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A Division of North American Aviation Inc.

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ATOMICS INTERNATIONAL A Division of North American Aviation, Inc TECHNICAL DATA RECORD		NAA-SR-TDR- TDR NO 11971	APPROVALS: MN
		PAGE 1 OF 14	<i>PB Hartig</i>
AUTHOR		DEPT & GROUP NO	DATE
J. L. Hedgecock		731-123	June 8, 1966
G. E. German		731-123	GO NO 7647
TITLE		S/A NO	TWR
Weight Scaling Factors for SNAP Reactor Shields		1414	
PROGRAM		SECURITY CLASSIFICATION	
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DISTRIBUTION		CONF. <input type="checkbox"/>	DEFENSE INFO. <input type="checkbox"/>
E. Ash C2		SECRET <input type="checkbox"/>	
J. Asquith C2		AUTHORIZED CLASSIFIER SIGNATURE DATE	
R. Audette C2		<i>PB Hartig</i> 6/3/66	
J. Belcher C5	STATEMENT OF PROBLEM		
W. Botts C2	The problem was to develop data which would be useful in estimating the shield weights for future SNAP reactor nuclear power systems.		
J. Brunings C2	ABSTRACT		
W. Burke C2	A series of weight scaling factor graphs are presented for the following basic shield configurations:		
D. Cockeram C2	<ol style="list-style-type: none"> 1. Instrument-rated shadow shields 2. Man-rated shadow shields 3. Man-rated four-pi shields. 		
E. Donovan C2	Each graph shows the weight ratio of a new shield design with respect to a Base Case design as a function of one parameter. The parameters for which the weight ratios are given include reactor power, dose rates, and the principal overall dimensions. Each parameter is considered to be essentially independent of the other parameters; thus the total weight ratio for a new design is the product of the weight ratios for the individual parameters. Shield weights for each of the Base Case designs are given.		
G. German C2			
R. Gimera C2			
C. Goetz C2			
J. Gyffe C2			
R. Hartig C2			
J. Hedgecock C2			
R. Johnson C5			
W. Kurzeka C5			
R. Lancet C2			
L. Maki C5			
D. Mason C5			
L. Mims C2			
W. Morgan C2			
T. Nakai C5			
R. Newman C2			
G. Parker C2			
R. Paulson C2			
E. Robb C2			
D. Sobo C2			
O. Tenzler C2			
B. Thompson C5			
F. Welch C2			
R. Wilson C2			

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. NAA-SR-TDR-11971

DATE June 8, 1966

PAGE 2 OF 14

The mathematical models used in calculating the shield weights and weight ratios are shown in Figures 1, 2, & 3, pages 3, 4, & 5. The shield thicknesses were calculated by F. Ridolphi and J. A. Belcher, 731-145, using the OPEX code for the man-rated cases and hand calculations for the instrument-rated case. For the instrument-rated case the gamma dose comprises 64% and the neutron dose 36% of the total dose based on the conversion relationship that 1 rad = 1.8×10^6 nvt equiv. For the man-rated cases a neutron RBE of 5 was used.

Shield weights were calculated using Deck No. 4W099 and the shield thicknesses previously calculated; they were normalized to the Base Case conditions listed below to give the shield weight scaling factors shown in the graphs which follow. The total neutron shield weight was taken equal to 1.39 times the weight of the lithium hydride neutron shield material alone to allow for the weight of structural members.

The Base Case conditions for the three shield configurations are:

INSTRUMENT-RATED SHADOW SHIELD

Base Case weight	844 lb.
Parameter values	
A = Reactor power	600 kw.
B = Shadow cone diam. at reactor midplane	20 in.
C = Fuel element length	20 in.
D = Separation distance	50 ft.
E = Dose plane diameter	25 ft.
F = Core diameter	10 in.
G = Dose rate at dose plane	2.8×10^{12} nvt equiv.

MAN-RATED SHADOW SHIELD

Base Case weight	4588 lb.
Parameter values	
A = Reactor power	600 kw.
B = Shadow cone diam. at reactor midplane	20 in.
C = Fuel element length	20 in.
D = Separation distance	150 ft.
E = Dose plane diameter	60 ft.
F = Core diameter	10 in.
G = Dose rate at dose plane	1.5 mrem/hr.
H = Gallery height	24 in.

MAN-RATED FOUR PI SHIELD

Base Case weight	15383 lb.
Parameter values	
A = Reactor power	600 kw.
B = Shadow cone diam. at reactor midplane	20 in.
C = Fuel element length	20 in.
D = Separation distance	150 ft.
E = Dose plane diameter	60 ft.
F = Core diameter	10 in.
G = Dose rate at dose plane	1.5 mrem/hr.
H = Gallery height	12 in.
I = Dose rate at reactor midplane	100 r/hr. @ 100 ft.

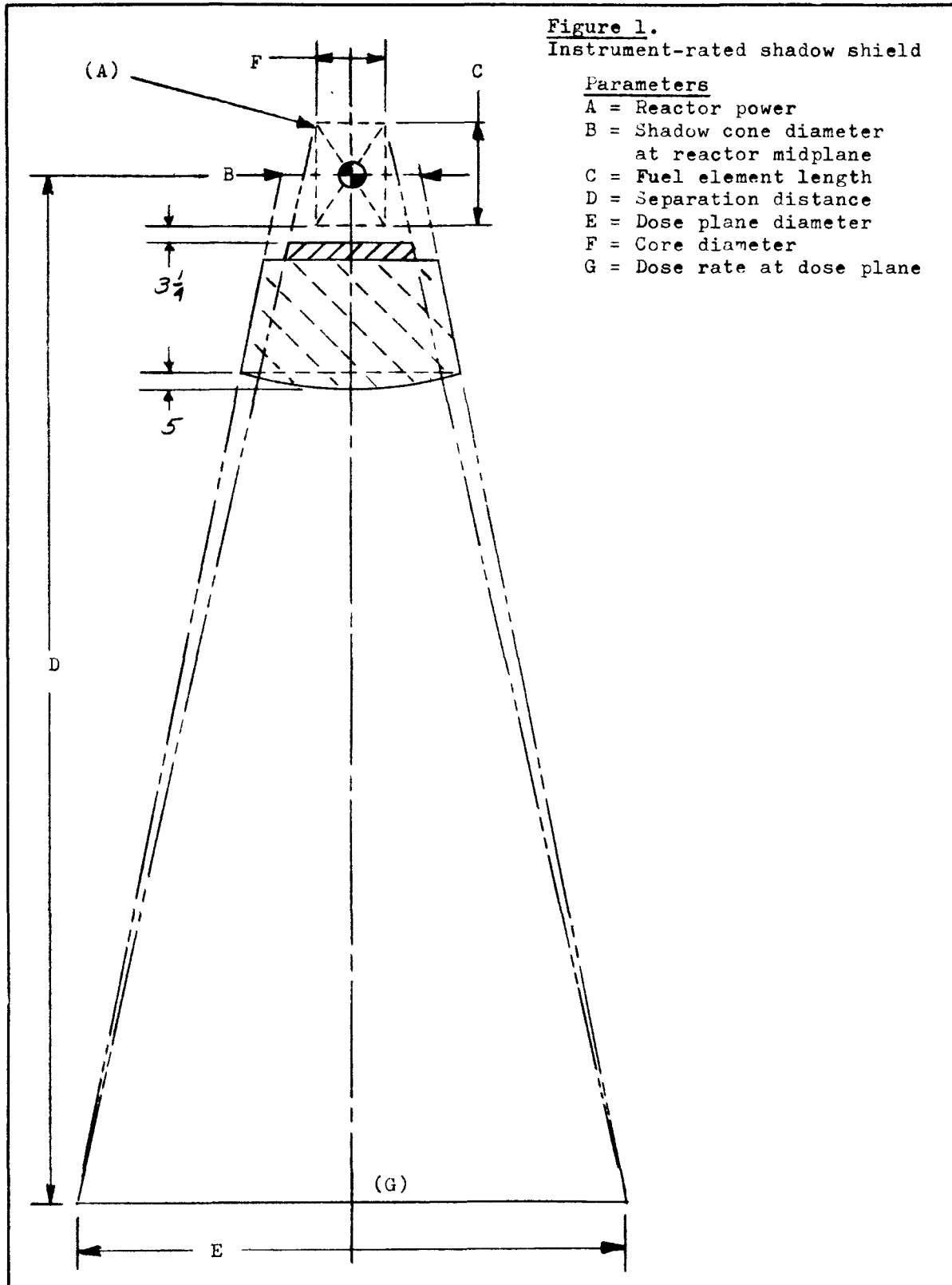
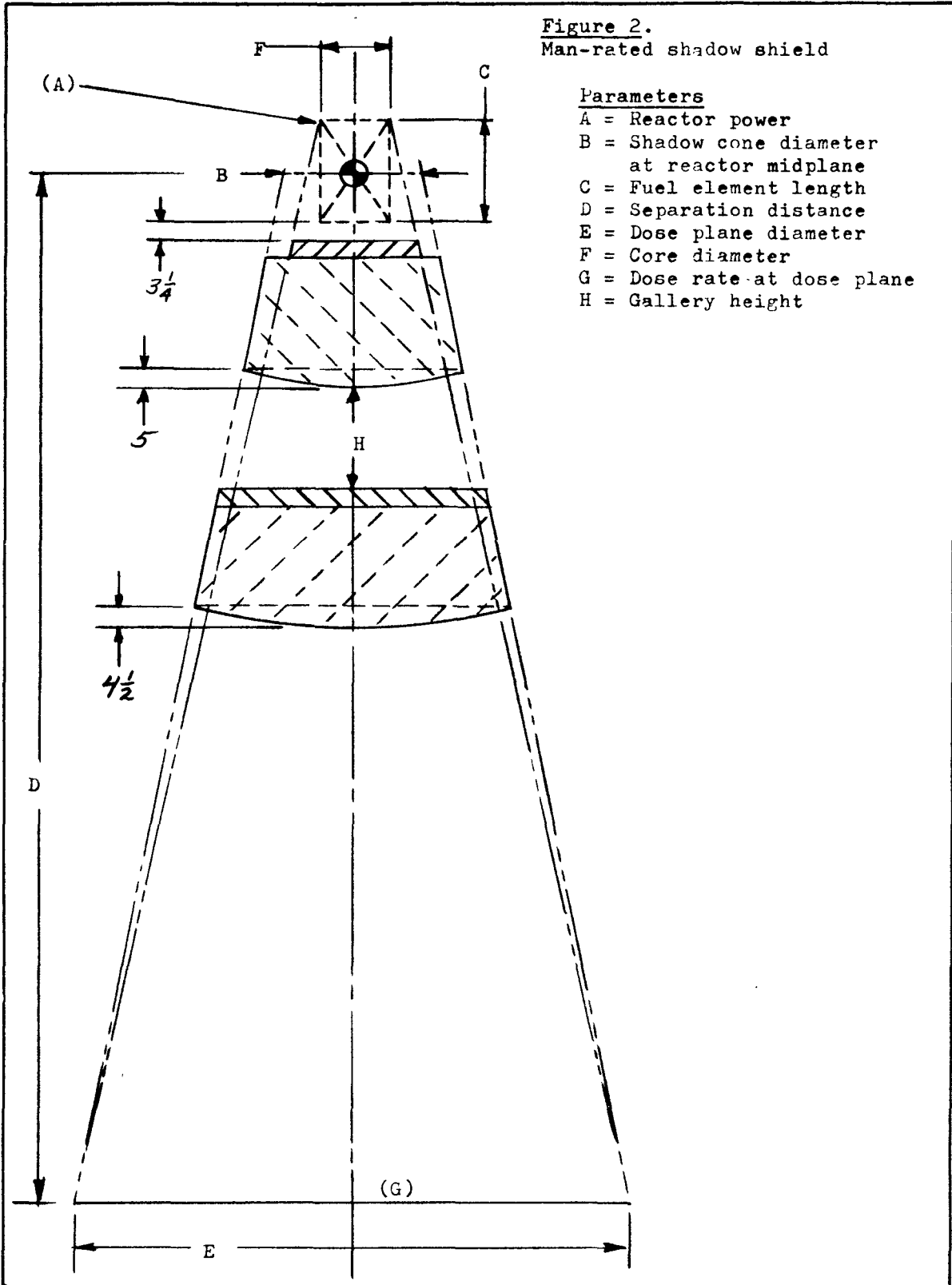
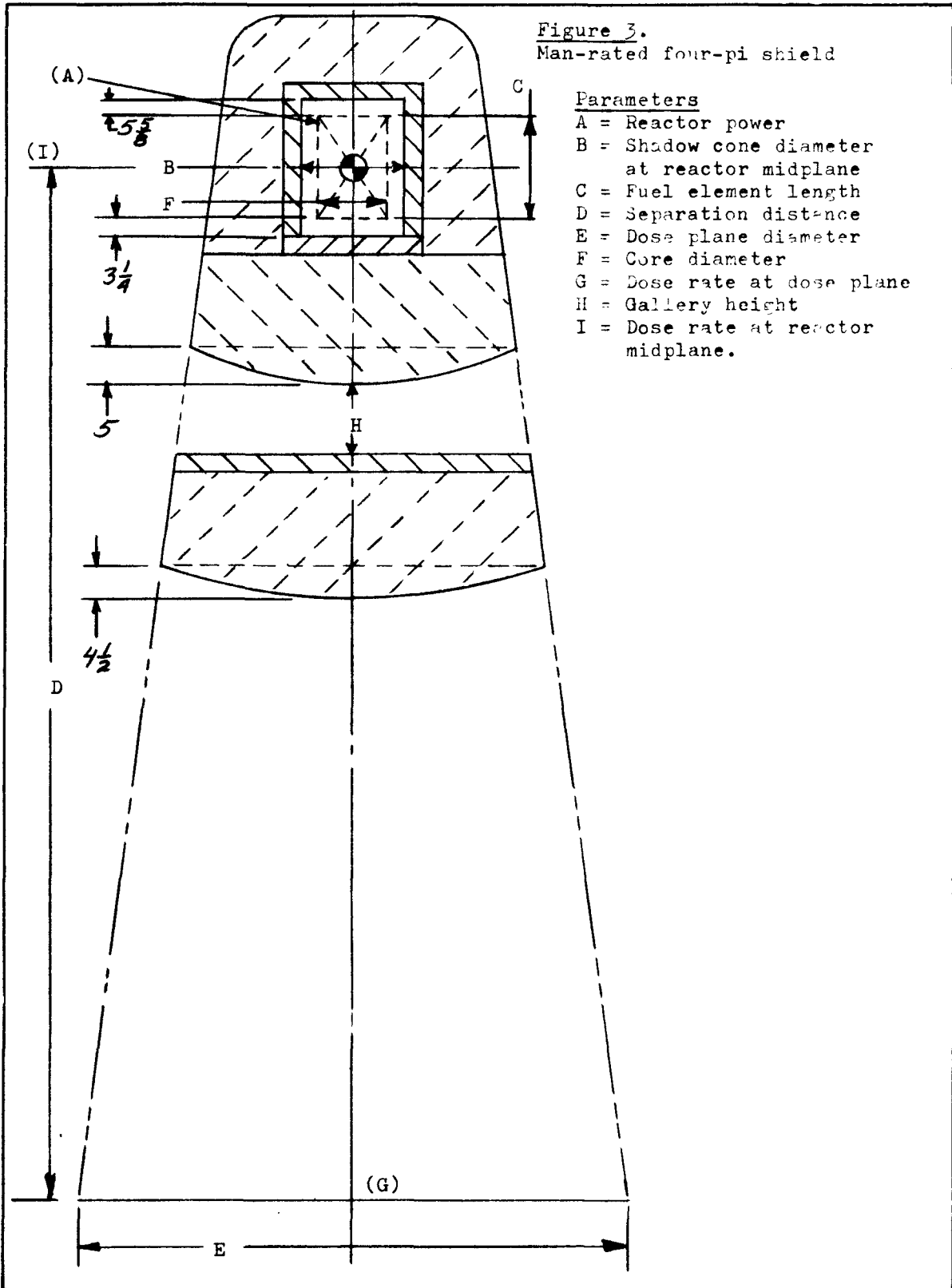
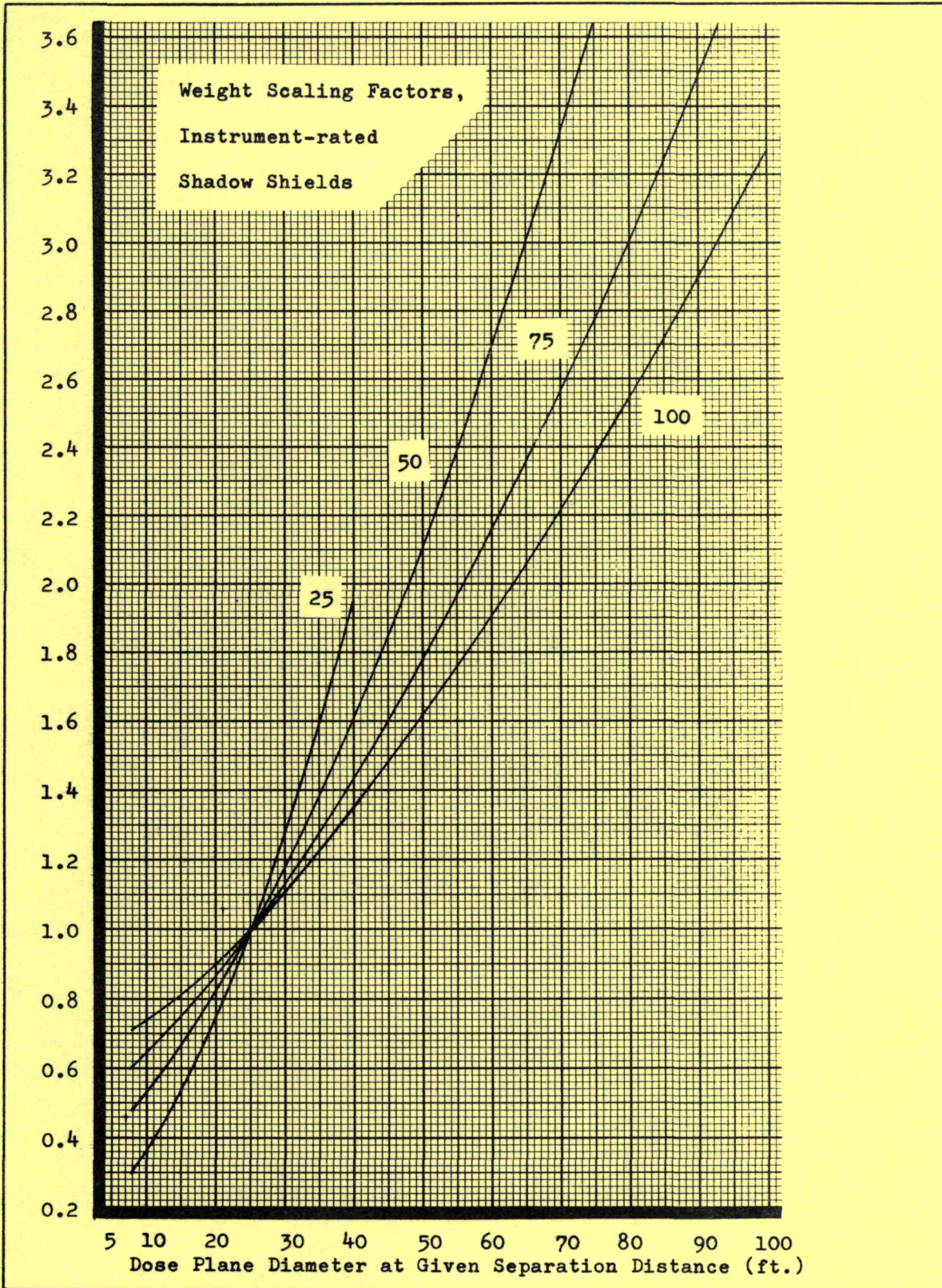


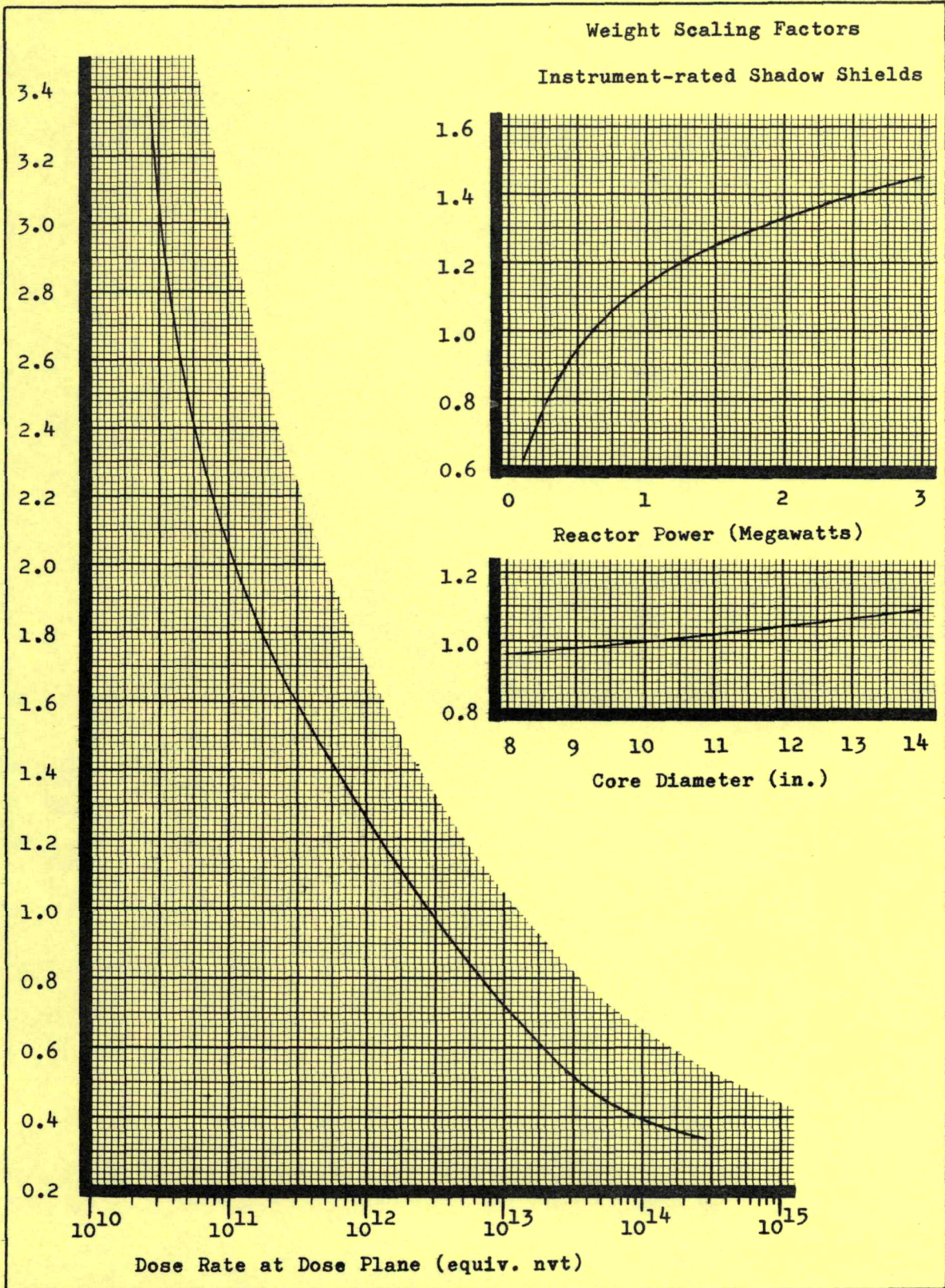
Figure 1.
Instrument-rated shadow shield

- Parameters
A = Reactor power
B = Shadow cone diameter
at reactor midplane
C = Fuel element length
D = Separation distance
E = Dose plane diameter
F = Core diameter
G = Dose rate at dose plane









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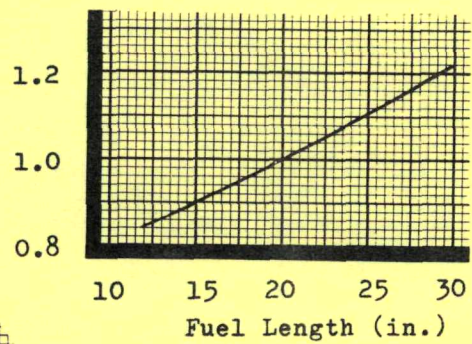
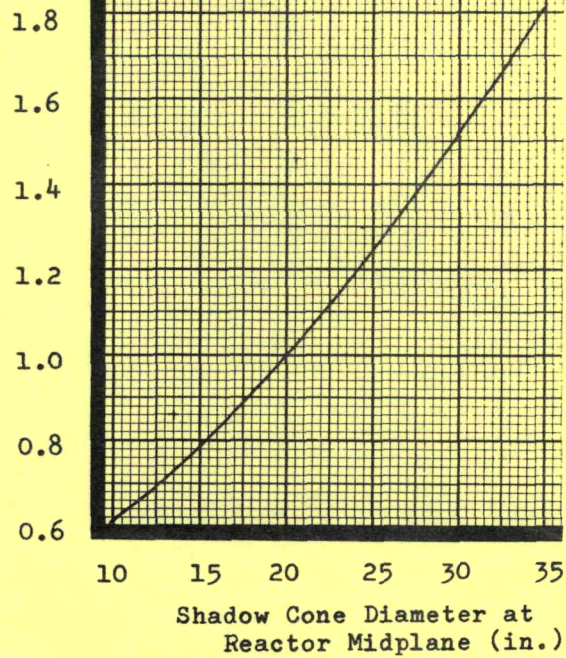
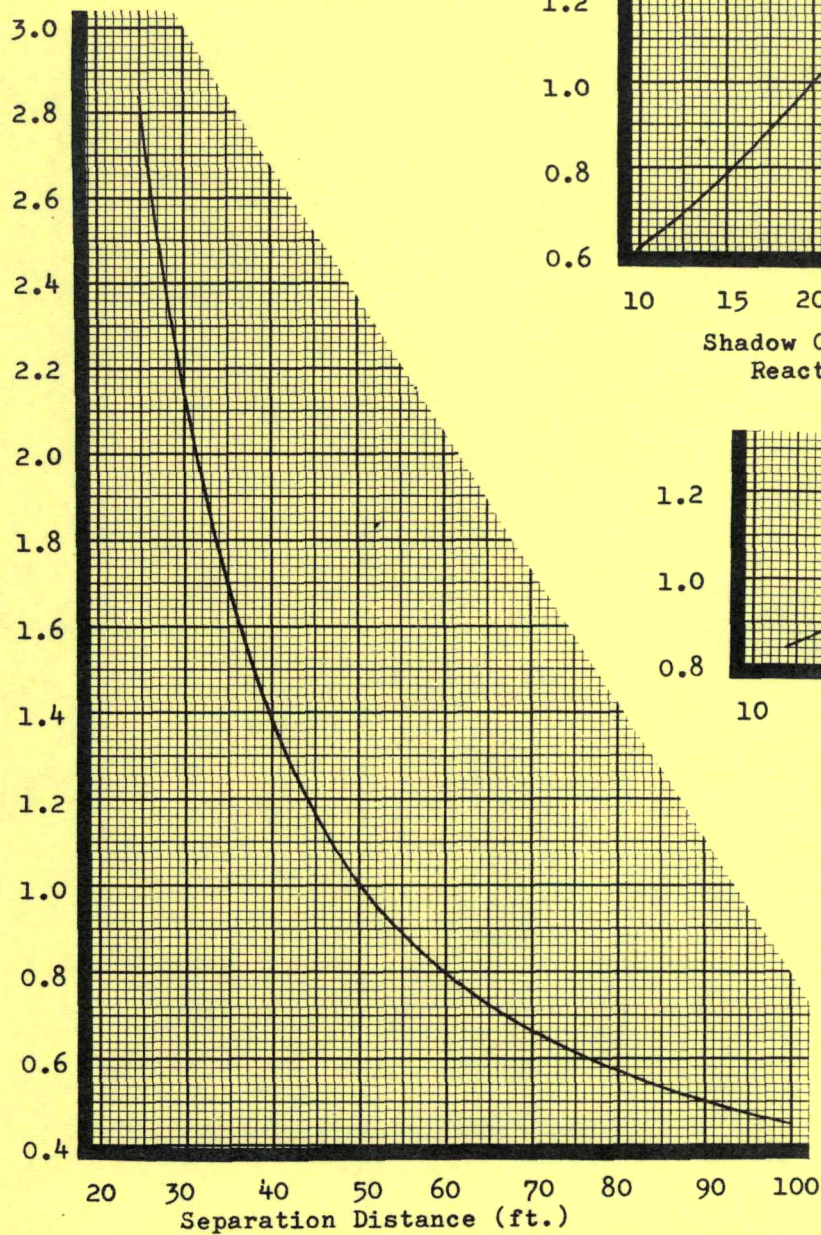
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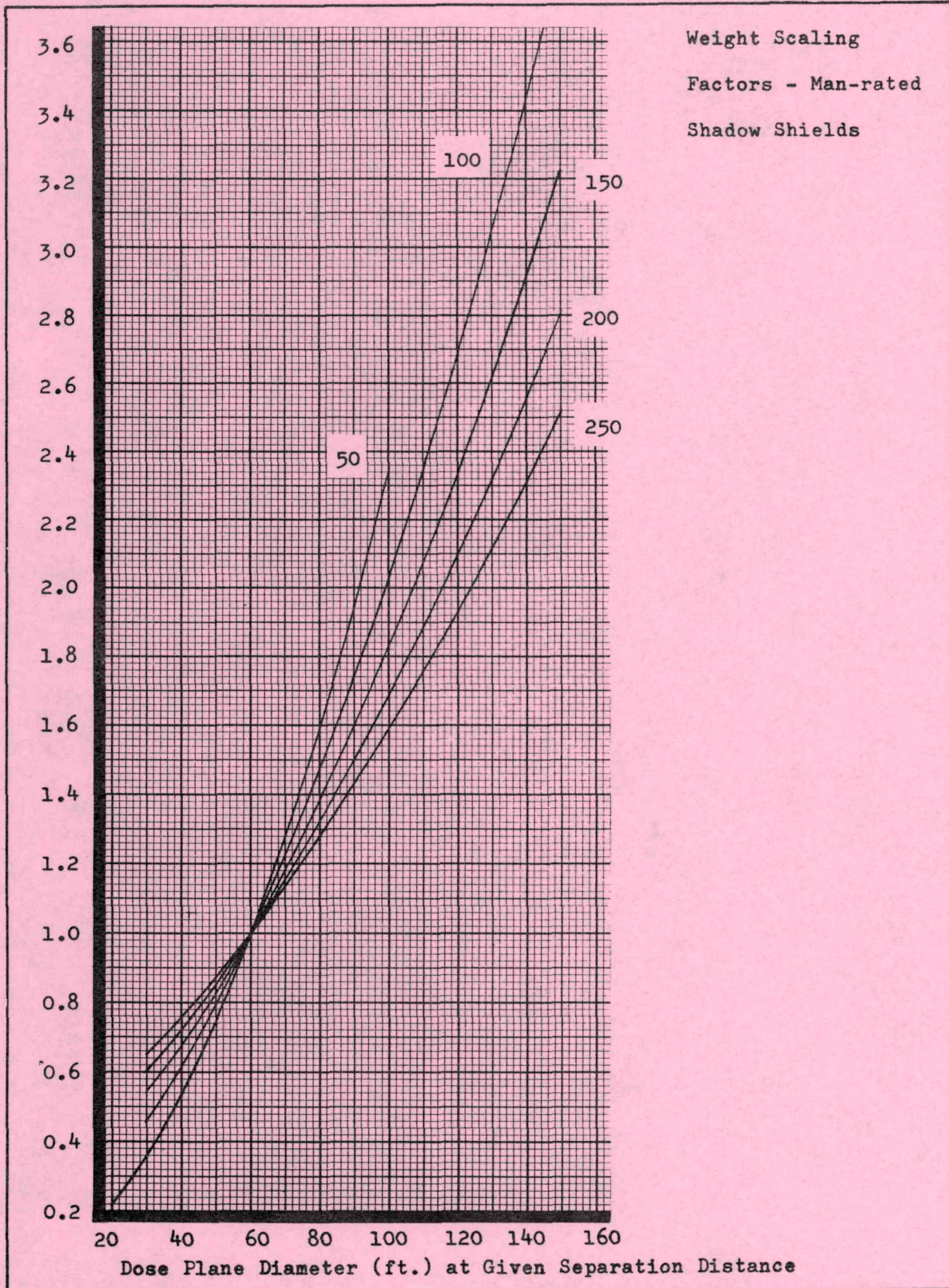
PAGE 8 OF 14

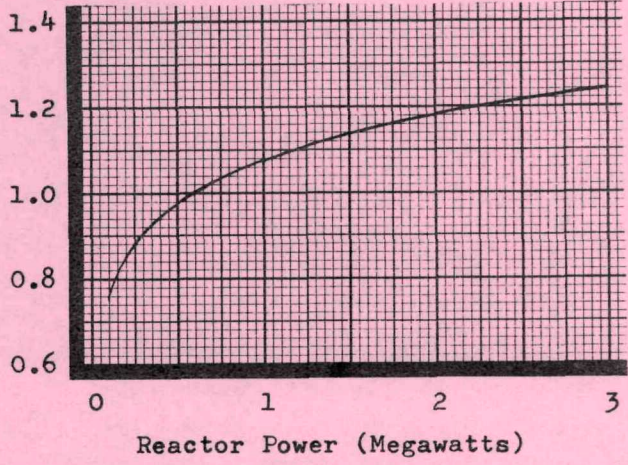
Weight Scaling Factors -

Instrument-rated

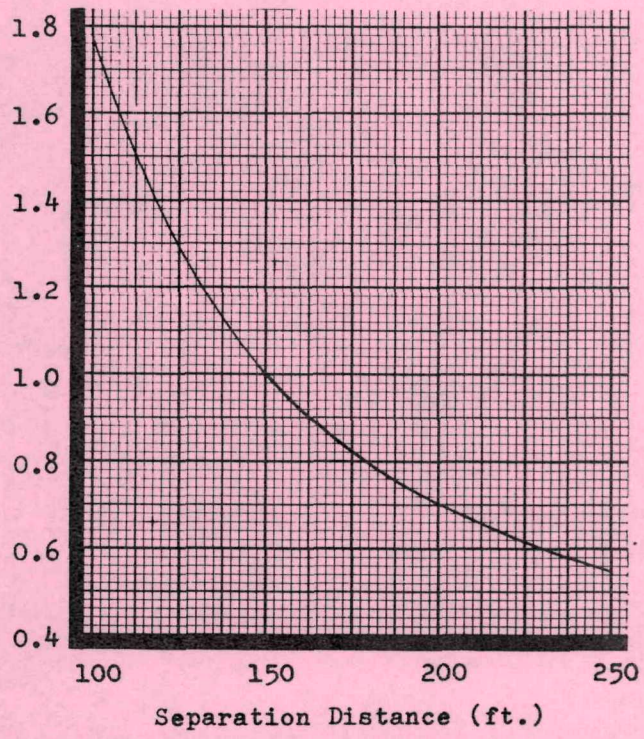
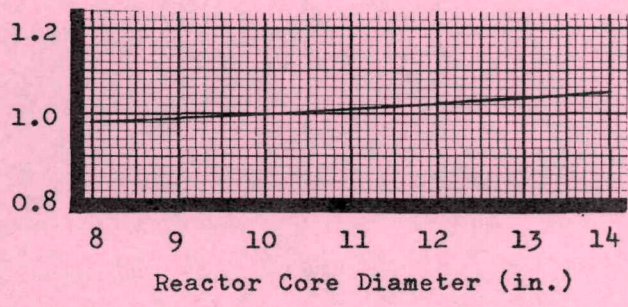
Shadow Shields



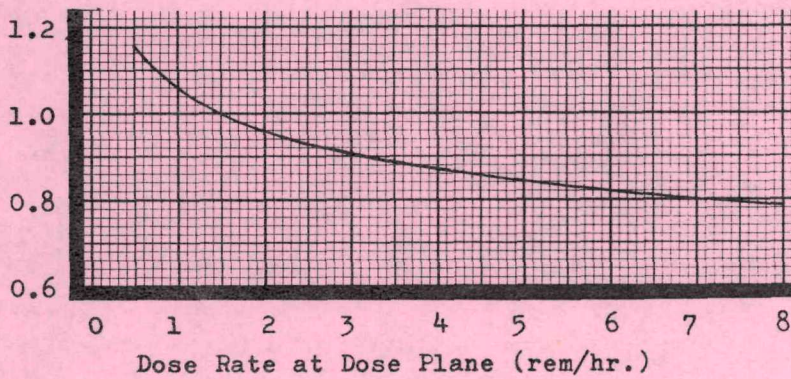
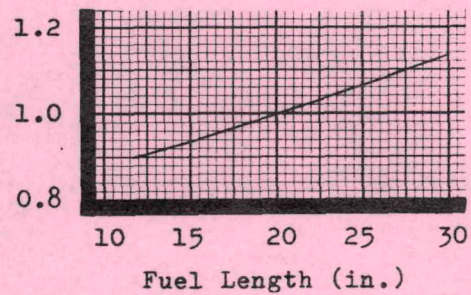
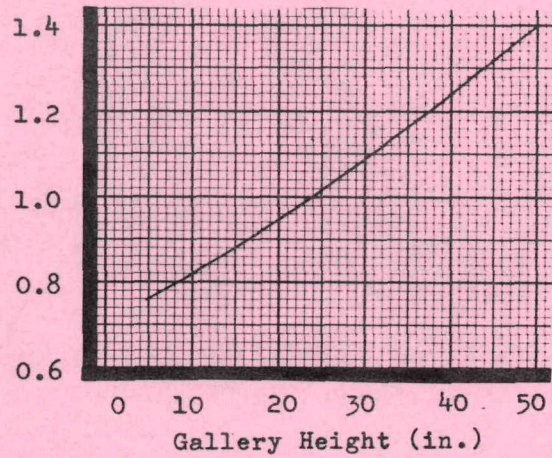
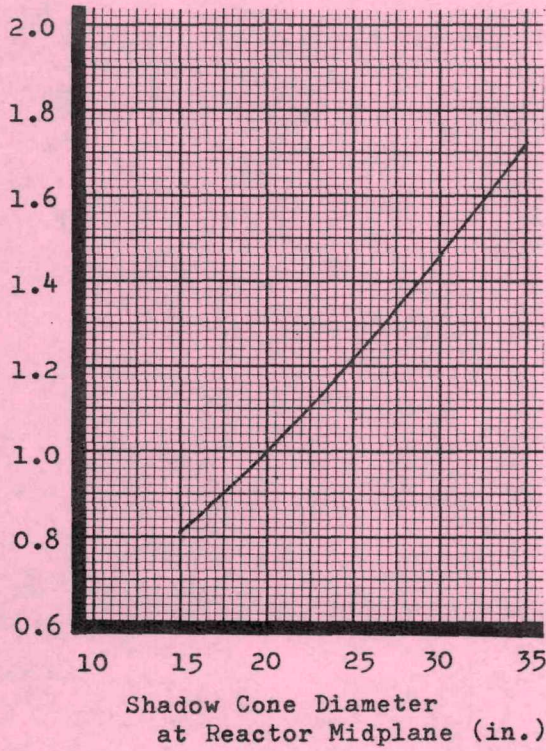




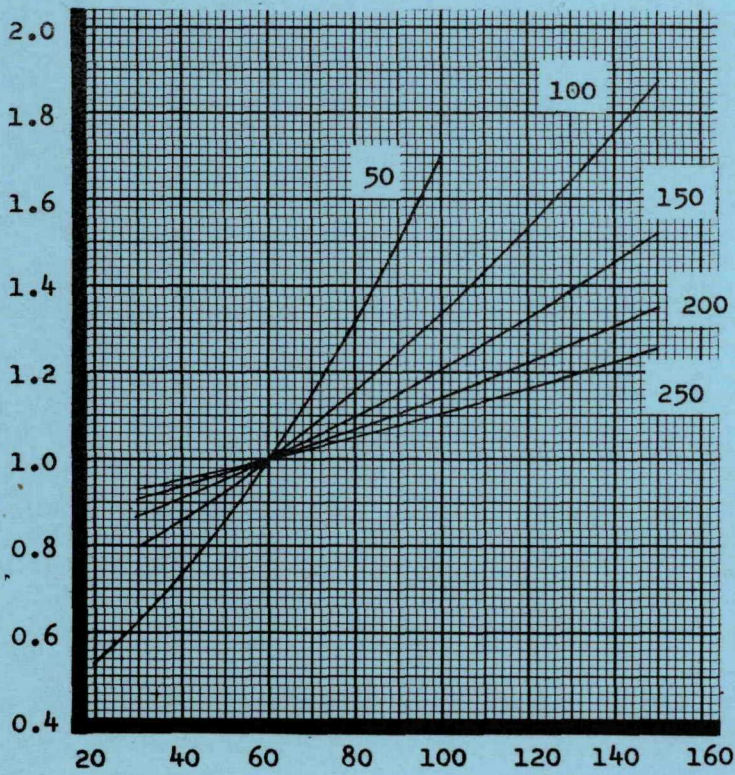
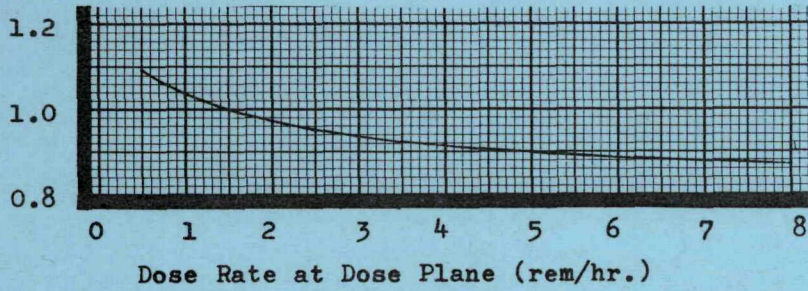
Weight Scaling
Factors - Man-rated
Shadow Shields.



Weight Scaling Factors
 Man-rated Shadow Shields

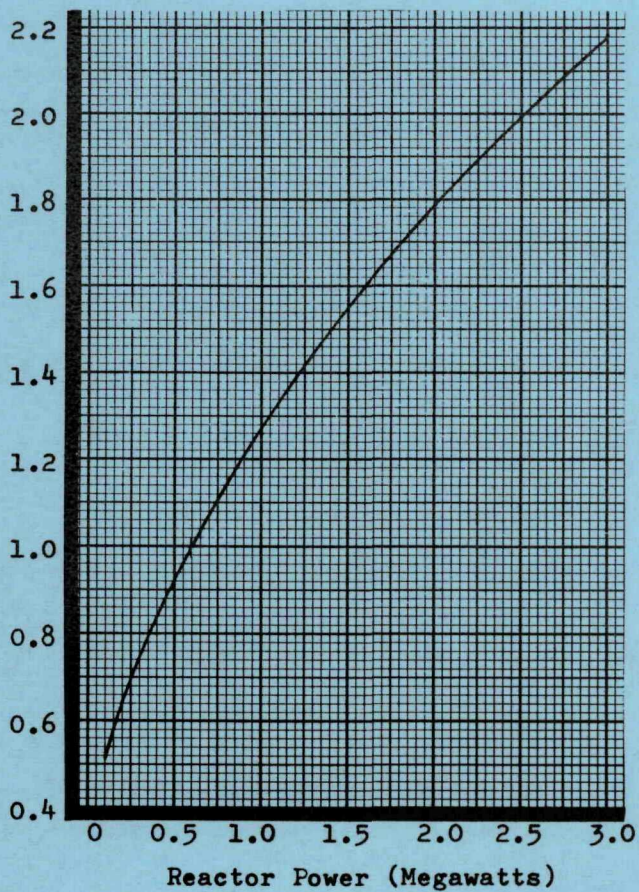
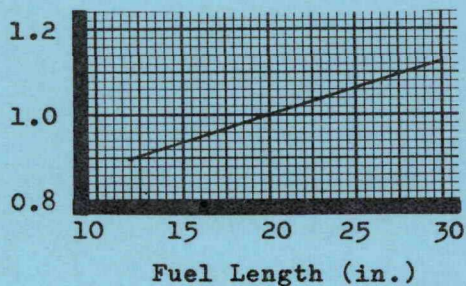
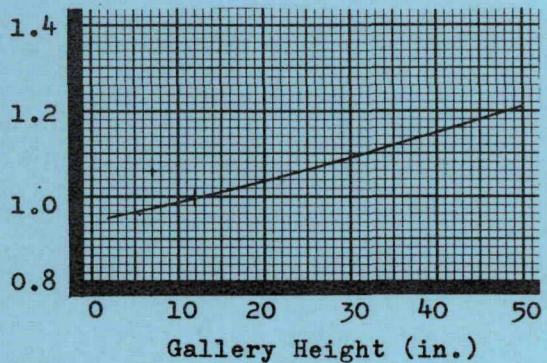


Weight Scaling Factors
Man-rated 4 π Shields



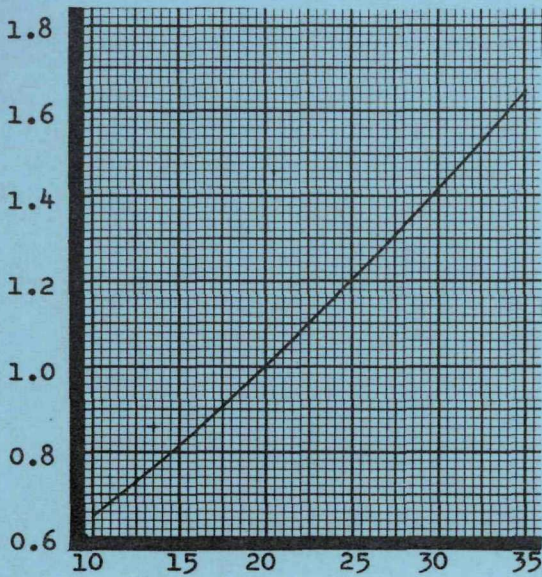
Weight Scaling Factors

Man-Rated 4T Shields

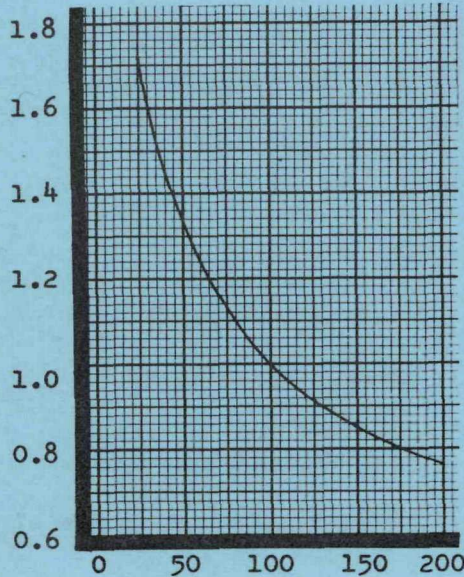


Weight Scaling Factors

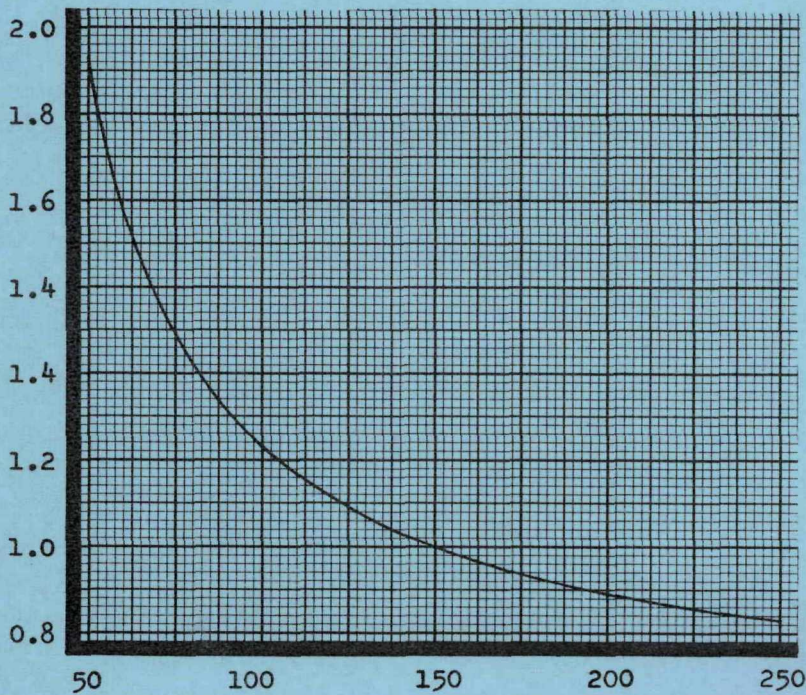
Man-rated 4π Shields



Shield I. D. at
 Reactor Midplane (in.)



Rendezvous Zone Dose Rate
 (rads/hr.)



Separation Distance (ft.)