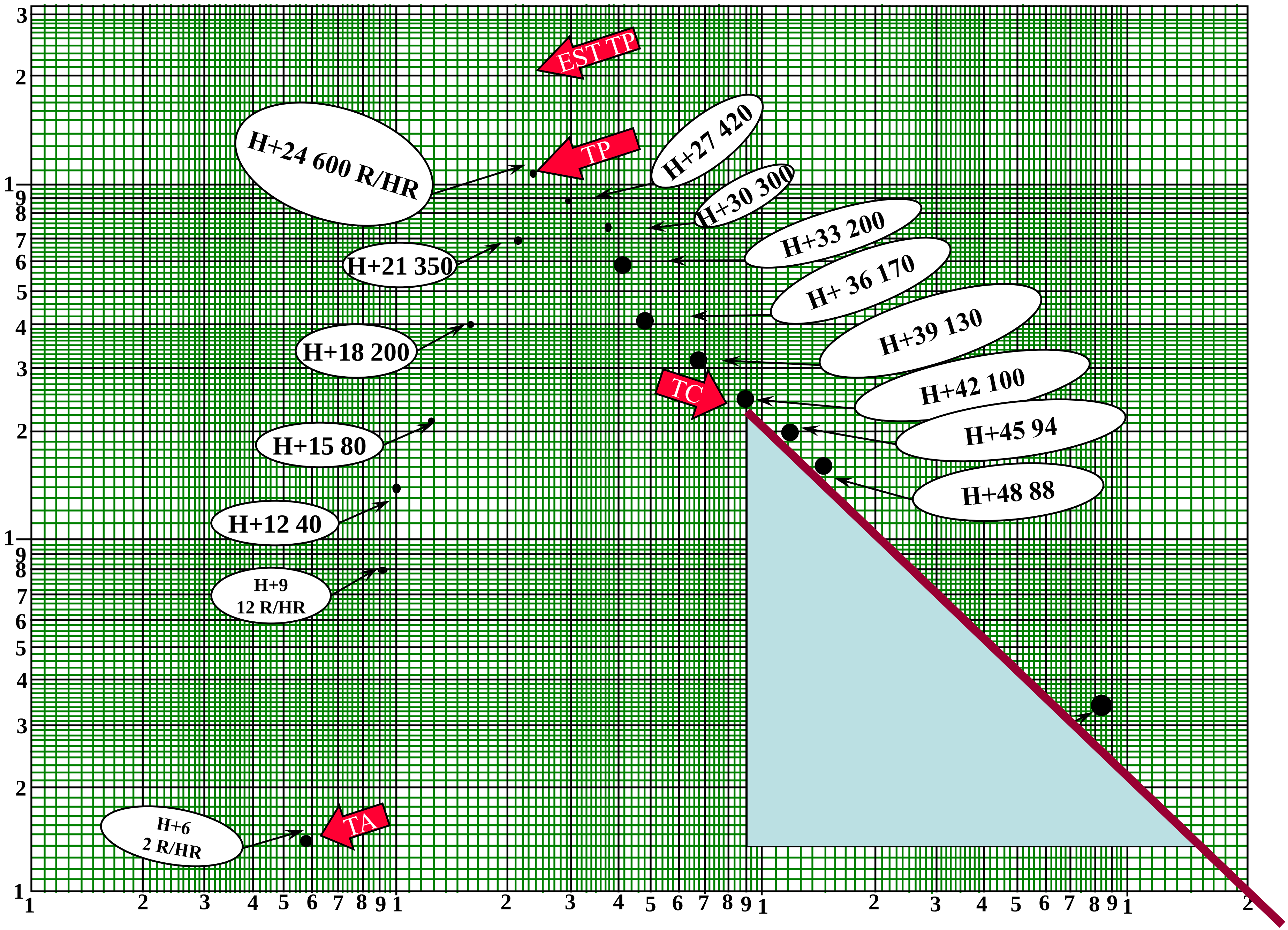
Tf= Multiply in
Divide out

DCC	D/S	REP 3	BRIDGE
0.1	0.15	0.2	0.5

78.50 R
Bridge

157.00 R
Topside

15.70 R x DCC



EST TP
TP
TC
TA
H+24 600 R/HR
H+27 420
H+30 300
H+33 200
H+ 36 170
H+39 130
H+42 100
H+45 94
H+48 88
H+21 350
H+18 200
H+15 80
H+12 40
H+9
12 R/HR
H+6
2 R/HR

After Tc has been determined, the CO orders out the Rapid Internal Survey team. Their readings are as follows. **(DIVIDE OUT)**

Station	Intensity	T/F	Topside
1	130	.5	260.00 R/HR
2	128	.6	213.33 R/HR
3	70	.4	175.00 R/HR
Decon	75	.5	150.00 R/HR
D/S	10	.3	33.33 R/HR

Question # 13
What is the internal hot spot in REP III area?

Station #1 or 2-0-5-Q

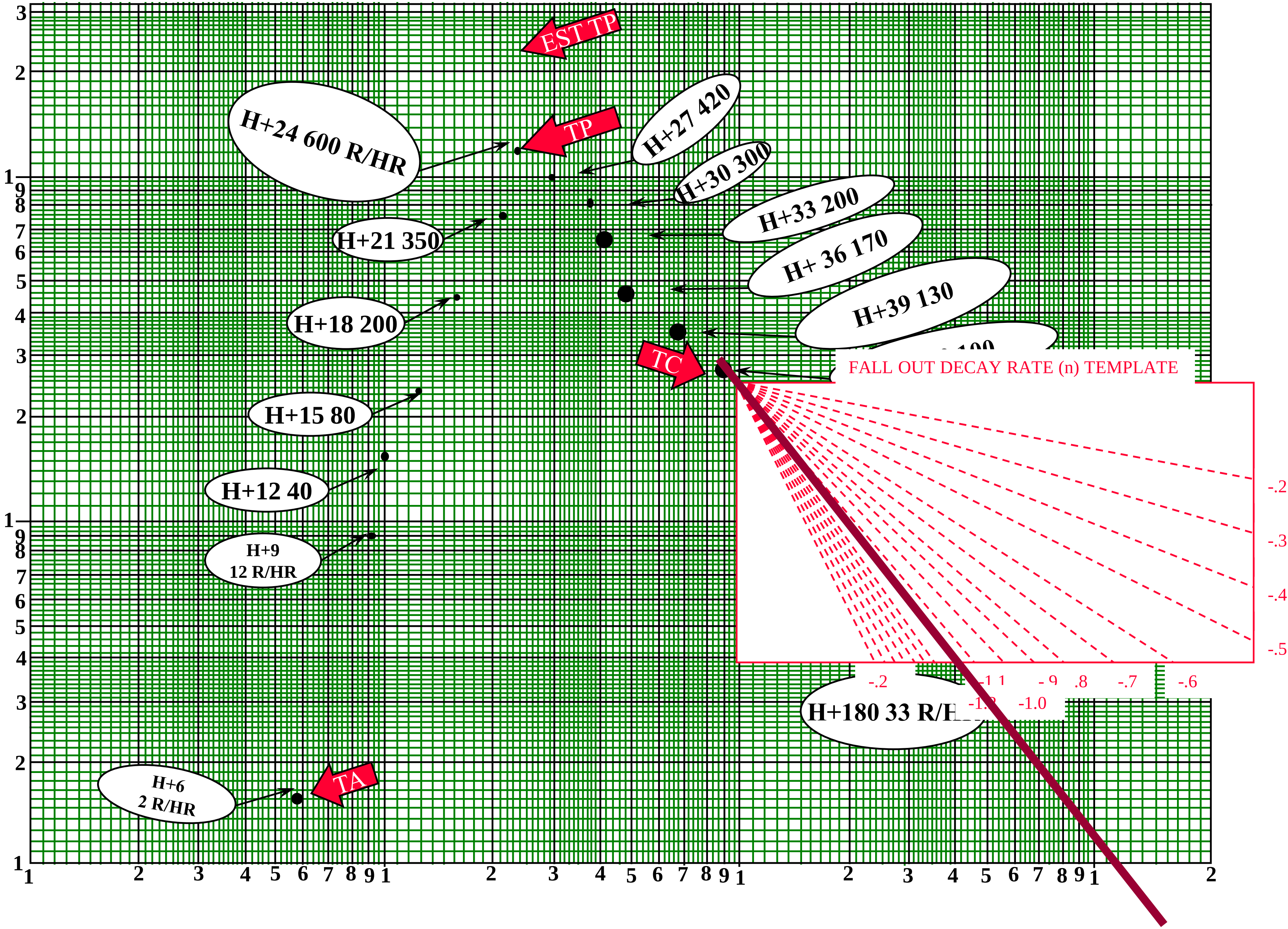
Question #14
What is the Intensity of the Station #1 hot spot area?

260.00 R/HR

NOMOGRAMS

- Nomograms are used to determine the decrease in dose rate (INTENSITY) at any time for a single burst known from log-log plot.

- To determine decay slope use template from NSTM 070


EST TP
TP
H+24 600 R/HR
H+27 420
H+30 300
H+33 200
H+ 36 170
H+39 130
H+21 350
H+18 200
TC
H+15 80
H+12 40
H+9
12 R/HR
H+6
2 R/HR
TA
FALL OUT DECAY RATE (n) TEMPLATE
-.2
-.3
-.4
-.5
-.2
-1.0
-.7
-.6
H+180 33 R/H

Question 13-16

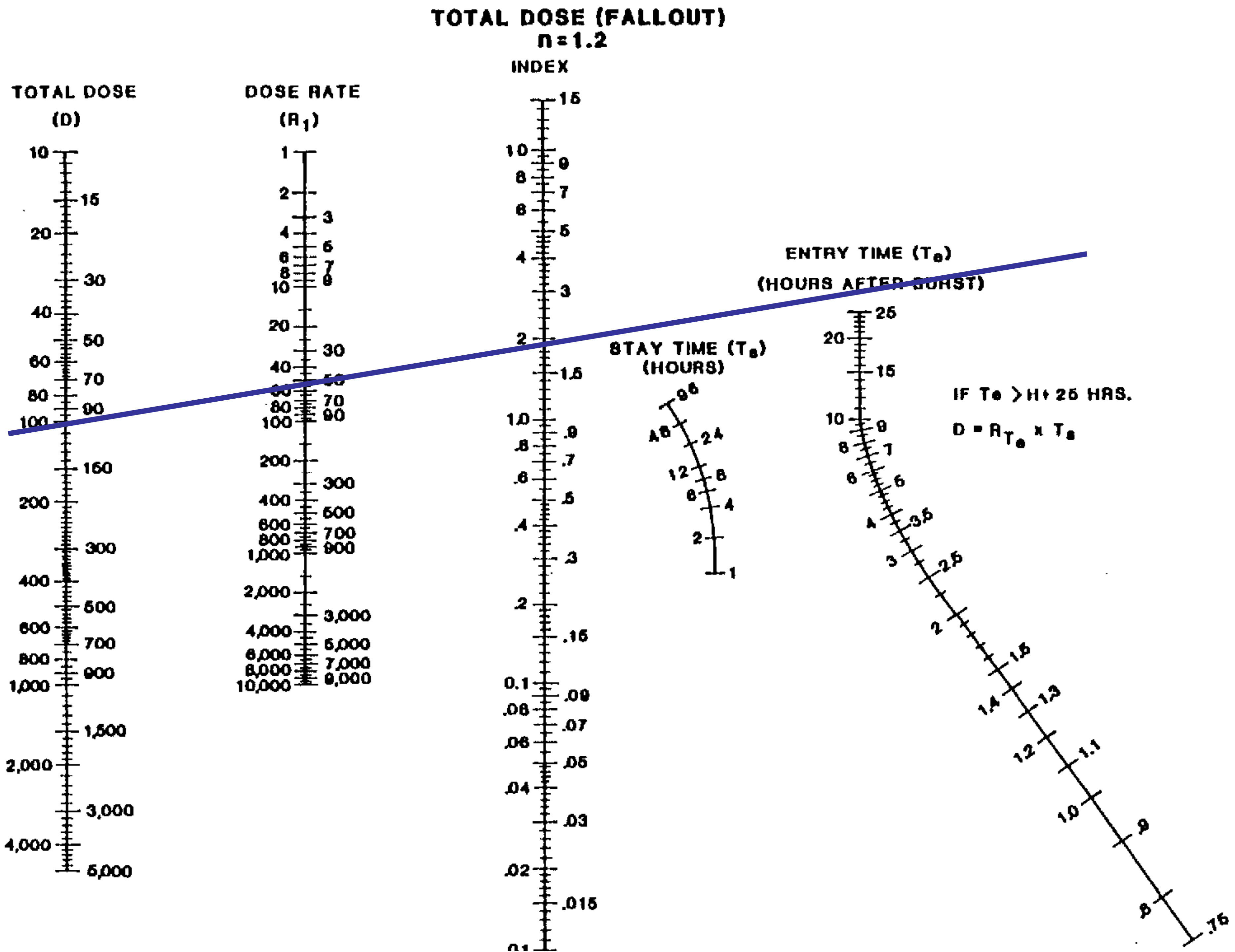
Remember to obtain total dose, **do not forget to subtract the dose from the station being used from your MPE** which is 150.
(credit card#)

Using the following and past information, solve problems #13 through #16.

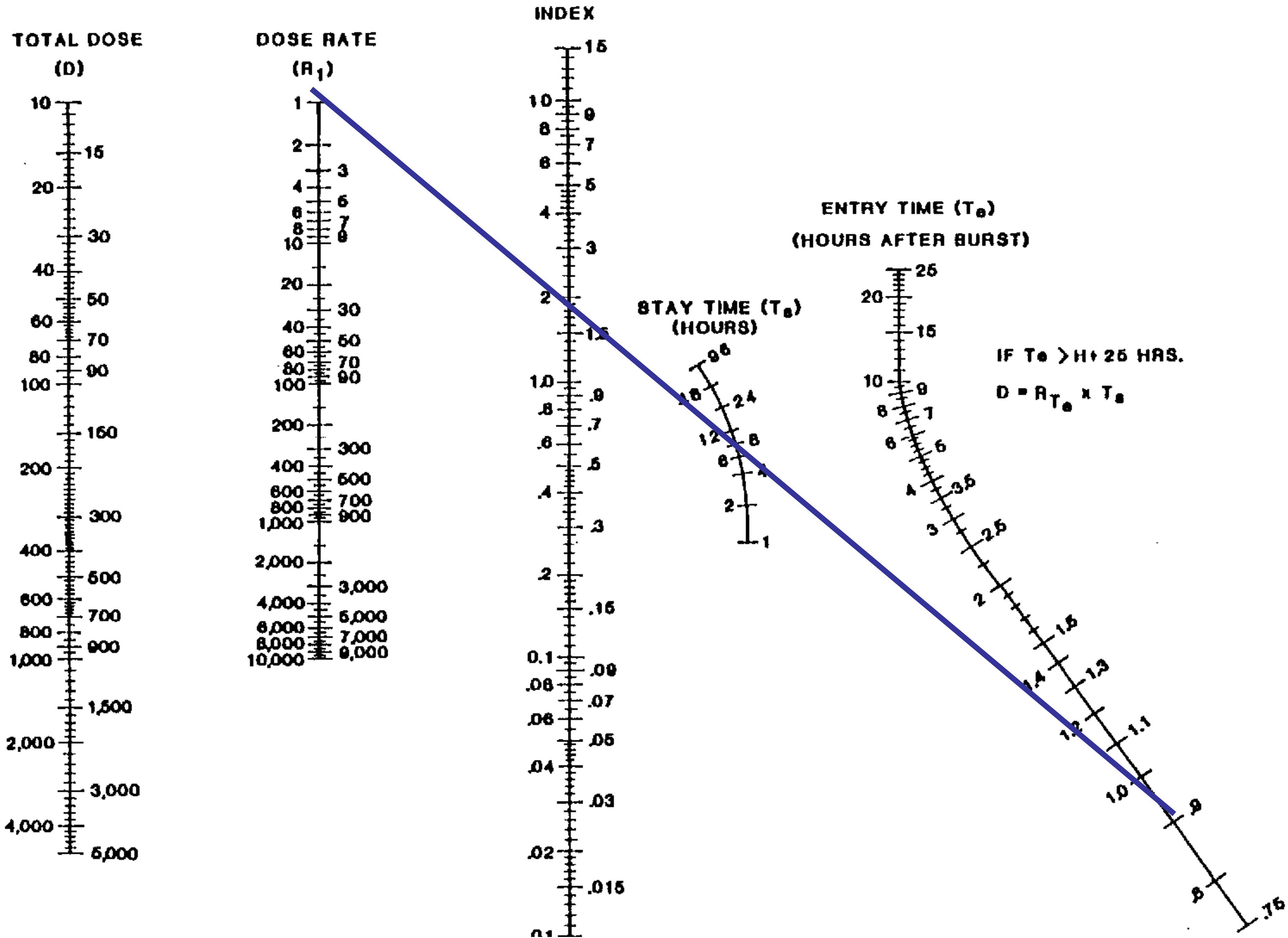
TIME	INTENSITY	DECAY ANGEL
H+ 1 HOUR	65 R/HR	N=1.2

Question # 13

- What is the safe time for personnel in Station 1?


TOTAL DOSE (FALLOUT)
n=1.2
INDEX
TOTAL DOSE
(D)
DOSE RATE
(R_1)
ENTRY TIME (T_e)
(HOURS AFTER BURST)
STAY TIME (T_s)
(HOURS)
IF Te > H+25 HRS.
$D = R_{T_e} \times T_s$

TOTAL DOSE (FALLOUT)
n=1.2



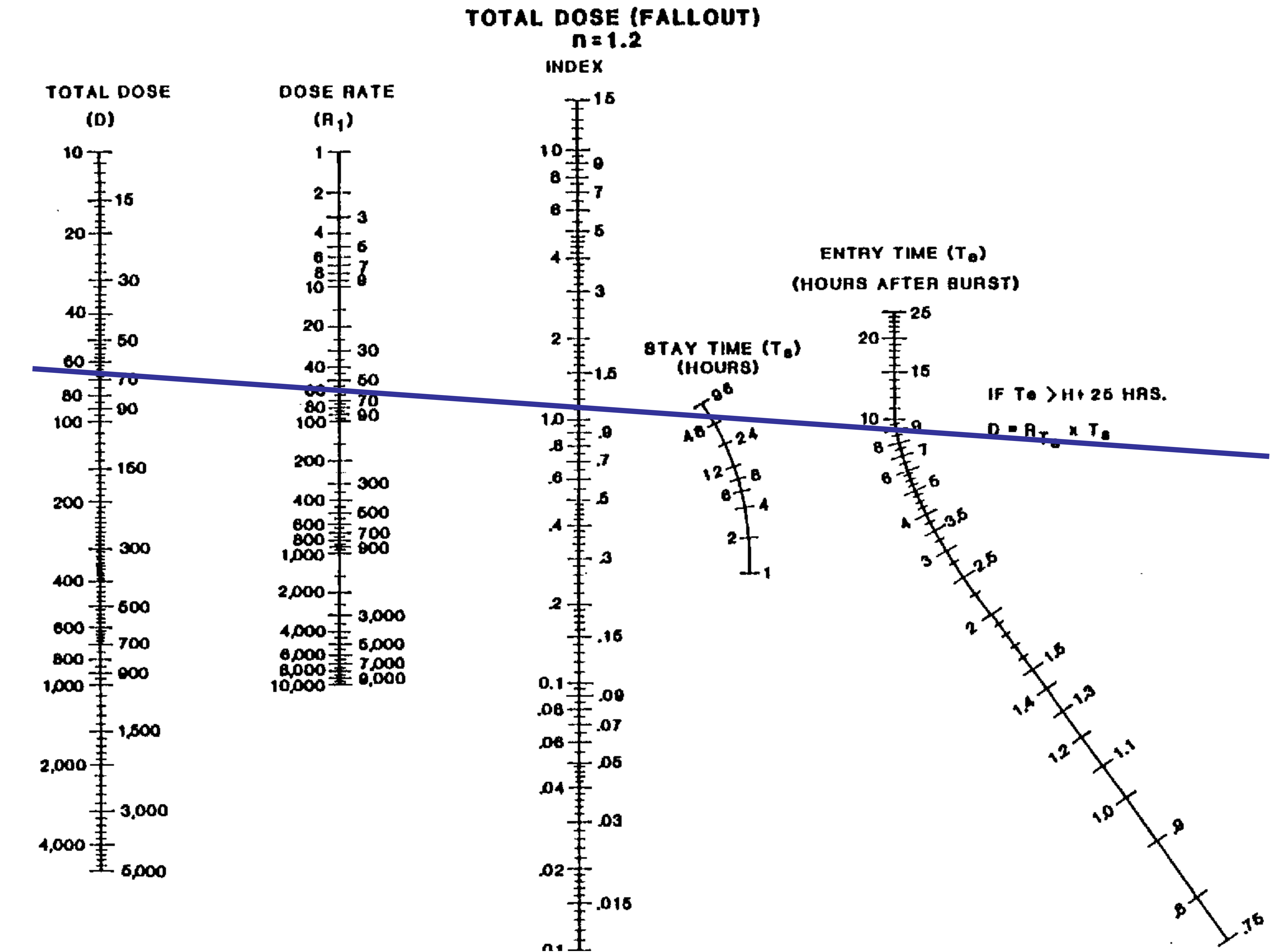
Question # 13

What is the safe stay time for personnel in Station 1?

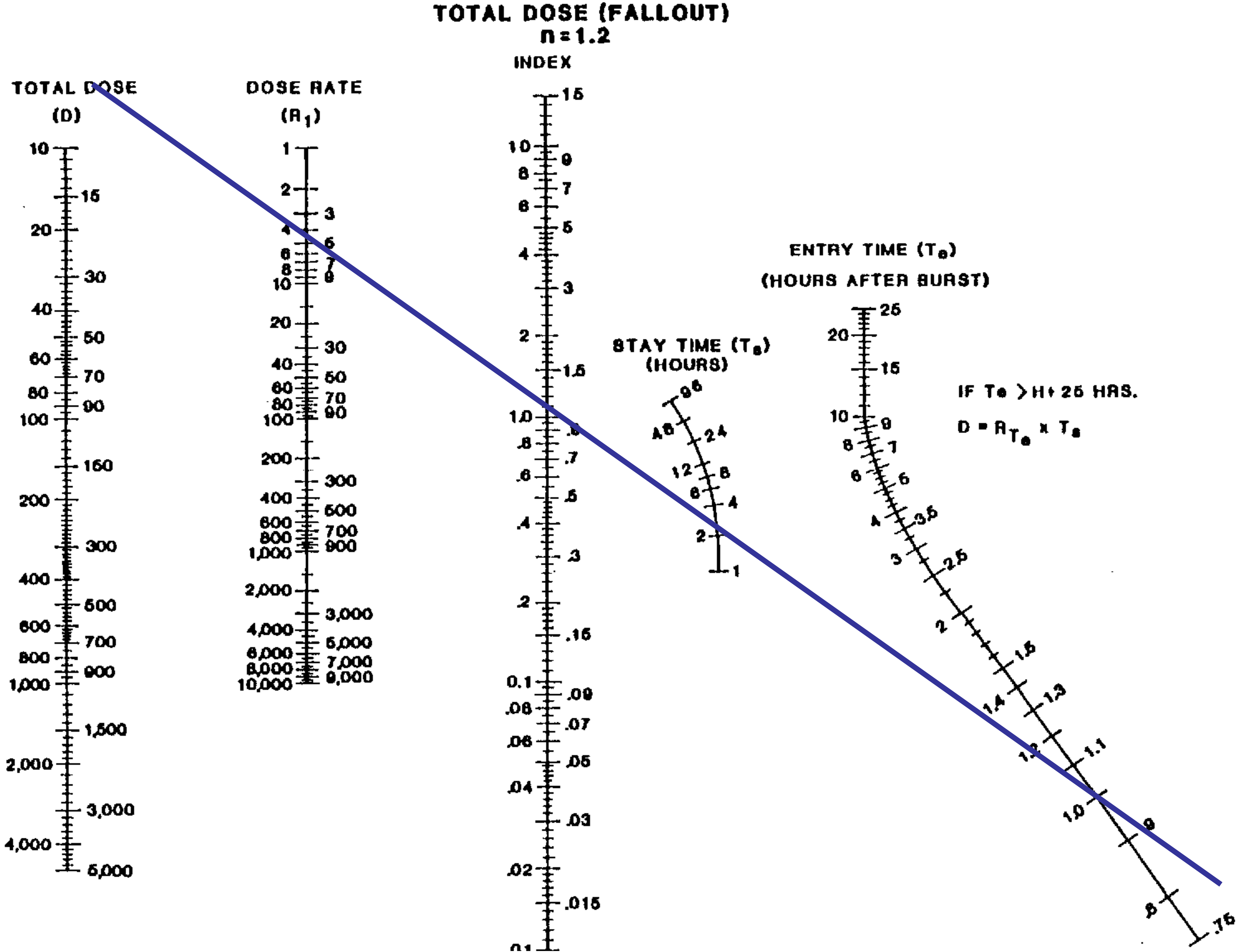
5 hours

Question #14

What is the safe stay time for personnel in Station 2?



TOTAL DOSE (FALLOUT)
n=1.2
INDEX
TOTAL DOSE
(D)
DOSE RATE
(R_1)
ENTRY TIME (T_e)
(HOURS AFTER BURST)
STAY TIME (T_s)
(HOURS)
IF Te > H+25 HRS.
D = R_{T_e} x T_s


TOTAL DOSE (FALLOUT)
n=1.2
INDEX
TOTAL DOSE
(D)
DOSE RATE
(R1)
ENTRY TIME (Te)
(HOURS AFTER BURST)
STAY TIME (Ts)
(HOURS)
IF Te > H+25 HRS.
D = RTe x Ts

Question #14

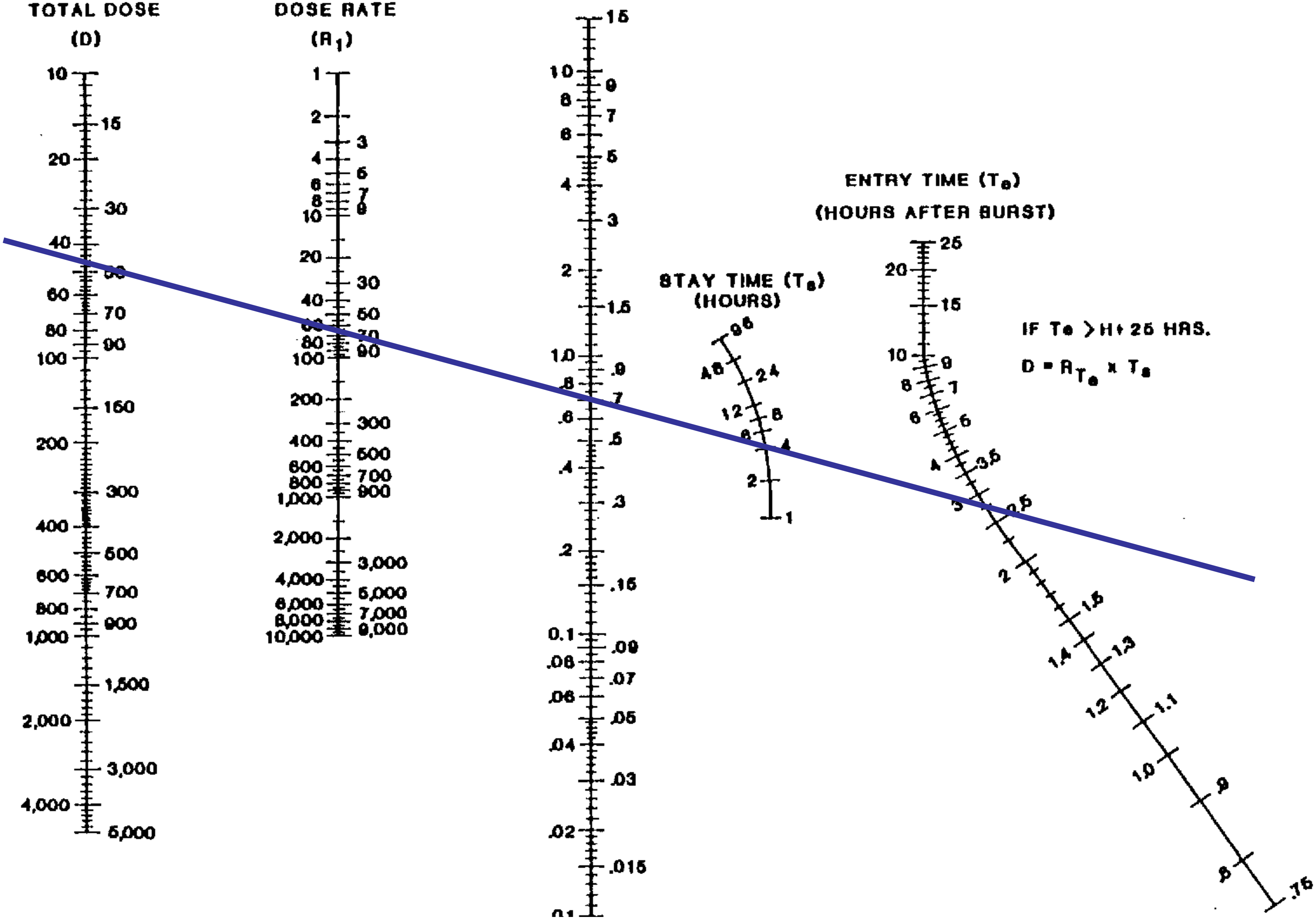
What is the safe stay time for personnel in Station 2?

2 Hours

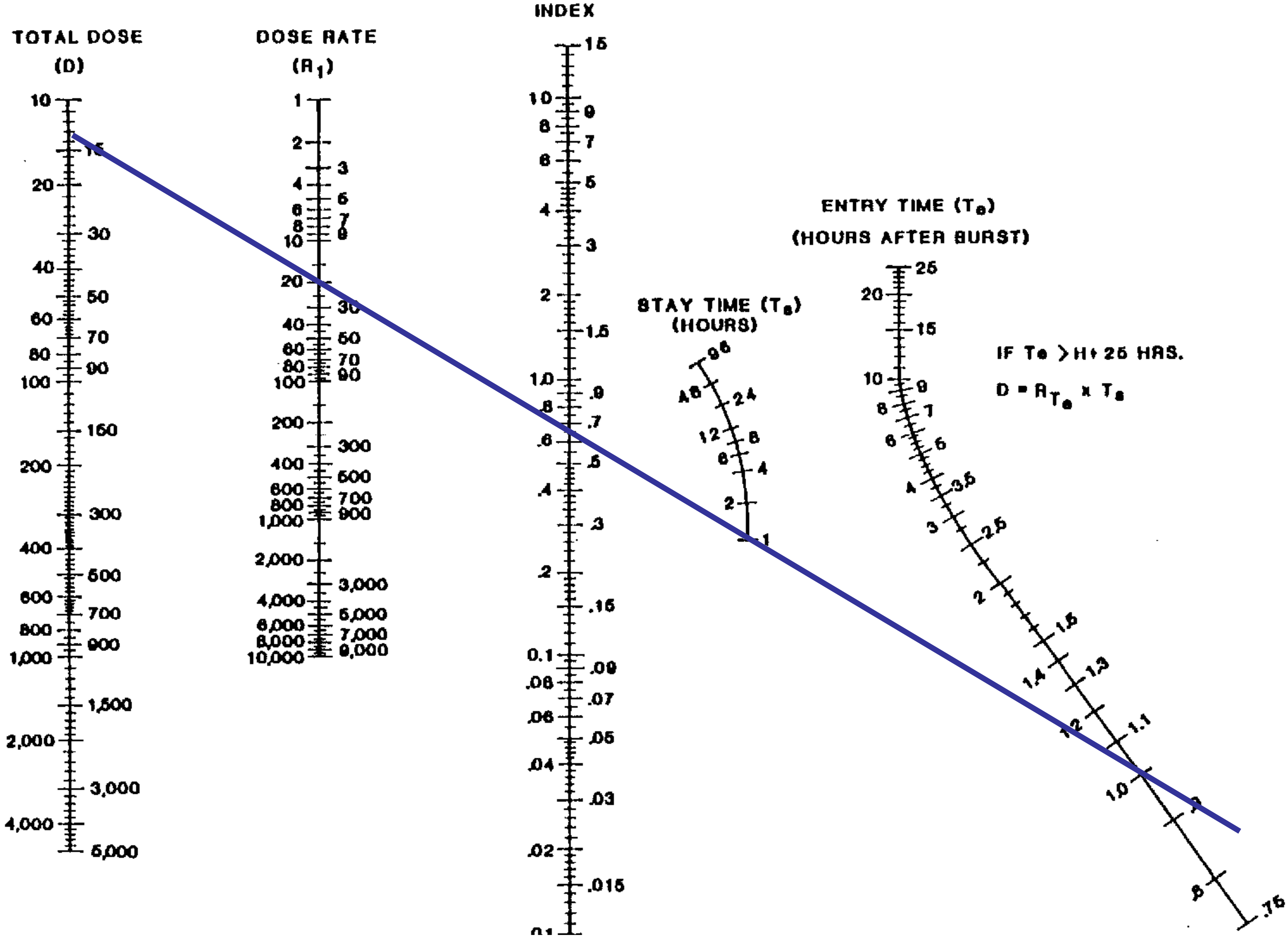
Question #15

What is the safe stay time for personnel in Station 3?

TOTAL DOSE (FALLOUT)
n = 1.2



# TOTAL DOSE (FALLOUT)
n=1.2



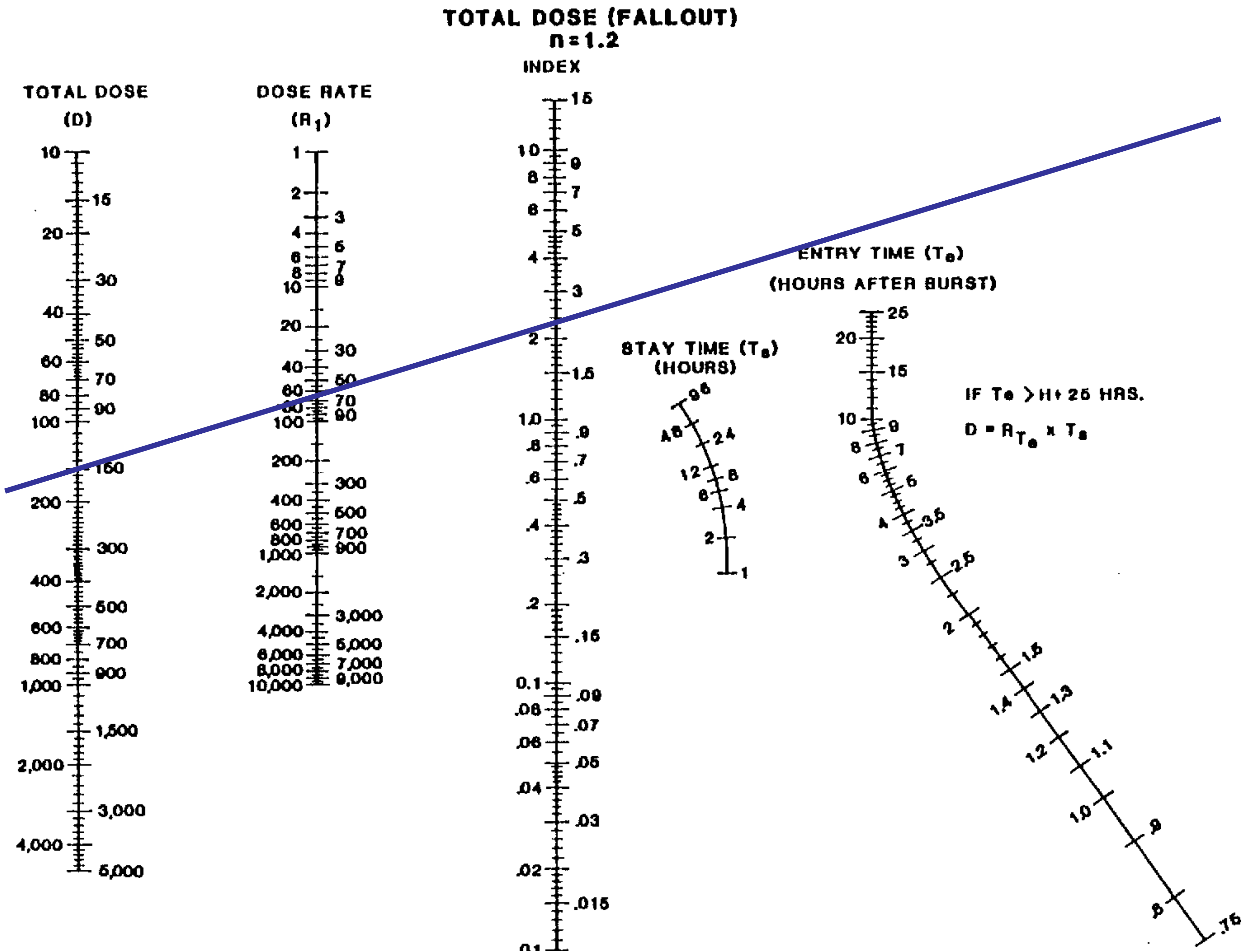
Question #15

What is the safe stay time for personnel in Station 3?

1 Hour

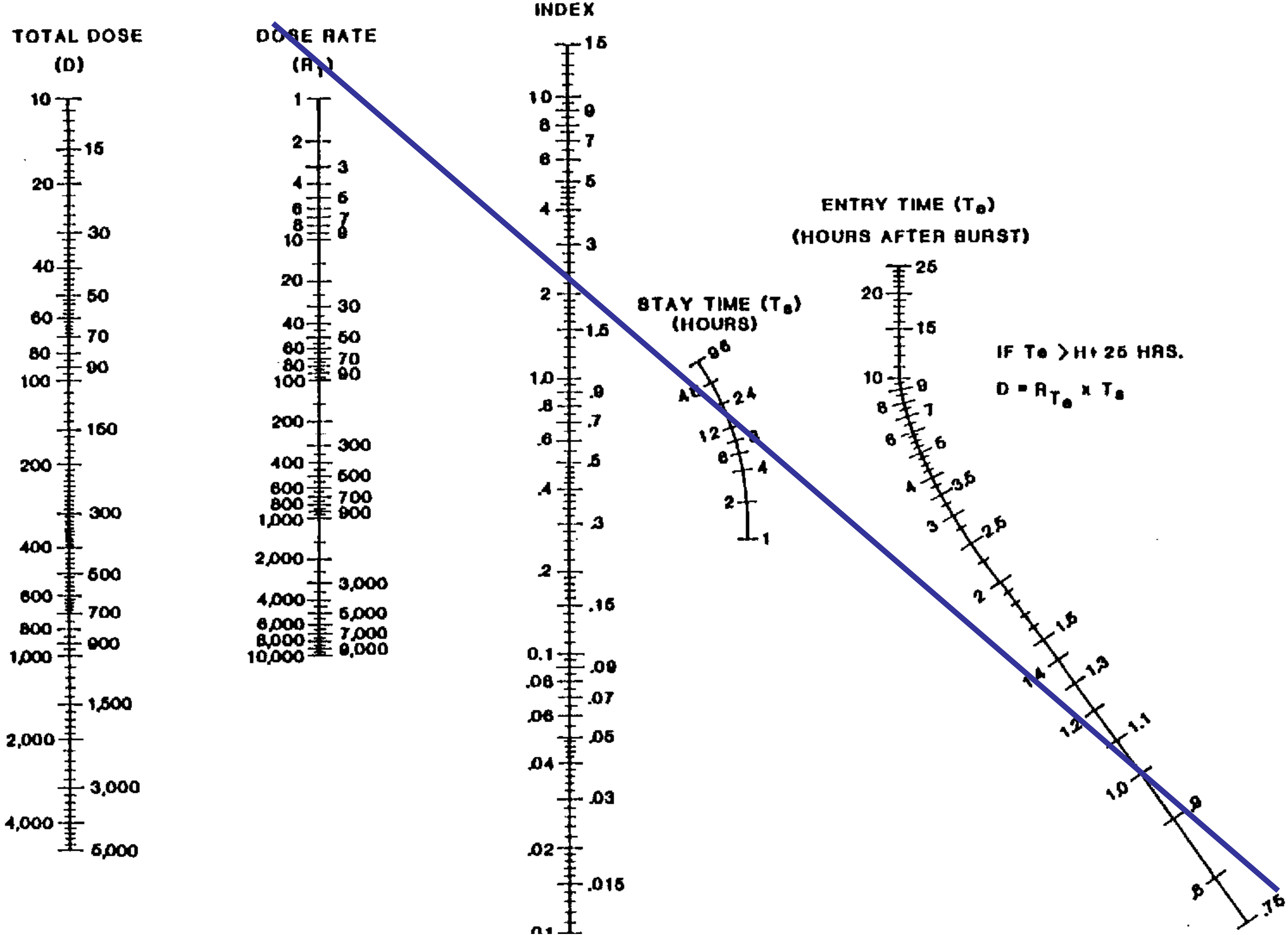
Question #16

What is the safe stay time for external monitors in Deep Shelter?



TOTAL DOSE (FALLOUT)
n=1.2
TOTAL DOSE
(D)
DOSE RATE
(R_1)
INDEX
STAY TIME (T_s)
(HOURS)
ENTRY TIME (T_e)
(HOURS AFTER BURST)
IF Te > H+25 HRS.
D = R_{T_e} x T_s

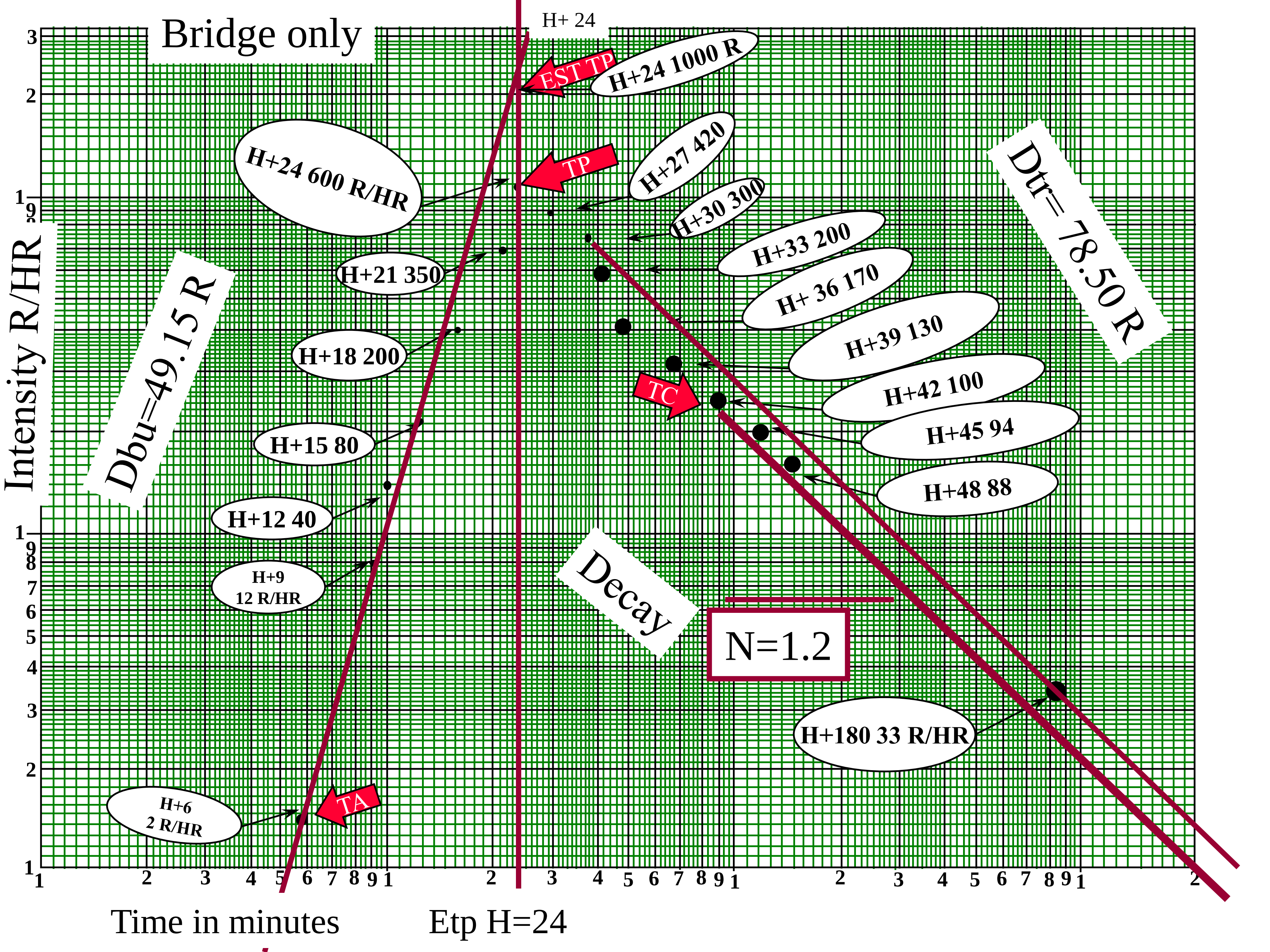
TOTAL DOSE (FALLOUT)
n = 1.2



Question #18

What is the safe stay time for external monitors in Deep Shelter?

24 Hours.



Bridge only
H+ 24
EST TP
H+24 1000 R
H+24 600 R/HR
TP
H+27 420
H+30 300
H+33 200
H+ 36 170
H+39 130
H+42 100
H+45 94
H+48 88
TC
Dtr= 78.50 R
H+21 350
H+18 200
H+15 80
H+12 40
H+9
12 R/HR
H+6
2 R/HR
TA
Dbu=49.15 R
Intensity R/HR
Decay
N=1.2
H+180 33 R/HR
Time in minutes
Etp H=24

TA H+ 6 TP H + 24 TC H + 42 MPE = 150 R

EST TP 24 EST PI 1000 R/HR **N=** - 1.2

	OUTSIDE		BRIDGE (TF=0.5)		DCC (TF= 0.1)		REP-2 (TF=)		REP-3 (TF= 0.2)		REP-5 (TF=)		DEEP SHEL (TF= 0.15)	
.05	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
Ta H+ 6			2											
H+ 9			12	.35										
H+ 12			40	1.30 / 1.65										
H+ 15			80	3.00 / 4.65										
H+ 18			200	7.00 / 11.65										
H+ 21			350	13.75 / 25.40										
Tp H+ 24	1200		600	23.75 / 49.15	← Dub				240					
H+ 27	840		420	25.50 / 74.65					168					
H+ 30	600		300	18.00 / 92.65					120					
H+ 33			200	12.50 / 105.15										
H+ 36			170	9.25 / 114.40										
H+ 39			130	7.50 / 121.90										
Tc H+ 42			100	5.75 / 127.65										

(Ta to Tp: Dbu; Tp to Tc: Dtr)

CLOSE IN 4 X TA

DISTANT 2 X TA

$$DOSE = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN
DIVIDE OUT

.05	OUTSIDE		BRIDGE TF=0.5		DCC TF= 0.1		REP-2 TF=		REP-3 TF= 0.2		REP-5 TF=		DEEP SHEL TF= 0.15	
	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE	INT	DOSE
H+ 42			100	5.75 127.65										
H+ 45			94	4.85 132.50										
H+ 48			88	4.55 **137.05**										
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														
H+														

CLOSE IN 4 x TA

DISTANT 2 x TA

$$\text{DOSE} = \frac{(I_1 + I_2)}{2} \times \frac{(T_2 - T_1)}{60}$$

TF: MULTIPLY IN

DIVIDE OUT

THE END