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NEDR
A COMPUTER PROGRAM
FOR CALCULATING AC LOSSES
IN A TYPE-II SUPERCONDUCTOR WITH
A FIELD-DEPENDENT SURFACE BARRIER

MASTER

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NEDR

A COMPUTER PROGRAM FOR CALCULATING AC LOSSES IN A
TYPE-II SUPERCONDUCTOR WITH A FIELD-DEPENDENT SURFACE BARRIER*

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ABSTRACT

A computer program "NEDR" which calculates low-frequency ac losses in a type-II superconductor with a field-dependent surface barrier, is presented and described. Numerous quantities associated with the losses can be calculated, including the magnetic field and flux density profiles, the surface, bulk-pinning, and bulk-annihilation contributions to the losses, the spatial dependence of the bulk losses, and the net energy loss per cycle. The program is constructed such that the critical current density J_c , field H_{eq} , the critical entry field H_{en} , and the critical exit field H_{ex} as functions of the flux density B are written as subprogram functions and may be easily changed for different models.

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I. INTRODUCTION

The program "NEDR" was prepared to help understand the types and quantities of energy losses when a time-dependent longitudinal magnetic field of the form $H_a = H_0 + h_0 \cos \omega t$ is applied to a cylindrical type-II superconductor. Its theoretical background may be found in a paper by John R. Clem entitled "Theory of AC Losses in Type-II Superconductors with a Field-Dependent Surface Barrier." The program is divided into three main sections - model characteristics, energy loss and function determinations for a given H_0 and h_0 , and effects of varying H_0 and h_0 - and is constructed such that the critical current density J_c , the equilibrium field H_{eq} , the critical entry field H_{en} , and the critical exit field H_{ex} as functions of the flux density B are written as sub-program functions and may be easily changed for different models. The program has been designed to run on the Iowa State University Computation Center's IBM 360/370 installation and uses its SIMPLOTTER, THREED, and QG10 library routines.

II. FLOWCHART

A flowchart of the program showing the order of execution of its major steps begins on the next page.

III. OPTION DESCRIPTIONS

A. Model Characteristics

Option 2: The interval from 0 to $3H_s$ is divided into 100 subintervals, and 101 functional values of H_{eq} , H_{en} , and H_{ex} vs. B and of B_{eq} , B_{en} , and B_{ex} vs. H are calculated, from which tables may be listed and/or graphs plotted.

Option 3: The interval from $H_{\min}$ to $H_{\max}$ is divided into 200 subintervals, and 201 functional values of $B_{s\uparrow}$ and $B_{s\downarrow}$ are calculated for the 8 different combinations of $H_{\min}$ and $H_{\max}$ made from the following values:

$$H_{\max} = \frac{3}{2} H_s, \quad H_{\min} = -\frac{3}{2} H_s,$$

$$H_{\max} = \frac{2}{3} H_s, \quad H_{\min} = -\frac{2}{3} H_s,$$

$$H_{\max} = -\frac{1}{3} H_s, \quad H_{\min} = \frac{1}{3} H_s,$$

excluding the combination $H_{\max} = -\frac{1}{3} H_s$ and $H_{\min} = \frac{1}{3} H_s$.

Tables may be listed and/or graphs plotted.

B. Energy Loss and Function Determinations for a Given H_o and h_o

Option 1: 101 values of $B_{z\max}$ and $H_{z\max}$ vs. x for $0 \leq x \leq x_p$ and 101 values of $B_{z\downarrow}$ and $H_{z\downarrow}$ vs. x for $0 \leq x \leq x_p$ and $H_a = \frac{3}{2} H_{c1}$, H_a decreasing, are calculated. Tables may be listed and/or one graph containing all curves may be plotted.

Option 4: 201 values of $G(B)$ vs. B for $-H_{\max} \leq B \leq H_{\max}$ may be listed and/or plotted. 101 values of $I(B)$ vs. B for $-H_{\max} \leq B \leq H_{\max}$ may be listed and/or plotted. $H_{\max}$ is the largest value of the applied field used in the entire program.

Option 5: 101 values of $B_{z\max}$, $B_{z\min}$, $B_{z\uparrow}$ with $H_a = H_{\min} + \frac{H_{\max} - H_{\min}}{3}$ and increasing, and $B_{z\downarrow}$ with $H_a = H_{\min} + \frac{2(H_{\max} - H_{\min})}{3}$ and decreasing vs. x for $0 \leq x \leq x_p$ are calculated. Tables may be listed and/or one graph containing all curves may be plotted.

- Option 6: 201 values of $L_{\uparrow}$, $L_{\downarrow}$, $D_{\uparrow}$, and $D_{\downarrow}$ vs. H_a for $H_{\min} \leq H_a \leq H_{\max}$ may be listed and/or graphs of $L_{\uparrow}$ vs. H_a , $L_{\downarrow}$ vs. H_a , and $L_{\downarrow}$ vs. $\tilde{H}_a$ may be plotted.
- Option 7: 201 values of $B_{s\uparrow}$ and $B_{s\downarrow}$ vs. H_a for $H_{\min} \leq H_a \leq H_{\max}$ may be listed and/or one graph with both curves may be plotted.
- Option 8: 101 values of $H_{z\max}$, $H_{z\min}$, $B_{z\max}$, and $B_{z\min}$ vs. x for $0 \leq x \leq x_p$ are calculated, may be listed, and/or one graph containing all curves may be plotted.
- Option 9: 10 values of $a\mu_n^I$ and $a\mu_n^{II}$ vs. n for $1 \leq n \leq 10$ are calculated and may be listed and/or plotted on the same graph.
- Option 10: Values of $W_{s\uparrow}^I$, $W_{s\downarrow}^I$, W_s^I , $W_{ba\uparrow}^I$, $W_{ba\downarrow}^I$, W_{ba}^I , $W_{bp\uparrow}^I$, $W_{bp\downarrow}^I$, W_{bp}^I , $W_{b\uparrow}^I$, $W_{b\downarrow}^I$, W_b^I , $W_{L\uparrow}^I$, $W_{L\downarrow}^I$, W_L^I , $F_{\uparrow}^I$, $F_{\downarrow}^I$, F^I , $W_{a\uparrow}^I$, $W_{a\downarrow}^I$, W_a^I , $\Phi_{t\uparrow}^I$ and $\Phi_{t\downarrow}^I$ are listed. 201 values of the derivatives with respect to B of each of the above quantities except $\Phi_{t\uparrow}^I$ and $\Phi_{t\downarrow}^I$, may be calculated for $B_{\min} \leq B \leq B_{\max}$. Tables of the derivatives may be listed and/or two graphs, the field-increasing and field-decreasing cases, may be plotted.
- Option 11: 101 values of $\Phi_{\uparrow}^I$ and $\Phi_{\downarrow}^I$ vs. H_a for $H_{\min} \leq H_a \leq H_{\max}$ are calculated and may be listed and/or plotted on the same graph.
- Option 12: Up to 101 values of W_{ba}^{II} , W_{bp}^{II} , and W_b^{II} vs. x for $0 \leq x \leq x_p$ are calculated. A table may be listed and/or a graph may be plotted.

C. Effects of Varying H_0 and h_0

Option 13: Given a constant h_0 , H_0 may be varied from a given minimum to a given maximum in given intervals, ΔH_0 . For up to 101 combinations of H_0 and h_0 , the energy loss per cycle and the 50 and 60 Hz power losses are calculated, from which tables may be listed and/or a graph of P_{50} (log scale) vs. H_0 (linear scale) may be plotted.

Option 14: Given a constant H_0 , h_0 may be varied from a given minimum to a given maximum in given intervals, Δh_0 . For up to 101 combinations of H_0 and h_0 , the rms surface current density sigma, the energy loss per cycle, and the 50 and 60 Hz power losses are calculated, from which tables may be listed and/or a graph of P_{50} (log scale) vs. h_0 (log scale) may be plotted.

Option 15: Given a value of h_0 , H_0 may be varied from a given minimum to a given maximum in given intervals, ΔH_0 . This is done for each value of h_0 , which also varies from a given minimum to a given maximum in given intervals, Δh_0 . For up to 101 values of H_0 and 101 values of h_0 , the energy loss per cycle and the 50 and 60 cycle power losses are calculated, from which tables may be listed and/or a graph of P_{50} (log scale) vs. H_0 (linear scale) may be plotted.

Option 16: Given a value of H_0 , h_0 may be varied from a given minimum to a given maximum in given intervals, Δh_0 . This is done for each value of H_0 , which also varies from a given minimum to a given maximum in given intervals, ΔH_0 . For up to 101 values of

h_o and 101 values of H_o , the rms surface current density σ , the energy loss per cycle, and the 50 and 60 cycle power losses are calculated, from which tables may be listed and/or a graph of P_{50} (log scale) vs. h_o (log scale) may be plotted. The minimum, maximum, and interval values of H_o and h_o are the same as in Option 15.

Option 17: A three-dimensional surface plot of $\log(P_{50})$ vs. H_o and h_o may be plotted using the same minimum, maximum, and interval values of H_o and h_o as in Options 15 and 16.

IV. INPUT

A. Model Functions

The functions $H_{eq}(B)$, $B_{eq}(H)$, $dH_{eq}(B)/dB$, $J_c(B)$, $H_{en}(B)$, $B_{en}(H)$, $\mu'_{en}(H)$, $H_{ex}(B)$, $B_{ex}(H)$, $\mu'_{ex}(H)$, and $F(B)$ represent the equilibrium, entry, and exit relationships between B and H , their slopes, the critical current density, and the integral of $H_{eq}(B)$ over B from 0 to B . These functions are placed in the program as subprogram functions and are used to calculate a functional value using the argument and the constants H_{c1} , H_{c2} , $J_c(0)$, B_o , H_s , and $H_{ex}(\epsilon)$ which are in the common space labeled "AREA3."

B. Data Cards

Five data cards must be included with each run:
The first card specifies which options are to be run and what output is desired from each by using the first 17 columns, one column per option. Except for Options 10 and 17, the option codes are:

- 0 - option is not to be run.
- 1 - option is run, tables are listed
- 2 - option is run, graphs are plotted
- 3 - option is run, tables are listed and graphs are plotted

Every time Option 10 is run, the values of energy losses in the field-increasing, field-decreasing, and total cases are printed. An option code of 4 will give only this information while codes 1, 2, or 3 will include tables and/or graphs of the loss function derivatives. In Option 17 any value not equal to 0 indicates that it is to be executed.

The second card provides the values of H_{c1} , H_{c2} , $J_c(0)$, B_0 , H_s , and $H_{ex}(\epsilon)$ using six consecutive 8-column fields of E format code with one decimal position.

The third card provides the value of H_0 and h_0 for Options 1 and 4-12 and the number of positions at which the loss functions in Option 12 are to be calculated using three consecutive fields, two 8-column fields of E format code with one decimal position for H_0 and h_0 , and one 3-column field of I format code. h_0 must never be negative.

The fourth card provides the values for H_0 and h_0 needed to run Options 13 and 14. Eight consecutive 8-column fields of E format code with one decimal position are used - the first four with Option 13 and the second four with Option 14. The fields specify:

Option 13:

- maximum value of H_0
- minimum value of H_0

- H_0 interval spacing
- constant value of h_0

Option 14:

- maximum value of h_0
- minimum value of h_0
- h_0 interval spacing
- constant value of H_0

The final card provides the values for H_0 and h_0 needed to run Options 15, 16, and 17. Six consecutive 8-column fields of E format code with one decimal position are used as follows:

- maximum value of H_0
- minimum value of H_0
- H_0 interval spacing
- maximum value of h_0
- minimum value of h_0
- h_0 interval spacing

All values of H and B that are input should be in units of gauss and values of $J_c(0)$ should be in units of amp/cm^2 .

V. GLOSSARY

All B and H units are gauss. Other units are A(amp), cm (centimeter), G (gauss), J (joule), m (meter) and W (watt).

<u>Program symbol</u>	<u>Clem paper symbol</u>	<u>Description</u>
A		100 x 100 array - THREED routine
AMUP	$a\mu'$	10 x 1 array - Option 9 (cm)
AMUPP	$a\mu''$	10 x 1 array - Option 9 (cm)
ANGA		Horizontal angle - THREED routine
ANGB		Vertical angle - THREED routine
ANTFUP	$\Phi'_{t\uparrow}$	Annihilated negative trapped flux - field-increasing (G cm)
APTFDN	$\Phi'_{t\downarrow}$	Annihilated positive trapped flux - field-decreasing (G cm)
B	B	201 x 1 array - $(-H_{MAX}) \leq B \leq H_{MAX}$
B101	B	101 x 1 array - $(-H_{MAX}) \leq B \leq H_{MAX}$
BB	B	B
BDN	$B_{\downarrow}$	B - field-decreasing
BEN	$B_{en}(H)$	Function $B_{en}(H)$
BEQ	$B_{eq}(H)$	Function $B_{eq}(H)$
BEX	$B_{ex}(H)$	Function $B_{ex}(H)$
BHA	B	201 x 1 array - $B_{min} \leq B \leq B_{max}$
BIGHMN		Minimum H_0 - Option 13
BIGHMX		Maximum H_0 - Option 13
BIGHO	H_0	H_0
BLIMIT		Limit to an integral
BMAX	B_{max}	B_{max}

BMIN	$B_{\min}$	$B_{\min}$
BMXMN		Function to calculate $B_{\max}$ and $B_{\min}$
BP	B_p	B_p
BSDN	$B_{s\downarrow}$	$B_{s\downarrow}$
BSUP	$B_{s\uparrow}$	$B_{s\uparrow}$
BUP	$B_{\uparrow}$	$B_{\uparrow}$
BZ		Function - calculates B given $\text{INTG}(B)$
BZDN	$B_{z\downarrow}(x)$	101 x 1 array - $0 \leq x \leq x_p$
BZMAX	$B_{z\max}(x)$	101 x 1 array - $0 \leq x \leq x_p$
BZMIN	$B_{z\min}(x)$	101 x 1 array - $0 \leq x \leq x_p$
BZUP	$B_{z\uparrow}(x)$	101 x 1 array - $0 \leq x \leq x_p$
CBIGHO		Constant H_o - Option 14
CLTLHO		Constant h_o - Option 13
DATE		Parameter for THREEED routine
DBIGHO		H_o interval spacing - Option 13
DDN	$D_{\downarrow}$	$D_{\downarrow}(\text{cm})$
DELBHO		H_o interval spacing - Options 15, 16, 17
DELHDN	$\Delta H_{\downarrow}$	$\Delta H_{\downarrow}$
DELHUP	$\Delta H_{\uparrow}$	$\Delta H_{\uparrow}$
DELLHO		L_o interval spacing - Options 15, 16, 17
DELTAB		ΔB
DELTAH		ΔH
DELTAT		$\Delta \theta$
DELTAX		Δx
DHEQDB	dH_{eq}/dB	dH_{eq}/dB

DLTLHO		h_o interval spacing - Option 14
DUMMY		Dummy variables - THREEED routine
DUP	$D_{\uparrow}$	$D_{\uparrow}$ (cm)
F	$F(B)$	Function $F(B)$
FBDN	$B_{\downarrow}(B_{S\downarrow})$	Function $B_{\downarrow}(B_{S\downarrow})$
FBUP	$B_{\uparrow}(B_{S\uparrow})$	Function $B_{\uparrow}(B_{S\uparrow})$
FDDN	$D_{\downarrow}(B)$	Function $D_{\downarrow}(B)$ (cm)
FDUP	$D_{\uparrow}(B)$	Function $D_{\uparrow}(B)$ (cm)
FDFDN	$dF'_{\downarrow}/dB$	Function FDFDN(B) ($\mu J/G \text{ cm}^2$)
FDFUP	$dF'_{\uparrow}/dB$	Function FDFUP(B) "
FDWADN	$dW'_{a\downarrow}/dB$	Function FDWADN(B) "
FDWAUP	$dW'_{a\uparrow}/dB$	Function FDWAUP(B) "
FDWBAD	$dW'_{ba\downarrow}/dB$	Function FDWBAD(B) "
FDWBAU	$dW'_{ba\uparrow}/dB$	Function FDWBAU(B) "
FDWBDN	$dW'_{b\downarrow}/dB$	Function FDWBDN(B) "
FDWBUP	$dW'_{b\uparrow}/dB$	Function FDWBUP(B) "
FDWSDN	$dW'_{s\downarrow}/dB$	Function FDWSDN(B) "
FDWSUP	$dW'_{s\uparrow}/dB$	Function FDWSUP(B) "
FIG3		Subroutine FIG3
FNTFUP	$d\Phi'_{t\uparrow}/dB$	Function FNTFUP (cm)
FPTFDN	$d\Phi'_{t\downarrow}/dB$	Function FPTFDN (cm)
FPULDN	$\Phi'_{\downarrow}$	101 x 1 array - flux per unit length (G cm)
FPULUP	$\Phi'_{\uparrow}$	101 x 1 array - flux per unit length (G cm)
G	$G(B)$	Function $G(B)$ (cm/G)
GB		201 x 1 array of $G(B)$
GBB		$G(BB)$ (cm/G)

GRAPH		SIMPLOTTER graphing subroutine
GRAPHS		SIMPLOTTER graphing subroutine
HA	H_a	Value of applied field
HADN	$H_{a\downarrow}$	Value of applied field - field-decreasing
HAMAX		Greatest applied field in entire program
HATILD	$\tilde{H}_a$	201 x 1 array - $\tilde{H}_a = H_{\min} + H_{\max} - H_a$
HAUP	$H_{a\uparrow}$	Value of applied field - field-increasing
HC1	H_{c1}	H_{c1}
HC2	H_{c2}	H_{c2}
HEN	$H_{en}(B)$	Function $H_{en}(B)$
HEQ	$H_{eq}(B)$	Function $H_{eq}(B)$
HEX	$H_{ex}(B)$	Function $H_{ex}(B)$
HEXEPS	$H_{ex}(\epsilon)$	$H_{ex}(\epsilon)$
HMAX	$H_{\max}$	$H_{\max}$
HMIN	$H_{\min}$	$H_{\min}$
HS	H_s	$H_s = H_{en}(\epsilon)$
HV		Parameter of THREEED routine
HZDN	$H_{z\downarrow}(x)$	101 x 1 array - $0 \leq x \leq x_p$
HZUP	$H_{z\uparrow}(x)$	101 x 1 array - $0 \leq x \leq x_p$
I		DO-LOOP parameter
IGB		101 x 1 array of $\text{INTG}(B) - (-HC2MAX) \leq B \leq HC2MAX$
IGBMAX	$I(B_{\max})$	$\text{INTG}(B_{\max})$ (cm)
IGBMIN	$I(B_{\min})$	$\text{INTG}(B_{\min})$ (cm)
IGBSDN	$I(B_{s\downarrow})$	$\text{INTG}(B_{s\downarrow})$ (cm)
IGBSUP	$I(B_{s\uparrow})$	$\text{INTG}(B_{s\uparrow})$ (cm)

INTERP		Function - interpolates from one array to another
INTG(B)	$I(B)$	Function - calculates $I(B)$ from IGB array
J		10 x 1 array - n values - Option 9
JC	$J_c(B)$	Function - calculates $J_c(B)$ (statamp/cm ²)
JCO	$J_c(0)$	$J_c(0)$ (statamp/cm ²)
KODE		Parameter for THREEED routine
L		D0-L00P parameter
LDN	$L_{\downarrow}$	201 x 1 array - $L_{\downarrow}$ values - $H_{\min} \leq H_a \leq H_{\max}$ (cm)
LDNANG	$L_{\downarrow}$	201 x 1 array - $L_{\downarrow}$ values - $0 \leq \theta \leq 2\pi$ (cm)
LOSS50		101 x 1 array - P_{50} values ($\mu W/cm^2$)
LOSS60		101 x 1 array - P_{60} values ($\mu W/cm^2$)
LOS50T		101 x 101 array - P_{50} values ($\mu W/cm^2$)
LOS60		P_{60} ($\mu W/cm^2$)
LTLHMN		h_o minimum - Option 14
LTLHMX		h_o maximum - Option 14
LTLHO	h_o	h_o
LTLLOG		101 x 1 array - $\log(h_o)$ values
LUP	$L_{\uparrow}$	201 x 1 array - $L_{\uparrow}$ values - $H_{\min} \leq H_a \leq H_{\max}$ (cm)
LUPANG	$L_{\uparrow}$	201 x 1 array - $L_{\uparrow}$ values - $0 \leq \theta \leq 2\pi$ (cm)
L1		L+1
M		D0-L00P parameter
MNBIGH		H_o minimum - Options 15, 16, 17
MNLTLH		h_o minimum - Options 15, 16, 17
MUDN	$\mu_{\downarrow}^I(H_a)$	Function - calculates $\mu_{\downarrow}^I(H_a)$
MUEN	$\mu_{en}^I(H_a)$	Function - calculates $\mu_{en}^I(H_a)$
MUEX	$\mu_{ex}^I(H_a)$	Function - calculates $\mu_{ex}^I(H_a)$

MUP		201 x 1 array - Option 9
MUPP		201 x 1 array - Option 9
MUUP	$\mu_{\uparrow}^{\dagger}(H_a)$	Function - calculates $\mu_{\uparrow}^{\dagger}(H_a)$
MXBIGH		H_o maximum - Options 15, 16, 17
MXLTLH		h_o maximum - Options 15, 16, 17
M1		M+1 - D0-LOOP parameter
N		D0-LOOP parameter
NX		THREED parameter
NY		THREED parameter
PAMUP	$a\mu_n^{\dagger}$	10 x 1 array - Option 9 (μm)
PAMUPP	$a\mu_n^{\dagger\dagger}$	10 x 1 array - Option 9 (μm)
PARM		THREED parameter
PDFDN	$dF_{\downarrow}^{\dagger}/dB$	201 x 1 array ($\mu J/G \text{ cm}^2$)
PDFUP	$dF_{\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWADN	$dW_{a\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWAUP	$dW_{a\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWBAD	$dW_{ba\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWBAU	$dW_{ba\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWBDN	$dW_{b\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWBPD	$dW_{bp\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWBPU	$dW_{bp\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWBUP	$dW_{b\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWLDN	$dW_{L\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWLUP	$dW_{L\uparrow}^{\dagger}/dB$	201 x 1 array "
PDWSDN	$dW_{s\downarrow}^{\dagger}/dB$	201 x 1 array "
PDWSUP	$dW_{s\uparrow}^{\dagger}/dB$	201 x 1 array "

PF	F'	$F' (\mu\text{J}/\text{cm}^2)$
PFDN	$F_{\downarrow}$	$F_{\downarrow} (\mu\text{J}/\text{cm}^2)$
PFUP	$F_{\uparrow}$	$F_{\uparrow} (\mu\text{J}/\text{cm}^2)$
PGB		101 x 1 array of GB values (μm)
PJCO	$J_c(0)$	$J_c(0) (\text{A}/\text{cm}^2)$
PLDN	$L_{\downarrow}$	201 x 1 array (μm)
PLUP	$L_{\uparrow}$	201 x 1 array (μm)
PWA	w'_a	$w'_a (\mu\text{J}/\text{cm}^2)$
PWADN	$w'_{a\downarrow}$	$w'_{a\downarrow}$ "
PWAUP	$w'_{a\uparrow}$	$w'_{a\uparrow}$ "
PWB	w'_b	w'_b "
PWBA	w'_{ba}	w'_{ba} "
PWBADN	$w'_{ba\downarrow}$	$w'_{ba\downarrow}$ "
PWBADX	$w'_{ba\downarrow}(x)$	$w'_{ba\downarrow}(x) (\mu\text{J}/\text{cm}^3)$
PWBAUP	$w'_{ba\uparrow}$	$w'_{ba\uparrow} (\mu\text{J}/\text{cm}^2)$
PWBAUX	$w'_{ba\uparrow}(x)$	$w'_{ba\uparrow}(x) (\mu\text{J}/\text{cm}^3)$
PWBDN	$w'_{b\downarrow}$	$w'_{b\downarrow} (\mu\text{J}/\text{cm}^2)$
PWBDNX	$w'_{b\downarrow}(x)$	$w'_{b\downarrow}(x) (\mu\text{J}/\text{cm}^3)$
PWBP	w'_{bp}	$w'_{bp} (\mu\text{J}/\text{cm}^2)$
PWBPDN	$w'_{bp\downarrow}$	$w'_{bp\downarrow}$ "
PWBPDX	$w'_{bp\downarrow}(x)$	$w'_{bp\downarrow}(x) (\mu\text{J}/\text{cm}^3)$
PWBPU	$w'_{bp\uparrow}$	$w'_{bp\uparrow} (\mu\text{J}/\text{cm}^2)$
PWBPUX	$w'_{bp\uparrow}(x)$	$w'_{bp\uparrow}(x) (\mu\text{J}/\text{cm}^3)$
PWBUP	$w'_{b\uparrow}$	$w'_{b\uparrow} (\mu\text{J}/\text{cm}^2)$
PWBUPX	$w'_{b\uparrow}(x)$	$w'_{b\uparrow}(x) (\mu\text{J}/\text{cm}^3)$

PWL	W_L^i	W_L^i ($\mu\text{J}/\text{cm}^2$)
PWLDN	$W_L^i \downarrow$	$W_L^i \downarrow$ "
PWLUP	$W_L^i \uparrow$	$W_L^i \uparrow$ "
PWS	W_S^i	W_S^i "
PWSDN	$W_S^i \downarrow$	$W_S^i \downarrow$ "
PWSUP	$W_S^i \uparrow$	$W_S^i \uparrow$ "
PX	x	101 x 1 array of x (μm)
PXP	x_p	x_p (μm)
S		variable
SIGMA	σ	101 x 1 array of σ (rms A/cm ²)
SIGMAL	σ	σ (rms A/cm ²)
SIMPSN		Function - integrates with Simpson's Rule
SWACMU		Option 9 control code
SWBIGH		" 13 " "
SWBIGT		" 15 " "
SWFIG1		" 1 " "
SWFIG3		" 3 " "
SWFIG5		" 5 " "
SWFLUX		" 11 " "
SWG		" 4 " "
SWH		" 2 " "
SWITCH		Control Code
SWL		Option 6 control code
SWLOSS		" 10 " "
SWLTLH		" 14 " "

SWLTCT		Option 16 control code
SWPLOT		" 17 " "
SWPROF		" 8 " "
SWTRAJ		" 7 " "
S1		Variable
TB		101 x 1 array of B
TBEN	$B_{en}(H)$	101 x 1 array of $B_{en}(H)$
TBEQ	$B_{eq}(H)$	101 x 1 array of $B_{eq}(H)$
TBEX	$B_{ex}(H)$	101 x 1 array of $B_{ex}(H)$
TBIGHO	H_o	101 x 1 array of H_o - Option 13
TBSDN	$B_{s\downarrow}$	201 x 1 array of $B_{s\downarrow}$
TBSUP	$B_{s\uparrow}$	201 x 1 array of $B_{s\uparrow}$
TH		101 x 1 array of H
THA	H_a	201 x 1 array of H_a
THADN	$H_a(B_{s\downarrow})$	101 x 1 array of $H_a(B_{s\downarrow})$
THAUP	$H_a(B_{s\uparrow})$	101 x 1 array of $H_a(B_{s\uparrow})$
THEN	$H_{en}(B)$	101 x 1 array of $H_{en}(B)$
THEQ	$H_{eq}(B)$	101 x 1 array of $H_{eq}(B)$
THEX	$H_{ex}(B)$	101 x 1 array of $H_{ex}(B)$
TLTLHO	h_o	101 x 1 array of h_o - Option 14
TPWA	W'_a	101 x 1 array of $W'_a - (\mu J/cm^2)$
TWA	W'_a	101 x 1 array of $W'_a - (erg/cm^2)$
X	x	101 x 1 array of x - $0 \leq x \leq x_p$ (cm)
XDN	$x_{\downarrow}$	$x_{\downarrow}$ (cm)
XP	x_p	x_p (cm)
XSIZE		SIMPLOTTER graph parameter
XUP	$x_{\uparrow}$	$x_{\uparrow}$ (cm)
WA	W'_a	$W'_a - (erg/cm^2)$

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//A325NEDR JOB A0315,CLEM
/*JOBPARM LINES=12
//STEP1 EXEC FORTG,REGION,GO=270K,TIME,GO=(4,59)
FORT.SYSIN DD *
BEGIN TEXT OF NEDR -- A PROGRAM TO CALCULATE
C AC LOSSES IN TYPE-II SUPERCONDUCTORS:
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
REAL B(201),GB(201),PGB(201),IGB(101),B101(101)
REAL JCO,LTLHMX,LTLHMN,MXBIGH,MNBIGH,MXLTLH,MNLTLH,LTLHO
INTEGER SWFIG1,SWH,SWFIG3,SWG,SWFIG5,SWL,SWTRAJ,SWPROF,SWACMU,SWLO
1SS,SWBIGH,SWLTLH,SWITCH,SWFLUX,SWBIGT,SWLTLT,SWWBX
COMMON/AREA1/B,IGB
READS012,SWFIG1,SWH,SWFIG3,SWG,SWFIG5,SWL,SWTRAJ,SWPROF,SWACMU,SWL
1OSS,SWFLUX,SWWBX,SWBIGH,SWLTLH,SWBIGT,SWLTLT,SWPLOT
READS013,HC1,HC2,PJCO,BO,HS,HEXEPS
JCO=PJCO*3.E9
READS014,BIGHO,LTLHO,NWX
READS039,BIGHMX,BIGHMN,DBIGHO,CLTLHO,LTLHMX,LTLHMN,DLTLHO,CBIGHO
READS057,MXBIGH,MNBIGH,DELBHO,MXLTLH,MNLTLH,DELLHO
PRINT5044,HC1
PRINT5045,HC2
PRINT5046,PJCO
PRINT5047,BO
PRINT5048,HS
PRINT5074,HEXEPS
PRINT 5075,SWFIG1,SWH,SWFIG3,SWG,SWFIG5,SWL,SWTRAJ,SWPROF,SWACMU,
1SWLOSS,SWFLUX,SWWBX,SWBIGH,SWLTLH,SWBIGT,SWLTLT,SWPLOT
C GB TABLE GENERATION
HAMAX=ABS(BIGHO)+LTLHO
IF(ABS(BIGHMX)+CLTLHO.GT.HAMAX)HAMAX=ABS(BIGHMX)+CLTLHO
IF(ABS(BIGHMN)+CLTLHO.GT.HAMAX)HAMAX=ABS(BIGHMN)+CLTLHO
IF(ABS(CBIGHO)+LTLHMX.GT.HAMAX)HAMAX=ABS(CBIGHO)+LTLHMX
IF(ABS(MXBIGH)+MXLTLH.GT.HAMAX)HAMAX=ABS(MXBIGH)+MXLTLH
DELTAB=HAMAX/100.
DO10I=1,201
B(I)=-HAMAX+DELTAB*(I-1)
GB(I)=G(B(I))
10 PGB(I)=GB(I)*1.E4
B(101)=0.
DO 15 I=1,101
15 B101(I)=B(2*I-1)
C IGB TABLE GENERATION
IGB(51)=0.
S=0.
DO20I=52,101
S=S+GB(2*I-3)+4*GB(2*I-2)+GB(2*I-1)
20 IGB(I)=S*DELTAB/3.
S=0.
DO30I=1,50
S=S-GB((51-I)*2-1)-4*GB((51-I)*2)-GB((51-I)*2+1)
30 IGB(51-I)=S*DELTAB/3.
C FIGURE 4 GENERATION
IF(SWG.EQ.0)GOTO60
IF(SWG.EQ.2)GOTO50
PRINT5050
PRINT5008
PRINT5009
PRINT5004
DO40I=1,201
40 PRINT5002,B(I),GB(I),PGB(I)

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      TBEQ(I)=BEQ(TH(I))
      TBEN(I)=BEN(TH(I))
110  TBEX(I)=BEX(TH(I))
      IF(SWH.EQ.2)GOTO140
      PRINT5050
      PRINT5000
      PRINT 5001
      PRINT5004
      DO120I=1,101
120  PRINT5002,TB(I),THEQ(I),THEN(I),THEX(I)
      PRINT5050
      PRINT5003
      PRINT5001
      PRINT5004
      DO130I=1,101
130  PRINT5002,TH(I),TBEQ(I),TBEN(I),TBEX(I)
      IF(SWH.EQ.1)GOTO200
140  CALL GRAPH(101,TB,THEQ,3,107,12.,9.,0.,0.,0.,0.,'B (GAUSS);','H (G
1AUSS);','H VS. B;','HEQ(B);')
      CALL GRAPHS(101,TB,THEN,11,107,'HEN(B);')
      CALL GRAPHS(101,TE,THEX,4,107,'HEX(B);')
      CALL GRAPH(101,TH,TBEQ,3,107,12.,9.,0.,0.,0.,0.,'H (GAUSS);','B (G
1AUSS);','B VS. H;','BEQ(H);')
      CALL GRAPHS(101,TH,TBEN,11,107,'BEN(H);')
      CALL GRAPHS(101,TH,TBEX,4,107,'BEX(H);')
C FIGURE 3 GENERATION
200  IF(SWFIG3.EQ.0)GOTO250
      HMAX=3.*HS/2.
      HMIN=-3.*HS/2.
      CALL FIG3(SWFIG3)
      HMAX=3.*HS/2.
      HMIN=-2.*HS/3.
      CALL FIG3(SWFIG3)
      HMAX=3.*HS/2.
      HMIN=HS/3.
      CALL FIG3(SWFIG3)
      HMAX=2.*HS/3.
      HMIN=-3.*HS/2.
      CALL FIG3(SWFIG3)
      HMAX=2.*HS/3.
      HMIN=-2.*HS/3.
      CALL FIG3(SWFIG3)
      HMAX=2.*HS/3.
      HMIN=HS/3.
      CALL FIG3(SWFIG3)
      HMAX=-HS/3.
      HMIN=-3.*HS/2.
      CALL FIG3(SWFIG3)
      HMAX=-HS/3.
      HMIN=-2.*HS/3.
      CALL FIG3(SWFIG3)
C BSUP, BSDN, AND TRAJECTORY GENERATION
250  HMAX=BIGHQ+LTLHQ
      HMIN=BIGHQ-LTLHQ
      CALL BMXMN(HMAX,HMIN,BMAX,BMIN)
      DELHUP=ABS(HEN(BMIN)-HEX(BMIN))
      DELHDN=ABS(HEN(BMAX)-HEX(BMAX))
      IGBMAX=INTG(BMAX)
      IGBMIN=INTG(BMIN)
      XP=(IGBMAX-IGBMIN)/2.

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PXP=XP*1.E4	181.
BP=BZ((IGBMAX+IGBMIN)/2.)	182.
PRINT5050	183.
PRINT5049,BIGHO	184.
PRINT5051,LTLHO	185.
PRINT5052,HMAX	186.
PRINT5053,HMIN	187.
PRINT5007,BMAX	188.
PRINT5006,BMIN	189.
PRINT5059,PXP	190.
PRINT5058,BP	191.
CALL FIG3(SWTRAJ)	192.
5000 FORMAT(' ',5X,'B',18X,'HEQ',17X,'HEN',17X,'HEX')	193.
5001 FORMAT(' ',2X,'(GAUSS)',13X,'(GAUSS)',13X,'(GAUSS)',13X,'(GAUSS)')	194.
5002 FOPMAT(' ',1PE10.3,1P6E20.3)	195.
5003 FORMAT(' ',5X,'H',18X,'BEQ',17X,'BEN',17X,'BEX')	196.
5004 FORMAT(' ')	197.
5006 FOPMAT(' ', 'BMIN=',1PE10.3,' GAUSS')	198.
5007 FOPMAT(' ', 'BMAX=',1PE10.3,' GAUSS')	199.
5049 FOPMAT(' ', 'BIGHO=',1PE10.3,' GAUSS')	200.
5050 FOPMAT('1')	201.
5051 FOPMAT(' ', 'LTLHO=',1PE10.3,' GAUSS')	202.
5052 FOPMAT(' ', 'HMAX=',1PE10.3,' GAUSS')	203.
5053 FOPMAT(' ', 'HMIN=',1PE10.3,' GAUSS')	204.
5058 FOPMAT(' ', 'BP=',1PE10.3,' GAUSS')	205.
5059 FOPMAT(' ', 'XP=',1PE10.3,' MICRON')	206.
RETURN	207.
END	208.
C OPTIONS 5,1,8	209.
SUBROUTINE SUB2(SWFIG5,SWFIG1,SWPROF)	210.
REAL THA(201),HATILD(201),TBSUP(201),TBSDN(201)	211.
REAL BZMAX(101),BZMIN(101),BZUP(101),BZDN(101)	212.
REAL HZUP(101),HZDN(101),X(101),PX(101)	213.
COMMON/AREA2/HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN	214.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	215.
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP	216.
COMMON/AREA6/X,I	217.
REAL IGBMAX,IGBMIN,IGBSUP,IGBSDN,INTG,INTERP	218.
INTEGER SWFIG5,SWFIG1,SWPROF	219.
C X, PX, BZMAX, AND BZMIN TABLE GENERATION	220.
400 IF(SWFIG1+SWFIG5+SWPROF.EQ.0)GOTO700	221.
DELTA=XP/100.	222.
DO410I=1,101	223.
X(I)=DELTA*(I-1)	224.
PX(I)=X(I)*1.E4	225.
BZMAX(I)=BZ(IGBMAX-X(I))	226.
410 BZMIN(I)=BZ(IGBMIN+X(I))	227.
C FIGURE 5 GENERATION (OPTION 5)	228.
HAUP=HMIN+(HMAX-HMIN)/3.	229.
HADN=HMIN+(HMAX-HMIN)*2./3.	230.
IGBSUP=INTG(INTERP(HAUP,THA,TBSUP))	231.
IGBSDN=INTG(INTERP(HADN,THA,TBSDN))	232.
XUP=(IGBSUP-IGBMIN)/2.	233.
XDN=(IGBMAX-IGBSDN)/2.	234.
M=XUP/XP*100+1	235.
DO420I=1,M	236.
420 BZUP(I)=BZ(IGBSUP-DELTA*(I-1))	237.
M1=M+1	238.
DO430I=M1,101	239.
430 BZUP(I)=BZMIN(I)	240.

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      M=XDN/XP*100+1
      DO440I=1,M
440  BZDN(I)=BZ(IGBSDN+DELTAX*(I-1))
      M1=M+1
      DO450I=M1,101
450  BZDN(I)=BZMAX(I)
      IF(SWFIG5.EQ.0)GOTO500
      IF(SWFIG5.EQ.2)GOTO470
      PRINT5050
      PRINT5010
      PRINT5011
      PRINT5004
      DO460I=1,101
460  PRINT5002,X(I),PX(I),BZMAX(I),BZMIN(I),BZUP(I),BZDN(I)
      IF(SWFIG5.EQ.1)GOTO500
470  CALL GRAPH(101,PX,BZUP,3,107,9.,9.,0.,0.,0.,0.,'X (MICRON);','B (G
      1(AUSS);','B VS. X;','BZUP;')
      CALL GRAPHS(101,PX,BZDN,11,107,'BZDN;')
      CALL GRAPHS(101,PX,BZMAX,3,7,'BZMAX;')
      CALL GRAPHS(101,PX,BZMIN,11,7,'BZMIN;')
C  FIGURE 1 GENERATION (OPTION 1)
500  IF(SWFIG1.EQ.0)GOTO600
      HADN=3.*HC1/2.
      IGBSDN=INTG(INTERP(HADN,THA,TBSDN))
      XDN=(IGBMAX-IGBSDN)/2.
      M=XDN/XP*100+1
      DO510I=1,M
      BZDN(I)=BZ(IGBSDN+DELTAX*(I-1))
      HZUP(I)=HEQ(BZMAX(I))
510  HZDN(I)=HEQ(BZDN(I))
      M1=M+1
      DO520I=M1,101
      BZDN(I)=BZMAX(I)
      HZUP(I)=HEQ(BZMAX(I))
520  HZDN(I)=HEQ(BZDN(I))
      IF(SWFIG1.EQ.2)GOTO540
      PRINT5050
      PRINT5015
      PRINT5011
      PRINT5004
      DO530I=1,101
530  PRINT5002,X(I),PX(I),BZMAX(I),HZUP(I),BZDN(I),HZDN(I)
      IF(SWFIG1.EQ.1)GOTO600
540  CALL GRAPH(101,PX,BZDN,3,107,9.,9.,0.,0.,0.,0.,'X (MICRON);','B,H
      1(GAUSS);','B,H VS. X;','BZDN;')
      CALL GRAPHS(101,PX,BZMAX,1,107,'BZMAX;')
      CALL GRAPHS(101,PX,HZDN,4,107,'HZDN;')
      CALL GRAPHS(101,PX,HZUP,11,107,'HZMAX;')
C  PROFILE GENERATION (OPTION 8)
600  IF(SWPROF.EQ.0)GOTO700
      DO610I=1,101
      HZUP(I)=HEQ(BZMAX(I))
610  HZDN(I)=HEQ(BZMIN(I))
      IF(SWPROF.EQ.2)GOTO630
      PRINT5050
      PRINT5069
      PRINT5011
      PRINT5004
      DO620I=1,101
620  PRINT5002,X(I),PX(I),BZMAX(I),HZUP(I),BZMIN(I),HZDN(I)

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      IF(SWPROF.EQ.1)GOTO700
630 CALL GRAPH(101,PX,BZMIN,3,107,9.,9.,0.,0.,0.,0.,0.,'X (MICRON);','B,H
1 (GAUSS);','B,H VS. X;','BZMIN;')
      CALL GRAPHS(101,PX,BZMAX,1,107,'BZMAX;')
      CALL GRAPHS(101,PX,HZDN,4,107,'HZMIN;')
      CALL GRAPHS(101,PX,HZUP,11,107,'HZMAX;')
700 RETURN
5002 FORMAT(' ',1P10.3,1P6E20.3)
5004 FORMAT(' ')
5010 FORMAT(' ',5X,'X',19X,'X',17X,'BZMAX',15X,'BZMIN',15X,'BZUP',16X,'
1BZDN')
5011 FORMAT(' ',3X,'(CM)',14X,'(MICRON)',13X,'(GAUSS)',13X,'(GAUSS)',13
1X,'(GAUSS)',13X,'(GAUSS)')
5015 FORMAT(' ',5X,'X',19X,'X',17X,'BZMAX',15X,'HZMAX',15X,'BZDN',16X,
1 'HZDN')
5050 FORMAT('1')
5069 FORMAT(' ',5X,'X',19X,'X',17X,'BZMAX',15X,'HZMAX',15X,'BZMIN',15X,
1'HZMIN')
      END
C OPTIONS 6.9
      SUBROUTINE SUB3(SWL,SWACMU)
      REAL THA(201),HATILD(201),TBSUP(201),TBSDN(201)
      REAL LUP(201),PLUP(201),LUPANG(201),PDUP(201),MUP(201)
      REAL LDN(201),PLDN(201),LDNANG(201),PDDN(201),MUPP(201)
      REAL J(10),AMUP(10),PAMUP(10),AMUPP(10),PAMUPP(10)
      COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
      REAL LTLHO,INTERP,MUUP,MUDN
      INTEGER SWL,SWACMU
      DELHUP=ABS(HEN(BMIN)-HEX(BMIN))
      DELHDN=ABS(HEN(BMAX)-HEX(BMAX))
C LUP AND LDN TABLE GENERATION
700 IF(SWL+SWACMU.EQ.0)GOTO900
      DO710I=1,201
      BSUP=TBSUP(I)
      DUP=G(BSUP)*(BSUP-FBUP(BSUP))
      LUP(I)=DUP*MUUP(THA(I),HMIN,DELHUP)
      IF(BSUP.EQ.0.) LUP(I)=0.
      BSDN=TBSDN(I)
      DDN=G(BSDN)*(FBDN(BSDN)-BSDN)
      LDN(I)=DDN*MUDN(THA(I),HMAX,DELHDN)
      IF(BSDN.EQ.0.) LDN(I)=0.
      PDUP(I)=DUP*1.E4
      PLUP(I)=LUP(I)*1.E4
      PDDN(I)=DDN*1.E4
710 PLDN(I)=LDN(I)*1.E4
      IF(SWL.EQ.0)GOTO800
      IF(SWL.EQ.2)GOTO730
      PRINT5050
      PRINT5016
      PRINT5017
      PRINT5004
      DO720I=1,201
720 PRINT5060,THA(I),HATILD(I),TBSUP(I),TBSDN(I),PLUP(I),PDUP(I),PLDN(
1I),PDDN(I)
      IF(SWL.EQ.1)GOTO800
730 CALL GRAPH(201,THA,PLUP,3,7,12.,9.,0.,0.,0.,0.,'HA (GAUSS);','LUP
1(MICRON);','LUP VS. HA;',';')
      CALL GRAPH(201,THA,PLDN,3,7,12.,9.,0.,0.,0.,0.,'HA (GAUSS);','LDN
1(MICRON);','LDN VS. HA;',';')
      CALL GRAPH(201,HATILD,PLDN,3,7,12.,9.,0.,0.,0.,0.,'HATILD (GAUSS);'

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1', 'LDN (MICRON);', 'LDN VS. HATILD;', '','')
C MU TABLE GENERATION
300 IF(SWACMU.EQ.0)GOTC900
    BIGHO=(HMAX+HMIN)/2.
    LTLHO=(HMAX-HMIN)/2.
    DELTAT=3.14159/200.
    DO 810 I=1,201
        HA=BIGHO+LTLHO*COS(DELTAT*(I-1))
        LUPANG(I)=INTERP(HA,THA,LUP)
810 LDNANG(I)=INTERP(HA,THA,LDN)
    DO830N=1,10
    DO820I=1,201
        THETA=DELTAT*(I-1)
        MUP(I)=(LUPANG(I)+LDNANG(I))*SIN(THETA)*SIN(N*THETA)
820 MUPP(I)=(LUPANG(I)-LDNANG(I))*SIN(THETA)*COS(N*THETA)
        J(N)=N
        AMUP(N)=3IMPSN(DELTAT,MUP)*2./N/3.14159
        PAMUP(N)=AMUP(N)*1.E4
        AMUPP(N)=SIMPSN(DELTAT,MUPP)*2./N/3.14159
830 PAMUPP(N)=AMUPP(N)*1.E4
        IF(SWACMU.EQ.2)GOTC850
        PRINT5050
        PRINT5018
        PRINT5019
        PRINT5004
        DO840N=1,10
840 PRINT5020,N,AMUP(N),PAMUP(N),AMUPP(N),PAMUPP(N)
        IF(SWACMU.EQ.1)GOTO900
850 CALL GRAPH(10,J,PAMUP,3,107,12.,9.,1.,0.,0.,0., 'N;', 'MU(N);', 'MU(N
1);', 'AMUP;')
        CALL GRAPHS(10,J,PAMUPP,11,107,'AMUPP;')
900 RETURN
5004 FORMAT(' ')
5016 FORMAT(' ',4X,'HA',12X,'HATILD', 9X,'BSUP',11X,'BSDN',12X,'LUP',12
1X,'DUP',12X,'LDN',12X,'DDN')
5017 FCRMAT(' ',2X,'(GAUSS)',8X,'(GAUSS)',8X,'(GAUSS)',8X,'(GAUSS)',7X,
1'(MICRON)',7X,'(MICRON)',7X,'(MICRON)',7X,'(MICRON)')
5018 FORMAT(' ',5X,'N',17X,'AMUP',16X,'AMUP',16X,'AMUPP',15X,'AMUPP')
5019 FORMAT(' ',23X,'(CM)',14X,'(MICRON)',14X,'(CM)',14X,'(MICRON)')
5020 FORMAT(' ',4X,12,4X,1P4E20.3)
5050 FORMAT('1')
5060 FORMAT(' ',1P10.3,1P8E15.3)
END
C OPTIONS 10,11,12
SUBROUTINE SUB4(SWLOSS,SWFLUX,SWWBX,NWX)
REAL PDWSUP(201),PDWBUP(201),PDWBAU(201),PDWBPU(201),PDWLUP(201)
REAL PDWSDN(201),PDWBDN(201),PDWBAD(201),PDWBPD(201),PDWLDN(201)
REAL PDFUP(201),PDWAUP(201),FPULUP(201),PWBAUX(101),PWBPUX(101)
REAL PDFDN(201),PDWADN(201),FPULDN(201),PWBADX(101),PWBPD(101)
REAL PWBAUX(101),PWBPX(101),PWBX(101)
REAL BHA(201),TB(101),THAUP(101),THADN(101),X(101),PX(101)
REAL THA(201),HATILD(201),TBSUP(201),TBSDN(201)
COMMON/AREA2/HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
COMMON/AREA6/X,I
REAL IGBMAX,IGBMIN,INTERP
INTEGER SWLOSS,SWFLUX,SWWBX
C POWER LOSS GENERATION
900 IF(SWLOSS.EQ.0)GOTO1000

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IF(-IGBMIN.LT.IGBMAX)GOTO910	421.
EXTERNAL FNTFUP	422.
CALL QG10(BP,FBUP(0.),FNTFUP,ANTFUP)	423.
ANTFUP=IGBMAX*BP+ANTFUP	424.
EXTERNAL FPTFDN	425.
CALL QG10(0.,FBDN(0.),FPTFDN,APTFDN)	426.
GOTO920	427.
910 CONTINUE	428.
EXTERNAL FNTFUP	429.
CALL QG10(0.,FBUP(0.),FNTFUP,ANTFUP)	430.
EXTERNAL FPTFDN	431.
CALL QG10(BP,FBDN(0.),FPTFDN,APTFDN)	432.
APTFDN=APTFDN-IGSMIN*BP	433.
996 CONTINUE	434.
920 PWSUP=0.	435.
PWBUP=0.	436.
PWAUP=0.	437.
PFUP=0.	438.
PWSDN=0.	439.
PWBDN=0.	440.
PWADN=0.	441.
PFDN=0.	442.
IF(BMIN.GE.0.)GOTO930	443.
BLIMIT=0.	444.
IF(BMAX.LT.0.)BLIMIT=BMAX	445.
EXTERNAL FDWSUP	446.
CALL QG10(BMIN,BLIMIT,FDWSUP,PWSUP)	447.
EXTERNAL FDWBUP	448.
CALL QG10(BMIN,BLIMIT,FDWBUP,PWBUP)	449.
EXTERNAL FDWAUP	450.
CALL QG10(BMIN,BLIMIT,FDWAUP,PWAUP)	451.
EXTERNAL FDFUP	452.
CALL QG10(BMIN,BLIMIT,FDFUP,PFUP)	453.
EXTERNAL FDWSDN	454.
CALL QG10(BMIN,BLIMIT,FDWSDN,PWSDN)	455.
PWSDN=-PWSDN	456.
EXTERNAL FDWBDN	457.
CALL QG10(BMIN,BLIMIT,FDWBDN,PWBDN)	458.
PWBDN=-PWBDN	459.
EXTERNAL FDWADN	460.
CALL QG10(BMIN,BLIMIT,FDWADN,PWADN)	461.
PWADN=-PWADN	462.
EXTERNAL FDFDN	463.
CALL QG10(BMIN,BLIMIT,FDFDN,PFDN)	464.
PFDN=-PFDN	465.
930 IF(BMAX.LE.0.)GOTO940	466.
BLIMIT=0.	467.
IF(BMIN.GT.0.)BLIMIT=BMIN	468.
EXTERNAL FDWSUP	469.
CALL QG10(BLIMIT,BMAX,FDWSUP,S)	470.
PWSUP=PWSUP+S	471.
EXTERNAL FDWBUP	472.
CALL QG10(BLIMIT,BMAX,FDWBUP,S)	473.
PWBUP=PWBUP+S	474.
EXTERNAL FDWAUP	475.
CALL QG10(BLIMIT,BMAX,FDWAUP,S)	476.
PWAUP=PWAUP+S	477.
EXTERNAL FDFUP	478.
CALL QG10(BLIMIT,BMAX,FDFUP,S)	479.
PFUP=PFUP+S	480.

EXTERNAL FDWSDN	481.
CALL QG10(BLIMIT,EMAX,FDWSDN,S)	482.
PWSDN=PWSDN-S	483.
EXTERNAL FDWBDN	484.
CALL QG10(BLIMIT,EMAX,FDWBDN,S)	485.
PWBDN=PWBDN-S	486.
EXTERNAL FDWADN	487.
CALL QG10(BLIMIT,EMAX,FDWADN,S)	488.
PWADN=PWADN-S	489.
EXTERNAL FDFDN	490.
CALL QG10(BLIMIT,EMAX,FDFDN,S)	491.
PFDN=PFDN-S	492.
940 PWLUP=PWSUP+PWBUP	493.
PWLDN=PWSDN+PWBDN	494.
IF(BMIN.GE.0.)GOTO950	495.
IF(BMAX.LE.0.)GOTO950	496.
BLIMIT=-BMIN	497.
IF(BMAX.LE.-BMIN)BLIMIT=BMAX	498.
EXTERNAL FDWBAU	499.
CALL QG10(0.,BLIMIT,FDWBAU,PWBAUP)	500.
BLIMIT=-BMAX	501.
IF(BMIN.GE.-BMAX)BLIMIT=BMIN	502.
EXTERNAL FDWBAD	503.
CALL QG10(BLIMIT,0.,FDWBAD,PWBADN)	504.
PWBADN=-PWBADN	505.
GOTO960	506.
950 PWBAUP=0.	507.
PWBADN=0.	508.
960 PWBPUP=PWBUP-PWBAUP	509.
PWBPDN=PWBDN-PWBADN	510.
PWS=PWSUP+PWSDN	511.
PWL=PWLUP+PWLDN	512.
PWB=PWBUP+PWBDN	513.
PWBA=PWBAUP+PWBADN	514.
PWBP=PWB-PWBA	515.
PWA=PWAUP+PWADN	516.
PF=PFUP+PFDN	517.
PRINT5050	518.
PRINT5023,PWSUP	519.
PRINT5067,PWBAUP	520.
PRINT5068,PWBPUP	521.
PRINT5024,PWBUP	522.
PRINT5025,PWLUP	523.
PRINT5026,PFUP	524.
PRINT5027,PWAUP	525.
PRINT5063,ANTFUP	526.
PRINT5004	527.
PRINT5029,PWSDN	528.
PRINT5061,PWBADN	529.
PRINT5062,PWBPDN	530.
PRINT5030,PWBDN	531.
PRINT5031,PWLDN	532.
PRINT5032,PFDN	533.
PRINT5033,PWADN	534.
PRINT5064,APTFDN	535.
PRINT5004	536.
PRINT5034,PWS	537.
PRINT5065,PWBA	538.
PRINT5066,PWBP	539.
PRINT5035,PWB	540.

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PRINT5036,PWL 541.
PRINT5037,PF 542.
PRINT5038,PWA 543.
IF(SWLOSS.EQ.4)GOTC1000 544.
IF(SWLOSS.EQ.2)GOTO990 545.
DELTAB=(BMAX-BMIN)/200. 546.
PRINT5050 547.
PRINT5021 548.
PRINT5022 549.
PRINT5004 550.
DO970 I=1,201 551.
BB=BMIN+(I-1)*DELTAB 552.
HAUP=INTERP(BB,TBSUP,THA) 553.
IF(I.EQ.0)HAUP=HMIN 554.
IF(I.EQ.201)HAUP=HMAX 555.
BHA(I)=BB 556.
BUP=FBUP(BB) 557.
GBB=G(BB) 558.
PDWSUP(I)=(HAUP-HEQ(BB))*GBB*(BB-BUP)/4./3.14159*0.1 559.
IF(BB.EQ.0.)PDWSUP(I)=(HAUP-HC1)* 560.
1 GBB*(-BUP)/4./3.14159*0.1 561.
PDFUP(I)=GBB*(F(BB)-F(BUP))*0.1 562.
PDWBUP(I)=HEQ(BB)*GBB*(BB-BUP)/4./3.14159*0.1-PDFUP(I) 563.
PDWBAU(I)=-HC1*BUP*GBB/2./3.14159*0.1 564.
IF(BUP.GE.0.)PDWBAU(I)=0. 565.
IF(BB.LE.0.)PDWBAU(I)=0. 566.
IF(BB.EQ.0.)PDWBUP(I)=-HC1*GBB*(-BUP) 567.
1 /4./3.14159*0.1-PDFUP(I) 568.
PDWBPU(I)=PDWBUP(I)-PDWBAU(I) 569.
PDWLUP(I)=PDWSUP(I)+PDWBUP(I) 570.
PDWAUP(I)=HAUP*GBB*(BB-BUP)/4./3.14159*0.1 571.
970 PRINT5060,BB,HAUP,PDWSUP(I),PDWBAU(I),PDWBPU(I),PDWBUP(I),PDWLUP(I) 572.
1),PDFUP(I),PDWAUP(I) 573.
PRINT5050 574.
PRINT5028 575.
PRINT5022 576.
PRINT5004 577.
DO980 I=1,201 578.
BB=BMIN+(I-1)*DELTAB 579.
HADN=INTERP(BB,TBBDN,THA) 580.
IF(I.EQ.0)HADN=HMIN 581.
IF(I.EQ.201)HADN=HMAX 582.
GBB=G(BB) 583.
BDN=FBBDN(BB) 584.
PDWSDN(I)=(HADN-HEQ(BB))*GBB*(BDN-BB)/4./3.14159*0.1 585.
IF(BB.EQ.0.)PDWSDN(I)=(HADN-HC1)* 586.
1 GBB*BDN/4./3.14159*0.1 587.
PDFDN(I)=GBB*(F(BDN)-F(BB))*0.1 588.
PDWBDN(I)=HEQ(BB)*GBB*(BDN-BB)/4./3.14159*0.1-PDFDN(I) 589.
PDWBAD(I)=-HC1*BDN*GBB/2./3.14159*0.1 590.
IF(BDN.LE.0.)PDWBAD(I)=0. 591.
IF(BB.GE.0.)PDWBAD(I)=0. 592.
PDWBPD(I)=PDWBDN(I)-PDWBAD(I) 593.
PDWLDN(I)=(PDWSDN(I)+PDWBDN(I)) 594.
PDWADN(I)=HADN*GBB*(BDN-BB)/4./3.14159*0.1 595.
980 PRINT5060,BB,HADN,PDWSDN(I),PDWBAD(I),PDWBPD(I),PDWBDN(I),PDWLDN(I) 596.
1),PDFDN(I),PDWADN(I) 597.
IF(SWLOSS.EQ.1)GOTC1000 598.
990 CALL GRAPH(201,BHA,PDWSUP,3,107,12.,9.,0.,0.,0.,0.,'B (GAUSS);','D 599.
1W/DB (UJ/CM2G);','DW/DB VS. B;','PDWSUP;') 600.

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CALL GRAPHS(201,BHA,PDWBUP,11,107,'PDWBUP;') 601.
CALL GRAPHS(201,BHA,PDWLUP,1,107,'PDWLUP;') 602.
CALL GRAPHS(201,BHA,PDFUP,4,107,'PDFUP;') 603.
CALL GRAPHS(201,BHA,PDWAUP,13,107,'PDWAUP;') 604.
DO995I=1,201 605.
PDWSDN(I)=-PDWSDN(I) 606.
PDWBDN(I)=-PDWBDN(I) 607.
PDWLDN(I)=-PDWLDN(I) 608.
PDWADN(I)=-PDWADN(I) 609.
995 PDFDN(I)=-PDFDN(I) 610.
CALL GRAPH(201,BHA,PDWSDN,3,107,12.,9.,0.,0.,0.,0.,'B (GAUSS);','- 611.
1DW/DB (UJ/CM2G);','-DW/DB VS. B;','',-PDWSDN;') 612.
CALL GRAPHS(201,BHA,PDWBDN,11,107,'-PDWBDN;') 613.
CALL GRAPHS(201,BHA,PDWLDN,1,107,'-PDWLDN;') 614.
CALL GRAPHS(201,BHA,PDFDN,4,107,'-PDFDN;') 615.
CALL GRAPHS(201,BHA,PDWADN,13,107,'-PDWADN;') 616.
1000 IF(SWFLUX.EQ.0)GOTO1100 617.
S=0. 618.
S1=0. 619.
DELTAB=(BMAX-BMIN)/200. 620.
FPULUP(1)=0. 621.
FPULDN(1)=0. 622.
TB(1)=BMIN 623.
DO1010I=2,101 624.
BMID=BMIN+(2*I-3)*DELTAB 625.
TB(I)=BMID+DELTAB 626.
S=S+FDUP(BMID-DELTAB)+4*FDUP(BMID)+FDUP(BMID+DELTAB) 627.
FPULUP(I)=S*DELTAB/3. 628.
S1=S1+FDDN(BMID-DELTAB)+4*FDDN(BMID)+FDDN(BMID+DELTAB) 629.
1010 FPULDN(I)=S1*DELTAB/3. 630.
THAUP(1)=HMIN 631.
THADN(1)=HMIN 632.
THAUP(101)=HMAX 633.
THADN(101)=HMAX 634.
DO 1015 I=2,100 635.
THAUP(I)=INTERP(TB(I),TBSUP,THA) 636.
1015 THADN(I)=INTERP(TB(I),TBSDN,THA) 637.
IF(SWFLUX.EQ.2)GOTC1030 638.
PRINT5050 639.
PRINT5070 640.
PRINT5071 641.
PRINT5004 642.
DO1020I=1,101 643.
1020 PRINT5002,TB(I),THAUP(I),FPULUP(I),THADN(I),FPULDN(I) 644.
IF(SWFLUX.EQ.1)GOTC1100 645.
1030 CALL GRAPH(101,THAUP,FPULUP,3,107,12.,9.,0.,0.,0.,0.,'HA (GAUSS);' 646.
1,'FLUX (G CM);', 'FLUX VS. HA;','',FPULUP;') 647.
CALL GRAPHS(101,THADN,FPULDN,11,107,'FPULDN;') 648.
C WB VS. X TABLE GENERATION 649.
1100 IF(SWWBX.EQ.0)GOTO1200 650.
IF(NWX.EQ.1)NWX=2 651.
DELTAX=XP/(NWX-1) 652.
DO1110I=1,NWX 653.
X(I)=(I-1)*DELTAX 654.
PX(I)=X(I)*1.54 655.
PWBAUX(I)=-HC1*BZ((IGBMIN+X(I))/2.)/2./3.14159*0.1 656.
PWBADX(I)=HC1*BZ((IGBMAX-X(I))/2.)/2./3.14159*0.1 657.
BLIMIT=BZ(IGBMIN+X(I)) 658.
EXTERNAL FWBPUX 659.
CALL QG10(BLIMIT,0.,FWBPUX,PWBPUX(I)) 660.

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EXTERNAL FWBPDx                                     661.
CALL QG10(BLIMIT,0.,FWBPDx,PWBPDx(I))               662.
BLIMIT=BZ(IGBMx-x(I))                               663.
EXTERNAL FWBPuX                                     664.
CALL QG10(0.,BLIMIT,FWBPuX,S)                       665.
PWBPUX(I)=PWBPUX(I)+S                               666.
EXTERNAL FWBPDx                                     667.
CALL QG10(0.,BLIMIT,FWBPDx,S)                       668.
PWBPDx(I)=PWBPDx(I)+S                               669.
PWBAX(I)=PWBAX(I)+PWBADx(I)                         670.
PWBpX(I)=PWBPUX(I)+PWBPDx(I)                       671.
1110 PWBX(I)=PWBAX(I)+PWBpX(I)                      672.
IF(SWWBX.EQ.2)GOTO1130                             673.
PRINT5050                                           674.
PRINT5072                                           675.
PRINT5073                                           676.
PRINT5004                                           677.
DO1120I=1,NWx                                       678.
1120 PRINT5002,PX(I),PWBAX(I),PWBpX(I),PWBX(I)     679.
IF(SWWBX.EQ.1)GOTO1200                             680.
1130 CALL GRAPH(NWx,PX,PWBAX,3,107,12.,9.,0.,0.,0.,0.,'X (MICRON);','WB 681.
1 (UJ/CM**2);','WB VS. X;','WBA;')
CALL GRAPHS(NWx,PX,PWBpX,11,107,'WBP;')           682.
CALL GRAPHS(NWx,PX,PWBX,4,107,'WB;')              683.
1200 RETURN                                          684.
5002 FORMAT(' ',1PE10.3,1P6E20.3)                  685.
5004 FORMAT(' ')                                     686.
5021 FORMAT(' ',5X,'B',12X,'HAUP',11X,'DWSUP',10X,'DWBAUP',9X,'DWBPUP', 687.
19X,'DWBU',10X,'DWLUP',10X,'DFUP',11X,'DWAUP')
5022 FORMAT(' ',2X,'(GAUSS)',8X,'(GAUSS)',7X,'(UJ/CM2G)',6X,'(UJ/CM2G)' 688.
1,6X,'(UJ/CM2G)',6X,'(UJ/CM2G)',6X,'(UJ/CM2G)',6X,'(UJ/CM2G)',6X,'( 689.
2UJ/CM2G)')
5023 FORMAT(' ', 'WSUP =',1PE10.3,' MICROJ/CM**2') 690.
5024 FORMAT(' ', 'WBUP =',1PE10.3,' MICROJ/CM**2') 691.
5025 FORMAT(' ', 'WLUP =',1PE10.3,' MICROJ/CM**2') 692.
5026 FORMAT(' ', 'FUP =',1PE10.3,' MICROJ/CM**2') 693.
5027 FORMAT(' ', 'WAUP =',1PE10.3,' MICROJ/CM**2') 694.
5028 FORMAT(' ',5X,'B',12X,'HADN',11X,'DWSDN',10X,'DWBADN',9X,'DWBPDN', 695.
19X,'DWBDN',10X,'PWLDN',10X,'DFDN',11X,'DWADN')
5029 FORMAT(' ', 'WSDN =',1PE10.3,' MICROJ/CM**2') 696.
5030 FORMAT(' ', 'WBDN =',1PE10.3,' MICROJ/CM**2') 697.
5031 FORMAT(' ', 'WLDN =',1PE10.3,' MICROJ/CM**2') 698.
5032 FORMAT(' ', 'FDN =',1PE10.3,' MICROJ/CM**2') 699.
5033 FORMAT(' ', 'WADN =',1PE10.3,' MICROJ/CM**2') 700.
5034 FORMAT(' ', 'WS =',1PE10.3,' MICROJ/CM**2') 701.
5035 FORMAT(' ', 'WB =',1PE10.3,' MICROJ/CM**2') 702.
5036 FORMAT(' ', 'WL =',1PE10.3,' MICROJ/CM**2') 703.
5037 FORMAT(' ', 'F =',1PE10.3,' MICROJ/CM**2') 704.
5038 FORMAT(' ', 'WA =',1PE10.3,' MICROJ/CM**2') 705.
5050 FORMAT('1')                                     706.
5060 FORMAT(' ',1PE10.3,1P8E15.3)                  707.
5061 FORMAT(' ', 'WBADN=',1PE10.3,' MICROJ/CM**2') 708.
5062 FORMAT(' ', 'WBPDN=',1PE10.3,' MICROJ/CM**2') 709.
5063 FORMAT(' ', 'ANTFUP=',1PE10.3,' GAUSS CM') 710.
5064 FORMAT(' ', 'APTFDN=',1PE10.3,' GAUSS CM') 711.
5065 FORMAT(' ', 'WBA=',1PE10.3,' MICROJ/CM**2') 712.
5066 FORMAT(' ', 'WBP=',1PE10.3,' MICROJ/CM**2') 713.
5067 FORMAT(' ', 'WBAUP=',1PE10.3,' MICROJ/CM**2') 714.
5068 FORMAT(' ', 'WBPU=',1PE10.3,' MICROJ/CM**2') 715.
5070 FORMAT(' ',5X,'B',17X,'HAUP',15X,'FPULUP',15X,'HADN',15X,'FPULDN') 716.

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5071 FORMAT(' ',2X,'(GAUSS)',13X,'(GAUSS)',13X,'(G CM)',14X,'(GAUSS)', 721.
      1 13X,'(G CM)') 722.
5072 FORMAT(' ',5X,'X',18X,'WBA',17X,'WBP',17X,'WB') 723.
5073 FORMAT(' ',1X,'(MICRON)',11X,'(UJ/CM**3)',10X,'(UJ/CM**3)',10X,'(U 724.
      1J/CM**3)') 725.
      END 726.
C OPTIONS 13,14 727.
      SUBROUTINE SUB5(SWBIGH,SWLTLH,BIGHMX,BIGHMN,DBIGHO,CLTLHO,LTLHMX,L 728.
      1TLHMN,DLTLHO,CBIGHO) 729.
      REAL LOSS50(101),LOSS60(101),LOSSOT(101,101),LTLLOG(101) 730.
      REAL TBIGHO(101),TLTLHO(101),TPWA(101),TWA(101),SIGMA(101) 731.
      REAL THA(201),HATILD(201),TBSUP(201),TBSDN(201) 732.
      COMMON/AREA2/HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN 733.
      COMMON/AREA5/IGBMAX,IGBMIN,XP,BP 734.
      REAL IGBMAX,IGBMIN,INTG,LTLHMX,LTLHMN 735.
      INTEGER SWBIGH,SWLTLH,SWITCH 736.
C PWA VS. BIGHO TABLE GENERATION 737.
1200 SWITCH=0 738.
      IF(SWBIGH.EQ.0)GOTO1300 739.
      M=(BIGHMX-BIGHMN)/DBIGHO+1.999 740.
      DO1230N=1,M 741.
      TBIGHO(N)=BIGHMN+(N-1)*DBIGHO 742.
      HMAX=TBIGHO(N)+CLTLHO 743.
      HMIN=TBIGHO(N)-CLTLHO 744.
      CALL FIG3(SWITCH) 745.
      IGBMAX=INTG(BMAX) 746.
      IGBMIN=INTG(BMIN) 747.
      PWAUP=0. 748.
      PWADN=0. 749.
      IF(BMIN.GE.0.)GOTO1210 750.
      BLIMIT=0. 751.
      IF(BMAX.LT.0.)BLIMIT=BMAX 752.
      EXTERNAL FDWAUP 753.
      CALL QG10(BMIN,BLIMIT,FDWAUP,PWAUP) 754.
      EXTERNAL FDWADN 755.
      CALL QG10(BMIN,BLIMIT,FDWADN,PWADN) 756.
1210 IF(BMAX.LE.0.)GOTO1220 757.
      BLIMIT=0. 758.
      IF(BMIN.GT.0.)BLIMIT=BMIN 759.
      EXTERNAL FDWAUP 760.
      CALL QG10(BLIMIT,BMAX,FDWAUP,S) 761.
      PWAUP=PWAUP+S 762.
      EXTERNAL FDWADN 763.
      CALL QG10(BLIMIT,BMAX,FDWADN,S) 764.
      PWADN=PWADN+S 765.
1220 TPWA(N)=PWAUP-PWADN 766.
      TWA(N)=TPWA(N)*10. 767.
      LOSS50(N)=50.*TPWA(N) 768.
1230 LOSS60(N)=60.*TPWA(N) 769.
      IF(SWBIGH.EQ.2)GOTO1250 770.
      PRINT5050 771.
      PRINT5051,CLTLHO 772.
      PRINT5004 773.
      PRINT 5040 774.
      PRINT5041 775.
      PRINT5004 776.
      DO1240I=1,M 777.
1240 PPINT5002,TBIGHO(I),TPWA(I),TWA(I),LOSS50(I),LOSS60(I) 778.
      IF(SWBIGH.EQ.1)GOTO1300 779.
1250 DO1260I=1,M 780.

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      IF(LOSS50(I).LE.0.)LOSS50(I)=1.E-3
1260 LOSS50(I)=ALOG10(LOSS50(I))
      CALL GRAPH( M,TBIGHO,LOSS50,3,7,12.,-9.,0.,0.,0.,5,0.,'BIGHO (GAUSS)
      I:','LOSS50(MICROW/CM**2)',';',';')
WA VS. LTLHO TABLE GENERATION
1300 IF(SWLT LH.EQ.0)GOTO1400
      M=(LTLHMX-LTLHMN)/DLTLHO+1.999
      DO1330N=1,M
      TLTLHO(N)=(N-1)*DLTLHO+LTLHMN
      HMAX=CBIGHO+TLTLHC(N)
      HMIN=CBIGHO-TLTLHC(N)
      CALL FIG3(SWITCH)
      IGBMAX=INTG(BMAX)
      IGBMIN=INTG(BMIN)
      PWAUP=0.
      PWADN=0.
      IF(BMIN.GE.0.)GOTO1310
      BLIMIT=0.
      IF(BMAX.LT.0.)BLIMIT=BMAX
      EXTERNAL FDWAUP
      CALL QG10(BMIN,BLIMIT,FDWAUP,PWAUP)
      EXTERNAL FDWADN
      CALL QG10(BMIN,BLIMIT,FDWADN,PWADN)
1310 IF(BMAX.LE.0.)GOTO1320
      BLIMIT=0.
      IF(BMIN.GT.0.)BLIMIT=BMIN
      EXTERNAL FDWAUP
      CALL QG10(BLIMIT,BMAX,FDWAUP,S)
      PWAUP=PWAUP+S
      EXTERNAL FDWADN
      CALL QG10(BLIMIT,BMAX,FDWADN,S)
      PWADN=PWADN+S
1320 TPWA(N)=PWAUP-PWADN
      TWA(N)=TPWA(N)*10.
      SIGMA(N)=0.562698*TLTLHO(N)
      LOSS50(N)=50.*TPWA(N)
1330 LOSS60(N)=60.*TPWA(N)
      IF(SWLT LH.EQ.2)GOTO1350
      PRINT5050
      PRINT5049,CBIGHO
      PRINT5004
      PRINT5042
      PRINT5043
      PRINT5004
      DO1340I=1,M
1340 PPINT5002,TLTLHO(I),SIGMA(I),TPWA(I),TWA(I),LOSS50(I),LOSS60(I)
1350 DO1360I=1,M
      LTLLOG(I)=ALOG10(TLTLHO(I))
      IF(LOSS50(I).LE.0.)LOSS50(I)=1.E-3
1360 LOSS50(I)=ALOG10(LOSS50(I))
      CALL GRAPH(M,LTLLOG,LOSS50,3,7,-12.,-9.,0.,0.,0.,0.,'LTLHO (GAUSS)
      I:','LOSS50(MICROW/CM**2)',';',';')
1400 RETURN
5002 FORMAT(' ',1PE10.3,1PE20.3)
5004 FORMAT(' ')
5040 FORMAT(' ',3X,'BIGHO',16X,'WA',18X,'WA',16X,'LOSS50',14X,'LOSS60')
5041 FORMAT(' ',2X,'(GAUSS)',10X,'(MICROW/CM**2)',8X,'(ERG/CM**2)',7X,'
      1(MICROW/CM**2)',6X,'(MICROW/CM**2)')
5042 FORMAT(' ',3X,'LTLHO',15X,'SIGMA',16X,'WA',18X,'WA',16X,'LOSS50',1
      14X,'LOSS60')

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5043 FORMAT(' ',2X,'(GAUSS)',12X,'(RMSA/CM)',8X,'(MICROJ/CM**2)',8X,'(F 841.
      1RG/CM**2)',7X,'(MICROW/CM**2)',6X,'(MICROW/CM**2)') 842.
5049 FORMAT(' ',1X,'BIGHO=',1PE10.3,' GAUSS') 843.
5050 FORMAT('1') 844.
5051 FORMAT(' ',1X,'LTLHO=',1PE10.3,' GAUSS') 845.
      END 846.
C OPTIONS 15,16,17 847.
      SUBROUTINE SUB6(SWBIGT,SWLTLT,SWPLOT,MXBIGH,MNBIGH,DELBHO,MXLTLH,M 848.
      INLTLH,DELLHO) 849.
      REAL TBIGHO(101),TLTLHO(101),TPWA(101),TWA(101),SIGMA(101) 850.
      REAL LOSS50(101),LOSS60(101),LOSSOT(101,101),LTLLCG(101) 851.
      REAL A(100,100) 852.
      REAL THA(201),HATILD(201),TBSUP(201),TBSDN(201) 853.
      COMMON ANGA,ANGB,HV,DUMMY(14) 854.
      COMMON/AREA2/HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN 855.
      COMMON/ARFA5/IGBMAX,IGBMIN,XP,BP 856.
      REAL IGBMAX,IGBMIN,INTG,MXBIGH,MNBIGH,MXI T I H,MNI T I H,I NS60 857.
      REAL*4 DATE(7),PARM(11) 858.
      INTEGER SWBIGT,SWLTLT,SWPLOT,SWITCH 859.
C PWA VS. BIGHO AND LTLHO TABLE GENERATION 860.
1400 SWITCH=0 861.
      IF(SWBIGT+SWLTLT+SWPLOT.EQ.0)GOTO1700 862.
      L=(MXLTLH-MNLTLH)/DELLHO+1.999 863.
      M=(MXBIGH-MNBIGH)/DELBHO+1.999 864.
      XSIZE=12. 865.
      IF(SWBIGT.EQ.1)PRINT5050 866.
      IF(SWBIGT.EQ.3)PRINT5050 867.
      DO1460K=1,L 868.
        TLTLHO(K)=MNLTLH+(K-1)*DELLHO 869.
        LTLLCG(K)=ALOG10(TLTLHO(K)) 870.
      DO1420N=1,M 871.
        TBIGHO(N)=MNBIGH+(N-1)*DELBHO 872.
        HMAX=TBIGHO(N)+TLTLHO(K) 873.
        HMIN=TBIGHO(N)-TLTLHO(K) 874.
        CALL FIG3(SWITCH) 875.
        IGBMAX=INTG(BMAX) 876.
        IGBMIN=INTG(BMIN) 877.
        PWAUP=0. 878.
        PWADN=0. 879.
        IF(BMIN.GE.0.)GOTO1410 880.
        BLIMIT=0. 881.
        IF(BMAX.LT.0.)BLIMIT=BMAX 882.
        EXTERNAL FDWAUP 883.
        CALL QG10(BMIN,BLIMIT,FDWAUP,PWAUP) 884.
        EXTERNAL FDWADN 885.
        CALL QG10(BMIN,BLIMIT,FDWADN,PWADN) 886.
1410 IF(BMAX.LE.0.)GOTO1420 887.
        BLIMIT=0. 888.
        IF(BMIN.GT.0.)BLIMIT=BMIN 889.
        EXTERNAL FDWAUP 890.
        CALL QG10(BLIMIT,BMAX,FDWAUP,S) 891.
        PWAUP=PWAUP+S 892.
        EXTERNAL FDWADN 893.
        CALL QG10(BLIMIT,BMAX,FDWADN,S) 894.
        PWADN=PWADN+S 895.
1420 LOSSOT(K,N)=50.*(PWAUP-PWADN) 896.
      IF(SWBIGT.EQ.0)GOTO1460 897.
      IF(SWBIGT.EQ.2)GOTO1440 898.
      PRINT5004 899.
      PRINT5051,TLTLHO(K) 900.

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PRINT5004
PRINT5040
PRINT5041
PRINT5004
DO1430N=1,M
LOSS50(N)=LOSS0T(K,N)
PWA=LOSS50(N)/50.
WA=PWA*10.
LOS60=PWA*60.
1430 PRINT5002,TBIGHO(N),PWA,WA,LOSS50(N),LOS60
IF(SWBIGT.EQ.1)GOTO1460
1440 DO1450N=1,M
LOSS50(N)=LOSS0T(K,N)
IF(LOSS50(N).LE.0.)LOSS50(N)=1.E-3
1450 LOSS50(N)=ALOG10(LOSS50(N))
CALL GRAPH(M,TBIGHO,LOSS50,3,7,XSIZE,-9.,0.,0.,4.,-1.,'BIGHO (GAUS
1S);','LOSS50(MICROW/CM**2)',';',';')
XSIZE=0.
1460 CONTINUE
1500 IF(SWLTLT.EQ.0)GOTO1600
XSIZE=-12.
IF(SWLTLT.EQ.1)PRINT5050
IF(SWLTLT.EQ.3)PRINT5050
DO1540N=1,M
IF(SWLTLT.EQ.2)GOTO1520
PRINT5004
PRINT5049,TBIGHO(N)
PRINT5004
PRINT5042
PRINT5043
PRINT5004
DO1510K=1,L
LOSS50(K)=LOSS0T(K,N)
PWA=LOSS50(K)/50.
WA=PWA*10.
LOS60=PWA*60.
SIGMAL=0.562698*TLTLHO(K)
1510 PRINT5002,TLTLHO(K),SIGMAL,PWA,WA,LOSS50(K),LOS60
IF(SWLTLT.EQ.1)GOTO1540
1520 DO1530K=1,L
LOSS50(K)=LOSS0T(K,N)
IF(LOSS50(K).LE.0.)LOSS50(K)=1.E-3
1530 LOSS50(K)=ALOG10(LOSS50(K))
CALL GRAPH(L,LTLLCG,LOSS50,3,7,XSIZE,-9.,0.5,0.,4.,-1.,'LTLHO (GAU
1SS);','LOSS50(MICROW/CM**2)',';',';')
XSIZE=-0.
1540 CONTINUE
1600 IF(SWPL0T.EQ.0)GOTO1700
L1=L+1
M1=M+1
IF(L1.GT.100)L1=100
IF(M1.GT.100)M1=100
N=1
DO1610K=1,L1
1610 A(N,K)=-3.
DO1630N=2,M1
A(N,1)=-3.
DO1620K=2,L1
IF(LOSS0T(K-1,N-1).LE.0.)LOSS0T(K-1,N-1)=1.E-3
1620 A(N,K)=ALOG10(LOSS0T(K-1,N-1))

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1630 CONTINUE	961.
ANGA=3.14159/180.*240.	962.
ANGB=3.14159/180.*30.	963.
HV=5.	964.
KODE=3	965.
NX=M1	966.
NY=L1	967.
CALL LABEL(DATE, PARM, NPARM)	968.
CALL THREED(A, NX, NY, KODE)	969.
CALL ENDPLT	970.
1700 RETURN	971.
5002 FORMAT(' ', 1PE10.3, 1PE20.3)	972.
5004 FORMAT(' ')	973.
5040 FORMAT(' ', 3X, 'BIGHO', 16X, 'WA', 18X, 'WA', 16X, 'LOSS50', 14X, 'LOSS60')	974.
5041 FORMAT(' ', 2X, '(GAUSS)', 10X, '(MICROJ/CM**2)', 8X, '(ERG/CM**2)', 7X, '1(MICROW/CM**2)', 6X, '(MICROW/CM**2)')	975.
5042 FORMAT(' ', 3X, 'LTLHO', 15X, 'SIGMA', 16X, 'WA', 18X, 'WA', 16X, 'LOSS50', 14X, 'LOSS60')	976.
5043 FORMAT(' ', 2X, '(GAUSS)', 12X, '(FMSA/CM)', 8X, '(MICROJ/CM**2)', 8X, '(ERG/CM**2)', 7X, '(MICPOW/CM**2)', 6X, '(MICROW/CM**2)')	977.
5049 FORMAT(' ', 'BIGHO=', 1PE10.3, ' GAUSS')	978.
5050 FORMAT('1')	979.
5051 FORMAT(' ', 'LTLHO=', 1PE10.3, ' GAUSS')	980.
END	981.
FUNCTION FBUP(BSUP)	982.
COMMON/AREA5/IGBMAX, IGBMIN, XP, BP	983.
REAL INTG, IGBMIN	984.
FBUP=BZ((INTG(BSUP)+IGBMIN)/2.)	985.
RETURN	986.
END	987.
FUNCTION FBDN(BSDN)	988.
COMMON/AREA5/IGBMAX, IGBMIN, XP, BP	989.
REAL INTG, IGBMAX	990.
FBDN=BZ((INTG(BSDN)+IGBMAX)/2.)	991.
RETURN	992.
END	993.
FUNCTION G(B)	994.
COMMON/AREA3/HC1, HC2, JCO, BO, HS, HEXEPS	995.
REAL JC, JCO	996.
G=3.E10*DHEQDB(B)/4./3.14159/JC(B)	997.
RETURN	998.
END	999.
SUBROUTINE QG10(XL, XU, FCT, Y)	1000.
A=.5*(XU+XL)	1001.
B=XU-XL	1002.
C=.4869533*B	1003.
Y=.03333567*(FCT(A+C)+FCT(A-C))	1004.
C=.4325317*B	1005.
Y=Y+.07472567*(FCT(A+C)+FCT(A-C))	1006.
C=.3397048*B	1007.
Y=Y+.1095432*(FCT(A+C)+FCT(A-C))	1008.
C=.2166977*B	1009.
Y=Y+.1346334*(FCT(A+C)+FCT(A-C))	1010.
C=.07443717*B	1011.
Y=Y+.1477621*(FCT(A+C)+FCT(A-C))	1012.
RETURN	1013.
END	1014.
FUNCTION FWBPX(B)	1015.
COMMON/AREA5/IGBMAX, IGBMIN, XP, BP	1016.
COMMON/AREA6/X(101), I	1017.
	1018.
	1019.
	1020.

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REAL INTG,IGBMIN,IGBMAX
FWBPDX=DHEQDB(B)*((B-BZ((IGBMIN+INTG(B)+X(1))/2.))/4./3.14159*0.1
RETURN
END
FUNCTION FWBPDX(B)
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
COMMON/AREA6/X(101),I
REAL INTG,IGBMAX,IGBMIN
FWBPDX=DHEQDB(B)*((BZ((IGBMAX+INTG(B)-X(1))/2.))-B)/4./3.14159*0.1
RETURN
END
FUNCTION FDUP(B)
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,IGBMAX,IGBMIN,JC
FDUP=G(B)*((B-FEUP(B))
RETURN
END
FUNCTION FDDN(B)
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,IGBMAX,IGBMIN,JC
FDDN=G(B)*((FBDN(B))-B)
RETURN
END
FUNCTION SIMPSN(DELTA,B)
DIMENSIONB(201)
S=0.
DO10I=2,200,2
10 S=S+B(I-1)+4*B(I)+B(I+1)
SIMPSN=DELTA*S/3.
RETURN
END
REAL FUNCTION INTERP(A,B,C)
DIMENSION B(201),C(201)
IF(A.EQ.B(1))GO TO 40
IF(A.EQ.B(201))GO TO 50
DO10I=2,201
IF(A.LT.B(I))GOTO20
10 CONTINUE
20 IF(B(I).EQ.B(I-1))GOTO30
INTERP=(A-B(I-1))*(C(I)-C(I-1))/(B(I)-B(I-1))+C(I-1)
RETURN
30 INTERP=C(I)
RETURN
40 INTERP=C(1)
RETURN
50 INTEPP=C(201)
RETURN
END
REAL FUNCTION MUUP(HA,HMIN,DELHUP)
COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
REAL MUEN,MUEX
IF(HA.GT.HMIN+DELHUP)GOTO10
MUUP=0.
RETURN
10 MUUP=0.
IF((HMIN.LE.-HS).AND.(HA.LT.-HEXEPS))MUUP=MUEX(HA)
IF(HA.GT.HS)MUUP=MUEN(HA)
RETURN
END
REAL FUNCTION MUDN(HA,HMAX,DELHDN)

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COMMON/AREA3/HC1,HC2,JCO,B0,HS,HEXEPS
REAL MUEN,MUEX
IF(HA.LT.HMAX-DELHDN)GOTO10
MUDN=0.
RETURN
10 MUDN=0.
IF((HMAX.GE.HS).AND.(HA.GT.HEXEPS))MUDN=MUEX(HA)
IF(HA.LT.-HS)MUDN=MUEN(HA)
RETURN
END
FUNCTION BZ(IBZ)
REAL IGB(101)
COMMON/AREA1/B(201),IGB
REAL IBZ
DO10I=2,101
IF(IBZ.LT.IGB(I))GOTO20
10 CONTINUE
20 BZ=(IBZ-IGB(I-1))*(B(2*I-1)-B(2*I-3))/(IGB(I)-IGB(I-1))+B(2*I-3)
RETURN
END
REAL FUNCTION INTG(BZ)
REAL IGB(101)
COMMON/AREA1/B(201),IGB
DO10I=3,201,2
IF(B(I).GT.BZ)GOTO20
10 CONTINUE
20 INTG=(BZ-B(I-2))*(IGB((I+1)/2)-IGB((I-1)/2))/(B(I)-B(I-2))+IGB((I-1)/2)
RETURN
END
SUBROUTINE FIG3(SWITCH)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
INTEGER SWITCH
COMMON/AREA3/HC1,HC2,JCO,B0,HS,HEXEPS
CALLBMXMN(HMAX,HMIN,BMAX,BMIN)
DELTAH=(HMAX-HMIN)/200.
DELHUP=ABS(HEN(BMIN)-HEX(BMIN))
IF(BMIN.EQ.0.)DELHUP=(HS-HMIN)
DELHDN=ABS(HEN(BMAX)-HEX(BMAX))
IF(BMAX.EQ.0.)DELHDN=(HS+HMAX)
DO50I=1,201
HA=HMIN+(I-1)*DELTAH
IF(HA.GT.HMIN+DELHUP)GOTO10
BSUP=BMIN
GOTO20
10 BSUP=0.
IF((BMIN.LT.0.).AND.(HA.LT.-HEXEPS))BSUP=-BEX(-HA)
IF(HA.GT.HS)BSUP=BEN(HA)
20 IF(HA.LT.HMAX-DELHDN)GOTO30
BSDN=BMAX
GOTO40
30 BSDN=0.
IF((BMAX.GT.0.).AND.(HA.GT.HEXEPS))BSDN=BEX(HA)
IF(HA.LT.-HS)BSDN=BEN(HA)
40 HATILD(I)=HMAX+HMIN-HA
THA(I)=HA
TBSUP(I)=BSUP
50 TBSDN(I)=BSDN
IF(SWITCH.EQ.0)RETURN

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      IF(SWITCH.EQ.2)GOTO70
      PRINT5050
      PRINT5052,HMAX
      PRINT5053,HMIN
      PRINT5007,BMAX
      PRINT5006,BMIN
      PRINT5004
      PRINT5005
      PRINT5001
      PRINT5004
      DO60I=1,201
60    PRINT 5002,THA(I),HATILD(I),TBSUP(I),TBSDN(I)
      IF(SWITCH.EQ.1)RETURN
70    CALL GRAPH(201,THA,TBSUP,3,107,12.,9.,0.,0.,0.,0.,'HA (GAUSS);',
1    'BS (GAUSS);','BS VS. HA;','BSUP;')
      CALL GRAPHS(201,THA,TBSDN,11,107,'BSDN;')
      RETURN
5001  FORMAT(' ',2X,'(GAUSS)',13X,'(GAUSS)',13X,'(GAUSS)',13X,'(GAUSS)')
5002  FORMAT(' ',1PE10.3,1P3E20.3)
5004  FORMAT(' ')
5005  FORMAT(' ',4X,'HA',16X,'HATILD',15X,'BSUP',16X,'BSDN')
5006  FORMAT(' ', 'BMIN=',1PE10.3, ' GAUSS')
5007  FORMAT(' ', 'BMAX=',1PE10.3, ' GAUSS')
5050  FORMAT('1')
5052  FORMAT(' ', 'HMAX=',1PE10.3, ' GAUSS')
5053  FORMAT(' ', 'HMIN=',1PE10.3, ' GAUSS')
      END
      SUBROUTINEBMXMN(HMAX,HMIN,BMAX,BMIN)
      COMMON/AREA3/HC1,HC2,JCO,BD,HS,HEXEPS
      IF(HMAX.LE.HS) GO TO 10
      BMAX=BEN(HMAX)
      IF(HMIN.GE.HEX(BMAX)) GO TO 100
      IF(HMIN.GT.HEXEPS) GO TO 110
      IF(HMIN.GE.-HS) GO TO 120
      BMIN=BEN(HMIN)
      RETURN
10    IF(HMAX.LT.-HEXEPS) GO TO 20
      BMAX=0.
      IF(HMIN.LT.-HS) GO TO 130
      GO TO 120
20    IF(HMIN.GE.-HS) GO TO 30
      BMIN=BEN(HMIN)
      IF(HMAX.LE.HEX(BMIN)) GO TO 40
      BMAX=-BEX(-HMAX)
      RETURN
30    BMAX=0.
      GO TO 120
40    BMAX=BMIN
      RETURN
100   BMIN=BMAX
      RETURN
110   BMIN=BEX(HMIN)
      RETURN
120   BMIN=0.
      RETURN
130   BMIN=BEN(HMIN)
      RETURN
      END
      FUNCTION FDWBAU(B)
      COMMON/AREA3/HC1,HC2,JCO,BD,HS,HEXEPS

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COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,IGBMIN,IGBMAX,JC
FDWBAU=-HC1*FBUP(B)*G(B)/2./3.14159*0.1
RETURN
END
FUNCTION FDWBAD(B)
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,IGBMIN,IGBMAX,JC
FDWBAD=-HC1*FBDN(B)*G(B)/2./3.14159*0.1
RETURN
END
FUNCTION FDWSUP(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TESDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TESDN(201)
REAL INTERP
FDWSUP=(INTERP(B,TBSUP,THA)-HEQ(B))*FDUP(B)/4./3.14159*0.1
IF (B.EQ.0.) FDWSUP=(INTERP(0.,TBSUP,THA)-HEQ(1.E-6))
1 *FDUP(0.)/4./3.14159*.1
RETURN
END
FUNCTION FDWBUP(B)
FDWBUP=HEQ(B)*FDUP(B)/4./3.14159*0.1-FDFUP(B)
RETURN
END
FUNCTION FDWAUP(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TESDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TESDN(201)
REAL INTERP
FDWAUP=INTERP(B,TBSUP,THA)*FDUP(B)/4./3.14159*0.1
RETURN
END
FUNCTION FDFUP(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TESDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TESDN(201)
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,INTERP,IGBMAX,IGBMIN,JC
FDFUP=G(B)*(F(B)-F(FBUP(B)))*0.1
RETURN
END
FUNCTION FDWSDN(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
REAL INTERP
FDWSDN=(INTERP(B,TBSDN,THA)-HEQ(B))*FDDN(B)/4./3.14159*0.1
IF (B.EQ.0.) FDWSDN=(INTERP(0.,TBSDN,THA)-HEQ(-1.E-6))
1 *FDDN(0.)/4./3.14159*.1
RETURN
END
FUNCTION FOWBDN(B)
FOWBDN=HEQ(B)*FDDN(B)/4./3.14159*0.1-FDFDN(B)
RETURN
END
FUNCTION FOWADN(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
REAL INTERP
FOWADN=INTERP(B,TBSDN,THA)*FDDN(B)/4./3.14159*0.1
RETURN
END

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FUNCTION FDFDN(B)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
COMMON/AREA5/IGBMAX,IGBMIN,XP,BP
REAL INTG,INTEFP,IGBMAX,IGBMIN,JC
FDFDN=G(B)*(F(FBDN(B))-F(B))*0.1
RETURN
END
FUNCTION FNTFUP(BB)
COMMON/AREA1/B(201),IGB(101)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
REAL INTG,IGB
FNTFUP=2.*INTG(BB)-INTG(BMIN)
RETURN
END
FUNCTION FPTFDN(BB)
COMMON/AREA1/B(201),IGB(101)
COMMON/AREA2/ HMAX,HMIN,BMAX,BMIN,THA,HATILD,TBSUP,TBSDN
DIMENSION THA(201),HATILD(201),TBSUP(201),TBSDN(201)
REAL INTG,IGB
FPTFDN=INTG(BMAX)-2.*INTG(BB)
RETURN
END
C END OF NEDR LISTING
C THIS MUST BE FOLLOWED BY:
C   1. JC MODEL (A) FUNCTION DEFINITION
C   2. HEQ MODEL (B) FUNCTION DEFINITIONS
C      (HEQ,BEQ,DHEQDB,F)
C   3. HEN MODEL (C) FUNCTION DEFINITIONS
C      (HEN,BEN,MUEN)
C   4. HEX MODEL (D) FUNCTION DEFINITIONS
C      (HEX,BEX,MUEX)
C   5. JCL AND DATA CARDS
C THE FOLLOWING ARE SAMPLES OF THE ABOVE:
C (NEDRA1)
C MODEL A1 FOR JC -- THE BEAN MODEL
  FUNCTION JC(B)
  COMMON/AREA3/HC1,HC2,JCO,B0,HS,HEXEPS
  REAL JC,JCO
  JC=JCO
  RETURN
  END
C (NEDRA2)
C MODEL A2 FOR JC -- THE KIM MODEL
  FUNCTION JC(B)
  COMMON/AREA3/HC1,HC2,JCO,B0,HS,HEXEPS
  REAL JC,JCO
  JC=JCO/(1.+ABS(B)/B0)
  RETURN
  END
C (NEDRA3)
C MODEL A3 FOR JC -- THE URBAN MODEL
  FUNCTION JC(B)
  COMMON/AREA3/HC1,HC2,JCO,B0,HS,HEXEPS
  REAL JC,JCO
  IF(ABS(B).GE.HC2)GOTO10
  JC=JCO*(1.-ABS(B)/HC2)/(1.+ABS(B)/B0)
  RETURN
10 JC=0.

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RETURN
END
C (NEDRB2)
MODEL B2 FOR HEQ AND RELATED FUNCTIONS (BEQ,DHEQDB,F) --
  THE SQUARE-ROOT MODEL
  FUNCTION HEQ(B)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  IF(ABS(B).GT.HC2)GOTO10
  IF(B.EQ.0.)GOTO20
  HEQ=(B/ABS(B))*SQRT(HC1**2+(1.-(HC1/HC2)**2)*B**2)
  RETURN
10 HEQ=B
  RETURN
20 HEQ=0.
  RETURN
  END
  FUNCTION BEQ(H)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  IF(ABS(H).GT.HC2)GOTO10
  IF(ABS(H).LE.HC1)GOTO20
  BEQ=H*SQRT((1.-(HC1/H)**2)/(1.-(HC1/HC2)**2))
  RETURN
10 BEQ=H
  RETURN
20 BEQ=0.
  RETURN
  END
  FUNCTION DHEQDB(B)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  IF(ABS(B).GT.HC2)GOTO10
  DHEQDB=ABS(B)*(1.-(HC1/HC2)**2)/SQRT(HC1**2+(1.-(HC1/HC2)**2)*B**2)
1)
  RETURN
10 DHEQDB=1.
  RETURN
  END
  FUNCTION F(B)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  REAL KEQ
  KEQ=SQRT(1-(HC1/HC2)**2)
  SQR=SQRT(HC1**2+KEQ**2*B**2)
  F=ABS(B*SQR+HC1**2/KEQ*ALOG((KEQ*B+SQR)/HC1))/8./3.14159
  RETURN
  END
C (NEDRB3)
C MODEL B3 FOR HEQ AND RELATED FUNCTIONS (BEQ,DHEQDB,F) --
C   THE DUNN-HLAWICZKA MODEL
  FUNCTION HEQ(B)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  IF(B.GE.0.)HEQ=B+HC1
  IF(B.LT.0.)HEQ=B-HC1
  RETURN
  END
  FUNCTION BEQ(H)
  COMMON/AREA3/HC1,HC2,JCO,BQ,HS,HEXEPS
  BEQ=0.
  IF(H.GT.HC1)BEQ=H-HC1
  IF(H.LT.-HC1)BEQ=H+HC1
  RETURN
  END

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FUNCTION DHEQDB(B)	1381.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1382.
DHEQDB=1.	1383.
RETURN	1384.
END	1385.
FUNCTION F(B)	1386.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1387.
IF(B.GE.0.)F=(B**2/2.+B*HC1)/4./3.14159	1388.
IF(B.LT.0.)F=(B**2/2.-B*HC1)/4./3.14159	1389.
RETURN	1390.
END	1391.
C (NEDRC1)	1392.
C MODEL C1 FOR HEN AND RELATED FUNCTIONS (BEN,MUEN) --	1393.
C THE NO-ENTRY-BARRIER MODEL	1394.
FUNCTION HEN(B)	1395.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1396.
HEN=HEQ(B)	1397.
RETURN	1398.
END	1399.
FUNCTION BEN(H)	1400.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1401.
BEN=BEQ(H)	1402.
RETURN	1403.
END	1404.
REAL FUNCTION MUEN(H)	1405.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1406.
IF (ABS(H).LE.HC1) GO TO 10	1407.
B=BEQ(H)	1408.
MUEN=1./DHEQDB(B)	1409.
RETURN	1410.
10 MUEN=0.	1411.
RETURN	1412.
END	1413.
C (NEDRC3)	1414.
C MODEL C3 FOR HEN AND RELATED FUNCTIONS (BEQ,MUEN) --	1415.
C THE SQUARE-ROOT MODEL	1416.
FUNCTION HEN(B)	1417.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1418.
IF(ABS(B).GT.HC2)GOTO10	1419.
IF(B.EQ.0.)GOTO20	1420.
HEN=(B/ABS(B))*SQRT(HS**2+(1.-(HS/HC2)**2)*B**2)	1421.
RETURN	1422.
10 HEN=B	1423.
RETURN	1424.
20 HEN=0.	1425.
RETURN	1426.
END	1427.
FUNCTION BEN(H)	1428.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1429.
IF(ABS(H).GT.HC2)GOTO10	1430.
IF(ABS(H).LE.HS)GOTO20	1431.
BEN=H*SQRT((1.-(HS/H)**2)/(1.-(HS/HC2)**2))	1432.
RETURN	1433.
10 BEN=H	1434.
RETURN	1435.
20 BEN=0.	1436.
RETURN	1437.
END	1438.
REAL FUNCTION MUEN(H)	1439.
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS	1440.

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      IF(ABS(H).GT.HC2)GOTO10
      IF(ABS(H).LT.HS)GOTO20
      IF(ABS(H).EQ.HS)GOTO30
      MUEN=ABS(H)/SQRT((H**2-HS**2)*(1.-(HS/HC2)**2))
      RETURN
10 MUEN=1.
      RETURN
20 MUEN=0.
      RETURN
30 MUEN=1.E6
      RETURN
      END
C (NEDRC4)
C MODEL C4 FOR HEN AND RELATED FUNCTIONS (BEN,MUEN) --
C   THE DUNN-HLAWICZKA MODEL
      FUNCTION HEN(B)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      IF(B.GE.0.)HEN=B+HS
      IF(B.LT.0.)HEN=B-HS
      RETURN
      END
      FUNCTION BEN(H)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      BEN=0.
      IF(H.GT.HS)BEN=H-HS
      IF(H.LT.-HS)BEN=H+HS
      RETURN
      END
      REAL FUNCTION MUEN(H)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      MUEN=0.
      IF(H.LE.-HS)MUEN=1.
      IF(H.GE.HS)MUEN=1.
      RETURN
      END
C (NEDRD3)
C MODEL D3 FOR HEX AND RELATED FUNCTIONS (BEX,MUEX) --
C   THE HEX=B MODEL
      FUNCTION HEX(B)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      HEX=B
      RETURN
      END
      FUNCTION BEX(H)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      BEX=H
      RETURN
      END
      REAL FUNCTION MUEX(H)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      MUEX=1.
      RETURN
      END
C (NEDRD5)
C MODEL D5 FOR HEX AND RELATED FUNCTIONS (BEX,MUEX) --
C   THE DUNN-HLAWICZKA MODEL
      FUNCTION HEX(B)
      COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
      IF(B.GE.0.)HEX=B+HEXEPS
      IF(B.LT.0.)HEX=B-HEXEPS

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RETURN
END
FUNCTION BEX(H)
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
BEX=0.
IF(H.GT.HEXEPS)BEX=H-HEXEPS
RETURN
END
REAL FUNCTION MUEX(H)
COMMON/AREA3/HC1,HC2,JCO,BO,HS,HEXEPS
MUEX=0.
IF(H.LE.-HEXEPS)MUEX=1.
IF(H.GE.HEXEPS)MUEX=1.
RETURN
END
C (NRDATADH)
C JCL AND DATA CARDS FOR THE DUNN-HLAWICZKA MODEL
//LKED.SYSLIB DD
// DD
// DD DSNAME=SYS1.PLOTLIB,DISP=SHR
//LKED.SYSLMOD DD SPACE=(TRK,(25,20,1))
//GO.PLOTTAPE DD SYSOUT=(W,PLOTWTR)
//GO.SYSIN DD *
33333333333333331
      2.E2      4.E5      5.E6      0.E0      5.E2      -1.E2
      0.E0      1.E3 51
      2.E3      0.E0      2.E2      1.E3      2.E3      2.E2      2.E2      0.E0
      2.E3      0.E0      2.E2      2.E3      2.E2      2.E2
/*
//GO.FT14F001 DD DSNAME=&SM,UNIT=SCRTCH,DISP=(NEW,PASS),
// SPACE=(800,(120,15)),DCB=(RECFM=VS,LRECL=796,BLKSIZE=800)
//SMPLTTR EXEC PLOT,PLOTTER=PRINTER
C (NRDATAIM)
C JCL AND DATA CARDS FOR THE INITIAL MODEL --
C NEDR,(NEDRA3),(NEDRP2),(NEDRC3),(NEDRD3)
//LKED.SYSLIB DD
// DD
// DD DSNAME=SYS1.PLOTLIB,DISP=SHR
//LKED.SYSLMOD DD SPACE=(TRK,(25,20,1))
//GO.PLOTTAPE DD SYSOUT=(W,PLOTWTR)
//GO.SYSIN DD *
100000000000000000
      2.E2      4.E5      5.F6      2.E2      5.E2      0.F0
      0.E0      1.E3 51
      2.E3      0.E0      2.E2      1.E3      2.E3      2.E2      2.E2      0.E0
      2.E3      0.E0      2.E2      2.E3      2.E2      2.E2
//GO.FT14F001 DD DSNAME=&SM,UNIT=SCRTCH,DISP=(NEW,PASS),
// SPACE=(800,(120,15)),DCB=(RECFM=VS,LRECL=796,BLKSIZE=800)
//SMPLTTR EXEC PLOT,PLOTTER=PRINTER
//

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SMPLT1/3
SMPLT2/3
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1550.

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