COMMON TAG		ITEM	UNITS
Line 3	~~PXI(1)~~ FSXI(1)	ξ_x components of attitude vector	
	~~PXI(3)~~ FSXI(2)	ξ_y components of attitude vector	
	~~PXI(5)~~ FSXI(3)	ξ_z components of attitude vector	
	FUFB(1)	Usable fuel booster	slugs
	FULB(1)	Usable LOX booster	slugs
	FUFS(1)	Usable fuel stage II	slugs
	FULS(1)	Usable LOX stage II	slugs
	I	CODE (X)	
		if X = 1, a simulation interval	
		if X = 2, an interrupt point	

(2) Group A_2 (at an interrupt point)

COMMON TAG		ITEM	UNITS
Line 1	FSPP(1)	Position X'_m	feet
	FSPP(3)	Position Y'_m	feet
	FSPP(5)	Position Z'_m	feet
	FSPV(1)	Velocity $\dot{X}'_m$	ft/sec
	FSPV(3)	Velocity $\dot{Y}'_m$	ft/sec
	FSPV(5)	Velocity $\dot{Z}'_m$	ft/sec
	FXTIM(1)	Interrupt time	seconds

Lines 2 and 3 are the same as in Group A_1.

(3) Group B (print when altitude $\leq$ 300,000 feet)

COMMON TAG	ITEM	UNITS
FVAX(1)	Wind velocity at missile position	ft/sec
FVAX(3)	Wind velocity at missile position	ft/sec
FVAX(5)	Wind velocity at missile position	ft/sec
FDRAG(1)	Drag d_x	pounds
FDRAG(3)	Drag d_y	pounds
FDRAG(5)	Drag d_z	pounds
FCØSA(1)	Cosine of angle of attack	
FDYNQ(1)	Dynamic pressure	lbs/ft^2
FQLPH(1)	Angle of attack x q	lbs-deg/ft^2
FMCHN(1)	Mach number	

(4) Heading format (print once for each target)

COMMON TAG	ITEM	UNITS
TWTDI	Target directory for ith target	BCD
TWDGZ	Desired ground zero ith target	BCD
TWGLT(1)	Geographic latitude of ith target	degrees
TWLN(1)	Longitude of ith target	degrees

COMMON TAG		ITEM	UNITS
	TWAL(1)	Altitude of ith target above sea level	feet

(5) Target end format (print once for each target)

COMMON TAG		ITEM	UNITS
Line 1	GCWMS(1)	Crosswise offset	feet
Line 2	GDRMS(1)	Down range offset	feet

c. Program Logic. FD P36

(1) Steps 1-3. The current total thrust force is computed as the vector sum of the axial and normal thrust forces. INTRØG interrogates SW(9). If ØN, RSDØRE places the desired quantities on tape 3. If ØFF, RSDØRE returns to the user subprogram.

(2) Steps 4-26. The output quantities desired are divided into three groups as described in the Outputs paragraph. The outputs will be required at an interrupt point or a simulation interval. If either SW(5), SW(6), or SW(7) is ØN, the interrupt point data is printed. Otherwise the simulation interval data is printed. The required outputs are put on the tape under the following conditions:

Heading	Print target identification once for each target. SW(10) ØN indicates that the heading is to be printed.
Group A	Print Group A_1 if at a simulation interval
	Print Group A_2 if at an interrupt point
Group B	Print Group B if the altitude is less than 300,000 feet; otherwise do not.
Target End	Print the offsets when targeting for a particular target is completed. SW(11) ØN indicates that the target end is to be printed.

2-257. SUBPROGRAM P84 (RSUØ). RSUØ sets up the first and last addresses of a block of information to be written as one record on tape B3 and transfers to U03 to write the record. The FORTRAN II reference statement is CALL RSUØ (A,B).

a. Inputs. The inputs are the arguments A and B, where A is the last address of the block to be written and B is the number of words to be written.

b. Outputs. No outputs are defined.

c. Program Logic. The last address of the block to be written is set up for U03. The contents of the index registers are saved and the first address of the block to be written is established. U03 writes this block as a binary record on tape B3 and the index registers are restored. The subprogram returns to the user subprogram.

2-259. SUBPROGRAM D56 (WNDTRP). WNDTRP interpolates the meteorological data for simulation of a missile flight during the same time interval in FSIMLC. The FORTRAN II reference statement is CALL WNDTRP.

a. Inputs. The inputs are as follows:

COMMON TAG	DIMENSION	ITEM	SYMBOL	UNITS
FMALT	2	Current missile altitude above earth ellipsoid	h_m'	feet
FIPRS	2,21,1	Pressure deviation-current detonation area MET data table	P_{MET}	pure no.
FIDNS	2,21,1	Density deviation-current detonation area MET data table	ρ_{MET}	pure no.
FINTH	2,21,1	North wind component-current detonation area MET data table	V_{NWD}	ft/sec
FIEST	2,21,1	East wind component-current detonation area MET data table	V_{EWD}	ft/sec
FMPRS	2	Current atmospheric pressure at missile	P	lbs/in^2

b. Outputs. The outputs are as follows:

COMMON TAG	DIMENSION	ITEM	SYMBOL	UNITS
FQPRS	2	Current pressure deviation factor at missile	P_{cdev}	pure no.
FQDNS	2	Current density deviation factor at missile	ρ_{cdev}	pure no.
FQNTH	2	Current north component of surface wind at missile	V_{NW}	ft/sec
FQEST	2	Current east component of surface wind at missile	V_{EW}	ft/sec

c. Program Logic. FD D56

(1) Steps 1-7. Current pressure deviation data tables are set for 0.0 to 1.192 range and density deviation tables are set at 1.0. IFLAG is set to identification integer 456. If the standard atmosphere is not to be modified by pressure and density deviations, the subprogram continues at step 8; otherwise, the status of impact area MET data is tested. If the impact area MET data modified by pressure and density deviations from the standard atmosphere is to be used, the subprogram continues at step 9; otherwise, the subprogram continues at step 8.

(2) Step 8. North and east surface wind components at the missile are set to zero, the current density deviation factor is set to one, and the subprogram continues at step 17.

(3) Steps 9-16. If all 10 chosen values FIPRS(1,M,1) from the pressure deviation and current detonation area MET data table are less than or equal to the current missile altitude above the earth ellipsoid FMALT, or if M2 is equal to two, the following parameters are defined: the current pressure deviation factor at missile FQPRS, current density deviation factor at missile FQDNS, current north component of surface wind at missile FQNTH, and current east component of surface wind at missile FQEST. Otherwise, FQPRS, FQDNS, FQNTH, and FQEST are computed by equations (1), (2), (3), and (4). If the current atmosphere pressure FMPRS at

the missile is greater than 0.001, the subprogram continues at step 19; otherwise, the subprogram continues at step 17.

(4) Step 17. FQPRS is set to one.

(5) Step 18. Counter CUTIE is incremented by one and the subprogram returns to the user subprogram.

(6) Steps 19-21. FQPRS is converted to consistent units for later use in computing final pressure. If FQPRS is less than 0.85 or greater than 1.15, the subprogram continues at step 17; otherwise, the subprogram continues at step 18.

d. Expressions.

$$P_{cdev} = P_{MET}(M_2 + 10) - \left[\frac{P_{MET}(M_2) - h'_m}{P_{MET}(M_2) - P_{MET}(M_2 - 1)}\right]\left[P_{MET}(M_2 + 10) - P_{MET}(M_2 + 9)\right] \quad (1)$$

$$\rho_{cdev} = \rho_{MET}(M_2 + 10) - \left[\frac{\rho_{MET}(M_2) - h'_m}{\rho_{MET}(M_2) - \rho_{MET}(M_2 - 1)}\right]\left[\rho_{MET}(M_2 + 10) - \rho_{MET}(M_2 + 9)\right] \quad (2)$$

$$V_{NW} = V_{NWD}(M_2 + 10) - \left[\frac{V_{NWD}(M_2) - h'_m}{V_{NWD}(M_2) - V_{NWD}(M_2 - 1)}\right]\left[V_{NWD}(M_2 + 10) - V_{NWD}(M_2 + 9)\right] \quad (3)$$

$$V_{EW} = V_{EWD}(M_2 + 10) - \left[\frac{V_{EWD}(M_2) - h'_m}{V_{EWD}(M_2) - V_{EWD}(M_2 - 1)}\right]\left[V_{EWD}(M_2 + 10) - V_{EWD}(M_2 + 9)\right] \quad (4)$$

2-250. C2 SUBPROGRAMS.

2-251. The subprograms described in this area include those which are not in C1 and which are required only during powered portions of basic missile flight simulations. The subprograms are as follows:

a.	BALEQ	G32	Ballistic Computations of Ratio of Velocity Required to Velocity Currently Calculated
b.	BSTIC	G39	Booster Initialization
c.	CØCØN	G11	Coordinate Conversion Radar to X,Y,Z
d.	CYCLE	G10	Step and Reset Counters
e.	DASMB	G09	Radar Data Assembly
f.	DP	P99	Convert Inertial Coordinates to Radar Coordinates
g.	EXAUST	C76	Monitor Usable Propellants Remaining
h.	GGDSIM	P10	Ground Guidance Simulation
~~i.~~	~~LABEL~~	~~G40~~	~~Determine a Best Representation of Four Input Values~~
j.	MSDST	G07	Compute Miss Distance
k.	MSPØS	G12	Compute Earth-Centered Missile Position
l.	ØLGSIM	D02	Open Loop Guidance Simulator
m.	PITCH	G28	Pitch Computations
n.	PRCSØ	G45	Process Steering Orders
o.	RADSIM	P09	Radar Data Simulator
p.	SGSEP	G46	Signal Separation
q.	SQDEW	G01	One-Step Square Root Approximation

r.	STEER	G26	Steering Filters and Gain Adjustment
s.	STUP1	G02	Setup 1 of GGDSIM
t.	STUP2	G03	Setup 2 of GGDSIM
u.	STUP3	G04	Setup 4 of GGDSIM
v.	SUSIC	G41	Sustainer Initialization
w.	TEST	G47	Check Outputs of GGDSIM
x.	TFLYT	G06	Compute Time of Flight
y.	VRNIC	G42	Vernier Initialization
z.	WIRES	G27	Constant Attitude Wires
a'.	YAWCØ	G50	Compute Correction Factor for Initial Value of Launch Azimuth

2-252. SUBPROGRAM G32 (BALEQ). BALEQ uses ballistic equations to compute the velocity required. The FORTRAN II reference statement is CALL BALEQ.

a. Inputs. The inputs are as follows:

COMMON TAG	ITEM		UNITS
XDEW(598)	$\dot{X}_M^{k-1}$	Aged upon entry (XDEW(598) through XDEW(508))	ft/sec
XDEW(602)	$\dot{Y}_M^{k-1}$		ft/sec
XDEW(606)	$\dot{Z}_M^{k-1}$		ft/sec
XDEW(612)	$(R_M \cdot V_N)^{k-1}$		ft^2/sec
XDEW(618)	$(V^{k-1})^2$		ft^2/sec^2
XDEW(624)	$(V_R)^{k-1}$		ft/sec
XDEW(628)	V^{k-1}		ft/sec
XDEW(508)	V_E^{k-1}		ft/sec
XDEW(52)	$\dot{X}_I^k$		ft/sec
XDEW(58)	$\dot{Y}_I^k$		ft/sec
XDEW(64)	$\dot{Z}_I^k$		ft/sec
XDEW(170)	X_M^k		feet
XDEW(174)	Y_M^k		feet
XDEW(178)	Z_M^k		feet
XDEW(200)	X_T^k		feet
XDEW(204)	Y_T^k		feet
XDEW(208)	Z_T^k		feet
XDEW(212)	X_C^k		$feet^2$

COMMON TAG	ITEM	UNITS
XDEW(218)	Y_C^{k}	$feet^2$
XDEW(224)	Z_C^{k}	$feet^2$
XDEW(254)	R_M^{k}	feet
XDEW(258)	$(R_M^{k})^2$	$feet^2$
XDEW(380)	$\dot{Y}_1^{k}$	ft/sec
XDEW(464)	$\dot{Z}_1^{k}$	ft/sec
XDEW(492)	$\dot{X}_1^{k}$	ft/sec
XDEW(592)	$\dot{Z}_{WN}^{k}$	ft/sec
XDEW(636)	$\dot{C}_W^{k-1}$	ft/sec
XDEW(642)	$\dot{Z}_W^{k-1}$	ft/sec
XDEW(698)	R_C^{k}	$feet^2$
XC(2)	C_1	feet
XS(150)	S_{75}	ft^3/sec^2
NFLAG(10)	P	integer
XDEW(250)	$\ddot{Z}_g^{k}$	ft/sec-cy
XDEW(246)	$\ddot{Y}_g^{k}$	ft/sec-cy

b. Outputs. The outputs are as follows:

COMMON TAG	ITEM	UNITS
XDEW(598)	$\dot{X}_M^{k}$	ft/sec
XDEW(600)	$\dot{X}_M^{k-1}$	ft/sec
XDEW(602)	$\dot{Y}_M^{k}$	ft/sec

COMMON TAG	ITEM	UNITS
XDEW(604)	$\dot{Y}_M^{k-1}$	ft/sec
XDEW(606)	$\dot{Z}_M^{k}$	ft/sec
XDEW(608)	$\dot{Z}_M^{k-1}$	ft/sec
XDEW(610)	$(R_M \cdot R_T)^k$	$feet^2$
XDEW(612)	$(R_M \cdot V_N)^k$	ft^2/sec
XDEW(614)	$(R_M \cdot V_N)^{k-1}$	ft^2/sec
XDEW(616)	$(R_T \cdot V_N)^k$	ft^2/sec
XDEW(618)	$(V^k)^2$	ft^2/sec^2
XDEW(620)	$(V^{k-1})^2$	ft^2/sec^2
XDEW(622)	$\left[(V_R)^k\right]^2$	ft/sec
XDEW(624)	$(V_R)^k$	ft/sec
XDEW(626)	$(V_R)^{k-1}$	ft/sec
XDEW(628)	V^k	ft/sec
XDEW(630)	V^{k-1}	ft/sec
XDEW(500)	V_E^{k-1}	ft/sec
XDEW(508)	V_E^{k}	ft/sec
XDEW(498)	$\dot{Y}_E^{k}$	ft/sec
XDEW(502)	$\dot{X}_N^{k}$	ft/sec
XDEW(504)	$\dot{Y}_N^{k}$	ft/sec
XDEW(506)	$\dot{Z}_N^{k}$	ft/sec
XDEW(518)	$(g \cdot V_E)^k$	ft^2/sec^2

c. Program Logic.

(1) IFLAG is set to identification integer 732. Items $\dot{X}_M$, $\dot{Y}_M$, $\dot{Z}_M$, $(R \cdot V)$, V^2, (V_R), V, and V_E are aged.

if $P \leq 15$ (missile prior to vernier)

$$\dot{Z}_M^{\ k} = \dot{Z}_{WN}^{\ k} + \dot{Z}_W^{\ k-1}$$

$$\dot{Y}_M^{\ k} = \dot{Y}_1^{\ k} + \dot{Y}_I^{\ k}$$

$$\dot{X}_M^{\ k} = (R_C^{\ k}\ \dot{C}_W^{\ k-1} - Y_C^{\ k}\ \dot{Y}_M^{\ k} - Z_C^{\ k}\ \dot{Z}_M^{\ k})/X_C^{\ k}$$

if $19 \leq P \leq 22$ (missile in vernier)

$$\dot{Z}_M^{\ k} = \dot{Z}_1^{\ k} + \dot{Z}_I^{\ k}$$

$$\dot{Y}_M^{\ k} = \dot{Y}_1^{\ k} + \dot{Y}_I^{\ k}$$

$$\dot{X}_M^{\ k} = (R_C^{\ k}\ \dot{C}_W^{\ k-1} - Y_C^{\ k}\ \dot{Y}_M^{\ k} - Z_C^{\ k}\ \dot{Z}_M^{\ k})/X_C^{\ k}$$

if $P \geq 30$ (missile after vernier)

$$\dot{Z}_M^{\ k} = \dot{Z}_1^{\ k} + \dot{Z}_I^{\ k}$$

$$\dot{Y}_M^{\ k} = \dot{Y}_1^{\ k} + \dot{Y}_I^{\ k}$$

$$\dot{X}_M^{\ k} = \dot{X}_1^{\ k} + \dot{X}_I^{\ k}$$

(2) for all values of P

$$(R_M \cdot R_T)^k = X_M^{\ k}\ X_T^{\ k} + Y_M^{\ k}\ Y_T^{\ k} + Z_M^{\ k}\ Z_T^{\ k}$$

$$(V^2)^k = (\dot{X}_M^{\ k})^2 + (\dot{Y}_M^{\ k})^2 + (\dot{Z}_M^{\ k})^2$$

$$V^k = \sqrt{(V^2)^k}$$

(3) if $P < 23$

$$\dot{Y}_E^{\,k} = \sqrt{(V_E^{\,k-1})^2 - (\dot{X}_M^{\,k})^2 - (\dot{Z}_M^{\,k})^2}$$

$$\dot{X}_N^{\,k} = \dot{X}_M^{\,k}\,(V^k / V_E^{\,k-1})$$

$$\dot{Y}_N^{\,k} = \dot{Y}_E^{\,k}\,(V^k / V_E^{\,k-1})$$

$$\dot{Z}_N^{\,k} = \dot{Z}_M^{\,k}\,(V^k / V_E^{\,k-1})$$

if $P \geq 30$

$$\dot{X}_N^{\,k} = \dot{X}_M^{\,k}$$

$$\dot{Y}_N^{\,k} = \dot{Y}_M^{\,k}$$

$$\dot{Z}_N^{\,k} = \dot{Z}_M^{\,k}$$

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(4) for all values of P

$$(R_M \cdot V_N)^k = X_M^{\,k}\,\dot{X}_N^{\,k} + Y_M^{\,k}\,\dot{Y}_N^{\,k} + Z_M^{\,k}\,\dot{Z}_N^{\,k}$$

$$(R_T \cdot V_N)^k = X_T^{\,k}\,\dot{X}_N^{\,k} + Y_T^{\,k}\,\dot{Y}_N^{\,k} + Z_T^{\,k}\,\dot{Z}_N^{\,k}$$

(5) if $P < 23$

$$(V_R^{\,2})^k = \frac{S_{75}\left[C_1 - \frac{(R_M \cdot R_T)^k}{R_M^{\,k}}\right](V^2)^k}{(R_M^{\,2})^k (V^2)^k - \left[(R_M \cdot V_N)^k\right]^2 - (V^2)^k (R_M \cdot R_T)^k + (R_M \cdot V_N)^k (R_T \cdot V_N)^k}$$

$$V_R^{\,k} = \sqrt{(V_R^{\,2})^k}$$

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$$(g \cdot V_E)^k = \ddot{Y}_g^k \dot{Y}_E^k + \ddot{Z}_g^k \dot{Z}_M^k$$

$$V_E^k = V_R^k + (g \cdot V_E)^k / V_E^{k-1}$$

(6) if $P \geq 30$

$$(V_R^2)^k = (V^2)^k$$

$$V_R^k = V^k$$

2-253. SUBPROGRAM G39 (BSTIC). BSTIC performs booster initialization. The FORTRAN II reference statement is CALL BSTIC.

a. Inputs. The inputs are system constants S_{92}-S_{102}. Constants S_{92}-S_{100} are duplexed in registers XS(183)-XS(200). The duplexed values are in consecutive core slots, i.e., system constant S_{93} is defined by XS(185) and the duplexed value by XS(186). Constants S_{101} and S_{102} are in core slots defined by XS(202) and XS(204). The other inputs are as follows:

COMMON TAG	DIMENSION	ITEM
XDEW(90)	1	Y_o^k
XDEW(254)	1	R_M^k

b. Outputs. The outputs are as follows:

COMMON TAG	ITEM	UNITS
XDEW(69), XDEW(70)	$\dot{\bar{\epsilon}}_z^k$	ft/sec
XDEW(71), XDEW(72)	$\dot{\bar{\epsilon}}_z^{k-1}$	ft/sec
XDEW(73), XDEW(74)	$\dot{\bar{\epsilon}}_z^{k-2}$	ft/sec
XDEW(75), XDEW(76)	$\dot{\bar{\epsilon}}_z^{k-3}$	ft/sec
XDEW(77, XDEW(78)	$\dot{\bar{\epsilon}}_c^k$	ft/sec
XDEW(79), XDEW(80)	$\dot{\bar{\epsilon}}_c^{k-1}$	ft/sec
XDEW(81), XDEW(82)	$\dot{\bar{\epsilon}}_c^{k-2}$	ft/sec
XDEW(83), XDEW(84)	$\dot{\bar{\epsilon}}_c^{k-3}$	ft/sec
XDEW(493), XDEW(494)	$\dot{\epsilon}_c^k$	ft/sec
XDEW(513), XDEW(514)	$\dot{\epsilon}_z^k$	ft/sec
XDEW(533), XDEW(534)	$\dot{\theta}_o^k$	$\frac{\text{quanta-ft}}{\text{sec}^2\text{cy}}$

COMMON TAG	DIMENSION	UNITS
XDEW(535), XDEW(536)	$\dot{\theta}_o^{k-1}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(537), XDEW(538)	$\dot{\theta}_o^{k-2}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(539), XDEW(540)	$\dot{\theta}_o^{k-3}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(541), XDEW(542)	$\dot{\Psi}_o^{k}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(543), XDEW(544)	$\dot{\Psi}_o^{k-1}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(545), XDEW(546)	$\dot{\Psi}_o^{k-2}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(547), XDEW(548)	$\dot{\Psi}_o^{k-3}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(667), XDEW(668)	$\dot{\theta}_A^{k}$	quanta/cy
XDEW(671), XDEW(672)	$\dot{\theta}_B^{k}$	quanta/cy
XDEW(681), XDEW(682)	$\dot{\Psi}_A^{k}$	quanta/cy
XDEW(685), XDEW(686)	$\dot{\Psi}_B^{k}$	quanta/cy
XDEW(636)	$\dot{C}_W^{k}$	ft/sec
XDEW(638)	$\dot{C}_W^{k-1}$	ft/sec
XDEW(642)	$\dot{Z}_W^{k}$	ft/sec
XDEW(644)	$\dot{Z}_W^{k-1}$	ft/sec
XDEW(562)	$\dot{\theta}_{ni}^{k}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$
XDEW(564)	$\dot{\theta}_{ni}^{k-1}$	$\frac{\text{quanta ft}}{\text{sec}^2 \text{ cy}}$

COMMON TAG	ITEM	UNITS
XC(82)	C_{41}	
.	.	
XC(88)	C_{44}	
XC(61), XC(62)	C_{31}	
.	.	
XC(77), XC(78)	C_{39}	
NFLAG(4)	Substage cycle counter, q	

c. <u>Program Logic</u>. IFLAG is set to identification integer 739 and substage cycle counter, q, is set to zero. BSTIC performs the following expressions for booster initialization:

$$C_{31} = S_{92},\ C_{32} = S_{93},\ C_{33} = S_{94},\ C_{34} = S_{95},\ C_{35} = S_{96},$$

$$C_{36} = S_{97},\ C_{37} = S_{98},\ C_{38} = S_{99},\ C_{39} = S_{100},\ C_{41} = 0$$

$$C_{42} = 0,\ C_{43} = S_{101},\ C_{44} = S_{102}$$

$$\bar{\epsilon}_{z}^{\,k-i} = \bar{\epsilon}_{\dot{c}}^{\,k-i} = \dot{\theta}_{o}^{\,k-i} = \dot{\Psi}_{o}^{\,k-i} = 0 \qquad \text{for } i = 1,2,3$$

$$\theta_{A}^{\,k} = \theta_{B}^{\,k} = \Psi_{A}^{\,k} = \Psi_{B}^{\,k} = 0$$

$$\dot{C}_{W}^{\,k-i} = \dot{z}_{W}^{\,k-i} = 0 \qquad \text{for } i = 0,1$$

$$\dot{\theta}_{ni}^{\,k-j} = -Y_{o}^{\,k}/R_{M}^{\,k} \qquad \text{for } j = 0,1$$

CUTIE is stepped by one and control is returned to the user subprogram.

2-254. SUBPROGRAM G11 (CØCØN). CØCØN converts radar spherical coordinates to guidance simulator rectangular coordinates. The FORTRAN II reference statement is CALL CØCØN.

a. Inputs. The inputs are as follows:

COMMON TAG	ITEM	UNITS
XE(18)	$E*^K$	radians
XD(18)	$D*^K$	feet
XA(18)	$(A* - A_o)^K$	radians
XC(48)	C_{24}	pure no.
XC(50)	C_{25}	pure no.
SW(49)	Switch 49	
XDEW(94)	X_1^{k-1}	feet
XDEW(96)	X_1^{k-2}	feet
XDEW(98)	X_1^{k-3}	feet
XDEW(120)	Y_1^{k-1}	feet
.	.	.
.	.	.
XDEW(166)	Y_1^{k-24}	feet
XDEW(102)	Z_1^{k-1}	feet
.	.	.
.	.	.
XDEW(116)	Z_1^{k-8}	feet
XDEW(272)	Y_{2a}^K	
.	.	
.	.	
XDEW(286)	Y_{2a}^{k-7}	

COMMON TAG	ITEM	UNITS
XDEW(288)	Y_2^k	
.	.	
.	.	
XDEW(334)	Y_2^{k-23}	
XDEW(340)	$\dot{Y}_2^{k-1}$	
.	.	
.	.	
XDEW(364)	$\dot{Y}_2^{k-13}$	
XDEW(366)	$\Delta_2 Y_{2b}^k$	
.	.	
.	.	
XDEW(372)	$\Delta_2 Y_{2b}^{k-3}$	
XDEW(410)	Y_{DR}^k	

b. <u>Outputs</u>. The outputs are as follows:

COMMON TAG	ITEM	UNITS
XDEW(88)	X_o^k	feet
XDEW(90)	Y_o^k	feet
XDEW(92)	Z_o^k	feet
XDEW(94)	X_1^k	feet
XDEW(96)	X_1^{k-1}	feet
XDEW(98)	X_1^{k-2}	feet
XDEW(100)	X_1^{k-3}	feet
XDEW(120)	Y_1^k	feet
.	.	.
.	.	.
XDEW(168)	Y^{k-24}	feet

COMMON TAG	ITEM	UNITS
XDEW(102)	Z_1^k	feet
⋮	⋮	⋮
XDEW(118)	Z_1^{k-8}	feet
XDEW(274)	Y_{2a}^k	
⋮	⋮	
XDEW(288)	Y_{2a}^{k-7}	
XDEW(290)	Y_2^k	
⋮	⋮	
XDEW(336)	Y_2^{k-23}	
XDEW(340)	$\dot{Y}_2^k$	
⋮	⋮	
XDEW(366)	$\dot{Y}_2^{k-13}$	
XDEW(368)	$\Delta_2 Y_{2b}^K$	
⋮	⋮	
XDEW(374)	$\Delta_2 Y_{2b}^{k-3}$	

c. Program Logic.

(1) IFLAG is set to identification integer 711. CØCØN converts radar spherical coordinates to guidance simulator rectangular coordinates by the following expressions:

$$X_o^k = D*^K \cos E*^K \sin (A* - A_o)^K$$

$$Y_o^k = D*^K \cos E*^K \cos (A* - A_o)^K$$

$$Z_o^k = D*^K \sin E*^K$$

$BX = X_o^K$

$BY = Y_o^k C_{24} + Z_o^k C_{25}$

$BZ = Z_o^k C_{24} - Y_o^k C_{25}$

In the preceding expressions, SINE and CØSINE compute the sine and cosine. RØUND rounds the double-precision outputs of SINE and CØSINE to the single-precision equivalent.

(2) INTRØG interrogates SW(49). If ØFF, SW(49) is set ØN and the following expressions are performed:

Set $X_i^{k-1} = BX$ for $i = 0, 1, 2, 3$

Set $Y_i^{k-1} = BY$ for $i = 0, 1, \ldots, 24$

Set $Z_i^{k-1} = BZ$ for $i = 0, 1, \ldots, 8$

If ØN, the following steps are performed:

Age X_1, Y_1, Z_1

Set $X_1^k = BX$

Set $Y_1^k = BY$

Set $Z_1^k = BZ$

(3) The following steps are performed:

Age Y_{2a}, Y_2, $\dot{Y}_2$, $\Delta_2 Y_{2b}$

Set $Y_{2a}^{k-7} = Y_1^k - Y_{DR}^k$

Set $Y_{2a}^k = Y_{2a}^{k-7} - Y_2^{k-15}$

$$\text{Set } \dot{Y}_2^{\,k} = Y_{2a}^{\,k-7} - Y_2^{\,k-11}$$

$$\text{Set } \dot{Y}_2^{\,k-13} = \dot{Y}_2^{\,k} - \dot{Y}_2^{\,k-8}$$

CUTIE is stepped by one and control is returned to the user subprogram.

2-255. SUBPROGRAM G10 (CYCLE). CYCLE steps K and resets certain registers. The FORTRAN II reference statement is CALL CYCLE.

a. Inputs. The inputs are as follows:

COMMON TAG	ITEM	UNITS
NFLAG(6)	k	integer
FINIT(1)	Largest possible number	pure no.

b. Outputs. The outputs are as follows:

COMMON TAG	ITEM	UNITS
XDEW(229)	$\dot{\theta}_1^k$	quanta/cy
XDEW(230)	$\dot{\theta}_1^k$	quanta/cy
XDEW(231)	$\dot{\psi}_1^k$	quanta/cy
XDEW(232)	$\dot{\psi}_1^k$	quanta/cy
XDEW(573)	$\dot{\theta}_N^k$	quanta/cy
XDEW(574)	$\dot{\theta}_N^k$	quanta/cy
XDEW(659)	$\dot{\psi}_N^k$	quanta/cy
XDEW(660)	$\dot{\psi}_N^k$	quanta/cy
XSTOR(1), XSTOR(2)	$\dot{\theta}_A$	quanta/cy
XSTOR(3), XSTOR(4)	$\dot{\theta}_B$	quanta/cy
XSTOR(5), XSTOR(6)	$\dot{\theta}_C$	quanta/cy
XSTOR(7), XSTOR(8)	$\dot{\theta}_D$	quanta/cy

COMMON TAG	ITEM	UNITS
XSTOR(9), XSTOR(10)	$\dot{\Psi}_A$	quanta/cy
XSTOR(11), XSTOR(12)	$\dot{\Psi}_B$	quanta/cy
XSTOR(13), XSTOR(14)	$\dot{\Psi}_C$	quanta/cy
XSTOR(15), XSTOR(16)	$\dot{\Psi}_D$	quanta/cy
NFLAG(6)	k + 1	cycles
XN(2)	N register	pure no.
XV(2)	V register	seconds
XDBIT(1)-XDBIT(13)	XDBIT(1)-XDBIT(13)	integer

c. Program Logic. CYCLE sets the N register to one and steps K by one. The following registers are initialized:

$$\dot{\theta}_A = \dot{\theta}_B = \dot{\theta}_C = \dot{\theta}_D = \dot{\Psi}_A = \dot{\Psi}_B = \dot{\Psi}_C = \dot{\Psi}_D = 0$$

$$XDBIT(i) = 0, \; i = 1, \ldots, 13$$

$$\dot{\theta}_1{}^k = \dot{\Psi}_1{}^k = \dot{\theta}_N{}^k = \dot{\Psi}_N{}^k = 0$$

XV(2) = highest possible number

CUTIE is stepped by one and control is returned to the user subprogram.

2-256. SUBPROGRAM G09 (DASMB). DASMB produces one value of azimuth from one input set of three coordinates. The FORTRAN II reference statement is CALL DASMB.

a. Inputs. The inputs are as follows:

COMMON TAG	SYMBOL	UNITS
XC(90)	C_{45}	degrees
FRTØD	$180/\pi$	deg/rad
FPI	π	radians

b. Outputs. The output is as follows:

COMMON TAG	SYMBOL	UNITS
XA(20)	$(A^*-A_o)^{k-1}$	radians

c. Program Logic. IFLAG is set to identification integer 709. Constant C_{45} is converted to radians. The following expressions are evaluated for azimuth zero-set:

$$(A^*-A_o)_1^k = A_1^k - C_{45} + 2\pi \quad \text{if } (A_1 - C_{45}) < 0$$

$$= A_1^k - C_{45} - 2\pi \quad \text{if } (A_1 - C_{45}) \geq 0$$

$$= A_1^k - C_{45} \quad \text{if otherwise}$$

2-257. SUBPROGRAM P99 (DP). DP is called by RADSIM to perform coordinate conversion of missile position from inertial rectangular to earth-fixed radar coordinate form. The FORTRAN II reference statement is CALL DP (DFSPP, DFTM, DGDAE).

a. Inputs. The inputs are the argument DFSPP which refers to the missile position for the first to fourth interval and the argument DFTM which refers to the time since liftoff for the same time interval. The other inputs are as follows:

COMMON TAG	DIMENSION	ITEM	SYMBOL	UNITS
GØMGA	2	Rotation rate of earth	Ω	rad/sec
PRSCL	2	Sine of geographic latitude of radar	$\sin L_{GR}$	
PRCCL	2	Cosine of geographic latitude of radar	$\cos L_{GR}$	
GRXYZ	6	Position of guidance radar at time of missile launch	X_R, Y_R, Z_R	feet
XGI(1,3)	2,24	$R_R \sin \varnothing'_R$ - R_R is the distance from center of earth to radar antenna	Z_R	
XGI(1,4)	2,24	$R_R \cos \varnothing'_R$ - $\varnothing'_R$ is the mean geocentric radar latitude	X_R	

b. Outputs. The output is one set of D, A, and E simulated radar data corresponding to the set of input missile position data. The output is placed in the last register designated by the above CALL state   It is of dimension two, three. The first of the duplexed registers contains distance D in feet; the second contains azimuth A in radians; and the third contains elevation angle E in radians.

c. Program Logic. FD P99

(1) Steps 1-2. The inertial earth-centered rectangular coordinates X, Y, and Z are converted to earth-fixed, radar-centered spherical coordinates D, E, and A. X', Y', Z' are earth-centered, earth-fixed, rectangular coordinates obtained from expressions (1),(2),(3) ~~(1)-(3)~~ ~~and~~ CØSINE, and SINE, and RØUND. X'', Y'', and Z'' are earth-fixed, radar-centered rectangular coordinates obtained from expressions (4),(5), and (6) ~~(4)-(6)~~.

(2) Steps 3-9 ~~10~~. X''', Y''', and Z''' are oriented in the same manner as X'', Y'', and Z'' except Z''' is pe pendicular to the tangent plane at the radar site. D, E, and A are then defined in terms of the new rectangular coordinates X''', Y''', and Z'''. VECMAG computes the vector magnitude of range D. ARCSIN computes elevation E by expression (11) and ARCTAN is used in expression (12) to evaluate A. ~~CUPIE is stepped by one and~~ Control is returned to the user subprogram.

d. Expressions.

$$X' = X \cos \Omega t_L + Y \sin \Omega t_L \quad (1)$$

$$Y' = Y \cos \Omega t_L - X \sin \Omega t_L \quad (2)$$

$$Z' = Z \quad (3)$$

$$X'' = X' - X_R \quad (4)$$

$$Y'' = Y' - Y_R \quad (5)$$