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Enclosure: (1) Design Note No. 1.4-7-48, "Dispersion Analysis for the First Orbital Flight Test (OFT-1) Mission

1. The enclosure presents a dispersion analysis for the nominal profile of the First Orbital Flight Test (OFT-1) mission.

Very truly yours,

W. E. Hayes

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MCDONNELL DOUGLAS CORPORATION

MCDONNELL DOUGLAS TECHNICAL SERVICES CO.
HOUSTON ASTRONAUTICS DIVISION

SPACE SHUTTLE ENGINEERING AND OPERATIONS SUPPORT

DESIGN NOTE NO. 1.4-7-48

DISPERSION ANALYSIS FOR THE FIRST ORBITAL FLIGHT TEST (OFT-1) MISSION

MISSION PLANNING, MISSION ANALYSIS AND SOFTWARE FORMULATION

25 FEBRUARY 1977

This Design Note is Submitted to NASA Under Task Order No. D0609, Contract NAS 9-14960.

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1.0 SUMMARY AND INTRODUCTION

A dispersion analysis considering 3-sigma (3σ) uncertainties (or perturbations) in platform, vehicle, and environmental parameters has been performed for the first orbital flight test (OFT-1) mission. The dispersion analysis is based on the nominal trajectory for the OFT-1 reference flight profile (RFP) which is described in Reference 1. The analysis has been performed to determine state vector and performance dispersions (or variations) which result from the indicated 3σ uncertainties. The dispersions are determined at major mission events and fixed times from liftoff (time slices). The dispersion results will be used to evaluate the capability of the vehicle to perform the mission within a 3σ level of confidence and to determine flight performance reserves (FPR).

1.0 SUMMARY AND INTRODUCTION

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2.0 DISCUSSION

2.1 Groundrules and Assumptions

The same groundrules describing the OFT-1 RFP (Reference 1) are also used for this dispersion analysis. In addition, the following assumptions are made:

(a) Dispersion analysis simulations are generated using the Space Vehicle Dynamics Simulation (SVDS) program operating in a three-degree-of-freedom flight simulation mode.

(b) Dispersion analysis results are based on the nominal mission for OFT-1.

(c) First stage steering is defined by vehicle attitude as a function of relative velocity from the nominal profile. This attitude history is used to provide steering commands for all perturbation simulations.

(d) The perturbations considered for evaluation in this dispersion analysis are assumed normally distributed about their statistical mean.

(e) The perturbations are statistically independent.

(f) The perturbations considered include error sources in

guidance and propulsion systems, uncertainties in measurements of system properties, and perturbations in nominal environmental conditions.

2.2 General

2.2.1 Dispersion simulation techniques.- A dispersion analysis is based on a nominal trajectory generated without including any of the uncertainties. Performance-optimum first stage steering commands and second stage guidance inputs are determined for the nominal profile. Since perturbations are unplanned occurrences, the nominal steering and guidance inputs are used in simulating trajectories with perturbations.

The perturbation simulations in this analysis are determined by independently simulating 3σ values of the indicated uncertainties. That is, a complete trajectory simulation (liftoff to 30 seconds after nominal circularization) is developed using only one error source. The dispersion results from these independent simulations are then statistically correlated by 1) a root-rum-square (RSS) process and 2) determining a covariance matrix indicative of all error sources.

2.2.2 Error sources, symbols, and definitions.- A list of the error sources used in this study and their 3σ values is given in Table I. Included in Table I are symbols used in the RSS data tables to identify dispersions resulting from the error sources.

With the exception of the initial platform misalignment error source, the 3σ uncertainty values for the platform error sources and related explanation was obtained from Reference 2. The 3σ uncertainty values for the initial platform misalignment error sources (azimuth, tilt, and roll) at liftoff were derived from data obtained from Reference 2 using a technique given in Reference 3. Center-of-gravity (C.G.) 3σ uncertainty values for only the first stage integrated vehicle were obtained from Reference 4. Upper stage C.G. 3σ uncertainties were not included because of a lack of known reference material. Solid rocket booster propulsion system 3σ uncertainty values were obtained from Reference 5. Reference 5 was also used to obtain the 3σ uncertainty values for the orbiter main propulsion system thrust and specific impulse (ISP) and for the external tank (ET) propellant loading. The orbiter inert weight 3σ uncertainty value was obtained from Reference 4. Reference 4 was also used for the source of the ET inert weight 3σ uncertainty value. Propulsion system uncertainties for the orbital maneuvering system (OMS) were not included due to the lack of a known reference source. The cold atmosphere was obtained from Reference 6. It should be noted the hot atmosphere, also from Reference 6, was analyzed but was not included in the RSS results in as much as the cold atmosphere produced larger dispersions. It should also be noted that uncertainties in atmospheric winds, main propulsion system venting, aerodynamics, and SSME thrust tailoff were not simulated due to either a lack of reference sources or simulation capability.

Figure 1 contains the definition of a local horizontal coordinate system (LHS). The RSS data and covariance matrices indicate state vector dispersions in the LHS. Since the LHS is determined from the nominal state, a different LHS is determined at each instance for which RSS or covariance data is required.

Tables II and III contain symbols used to identify elements of the covariance matrices, a definition of the symbols, and the format of the covariance matrices. Although 3σ values of the error sources are used in the trajectory simulations, state vector dispersions are adjusted to a 1σ level for determining the covariance matrices.

2.2.3 Events and time slices for dispersion analysis.- RSS and covariance matrix data are presented for several events and time slices in this analysis. An event is defined as a fixed occurence (sensed by attaining a given target value) and may have a time-from-liftoff dispersion associated with it. A time slice is indicative of a fixed time from liftoff.

The events and time slices for which RSS and covariance matrix data are presented are as follows:

(a) Solid Rocket Booster (SRB) Separation (See Tables IV-A, IV-B)

(b) Main Engine Cutoff (MECO) (See Tables V-A, V-B)

(c) Time slice defined as nominal MECO time plus 30 seconds, 554.0 seconds from liftoff (See Tables VI-A, VI-B)

(d) Insertion, i.e., completion of the orbital maneuvering system's (OMS) first burn maneuver (OMS-1) (See Tables VII-A, VII-B)

(e) Time slice defined as nominal insertion time plus 150 seconds, 813.2 seconds from liftoff (See Tables VIII-A, VIII-B)

(f) Circularization, i.e., completion of the OMS's second burn maneuver (OMS-2) (See Tables IX-A, IX-B)

(g) Time slice defined as nominal circularization time plus 30 seconds, 2669.8 seconds from liftoff (See Tables X-A, X-B)

As previously stated, the LHS in which state vector dispersions (RSS data and covariance matrix data) are calculated is determined by the nominal state at each of the indicated events and time slices. Each event and time slice has its own LHS in which dispersions are presented.

2.3 RSS Data

The RSS technique is the method used in this analysis to statistically combine dispersions in flight parameters to determine the 3σ limits in the significant parameters. In actual

vehicle flight, there is a 99.73 percent probability that the value of the parameter will be inside the 3σ band (the RSS value) if all assumptions required for this method are justified.

Inherent in the RSS method are the assumptions of linearity and normality. These assumptions are as follows:

(a) The perturbations are statistically independent; that is, the occurrence of one perturbation will not effect the probability of a second perturbation.

(b) A perturbation and its associated flight dispersions are linearly related.

The RSS data presented in this report includes dispersions in altitude, down range and cross range position, and cross range rate computed in the LHS. Velocity (or "speed" as is used in the tables), flight-path angle, altitude rate, time, and total vehicle weight dispersions are also included in the RSS data. The dispersions presented in the RSS data are computed as:

dispersion = (Actual integrated state of perturbed trajectory) - (nominal trajectory state).

RSS data are presented in Tables IV-A through X-A for the major events and time slices defined in Section 2.2.3. Data are included in the tables to indicate parameter dispersions for each

individual error source and the RSS combination of the dispersions. As previously stated, this study assumes all error sources to be normally distributed. Consequently, the RSS data indicated in Tables IV-A through X-A are computed from the dispersions without regard to sign.

RSS data at SRB separation (Table IV-A) and MECO (Table V-A) contain total vehicle weight dispersions and the resulting penalty in terms of orbiter main engine (SSME) propellant. The propellant variations will be used to indicate whether the cumulative penalty is within the flight performance reserve requirements.

RSS data Tables VI-A through X-A contain orbital maneuvering system (OMS) propellant dispersions.

2.4 Covariance Matrix Data

The covariance matrix represents a multivariate normal distribution of a 6 by 1 vector of dispersions in the actual (integrated) state, a 6 by 1 vector of navigated state deviations, and vehicle weight. The navigated state deviations represented in the covariance matrix are computed as:

deviation = (perturbed navigated state) - (actual integrated state of perturbed trajectory).

Table II defines the parameters presented in the covariance

matrices of this paper. The matrices are expressed in the LHS (UVW coordinates) defined by the nominal state vector at each event or time slice (see Figure 1). The covariance matrices are indicative of 1σ perturbations. Each diagonal element of the matrix (Table III) represents the variance of the associated parameter. For example, the element in the second row and second column represents the variance of the actual state in the V (or down-range) direction. Each off-diagonal element represents the covariance between the diagonal elements directly above and directly to the right of it. For example, the element in the fourth row and second column represents the covariance between the down-range variance and the $\dot{U}$ variance.

The elements of the matrix are symbolically defined in Table III. The matrices are given in Tables IV-B through X-B. Since a covariance matrix is symmetrical, only the lower triangle of the matrices is given.

2.5 Exchange Ratios

An exchange ratio is defined as the ratio of a dispersion in a given variable to the magnitude of the error source causing the dispersion. The use of exchange ratios enables a quick-look assessment of the variations from nominal which may be expected to result from the application of error sources of various magnitudes. To use an exchange ratio, multiply a change in a parameter by its corresponding exchange ratio. This defines the

predicted performance change at the event or time slice for which the ratio has been calculated.

Table XI contains exchange ratios indicating space shuttle main engine (SSME) propellant dispersion at MECO for several performance error sources. The exchange ratios are valid for perturbations only within a specified range. The exchange ratios show a sensitivity to an unplanned anomaly; that is, the trajectory is not optimized for the uncertainties. These exchange ratios may be used to predict SSME propellant variations at MECO.

2.6 RSS Summary Data

Summary tables of the RSS data are given in Tables XII and XIII. Table XII contains the RSS data of Tables IV-A through X-A. Data are presented for each event and time slice indicated in the tables. The RSS errors indicated by Table XII are the differences of the actual (integrated) perturbed state from the nominal state. Table XIII is the RSS of navigation deviations computed as defined in Section 2.4. Data are presented in Table XIII for each event and time slice indicated by Tables IV-B through X-B. In considering the data of Tables XII and XIII, it should be noted that uncertainties in atmospheric winds, main propulsion system venting, aerodynamics, and SSME thrust tailoff as well as other uncertainties discussed in Section 2.2.2 are not included. Results of these error sources will be included in the dispersion analysis at a later date.

3.0 CONCLUSIONS

Principal error contributors to the covariance matrix at MECO and circularization are listed in Tables XIV and XV, respectively. The dispersion data indicate that the largest position error occurs in the down range component. At MECO and circularization the vehicle performance uncertainties are the major contributors to down range error.

4.0 REFERENCE

1. JSC Internal Note No. 77-FM-14, "Ascent Reference Flight Profile for OFT-1", dated 7 March 1977.

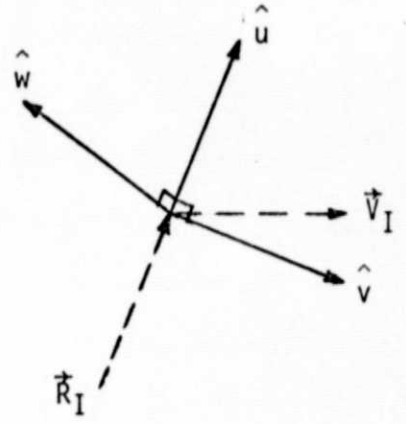
2. R.I. SD-72-SH-0105-1, "Requirements/Definition Document, Guidance and Navigation", dated 16 May 1975.

3. MDTSCO TM 1.4-MPB-444, "Transmittal of Working Paper E914-8A/B-015", dated 29 November 1976.

4. Presentation by J. Jones/RI, "Flight Performance Reserve", Ascent Performance Panel Meeting, 1 September 1976.

5. NASA TM X-64918, "Space Shuttle Launch Vehicle Performance Trajectory, Exchange Ratios, and Dispersion Analysis", dated March 1975.

6. NASA TM X-64757, "Terrestrial Environment (Climatic) Criteria Guidelines for Use in Aerospace Vehicle Development, 1973 Version", dated March 1974.



Let R_I be the inertial position vector and V_I be the inertial velocity vector. The LHS coordinate system is defined by the following three vector equations.

$$\hat{u} = \vec{R}_I / |\vec{R}_I|$$

$$\hat{v} = (\vec{R}_I \times \vec{V}_I \times \vec{R}_I) / |\vec{R}_I \times \vec{V}_I \times \vec{R}_I|$$

$$\hat{w} = \hat{u} \times \hat{v}$$

Figure 1 - Local Horizontal Coordinate System

TABLE I.

ERROR SOURCE DEFINITIONS

ERROR SOURCE SYMBOLS *	DEFINITION	3-SIGMA VALUES	REFERENCE	UNITS
PLATFORM ALINE	INITIAL PLATFORM MISALIGNMENT			
	AZIMUTH	210.000	2,3**	ARC SEC
	TILT,ROLL	66.600		ARC SEC
DRIFT BIAS	FREE GYRO BIAS	.045	2	DEG/HR
G-SENS IA DRIFT	GYRO INPUT AXIS ACCELERATION SENSITIVE DRIFT	.075	2	DEG/HR/G
G-SENS SA DRIFT	GYRO SPIN AXIS ACCELERATION SENSITIVE DRIFT	.075	2	DEG/HR/G
G-SENS OA DRIFT	GYRO OUTPUT AXIS ACCELERATION SENSITIVE DRIFT	.075	2	DEG/HR/G
G-SENS-SQ DRIFT	GYRO ACCELERATION SQUARED SENSITIVE DRIFT	.075	2	DEG/HR/G**2
ACCEL BIAS	ACCELEROMETER BIAS	150.000	2	MICRO-G
ACCEL SCALE FAC	ACCELEROMETER SCALE FACTOR	120.000	2	PPM
ACCEL IA ALINE	ACCELEROMETER INPUT AXIS MISALIGNMENT			
- TOWARD SA	- TOWARD SPIN AXIS	45.000	2	ARC SEC
- TOWARD OA	- TOWARD OUTPUT AXIS	45.000		ARC SEC
CG	CENTER OF GRAVITY - X COMPONENT	.083	4	FT
	Y COMPONENT	.043		FT
	Z COMPONENT	.250		FT
WEB ACT	WEB ACTION TIME	4.710	5	PERCENT
S ISP	SRB SPECIFIC IMPULSE	- .500	5	PERCENT
S PROP	SRB PROPELLANT LOADING	- .210	5	PERCENT
S INERT	SRB INERT WEIGHT	.850	5	PERCENT
		(2963.590)		(LB)
O THRST	ORBITER THRUST	- .797	5	PERCENT
O ISP	ORBITER SPECIFIC IMPULSE	- .292	5	PERCENT
O INERT	ORBITER INERT WEIGHT	.100	4	PERCENT
		(159.420)		(LB)
ET INERT	EXTERNAL TANK INERT WEIGHT	.250	4	PERCENT
		(196.250)		(LB)
ET PROP	EXTERNAL TANK PROPELLANT LOADING	- .480	5	PERCENT
		(7474.430)		(LB)
ATMOSPHERE -COLD	'63 PATRICK COLD ATMOSPHERE	NASA TM X-64757, 'TERRESTRIAL ENVIRONMENT (CLIMATIC) CRITERIA GUIDLINES FOR USE IN AEROSPACE VEHICLE DEVELOPMENT, 1973 VERSION'		

* SYMBOLS USED IN TABLES IV-A THROUGH X-A.

** REF. 3 PRESENTS TECHNIQUE USED FOR DERIVING NEW 3σ VALUE FROM REF. 2 DATA.

TABLE II

Covariance Matrix Parameter Definition

State Vector Component	Definition	Units
U ACT V ACT W ACT	Actual state vector position component dispersions in the Local Horizontal Coordinate System (LHS)	FT
U-DOT ACT V-DOT ACT W-DOT ACT	Actual state vector velocity component dispersion in the LHS	FT/SEC
U NAV V NAV W NAV	Navigated state vector position component deviations in a LHS*	FT
U-DOT NAV V-DOT NAV W-DOT NAV	Navigated state vector velocity component deviations in a LHS*	FT/SEC
WT	Vehicle weight	LB

*The navigated state has its own LHS developed from the nominal navigated state vectors similar to the actual state LHS development. Navigated state vector deviations are computed as:

deviation = (perturbed navigated state) - (actual integrated state of perturbed trajectory)

TABLE III

Covariance Matrix Format

U ACT	σ_u^2												
V ACT	$\sigma_u\sigma_v$	σ_v^2											
W ACT	$\sigma_u\sigma_w$	$\sigma_v\sigma_w$	σ_w^2										
U-DOT ACT	$\sigma_u\sigma_{\dot{u}}$	$\sigma_v\sigma_{\dot{u}}$	$\sigma_w\sigma_{\dot{u}}$	$\sigma_{\dot{u}}^2$									
V-DOT ACT	$\sigma_u\sigma_{\dot{v}}$	$\sigma_v\sigma_{\dot{v}}$	$\sigma_w\sigma_{\dot{v}}$	$\sigma_{\dot{u}}\sigma_{\dot{v}}$	$\sigma_{\dot{v}}^2$								
W-DOT ACT	$\sigma_u\sigma_{\dot{w}}$	$\sigma_u\sigma_{\dot{w}}$	$\sigma_w\sigma_{\dot{w}}$	$\sigma_{\dot{u}}\sigma_{\dot{w}}$	$\sigma_{\dot{v}}\sigma_{\dot{w}}$	$\sigma_{\dot{w}}^2$							
U NAV	$\sigma_u\sigma_{u'}$	$\sigma_v\sigma_{u'}$	$\sigma_w\sigma_{u'}$	$\sigma_{\dot{u}}\sigma_{u'}$	$\sigma_{\dot{v}}\sigma_{u'}$	$\sigma_{\dot{w}}\sigma_{u'}$	$\sigma_{u'}^2$						
V NAV	$\sigma_u\sigma_{v'}$	$\sigma_v\sigma_{v'}$	$\sigma_w\sigma_{v'}$	$\sigma_{\dot{u}}\sigma_{v'}$	$\sigma_{\dot{v}}\sigma_{v'}$	$\sigma_{\dot{w}}\sigma_{v'}$	$\sigma_{u'}\sigma_{v'}$	$\sigma_{v'}^2$					
W NAV	$\sigma_u\sigma_{w'}$	$\sigma_v\sigma_{w'}$	$\sigma_w\sigma_{w'}$	$\sigma_{\dot{u}}\sigma_{w'}$	$\sigma_{\dot{v}}\sigma_{w'}$	$\sigma_{\dot{w}}\sigma_{w'}$	$\sigma_{u'}\sigma_{w'}$	$\sigma_{v'}\sigma_{w'}$	$\sigma_{w'}^2$				
U-DOT NAV	$\sigma_u\sigma_{\dot{u}'}$	$\sigma_v\sigma_{\dot{u}'}$	$\sigma_w\sigma_{\dot{u}'}$	$\sigma_{\dot{u}}\sigma_{\dot{u}'}$	$\sigma_{\dot{v}}\sigma_{\dot{u}'}$	$\sigma_{\dot{w}}\sigma_{\dot{u}'}$	$\sigma_{u'}\sigma_{\dot{u}'}$	$\sigma_{v'}\sigma_{\dot{u}'}$	$\sigma_{w'}\sigma_{\dot{u}'}$	$\sigma_{\dot{u}'}^2$			
V-DOT NAV	$\sigma_u\sigma_{\dot{v}'}$	$\sigma_v\sigma_{\dot{v}'}$	$\sigma_w\sigma_{\dot{v}'}$	$\sigma_{\dot{u}}\sigma_{\dot{v}'}$	$\sigma_{\dot{v}}\sigma_{\dot{v}'}$	$\sigma_{\dot{w}}\sigma_{\dot{v}'}$	$\sigma_{u'}\sigma_{\dot{v}'}$	$\sigma_{v'}\sigma_{\dot{v}'}$	$\sigma_{w'}\sigma_{\dot{v}'}$	$\sigma_{\dot{u}'}\sigma_{\dot{v}'}$	$\sigma_{\dot{v}'}^2$		
W-DOT NAV	$\sigma_u\sigma_{\dot{w}'}$	$\sigma_v\sigma_{\dot{w}'}$	$\sigma_w\sigma_{\dot{w}'}$	$\sigma_{\dot{u}}\sigma_{\dot{w}'}$	$\sigma_{\dot{v}}\sigma_{\dot{w}'}$	$\sigma_{\dot{w}}\sigma_{\dot{w}'}$	$\sigma_{u'}\sigma_{\dot{w}'}$	$\sigma_{v'}\sigma_{\dot{w}'}$	$\sigma_{w'}\sigma_{\dot{w}'}$	$\sigma_{\dot{u}'}\sigma_{\dot{w}'}$	$\sigma_{\dot{v}'}\sigma_{\dot{w}'}$	$\sigma_{\dot{w}'}^2$	
WT	$\sigma_u\sigma_{w_t}$	$\sigma_v\sigma_{w_t}$	$\sigma_w\sigma_{w_t}$	$\sigma_{\dot{u}}\sigma_{w_t}$	$\sigma_{\dot{v}}\sigma_{w_t}$	$\sigma_{\dot{w}}\sigma_{w_t}$	$\sigma_{u'}\sigma_{w_t}$	$\sigma_{v'}\sigma_{w_t}$	$\sigma_{w'}\sigma_{w_t}$	$\sigma_{\dot{u}'}\sigma_{w_t}$	$\sigma_{\dot{v}'}\sigma_{w_t}$	$\sigma_{\dot{w}'}\sigma_{w_t}$	$\sigma_{w_t}^2$

Notes:
a. Unprimed symbols represent actual (integrated) state vector errors.
b. Primed symbols represent navigation state vector error.
c. W_t represents total vehicle weight error.

TABLE IV-A RSS DATA AT SRB SEPARATION (EVENT)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	SSME PROP LB
PLATFORM ALINE										
AZIMUTH	-0.	-33.	121.	-.2	.005	-.0	3.1	.0	0.	0.
TILT	25.	-70.	19.	-.7	.019	.7	.4	.0	0.	0.
ROLL	11.	-11.	-82.	.0	.005	.3	-1.4	.0	0.	0.
DRIFT BIAS										
X	-0.	-1.	2.	-.0	.000	-.0	.1	.0	0.	0.
Y	1.	-3.	1.	-.0	.001	.1	.0	.0	0.	0.
Z	0.	-1.	-3.	-.0	.000	.0	-.1	.0	0.	0.
G-SENS IA DRIFT										
X	-0.	-1.	5.	-.0	.000	-.0	.2	.0	0.	0.
Y	-1.	1.	-0.	.0	-.000	-.0	-.0	.0	0.	0.
Z	0.	-0.	-2.	.0	.000	.0	-.1	.0	0.	0.
G-SENS SA DRIFT										
X	0.	0.	-1.	.0	-.000	.0	-.0	.0	0.	0.
Y	1.	-2.	0.	-.0	.001	.0	.0	.0	0.	0.
Z	2.	-2.	-9.	.0	.001	.1	-.2	.0	0.	0.
G-SENS OA DRIFT										
X	-0.	-0.	1.	-.0	.000	-.0	.1	.0	0.	0.
Y	4.	-8.	2.	-.1	.003	.1	.0	.0	0.	0.
Z	-0.	0.	1.	-.0	-.000	-.0	.0	.0	0.	0.
G-SQ SEN DRIFT										
X	-0.	0.	-1.	.0	-.000	.0	-.0	.0	0.	0.
Y	-0.	1.	-0.	.0	-.000	-.0	-.0	.0	0.	0.
Z	1.	-1.	-4.	.0	.001	.0	-.1	.0	0.	0.
ACCEL BIAS										
X	-7.	14.	5.	.1	-.004	-.2	.1	.0	0.	0.
Y	2.	-4.	-1.	-.0	.001	.1	-.0	.0	0.	0.
Z	-5.	8.	3.	.1	-.003	-.1	.1	.0	0.	0.
ACCEL SCALE FAC										
X	-9.	18.	7.	.2	-.005	-.2	.1	.0	0.	0.
Y	-0.	0.	0.	.0	-.000	-.0	.0	.0	0.	0.
Z	-2.	3.	1.	.0	-.001	-.1	.0	.0	0.	0.
ACCEL IA ALINE										
- OA										
X	2.		-1.	-.0	.001	.1	-.0	.0	0.	0.
Y	1.		-0.	-.0	.001	.1	-.0	.0	0.	0.
Z	-11.		6.	.2	-.006	-.3	.1	.0	0.	0.
- SA										
X	-4.	7.	2.	.1	-.002	-.1	.0	.0	0.	0.
Y	5.	-8.	-2.	-.1	.003	.2	-.1	.0	0.	0.
Z	1.	-2.	-0.	-.0	.001	.1	-.0	.0	0.	0.
CG										
X	-5.	8.	1.	.1	-.003	-.2	.0	.0	0.	0.
Y	5.	-0.	91.	-.3	.003	.0	2.0	.0	0.	0.
Z	257.	-360.	10.	-2.7	.119	7.2	-1.7	.0	0.	0.
PERFORMANCE										
WEB ACT	2375.	7702.	-4956.	-57.6	-.044	-32.6	-15.3	5.9	-18232.	-18232.
S ISP	-1221.	-1693.	-514.	-39.0	.090	-13.5	-10.9	-.0	0.	0.
S PROP	-338.	-491.	-128.	-10.8	.026	-3.7	-3.0	-.0	49.	49.
S INERT	-245.	-332.	-101.	-9.2	.016	-3.6	-2.5	.0	2964.	0.
O THRST	-591.	-668.	-223.	-20.6	.005	-10.2	-5.2	.0	2723.	2723.
O ISP	32.	44.	13.	1.7	-.001	.8	.4	.0	-994.	-994.
O INERT	-14.	-18.	-6.	-.5	.001	-.2	-.1	.0	159.	0.
ET INERT	-16.	-22.	-7.	-.6	.001	-.2	-.2	.0	196.	0.
ET PROP	620.	838.	255.	23.2	-.034	9.4	6.2	.0	-7474.	-7474.
ATMOSPHERE										
COLD	329.	753.	170.	20.4	-.057	6.3	4.9	.0	0.	0.
RSS =	2866.	8024.	5002.	80.2	.174	39.5	21.8	5.9	20138.	19917.

TABLE IV-B

COVARIANCE MATRIX

AT SRB SEPARATION

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	9.1273797+05						
V ACT	2.4081872+06	7.1542505+06					
W ACT	-1.1916605+06	-4.0795347+06	2.7802462+06				
U-DOT ACT	-5.2404448+03	-2.4548295+04	2.0261031+04	1.8250620+02			
V-DOT ACT	-3.4319329+03	-2.6738234+04	2.9569317+04	2.9004868+02	5.5975298+02		
W-DOT ACT	-1.4670564+03	-9.3228683+03	9.5691355+03	9.0237750+01	1.6804281+02	5.2838819+01	
U NAV	-6.4170904+02	-8.1337040+02	9.7574437+02	-5.6027033-01	1.5379444+01	5.9825167+00	6.4759479+02
V NAV	6.5071411+02	4.3284339+02	-3.9467208+02	2.2278217-01	-2.4440229+01	9.6748779+00	-5.1085724+02
W NAV	1.8409487+02	9.7558978+02	-3.2334341+03	-6.2015437-01	9.3470705+00	-6.5780289+01	-1.8463731+02
U-DOT NAV	-5.3039857+00	9.5363742+00	4.6168525+00	-1.3276064-01	2.0046263-01	6.8392458-02	1.3082138+01
V-DOT NAV	3.9067632+00	-1.6132219+01	1.3610261+01	1.0604600-01	-2.6494918-01	3.3567622-01	-8.3016402+00
W-DOT NAV	8.1127027-01	1.2625210+01	-6.1534386+01	3.0930344-02	3.5844047-01	-1.4352782+00	-3.5098564+00
WT	-5.5912296+06	-1.6617311+07	9.7240225+06	5.7106332+04	6.8351584+04	2.3298659+04	2.2906366+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	2.8744997+03					
W NAV	-3.9338272+02	4.5258388+03				
U-DOT NAV	-1.3850064+01	-4.3258251+00	2.8075072-01			
V-DOT NAV	4.8195163+01	-1.1257347+01	-2.2628796-01	8.2533195-01		
W-DOT NAV	-1.0343030+01	8.9974744+01	-7.4289436-02	-2.9072750-01	1.8809731+00	
WT	-3.2071519+03	-1.1491949+03	2.8361148+00	1.1456369+00	1.5329373+00	4.5058348+07

TABLE V-A RSS DATA AT MECO (EVENT)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	SSME PROP LB
PLATFORM ALINE										
AZIMUTH	-99.	-712.	4518.	-.5	-.001	-.6	24.2	-.0	2.	2.
TILT	1202.	-1336.	-140.	-4.7	.013	5.6	-.4	-.0	17.	17.
ROLL	200.	22.	-1269.	.3	-.000	-.2	-3.0	-.0	5.	5.
DRIFT BIAS										
X	4.	-5.	233.	.1	.000	.1	1.8	-.0	0.	0.
Y	216.	-130.	-14.	-.7	.004	1.6	-.1	-.0	0.	0.
Z	-0.	3.	-94.	.1	-.001	-.2	-.3	.0	-0.	-0.
G-SENS IA DRIFT										
X	-2.	-31.	390.	.1	.000	.0	2.5	-.0	0.	0.
Y	-63.	45.	4.	.2	-.001	-.2	-.0	.0	-0.	-0.
Z	-19.	7.	-110.	.2	-.001	-.6	-.3	.0	-0.	-0.
G-SENS SA DRIFT										
X	0.	7.	-70.	.0	.000	.0	-.3	-.0	0.	0.
Y	350.	-173.	-20.	-1.1	.007	3.1	-.1	-.0	0.	0.
Z	24.	3.	-203.	.1	-.001	-.2	-.6	.0	-0.	-0.
G-SENS OA DRIFT										
X	9.	8.	373.	.4	.000	.2	3.4	-.0	0.	0.
Y	354.	-259.	-26.	-1.1	.005	2.1	-.1	-.0	1.	1.
Z	-5.	-0.	35.	-.0	-.000	-.0	.1	.0	-0.	-0.
G-SQ SEN DRIFT										
X	1.	11.	-111.	-.0	.000	.0	-.7	.0	-0.	-0.
Y	-55.	43.	4.	.1	.000	.0	.0	-.0	0.	0.
Z	7.	2.	-133.	.1	-.001	-.3	-.4	.0	-0.	-0.
ACCEL BIAS										
X	-688.	183.	18.	.6	-.006	-2.4	.1	-.0	27.	27.
Y	6.	-55.	637.	-.2	-.000	-.0	2.4	.0	-3.	-3.
Z	-156.	-606.	-50.	-2.3	-.003	-1.4	-.2	-.0	58.	58.
ACCEL SCALE FAC										
X	-522.	175.	14.	.3	-.003	-1.4	.0	-.0	24.	24.
Y	-2.	-18.	-68.	-.0	-.000	-.0	.2	-.0	4.	4.
Z	-134.	-744.	-41.	-2.8	-.003	-1.4	-.2	-.0	65.	65.
ACCEL IA ALINE										
- OA										
X	145.	-53.	-5.	.1	-.000	-.2	.0	.0	-8.	-8.
Y	10.	-162.	977.	-.4	-.000	-.0	5.1	-.0	7.	7.
Z	-212.	-500.	-64.	-2.0	-.004	-1.6	-.2	-.0	58.	58.
- SA										
X	-1027.	215.	30.	1.2	-.012	-5.4	.1	-.0	33.	34.
Y	9.	-34.	852.	-.1	-.000	-.1	2.0	.0	-14.	-14.
Z	29.	-81.	9.	-.3	.000	.1	-.0	-.0	4.	4.
CG										
X	-1.	25.	-0.	-.0	-.000	-.0	-.0	-.0	2.	2.
Y	-1.	-173.	-0.	-.0	.000	.0	-.0	.0	-3.	-3.
Z	-1.	-1079.	-1.	.4	.000	.2	.2	.0	-57.	-57.
PERFORMANCE										
WEB ACT	-28.	-35913.	-1.	-.4	-.001	-.3	-.6	2.4	-4718.	-4718.
S ISP	-0.	-6127.	-1.	-.2	-.000	-.2	-.3	.6	-1235.	-1235.
S PROP	-1.	-1623.	-1.	-.1	-.000	-.0	-.1	.2	-334.	-334.
S INERT	-0.	-1369.	0.	-.1	-.000	-.1	-.1	.1	-289.	-289.
O THRST	-23.	30073.	-3.	-.4	-.000	-.2	-.6	3.9	-661.	-661.
O ISP	-4.	-7885.	-0.	-.3	-.000	-.2	-.4	-.8	-1496.	-1496.
O INERT	2.	268.	-2.	.0	.000	.0	.0	.0	11.	-149.
ET INERT	0.	331.	-2.	.0	.000	.0	.0	.1	13.	-183.
ET PROP	-4.	-12772.	0.	.5	.000	.2	.3	-2.2	-537.	-537.
ATMOSPHERE										
COLD	-1.	3092.	-2.	.1	.000	.0	.1	-.3	633.	638.
RSS =	1926.	49761.	4959.	6.8	.022	9.7	25.6	5.2	5231.	5236.

TABLE V-B

COVARIANCE MATRIX

AT MECO

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	4.1202494+05						
V ACT	-1.6120359+05	2.7512783+08					
W ACT	-9.8954479+04	-3.6007677+05	2.7322666+06				
U-DOT ACT	2.1682748+03	-3.3214936+05	7.9936543+01	4.1142238+02			
V-DOT ACT	-8.0790688+02	4.3657498+03	-2.1806524+02	-8.8105468+00	5.2100449+00		
W-DOT ACT	-3.9477990+02	-1.3364926+03	1.3815214+04	-1.0893423-01	-9.9450874-01	7.2556751+01	
U NAV	-4.1208064+05	2.1851814+05	9.8694010+04	-2.2373394+03	8.1162933+02	3.9658331+02	4.1229166+05
V NAV	2.3265988+05	-4.7593084+05	4.6007100+05	1.5530435+03	-1.5170829+03	2.4954849+03	-2.3288298+05
W NAV	9.9032284+04	3.5032993+05	-2.7338942+06	-6.7647550+01	2.1844212+02	-1.3824042+04	-9.8769381+04
U-DOT NAV	-2.2650251+03	1.4387198+03	-2.2298946+02	-1.3398606+01	5.4996942+00	-1.3408802+00	2.2665283+03
V-DOT NAV	8.2674494+02	-1.3606944+03	1.8923571+02	5.3214955+00	-5.1026975+00	9.4237880-01	-8.2738581+02
W-DOT NAV	4.0923784+02	1.9513638+03	-1.3953198+04	-5.1795412-01	1.1106976+00	-7.3203383+01	-4.0782384+02
WT	8.9264502+03	1.9847939+07	-7.5656913+02	-2.3785686+04	4.9170653+02	4.3795274+02	9.1524940+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	5.5654457+05					
W NAV	-4.6044134+05	2.7355234+06				
U-DOT NAV	-1.6713540+03	2.2297620+02	1.3785362+01			
V-DOT NAV	1.5170018+03	-1.8954802+02	-5.5767552+00	5.1294738+00		
W-DOT NAV	-2.5234539+03	1.3962279+04	1.3142934+00	-9.5048612-01	7.3970783+01	
WT	1.3417337+04	6.1816757+02	3.3087210+01	5.1113777+01	-1.5459606+00	3.0402532+06

TABLE VI-A RSS DATA AT 554.0 SEC (NOMINAL MECO + 30 SEC)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	OMS PROP LB
PLATFORM ALINE										
AZIMUTH	-117.	-692.	5240.	-.9	-.001	-.6	23.9	.0	0.	0.
TILT	1368.	-1311.	-153.	-4.9	.012	5.3	-.4	.0	0.	0.
ROLL	195.	89.	-1357.	.3	-.000	-.2	-2.9	.0	0.	0.
DRIFT BIAS										
X	6.	-0.	286.	.1	.000	.1	1.8	.0	0.	0.
Y	263.	-157.	-16.	-.7	.003	1.5	-.1	.0	0.	0.
Z	-7.	5.	-103.	.1	-.001	-.2	-.3	.0	0.	0.
G-SENS IA DRIFT										
X	-2.	-24.	465.	.1	.000	.0	2.5	.0	0.	0.
Y	-70.	51.	3.	.2	-.000	-.2	-.0	.0	0.	0.
Z	-37.	13.	-120.	.2	-.001	-.6	-.3	.0	0.	0.
G-SENS SA DRIFT										
X	0.	9.	-78.	.0	.000	.0	-.3	.0	0.	0.
Y	443.	-221.	-24.	-1.3	.007	3.1	-.1	.0	0.	0.
Z	17.	5.	-219.	.1	-.000	-.2	-.6	.0	0.	0.
G-SENS OA DRIFT										
X	14.	22.	476.	.4	.000	.2	3.4	.0	0.	0.
Y	416.	-297.	-29.	-1.2	.005	2.0	-.1	.0	0.	0.
Z	-6.	-1.	38.	-.0	-.000	-.0	.1	.0	0.	0.
G-SQ SEN DRIFT										
X	2.	10.	-131.	-.0	.000	.0	-.7	.0	0.	0.
Y	-54.	49.	4.	.1	.000	.0	.0	.0	0.	0.
Z	-0.	4.	-145.	.1	-.001	-.2	-.4	.0	0.	0.
ACCEL BIAS										
X	-764.	571.	20.	.7	-.006	-2.6	.1	.0	0.	0.
Y	5.	-104.	707.	-.2	-.000	-.0	2.3	.0	0.	0.
Z	-194.	64.	-56.	-2.3	-.003	-1.5	-.2	.0	0.	0.
ACCEL SCALE FAC										
X	-561.	507.	15.	.3	-.003	-1.4	.0	.0	0.	0.
Y	-2.	28.	-63.	-.0	-.000	-.0	.2	.0	0.	0.
Z	-172.	-2.	-48.	-2.7	-.004	-1.6	-.2	.0	0.	0.
ACCEL IA ALINE - OA										
X	139.	-154.	-4.	.1	-.000	-.2	.0	.0	0.	0.
Y	9.	-83.	1131.	-.4	-.000	-.1	5.1	.0	0.	0.
Z	-257.	181.	-69.	-2.0	-.004	-1.8	-.2	.0	0.	0.
- SA										
X	-1185.	718.	33.	1.4	-.012	-5.3	.1	.0	0.	0.
Y	6.	-216.	913.	-.1	-.000	-.1	2.0	.0	0.	0.
Z	31.	-44.	9.	-.3	.000	.1	-.0	.0	0.	0.
CG										
X	-1.	47.	-1.	-.0	-.000	-.0	.0	.0	0.	0.
Y	-1.	-207.	-1.	-.0	.000	.0	-.0	.0	0.	0.
Z	1.	-1725.	5.	.3	.001	.3	.2	.0	0.	0.
PERFORMANCE										
WEB ACT	-749.	-96307.	-13.	.2	-.000	-.0	-.5	.0	0.	0.
S ISP	-145.	-21846.	-9.	-.1	-.000	-.1	-.3	.0	0.	0.
S PROP	-37.	-5871.	-3.	-.1	-.000	-.0	-.1	.0	0.	0.
S INERT	-33.	-5050.	-1.	-.0	-.000	-.0	-.1	.0	0.	0.
O THRST	-952.	-70488.	-21.	.5	.001	.3	-.3	.0	0.	0.
O ISP	146.	11379.	-11.	-.5	-.001	-.3	-.4	.0	0.	0.
O INERT	-8.	-913.	-1.	.0	.000	.0	.0	.0	159.	0.
ET INERT	-10.	-1120.	-1.	.0	.000	.0	.0	.0	0.	0.
ET PROP	418.	42423.	10.	-.1	-.000	-.0	.1	.0	0.	0.
ATMOSPHERE										
COLD	64.	11214.	0.	.0	.000	.0	.1	.0	0.	0.
RSS =	2544.	129896.	5710.	6.9	.021	9.5	25.3	.0	159.	0.

TABLE VI-B

COVARIANCE MATRIX

AT NOMINAL MECO + 30 SEC

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	7.1929730+05						
V ACT	1.7402614+07	1.8747616+09					
W ACT	-1.1988736+05	-7.5483294+04	3.6222228+06				
U-DOT ACT	-1.8768518+04	-2.2627013+06	-3.3736739+02	2.7410127+03			
V-DOT ACT	-8.7612639+02	1.5957897+04	-2.2216593+02	-2.2869303+01	5.5240994+00		
W-DOT ACT	-3.6699181+02	6.7314474+03	1.5830616+04	-9.9313544+00	-8.7693675-01	7.1199259+01	
U NAV	-5.3798194+05	4.1836581+05	1.2249848+05	-2.7446945+03	1.0020341+03	4.4164449+02	5.3989691+05
V NAV	3.0939831+05	-4.0411227+05	5.3632327+05	1.5475118+03	-1.7457727+03	2.4847531+03	-3.0871639+05
W NAV	1.2380608+05	4.0757145+05	-3.6292055+06	-6.0012718+01	2.2626478+02	-1.5861195+04	-1.2302501+05
U-DOT NAV	-2.6285341+03	2.1113511+03	-2.4585177+02	-1.4009393+01	5.8293433+00	-1.2737519+00	2.6370952+03
V-DOT NAV	1.0193378+03	-9.4108698+02	2.0311579+02	4.8343371+00	-5.4120895+00	8.7555172-01	-1.0161021+03
W-DOT NAV	4.6061453+02	1.9389566+03	-1.6000805+04	-4.2988056-01	9.8435738-01	-7.1915692+01	-4.5691124+02
WT	-1.3860256+02	-1.6171205+04	-2.1675242+01	1.9898916+01	4.5428061-01	2.4014436-01	-2.5607367+01

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	6.7390845+05					
W NAV	-5.3763519+05	3.6363030+06				
U-DOT NAV	-1.8966706+03	2.4482557+02	1.3894981+01			
V-DOT NAV	1.7560484+03	-2.0382177+02	-5.8863566+00	5.4682788+00		
W-DOT NAV	-2.5112473+03	1.6034320+04	1.2347851+00	-8.7769930-01	7.2718418+01	
WT	2.2967268+01	2.6836932+01	-3.4762980-02	-3.1642022-02	-2.5090509-02	2.8239260+03

TABLE VII-A RSS DATA AT INSERTION (EVENT)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	OMS PROP LB
PLATFORM ALINE										
AZIMUTH	-171.	1185.	7834.	-.3	-.001	-.7	23.6	.1	-5.	-3.
TILT	1903.	-1010.	-151.	-5.6	.010	4.3	.5	.0	-3.	-2.
ROLL	188.	738.	-1640.	.3	-.000	-.1	-2.2	.0	-2.	-1.
DRIFT BIAS										
X	20.	217.	482.	.1	.000	.1	1.8	.0	-1.	-0.
Y	424.	-299.	-19.	-1.0	.003	1.4	.0	-.0	-0.	-0.
Z	-31.	149.	-133.	.1	-.001	-.2	-.2	.0	-0.	-0.
G-SENS IA DRIFT										
X	3.	77.	735.	.1	.000	.1	2.5	.0	-0.	-0.
Y	-91.	19.	1.	.2	-.000	-.2	-.0	-.0	0.	0.
Z	-97.	165.	-154.	.3	-.001	-.6	-.3	.0	-0.	-0.
G-SENS SA DRIFT										
X	2.	-25.	-108.	.0	.000	.0	-.3	-.0	0.	0.
Y	765.	-464.	-33.	-1.7	.004	2.9	-.1	-.0	-0.	-0.
Z	-5.	161.	-274.	.1	-.000	-.2	-.4	.0	-0.	-0.
G-SENS OA DRIFT										
X	95.	962.	850.	.3	.001	.3	3.5	.0	-1.	-1.
Y	629.	-771.	-29.	-1.5	.004	1.8	.1	.0	-0.	-0.
Z	-7.	-1.	47.	-.0	-.000	-.0	.1	.0	0.	-0.
G-SQ SEN DRIFT										
X	4.	37.	-202.	-.0	-.000	-.0	-.7	.0	-0.	-0.
Y	-47.	-45.	4.	.1	.000	.1	-.0	-.0	0.	0.
Z	-26.	91.	-184.	.1	-.001	-.2	-.3	.0	-0.	-0.
ACCEL BIAS										
X	-1049.	2286.	-8.	1.2	-.007	-3.1	-.6	.1	-5.	-3.
Y	7.	822.	982.	-.2	-.000	-.1	3.0	.0	-2.	-1.
Z	-493.	-9602.	-112.	-2.5	-.004	-2.6	-1.0	-.4	23.	13.
ACCEL SCALE FAC										
X	-728.	-1009.	-18.	.5	-.003	-1.4	-.7	-.1	4.	2.
Y	-3.	-130.	-44.	-.0	-.000	-.0	.2	-.0	0.	0.
Z	-410.	-3001.	-104.	-2.5	-.005	-2.4	-1.0	-.1	5.	3.
ACCEL IA ALINE										
- OA										
X	123.	221.	12.	.1	-.000	-.2	.3	.0	-1.	-0.
Y	-3.	-33.	1683.	-.4	-.000	-.2	5.0	.0	-0.	-0.
Z	-496.	-2053.	-140.	-1.6	-.005	-2.3	-1.2	-.1	4.	2.
- SA										
X	-1768.	-116.	12.	2.1	-.011	-5.2	-.6	-.0	2.	1.
Y	2.	366.	1140.	-.2	-.000	-.1	2.2	.0	-1.	-1.
Z	29.	-480.	11.	-.3	-.000	-.0	.0	-.0	1.	1.
CG										
X	-3.	-295.	-14.	.0	-.000	-.0	-.2	-.0	1.	0.
Y	1.	97.	-1.	-.0	-.000	-.0	.1	.0	-1.	-0.
Z	147.	15476.	511.	-.2	.001	.2	10.0	.7	-44.	-25.
PERFORMANCE										
WEB ACT	-276.	-53569.	-1255.	.5	-.002	-.9	-25.2	1.7	46.	26.
S ISP	-167.	-20860.	-658.	.3	-.001	-.4	-13.0	.0	39.	22.
S PROP	-46.	-5904.	-163.	.1	-.000	-.1	-3.2	-.0	11.	6.
S INERT	-42.	-5117.	-138.	.1	-.000	-.1	-2.7	-.0	10.	6.
O THRST	-172.	12216.	-1161.	.2	.000	.1	-22.0	3.2	47.	27.
O ISP	-192.	-24135.	-789.	.3	-.001	-.4	-15.6	-1.4	43.	24.
O INERT	31.	3283.	31.	-.0	.000	.1	.7	.2	151.	-4.
ET INERT	17.	1689.	41.	-.0	.000	.0	.9	.1	-4.	-2.
ET PROP	282.	16952.	622.	.2	-.000	-.1	12.3	-1.0	-78.	-44.
ATMOSPHERE										
COLD	43.	7287.	143.	-.1	.000	.1	2.9	-.2	-11.	-6.
RSS =	3252.	69383.	8496.	7.7	.021	9.5	49.3	4.1	199.	73.

TABLE VII-B

COVARIANCE MATRIX

AT INSERTION

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	1.1751393+06						
V ACT	3.5165334+06	5.3488419+08					
W ACT	-7.3679965+04	1.3199645+07	8.4024919+06				
U-DOT ACT	-9.8552442+02	-6.3709447+05	-1.6364515+04	7.6864894+02			
V-DOT ACT	-1.7549634+03	6.6251709+03	-2.3884667+02	-1.1670358+01	6.7917252+00		
W-DOT ACT	2.4180416+03	2.4356186+05	3.3446459+04	-2.9123023+02	-1.1318079+00	2.7054494+02	
U NAV	-1.1410771+06	-2.1109640+05	2.0808807+05	-2.9562430+03	1.7914039+03	-7.8832508+00	1.1388119+06
V NAV	6.9458307+05	-1.7786437+06	8.0738037+05	3.4977431+03	-2.8176692+03	2.5754909+03	-7.0374948+05
W NAV	2.2764626+05	-1.2330107+06	-7.9042712+06	2.1600050+03	2.0972827+02	-2.3267530+04	-2.4203356+05
U-DOT NAV	-4.0534692+03	-2.7939339+02	-3.8102880+02	-1.1100530+01	7.1145166+00	-3.0142434+00	4.0483787+03
V-DOT NAV	1.7622770+03	-4.9527488+03	2.3267278+02	9.6531756+00	-6.7752601+00	9.9859826-01	-1.7925690+03
W-DOT NAV	5.9259730+02	-3.8578412+03	-2.2969113+04	6.5815474+00	5.8773564-01	-6.8690752+01	-6.3849210+02
WT	-9.3418552+03	-6.3915387+05	-3.2146694+04	7.5650429+02	-7.4398364+00	-5.4924692+02	2.2916029+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	1.2965479+06					
W NAV	-8.0310216+05	7.9288534+06				
U-DOT NAV	-2.9262433+03	2.7525961+02	1.4929224+01			
V-DOT NAV	2.8227983+03	-2.1277941+02	-7.1197054+00	6.7891960+00		
W-DOT NAV	-2.4148752+03	2.3037465+04	9.2034718-01	-5.9558581-01	6.7880776+01	
WT	1.6033870+03	4.9150400+03	7.8401675+00	6.0708436+00	1.5083075+01	4.4214578+03

TABLE VIII-A RSS DATA AT 813.2 (NOMINAL INSERTION + 150 SEC)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	OMS PROP LB
PLATFORM ALINE										
AZIMUTH	-303.	-705.	11233.	-.2	-.002	-.8	21.6	.0	-3.	-3.
TILT	2412.	-3405.	-69.	-6.2	.006	2.6	.6	.0	-2.	-2.
ROLL	184.	119.	-1940.	.3	.000	.1	-1.8	.0	-1.	-1.
DRIFT BIAS										
X	36.	22.	743.	.1	.000	.1	1.7	.0	-0.	-0.
Y	617.	-556.	-18.	-1.2	.003	1.1	.0	.0	-0.	-0.
Z	-65.	49.	-166.	.2	-.000	-.2	-.2	.0	-0.	-0.
G-SENS IA DRIFT										
X	13.	-6.	1092.	.1	.000	.1	2.3	.0	-0.	-0.
Y	-112.	136.	-5.	.2	-.000	-.1	-.0	.0	0.	0.
Z	-176.	122.	-190.	.4	-.001	-.5	-.2	.0	-0.	-0.
G-SENS SA DRIFT										
X	6.	14.	-146.	.0	.000	.0	-.2	.0	0.	0.
Y	1161.	-929.	-41.	-2.1	.005	2.4	-.0	.0	-0.	-0.
Z	-32.	45.	-331.	.2	-.000	-.2	-.3	.0	-0.	-0.
G-SENS DA DRIFT										
X	98.	88.	1355.	.3	.001	.4	3.2	.0	-1.	-1.
Y	867.	-901.	-13.	-1.8	.003	1.4	.1	.0	-0.	-0.
Z	-11.	-0.	56.	-.0	-.000	-.0	.1	.0	0.	-0.
G-SQ SEN DRIFT										
X	1.	6.	-297.	-.0	-.000	-.0	-.6	.0	-0.	-0.
Y	-29.	90.	-0.	.1	.000	.1	-.0	.0	0.	0.
Z	-58.	51.	-227.	.2	-.000	-.2	-.3	.0	-0.	-0.
ACCEL BIAS										
X	-1506.	1260.	-104.	1.8	-.006	-2.8	-.6	.0	-3.	-3.
Y	-22.	-157.	1411.	-.2	-.000	-.2	2.7	.0	-1.	-1.
Z	-863.	-347.	-260.	-2.0	-.008	-3.5	-1.0	.0	13.	13.
ACCEL SCALE FAC										
X	-915.	895.	-128.	.8	-.003	-1.3	-.7	.0	2.	2.
Y	-3.	26.	-19.	-.0	-.000	-.0	.2	.0	0.	0.
Z	-808.	-470.	-247.	-2.0	-.007	-3.3	-.9	.0	3.	3.
ACCEL IA ALINE - DA										
X	101.	-168.	53.	.1	-.000	-.1	.3	.0	-0.	-0.
Y	-48.	-174.	2407.	-.4	-.001	-.3	4.6	.0	-0.	-0.
Z	-866.	-44.	-324.	-1.2	-.006	-2.9	-1.2	.0	2.	2.
- SA										
X	-2495.	1902.	-76.	3.0	-.010	-9.7	-.6	.0	1.	1.
Y	-24.	-252.	1448.	-.1	-.000	-.2	1.9	.0	-1.	-1.
Z	19.	-135.	16.	-.3	-.000	-.1	.0	.0	'	1.
CG										
X	-1.	48.	-51.	-.0	-.000	-.0	-.2	.0	0.	0.
Y	-9.	-209.	14.	-.0	-.000	-.0	.1	.0	-0.	-0.
Z	8.	-1785.	1995.	-.1	.000	.1	9.8	.0	-25.	-25.
PERFORMANCE										
WEB ACT	-1013.	-96574.	3083.	1.3	-.003	-1.1	-24.9	.0	26.	26.
S ISP	-234.	-21862.	-2600.	.4	-.001	-.4	-12.8	.0	22.	22.
S PROP	-63.	-5881.	-641.	.1	-.000	-.1	-3.2	.0	6.	6.
S INERT	-56.	-5057.	-548.	.1	-.000	-.1	-2.7	.0	6.	6.
D THRST	-1144.	-71064.	-9389.	1.4	-.002	-.7	-21.7	.0	27.	27.
D ISP	129.	11540.	-3139.	.0	-.000	-.0	-15.3	.0	24.	24.
D INERT	-5.	-931.	133.	.0	.000	.0	.7	.0	155.	-9.
ET INERT	-8.	-1132.	170.	.0	-.000	-.0	.8	.0	-2.	-2.
ET PROP	495.	42673.	2472.	-.3	.000	.1	12.1	.0	-44.	-44.
ATMOSPHERE COLD	100.	11246.	580.	-.2	.000	.1	2.9	.0	-6.	-6.
RSS =	4759.	130466.	14693.	8.6	.020	9.1	47.8	.0	171.	73.

TABLE VIII-B

COVARIANCE MATRIX

AT NOMINAL INSERTION + 150 SEC

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	2.5164557+06						
V ACT	2.1290092+07	1.8912660+09					
W ACT	9.8734797+05	1.0212747+08	2.3986979+07				
U-DOT ACT	-2.1371633+04	-2.2647322+06	-1.2278891+05	2.7209325+03			
V-DOT ACT	-2.9886814+03	4.1228680+03	-3.8926961+02	-8.1977129+00	8.0637976+00		
W-DOT ACT	6.4673367+03	5.1006149+05	6.9867888+04	-6.0976746+02	-1.5524425+00	2.5392281+02	
U NAV	-2.2389708+06	1.9311118+06	3.0284126+05	-6.4525284+03	2.9886537+03	-5.5298199+01	2.2592942+06
V NAV	1.5734108+06	-2.4019847+06	1.1796348+06	4.3369976+03	-4.6438459+03	2.5099138+03	-1.5790114+06
W NAV	4.9354655+05	8.2261821+05	-1.5972007+07	1.3702180+02	1.1639192+02	-3.0220008+04	-4.9288586+05
U-DOT NAV	-6.0776395+03	5.6255334+03	-6.7700208+02	-1.7693028+01	8.8360833+00	-2.8514556+00	6.1350396+03
V-DOT NAV	2.9811371+03	-3.9997116+03	2.5420338+02	7.9316239+00	-8.2354519+00	9.1240966-01	-2.9929848+03
W-DOT NAV	8.6934222+02	1.4892533+03	-2.9983125+04	2.7653172-01	2.0715676-01	-5.7272061+01	-8.7057960+02
WT	-1.1477655+04	-7.4760805+05	-6.3144562+04	8.8777299+02	-1.9228600+00	-2.9974678+02	2.2509410+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	2.8242758+06					
W NAV	-1.1062267+06	1.5961199+07				
U-DOT NAV	-4.8470127+03	1.9184748+02	1.7052414+01			
V-DOT NAV	4.7554445+03	-1.0841005+02	-8.8576770+00	8.4818796+00		
W-DOT NAV	-2.1267693+03	2.9947824+04	4.6485692-01	-1.8958477-01	5.6685045+01	
WT	1.1147052+03	4.0097105+03	6.0599670+00	3.1207132+00	7.9121898+00	3.2614352+03

TABLE IX-A RSS DATA AT CIRCULARIZATION (EVENT)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	OMS PROP LB
PLATFORM ALINE										
AZIMUTH	-1806.	5015.	8960.	1.6	-.000	-.1	-22.7	.1	-3.	-3.
TILT	-8287.	-4781.	434.	6.3	-.021	-9.4	-.2	.0	-2.	-2.
ROLL	1448.	-1332.	-179.	-1.1	.002	.7	2.9	.0	-1.	-1.
DRIFT BIAS										
X	941.	-619.	769.	-.4	.000	.1	-1.7	.0	-0.	-0.
Y	-718.	-3646.	19.	.4	-.004	-1.9	.0	-.0	0.	0.
Z	113.	555.	-52.	-.1	.001	.3	.3	.0	-0.	-0.
G-SENS IA DRIFT										
X	255.	-463.	995.	-.2	.000	.1	-2.3	-.0	0.	0.
Y	241.	237.	-27.	-.2	.001	.3	.0	-.0	0.	0.
Z	174.	1347.	-52.	-.0	.002	.7	.3	.0	-0.	-0.
G-SENS SA DRIFT										
X	85.	-200.	-86.	-.1	.000	.0	.3	-.0	0.	0.
Y	-918.	-7296.	-10.	.3	.008	-3.6	.1	-.0	0.	0.
Z	260.	271.	-60.	-.2	.001	.3	.5	.0	-0.	-0.
G-SENS OA DRIFT										
X	1258.	-1891.	1533.	-1.1	.001	.3	-3.1	.0	-0.	-0.
Y	-1446.	-3957.	86.	.9	-.006	-2.8	-.0	.0	-0.	-0.
Z	-54.	75.	7.	.0	.000	.0	-.1	-.0	0.	0.
G-SQ SEN DRIFT										
X	-29.	[illegible]	-259.	.0	-.000	-.0	.6	.0	-0.	-0.
Y	248.	-455.	-18.	-.2	.000	.1	.0	-.0	0.	0.
Z	184.	361.	-58.	-.1	.001	.3	.4	.0	-0.	-0.
ACCEL BIAS										
X	-1162.	11431.	-202.	1.8	.009	4.1	.5	.0	-1.	-1.
Y	-729.	2158.	1152.	.6	-.001	-.4	-2.4	.0	-2.	-2.
Z	-10106.	15281.	-535.	8.9	-.007	-3.2	.7	-.1	4.	4.
ACCEL SCALE FAC										
X	-1283.	5144.	-445.	1.2	.002	1.1	.5	-.1	2.	2.
Y	-51.	-76.	129.	.0	-.000	-.0	-.1	-.0	0.	0.
Z	-9702.	14494.	-515.	8.3	-.006	-2.5	.7	-.1	3.	3.
ACCEL IA ALINE										
- OA										
X	493.	-372.	163.	-.3	.001	.3	-.2	.0	-0.	-0.
Y	-1250.	1734.	1899.	1.1	-.001	-.5	-4.8	-.0	-0.	-0.
Z	-7384.	12643.	-671.	6.4	-.003	-1.3	1.0	-.1	2.	2.
- SA										
X	-1801.	17004.	-370.	2.2	.011	5.0	.4	-.0	1.	1.
Y	-506.	1155.	535.	.4	-.000	-.1	-2.4	.0	-1.	-1.
Z	-895.	587.	17.	.7	-.001	-.4	-.0	-.0	1.	1.
CG										
X	-7.	-167.	-145.	.0	.000	.0	.2	-.0	0.	0.
Y	-25.	138.	63.	.0	.000	.0	-.1	.0	-0.	-0.
Z	-118.	13471.	5842.	.1	-.000	-.1	-7.3	.6	-22.	-22.
PERFORMANCE										
WEB ACT	503.	-49377.	-14800.	-.5	.000	.2	18.3	1.8	21.	21.
S ISP	265.	-18812.	-7620.	-.3	.000	.1	9.4	.1	19.	19.
S PROP	9.	-5411.	-1877.	-.0	.000	.0	2.3	.0	6.	6.
S INERT	4.	-4445.	-1610.	-.0	.000	.0	2.0	.0	5.	5.
O THRST	565.	13388.	-12906.	-.6	.000	.0	14.1	3.3	25.	25.
O ISP	310.	-21815.	-9138.	-.3	.000	.1	11.3	-1.3	21.	21.
O INERT	10.	3898.	399.	-.0	.000	.0	-.5	.2	154.	-6.
ET INERT	10.	1522.	506.	-.0	-.000	-.0	-.6	.1	-2.	-2.
ET PROP	683.	16115.	7215.	-.6	-.000	-.0	-8.9	-1.0	-99.	-99.
ATMOSPHERE										
COLD	-34.	6784.	1719.	.0	-.000	-.0	-2.1	-.2	-6.	-6.
RSS =	18473.	72116.	24723.	15.8	.030	13.2	39.2	4.2	168.	67.

TABLE IX-B

COVARIANCE MATRIX

AT CIRCULARIZATION

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	3.7915991+07						
V ACT	-4.6952463+07	5.7785143+08					
W ACT	-2.1676251+06	1.2613275+08	7.9345110+07				
U-DOT ACT	7.0221792+04	-6.5984024+05	-1.4808131+05	7.7273302+02			
V-DOT ACT	-3.2225365+04	4.5013509+04	2.2852263+03	-6.3982930+01	2.7614738+01		
W-DOT ACT	5.1902762+03	-1.6332423+05	-1.1113675+05	1.9174486+02	-4.9970766+00	1.7089696+02	
U NAV	-3.9628798+07	4.7320636+07	4.8690651+05	-7.1398050+04	3.3684866+04	-3.0914859+03	4.1820395+07
V NAV	5.1901867+07	-1.4766668+08	1.7275570+06	1.5848083+05	-4.8452292+04	2.6299393+03	-5.5179014+07
W NAV	1.6472045+06	-5.2303065+06	-9.7783581+06	6.0870239+03	-1.4375116+03	2.4680074+04	-1.6374469+06
U-DOT NAV	-7.6146072+04	1.5831119+05	-1.2527753+03	-1.8831059+02	6.8119596+01	-4.0627704+00	8.0760802+04
V-DOT NAV	3.3900094+04	-4.4515590+04	-3.0647905+02	6.4142947+01	-2.9037210+01	2.5370795+00	-3.5831327+04
W-DOT NAV	-4.5512710+03	1.3866648+04	2.4964956+04	-1.6207224+01	3.9517937+00	-6.3904177+01	4.5246011+03
WT	-6.3072305+03	-2.1073650+05	-1.5718462+05	2.4693029+02	4.0057434+00	1.9845456+02	7.7648498+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	1.6578137+08					
W NAV	3.0831475+06	9.6149857+06				
U-DOT NAV	-1.7985871+05	-3.5805906+03	2.1382488+02			
V-DOT NAV	5.1633375+04	1.4346556+03	-7.2615649+01	3.0926930+01		
W-DOT NAV	-8.6075144+03	-2.4548239+04	1.0068184+01	-3.9414155+00	6.3578999+01	
WT	-1.8604908+04	2.9417346+03	2.1927656+01	-7.1024289+00	-7.2033035+00	3.1203315+03

TABLE X-A RSS DATA AT 2669.8 SEC (NOMINAL CIRCULARIZATION + 30 SEC)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	OMS PROP LB
PLATFORM ALINE										
AZIMUTH	-1808.	3433.	8246.	1.6	-.000	-.1	-23.1	.0	-3.	-3.
TILT	-8577.	-5081.	427.	6.7	-.021	-9.2	-.3	.0	-2.	-2.
ROLL	1471.	-1991.	-90.	-1.2	.002	.7	2.9	.0	-1.	-1.
DRIFT BIAS										
X	445.	-799.	710.	-.4	.000	.1	-1.7	.0	-0.	-0.
Y	-776.	-3355.	19.	.5	-.004	-1.9	.0	.0	0.	0.
Z	192.	458.	-43.	-.1	.001	.3	.3	.0	-0.	-0.
G-SENS IA DRIFT										
X	257.	-470.	923.	-.2	.000	.1	-2.3	.0	0.	0.
Y	252.	354.	-26.	-.2	.001	.3	.0	.0	0.	0.
Z	196.	1242.	-43.	-.1	.002	.7	.3	.0	-0.	-0.
G-SENS SA DRIFT										
X	86.	-136.	-78.	-.1	.000	.0	.3	.0	0.	0.
Y	-1032.	-7132.	-8.	.5	-.008	-3.6	.1	.0	0.	0.
Z	271.	131.	-44.	-.2	.001	.3	.5	.0	-0.	-0.
G-SENS DA DRIFT										
X	1268.	-2297.	1435.	-1.1	.001	.3	-3.2	.0	-0.	-0.
Y	-1533.	-3957.	84.	1.0	-.006	-2.8	-.1	.0	-0.	-0.
Z	-54.	133.	4.	.0	.000	.0	-.1	.0	0.	0.
G-SQ SEN DRIFT										
X	-29.	74.	-239.	.0	-.000	-.0	.6	.0	-0.	-0.
Y	251.	-348.	-18.	-.2	.000	.1	.0	.0	0.	0.
Z	195.	346.	-46.	-.1	.001	.3	.4	.0	-0.	-0.
ACCEL BIAS										
X	-1032.	11321.	-377.	1.6	.009	4.2	.5	.0	-1.	-1.
Y	-740.	989.	1076.	.6	-.001	-.3	-2.5	.0	-2.	-2.
Z	-10206.	18991.	-512.	9.0	-.007	-3.0	.8	.0	4.	4.
ACCEL SCALE FAC										
X	-1251.	6819.	-428.	1.1	.002	1.1	.5	.0	2.	2.
Y	-52.	109.	127.	.0	-.000	-.0	-.1	.0	0.	0.
Z	-9779.	17854.	-491.	8.4	-.005	-2.3	.8	.0	3.	3.
ACCEL IA ALINE										
- DA										
X	503.	-730.	157.	-.4	.001	.3	-.2	.0	-0.	-0.
Y	-1245.	1823.	1746.	1.1	-.001	-.4	-4.9	.0	-0.	-0.
Z	-7425.	15255.	-640.	6.5	-.003	-1.2	1.0	.0	2.	2.
- SA										
X	-1644.	18311.	-358.	2.0	.011	5.1	.4	.0	1.	1.
Y	-510.	634.	459.	.4	-.000	-.1	-2.5	.0	-1.	-1.
Z	-908.	1050.	15.	.8	-.001	-.4	-.0	.0	1.	1.
CG										
X	-7.	75.	-139.	.0	.000	.0	.2	.0	0.	0.
Y	-24.	-152.	61.	.0	.000	.0	-.1	0	-0.	-0.
Z	-112.	-1970.	5616.	.1	-.000	-.1	-7.5	.0	-22.	-22.
PERFORMANCE										
WEB ACT	373.	-95436.	-14252.	-.6	.000	.2	18.9	.0	21.	21.
S ISP	267.	-21509.	-7321.	-.3	.000	.1	9.8	.0	19.	19.
S PROP	11.	-5685.	-1803.	-.0	.000	.0	2.4	.0	6.	6.
S INERT	5.	-4876.	-1547.	-.0	.000	.0	2.1	.0	5.	5.
O THRST	487.	-70078.	-12450.	-.6	.000	.1	14.6	.0	25.	25.
O ISP	311.	11369.	-8763.	-.3	.000	.1	11.7	.0	21.	21.
O INERT	13.	-1003.	383.	-.1	.000	.0	-.5	.0	154.	-6.
ET INERT	11.	-1161.	486.	-.0	-.000	-.0	-.6	.0	-2.	-2.
ET PROP	639.	91566.	6922.	-.6	-.000	-.1	-9.2	.0	-44.	-44.
ATMOSPHERE										
COLD	-38.	11054.	1646.	.0	-.000	-.0	-2.2	.0	-6.	-6.
RSS =	18706.	134459.	25578.	16.0	.030	13.1	40.2	.0	168.	67.

TABLE X-B

COVARIANCE MATRIX

AT NOMINAL CIRCULARIZATION + 30 SEC

	U ACT	V ACT	W ACT	U-DOT ACT	V-DOT ACT	W-DOT ACT	U NAV
U ACT	3.8879305+07						
V ACT	-5.9442919+07	2.0088080+09					
W ACT	-1.7501141+06	2.8735376+08	7.2691891+07				
U-DOT ACT	8.4591834+04	-2.3240879+06	-3.3533977+05	2.7079248+03			
V-DOT ACT	-3.3154441+04	6.1352457+04	2.6064995+03	-8.3025173+01	2.8497084+01		
W-DOT ACT	4.9280679+03	-3.8680482+05	-1.0889238+05	4.5141037+02	-5.7132204+00	1.7988334+02	
U NAV	-4.0648694+07	5.7987069+07	4.1032795+05	-8.3620175+04	3.4644968+04	-3.1360947+03	4.2872469+07
V NAV	5.4042965+07	-1.7354693+08	1.7846074+06	1.8820428+05	-5.0115105+04	2.7478312+03	-5.7468622+07
W NAV	1.5021583+06	-3.1069577+06	-8.2821557+06	3.5839680+03	-1.3128661+03	2.3036629+04	-1.4936992+06
U-DOT NAV	-7.8475554+04	1.8868404+05	-1.3505720+03	-2.2287044+02	7.0079076+01	-4.1756387+00	8.3233576+04
V-DOT NAV	3.4992469+04	-5.4067560+04	-2.4417391+02	7.5274854+01	-3.0022779+01	2.5704916+00	-3.6976656+04
W-DOT NAV	-4.6187286+03	9.6028746+03	2.3303456+04	-1.1155215+01	4.0149899+00	-6.5888967+01	4.5937744+03
WT	-6.5667833+03	-6.3834169+05	-1.5103844+05	7.4394967+02	3.3803752+00	2.0479866+02	7.7796373+03

	V NAV	W NAV	U-DOT NAV	V-DOT NAV	W-DOT NAV	WT
V NAV	1.7317680+08					
W NAV	2.9063013+06	8.1336971+06				
U-DOT NAV	-1.8794159+05	-3.3395167+03	2.2235106+02			
V-DOT NAV	5.3771474+04	1.3083069+03	-7.5111576+01	3.2107734+01		
W-DOT NAV	-9.0284541+03	-2.2884498+04	1.0458021+01	-4.0007791+00	6.5494760+01	
WT	-1.9107408+04	2.7249098+03	2.2359422+01	-7.1563371+00	-7.2902715+00	3.1203315+03

TABLE XI

EXCHANGE RATIOS AT NOMINAL MECO

Parameter Varied	Δ ET Propellant/ Δ Parameter	
Web Action Time (constant ISP)	-1002.	lb/%
SRB Vacuum ISP (constant $\dot{W}$)	2470.	lb/%
SRB Propellant Loading	1590.	lb/%
SRB Inert Weight	-.10	lb/lb
Orbiter Thrust (constant ISP)	829.	lb/%
Orbiter ISP (constant $\dot{W}$)	5123.	lb/%
Orbiter Inert Weight	-.93	lb/lb
External Tank Inert Weight	-.93	lb/lb
External Tank Propellant Loading	.07	lb/lb

TABLE XII RSS SUMMARY DATA (ACTUAL PERTURBED STATE - NOMINAL STATE)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	SSME PROP LB	OMS PROP LB
SRB SEPARATION	2866.	8024.	5002.	80.2	.174	39.5	21.8	5.9	20138.	19917.	-
MECO	1926.	49761.	4959.	6.8	.022	9.7	25.6	5.2	5231.	5236.	-
NOMINAL MECO + 30 SEC	2544.	129896.	5710.	6.9	.021	9.5	25.3	.0	159.	-	0.
INSERTION	3252.	69383.	8696.	7.7	.021	9.5	49.3	4.1	199.	-	73.
NOMINAL INSERTION + 150 SEC	4759.	130466.	14693.	8.6	.020	9.1	47.8	.0	171.	-	73.
CIRCULARIZATION	18473.	72116.	26723.	15.8	.030	13.2	39.2	4.2	168.	-	67.
NOMINAL CIRCULARIZATION + 30 SEC	18706.	134459.	25578.	16.0	.030	13.1	40.2	.0	168.	-	67.

NOTE: These dispersions are indicative of simulated 3σ uncertainties.

TABLE XIII RSS SUMMARY DATA (PERTURBED NAVIGATED STATE - ACTUAL PERTURBED STATE)

	ALTITUDE FT	DOWN RANGE FT	CROSS RANGE FT	SPEED FPS	FLIGHT-PATH ANGLE-DEG	ALTITUDE RATE-FPS	CROSS RANGE RATE-FPS	TIME SEC	WEIGHT LB	SSME PROP LB	OMS PROP LB
SRB SEPARATION	76.	161.	202.	2.1	.028	1.6	4.1	5.9	20138.	19917.	-
MECO	1926.	2238.	4962.	6.7	.022	9.8	25.8	5.2	5231.	5236.	-
NOMINAL MECO + 30 SEC	2204.	2463.	5721.	7.0	.022	9.6	25.6	.0	159.	-	0.
INSERTION	3201.	3416.	8447.	7.7	.021	9.4	24.7	4.1	199.	-	73.
NOMINAL INSERTION + 150 SEC	4509.	5042.	11985.	8.6	.021	9.2	22.6	.0	171.	-	73.
CIRCULARIZATION	19401.	38627.	9302.	16.7	.030	13.3	23.9	4.2	168.	-	67.
NOMINAL CIRCULARIZATION + 30 SEC	19643.	39479.	8556.	17.0	.030	13.2	24.3	.0	168.	-	67.

NOTE: These dispersions are indicative of simulated 3σ uncertainties.

TABLE XIV

PRINCIPAL ERROR CONTRIBUTORS TO COVARIANCE MATRIX AT MECO

State Vector Component*	Principal Error Source
u	Platform misalignment (tilt), and accelerometer input axis misalignment toward spin axis (X).
v	Web action time, orbiter thrust and external tank propellant loading.
w	Platform misalignment (azimuth and roll) and accelerometer input axis misalignment toward output axis (Y).
.	
.	
u	Web action time, orbiter thrust, and external tank propellant loading.
.	
.	
v	Platform misalignment (tilt), accelerometer bias (Z), accelerometer scale factor (Z) and accelerometer input axis misalignment toward output axis (Z).
.	
.	
w	Platform misalignment (azimuth).

*Both the actual and navigated state vectors.

TABLE XV

PRINCIPAL ERROR CONTRIBUTIONS TO COVARIANCE MATRIX
AT CIRCULARIZATION

State Vector Component*	Principal Error Source
u	Platform misalignment (tilt), accelerometer bias (Z), accelerometer scale factor (Z) and accelerometer input axis misalignment toward output axis (Z).
v	Accelerometer bias (Z), accelerometer input axis misalignment toward spin axis (X), web action time, SRB specific impulse, orbiter specific impulse and external tank propellant loading.
w	Platform misalignment (azimuth), web action time, orbiter thrust and orbiter specific impulse.
.	
u	Accelerometer bias (Z), accelerometer scale factor (Z), web action time, SRB specific impulse and orbital specific impulse.
.	
v	Platform misalignment (tilt), accelerometer bias (Z), accelerometer scale factor (Z) and accelerometer input axis misalignment toward output axis (Z).
.	
w	Platform misalignment (azimuth), web action time, orbiter thrust and orbiter specific impulse.

*Both the actual and navigated state vectors.