https://ntrs.nasa.gov/search.jsp?R=19650021410 2020-03-17T01:05:22+00:00Z

TECHNICAL INFORMATION SERIES

THREE COMPUTER PROGRAMS FOR N-BODY TRAJECTORIES AND INTERPLANETARY TRAJECTORIES

N 65-ccc 301 NO.1 (THRU) CR 64357 (CODE) 5*0*

ICE	\$		
PRICE	S) \$		
/ Hard copy Microfiche	(HC) (MF)	<u>75</u>	
ff 653 July 65		. c:	

J. P. de Vries T. Coffin

R64507

SPACE SCIENCES LABORATORY GENERAL BELECTRIC MISSILE AND SPACE DIVISION

SPACE SCIENCES LABORATORY

MECHANICS SECTION

THREE COMPUTER PROGRAMS FOR N-BODY TRAJECTORIES AND INTERPLANETARY TRAJECTORIES*

Bу

J. P. deVries T. Coffin

*Prepared under contract no. NAS2-1706 with NASA-Ames Research Center

-

R64SD7 January 1964

MISSILE AND SPACE DIVISION



FOREWORD

This report was prepared by the Space Sciences Laboratory, Missile and Space Division, General Electric Company, King of Prussia, Pennsylvania, under NASA contract no. NAS2-1706 for the NASA Ames Research Center, Moffett Field, California.

This report is a description of three computer programs delivered to NASA-Ames according to the terms of the above mentioned contract. The preparation of the report was performed under the supervision of Dr. F. Wendt, Acting Manager-Mechanics Section, by Messrs. J. P. deVries, W. M. Pauson, T. Coffin and F. T. Nicholson.

31011

ABSTRACT

This report contains complete input instructions, operating instructions and sample problems with computer output for three IBM-7094 Computer Programs. The Programs and their essential features are:

- Interplanetary Trajectory Program. This program determines the burnout velocity for a trajectory from Earth to any other planet or from any other planet to Earth.
- II) N-Body Trajectory Program. This is an N-body program with fourth order Runge-Kutta integration with optional doubling and halving procedure and according to the Cowell or the Encke method. It also can print out central angle, ground trace and azimuth and elevation of the velocity vector.
- III) N-Body Program with Sensitivity Coefficients and Differential Correction. This is in purpose similar to the Interplanetary Trajectory Program, but a first estimate of the trajectory must be available from an external source. It computes a 6 x 6 sensitivity matrix by integration along the trajectory; it also makes use of an improved differential correction procedure.

A full description of Program I is available in reference 1 and 2. This report presents an outline of the pertinent sections of those references, to facilitate their use. Full descriptions and analyses are presented for those features that distinguish Programs II and III from Program I.

Auto

TABLE OF CONTENTS

Page

•

*

		Foreword	i		
		Abstract			
	1.	General Description of the Three Programs	1		
		l.l Introduction	1		
		l.2 Program I, The Interplanetary Trajectory Program	2		
		1.2.1 Mode 1, Interplanetary Trajectory	2		
		l.2.2 Mode 2, Initial Configuration Angle	5		
		1.2.3 Mode 3, N-Body Trajectory	5		
		1.3 Program II, the N-Body Program With Options	6		
		1.4 Program III, the N-Body Program with Sensitivity Coefficients and Differential Corrections	6		
	2.	Outline of References 1 and 2	7		
		2.1 Introduction			
		2.2 Reference 1	7		
		2.3 Reference 2	9		
	2.4 Reference 2 Supplement				
	3.	Additions and Modifications	14		
	3.1 Introduction				
		3.2 Ground Trace, Central Angle and Azimuth and Elevation of Velocity Vector			
		3.3 Computation of Sensitivity Coefficients			
4.		Operating Instructions			
		General Operating Procedures	28		
		General Operating Procedures 4.1 Program I			
		4.1.1 Computer Input	32		
		Type l	32		
		Type 2	35 ·		
		Туре 3	35		

4.1.2	Computer Output	38
	Type l	38
	Type 2	39
	Туре З	39
4.1.3	Sample Problem	40
4.1.4	Listing	45
4.2 Progra	am II	56
4.2.1	Computer Input	56
4.2.2	Computer Output	59
4.2.3	Sample Problem	60
4.2.4	Listing	63
4.3 Progra	am III	66
4.3.1	Computer Input	66
4.3.2	Computer Output	69
4.3.3	Sample Problem	71
4.3.4	Listing	79
References	6	83

5.

1. GENERAL DESCRIPTIONS OF THE THREE PROGRAMS

1.1 Introduction

This section is a general description of three computer programs. Complete operating instructions and the in-and output formats are given in section 4. Sample problems are presented in section 5. The three computer programs described in this report are:

I. Interplanetary Trajectory Program

This program can be used in three ways:

- mode 1) To determine the burnout velocity and the trajectory between Earth and any other planet except Pluto (or vice versa) when departure date and trip time are given.
- mode 2) To determine the initial configuration angle between departure and destination planets for a given departure date.
- mode 3) To compute an N-body trajectory when initial position and velocity components are given; this includes as an option the use of six (or less) midcourse velocity corrections.
 - II. N-body Program with Options

This is the same program as (I, 3) above, but the units of the output may be miles and feet-per-second (or any other units, depending on input) whereas the units of (I, 3) are always A. U. and A. U. per hour. This program also contains options to compute ground trace information, azimuth and elevation of velocity vector and central angle. It does not have the midcourse correction option.

III. <u>N-body Program with Sensitivity Coefficients and Differential</u> Corrections

This program determines the burnout velocity of interplanetary trajectories (similarly to I, 1) by differential correction of a first estimate. It differs from (I, 1) in three aspects:

a) a first estimate of the initial conditions obtained from another source, must be used as input (the program (I, 1) computes its own estimate) b) the sensitivity coefficients are computed by integration along the trajectory, whereas (I, 1) computes them by perturbing the initial velocity components.

c) it has an option to print out the 6 x 6 sensitivity coefficient matrices along a nominal trajectory.

The content and operation of program I are reported in G.E. TIS reports R60SD465 (Ref. 1) and R61SD047 (Ref. 2). Ref. 1 deals with the N-body program which is the common basis for all the programs mentioned above. Ref. 2 is a complete description and operation manual for program I, the Interplanetary Trajectory Program, in its three modes of operation. Ref. 2 also contains flow charts.

Programs II and III grew out of program I by a process of adding and modifying. The additions and modifications are described in this report. To facilitate the use of references 1 and 2, this report contains an outline of their content.

The chart on page 3 is a summary of this introduction.

1.2 Program I, The Interplanetary Trajectory Program

This program is fully described in Ref. 2. It may be used in three ways.

1.2.1 Mode 1, Interplanetary Trajectory

In this mode the program computes an interplanetary trajectory from Earth to any other planet (except Pluto) or from any planet to Earth. The initial condition is some altitude above a given launch site at some time during a given departure date. The end condition is intersection of a sphere of given radius (which may or may not be the actual radius from the center of the destination planet after a given trip time. The time of burnout on the departure date is determined to take the best advantage of the planet's rotation. (For those planets of which the rotation is not known this feature is dispensed with.) The trip time is satisfied within a tolerance specified in the input.

The input is principally the identification of departure and arrival planets, the departure date and the trip time; other input consists of physical

	SUMMARY OF RELATION BETWEEN THE THREE PROGRAMS
Program	I Interplanetary Trajectory
Three m	des of operation
mode 1	Interplanetary trajectory
	Heliocentric transfer analysis Geocentric departure analysis First estimate of trajectory N-body trajectory Sensitivity coefficients (by perturbation) Iteration by differential correction Needs first estimate from other source N-body trajectory Iteration by modified differential correction Sensitivity coefficients by integration Option to print out 6 x 6 sensitivity matrix
mode 2	Computation of Initial Configuration Angle
mode 3	N-body TrajectoryProgram IIDoubling and halving, Runge-KuttaN-body trajectory with options: output in mi, ft/sec ground traceCowell or Encke, with optional switch Option to transfer coordinate center Option for 6 midcourse correctionsProgram II N-body trajectory ground trace azimuth and elevation of velocity vector
	(no option for midcourse corrections)
	Described in references 1 and 2 Described in this report

constants, indicators to make the N-body subroutine compute according to the desired mode and conditions to end the program.

The program begins with the computation of an estimated burnout velocity on the basis of a two body analysis (the "heliocentric transfer analysis") in which the planets are massless. This estimate is refined by introducing the orbital eccentricities of departure and arrival planets (the "geocentric departure analysis"); this part of the program also determines the time of burnout during the departure day to take the best advantage of the planet's rotation. The refined estimate is run as an N-body trajectory; sensitivity coefficients are computed by perturbing the initial velocity components. The estimate is improved iteratively by a differential correction procedure that is based on the sensitivity coefficients.

The heliocentric transfer analysis computes the eccentricity and semi-major axis of the transfer ellipse (or hyperbola, if desired) for given departure date and trip time. This is done by a rather simple iteration procedure, but the formulas to be used depend on the type of transfer to be made. There are four types of elliptic transfers: direct, indirect, perihelion, aphelion; these terms are defined in Ref. 2. To get the iteration started properly, the particular kind of transfer must be indicated in the input. Ref. 2 contains graphs of Earth-planet and planet-Earth transfers; in each graph the trip time -- initial configuration angle space is divided in several areas each of which is associated with a particular type of transfer. Thus, for given trip time and departure date an estimate can be made about which type of transfer is required, since the knowledge of departure date is equivalent to that of initial configuration angle. Since the plots are based on coplanar, circular planetary orbits, their information may be in error especially when a close-to-Hohmann transfer is desired. In that case a number of possible types of transfer may be indicated in the input; the program will then try each type in turn until the correct one is found.

If one does not want to determine the initial configuration angle by referring to the ephemeris and computing the scalar vector of the position vectors, one may use mode 2 of the program to obtain that angle.

1.2.2 Mode 2, Initial Configuration Angle

In this mode the program computes the angle between the departure and destination planets on the departure date by looking up their positions in the ephemeris and computing the scalar product of the position vectors. Input consists of identification of planets, departure date and trip time (but trip time is not used in the computation, it is a "dummy" input).

1.2.3 Mode 3, N-Body Trajectory

The N-body trajectory program is characterized by:

1) Fourth order Runge-Kutta integration in double precision, with optional doubling and halving procedure;

2) Position data of Sun, Moon and all planets except Pluto given at 12 hour intervals, referred to the mean equinox and mean equator of 1950.0;

3) Cowell or Encke solution method with optional switching from one to the other;

4) Optional switching of coordinate center.

The input consists of a) identification of reference planet, b) initial position (in A. U.) and velocity (in A. U. /hour) components with respect to the center of the origin planet, c) physical constants, including the identification of planets to be included in the computation, d) indicators for the particular mode of running the program and e) conditions on which to terminate the computation.

Output lists position, velocity and acceleration components and magnitude with respect to origin planet; position components and magnitude with respect to earth, sun and target planet; all this at each integration step or intermittently at any desired number of steps.

This mode of the Interplanetary Trajectory Program also has an option to include the effects on the trajectory of up to six midcourse corrections. The corrections must be defined in the input by the specific impulse and mass flow (the same for all corrections) and the time of initiation, the burning time and the direction as referred to local velocity vector and trajectory plane.

1.3 Program II, the N-Body Program with Options

This is the same program as that described in section 1.2.3, except for the following.

1) It does not have the option for midcourse corrections.

2) It has an option to print out in miles, feet per second and feet per (second)², or any other units, depending on the input conversion factors.

3) It has an option to print out the ground traces over the Earth's surface in latitude and longitude.

4) It has an option to print out the central angle, i.e. the angle between the instantaneous and the initial position vectors.

5) It has an option to print out aximuth and elevation of the velocity vector.

1.4 Program III, N-Body Program with Sensitivity Coefficients and Differential Correction

This program may take the place of Program I if a first estimate of initial conditions of an interplanetary trajectory is available from some other source. Such a source can be, for instance, the JPL Heliocentric Conic Program. Progam III cannot compute the first estimate (as Program I can), but it does contain improvements in the computation of sensitivity coefficients and the differential correction. These improvements are fully described in section 3 of this report; the following is a general description.

The complete (6 x 6) matrix of sensitivity coefficients is computed along the trajectory by integration of the equations of variations. There is an option to print out the sensitivity matrix at each integration interval.

The differential correction procedure has been improved (or, at least, made more flexible) by permitting the use of only a percentage (determined by the "K-factor" which is supplied as input) of the velocity correction determined by the sensitivity matrix's inversion.

Because of the way in which the sensitivity coefficients are computed, this program must be run with the Cowell solution method and must use the doubling and halving option.

2. OUTLINE OF REFERENCES 1 AND 2

2.1 Introduction

The purpose of this section is to facilitate the use of references 1 and 2. Together, they give a full description of program I (the Interplanetary Trajectory Program). Reference 1 concentrates on the N-body part of the program and discusses two demonstration problems; Reference 2 describes the Interplanetary Trajectory Program and repeats some parts of Reference 1. Reference 2 is thus a complete report in itself. The following is an outline of the relevant materials in the two reports, or an elaborate table of contents (Introductions and abstracts are not mentioned). Some of the contents are merely mentioned, some other matters are discussed in some detail wherever it was felt that further explanation was necessary. Reference is by section number. The title of the reports, "Generalized Interplanetary Trajectory Study," was the title of the WADD contract under which the work was performed. Section IV of Reference 1, "Interplanetary Weather," was the result of a part of that work; it will not be further discussed here.

2.2 Reference 1

("General Interplanetary Trajectory Study," J. P. deVries, coordinator, General Electric TIS R60SD465, August 1960)

- Section 2.1 Definition of coordinate system. Reference is the mean equator and mean equinox of 1950.0.
- Section 2.2 Equations of motion for the N-body problem are derived for one body with respect to another. The accelerations due to the first earth oblateness term are also indicated.

Section 2.3 Definition of the "Cowell" and "Encke" solution techniques. The program uses either technique (according to input instructions).

Section 2.4 Description of the integration method. The method used is the fourth order Runge-Kutta; the selection of the time step is made by the doubling and halving method. The criterion by which the integration proceeds with the same interval or with half the interval is that both integrations should agree within a certain tolerance. (In our use of the program it has become customary to use a tolerance of 4×10^{-10} A.U.). A possible criticism is that the tolerance is an absolute distance, whereas a certain percentage of the instantaneous distance to the center of the coordinate system may be more satisfactory. Be this as it may, the program has performed well, and the automatic time step selection provides a great time saving for interplanetary trajectories since small steps are taken near a center of attraction and long steps far away from it. The doubling and halving procedure is optional.

Section 2.5 It may be argued that for trajectories between two planets it is advantageous (for accuracy and speed) to translate the coordinate system from the departure planet to the sun, and later to the arrival planet. Such translations may be executed automatically (by option, according to input instructions). When using the Cowell method the coordinates are translated to the closest body; when using the Encke method the translation is to that body of which the gravitational force is greater than 25% of the total force. Whenever a translation is needed, the relative velocity between the old and the new coordinate system is computed by numerical differentiation. Usually this does not produce a sufficiently accurate velocity; the velocity is corrected in an iteration procedure which is based on running the trajectory in the old as well as in the new coordinate system for a few integration steps.

The program also has an option to switch solution techniques from Cowell to Encke, or from Encke to Cowell. The criterion is (more or less arbitrarily) that the Encke technique is used when the body at the coordinate center is responsible for more than 75% of the total force; otherwise, the Cowell technique is used.

Section 2.6 The sources for the planetary tapes are indicated. Positions of all planets (except Pluto), Moon and Sun are stored on tape at 12 hour intervals. Interpolation was by nine-point Lagrange interpolation of the original ephemerides. Time is Ephemeris Time. Appendix I gives the formulas which were used to convert the Naval Observatory data for the Moon and Mercury.

- Section 2.7 All physical constants are input quantities, but this section suggests a set of numbers which is consistent with standards adopted by the International Astronomical Union.
- Sections 2.8 and 2.9 Computer input and output are more fully defined in Reference 2 and also in this report, section 4.
- Section 3 Two demonstration problems are discussed in detail. The first is the computation of the Lunik III trajectory. The second is the computation of an Earth-Venus trajectory for given departure date and trip time. The method by which a first estimate was obtained is discussed in detail in Appendix II. The method consists of two parts: the heliocentric transfer analysis ("Vertregt") and the geocentric departure analysis ("Moeckel"). These analyses were later generalized and programmed and are now part of the Interplanetary Trajectory Program. The use of differential correction to refine the estimate is also discussed (see also Appendix III); this was also programmed later to be part of Program I.
- 2.3 Reference 2

("Generalized Interplanetary Trajectory Study," Part II and Supplement I, J. P. deVries, Coordinator, General Electric TIS R61SD047, Jan. 1961)

- Section 2 Description of the N-body program. This repeats section 2 of reference 1. The list of astronomical constants contains suggested values for several physical properties of the planets.
- Section 3.1 Description of the Interplanetary Trajectory Program. The problem to be solved by this program is briefly: to determine the burnout velocity for a trajectory from Earth to any other planet (or vice versa) when departure date and trip time are known. The program operates in three phases: 1) first estimate, 2) N-body program and 3) differential correction.
- Section 3.2 The heliocentric transfer analysis determines the semimajor axis and eccentricity of the transfer ellipse, assuming that the planets have no mass. For elliptic trajectories four kinds of transfer

("routes") are defined (direct, indirect, aphelion and perihelion); two routes are defined for hyperbolic transfers. No retrograde transfers are considered. In plots having trip time as ordinate and initial configuration angle (or departure date) as abscissa each route is confined to a certain region (i.e combination of trip times and departure dates). The four regions belonging to the elliptic routes come together in a point which corresponds to the single trip timedeparture date combination for a Hohmann (least energy) transfer. There are fourteen such plots, seven for earth-planet and seven for planet-earth transfers. The plots are used to determine which route will be taken for the desired trip time-configuration angle combination. This information is needed in the input data, because the computation of semi-major axis and eccentricity requires different formulas for different routes. Since the plots are based on an idealized model there is some uncertainty about the route that is required, especially in the neighborhood of the Hohmann point. One may therefore specify a number of routes; the computer will try each one in succession.

This section gives all the formulas for the computation of semimajor axis and eccentricity (for each of the different routes) and the iteration procedure which is used in the program.

Section 3.3 The purpose of the departure analysis is to obtain a first estimate of the burnout velocity. The burnout point is taken to be some given distance vertically above the launch site and the burnout time during the given departure date is determined to take the maximum advantage of the earth's (or other planet's) rotation. (Departures from Mercury and Venus are dealt with slightly differently because not enough is known about their rotations and direction of their axes.) The escape from the planet is taken to be along a hyperbola which is "patched" to the transfer ellipse that was the result of the heliocentric transfer analysis.

Pages 55-57 of this section have a more general significance. A step-by-step procedure is given for the determination of the Universal

Time that corresponds to local mean sidereal time; this is a "translation" of the instructions in the American Ephemeris and Nautical Almanac (as well as the Explanatory Supplement).

- Section 3.4 The differential correction by which the first estimate is corrected to produce an impacting trajectory is based on the sensitivity matrix between positions at arrival time and velocities at departure time. The sensitivity coefficients are computed by making small changes in each of the burnout velocity components in turn and computing three new trajectories. The inversion of the sensitivity matrix produces the burnout velocity correction and a new trajectory is run. With the same sensitivity matrix up to ten iterations may be performed; if impact is still not obtained, a new sensitivity matrix is computed along the last trajectory and another 10 iterations may be performed. If after three computations of sensitivity matrices (or a total of 30 tries) impact is still not achieved, the run is given up as a hopeless case. The end condition of the trajectory is impact on a sphere centered at the arrival planet's center with arbitrary (i.e. input data) radius at the arrival time to within a given tolerance (also input data).
- Section 3.5 This is a complete discussion of the computation of a Mars-Earth trajectory.

Section 3.7 This is a summary of 7 Earth-Venus trajectories with departure dates at 12-day intervals and a trip time of 100 days.

Sections 4.1 and 4.2 It is argued that to use the Encke method advantageously the coordinate center must be translated from one body to another when the second becomes prominent. To perform this translation relative velocity of the old and the new coordinate center must be determined by differentiation of the ephemeris data. Even when using the iteration procedure described in section 2.5 of reference 1 it has been found that the results are not always consistent. The reasons for this are quite complex, maybe a combination of some

small interval inconsistency in the ephemeris with the fact that light significant figures in the initial velocity does not give enough accuracy. Section 4.2 presents an improved method for the velocity determination; this method has been applied with some success, but it has not been incorporated into the present program. (Our practice has become to use the Cowell method always, without translating coordinate centers).

Section 5 This section describes how the program handles the midcourse correction option. Up to six midcourse corrections may be specified. Specific impulse and mass flow must be the same for each correction. The corrections are further specified by giving the starting time (hours from beginning of trajectory), the burning time and two angles which define the thrust direction. The thrust direction is to be specified in a coordinate system that is directed along the local velocity and the trajectory plane.

Appendix I. This reports the two-body formulas that are used in the Encke method.

2.4 Reference 2, Supplement

Section 2 The complete input instructions for the three modes of the Interplanetary Trajectory Program.

Section 3 Description of computer output.

Section 4 Operating instructions.

Note: The contents of sections 2, 3 and 4 of this Supplement are repated in section 4 of this report.

- Section 5 Description of the binary tapes of planetary tables.
- Section 6 Block diagrams of the most important parts of the Interplanetary Trajectory Program: tape data to angular parameters (fig. 1), heliocentric analysis (fig. 2), departure analysis (fig. 3), Encke integration program (fig. 4), Cowell integration program (fig. 4 cont.) and differential correction analysis (fig. 5).

Appendix I Description of the modified DBC FORTRAN input routine. Appendix II Complete input and computer output sheets of two examples:

1) Earth-Venus trajectory, 110 days trip time, departure date

Dec. 12, 1960 or 346 days from beginning of tape (Jan. 1, 1960) and

2) Venus-Earth trajectory, 110 days trip time, departure date

April 1, 1961, or 456 days from beginning of tape.

Appendix III List of Julian dates, calendar dates and table days.

3. ADDITIONS AND MODIFICATIONS OF PROGRAM I

3.1 Introduction

Since the completion of Program I several additions and modifications have been made. Programs II and III are the results. This section describes

- 1) the computation of ground trace parameters, azimuth and elevation
- of velocity vector and central angle (for Program II)
- 2) Computation of 6 x 6 sensitivity matrix (for Program III)
- 3) Modified differential correction procedure (for Program III).

The use of these additional features is fully explained in the section on input instructions and operating procedures later in this report.

3.2 <u>Computation of Ground Trace, Central Angle and Azimuth and Elevation</u> of Velocity Vector

Program II offers the option of printing out ground trace information, the central angle (or travel angle and aximuth and elevation of the velocity vector. This section describes how this information is obtained. The program can also print out distances in miles, velocities in ft/sec and accelerations in ft/sec², or any other units depending on the conversion constants (from A. U. and A. U. /hour) which are supplied as input.

3.2.1 GroundTrace

The parameters computed are the latitude of the vehicle referenced to the equatorial plane and the longitude referenced to the Greenwich meridian. Negative longitudes indicate angles west of Greenwich.

The additional input quantities required for this option are:

- H = Greenwich Hour Angle for starting day of trajectory (deg.)
- t = Table hours for $O^{h}U.T.$ on starting day of trajectory
- ω_{e} = Angular rate of Earth's rotation (ω_{e} = .262516 rad/hour)

The coordinates (X, Y, Z) of the vehicle with respect to the Earth referenced to the vernal equinox of 1950.0, found by the n-body program are transformed to coordinates referenced to the Greenwich meridian at $t_0(X', Y', Z')$. This involves a rotation about the Z axis through the angle H as shown in Fig. 1.



Fig. 1 Computation of Ground Trace

 $X' = X \cos H + Y \sin H$ $Y' = -X \sin H + Y \cos H$ Z' = Z

Now, if R is the geocentric distance to the vehicle, the latitude $\boldsymbol\ell$ is given by

 $\ell = \sin^{-1}(Z/R)$ where $-90^{\circ} \le \ell \le 90^{\circ}$. Negative values of ℓ indicate latitudes in the southern hemisphere.

The longitude with respect to the Greenwich meridian at
$$t_0$$
 is
 $\lambda_0 = \sin^{-1} (Y'/R \cos \ell)$
 $\lambda_0 = \cos^{-1} (X'/R \cos \ell)$

To find the longitude, λ , with respect to the Greenwich meridian at the time of the printout step, t, a correction for the Earth's rotation is applied

$$\lambda = \lambda_{o} - \omega_{e} (t - t_{o})$$

3.2.2 Central Angle and Azimuth and Elevation of Velocity Vector

The desired parameters are shown in Fig. 2



Fig. 2 Central Angle and Direction of Velocity Vector

- θ = central angle, or angle traveled from injection, $\overline{R_i}$, to \overline{R} at any time t.
- β = elevation of velocity vector, \overline{V} , measured positive above local horizontal plane

 σ = azimuth of \overline{V} , measured positive clockwise from north in local X, Y, Z; X, Y, Z = components of geocentric position and velocity vectors at any time t subscript i refers to injection time

The central angle is given by

$$\theta = \cos^{-1} \left(\frac{XX_{i} + YY_{i} + ZZ_{i}}{RR_{i}} \right)$$

where $0^{\circ} \leq \theta \leq 180^{\circ}$.

The elevation of \overline{V} is

$$\beta = \sin^{-1} \left(\frac{XX + YY + ZZ}{RV} \right)$$

where $-90^{\circ} \leq \beta \leq 90^{\circ}$.

The declination of the vehicle, δ , is the latitude found previously as part of the ground trace computation. The right ascension is found from $\alpha = \sin^{-1} (Y/R \cos \delta)$

 $\alpha = \cos^{-1} (X/R \cos \delta)$

The azimuth of \overline{V} is thus given by

 $\sigma = \cos^{-1} (X \sin \delta \cos \alpha - Y \sin \delta \sin \alpha \sin + Z \cos \delta) / V \cos \beta$

where

$$\sigma = \sigma \text{ if } (-X \sin \alpha + Y \cos \alpha) \ge 0$$

$$\sigma = 2\pi - \sigma \text{ if } (-X \sin \alpha + Y \cos \alpha) < 0$$

3.2.3 Discussion

It must be noted that some simplifications have been used in the computations described in this section. The ground trace is computed using the mean equator and mean equinox of 1950.0; it should thus be corrected by introducing the nutation and precession to get the ground trace properly in the coordinates of date. The error amounts to about 50 secs of arc per year, counted from 1950; most of the error is in the direction of longitude. (When the option was introduced in the program the purpose warranted neglecting this correction.)

Also in defining the direction of the velocity vector the coordinate system is that of the 1950.0 mean equator and mean equinox.

3.2.4 Modification of the Differential Correction Procedure

In determining the burnout velocity for an interplanetary trajectory with the Interplanetary Trajectory Program (Program I), the linear differential correction procedure has sometimes shown a slowly converging or even diverging behavior. It is typical in such cases that the miss distance will oscillate from one side of the target planet to the other in successive

iterations. The modification of the differential correction procedure (described in this section) has improved the computation of such difficult cases considerably.

Since the completion of the Interplanetary Trajectory Program other means of getting a first estimate have become available; in some cases such estimates produce a smaller miss distance (when run in an N-body program) then the estimate determined by the Interplanetary Trajectory Program. An example of such other means is the JPL Heliocentric Patched Conic Program, used directly or with its own differential correction.

The improvement of the Interplanetary Trajectory Program thus consisted of three parts:

1) Make it possible to begin with an estimated burnout velocity which is computed externally.

2) Modify the differential correction procedure to improve convergence.

3) Improve the computation of the sensitivity coefficients by getting them through integration of the equations of variation along the estimated trajectory. (This takes only 10% more computer time than integrating the trajectory alone, whereas the finite perturbation method requires 300% more; the results have consistently agreed within 1%. Also, in this manner the complete 6 x 6 matrix becomes available for printout at any integration interval.

It was therefore decided to let the Interplanetary Trajectory Program stand unchanged and to add the new sensitivity matrix computations and the modified differential correction procedure to the N-body program. The first estimate of initial conditions must now come from an external source. One such source may of course still be the old Interplanetary Trajectory Program (Program I) when it is stopped just before it goes into the N-body subroutine.

The modification of the differential correction procedure consists essentially of limiting the magnitude of the velocity correction that is

predicted by the inversion of the sensitivity matrix. A "limiting factor" k is defined below; to date values of .1 and .2 have been used successfully al although not enough experience has been gained to determine a "best" (if there is one!). Low values of k tend to increase the number of iterations required to find an impacting trajectory, larger values may not sufficiently reduce the oscillatory behavior of the differential correction. As shown in Figure 3, only the magnitude of the predicted velocity correction is changed, the direction is maintained.



Figure 3. Velocity Diagram

The modification also limits the initial velocity to values greater than the escape velocity of the departure planet.

The modification is described below by a list of symbols, a logic diagram and the pertinent equations.

List of Symbols

ro	radial distance from origin at injection
v _o	velocity at injection, from two-body estimate or previous
	n-body run, to be corrected
(X, Y, Z)	rectangular components of velocity
$\Delta \overline{v}$	velocity correction predicted by linear differential
	correction procedure

LOGIC DIAGRAM



3.3 Computations of Sensitivity Coefficients

In Program I (the Interplanetary Trajectory Program) the sensitivity coefficients are computed by perturbation of the initial conditions; a 3×3 sensitivity matrix is computed between position components at the end of trajectory and velocity components at the beginning. In Program III the sensitivity coefficients are obtained by integrating the equations of variation along the trajectory. The sensitivity coefficients denote the rate of change of position and velocity components at some time with respect to changes in position and velocity components at the initial time. A 3×3 submatrix of the 6×6 matrix at the final time is used in the differential correction procedure; the complete 6×6 matrix may also be printed out at the integration intervals of the nominal trajectory.

In the computation of the sensitivity coefficients advantage is taken of the doubling and halving procedure of integration. Because of this, the gravity gradients are available at the beginning, the midpoint and the end of the integration interval. This results in a computation of the sensitivity coefficients with errors proportional to the fifth power of the integration interval.

Let the equations of motion be represented by

$$\frac{\cdot \cdot}{r} = -\nabla \phi \ (\overline{r}, t)$$
(1)

where ϕ is the gravitational potential of N bodies. Let \overline{r}_n be the position vector on the nominal trajectory, \overline{r} the position vector of a variation trajectory. The equations of variation are then

$$\delta \frac{\ddot{\mathbf{r}}}{\mathbf{r}} = \frac{\ddot{\mathbf{r}}}{\mathbf{r}} - \frac{\ddot{\mathbf{r}}}{\mathbf{r}}_{\mathbf{n}} = -\left[\nabla \phi (\mathbf{\bar{r}}_{\mathbf{n}}, \mathbf{t}) + \frac{\partial}{\partial \mathbf{x}} \nabla \phi (\mathbf{\bar{r}}_{\mathbf{n}}, \mathbf{t}) \delta \mathbf{x} + \frac{\partial}{\partial \mathbf{y}} \nabla \phi \delta \mathbf{y} + \frac{\partial}{\partial z} \nabla \phi \delta z\right] + \nabla \phi (\mathbf{\bar{r}}_{\mathbf{n}}, \mathbf{t})$$

or, expanded,

$$\delta \ddot{x} = G_{xx} \delta_{x} + G_{xy} \delta_{y} + G_{xz} \delta_{z}$$

$$\delta \ddot{y} = G_{yx} \delta_{x} + G_{yy} \delta_{y} + G_{yz} \delta_{z}$$

$$\delta \ddot{z} = G_{zx} \delta_{x} + G_{zy} \delta_{y} + G_{zz} \delta_{z}$$
(2)

with
$$G_{xx} = \frac{-\partial^2 \phi(\overline{r}_n, t)}{\partial x^2}$$
, $G_{xy} = \frac{-\partial^2 \phi(\overline{r}_n, t)}{\partial y \partial x}$, etc.

This is a set of linear second order equations

$$\delta \frac{\ddot{r}}{r} = G(t) \delta \bar{r}$$
(3)

The G are the components of the gravity gradient tensor; they are evaluated ij on the nominal trajectory as follows.

The gravitational potential is given by

$$\phi = \frac{\mu_{k}}{r_{k}} \left[1 + J \frac{r_{e}^{2}}{r_{k}^{2}} \left(\frac{1}{3} - \frac{z^{2}}{r_{k}^{2}} \right) \right] + \frac{N}{r_{j}} \frac{\mu_{j}}{r_{j}}$$
(4)

where the first term represents the earth potential (including the second harmonic) and the second term the N-body potential. The notation is

$$r_{k} = \text{distance from earth center}$$

$$r_{e} = \text{earth radius}$$

$$r_{j} = \text{distance to center of body j}$$

$$\mu_{k} = k^{2} \text{ M, M is mass of earth}$$

$$\mu_{j} = k^{2} \text{ M}_{j}, \text{ M}_{j} \text{ is mass of body j}$$

$$J = \text{first oblateness constant}$$

$$z = \text{position coordinate parallel to earth's axis of rotation.}$$

By differentiation of (4) the components of the gravity gradient are obtained

$$G_{xx} = -\sum_{j} \frac{\mu_{j}}{r_{j}^{3}} \left(1 - 3 \frac{x^{2}_{j}}{r_{j}^{2}} \right) - J \frac{\mu_{k} r_{e}^{2}}{r_{k}^{5}} \left(1 - 5 \frac{(x_{k}^{2} + z_{k}^{2})}{r_{k}^{2}} + 35 \frac{x_{k}^{2} z_{k}^{2}}{r_{k}^{4}} \right)$$

$$G_{yy} = -\sum_{j} \frac{\mu_{j}}{r_{j}^{3}} \left(1 - 3 \frac{y^{2}_{j}}{r_{j}^{2}} \right) - J \frac{\mu_{k} r_{e}^{2}}{r_{k}^{5}} \left(1 - 5 \frac{(y^{2}_{k} + z_{k}^{2})}{r_{k}^{2}} + 35 \frac{y_{k}^{2} z_{k}^{2}}{r_{k}^{4}} \right)$$

$$G_{zz} = -\sum_{j} \frac{\mu_{j}}{r_{j}^{3}} \left(1 - 3 \frac{z_{j}^{2}}{r_{j}^{2}} \right) - J \frac{\mu_{k}r_{e}^{2}}{r_{k}^{5}} \left(3 - 30 \frac{z_{k}^{2}}{r_{k}^{2}} + 35 \frac{z_{k}^{4}}{r_{k}^{4}} \right)$$

$$G_{zz} = G_{zy} = \sum_{j} \mu_{j} \frac{3x_{j}y_{j}}{r_{j}^{5}} + J \frac{\mu_{k}r_{e}^{2}x_{k}y_{k}}{r_{k}^{7}} \left(5 - 35 \cdot \frac{z_{k}^{2}}{r_{k}^{2}} \right)$$

$$G_{xz} = G_{zx} = \sum_{j} \mu_{j} \frac{3x_{j}z_{j}}{r_{j}^{5}} + J \frac{\mu_{k}r_{e}^{2}x_{k}x_{k}}{r_{k}^{7}} \left(15 - 35 \frac{z_{k}^{2}}{r_{k}^{2}} \right)$$

$$G_{yz} = G_{zy} = \sum_{j} \mu_{j} \frac{3y_{j}z_{j}}{r_{j}^{5}} + J \frac{\mu_{k}r_{e}y_{k}z_{k}}{r_{k}^{7}} \left(15 - 35 \frac{z_{k}^{2}}{r_{k}^{2}} \right)$$
The summation signs \sum_{j} stand for $\sum_{j=1}^{N}$

Since the positions on the nominal trajectory are available at three points of the integration interval (because of the doubling and halving procedure), the gravity gradient is also available at three points.

If
$$\overline{X}$$
 is the vector $\left\{ \delta \overline{r}, \delta \overline{r} \right\}$, equation (3) can be written as
 $\frac{\delta}{\overline{X}} = F(t)\overline{X}$ (5)

with

$$\mathbf{F} = \begin{bmatrix} \mathbf{O} & \mathbf{I} \\ \mathbf{G} & \mathbf{O} \end{bmatrix}$$
(6)

Here I is the $3 \ge 3$ unit matrix, O is the $3 \ge 3$ null matrix and G is the gravity gradient matrix.

If six solutions of equ. (4) are obtained at some time t_1 with the initial conditions taken as

$$\overline{X}(t_{0}) = \begin{vmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{vmatrix}, \begin{vmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{vmatrix}, \begin{vmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{vmatrix}, \begin{vmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{vmatrix}, etc.$$

and column wise arranged in a matrix, the resulting matrix is the sensitivity matrix from t_0 to t_1 . Let this matrix be $H_{1,0}$; the following equation then represents the relation between position and velocity deviations at t_1 and t_0 :

$$\overline{\mathbf{X}}(\mathbf{t}_1) = \mathbf{H}_{1,0} \ \overline{\mathbf{X}}(\mathbf{t}_2) \tag{7}$$

where

$$H_{1,0} = \begin{vmatrix} \frac{\partial x_1}{\partial x_0} & \frac{\partial x_1}{\partial y_0} & \cdots \\ \frac{\partial y_1}{\partial x_0} & \frac{\partial x_1}{\partial y_0} & \cdots \\ \frac{\partial y_1}{\partial x_0} & \frac{\partial x_1}{\partial x_0} & \frac{\partial x_1}{\partial x_0} \\ \frac{\partial x_1}{\partial x_0} & \frac{\partial x_1}{\partial x_0} \end{vmatrix}$$

For a time t_2 , equation (7) gives $\overline{X}(t_2) = H_{2,1} \overline{X}(t_1)$

But

thus $\bar{X}(t_2) = H_{2,1} H_{1,0} \bar{X} (t_0)$

 $\overline{X}(t_1) = H_{1,0} \overline{X}(t_0)$

and

$$H_{2,0} = H_{2,1} H_{1,0}$$

By continuing this procedure, the chain rule for sensitivity matrices follows

$$H_{n,0} = H_{n,n-1} H_{n-1,n-2} - H_{2,1} H_{1,0} = \prod_{i=n}^{n} H_{i,i-1}$$
(8)

This suggests that the sensitivity matrix for an arbitrary time interval can be computed by multiplying the sensitivity matrices for a number of subintervals. As convenient subintervals, the integration intervals of the nominal trajectory may be chosen. If a constant value of G is assumed during an integration interval (for instance the value at the midpoint), simple expressions follow for the H covering that interval, but the errors are proportional to the third power of the interval. Better expressions (resulting in errors proportional to the fifth power of the interval) are found by using the fourth order Runge-Kutta formula. For its use three values of G are needed, at the beginning, the midpoint and the end of the interval. If the doubling and halving procedure is used for the integration of the trajectory, these three values of G are available. Applying this to equation (5), that equation is first written as a matrix equation

$$[X] = F[X]$$
(9)

To integrate this equation for a time step $\Delta t = t_{n+1} - t_n$, the Runge-Kutta formula is applied as follows.

 $\begin{bmatrix} \mathbf{v} \end{bmatrix}$

T of

 $[\mathbf{v}]$

$$\begin{aligned} & \text{Let} \quad [\text{LA}]_{t=t_{n}} \quad [\text{LA}]_{n}, \\ & \text{let also } \quad F_{o} = F(t_{n}), \quad F_{1/2} = F(t_{n} + \frac{1}{2}\Delta t), \quad F_{1} = F(t_{n} + \Delta t), \\ & \text{then } \quad K_{1} = F_{o} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t \\ & K_{2} = F_{1/2} \begin{bmatrix} I + \frac{1}{2} & K_{1} \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t = F_{1/2} \begin{bmatrix} I + F_{o}, \quad \frac{1}{2} \Delta t \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t \\ & K_{3} = F_{1/2} \begin{bmatrix} I + \frac{1}{2} & K_{2} \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t = \\ & = F_{1/2} \begin{bmatrix} I + F_{1/2}, \quad \frac{1}{2} \Delta t + F_{1/2} & F_{o} \quad \frac{1}{2} \Delta t \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t \\ & \text{and } \quad K_{4} = F_{1} \begin{bmatrix} I + K_{3} \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t = \\ & = F_{1/2} \begin{bmatrix} I + F_{1/2}, \quad \frac{1}{2} \Delta t + F_{1/2}^{2}, \quad \frac{1}{2} \Delta t^{2} + F_{1/2}^{2} & F_{o} \quad \frac{1}{2} \Delta t^{3} \end{bmatrix} \begin{bmatrix} x \end{bmatrix}_{n} \Delta t . \end{aligned}$$

The result of the fourth-order Runge-Kutta integration is thus

$$\begin{bmatrix} X \end{bmatrix}_{n+1} = \begin{bmatrix} X \end{bmatrix}_{n} + \begin{bmatrix} \Delta X \end{bmatrix} = \begin{bmatrix} I + (F_{o}^{+4}F_{1/2}^{+}F_{1}) \frac{\Delta t}{6} \\ + (F_{1/2}F_{o}^{+}F_{1/2}^{2} + F_{1}F_{1/2}) \frac{\Delta t^{2}}{6} + (F_{1/2}^{2}F_{o}^{+}F_{1}F_{1/2}^{2}) \frac{\Delta t^{3}}{12} \\ + F_{1}F_{1/2}^{2}F_{o} \frac{\Delta t^{4}}{24} \end{bmatrix} \begin{bmatrix} X_{n} \end{bmatrix}$$
(10)

(11)

or

where $H_{n+1,n}$ is the "incremental" sensitivity matrix from t_n to t_{n+1} . If equation (6) is substituted in (10), the following expressions result for the submatrices of the partitioned sensitivity matrix $H_{n+1,n}$.

Let

$$H_{n+1,n} = \begin{pmatrix} H_1 & H_2 \\ H_3 & H_4 \end{pmatrix}.$$

 $[x]_{n+1} = H_{n+1,n} [x]_n$

Then

where

$$H_{1} = I + (G_{o} + 2G_{1/2}) \frac{\Delta t^{2}}{6} + G_{1/2} G_{o} \frac{\Delta t^{4}}{24}$$

$$H_{2} = I \Delta t + G_{1/2} \frac{\Delta t^{3}}{6}$$

$$H_{3} = (G_{o} + 4G_{1/2} + G_{1}) \frac{\Delta t}{6} + (G_{1/2}G_{o} + G_{1}G_{1/2}) \frac{\Delta t^{3}}{12}$$

$$H_{4} = I + (2G_{1/2} + G_{1}) \frac{\Delta t^{2}}{6} + G_{1}G_{1/2} \frac{\Delta t^{4}}{24}$$

$$G_{o} = G(t_{n}), G_{1/2} = G(t_{n} + \frac{1}{2}\Delta t), G_{1}G(t_{n} + \Delta t).$$
(12)

In the computation of the sensitivity matrix $H_{n,o}$ by continued product, as in equ. (8), the integration for the ith interval is carried out with $[X]_i = I$, the unit matrix. This method is used in the computer program described in this report. If $H_{n,o}$ were to be computed by continuous integration, the initial condition for the ith interval would be $[X]_i$, the result of all previous integrations. Because of the linearity of the equations of variation the two processes are precisely equivalent with respect to the truncation error. In the build up of round off error they behave differently, although it is not immediately obvious that either one is inferior to the other. To reduce the influence of roundoff error all computations are done in double precision.

Expressions for the truncation errors of a single integration step may be derived by carrying out a few steps of the Peano-Baker method, using a Taylor series expansion for the gravity gradient matrix G. The result may be compared with the expressions obtained by substituting Taylor expansions for $G_{1/2}$ and G_1 in equ. (12). If ϵ is defined as the exact solution minus the computed solution, the truncation errors for the submatrices of $H_{n+1,n}$ are

$$\begin{aligned} \epsilon_{1} &= \left(\frac{1}{720} \cdot \frac{G}{G} + \frac{1}{240} \cdot \frac{G}{G} \cdot G_{O} + \frac{1}{120} \cdot G_{O} \cdot \frac{G}{G} \right) \Delta t^{5} \\ \epsilon_{2} &= \left(\frac{1}{240} \cdot \frac{G}{G} + \frac{1}{120} \cdot G_{O}^{2} \right) \Delta t^{5} \\ \epsilon_{3} &= -\left[\frac{1}{2880} \cdot \frac{G}{G} + \frac{1}{480} \cdot (G_{O} \cdot G_{O} + G_{O} \cdot G_{O}) + \frac{1}{120} \cdot \frac{G}{G}^{2} - \frac{1}{120} \cdot G_{O}^{3} \right] \Delta t^{5} \\ \epsilon_{4} &= -\left(\frac{1}{720} \cdot \frac{G}{G} + \frac{1}{120} \cdot \frac{G}{G} \cdot G_{O} + \frac{1}{240} \cdot G_{O} \cdot \frac{G}{G} \right) \Delta t^{5} \end{aligned}$$

The program can print out the incremental as well as the total sensitivity matrix at every trajectory print out. The final sensitivity matrix is also printed out, together with its "theoretical" inverse, i.e., the matrix obtained by rearranging the components of the sensitivity matrix according to

$$H^{-1} = \begin{bmatrix} H_4 - H_2 \\ -H_3 & H_1 \end{bmatrix}^{T}$$

4. OPERATING INSTRUCTIONS

This section outlines the operational procedures for the three decks. The Interplanetary Trajectory Program is Program I, the N-Body Program with the ground trace feature and optional output conversion is Program II, and the N-Body Program with sensitivity coefficients is Program III. Each program is completely described in each section so that there need be no cross referencing from one part of the report to another when setting up a job. Included in each section are the FORTRAN statements for the 3 decks showing the main programs as they request input and call for subroutines.

The following listings of input data show certain values for the constants (gravitational constant, radius and mass of the earth, oblateness constant). The values have been chosen to conform with those which are presently in use at J.P.L; they differ therefore from the constants which were recommended in references 1 and 2. Also, the sample problems listed in this report have been run with different values. The J.P.L. constants which are the basis for the values in the input listings are:

> $1AU = 1.49599 \times 10^{8} \text{km}$ $\text{k}^{2}M_{E} = 398603.2 \text{ km}^{3}/\text{sec}^{2}$ $R_{E} = 6378.165 \text{ km} \text{ (earth equatorial radius)}$ $J = 1.62345 \times 10^{-3} \text{ (oblateness constant)}$

General Operating Procedure

A. Input Format

The format for input is as follows. Card columns (cc) 1 through 72 may be used. The first character on a data card must be an F or an X. The F denotes floating point numbers and the X, fixed point numbers (Integers). The numbers on each card are to be separated by commas and the last character on each card must be an asterisk. At the end of each program description in this section, there is a sample case with input data included in the proper format. A sample input data card might have the following set of numbers:

- B. Deck Make-up (Monitor Control Cards)
- (1) Card 1 (optional)

This is an ID card. Columns 1 and 2 contain asterisks and columns 3-16 are available for the programmer's name.

(2) Card 2 (optional)

The next card(s) are used to notify the operator if any additional tapes are to be mounted for the run. In our case, an ephemeris tape must be mounted on B-6. CCl and 2 contain dollar signs (\$\$), CC5 contains the number 1; (if two tapes had to be used, the second card would have the number 2 in CC5).

CC7-16 contain the library number of the tape(s) to be used. CC20-22 are used to indicate the number of the particular tape drive. CC78-79 is for a sequence number and are the same as CC5.

(3) Card 3 (must be included)

Card #3 has a \$ sign in CC1 and the word EXECUTE in CC2-8. CC16-17 contain F2 (indicating FORTRAN II).

(4) Card 4 (must be included)

Card #4 has an asterisk in CCl and in CC7-9, the letters XEQ.

(5) Card 5 (must be included)

Card #5 is placed directly behind the binary deck and directly in front of the input data. Cl has an asterisk and CC7-10 have the word DATA.

(6) Card 6 (must be included)

This is an end of file card and is the last card on the job deck. It has a multiple 7, 8 punch in CC1. Thus, the deck make up is as follows:

CARD COLUMN NUMBERS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ---- 78 79 80

Card Number						
I	**T.	COFFIN				
II	\$\$	1 A2 96	0 7		0	1
III	\$ E X E	CUTE		F 2		
IV	*	XEQ				
v	*	DATA	BINAR Y DECK			
			INPUT DATA			

VI 7 8
GENERAL OPERATING NOTES FOR THE 3 PROGRAMS

1. Tapes Used

All tapes used in normal FORTRAN System. Tape B-6, Planet Position Tables Tape.

2. Sense Switches

Sense Switch 1 is the only switch tested. In the down position, output will be printed on-line as well as on tape A-3. The sense switch may be repositioned at any time. Printing on line uses the Share No. 2 printer board.

3. Card Deck

Normal FORTRAN System deck set-up with input cases following. Operation is initiated by the FORTRAN System.

- 4. Stops
 - a. All FORTRAN stops.
 - b. Stops of form HTR^{*}. These are double precision subroutine stops caused by overflow. Experience has shown these to be due to machine error or input error.
 - c. HPR 77777 Error in two-body solution.

4.1 PROGRAM I

Three types of runs may be made with the Interplanetary Trajectory Program:

- 1. Interplanetary trajectory
- 2. Determination of initial configuration angle,
- 3. N-body trajectory.

The required information is listed for each type of run, along with the corresponding computer output. Also included is a description of the FORTRAN II input-routine to be used with the program.

^{*}To begin processing another case when machine has stopped, manually transfer to 171_{g} .

4.1.1 COMPUTER INPUT

This section lists the computer input required for the three types of problems which may be run with the Interplanetary Trajectory Program. These are:

- Type 1. Interplanetary trajectory Computation of trajectory with differential correction procedure from trip time, departure date, and route.
- Type 2. Determination of initial configuration angle Computation of from trip time and departure date. This problem is run prior to run type 1 if the angle ϕ has not been determined by hand computation in order to find the required route.
- Type 3. N-body trajectory Computation of trajectory from initial position and velocity, including midcourse correction capability.

All decimal input is read by a modified DBC FORTRAN subroutine which accepts variable length fields. An (x) following the field number in the following listings indicates a fixed point variable. All other inputs are floating point variables.

TYPE 1.

INTERPLANETARY TRAJECTORY

	FOR TR AN Symbols		
Read Statement 1			
Field 1 (x)	NTYPE		code digit for type of run = l
Read Statement 2			
Field 1	ТТ	Т	trip time, hours
2	DJD	t s	date of departure, days from beginning of tape (table-days)
3 (x)	ND		code digit for departure planet
4 (x)	NT		code digit for destination planet

Read Statem	ent 3			
Field	d l (x)	NR	NR	number of routes to be designated (see note 1)
				NR sets of data, each set composed of the next two fields
	2 (x)	NJ(I)		code digit of the route
	3 (x)	EC(I)	e i	initial estimate of the eccentricity (see note 2)
	4	GEE	q_i	initial estimate of the ratio a/r_1
	5 (x)	KIT	К	number of iterations before attempting next route
	6	DT	ΔT	allowable tolerance on trip time, hours
	7	DPHI	Δφ	allowable tolerance on vehicle travel angle, degrees
Read Statem	ient 4			
Field	d 1	BLE	λ_{E}	launch site latitude, degrees (0 for non-Earth departure)
	2	GEL	L	launch site longitude, degrees (0 for non-Earth departure)
	3	RO	ro	burnout radius, statute miles
	4	G(1)	k^2	gravitational constant = 2.9591221 x 10^{-4} , (radians/day) ²
	5	WTE	M	mass of the Earth = 3.0034424×10^{-6} , solar mass units
	6	WTV	m v	mass of vehicle, solar mass units
	7	RADE	R, ⊕e	equatorial radius of the Earth = $.42635078 \times 10^{-4}$. A.U.

Note 1: One or more of the six possible routes may be designated as input in preferential order. If after K iterations for each route a successful trajectory is not attained with any of these routes, the remaining routes will automatically be attempted by the computer.

Note 2: The initial eccentricities, e_i , used for routes which are not designated as input are 0.5 for elliptic routes and 1.5 for hyperbolic routes.

	8	OBJ	ינ	oblateness constant for the Earth = $JM_{\oplus}R_{\oplus}^2 = 8.8632361 \times 10^{-18}$, (solar mass units, A.U. ²)
Read S tateme	ent 5			
Field	1	EMAX	D _{l max}	maximum distance from Earth, A.U.
	2	GMAX	D _{2 max}	maximum distance from target, A.U.
	3	SMAX	D _{3 max}	maximum distance from Sun, A.U.
Read Statem	ent 6			
Field	1 (x)	NCKE		control digit indicating computing scheme, 0 = Cowell, 1 = Encke
	2 (x)	MSDT		control digit indicating selection of integration time step interval, $0 = doubling$ and halving procedure $l = three$ fixed Δt 's
	3 (x)	MET		control digit indicating whether computing scheme (Cowell, Encke) is to be switched, 0 = retain original scheme, l = switch schemes on test
	4 (x)	NOUT	n	print digit n indicates print every n integrations
	5 (x)	NOSW		control digit, 0 = retain initial origin l = switch origins on test
Read Statem	ent 7 (u	used only if Fiel	ld 2 of Re	ead Statement 6 is 0)
Field	1	DTOR	Δt _i	initial Δ t, hours
	2	DTMAX	Δt_{max}	maximum Δt , hours
	3	EPI	¢	value to test accuracy of integration, A.U.
Read Statem	ent 8 (u	used only if Fie	ld 2 of Re	ead Statement 6 is 1)
Field	11	DTA	Δt_1	Δ t within 3 radii of origin, hours
	2	DTB	Δt_2	Δ t within 100 radii of origin, hours
	3	DTC	Δt_3^{-}	Δ t 100 radii from origin, hours
			-	

Read St a tment 9			
Field 1 (x)	NBD	N _b	the number of bodies other than the Earth to be included in the study (the Earth is always included)
Read Statement 10			
	N _b sets of da	ta, each	including
Field 1(x)	NB (I)		code digit of body
2	WT (I)		mass of body, solar mass units
3	RAD(I)		radius of body, A.U.
TYPE 2.			
DETERMINATION	OF INITIAL CO	ONFIGUR.	ATION ANGLE
Read Statement 1			
Field l(x)	NTYPE	2	code digit for type of run
Read Statement 2			
Field 1	DJD	t s	date of departure, days from beginning of tape (table-day)
2	ТТ	Т	trip time, hours
3 (x)	ND		code digit for departure planet
4 (x)	NT		code digit for destination planet
TYPE 3.			
N-BODY TRAJECT	'OR Y		
Read Statement 1			
Field l(x)	NTYPE	3	code digit for type of run
Read Statement 2		-	
Field l	G91)	k k	gravitational constant = 2.9591221 x 10^{-4} , (radians/day) ²
2	WTE	^M ⊕	mass of Earth = 3.0034424×10^{-6} ,

_

35

	3	RADE	₽€	equatorial radius of the Earth = $.42635078 \times 10^{-4}$, A.U.
	4	WTV	m v	mass of the vehicle, solar mass units
	5	OBJ	<u></u> Т,	oblateness constant for the Earth = $JM \xrightarrow{R_{\oplus}^2} = 8.8632361 \times 10^{-18}$, (solar mass units) (A.U.) ²
Read Statem	ent 3			
Field	1	EMAX	D _{l max}	maximum distance from Earth, A.U.
	2	GMAX	$D_{2 \max}$	maximum distance from target, A.U.
	3	SMAX	D _{3 max}	maximum distance from Sun, A.U.
	4	TMAX	Т	trip time, hours
	5	ТО	t s	date of departure, hours from Jan. 1960, O ^h UT
Read Statem	ent 4			
Field	l 1 (x)	NCKE		control digit indicating computing scheme, 0 = Cowell, 1 = Encke
	2 (x)	MSDT		control digit indicating selection of integration time step interval, $0 =$ doubling and halving procedure, $1 =$ three fixed Δt 's
	3 (x)	MET		<pre>control digit indicating whether com- puting scheme (Cowell, Encke) is to be switched 0 = retain original scheme l = switch schemes on test</pre>
	4 (x)	NOUT	n	print digit n indicates print every n integrations
	5 (x)	NOSW		control digit, 0 = retain initial origin l = switch origins on test
	6 (x)	NMC	N _M	number of midcourse corrections
Read Statem	ent 5 (1	used only if Fie	ld 2 of Re	ead Statement 4 is 0)

Field 1	DT	Δt_i	initial Δt , hours
2	DTMAX	Δt_{max}	maximum Δt , hours
3	DP1	€	value to test accuracy of integration, A.U.
		36	

Read Statement	6 (us	ed only if Field	d 2 of Re	ad Statement 4 is 1)
Field 1		DTA	Δt	Δ t within 3 radii of origin, hours
2		DTB	Δt_2	Δt > 100 radii from origin, hours
Read Statement	7			
Field 1 ((x)	Ν	N _b	number of bodies other than the Earth to be included in the study (Earth is always included)
2 ((x)	NEWORG		code digit for origin planet
3 ((x)	NTARG		code digit for destination planet
Read Statement	8			
		N sets of data	ı, each ir	ncluding
Field 1 ((x)	NB(I)		code digit of body
2		WT(I)		mass of body, solar mass units
3		RAD(I)		radius of body, A.U.
Read Statement	9			
Field 1		PM(1)	×)	position coordinates with
2		PM(2)	y {	respect to origin at burnout, A.U.
3		PM(3)	z)	
4		PM(4)	×́,	velocity components with respect
5		PM(5)	ý	to origin at burnout, A.U./hour
6		PM(6)	ż)	
Read Statement	10 (ı	used only if Fie	ld 6 of R	ead Statement 4 is not 0)
Field 1		SIMC	I sp	specific impulse, seconds
2		FMC	'n	mass flow, lb /sec
3*	:	WVMC	m v	mass of vehicle, lb m
	N _M	sets of data, e	ach inclu	ding
4		PPM(I)	т _м	time of midcourse correction application, hours from start of trip

*Not necessarilly equal to Field 4 of Read Statement 2.

5	PPL(I)	Δt	burning time, seconds
6	QM(I)	α	component of angle between ΔV and velocity vector in trajectory plane degrees
7	QL(I)	β	component of angle between ΔV and velocity vector normal to trajectory plane, degrees

The code digits for the various planets and routes are as follows: Planetary Code Digits:

0	Earth		5	Mars
1	Sun		6	Jupiter
2	Moon		7	Saturn
3	Mercury		8	Uranus
4	Venus		9	Neptune
Route	Code Digits:			
1	Route	D	(dire	ct)
2	Route	P	(peri	helion)
3	Route	А	(aphe	lion)
4	Route	I	(indi	rect)
5	Route	D _H	(dire	ct hyperbolic)
6	Route	Р Н	(peri	helion hyperbolic)

4.1.2 COMPUTER OUTPUT

TYPE 1.

INTERPLANETARY TRAJECTORY

Normally, output will be obtained from each major section of the program as follows:

A. Heliocentric Transfer Analysis

- 1. The eccentricity of the transfer orbit
- 2. q; the ratio a/r_1
- B. Departure Analysis
 - 1. Exact burnout time, hours from beginning of tape

- 2. Position coordinates at burnout; A.U.
- 3. Velocity components at burnout; A. U. /hour
- C. N-body Integration Program

The following information is printed-out after every n integration steps, where n is an input-control parameter

- 1. Flight time, hours from start of trajectory
- 2. Table time, hours from beginning of tape
- 3. Time increment of integration step, hours
- 4. Planetary code digit of body at the origin
- Acceleration components of the vehicle with respect to the origin, A.U./hr²
- Velocity components of the vehicle with respect to the origin, A.U./hr
- 7. Position coordinates of the vehicle with respect to the origin, A.U.
- 8. Position coordinates of the vehicle with respect to the Earth, A.U.
- 9. Position coordinates of the vehicle with respect to the target, A.U.
- 10. Position coordinates of the vehicle with respect to the Sun, A.U.

D. Differential Correction Analysis

1. Modified initial velocity components at burnout, A.U. /hr

All times are expressed in hours and distances in astronomical units. Position, Velocity, and acceleration components are expressed in a rectangular coordinate system, referenced to the equatorial plane and mean equinox of 1950.0

TYPE 2.

DETERMINATION OF INITIAL CONFIGURATION ANGLE

- 1. Trip time, days
- 2. Initial configuration angle, degrees

TYPE 3.

N-BODY TRAJECTORY

The following information is printed out after every n integration steps, where n is an input-control parameter.

- 1. Flight time, hours from start of trajectory
- 2. Table time, hours from beginning of tape
- 3. Time increment of integration step, hours
- 4. Planetary code digit of body at the origin
- 5. Acceleration components of the vehicle with respect to the origin, A.U./ hr^2
- Velocity components of the vehicle with respect to the origin, A.U./hr
- 7. Position coordinates of the vehicle with respect to the origin, A.U.
- 8. Position coordinates of the vehicle with respect to the Earth, A.U.
- 9. Position coordinates of the vehicle with respect to the target, A.U.
- 10. Position coordinates of the vehicle with respect to the Sun, A.U.

The following information is printed out after every midcourse correction.

- 1. Mass of the vehicle before correction, lb m
- 2. Mass of the vehicle after correction, 1b m
- 3. Change in velocity components with respect to origin due to correction, A.U./hr
- Velocity components of vehicle with respect to origin after correction, A.U./hr

4.1.3 SAMPLE PROBLEM

PROGRAM I

(Interplanetary Trajectory Program)

Mars to Earth Trajectory

CARD #

1	X1*
2	F5760.0, 1776.0, X5, 0*
3	X1, 1, F0.2300,0.8500,X30,F0.10,.10*
4	F0.0,0.0,2500.0,2.959122083E-04,2.9991123E-06,0.0*
5	F.426636E-04,8.8609392E-18*
6	F6.0;6.0,8.0*
7	X0,0,0,25,0*
8	F0.25,32.0,4.0E-09*

9 X2*

•

10 X5, F3. 2325845E-07, 2. 26E-05*

11 X1, F1.0, 4.655E-03*

N BODY TRAJECTERY

GENERAL ELECTRIC CO.

₩.\$.¥.Đ.

STARTING TABLE TIME = 42636.000

ORIGIN IS BODY 5 NASS = 3.232584E-07

DESTINATION IS BODY O MASS = 2.999112E-06

NASS OF VEHICLE = 0.

OTHER BODIES ARE-

BODY 1 MASS = 1.000000E 00

GRAVITATIONAL CONSTANT = 2.959122E-04

EPSILON OF INTEGRATION = 4.00E-09 MAXIMUM DELTA T = 32.0

CONELL METHOD IS USED

THE ORIGIN IS FIXED

0.85000	0.81167
" 0	" 0
E = 0.23000	E = 0.23231
PHE = 170.310	PHI = 170.312
(f = 240.000	TE 1 J = 240.002
	ROU

NOTE:

The above indicates the route selection for the nominal trajectory. The next page is only the nominal trajectory for Route 1. The perturbations on ×, y, z are not included.

1 -2.1900017E-00 1.623006E-04 0. 1 -1.5001045E-06 3.10085008E-04 0. 1 2.6911400E-05 3.10085008E-04 0. 1 2.6911400E-05 3.10085008E-04 0. 1 2.6911400E-05 3.10085008E-04 0. 1 2.6911400E-05 3.10085008E-04 0. 1 0 1.4994055E-04 -1.2355416E-09 1 1.5284808E-01 2.0309317E-04 -2.5480977E-08 1 1.5284808E-01 2.039305FE-04 -2.5480977E-08 1 1.5584808E-01 2.0359515E-04 1.2355416E-09 1 1.96657329E-01 2.049417E-04 7.66559306F-09 2.000 CENTER VELOCITY ACCELERATION 1 3.5554766-01 1.0497224E-01 1.0455211E-07 2.000 CENTER VELOCITY 7.66559306F-09 0. 2.000 CENTER VELOCITY 7.6655930E-09 0. 2.33395656E-01 1.0700147F-04 7.655930E-09 0. 2.440106F-01 2.359915F-04 1.04545210F-07 <t< th=""></t<>
-1.50010416-05 3.10056008E-04 0. 2.6911400E-05 3.1005608E-04 0. 2.6911400E-02 -1.0203517E-04 -4.2355576E-09 1.02733488E-01 2.8373057E-04 2.55859324E-08 1.0253488E-01 2.8373057E-04 2.55859324E-08 1.02733488E-01 2.8373057E-04 2.55859324E-08 1.0253456E-01 2.6303656E-01 2.630365966-09 1.25234556E-01 1.0700147E-04 3.559118E-07 2.33395556E-01 1.23494126-01 2.3559915E-04 1.0158211E-07 2.000 CENTER VELOCITY ACCELERATION 2.5013756E-01 1.23494126-06 1.45542526-07 2.5039556E-01 1.23494126-06 1.04552522-07 2.000 CENTER VELOCITY ACCELERATION 7.441173440E-01 2.3559915E-04 1.0158211E-07 2.000 CENTER VELOCITY ACCELERATION 4
0 2.6911400E-05 3.1085608E-04 0. 0 CENTER IS MO. 5 .veLOCITY ACCELERATION 1.000 CENTER IS MO. 5 .veLOCITY ACCELERATION 1.000 CENTER IS MO. 5 .1.2355616E-09 -1.2355616E-09 1.000 CENTER IS MO. 5 .1.2355616E-09 -1.2355616E-09 1.000 CENTER IS MO. 5 .2.5889377E-09 -2.5480977E-09 1.000 CENTER IS MO. 5 .2.5889377E-09 -2.5480977E-09 1.000 CENTER IS MO. 5 .2.5859324E-09 -4.230587E-09 2.000 CENTER VELOCITY ACCELERATION -2.5480977E-09 1.13566E-01 1.00700147E-04 7.6655930E-09 -0.5691078E-08 2.53839656E-01 1.00700147E-04 7.6655930E-07 -2.58891078E-01 2.53839656E-01 1.23494172E-04 7.6655930E-07 -2.58891078E-01 2.5000 CENTER VELOCITY ACCELERATION -4.230388437E-07 2.5010146E-01 2.5889437E-04 1.0158211E-07 -4.2304386-07 2.5000 CENTER VELOCITY ACCELERATION -4.2304386-07 2.5000 CENTER VELOCITY 2.5888437E-07<
000 CENTER 15 M0. 5 000 CENTER 15 M0. 5 1027336RE-01 1.4994055E-04 1.027336RE-01 1.4994055E-04 -6.9017357E-02 -1.02355616E-09 1.027336RE-01 1.4994055E-04 1.027336RE-01 2.83730657E-04 1.9667329FE-01 2.83730657E-04 1.9667329FE-01 2.689977E-08 2.5000 CENTER 15 M0. 5 2.000 CENTER 15 M0. 5 2.000 CENTER 15 M0. 5 2.1173440E-01 2.3559915E-04 2.383956E-01 -1.070147E-04 7.4012425E-01 1.0702534E-04 2.3839437E-01 2.3559915E-04 2.3839447E-01 2.3559915E-04 2.3839437E-01 2.3559915E-04 2.000 CENTER 15 M0. 5 2.1437616F-01 2.44317610N 2.000 CENTER 15 M0. 5
CENTER VELOCITY ACCELERATION 1.0273368E-01 1.4994055E-04 -1.23556766-09 -6.9017357E-02 -1.0203517E-04 -2.55899324E-08 1.5284888E-01 2.18196559E-04 -2.55899324E-08 1.5584888E-01 2.18196559E-04 -2.55899324E-08 1.9667329E-01 2.18196559E-04 -2.55899324E-08 2.000 CENTER VEL0CITY ACCELERATION 3.5054766E-01 1.027349477E-04 -2.55899324E-08 -2.38390556E-01 1.07001477-04 7.658211E-07 -2.38390556E-01 1.2349477E-04 7.6552510E-07 -2.38390556E-01 1.2349477E-04 7.658211E-07 -2.38390556E-01 1.2349477E-04 7.658211E-07 -2.3599175E-01 2.3559915E-04 1.0158211E-07 -2.36889361E-01 2.355915E-04 1.01552010 -2.35989172E-01 2.35498476-04 2.5888437E-07 -3.5999172E-01 2.4421216E-04 2.5888437E-07 -3.5999172E-01 2.344765702-05 1.4337013E-07 -3.5999172E-01 2.54421216E-04 2.5888437E-07
1.0273368E-01 1.4994055E-04 -1.2355676E-09 -6.9017357E-02 -1.0203517E-04 -2.55859324E-08 1.5584888E-01 2.1819659E-04 2.5859324E-08 1.5584888E-01 2.1819659E-04 2.5859324E-08 1.5584888E-01 2.83730657E-04 2.58599324E-08 2.000 CENTER VELOCITY ACCELERATION 2.5839556E-01 1.0700147E-04 7.6555930E-09 2.53839556E-01 1.0700147E-04 7.6555930E-09 2.53839556E-01 1.2349472E-04 7.6555930E-09 2.53839556E-01 1.2349472E-04 7.6555930E-09 2.53839556E-01 1.2349472E-01 2.5859336E-07 2.5000 CENTER VELOCITY ACCELERATION 2.50193646E-01 2.35599156-04 1.01582116-07 2.5000 CENTER VELOCITY ACCELERATION 2.501956501 2.7681046E-01 2.7591346-07 2.501956501 2.75813476E-04 2.753126E-07 2.501956501 2.7681046E-01 2.76813346E-07 2.5056333610500 2.74421216E-04 2.34446707
) -6.9017357E-02 -1.0203517E-04 -4.2305837E-09) 1.5584888E-01 2.1819659E-04 -2.5480977E-08) 1.95657329E-01 2.1819659E-04 -2.55859324E-08) 1.95657329E-01 2.16072558E-04 2.5859324E-08) 3.5054766E-01 1.0700147E-04 7.6655930E-09) 3.50554766E-01 1.23494725E-04 7.6655930E-09) 3.5054766E-01 1.23494725E-04 7.6655930E-09) 0.1173440E-01 2.3559915E-04 7.6655930E-07) 0.1173440E-01 2.3559915E-04 1.0158211E-07) 0.1173440E-01 2.3559915E-04 1.0158211E-07) 0.000 CENTER NO. 5) 0.015611 7.76810466E-05 1.5941334E-07) 0.000 CENTER NO. 5) 0.000 CENTER NO. 5) 0.000 CENTER NO. 5) 0.000 CENTER NO.
1.02084080E-01 2.18190595-04 2.5859324E-08 2.000 CENTER NO. 5 2.000 CENTER VELOCITY ACCELERATION 3.5054766E-01 1.6972536E-04 2.5859324E-08 3.5054766E-01 1.0700147E-04 7.6655930E-09 4.4102425E-01 1.2349472E-04 7.6655930E-09 6.1173440E-01 2.3559915E-04 1.0158211E-07 5.000 CENTER VELOCITY ACCELERATION 6.1173440E-01 2.3559915E-04 1.0158211E-07 2.000 CENTER NO. 5 2.000 CENTER VELOCITY ACCELERATION 7.0019661E-01 2.346804E-04 7.6655930E-07 9.2676160E-01 2.9736611E-04 2.5941334E-07 9.2676160E-01 -5.4421216E-06 1.5941334E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 9.2676160E-01 -5.9736611E-04 4.633716E-07 9.2676160E-01 2.9736611E-04 4.7438718697E-07 1.2479724E 00 CENTER VEL0CITY 1.2479374E 00 5.1191758E-04 4.7438718697E-07
CENTER IS NO. 5 Sected and the sector of
Image: Center velocity Cccleration 1 3.5954766E-01 1.0700147E-04 3.5961078E-08 -2.3839656E-01 -1.0700147E-04 7.6655930E-09 4.4102425E-01 1.2349472E-04 7.6655930E-08 6.1173440E-01 2.3559915E-04 1.0158211E-07 7.600 CENTER 15 NO. 5 -9.4694060E-08 7.0019661E-01 2.3659915E-04 1.0158211E-07 7.0019661E-01 2.3698893E-04 1.0452622E-07 1.59431216E-05 1.4397013E-07 2.5989172E-01 -5.4421216E-06 1.5941334E-07 7.0019661E-01 2.9736611E-04 2.3888437E-07 1.3598172E-01 -7.7681046E-05 1.4397013E-07 2.000 CENTER 15 NO. 5 1.4397013E-07 2.000 CENTER 15 NO. 5 1.43971326E-07 2.000 CENTER 15 NO. 5 1.4397132929E-07 1.2675472E 0 6.4023747E-04 4.7438718E-07 2.2086303E-01 2.2686303E-01 4.7438718E-07 2.2005303E-01 2.267537374E-04 4.7438718E-07 2.2606303E-01 2.267537
1 3.5054766E-01 1.6972536E-04 3.5961078E-08 -2.3839656E-01 -1.0700147E-04 7.6655930E-09 6.1173440E-01 2.355915E-04 1.0158211E-07 6.1173440E-01 2.355915E-04 1.0158211E-07 6.1173440E-01 2.3559915E-04 1.0158211E-07 7.000 CENTER VELOCITY ACCELERATION 7.0019661E-01 2.356913E-04 1.0158214E-07 7.0019661E-01 2.356913E-04 1.0158214E-07 7.0019661E-01 2.8698893E-04 1.04526622E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 1.2479724E 00 5.1191758E-04 4.3775526E-07 2.2086303E-01 2.20587336E-04 4.7438718E-07 2.26764303E-01 2.24746570E-04 4.7438718E-07 2.2675385E-04 1.2675472E 00 5.0573385E-04 1 1.2675472E 0
-2.3839656E-01 -1.0700147E-04 7.6655930E-09 4.4102425E-01 1.2349472E-04 1.0158211E-07 2.000 CENTER IS NO. 5 -9.4694060E-08 2.000 CENTER IS NO. 5 -9.4694060E-07 2.000 CENTER VELOCITY ACCELERATION 7.00196/1E-01 2.3559915E-04 1.0158211E-07 7.00196/1E-01 2.3569915E-04 1.0452622E-07 1.3598045E-01 -7.7481046E-05 1.4397013E-07 2.35989172E-01 -5.4421216E-04 2.3888437E-07 4.88968046E-01 -7.7481046E-04 2.3888437E-07 2.9736611E-04 2.3888437E-07 2.000 CENTER VEL0CITY 2.20863031E-01 1.24795175E-04 4.74387186-07 2.20863031E-01 2.208630314E-04 4.7438718E-07 2.20062 CENTER NO. 5
000 CENTER IS ND. 5 -9.46734000 2.000 CENTER IS ND. 5 -9.4621100 2.000 CENTER VELOCITY ACCELERATION 7.00196616-01 2.86988936-04 1.01582116-07 7.00196616-01 2.86988936-04 1.01582100 1.01582126-01 -5.44212166-06 1.5941334E-07 4.889588046-01 -7.76810466-05 -1.43970136-07 2.000 CENTER IS ND. 5 2.000 CENTER IS ND. 5 2.000 CENTER IS ND. 7 2.000 CENTER IS ND. 5 2.000 CENTER IS ND. 7 2.000 CENTER IS ND. 7 2.000 CENTER IS ND. 7 2.1017758E-04 4.74387186-07 2.2086303E-01 -2.05873746-04 4.74387186-07 2.2086303E-01 -2.05873746-04 4.74387186-07 2.2086303E-01 -2.05873746-04 4.74387186-07 2.2075303E-01 -2.0581376-04 4.74387186-07 2.2075303E-01 -2.0581376-04 4.74387186-07 1.2675472E 0 6.40237476-04
:.000 CENTER IS ND. 5 :.000 CENTER VELOCITY ACCELERATION T.0019661E-01 2.8698893E-04 1.0452622E-07 1.3.5989172E-01 -5.4421216E-06 1.5941334E-07 1.3.5989172E-01 -5.4421216E-06 1.4397013E-07 1.3.5989172E-01 -5.4421216E-06 1.4397013E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 1.3.5989172E-01 -7.1681046E-05 -1.4397013E-07 2.000 CENTER IS ND. 5 2.9736611E-04 2.3888437E-07 2.000 CENTER IS ND. 5 2.3888437E-07 -2.1456329E-07 2.1.2479724E 3.2474670E-04 4.3775526E-07 -2.1456329E-07 2.1.2479724E 3.2474670E-04 4.3775526E-07 -2.1456329E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 -2.1456329E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 -2.1456329E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 -2.1456329E-07 2.2086303E-01 -2.0587334E-04 4.7438718E-07 -2.1456239E-07 2.2086303E-01 -2.05873374E-04 4.7438718E-07 -1.13079956-07<
CENTER VELOCITY ACCELERATION 7.0019661E-01 2.8698893E-04 1.0452622E-07 -3.5989172E-01 -5.4421216E-06 1.5941334E-07 4.8896804E-01 -7.7681046E-05 1.5941334E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 2.000 CENTER IS NO. 2.000 CENTER NO. 5 2.20863296-02 5.1191758E-04 4.3775526E-07 2.2086303F-01 -2.14563296-07 4.3775526E-07 2.2086303F-01 -2.0587374E-04 4.3775526E-07 2.2086303F-01 -2.0587374E-04 4.7438718E-07 2.2086303F-01 -2.0587374E-04 4.7438718E-07 2.2086303F-01 -2.0587374E-04 4.7438718E-07 2.2086303F-01 -2.0587374E-04 4.7438718E-07 2.12675776 4.02659956-07
7.0019661E-01 2.869893E-04 1.0452622E-07 -3.5989172E-01 -5.4421216E-06 1.5941334E-07 4.8896804E-01 -7.7681046E-05 -1.4397013E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 1.9.2676160E-01 2.9736611E-04 2.3888437E-07 2.000 CENTER NO. 5 2.000 CENTER VELBCITY ACCELERATION 2.000 CENTER VELBCITY ACCELERATION 2.201191758E-04 4.3775526E-07 4.3775526E-07 2.201450329E-01 -2.1191758E-04 4.7438718E-07 2.201450328E-01 -2.14563329E-02 4.023747E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 2.20865303E-01 -2.0537374E-04 4.7438718E-07 2.20162762 5.0139776-04 4.7438718E-07 2.3062 CENTER NO. 5.055738526E-07 2.2016201 2.4023747E-04 4.0266607 4.026659956-07 2.132985106 0 2.40251197E-04 4.026599956-07
-3.5989172E-01 -5.4421216E-06 1.5941334E-07 4.8896804E-01 -7.7681046E-05 -1.4397013E-07 9.2676160E-01 2.9736611E-04 2.3888437E-07 2.000 CENTER IS NO. 5 -1.4397013E-07 2.000 CENTER IS NO. 5 -1.4397013E-07 2.000 CENTER IS NO. 5 -1.4331929E-07 2.1275656 -2.97366704 -1.7631929E-07 2.2086303E-01 -2.0587374E-04 4.3775526E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 2.2086303E-01 -2.05587374E-04 4.7438718E-07 2.2086303E-01 -2.05587374E-04 4.7438718E-07 2.06579510F 00 5.0573316F-07 2.065995E-01 1.3707905E-01 1.0659849E-07 1 1.3707905E-01 5.0573519F-07 1 1.3472110E 00 7.0581756E-07
4.88968045-01 -7.76810465-05 -1.43970135-07 9.26761605-01 2.97366115-04 2.38884375-07 2.000 CENTER 15 N0.5 2.000 CENTER VELBCTY ACCELERATION 2.14563295-02 5.11917586-04 4.37755266-07 2.20863035-01 -2.05813745-04 4.74387186-07 2.20863035-01 -2.05813745-04 4.74387186-07 1.26754725 00 6.40237476-04 4.74387186-07 2.20863035-01 -2.05813745-04 4.74387186-07 2.20863035-01 -2.058173745-04 4.74387186-07 1.26754725 00 6.40237476-04 4.74387186-07 2.0662 CENTER NO. 5 2.286827166-07 1.267754725 00 6.40237476-04 4.74387186-07 2.06627196-01 6.402371976-04 4.74387186-07 2.06627196-01 5.0573856-04 4.02659956-07 1.1.37079056-01 6.29573856-04 4.02659956-07 1.1.34721106 00 7.0581756E-04 5.05735196-07
9.2676160E-01 2.9736611E-04 2.3888437E-07 2.000 CENTER IS M0. 5 ACCELERATION CENTER VELBCITY ACCELERATION 1.2479724E 3.2474670E-04 -1.7631929E-07 2.2086303E-01 3.2474670E-04 4.3775526E-07 1.2675472E 00 6.402374FE-04 4.7438718E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 2.2085303E-01 -2.0587374E-04 4.7438718E-07 1.1.2675472E 00 6.4023747E-04 4.7438718E-07 2.062 CENTER 1 2.50587374E-04 4.7438718E-07 1.1.2675472E 00 6.4023747E-04 4.7438718E-07 1.1.2675472E 00 5.4023747E-04 4.7438718E-07 1.1.2675472E 00 5.4023747E-04 4.7438718E-07 1.1.3707905E-01 6.2957385E-04 4.0265995E-07 1.1.3472110E 00 7.0581756E-04 5.0573519E-07
CENTER IS NO. 5 CENTER IS NO. 5 CENTER VELBCITY CENTER CENTER VELBCITY ACCELERATION CENTER VELBCITY CENTER VELBCITY CENTER VELBCITY CENTER VELBCITY -2.191758E-04 4.3775526E-07 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.2086303E-01 2.402374FE-04 4.7438718E-07 0.062 CENTER 1.2675472E 1.2675472E 0.062 CENTER 1.3298510E 1.33298510E 1.33707905E-01 1.3472110E 1.3472110E 1.3472110E 1.3477110E
CENTER VELBCITY ACCELERATION 1.2479724E 00 3.2474670E-04 -1.7631929E-07 2.2085329E-02 5.1191758E-04 4.3775526E-07 2.2085303E-01 -2.0587374E-04 4.3775526E-07 2.2085303E-01 -2.0587374E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.26775472E 00 6.4023747E-04 4.7438718E-07 1.1.2677546 00 2.6051197E-04 4.7438718E-07 1.1.3707905E-01 6.2957385E-04 4.0265995E-07 1.1.3707905E-01 -1.8425173E-04 4.0265995E-07 1.1.3472110E 00 7.0581756E-04 5.0573519E-07
1.2479724E 00 3.2474670E-04 -1.7631929E-07 1.2479724E 00 5.1191758E-04 4.3775526E-07 2.2086303E-01 -2.0587374E-04 4.3775526E-07 2.2086303E-01 -2.0587374E-04 4.7438718E-07 1.2675472E 00 6.4023747E-04 4.7438718E-07 1.1.26770 7.0651197E-04 4.0265995E-07 1.1.3207905E-01 6.2957385E-04 4.02659956E-07 1.1.3472110E 00 7.0581756E-04 5.0573519E-07
-2.145065295-02 -2.115173655-04 4.3775565-01 2.20863035-01 -2.05873745-04 4.74387185-01 1.2675472E 00 6.40237475-04 4.74387185-01 0.062 CENTER 15 N0. 5 0.062 CENTER 15 N0. 5 1.2675472E 00 6.40237475-04 4.74387185-01 0.062 CENTER 18 0.05 1.2675472E 00 6.40237475-04 4.74387185-07 1.1.32098510E 00 21.60511975-04 4.02659955-07 1.1.37079055-01 6.29573855-04 4.02659955-07 1.1.3472110E 00 7.0581756-04 5.05735196-07
I 1.2675472E 00 6.4023747E-04 4.7438718E-07 0.062 CENTER IS NO. 5 0.062 CENTER IS NO. 5 0.062 CENTER IS NO. 5 0.062 CENTER VELOCITY ACCELERATION 1 1.3298510E 00 216051197E-04 -2.8682716E-07 1 1.3207905E-01 6.2957385E-04 4.0265995E-07 1 1.3472110E 00 7.0581756E-04 5.0573519E-07
).062 CENTER IS NO. 5 CENTER VELOCITY ACCELERATION CENTER VELOCITY ACCELERATION 1 1.3298510E 00 216051197E-04 -2.8682716E-07 1 1.3707905E-01 6.2957385E-04 4.0265995E-07 1 1.6638200E-01 -1.8425173E-04 1.0659849E-07 1 1.3472110E 00 7.0581756E-04 5.0573519E-07
CENTER VELOCITY ACCELERATION I 1.3298510E 00 216051197E-04 -2.8682716E-07 I 1.3707905E-01 6.2957385E-04 4.0265995E-07 I 1.6638200E-01 -1.8425173E-04 1.0659849E-07 I 1.3472110E 00 7.0581756E-04 5.0573519E-07
I 1.3298510E 00 21.6051197E-04 -2.8682716E-07 I 1.3707905E-01 6.2957385E-04 4.0265995E-07 I 1.6638200E-01 -1.8425173E-04 1.0659849E-07 I 1.3472110E 00 7.0581756E-04 5.0573519E-07
I 1.3707905E-01 6.2957385E-04 4.0265995E-07 I 1.6638200E-01 -1.8425173E-04 1.0659849E-07 I 1.3472110E 00 7.0581756E-04 5.0573519E-07
L 1.6638200E-01 -1.8425173E-04 1.0659849E-07 L 1.3472110E 00 7.0581756E-04 5.0573519E-07
I 1.3472110E 00 7.0581756E-04 5.0573519E-07

4.1.4 LISTING

This listing is the main program for PROG #1. No subroutines are included since it is here included to assist in setting up job decks.

	INTERPLANETARY PROCIAM - SHERVIN
	EQUIVALENCE(WM(1),XIM),(WM(2),YI,),(WM(3),ZIM),(WM(4),XIDM),
	l(WM(6),ZIDM),(WM(5),YIDM),(WL(1),XIL),(WL(2),YIL),(WL(3),ZIL),
	2(ML(4),XIDL),(ML(5),YIDL),(ML(6),ZIDL)
	DAC PX(9,67),PY(9,67),PZ(9,67),IL(67),RKM(4,6),RKL(4,6),NB(9),
	IWT(9),RAD(9),X(9),Y(9),Z(9),DIS(9),DIST(9),PM(6),PL(6),PPM(6),
	2PPL(6),QM(6),QL(6),WM(6),WL(6),XX(9),YY(9),Z2(9),TI(6),CL(6)
	COMMON NEWORG, ZER, FMX, FLX, FMY, FLY, FMZ, FLZ, AM, AL, BM, BL, CM, CL
	COMMON NORGINTARGINSUNININNINNITITO.TMAXIDTMAXIHAFDT.WTEIWTV.MGM.
	IXTARG,YTARG,ZTARG,SCEN,VCEN,SMAX,GMAX,EMAX,RAD1,RAD2,RADE,WTA,
	2NBE,NBT,NBS,RADORG,SAM,SBM,SCM, SAL,SBL,SCL,XIM,XIL,YIM,YIL,ZIM,
	3ZIL,XIDM,XIDL,YIDM,YIDL,ZIDM,ZIDL,RM,RL,RR,RO,SS,RRM,RRL,TEM,TEL,
	4GMX,6LX,GMY,6LY,GMZ,6LZ,SUMX,SULX,SULX,SUMY,SULY,SUMZ,SULZ,FM,FL,GM,6L,
	5HM+HL+RRR+SSS+XM+YM+ZM+A+BX+BY+BZ+WRM+WRL+RCM+RCL+ROM+ROL+RPPM+
4	6XPM, XPL, YPM, YPL, ZPM, ZPL,
6	7KUB, VNZ, MEUT, MSDT, MDT, NOT, MET, NOUT, NCKE, TSAV, DTA, DTB, DTC, EPI
	DAC-G(2),WTS(2)
	DAC . S0G00D(6) • XD0T(2) • YD0T(2) • ZD0T(2) • WRONG(6) • 0X(2)
	1.0Y(2),0Z(2),XP(2),YP(2),ZP(2),XD0TP(2),YD0TP(2),ZD0TP(2),PI(2),
	2PI2(2),E(2),XMJ(2),CCON(2),XN(2)
	COMMON A1,A2,FJI,FJ2,SFJ1,SFJ2,CFJ1,CFJ2,S1,S2,EPS1
	COMMON DT.DTME.RPM
	DAC SM(6).SL(6).XMJP(2)
	COMMON OBJ, ISAVE, REA, RTA, RSN, HPI, THPI, KK, NOSW, POM(6), POL(6), ERR,
	1SIP0+COPO+SIECC+COECC+SIGVE+COGVE+CO2+GEGEH+DJD+GEL+GE+DL+U0+COPN+
	2SIPN, COEE, SIEE, CUH, SIH, SIDL, CODL, COAL, SIAL, VH, H, SIBLEH, COBLEH, GEH,
	3SIBLE, COBLE, RGEO, dLE, COGE, SIGE, ACOGEH, SCGEH, TAGEH, GBX, GBY, GBZ, GHX,
	46HY,6HZ,COTH3,SITH3,COTH2,SITH2,HX,HY,HZ,CETA,VDP,RDP,SIPI,COPI,
	5PHI,000.NJ(6),ND.NT.EC(6).RBAR(7).TD.PHID.DPHI,GEE.KIT.TT.RAPA.RDP.
	6VOX, VOY, VOZ, NMC, TMC(6), DTMC(6), ALMC(6), BEMC(6), SIMC, FMC, WVMC, VDP,
	1

7N, EE, NR, PSI
REAR(1) = .387099
RBAR(2) = .723332
RBAR(3) = 1.523691
RJAR(4) = 5.202803
RDAR(6) = 19.181945
RBAR(7) = 30.057767
EPS1 = 1.0E-11
MGM = 512
B PI = 202622077325
B PI(2) = 147042055061
B P12 = 203622077325
B PI2(2) = 150042055061
B HPI = 201622077325
b THPI = 203455457437
2 REWIND 26
ERASE NOT,NORG,PL,SL(4),SL(5),SL(6)
RIT 2, 3, NTYPE
3 FORMAT (312)
IF {NTYPE-2} 4, 40, 80
4 RIT 2, 3, TT, DJD, ND, NT
RIT 2, 3, NR, (NJ(I),EC(I),I=1,NR),GEE,KIT,DT,DPHI
RIT 2,3, BLE,GEL,RO,G(1),WTE,WTV,RADE,OBJ
5 G(2)=G/576.
6=-6(2)
TME = DJD*24.
RIT 2.3. EMAX.GMAT.SMAX

RIT 2,3. NCKE, MSDT, MET, NOUT, NUSW
IF (MSDT) 6, 7, 6
6 RIT 2,3,DTA,DTB,DTC
ERASE DT
7 RIT 2,3, DIOR, DIMAX, EPI
8 RIT 2,3, NBD
RIT 2,3, (NB(I),WT(I),RAD(I),I=1,NBD) [.]
ERASE ERR
CALL PHIS.
REWIND 26
IF(ERR) 2,10,2
10 IF (NJ-4) 12,12,11
11 NJ = NJ - 4
A 12 CALL DEPART
© GMAX = GMA1
D1=D1OR
HAFDT = DT/2•
NEWORG =ND
NTARG' =NT
N = NBD
25 TMAX = TIME
CALL DIFCOR
40 RIT 2.3, DJD.TT.ND.NT.
ERASE NJ(1)
CALL PHIS?
PSI = 57.29578*PSI

WOT 10.42.ND.NT.NDJD.PSI
42 FORMAT (1H115X,20HFOR DEPARTURE PLANET 12,1X, 22HAND DESTINATION P
ILANET I2, IX, IIHON TAPE DAY I5/1H025X, 26HTHE CONFIGURATION ANGLE IS
8 2F7.1,1X,4HDEG.)
GO TO 2
80 RIT 2,3,G(1),WTE,RADE,WTV,OBJ
6(2) = 6/576.
6 = -6(2)
84 RIT 2,3,EMAX,GMAX,SMAX,IMAX.TO
85 RIT 2,3,NCKE,MSDT,MET,NOUT,NOSW,NMC /
IF (MSDT) 86,87,86
86 RIT 2,3,DTA,DTB,DTC
ERASE DT
GO TO 88
A 87 RIT 2,3,DT,DTMAX,EP1
6 HAFDI = DI/2.
88 RIT 2,3,N,NEWORG,NTARG
RIT 2, 3, (Nb(1), WT(1), RAD(1), I = 1, N)
RIT 2,3,(PM(I),I = 1,6)
ERR = 1.
TMAXE = TMAX
92 IF (NMC) 93, 94,93 · ()
93 RIT 2,3,SIMC,FMC,WVMC,(PPM(I),PPL(I),QM(I),QL(I),I = 1,NMC)
DO 95 I = 1.NMC
J = NMC+1-1
TMC(I) = PPM(J)
DTMC(I) = PPL(J)
ALMC(I) = QM(J)
95 BEMC(I) = QL(J)
94 CALL TITLE

| Cull ORGN T = 0. T = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 Cull SET1 Cull SET1 F (FIEM) 97.2.97 F (FIEM) 97.2.97 97 (F (FIEK) 99.12.96) 97 (F (FIEK) 99.12.96) 97 (F (FIEK) 99.12.99) 97 (F (FIEK) 99.12.96) 97 (F (ERR) 99.12.99) 97 (F (ERR) 99.12.99) 97 (F (ERR) 99.12.99) 97 (F (ERR) 99.12.99) 97 (F (ERR) 99.12.99) 97 (F (ERR) 99.12.99) 97 (F (INC) 56.101.96) 97 (F (INC) 56.101.96) 199 (F (INC) CARDS FLA MCONNALD 97 (F (INC) 196.127).196 199 (F (INC) 46.1 201.203) 195 (F (INC) 46.1 201.203) 199 (F (INC) 196.127).196 195 (F (INC) 46.1 201.203) 199 (F (INC) 46.1 201.203) 195 (F (INC) 46.1 201.203) 190 (F (INW -61 201.203) 100 (F (INW -61 201.203) 191 (F (INW -61 205.205.205.205.204 100 (F (INW -61 205.205.205.205.205.205.204 192 (F (INW -61 205.205.205.205.204 100 (F (INW -61 205.205.205.205.204 101 2 20 101 2 20 101 2 20

 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

--
--
--|--|---|---|---|---|---|---|---
--|--|---|--|---|--|---|--|--|--
---|--|--|--|--|--|---|---|--|--|--|--|--|--|---|--|--|---|---|--
--|---|--|--|---|--|--|--|--|--|---|--|---|--|--|--|---|---|---|--|---|--|---|--|--|--|--|---|--|---|---|---|---------------------------------|---|---|---------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------|---|--------------------|---|---|--|--|-----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Cull ORGN Cull ORGN T = 0. Kx = 61 Kx = 61 Kx = 61 Cull SE1 F (IEM 97.2.91 F (IEM 97.2.91 91 F (IEM 97.2.94 97 F (IEM 97.2.94 92 E (IEM 97.2.94 96 F MAX = TMC(IMC) 96 Cull MBODY 97 F (IEM 97.2.94 96 Cull MBODY 96 Cull MBODY 96 Cull MBODY 11 F (IMC) 96.101.96 111 (IMC) 97.101.96 11 F (IMC) 97.101.96 111 (IMC) 97.101.96 11 F (IMC) 195.120.195 111 (IMC) 195.120.195 119 F (INCG-NTARG) 195.120.196 111 (IMC) 195.120.196 119 F (INCG-NTARG) 195.120.195 111 (IMC) 195.120.195 119 F (INCG-NTARG) 195.120.195 111 (IMC) 195.120.195 119 F (INCG-NTARG) 195.120.196 111 (IMC) 195.120.196 119 IT = NORG 110 (IMC) 195.120.196 119 IT = NORG 110 (IMC) 195.120.196 119 IT = NORG 111 (IMC) 195.120.196 119 IT = NORG 110 (IMC) 195.120.196 119 IT = NORG 110 (IMC) 195.120.196 110 IT NA = 1 110 (IMC) 195.120.196 111 IT NA = 1 110 (IMC) 105.120.196 </td

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN T = 0. T = 0. Kx = 61 Kx = 61 Kx = 61 CALL SETI F (TEN) 97.2.91 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 96.1 L MOOY 97.1 F (TEN) 97.2.91 97.1 F (TEN) 97.2.91 10.1 TAX = TAXE 11.1 F (TAX) 91.101.96 11.1 F (TAX) 91.101.96 11.1 F (TAX) 91.101.96 11.1 F (TAX) 1.97.120.129 11.1 F (TAX) 91.127.120.129 11.1 F (TAX) 1.97.120.1203 11.1 F (TAX) 1.97.120.1203 11.1 F (TAX) 1.97.120.1203 11.1 F (TAX) 1.97.120.1203 11.1 F (TAX) 1.97.1203 11.1 F (TAX) 1.97.1203 11.1 F (TAX) 1.97.1203.1203 11.1 F (TAX) 1.97.1203

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN T = 0: T = 0: Kx = 67 Kx = 67 Kx = 67 CALL SET1 F (TER) 971,297 F (TER) 971,297 F (TER) 971,297 97 F (TER) 971,297 97 F (TER) 971,297 96 TAX = TMC(MC) 97 F (TER) 971,297 97 F (TER) 971,297 97 F (TER) 971,297 97 F (TER) 971,296 101 F (TER) 971,296 101 F (MC) 961,101,966 101 F (MC) 1991,220,195 101 F (MC) 961,101,966 101 F (MC) 1991,220,195 101 F (MC) 961,101,966 101 F (MC) 1991,220,195 101 F (MC) 1991,220,195 101 F (MC) 1991,220,195

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cult DRGN Cult DRGN T = 0. Kx = 67 Xx = 67 Kx = 67 Cult SE1 F (TEN) 971.0136 91 F (HEN) 971.0136 91 F (HEN) 971.0136 92 F (MINC) 92 F (MINC) 93 F (MINC) 93 F (MINC) 94 F (MINC) 94 F (MINC) 95 Cult BROY 95 Cult BROY 96 F (MINC) 95 Cult BROS 97 F (MINC) 96 Cult BROS 98 Cult BROS 97 Cult BROS 99 F (MINC) 96 Cult BROS 101 F (MINC) 101 F (MINC) 101 F (MINC) 101 F (MINC) 101 F (MINC) 101 F (MINC) 102 F (MINCHOL) 101 F (MINC) 103 F (MINCE) 101 F (MINC) 104 F (MINC) 101 F (MINC) 105 F (MINCE) 101 F (MINC) 101 F (MINCE) 101 F (MINC) 102 F (MINCE) 101 F (MINCE) 103 F (MINCE) 101 F (MINCE) 103 F (MINCE) 101 F (MINCE) 103 F (MINCE) 101 F (MINCE) 104 F (MINCE) 101 F (MINCE) </td

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN T = 0. T = 0. Kx = 61 Kx = 61 Kx = 61 F (LL DEE) F (LL DEE) 91 [F (TEN) 99:12:91 97 [F (TEN) 99:12:91 92 [F (TEN) 99:12:92 93 [F (TEN) 99:12:92 93 [F (TEN) 99:12:92 95 [CLL MODY 95 [CLL MODY 95 [CLL MODY 95 [CLL MODY 95 [CLL MODY 95 [CLL MODY 16 [T MAK 95 [CLL MODY 16 [T MAK 95 [CLL MODY 17 [T MAK 96 [CLL MODY 19 [T MAK 97 [L MAK 19 [T MAK 96 [CLL MODY 10 [T MAK 97 [CLL MODY 10 [T MAK 97 [CLL MODY 10 [T MAK 97 [L MAK 199 [T (MAK 97 [L MAK 199 [T (MAK 191 [T MAK 199 [T (MAK 192 [F (MAK 199 [199 !191 [199 !197 !196 193 [F (MAK 199 !198 !191 [198 !197 !196 195 [F (MAK 199 !198 !191 [198 !197 !196 195 [F (MAK 199 !198 !191 [198 !197 !196 195 [F (MAK 190 !198 !191 !198 !197 !196 195 [

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull DRGN Cull DRGN T = 0. Kx = 61 Kx = 61 Kx = 61 Cull SET F (1EH) 912.95 F (1EH) 912.95 91 F (1EH) 912.95 91 F (1EH) 912.95 92 Cull DROY 95 Cull Set101.96 93 Cull DROY 96 Cull NBOY 95 Cull NBOY 97 F (1ER) 99.2199 95 Cull NBOY 97 F (1ER) 99.2199 95 Cull NBOY 97 Cull Set01.95 95 Cull NBOY 97 F (1HAZ = 1MXE) 195 Cull NCO 101 F (1NX = 1) MC = NIXC 101 F (1NX = 1) 101 Cull Set01.195 195 F (NIARC) 195.1200.196 195 Cull NCO 196 M T = NICR 195 LONOMINLD 197 H = NICR 195 LONOMINLD 198 M T = NICR 195 LONOMINLD 199 F (NUAC-NITARC) 195.1200.196 196 N T = NICR 190 F (NIN - 6) 201 201 203 201 E (NIN - 6) 201.203.204 201 RN = 1 201 RN - 50 201 RN = 29 201 RN - 59 201 RN = 29 201 RN - 59

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull OROH I 0. T = 0. Kx = 67 Kx = 67 Kx = 67 Kx = 67 Kx = 67 Kx = 67 Kx = 67 Kx = 67 Cull SE11 F (TEB) 97:291 97 16 F f (TEB) 97:291 97 16 100 96 Full NBOY 96 100 100 1 F (LER) 97:299 100 100 100 1 F (LER) 99:20:196 100 100 100 100 IF (LER) 99:20:196 I I 100

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGH T = 0. T = 0. KK = 61 KK = 61 KK = 61 KK = 61 CALL SET1 L = 0. KK = 61 F (TEN) 97.2.97 Set Licken(1) 91 F (KK) 90.01.96 Set Licken(2) 95 FMAX = TMC(MC) Set Licken(2) 96 FMAX = TMC(MC) Set Licken(2) 97 F (KR) 99.21.95 Set Licken(2) 96 FMAX = TMAX Mic = Mic-1 IF (LIC) NIC = Mic-1 IF (LIC) Set Licken(2) 101 TMAX = TMAX Mic = Mic-1 IF (MC) 96.101.96 Licken(2) 101 TMAX = TMAX Licken(2) 102 F (MIN-6) Licken(2) 103 F (TICKN-6) Licken(2) 104 C = 0 Licken(2) 105 L (MIN-6) Licken(2) 106 L (MIN-6) Licken(2) 107

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGH T = 0. T = 0. KK = 67 KK = 67 KK = 67 CALL SET1 IF (TEM) 972.97 IF (TEM) 972.97 91 F (TEM) 972.97 91 F (TEM) 972.97 91 F (TEM) 972.97 92 F (TEM) 972.97 91 F (TEM) 972.97 93 F (TEM) 992.99 91 F (TEM) 992.99 1 F (TEM) 992.99 91 F (TEM) 992.99 1 F (TEM) 992.9196 91 F (TEM) 992.9196 1 F (TEM) 992.9196 91 F (TEM) 992.9196 1 F (TEM) 992.9196 91 F (TEM) 992.9196 1 F (TEM) 992.9196 91 F (TEM) 992.9201.906 1 F (TEM) 992.9196 91 F (TEM) 992.9201.906 1 F (TEM) 992.9201.906 1957.2201.906 1 F (TEM) 992.9201.203 91 F (TEM) 992.9201.203 1 F (TEM) 201.201.203 91 F (TEM) 201.203.203.203.204 2 O T O ZOG 2 O T O ZOG 2 O HW = 59 2 O HW = 50

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORCH I 0. T = 0. KK = 61 KK = 61 KK = 61 KK = 61 KK = 61 Cull SET1 Cull SET1 F [F (ERN) 97.297] 97 [F (ERN) 97.297] 97 [F (ERN) 97.297] 96 Cull MOOY 98 Cull MOOY 97 [F (ERN) 97.297] 97 [F (ERN) 97.297] 97 [F (ERN) 97.297] 96 Cull MOOY 97 [F (ERN) 97.297] 97 [F (ERN) 97.297] 97 [F (INC) 76] 96 Cull MOOY 97 [F (INC) 96.101.96] IF (INC) 96.101.96 INC = NMC-1 19 [F (INCRO) 196.127.196] INC = NMC = NMC-1 19 [F (INCRO) 196.127.196] IST (INC) 19 [F (INCRO) 196.127.196] IST (INC) 19 [F (INTRO) 196.127.196] IST (INC) 19 [F (INTRO) 196.127.196] IST (INC) 19 [F (INTRO) 196.127.196] IST (INC) 10 [S IN = 1 IARG IST (INC) 10 [S IN = 1

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORGI T = 0. T = 0. Kx = 67 Kx = 67 Kx = 67 Kx = 67 Kx = 67 Cull SET1 IF (IER) 91.2.91 F (FIN) 91.2.97 91.2.97 97 F (INC) 95 Call NOD 98 Call NOD 96 Call NOD 99 Call NC 96 Call NOD 90 Call NC 96 Call NOD 91 F (INC) 96.101.96 91 F (INC) 191.196 191 F (INC) 191.196 191 F (INC) 191.196 191 F (INC) 195.1201.99 195 F (INTARC) 195.1201.99 195 F (INTARC) 195.1201.196 195 F (INTARC) 195.1201.196 196 MT = MTAR0 195.1201.196 197 MT = NORG 195.1201.196 197 MT = NORG 196.1201.196 197 MT = NORG 197.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 Call SET1 IF (IEB) 97.2.97 F (FK) 99.12.97 91.0.97 97 F (IKO) 99.101.96 91.0.11 97 F (IKO) 99.21.95 91.0.11 98 CALL NGOY 91.0.196 10 F = 1. MCCI 11 F (IRM) 99.101.96 11.000 11 F (IRM) 99.101.201 11.000 11 F (IRM) 99.101.96 11.000 11 F (IRM) 99.101.201 11.000 12 F (INTACE) 19.112.01.201 19 F (INTACE) 19.112.01.201 19 F (INTACE) 19.112.01.201 10 D ZOO 19.111 10 D ZOO 19.111 10 D ZOO 10.1100 10 D ZOO

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORGN KK = 61 KK = 61 T = 0. KK = 61 KK = 61 Cull SET1 IF (TEN) 97.2.97 IF (TEN) 97.2.97 T = 0. F Cull SET1 IF (TEN) 97.2.97 T = 10. F Cull SET1 IF (TEN) 97.2.97 T = 10. F F F Setul NGOY F F F IF (ER) 99.2195 F F F IST F (NEGO 195.1296 F F F IST F (NEGO 195.121/196 F F F IST F (NEGO 195.129/1203 F F F Sol F (NNN-6) 201.201/203 F F F Sol F (NNN-6) 201.203/203 F F F <tr f<="" td="" tinstancind=""> F F </tr> <tr><td>Cult ORGN I 0. T = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 Cult SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (IMMC) 96.101.96 96 ALL MCO IF (LER) 99.2.99 97 ALL MOOP 97 Cult MCC IF (LER) 99.2.99 98 Cult MCC 10 IMC = NMC-1 IMC = NMC-1 IMC = NMC-1 Immode IF (NUC) 99.101.96 IF (NUC) 99.101.96 Immode 101 TAL E TAXE Immode Immode Immode 102 Cult MCC IMCH (Sellor) Immode Immode 103 FF (NURSO) 195.1205.195 Immode Immode Immode 103 FF (NURSO) 195.1205.0195 Immode Immode Immode 105 FF (NURSO) 195.1205.1205 Immode Immode Immode 106 FF (NUR-6) 201.201.203 Immode Immode Immode 201 MU = 1 Immode Immode Immode Immode 201 MU = 1 Immo</td></tr> <tr><td>Cult ORGN I 0. I = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 F (LL SET) F (LEN) 97.2.97 F 97 IF (IMOC) 96.101.96 F KK = 67 96 TALX = TMC(MC) 96 TALX = TMC(MC) F 96 TALX = TMC(MC) 97.2.919 F 15 IF (IMOC) 97.2.919 F 16 LER1 99.2.99 F F 17 L INODY MC = MC-1 F 18 INMC = MMC1 MC = MMC1 F 19 IF (MOR) 96.101.96 F F 19 IF (MOR-MIARO) F F 19 IF (MORO-MIARO) F</td></tr> <tr><td>Cull ORGN KK = 67 1 = 0. KK = 57 Cull SET1 KK = 57 Cull SET1 F (TEM) 9712.97 97 IF (IEM) 9712.97 9712.97 96 TMAX = TMC(IMC) 96.1001.96 96 TMAX = TMC(IMC) 96.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2199 97.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2195 101.14X 97 IF (IEM) 99.2195 101.14X 98 Cull MC 199.197.196 199 IF (MARC) 195.220.195 199.197.196 199 IF (MARC) 195.1201.195.220.195 199.17.196 199 IF (MARC) 195.220.195 199.17.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = 100RG 199.197.196 191 ITMAY = 100RG 199.197.196 191 IT = NORG 199.197.196 191 IT = NORG 199.197.196 191 ITMAY = 100RG 199.197.196</td></tr> <tr><td>Call ORGN I = 0. I = 0. Kx = 67 Kx = 67 Kx = 67 Call SEI1 IF (1EN) 97.2.97 IF (1EN) 97.2.97 91.2.97 97 IF (1EN) 97.2.97 91.2.9 97 IF (1EN) 97.2.97 91.2.1.9 96 Call NGC 99.2.1.9 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 98 Call NGC 91.01.96 91 F (NOG-NIARG) 195.200.195 91.01.96 199 IF (NOG-NIARG) 195.200.195 91.01.97.00 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.01.01 199 IF (NOG-NIARG) 195.200.195 91.01.01.01 199 IF (NOG-</td></tr> <tr><td>Call ORGN I = 0. I = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEN) 97:2.97 IF (TEN) 97:2.97 97 97 IF (HMC) 06:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 96 CALL MCC 07 101 FMA 101 MC = NMC-1 MC 01 F (MMC) 95:101.96 101 101 FMA 101 101 FMA 195,220:195 193 IF (NDRG-NTARG) 195,220:195 199 199 IF (NDRG-NTARG) 195,220:195 197 197 II = NORG 00 200 197 M = 1 201 M 4 1</td></tr> <tr><td>Cull ORGN I Coll ORGN I = 0. KK = 67 KK = 67 I = 0. KK = 57 KK = 57 Cull SET1 IF (TEM) 971.2.97 97 97 IF (IMMC) 96.1001.96 97.12 10 96 TMAX = TMC(IMMC) 96.1001.96 97 97 IF (IMMC) 96.101.96 97 10 96 TMAX = TMC(IMMC) 96.101.96 10 97 IF (IMMC) 96.101.96 10 10 96 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 199 IF (NORG-NTARG) 195.220.195 101 TMAX = TMAXE 190.197.196 199 IF (NORG-NTARG) 195.220.195 191 TMAXE 191 TMAXE 190 IT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE</td></tr> <tr><td>Call ORGN I = 0. I = 0. I I = 0. Kx = 67 Kx = 67 Call SE1 IF (TEN) 97.2.97 97.15 97.15 (TEN) 97.2.97 97.15 96.14xx = TMC(MMC) 96.14xx = TMC(MMC) 96.74L NBOPY 16.100 97.15 (TERN 99.2.99) 97.15 97.15 (TERN 99.2.99) 97.15 97.15 (MC) 96.101.96 10.1 101 TMAX = TMAKE MC = MC-1 111 (TERN 99.2.919) 10.1 112 1.0 MC = MC-1 113 15 (LINEG) 195.220:195 10.1 114 1 = MAG 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 116 1111 10.1 117 1 =</td></tr> <tr><td>Call ORGN I 0. I 0. 1 0. I 0. 1 0. I 0. 1 1 0. I 0. 1 1 1 1 I 1</td></tr> <tr><td>Call ORGN I 0. T = 0. I 1 T = 0. KK = 67 KK = 67 KK = 67 Call SET IF (TEM) 97.2.97 97 IF (HMC) 90.101.96 97.2.97 IF (HMC) 90.101.96 96 TMAX = TMC(NMC) 96 CALL NBODY 96 CALL NBODY 97 IF (HMC) 99.121.96 IF (ERR) 99.2.99 IF (HMC) 96.101.96 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) 196.101.96 IF (MC) 199 IF (MCG-MTARG) 195.1220.195 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 199 IF (MCG-MTARG) 195.127.196 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 196 MT = MTARG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.120.1100 197 HT = MCG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.1100</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE1 IF
(TEM) 97.2.97 97 IF (IRMC) 96.101.96 97 IF (IRMC) 96.101.96 96 CALL NBODY 96 CALL NBODY 16 (IRR) 99.2.99 17 IF (IRR) 99.2.99 18 (IRR) 99.2.99 19 (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 IF (IRR) 99.2.9195 IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.127.196 IPUCH CARDS I95.107.196</td></tr> <tr><td>Call ORGN T = 0. T = 0. T = 0. T = 0. Kk = 67 Kk = 67 Kk = 67 F (TEM) 97.2.97 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 96 TAL NEOPY 96 TAL NEOPY 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 97 IF (INNC) 97 IF INDOP 190 IF (NORC-INTARG) 195.1201.95 199 IF (NORC-INTARG) 195.1201.95 190 IF INDOR 191 IF INDOR</td></tr> <tr><td>Call ORGN T = 0. T = 0. T = 0. T = 0. Kx = 67 Kx = 67 Call SET1 F (TEM) 97.2.97 97 IF (IRMC) 96.101.96 98 Call NBOPY 98 Call NBOPY 96 Talk = TWC(MKC) 97 IF (IRM) 99.101.96 97 IF (IRM) 99.101.96 98 Call NGOPY 97 IF (IRM) 99.101.96 19 IF (INMC) 96.101.96 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.121.166 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196</td></tr> <tr><td>Call ORGN I 0. I 0. I 0. I 0. I 0. I 0. KK = 67 KK = 67 KK = 67 Cull SE11 I I 1 IF (TEM) 97.2.97 91.2.97 91.2.97 97 IF (IEM) 97.2.97 91.2.97 91.2.97 96 TAX = TMC(MIC) 91.2.97 91.2.97 96 Call NBOV I I 1 I I I 1 1 I I I 1 1 I I I I 1 I I I I 1 I I I I I 1 I I I I I I 1 I I I I I I I 1 I I I I I I</td></tr> <tr><td>Call ORGN I 0. T 0. T 0. T 0. K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 61 S1.2.97 S1.2.97 S1 F KK S0.101.96 S1.2.97 S6 ALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.2.91 MC MC MC MC MC MC MC MC MC MC MC MC MC MC S1.2.2.2.1.9 199 IF INOC MC MC S1.2.2.2.1.9 196 MT MC MC MC S1.2.2.2.1.9 196 MT MC<</td></tr> <tr><td>Call ORGN I</td></tr> <tr><td>Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Cull SET1 I [[[EM) 97:297 I 0.1 ST = 1 S7:297 0.1 ST = 1 S7:297 1 [[[EM) 97:297 S7:297 1 [[[(INC) 96:101:96 S7:297 1 [[(ERI 99:2192 S7:297 1 [[(INC) 96:101:96 S7:297 1 [[(INC) 96:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[[(INC) 196:101:196 S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[INCONTALD S7:20:195</td></tr> <tr><td>Call ORGN Call ORGN T = 0. T T = 0. Kx = 6T Kx = 6T Call SEI Call SEI FIERN 971.397 1 F (TEM) 971.397 97.16 (TEM) 97.1397 97.1 F (TEM) 97.1397 99.101.96 97.1 F (TEM) 97.299 97.11 (TEM) 97.299 97.1 F (TEM) 99.2.999 97.11 (TEM) 99.2.999 97.1 F (TANC) 96.101.96 101.1496 1 F (TANC) 96.101.96 101.1401 I F (TANC) 96.101.96 101.1401 1 P (TANC) 196.101.96 101.1401 1 P (NCG-NITARG) 195.120.195 101.1486 1 P (NTARG) 196.197.196 101.1480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148</td></tr> <tr><td>Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 KK = 61 Call SEI1 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 97 IF (HMC) 96.101.96 96 TMX = TMC(MC) 96 TMX = TMC(MC) 99 Call MCC 97 IF (ERR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 96.101.96 11E (IRR) 96.101.96 11F (IRR) 96.101.96 11E (IRR) 96.101.96 119 IL (IRC) 96.101.96 118 (INC) 96.101.96 119 ILAX = TMAC 011 = 1.0 119 IL (INCG-NITARD) 195.1220.195 1195.1220.195 119 IL INRG- INGL 1195.127.196</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 61 TK = 61 Call SE11 IF (L SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 95 TMAX = TMC(MMC) 96 TMAX = TMC(MMC) 96 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 101 TMAX = TMAXE MMC = NMC-1 115 (NMC) 96.101.96 MMC = NMC-1 116 (NMC) 96.101.96 MMC = NMC-1 117 (MAX = TMAXE MMC = NMC-1 118 (NMC) 96.101.96 MMC = NMC-1 119 IF (NMC) 96.101.96 MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 111 (NAX = TMAXE) 195.220.195 MMC = NMC-1 1199 IF (NRGE-NITARG) 195.220.195 MMC = NMCONNALD 1199 IF (NRGE-NITARG) 195.120.195 MMC = NTARG) 195.121.196</td></tr> <tr><td>Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Call Still Call Still F (HML) 99:101:96 91 IF (HML) 99:101:96 Stat = TMC(HMC) 95 TMAX = TMC(HMC) Stat = TMC(HMC) 96 Call NBOPY IF (ERR) 99:2:99 101 TMAX = TMAC MMC = NUC-1 115 If (NMC) 96:101:96 Stat = TMAC 101 TMAX = TMAC Call NBOPY 199 IF (NDRG-NTARG) 195:220:195 LUNCH CARDS FOR MCDONNALD 195 IF (NTARG) 195:120:195 Stat Stat Stat Stat Stat Stat Stat Stat</td></tr> <tr><td>Call ORGN Call ORGN T = 0. T Kx = 67 T IF (IEM) 97.2.97 T 91 IF (IEM) 99.2.99 T 95 Call MGOY T 11 [(IER) 99.2.99 T 12 I. T 13 Call MGOY T 14 (IER) 99.2.99 T 15 (IER) 99.2.99 T 199 IF (NAGO-NIARD) 196.101.96 195 IF (NIARG) 196.127.196 T</td></tr> <tr><td>Call ORGN T = 0. T = 0. T = 0. KK = 67 Call SET IF
(TEM) 97.2.97 IF (TEM) 99.2.99 IF (TER) 99.2.99 IF (TRU) 96.101.96 IF (INC) 96.101.97 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.97</td></tr> <tr><td>Call ORGN T = 0: KK = 67 KK = 67 Call SET IF (TEM) 97:2.97 97 IF (HMC) 96:101.96 98 Call MGOY 1F (LAR) 99:2.99 01 = 1. MMC = NMC-1 1F (INMC) 96:101.96 01 = 1. 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 100 TMAX = TMAXE 100 TMAX = TMAXE</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2.97 97 IF (INNC) 96:101:96 97 IF (INNC) 96:101:96 98 Call NBODY 1F (ERN) 99:2.999 1F (ERN) 99:2.999 01 = 1. MMC = NMC-1 IF (INNC) 96:101:96 101 TMAX = IMAXE 101 TMAX = IMAXE</td></tr> <tr><td>Call ORGN T = 0. Kx = 67 Call SET I F (TEM) 97.2.97 I F (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.99 97 IF (TEM) 99.2.99 97 Call MCC 01 = 1. MC = MC-1 I MOC = MC-1 I F (MC) 96.101.96 101 HMX = TMAXE 101 HMX = TMAXE 101 HMX = TMAXE 00100 HLD</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 91:2:97 97 IF (HMC) 96:101:96 96 TMAX = TMC(IMC) 97 Call NGDY 101 FMC 01 = 1. IF (LAR) 99:2:99 01 = 1. IF (MMC) 96:101:96 01 = 1. IF (MMC) 96:101:96 OT = 1. IPONCH CARDS FOR MCDUNALD</td></tr> <tr><td>Call ORGN T = 0. Kk = 67 Kk = 67 Call SE11 IF (TEN) 97,2,97 97 IF (NMC) 96,101,96 98 CALL NBDY 98 CALL NBDY 1F (ERN) 99,2199 99 CALL NBDY 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (EN) 99,2199 1F (INUL) 96,101,96 101 TMAX = TMAK 101 TMAX = TMAK PUNCH CAROS FOR MCDONNALD</td></tr> <tr><td>Call ORGN T = 0: XK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 97 IF (TIMC) 96.101.96 97 IF (TIMC) 96 CALL NBODY 1F (ERR) 99.2.99 97 OLL NBODY 1F (ERR) 99.2.99 1F (INC) 96.101.96 1F (INC) 96.101.96</td></tr> <tr><td>Call ORIN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TMAX = TMC(MMC) 98 CALL MBOPY 1F (MMC) 99.2.99 98 CALL MBOPY 1F (INC) 99.2.99 01 = 1. MC = MMC-1 IF (MMC) 99.101.96</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (TMC) 96.101.96 98 Call NBOY 16 TAX = TMC(NMC) 01 = 1. NMC = NMC-1 IF (IANC) 96.101.96 01 TAX = TMACH Call NBOY</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2:97 97 IF (FMC) 96:101:96 96 THAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99:2:99 99 CALL NBODY 97 IF (ERR) 99:2:99 97 IF (ERR) 99:2:99 16 TAX = TMAXE IF (INMC) 96:101:96 IF (INMC) 96:101:96</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SF11 IF (TEM) 97.2.97 Start Start 97 IF (NMC) 96.101.96 Start Start 96 TMAX = TMC(NMC) Start NBODY 98 Call NBODY IF (LER) 99.2.99 97 Call MCC Start NBODY 97 IF (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 10 T = 1. NMC = NMC-1 101 TMAX = TMAXE IMAX = TMAXE</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 98 Call NBOPY 17 (ERR) 99.2.99 99 Call MCC 97 Call MC 16 (NMC) 96.101.96 17 (NMC) 90.101.96 16 (NMC) 96.101.96 17 (NMC) 96.101.96</td></tr> <tr><td>Cull ORGN T = 0. KK = 67 KK = 67 Cull SE11 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TUL NBODY 1F (ERR) 99.2.99 97 Cull MCC 96 Cull MCO 16 (ERR) 99.2.99 17 (ERR) 99.2.99 18 (IMC) 96.101.96 19 (IT = 1. MC = NMC-1 IF (INC) 96.101.96</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 I F (IEM) 97,2,97 97 IF (IEM) 97,2,97 96 TMAX = TMC(IMC) 98 Call NBOPY IF (ERR) 99,2,99 99 Call NGO 99 Call NGO 07 I F (IER) 99,2,99 97 Call NGO 16 (IER) 99,2,99 17 (IER) 99,2,99</td></tr> <tr><td>CALL ORGN T = 0. XK = 67 KK = 67 KK = 61 Status CALL SETI IF (TEM) 97.2.97 97 IF (NMC) 96 TMAX = TMC(NMC) 98 CALL NBODY 15 (ERR) 99.2.999 99 CALL NBODY 17 (ERR) 99.2.999 17 (ERR) 99.2.999 17 (ERR) 99.2.999 18 (INC) 96.101.966</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 KK = 1 State State State State 97 IF (KMC) 96.101.96 State State 98 CALL NGC State State 99 CALL MCC State State 11 = 1. MMC = NMC-1</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF (INIC) 96.101.96 If (INIC) 96.101.96 98 CALL NBODY IF (ERR) 99.2.99 99 CALL MCO IF (ERR) 99.2.99 97 IF (INIC) IF (INIC) 98 CALL MODY IF (INIC) 99 CALL MCO IF (INIC) 01 = 1. II</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI 1 F (TEM) 97.2.97 97.12.97 97 IF (INNC) 96.101.96 98.101.96 98 CALL NBOPY 1F (ERR) 99.2.99 97 CALL MODY 1F (ERR) 99.2.99 97 CALL MODY 1F (INNC) 96 CALL MSOPY 1F (INNC) 97 CALL MODY 1F (INNC)</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KK = 67 Call SETI JF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBOPY 1F (ERR) 99.2.99 0F = 1. NMC = NMC-1</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 CALL NBODY IF (ERN) 99.2399 97 CALL MCC If (ITM) 97.239</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 Call SE11 If (TEM) 97.2.97 97 IF (IMC) 96.101.96 State INC(INC) 98 CALL NBOPY If (ERR) 99.2.99 17 IF (ERR) 99.2.99 If (IMC) 99 CALL MCC If (IMC) 91 IF (IER) 99.2.99 If (IMC)</td></tr> <tr><td>Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF (NMC) 96.101.96 If (TEM) 97.2.97 96 TMAX = TMC(NMC) If (ERR) 99.2.99 98 CALL NBODY IF (ERR) 99.2.99 97 IF (ERR) 99.2.99 If (ERR) 99.2.99 97 IF (IST) 99.2.99 If (ERR) 99.2.99</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97:2:97 97 IF (NMC) 96:101:96 95 98 CALL NBOPY 16 15 (ERN) 99:2:99 16 99 CALL MGOP 16 16 1 = 1. 16</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 96 TMAX = TMC(NMC) 96 CALL NODY 1F (ERR) 99.2.999 99 CALL MCC</td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI 97 IF (I:MC) 96.101.96 97 IF (I:MC) 99.2.99 98 Call NBOPY 1F (ERR) 99.2.99 </td></tr> <tr><td>CALL ORGN CALL ORGN T = 0. </td></tr> <tr><td>CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI 97 IF (INMC) 96.101.96 96 TMAX = INC(NMC) 98 CALL NBODY 16 (ERR) 99.2.99 </td></tr> <tr><td>CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI IF (TEM) 91,23,97 97 IF (IMC) 96,101,96 98 CALL NBODY IF (ERR) 99,23,99 </td></tr> <tr><td>Call ORGN Call ORGN T = 0. </td></tr> <tr><td>Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 F (IEM) 97.2.97 If (IEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC)
 98 CALL NBODY If (ERR) 99.2.99</td></tr> <tr><td>CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI CALL SETI IF (TEM) 97.2.97 97 IF (INMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99.2.99</td></tr> <tr><td>Call ORGN T = 0. Kk = 67 Kk = 67 Call SEII IF (TEM) 97.2.97 97 IF (INNC) 96.101.96 98 CALL NBODY</td></tr> <tr><td>Call ORGN T = 0. KK = 67 KL SEII IF (IEM) 97.2.97 97 IF (IMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
F (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC)
98 CALL NBOPY</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC)
06 CALL NRODY</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC)</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC)</td></tr> <tr><td>CALL ORGN
T = 0.
KK = 67
KK = 67
CALL SEI1
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
97 IF (NMC) 96.101.96
97 TE (NMC)</td></tr> <tr><td>CALL ORGN
T = 0.
KK = 67
CALL SETI
IF (TEM) 97.2.97
97 IF (IMC) 96.101.96
96 TMAX = TMC(NMC)</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (KMC) 96.101.96
</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
IF (IMC) 96.101.96</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
IF (IEM) 97.2.97
IF (IEM) 97.2.97</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI
If (TEM) 97.2.97</td></tr> <tr><td>CALL ORGN
T = 0.
KK = 67
CALL SETI
T = 110000000000000000000000000000000000</td></tr> <tr><td>Call ORGN
T = 0.
KK = 67
Call SETI</td></tr> <tr><td>Call ORGN $K = 67$
Call SETI</td></tr> <tr><td>Call ORGN $T = 0$.
KK = 67
Call SETI</td></tr> <tr><td>CALL ORGN
T = 0.
KK = 67
CALL SETI</td></tr> <tr><td>Call ORGN $K = 67$
Call SETI</td></tr> <tr><td>CALL ORGN $T = 0$.
Kk = 67</td></tr> <tr><td>Call ORGN $T = 0$.
KK = 67</td></tr> <tr><td>Call ORGN $T = 0$.
KK = 67</td></tr> <tr><td>L = 0. $K = 67$</td></tr> <tr><td>CALL ORGN TERMS TO REPORT TO REPORT</td></tr> <tr><td>Call ORGN T = $0.$</td></tr> <tr><td>CALL ORGN PERSON PE
PERSON PERSON PER</td></tr> <tr><td>Laboration of the second se</td></tr> <tr><td></td></tr> <tr><td></td></tr> <tr><td>CALL ORGN</td></tr> <tr><td></td></tr> | Cult ORGN I 0. T = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 Cult SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (IMMC) 96.101.96 96 ALL MCO IF (LER) 99.2.99 97 ALL MOOP 97 Cult MCC IF (LER) 99.2.99 98 Cult MCC 10 IMC = NMC-1 IMC = NMC-1 IMC = NMC-1 Immode IF (NUC) 99.101.96 IF (NUC) 99.101.96 Immode 101 TAL E TAXE Immode Immode Immode 102 Cult MCC IMCH (Sellor) Immode Immode 103 FF (NURSO) 195.1205.195 Immode Immode Immode 103 FF (NURSO) 195.1205.0195 Immode Immode Immode 105 FF (NURSO) 195.1205.1205 Immode Immode Immode 106 FF (NUR-6) 201.201.203 Immode Immode Immode 201 MU = 1 Immode Immode Immode Immode 201 MU = 1 Immo | Cult ORGN I 0. I = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 F (LL SET) F (LEN) 97.2.97 F 97 IF (IMOC) 96.101.96 F KK = 67 96 TALX = TMC(MC) 96 TALX = TMC(MC) F 96 TALX = TMC(MC) 97.2.919 F 15 IF (IMOC) 97.2.919 F 16 LER1 99.2.99 F F 17 L INODY MC = MC-1 F 18 INMC = MMC1 MC = MMC1 F 19 IF (MOR) 96.101.96 F F 19 IF (MOR-MIARO) F F 19 IF (MORO-MIARO) F | Cull ORGN KK = 67 1 = 0. KK = 57 Cull SET1 KK = 57 Cull SET1 F (TEM) 9712.97 97 IF (IEM) 9712.97 9712.97 96 TMAX = TMC(IMC) 96.1001.96 96 TMAX = TMC(IMC) 96.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2199 97.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2195 101.14X 97 IF (IEM) 99.2195 101.14X 98 Cull MC 199.197.196 199 IF (MARC) 195.220.195 199.197.196 199 IF (MARC) 195.1201.195.220.195 199.17.196 199 IF (MARC) 195.220.195 199.17.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = 100RG 199.197.196 191 ITMAY = 100RG 199.197.196 191 IT = NORG 199.197.196 191 IT = NORG 199.197.196 191 ITMAY = 100RG 199.197.196 | Call ORGN I = 0. I = 0. Kx = 67 Kx = 67 Kx = 67 Call SEI1 IF (1EN) 97.2.97 IF (1EN) 97.2.97 91.2.97 97 IF (1EN) 97.2.97 91.2.9 97 IF (1EN) 97.2.97 91.2.1.9 96 Call NGC 99.2.1.9 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 98 Call NGC 91.01.96 91 F (NOG-NIARG) 195.200.195 91.01.96 199 IF (NOG-NIARG) 195.200.195 91.01.97.00 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.01.01 199 IF (NOG-NIARG) 195.200.195 91.01.01.01 199 IF (NOG- | Call ORGN I = 0. I = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEN) 97:2.97 IF (TEN) 97:2.97 97 97 IF (HMC) 06:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 96 CALL MCC 07 101 FMA 101 MC = NMC-1 MC 01 F (MMC) 95:101.96 101 101 FMA 101 101 FMA 195,220:195 193 IF (NDRG-NTARG) 195,220:195 199 199 IF (NDRG-NTARG) 195,220:195 197 197 II = NORG 00 200 197 M = 1 201 M 4 1 | Cull ORGN I Coll ORGN I = 0. KK = 67 KK = 67 I = 0. KK = 57 KK = 57 Cull SET1 IF (TEM) 971.2.97 97 97 IF (IMMC) 96.1001.96 97.12 10 96 TMAX = TMC(IMMC) 96.1001.96 97 97 IF (IMMC) 96.101.96 97 10 96 TMAX = TMC(IMMC) 96.101.96 10 97 IF (IMMC) 96.101.96 10 10 96 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 199 IF (NORG-NTARG) 195.220.195 101 TMAX = TMAXE 190.197.196 199 IF (NORG-NTARG) 195.220.195 191 TMAXE 191 TMAXE 190 IT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE | Call ORGN I = 0. I = 0. I I = 0. Kx = 67 Kx = 67 Call SE1 IF (TEN) 97.2.97 97.15 97.15 (TEN) 97.2.97 97.15 96.14xx = TMC(MMC) 96.14xx = TMC(MMC) 96.74L NBOPY 16.100 97.15 (TERN 99.2.99) 97.15 97.15 (TERN 99.2.99) 97.15 97.15 (MC) 96.101.96 10.1 101 TMAX = TMAKE MC = MC-1 111 (TERN 99.2.919) 10.1 112 1.0 MC = MC-1 113 15 (LINEG) 195.220:195 10.1 114 1 = MAG 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1
 115 1106 10.1 115 1106 10.1 116 1111 10.1 117 1 = | Call ORGN I 0. I 0. 1 0. I 0. 1 0. I 0. 1 1 0. I 0. 1 1 1 1 I 1 | Call ORGN I 0. T = 0. I 1 T = 0. KK = 67 KK = 67 KK = 67 Call SET IF (TEM) 97.2.97 97 IF (HMC) 90.101.96 97.2.97 IF (HMC) 90.101.96 96 TMAX = TMC(NMC) 96 CALL NBODY 96 CALL NBODY 97 IF (HMC) 99.121.96 IF (ERR) 99.2.99 IF (HMC) 96.101.96 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) 196.101.96 IF (MC) 199 IF (MCG-MTARG) 195.1220.195 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 199 IF (MCG-MTARG) 195.127.196 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 196 MT = MTARG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.120.1100 197 HT = MCG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.1100 | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE1 IF (TEM) 97.2.97 97 IF (IRMC) 96.101.96 97 IF (IRMC) 96.101.96 96 CALL NBODY 96 CALL NBODY 16 (IRR) 99.2.99 17 IF (IRR) 99.2.99 18 (IRR) 99.2.99 19 (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 IF (IRR) 99.2.9195 IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.127.196 IPUCH CARDS I95.107.196 | Call ORGN T = 0. T = 0. T = 0. T = 0. Kk = 67 Kk = 67 Kk = 67 F (TEM) 97.2.97 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 96 TAL NEOPY 96 TAL NEOPY 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 97 IF (INNC) 97 IF INDOP 190 IF (NORC-INTARG) 195.1201.95 199 IF (NORC-INTARG) 195.1201.95 190 IF INDOR 191 IF INDOR | Call ORGN T = 0. T = 0. T = 0. T = 0. Kx = 67 Kx = 67 Call SET1 F (TEM) 97.2.97 97 IF (IRMC) 96.101.96 98 Call NBOPY 98 Call NBOPY 96 Talk = TWC(MKC) 97 IF (IRM) 99.101.96 97 IF (IRM) 99.101.96 98 Call NGOPY 97 IF (IRM) 99.101.96 19 IF (INMC) 96.101.96 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.121.166 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 196 IF (INTARO) 196.191.196 | Call ORGN I 0. I 0. I 0. I 0. I 0. I 0. KK = 67 KK = 67 KK = 67 Cull SE11 I I 1 IF (TEM) 97.2.97 91.2.97 91.2.97 97 IF (IEM) 97.2.97 91.2.97 91.2.97 96 TAX = TMC(MIC) 91.2.97 91.2.97 96 Call NBOV I I 1 I I I 1 1 I I I 1 1 I I I I 1 I I I I 1 I I I I I 1 I I I I I I 1 I I I I I I I 1 I I I I I I | Call ORGN I 0. T 0. T 0. T 0. K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 61 S1.2.97 S1.2.97 S1 F KK S0.101.96 S1.2.97 S6 ALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.2.91 MC MC MC MC MC MC MC MC MC MC MC MC MC MC S1.2.2.2.1.9 199 IF INOC MC MC S1.2.2.2.1.9 196 MT MC MC MC S1.2.2.2.1.9 196 MT MC< | Call ORGN I | Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Cull SET1 I [[[EM) 97:297 I 0.1 ST = 1 S7:297 0.1 ST = 1 S7:297 1 [[[EM) 97:297 S7:297 1 [[[(INC) 96:101:96 S7:297 1 [[(ERI 99:2192 S7:297 1 [[(INC) 96:101:96 S7:297 1 [[(INC) 96:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[[(INC) 196:101:196 S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[INCONTALD S7:20:195 | Call ORGN Call ORGN T = 0. T T = 0. Kx = 6T Kx = 6T Call SEI Call SEI FIERN 971.397 1 F (TEM) 971.397 97.16 (TEM) 97.1397 97.1 F (TEM) 97.1397 99.101.96 97.1 F (TEM) 97.299 97.11 (TEM) 97.299 97.1 F (TEM) 99.2.999 97.11 (TEM) 99.2.999 97.1 F (TANC) 96.101.96 101.1496 1 F (TANC) 96.101.96 101.1401 I F (TANC) 96.101.96 101.1401 1 P (TANC) 196.101.96 101.1401 1 P (NCG-NITARG) 195.120.195 101.1486 1 P (NTARG) 196.197.196 101.1480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148 | Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 KK = 61 Call SEI1 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 97 IF (HMC) 96.101.96 96 TMX = TMC(MC) 96 TMX = TMC(MC) 99 Call MCC 97 IF (ERR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 96.101.96 11E (IRR) 96.101.96 11F (IRR) 96.101.96 11E (IRR) 96.101.96 119 IL (IRC) 96.101.96 118 (INC) 96.101.96 119 ILAX = TMAC 011 = 1.0 119 IL (INCG-NITARD) 195.1220.195 1195.1220.195 119 IL INRG- INGL
1195.127.196 | Call ORGN T = 0. T = 0. KK = 61 TK = 61 Call SE11 IF (L SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 95 TMAX = TMC(MMC) 96 TMAX = TMC(MMC) 96 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 101 TMAX = TMAXE MMC = NMC-1 115 (NMC) 96.101.96 MMC = NMC-1 116 (NMC) 96.101.96 MMC = NMC-1 117 (MAX = TMAXE MMC = NMC-1 118 (NMC) 96.101.96 MMC = NMC-1 119 IF (NMC) 96.101.96 MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 111 (NAX = TMAXE) 195.220.195 MMC = NMC-1 1199 IF (NRGE-NITARG) 195.220.195 MMC = NMCONNALD 1199 IF (NRGE-NITARG) 195.120.195 MMC = NTARG) 195.121.196 | Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Call Still Call Still F (HML) 99:101:96 91 IF (HML) 99:101:96 Stat = TMC(HMC) 95 TMAX = TMC(HMC) Stat = TMC(HMC) 96 Call NBOPY IF (ERR) 99:2:99 101 TMAX = TMAC MMC = NUC-1 115 If (NMC) 96:101:96 Stat = TMAC 101 TMAX = TMAC Call NBOPY 199 IF (NDRG-NTARG) 195:220:195 LUNCH CARDS FOR MCDONNALD 195 IF (NTARG) 195:120:195 Stat Stat Stat Stat Stat Stat Stat Stat | Call ORGN Call ORGN T = 0. T Kx = 67 T IF (IEM) 97.2.97 T 91 IF (IEM) 99.2.99 T 95 Call MGOY T 11 [(IER) 99.2.99 T 12 I. T 13 Call MGOY T 14 (IER) 99.2.99 T 15 (IER) 99.2.99 T 199 IF (NAGO-NIARD) 196.101.96 195 IF (NIARG) 196.127.196 T | Call ORGN T = 0. T = 0. T = 0. KK = 67 Call SET IF (TEM) 97.2.97 IF (TEM) 99.2.99 IF (TER) 99.2.99 IF (TRU) 96.101.96 IF (INC) 96.101.97 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.97 | Call ORGN T = 0: KK = 67 KK = 67 Call SET IF (TEM) 97:2.97 97 IF (HMC) 96:101.96 98 Call MGOY 1F (LAR) 99:2.99 01 = 1. MMC = NMC-1 1F (INMC) 96:101.96 01 = 1. 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 100 TMAX = TMAXE 100 TMAX = TMAXE | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2.97 97 IF (INNC) 96:101:96 97 IF (INNC) 96:101:96 98 Call NBODY 1F (ERN) 99:2.999 1F (ERN) 99:2.999 01 = 1. MMC = NMC-1 IF (INNC) 96:101:96 101 TMAX = IMAXE 101 TMAX = IMAXE | Call ORGN T = 0. Kx = 67 Call SET I F (TEM) 97.2.97 I F (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.99 97 IF (TEM) 99.2.99 97 Call MCC 01 = 1. MC = MC-1 I MOC = MC-1 I F (MC) 96.101.96 101 HMX = TMAXE 101 HMX = TMAXE 101 HMX = TMAXE 00100 HLD | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 91:2:97 97 IF (HMC) 96:101:96 96 TMAX = TMC(IMC) 97 Call NGDY 101 FMC 01 = 1. IF (LAR) 99:2:99 01 = 1. IF (MMC) 96:101:96 01 = 1. IF (MMC) 96:101:96 OT = 1. IPONCH CARDS FOR MCDUNALD | Call ORGN T = 0. Kk = 67 Kk = 67 Call SE11 IF (TEN) 97,2,97 97 IF (NMC) 96,101,96 98 CALL NBDY 98 CALL NBDY 1F (ERN) 99,2199 99 CALL NBDY 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (EN) 99,2199 1F (INUL) 96,101,96 101 TMAX = TMAK 101 TMAX = TMAK PUNCH CAROS FOR MCDONNALD | Call ORGN T = 0: XK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 97 IF (TIMC) 96.101.96 97 IF (TIMC) 96 CALL NBODY 1F (ERR) 99.2.99 97 OLL NBODY 1F (ERR) 99.2.99 1F (INC) 96.101.96 1F (INC) 96.101.96 | Call ORIN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TMAX = TMC(MMC) 98 CALL MBOPY 1F (MMC) 99.2.99 98 CALL MBOPY 1F (INC) 99.2.99 01 = 1. MC = MMC-1 IF (MMC) 99.101.96 | Call ORGN T = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (TMC) 96.101.96 98 Call NBOY 16 TAX = TMC(NMC) 01 = 1. NMC = NMC-1 IF (IANC) 96.101.96 01 TAX = TMACH Call NBOY | Call ORGN T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2:97 97 IF (FMC) 96:101:96 96 THAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99:2:99 99 CALL NBODY 97 IF (ERR) 99:2:99 97 IF (ERR) 99:2:99 16 TAX = TMAXE IF (INMC) 96:101:96 IF (INMC) 96:101:96 | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SF11 IF (TEM) 97.2.97 Start Start 97 IF (NMC) 96.101.96 Start Start 96 TMAX = TMC(NMC) Start NBODY 98 Call NBODY IF (LER) 99.2.99 97 Call MCC Start NBODY 97 IF (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 10 T = 1. NMC = NMC-1 101 TMAX = TMAXE IMAX = TMAXE | Call ORGN T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 98 Call NBOPY 17 (ERR) 99.2.99 99 Call MCC 97 Call MC 16 (NMC) 96.101.96 17 (NMC) 90.101.96 16 (NMC) 96.101.96 17 (NMC) 96.101.96 | Cull ORGN T = 0. KK = 67 KK = 67 Cull SE11 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TUL NBODY 1F (ERR) 99.2.99 97 Cull MCC 96 Cull MCO 16 (ERR) 99.2.99 17 (ERR) 99.2.99 18 (IMC) 96.101.96 19 (IT = 1. MC = NMC-1 IF (INC) 96.101.96 | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 I F (IEM) 97,2,97 97 IF (IEM) 97,2,97 96 TMAX = TMC(IMC) 98 Call NBOPY IF (ERR) 99,2,99 99 Call NGO 99 Call NGO 07 I F (IER) 99,2,99 97 Call NGO 16 (IER) 99,2,99 17 (IER) 99,2,99 | CALL ORGN T = 0. XK = 67 KK = 67 KK = 61 Status CALL SETI IF (TEM) 97.2.97 97 IF (NMC) 96 TMAX = TMC(NMC) 98 CALL NBODY 15 (ERR) 99.2.999 99 CALL NBODY 17 (ERR) 99.2.999 17 (ERR) 99.2.999 17 (ERR) 99.2.999 18 (INC) 96.101.966 | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 KK = 1 State State State State 97 IF (KMC) 96.101.96 State State 98 CALL NGC State State 99 CALL MCC State State 11 = 1. MMC = NMC-1 | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF (INIC) 96.101.96 If (INIC) 96.101.96 98 CALL NBODY IF (ERR) 99.2.99 99 CALL MCO IF (ERR) 99.2.99 97 IF (INIC) IF (INIC) 98 CALL MODY IF (INIC) 99 CALL MCO IF (INIC) 01 = 1. II | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI 1 F (TEM) 97.2.97 97.12.97 97 IF (INNC) 96.101.96 98.101.96 98 CALL NBOPY 1F (ERR) 99.2.99 97 CALL MODY 1F (ERR) 99.2.99 97 CALL MODY 1F (INNC) 96 CALL MSOPY 1F (INNC) 97 CALL MODY 1F (INNC) | Call ORGN T = 0. KK = 67 KK = 67 Call SETI JF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBOPY 1F (ERR) 99.2.99 0F = 1. NMC = NMC-1 | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 CALL NBODY IF (ERN) 99.2399 97 CALL MCC If (ITM) 97.239 | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 Call SE11 If (TEM) 97.2.97 97 IF (IMC) 96.101.96 State INC(INC) 98 CALL NBOPY If (ERR) 99.2.99 17 IF (ERR) 99.2.99 If (IMC) 99 CALL MCC If (IMC) 91 IF (IER) 99.2.99 If (IMC) | Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF
(NMC) 96.101.96 If (TEM) 97.2.97 96 TMAX = TMC(NMC) If (ERR) 99.2.99 98 CALL NBODY IF (ERR) 99.2.99 97 IF (ERR) 99.2.99 If (ERR) 99.2.99 97 IF (IST) 99.2.99 If (ERR) 99.2.99 | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97:2:97 97 IF (NMC) 96:101:96 95 98 CALL NBOPY 16 15 (ERN) 99:2:99 16 99 CALL MGOP 16 16 1 = 1. 16 | Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 96 TMAX = TMC(NMC) 96 CALL NODY 1F (ERR) 99.2.999 99 CALL MCC | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI 97 IF (I:MC) 96.101.96 97 IF (I:MC) 99.2.99 98 Call NBOPY 1F (ERR) 99.2.99 | CALL ORGN CALL ORGN T = 0. | CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI 97 IF (INMC) 96.101.96 96 TMAX = INC(NMC) 98 CALL NBODY 16 (ERR) 99.2.99 | CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI IF (TEM) 91,23,97 97 IF (IMC) 96,101,96 98 CALL NBODY IF (ERR) 99,23,99 | Call ORGN Call ORGN T = 0. | Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 F (IEM) 97.2.97 If (IEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY If (ERR) 99.2.99 | CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI CALL SETI IF (TEM) 97.2.97 97 IF (INMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99.2.99 | Call ORGN T = 0. Kk = 67 Kk = 67 Call SEII IF (TEM) 97.2.97 97 IF (INNC) 96.101.96 98 CALL NBODY | Call ORGN T = 0. KK = 67 KL SEII IF (IEM) 97.2.97 97 IF (IMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY | Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
F (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC)
98 CALL NBOPY | Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC)
06 CALL NRODY | Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC) | Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC) | CALL ORGN
T = 0.
KK = 67
KK = 67
CALL SEI1
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
97 IF (NMC) 96.101.96
97 TE (NMC) | CALL ORGN
T = 0.
KK = 67
CALL SETI
IF (TEM) 97.2.97
97 IF (IMC) 96.101.96
96 TMAX = TMC(NMC) | Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (KMC) 96.101.96
 | Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96 | Call ORGN
T = 0.
KK = 67
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96 | Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
IF (IMC) 96.101.96 | Call ORGN
T = 0.
KK = 67
IF (IEM) 97.2.97
IF (IEM) 97.2.97 | Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97 | Call ORGN
T = 0.
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97 | Call ORGN
T = 0.
KK = 67
Call SETI
If (TEM) 97.2.97 | CALL ORGN
T = 0.
KK = 67
CALL SETI
T = 110000000000000000000000000000000000 | Call ORGN
T = 0.
KK = 67
Call SETI | Call ORGN $K = 67$
Call SETI | Call ORGN $T = 0$.
KK = 67
Call SETI | CALL ORGN
T = 0.
KK = 67
CALL SETI | Call ORGN $K = 67$
Call SETI | CALL ORGN $T = 0$.
Kk = 67 | Call ORGN $T = 0$.
KK = 67 | Call ORGN $T = 0$.
KK = 67 | L = 0. $K = 67$ | CALL ORGN TERMS TO REPORT | Call ORGN T = $0.$ | CALL ORGN PERSON PE
PERSON PERSON PER | Laboration of the second se | | | CALL ORGN | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cult ORGN I 0. T = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 Cult SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (IMMC) 96.101.96 96 ALL MCO IF (LER) 99.2.99 97 ALL MOOP 97 Cult MCC IF (LER) 99.2.99 98 Cult MCC 10 IMC = NMC-1 IMC = NMC-1 IMC = NMC-1 Immode IF (NUC) 99.101.96 IF (NUC) 99.101.96 Immode 101 TAL E TAXE Immode Immode Immode 102 Cult MCC IMCH (Sellor) Immode Immode 103 FF (NURSO) 195.1205.195 Immode Immode Immode 103 FF (NURSO) 195.1205.0195 Immode Immode Immode 105 FF (NURSO) 195.1205.1205 Immode Immode Immode 106 FF (NUR-6) 201.201.203 Immode Immode Immode 201 MU = 1 Immode Immode Immode Immode 201 MU = 1 Immo

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cult ORGN I 0. I = 0. KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 KK = 67 F (LL SET) F (LEN) 97.2.97 F 97 IF (IMOC) 96.101.96 F KK = 67 96 TALX = TMC(MC) 96 TALX = TMC(MC) F 96 TALX = TMC(MC) 97.2.919 F 15 IF (IMOC) 97.2.919 F 16 LER1 99.2.99 F F 17 L INODY MC = MC-1 F 18 INMC = MMC1 MC = MMC1 F 19 IF (MOR) 96.101.96 F F 19 IF (MOR-MIARO) F F 19 IF (MORO-MIARO) F

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORGN KK = 67 1 = 0. KK = 57 Cull SET1 KK = 57 Cull SET1 F (TEM) 9712.97 97 IF (IEM) 9712.97 9712.97 96 TMAX = TMC(IMC) 96.1001.96 96 TMAX = TMC(IMC) 96.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2199 97.101.96 96 TMAX = TMC(IMC) 96.101.96 97 IF (IEM) 99.2195 101.14X 97 IF (IEM) 99.2195 101.14X 98 Cull MC 199.197.196 199 IF (MARC) 195.220.195 199.197.196 199 IF (MARC) 195.1201.195.220.195 199.17.196 199 IF (MARC) 195.220.195 199.17.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = TMAKC 199.197.196 191 ITMAX = 100RG 199.197.196 191 ITMAY = 100RG 199.197.196 191 IT = NORG 199.197.196 191 IT = NORG 199.197.196 191 ITMAY = 100RG 199.197.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I = 0. I = 0. Kx = 67 Kx = 67 Kx = 67 Call SEI1 IF (1EN) 97.2.97 IF (1EN) 97.2.97 91.2.97 97 IF (1EN) 97.2.97 91.2.9 97 IF (1EN) 97.2.97 91.2.1.9 96 Call NGC 99.2.1.9 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 IF (1EN) 99.2.1.99 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 97 Call NGC 91.01.96 98 Call NGC 91.01.96 91 F (NOG-NIARG) 195.200.195 91.01.96 199 IF (NOG-NIARG) 195.200.195 91.01.97.00 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.06 199 IF (NOG-NIARG) 195.200.195 91.01.01.01.01 199 IF (NOG-NIARG) 195.200.195 91.01.01.01 199 IF (NOG-

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I = 0. I = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEN) 97:2.97 IF (TEN) 97:2.97 97 97 IF (HMC) 06:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 97 IF (HMC) 05:101.96 97 96 CALL MCC 07 101 FMA 101 MC = NMC-1 MC 01 F (MMC) 95:101.96 101 101 FMA 101 101 FMA 195,220:195 193 IF (NDRG-NTARG) 195,220:195 199 199 IF (NDRG-NTARG) 195,220:195 197 197 II = NORG 00 200 197 M = 1 201 M 4 1

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORGN I Coll ORGN I = 0. KK = 67 KK = 67 I = 0. KK = 57 KK = 57 Cull SET1 IF (TEM) 971.2.97 97 97 IF (IMMC) 96.1001.96 97.12 10 96 TMAX = TMC(IMMC) 96.1001.96 97 97 IF (IMMC) 96.101.96 97 10 96 TMAX = TMC(IMMC) 96.101.96 10 97 IF (IMMC) 96.101.96 10 10 96 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 199 IF (NORG-NTARG) 195.220.195 101 TMAX = TMAXE 190.197.196 199 IF (NORG-NTARG) 195.220.195 191 TMAXE 191 TMAXE 190 IT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE 197 NT = NORG 191 TMAXE 191 TMAXE

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I = 0. I = 0. I I = 0. Kx = 67 Kx = 67 Call SE1 IF (TEN) 97.2.97 97.15 97.15 (TEN) 97.2.97 97.15 96.14xx = TMC(MMC) 96.14xx = TMC(MMC) 96.74L NBOPY 16.100 97.15 (TERN 99.2.99) 97.15 97.15 (TERN 99.2.99) 97.15 97.15 (MC) 96.101.96 10.1 101 TMAX = TMAKE MC = MC-1 111 (TERN 99.2.919) 10.1 112 1.0 MC = MC-1 113 15 (LINEG) 195.220:195 10.1 114 1 = MAG 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 115 1106 10.1 116 1111 10.1 117 1 =

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I 0. I 0. 1 0. I 0. 1 0. I 0. 1 1 0. I 0. 1 1 1 1 I 1

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I 0. T = 0. I 1 T = 0. KK = 67 KK = 67 KK = 67 Call SET IF (TEM) 97.2.97 97 IF (HMC) 90.101.96 97.2.97 IF (HMC) 90.101.96 96 TMAX = TMC(NMC) 96 CALL NBODY 96 CALL NBODY 97 IF (HMC) 99.121.96 IF (ERR) 99.2.99 IF (HMC) 96.101.96 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) IF (MC) IF (MC) 10 T = 1. IF (MC) 196.101.96 IF (MC) 199 IF (MCG-MTARG) 195.1220.195 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 199 IF (MCG-MTARG) 195.127.196 IP (MCG-MTARG) 195.120.196 IP (MCG-MTARG) 195.120.196 196 MT = MTARG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.120.1100 197 HT = MCG IP (MCG-MTARG) 195.120.1100 IP (MCG-MTARG) 195.1100

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE1 IF (TEM) 97.2.97 97 IF (IRMC) 96.101.96 97 IF (IRMC) 96.101.96 96 CALL NBODY 96 CALL NBODY 16 (IRR) 99.2.99 17 IF (IRR) 99.2.99 18 (IRR) 99.2.99 19 (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 10 IF all IF (IRR) 99.2.99 IF (IRR) 99.2.9195 IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS FOR MCDONNALD IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.120.195 IPUCH CARDS I95.127.196 IPUCH CARDS I95.107.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. T = 0. T = 0. Kk = 67 Kk = 67 Kk = 67 F (TEM) 97.2.97 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 96 TAL NEOPY 96 TAL NEOPY 97 IF (IRNC) 96.101.96 97 IF (IRNC) 96.101.96 97 IF (INNC) 97 IF INDOP 190 IF (NORC-INTARG) 195.1201.95 199 IF (NORC-INTARG) 195.1201.95 190 IF INDOR 191 IF INDOR

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. T = 0. T = 0. Kx = 67 Kx = 67 Call SET1 F (TEM) 97.2.97 97 IF (IRMC) 96.101.96 98 Call NBOPY 98 Call NBOPY 96 Talk = TWC(MKC) 97 IF (IRM) 99.101.96 97 IF (IRM) 99.101.96 98 Call NGOPY 97 IF (IRM) 99.101.96 19 IF (INMC) 96.101.96 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.220.195 199 IF (NORG-NTARG) 199.121.166 196 IF (INTARO) 196.191.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I 0. I 0. I 0. I 0. I 0. I 0. KK = 67 KK = 67 KK = 67 Cull SE11 I I 1 IF (TEM) 97.2.97 91.2.97 91.2.97 97 IF (IEM) 97.2.97 91.2.97 91.2.97 96 TAX = TMC(MIC) 91.2.97 91.2.97 96 Call NBOV I I 1 I I I 1 1 I I I 1 1 I I I I 1 I I I I 1 I I I I I 1 I I I I I I 1 I I I I I I I 1 I I I I I I

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I 0. T 0. T 0. T 0. K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 67 K 61 KK 61 S1.2.97 S1.2.97 S1 F KK S0.101.96 S1.2.97 S6 ALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.97 S6 CALL NBOY S6 S4.L S1.2.2.91 MC MC MC MC MC MC MC MC MC MC MC MC MC MC S1.2.2.2.1.9 199 IF INOC MC MC S1.2.2.2.1.9 196 MT MC MC MC S1.2.2.2.1.9 196 MT MC<

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN I

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Cull SET1 I [[[EM) 97:297 I 0.1 ST = 1 S7:297 0.1 ST = 1 S7:297 1 [[[EM) 97:297 S7:297 1 [[[(INC) 96:101:96 S7:297 1 [[(ERI 99:2192 S7:297 1 [[(INC) 96:101:96 S7:297 1 [[(INC) 96:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[(INC) 196:101:96 S7:20:195 1 [[[(INC) 196:101:196 S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[[INCONTALD S7:20:195 1 [[[INCONTALD S7:20:195

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. T T = 0. Kx = 6T Kx = 6T Call SEI Call SEI FIERN 971.397 1 F (TEM) 971.397 97.16 (TEM) 97.1397 97.1 F (TEM) 97.1397 99.101.96 97.1 F (TEM) 97.299 97.11 (TEM) 97.299 97.1 F (TEM) 99.2.999 97.11 (TEM) 99.2.999 97.1 F (TANC) 96.101.96 101.1496 1 F (TANC) 96.101.96 101.1401 I F (TANC) 96.101.96 101.1401 1 P (TANC) 196.101.96 101.1401 1 P (NCG-NITARG) 195.120.195 101.1486 1 P (NTARG) 196.197.196 101.1480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148 1 P NICH CARDS FOR MCDONNALD 101.11480 1 P NICH CARDS FOR MCDONNALD 101.1148

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 KK = 61 Call SEI1 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 97 IF (HMC) 96.101.96 96 TMX = TMC(MC) 96 TMX = TMC(MC) 99 Call MCC 97 IF (ERR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 99.2.99 11F (IRR) 96.101.96 11E (IRR) 96.101.96 11F (IRR) 96.101.96 11E (IRR) 96.101.96 119 IL (IRC) 96.101.96 118 (INC) 96.101.96 119 ILAX = TMAC 011 = 1.0 119 IL (INCG-NITARD) 195.1220.195 1195.1220.195 119 IL INRG- INGL 1195.127.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 61 TK = 61 Call SE11 IF (L SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 95 TMAX = TMC(MMC) 96 TMAX = TMC(MMC) 96 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 97 CALL NGOPY 101 TMAX = TMAXE MMC = NMC-1 115 (NMC) 96.101.96 MMC = NMC-1 116 (NMC) 96.101.96 MMC = NMC-1 117 (MAX = TMAXE MMC = NMC-1 118 (NMC) 96.101.96 MMC = NMC-1 119 IF (NMC) 96.101.96 MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 110 TMAX = TMAXE MMC = NMC-1 111 (NAX = TMAXE) 195.220.195 MMC = NMC-1 1199 IF (NRGE-NITARG) 195.220.195 MMC = NMCONNALD 1199 IF (NRGE-NITARG) 195.120.195 MMC = NTARG) 195.121.196

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. T T = 0. KK = 61 KK = 61 Call Still Call Still F (HML) 99:101:96 91 IF (HML) 99:101:96 Stat = TMC(HMC) 95 TMAX = TMC(HMC) Stat = TMC(HMC) 96 Call NBOPY IF (ERR) 99:2:99 101 TMAX = TMAC MMC = NUC-1 115 If (NMC) 96:101:96 Stat = TMAC 101 TMAX = TMAC Call NBOPY 199 IF (NDRG-NTARG) 195:220:195 LUNCH CARDS FOR MCDONNALD 195 IF (NTARG) 195:120:195 Stat Stat Stat Stat Stat Stat Stat Stat

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. T Kx = 67 T IF (IEM) 97.2.97 T 91 IF (IEM) 99.2.99 T 95 Call MGOY T 11 [(IER) 99.2.99 T 12 I. T 13 Call MGOY T 14 (IER) 99.2.99 T 15 (IER) 99.2.99 T 199 IF (NAGO-NIARD) 196.101.96 195 IF (NIARG) 196.127.196 T

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. T = 0. KK = 67 Call SET IF (TEM) 97.2.97 IF (TEM) 99.2.99 IF (TER) 99.2.99 IF (TRU) 96.101.96 IF (INC) 96.101.97 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.96 IF (INC) 96.101.97

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0: KK = 67 KK = 67 Call SET IF (TEM) 97:2.97 97 IF (HMC) 96:101.96 98 Call MGOY 1F (LAR) 99:2.99 01 = 1. MMC = NMC-1 1F (INMC) 96:101.96 01 = 1. 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 101 TMAX = TMAXE 100 TMAX = TMAXE 100 TMAX = TMAXE

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2.97 97 IF (INNC) 96:101:96 97 IF (INNC) 96:101:96 98 Call NBODY 1F (ERN) 99:2.999 1F (ERN) 99:2.999 01 = 1. MMC = NMC-1 IF (INNC) 96:101:96 101 TMAX = IMAXE

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. Kx = 67 Call SET I F (TEM) 97.2.97 I F (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.97 97 IF (TEM) 97.2.99 97 IF (TEM) 99.2.99 97 Call MCC 01 = 1. MC = MC-1 I MOC = MC-1 I F (MC) 96.101.96 101 HMX = TMAXE 101 HMX = TMAXE 101 HMX = TMAXE 00100 HLD

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 91:2:97 97 IF (HMC) 96:101:96 96 TMAX = TMC(IMC) 97 Call NGDY 101 FMC 01 = 1. IF (LAR) 99:2:99 01 = 1. IF (MMC) 96:101:96 01 = 1. IF (MMC) 96:101:96 OT = 1. IPONCH CARDS FOR MCDUNALD

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. Kk = 67 Kk = 67 Call SE11 IF (TEN) 97,2,97 97 IF (NMC) 96,101,96 98 CALL NBDY 98 CALL NBDY 1F (ERN) 99,2199 99 CALL NBDY 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (ERN) 99,2199 1F (EN) 99,2199 1F (INUL) 96,101,96 101 TMAX = TMAK 101 TMAX = TMAK PUNCH CAROS FOR MCDONNALD

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0: XK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 97 IF (TIMC) 96.101.96 97 IF (TIMC) 96 CALL NBODY 1F (ERR) 99.2.99 97 OLL NBODY 1F (ERR) 99.2.99 1F (INC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORIN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TMAX = TMC(MMC) 98 CALL MBOPY 1F (MMC) 99.2.99 98 CALL MBOPY 1F (INC) 99.2.99 01 = 1. MC = MMC-1 IF (MMC) 99.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KK = 67 KK = 67 Call SET1 IF (TEM) 97.2.97 IF (TEM) 97.2.97 97 IF (TMC) 96.101.96 98 Call NBOY 16 TAX = TMC(NMC) 01 = 1. NMC = NMC-1 IF (IANC) 96.101.96 01 TAX = TMACH Call NBOY

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KK = 67 Call SET1 IF (TEM) 97:2:97 97 IF (FMC) 96:101:96 96 THAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99:2:99 99 CALL NBODY 97 IF (ERR) 99:2:99 97 IF (ERR) 99:2:99 16 TAX = TMAXE IF (INMC) 96:101:96 IF (INMC) 96:101:96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SF11 IF (TEM) 97.2.97 Start Start 97 IF (NMC) 96.101.96 Start Start 96 TMAX = TMC(NMC) Start NBODY 98 Call NBODY IF (LER) 99.2.99 97 Call MCC Start NBODY 97 IF (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 1F (IAR) 99.2.99 Start NBODY 10 T = 1. NMC = NMC-1 101 TMAX = TMAXE IMAX = TMAXE

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KK = 67 Call SE11 IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 98 Call NBOPY 17 (ERR) 99.2.99 99 Call MCC 97 Call MC 16 (NMC) 96.101.96 17 (NMC) 90.101.96 16 (NMC) 96.101.96 17 (NMC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cull ORGN T = 0. KK = 67 KK = 67 Cull SE11 IF (TEM) 97.2.97 97 IF (HMC) 96.101.96 96 TUL NBODY 1F (ERR) 99.2.99 97 Cull MCC 96 Cull MCO 16 (ERR) 99.2.99 17 (ERR) 99.2.99 18 (IMC) 96.101.96 19 (IT = 1. MC = NMC-1 IF (INC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SET1 I F (IEM) 97,2,97 97 IF (IEM) 97,2,97 96 TMAX = TMC(IMC) 98 Call NBOPY IF (ERR) 99,2,99 99 Call NGO 99 Call NGO 07 I F (IER) 99,2,99 97 Call NGO 16 (IER) 99,2,99 17 (IER) 99,2,99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN T = 0. XK = 67 KK = 67 KK = 61 Status CALL SETI IF (TEM) 97.2.97 97 IF (NMC) 96 TMAX = TMC(NMC) 98 CALL NBODY 15 (ERR) 99.2.999 99 CALL NBODY 17 (ERR) 99.2.999 17 (ERR) 99.2.999 17 (ERR) 99.2.999 18 (INC) 96.101.966

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 KK = 1 State State State State 97 IF (KMC) 96.101.96 State State 98 CALL NGC State State 99 CALL MCC State State 11 = 1. MMC = NMC-1

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF (INIC) 96.101.96 If (INIC) 96.101.96 98 CALL NBODY IF (ERR) 99.2.99 99 CALL MCO IF (ERR) 99.2.99 97 IF (INIC) IF (INIC) 98 CALL MODY IF (INIC) 99 CALL MCO IF (INIC) 01 = 1. II

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI 1 F (TEM) 97.2.97 97.12.97 97 IF (INNC) 96.101.96 98.101.96 98 CALL NBOPY 1F (ERR) 99.2.99 97 CALL MODY 1F (ERR) 99.2.99 97 CALL MODY 1F (INNC) 96 CALL MSOPY 1F (INNC) 97 CALL MODY 1F (INNC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KK = 67 Call SETI JF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBOPY 1F (ERR) 99.2.99 0F = 1. NMC = NMC-1

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 IF (IMC) 96.101.96 If (ITM) 97.2397 97 CALL NBODY IF (ERN) 99.2399 97 CALL MCC If (ITM) 97.239

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 Call SE11 If (TEM) 97.2.97 97 IF (IMC) 96.101.96 State INC(INC) 98 CALL NBOPY If (ERR) 99.2.99 17 IF (ERR) 99.2.99 If (IMC) 99 CALL MCC If (IMC) 91 IF (IER) 99.2.99 If (IMC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 If (TEM) 97.2.97 97 IF (NMC) 96.101.96 If (TEM) 97.2.97 96 TMAX = TMC(NMC) If (ERR) 99.2.99 98 CALL NBODY IF (ERR) 99.2.99 97 IF (ERR) 99.2.99 If (ERR) 99.2.99 97 IF (IST) 99.2.99 If (ERR) 99.2.99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI Call SETI If (TEM) 97:2:97 97 IF (NMC) 96:101:96 95 98 CALL NBOPY 16 15 (ERN) 99:2:99 16 99 CALL MGOP 16 16 1 = 1. 16

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KK = 67 Call SETI IF (TEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 96 TMAX = TMC(NMC) 96 CALL NODY 1F (ERR) 99.2.999 99 CALL MCC

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SETI 97 IF (I:MC) 96.101.96 97 IF (I:MC) 99.2.99 98 Call NBOPY 1F (ERR) 99.2.99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN CALL ORGN T = 0.

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI 97 IF (INMC) 96.101.96 96 TMAX = INC(NMC) 98 CALL NBODY 16 (ERR) 99.2.99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI IF (TEM) 91,23,97 97 IF (IMC) 96,101,96 98 CALL NBODY IF (ERR) 99,23,99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0.

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN Call ORGN T = 0. KK = 67 KK = 67 Call SE11 F (IEM) 97.2.97 If (IEM) 97.2.97 97 IF (NMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY If (ERR) 99.2.99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN CALL ORGN T = 0. KK = 67 KK = 67 CALL SETI CALL SETI IF (TEM) 97.2.97 97 IF (INMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY 1F (ERR) 99.2.99

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. Kk = 67 Kk = 67 Call SEII IF (TEM) 97.2.97 97 IF (INNC) 96.101.96 98 CALL NBODY

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = 0. KK = 67 KL SEII IF (IEM) 97.2.97 97 IF (IMC) 96.101.96 96 TMAX = TMC(NMC) 98 CALL NBODY

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
F (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC)
98 CALL NBOPY

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC)
06 CALL NRODY

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (INMC) 96.101.96
97 IF (INMC) 96.101.96
96 TMAX = TMC(NMC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
96 TMAX = TMC(NMC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN
T = 0.
KK = 67
KK = 67
CALL SEI1
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96
97 IF (NMC) 96.101.96
97 TE (NMC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN
T = 0.
KK = 67
CALL SETI
IF (TEM) 97.2.97
97 IF (IMC) 96.101.96
96 TMAX = TMC(NMC)

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (KMC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97
97 IF (NMC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
KK = 67
Call SETI
IF (TEM) 97.2.97
IF (IMC) 96.101.96

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
IF (IEM) 97.2.97
IF (IEM) 97.2.97

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI
IF (TEM) 97.2.97

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
IF (TEM) 97.2.97
IF (TEM) 97.2.97

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI
If (TEM) 97.2.97

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN
T = 0.
KK = 67
CALL SETI
T = 110000000000000000000000000000000000

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN
T = 0.
KK = 67
Call SETI

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN $K = 67$
Call SETI

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN $T = 0$.
KK = 67
Call SETI

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN
T = 0.
KK = 67
CALL SETI

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN $K = 67$
Call SETI

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN $T = 0$.
Kk = 67

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN $T = 0$.
KK = 67

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN $T = 0$.
KK = 67

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L = 0. $K = 67$

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN TERMS TO REPORT

 |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Call ORGN T = $0.$

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN PERSON PE
PERSON PERSON PER

 |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Laboration of the second se

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CALL ORGN

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|

 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | |
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

211 DD 214. I = NRV.NCV
208 NAV = NAV+1
IF (TL(NAV)-T) 211,208,211
211 TAB(I,1) = PX(NI,NAV)
TAB(1,2) = PY(NT,NAV)
TAB(1,3) = P2(NT,NAV)
214 TIMV(I) = TL(NAV)
IF (NBV-7) 209,210,209
209 NBV = 7
NCV = 10
GO TO 207
210 IF (NORG) 212,213,212
212 TAB(6,1) = -X
TAB(6.2) = -Y
TAB(6,3) = -2
L GO TO 215
213 NBT = NBT
TAB(6,1) = X(NBT)
IAB(6,2) = Y(NBI)
TAB(6,3) = 2(NBT)
215 TIMV(6) = I
CALL VELOC(TIMV.TAB.OM)
IF (NORG) 218,219,218
218 GM(1) = -GM(1)
QM(2) = -QM(2)
QM[3] = -OM[3]
219 PM(1) = XTARG
PM(2) = YIARG
PM(3) = Z1ARG

(

PM(5) = PM(5)-OM(2) PM(6) = PM(6)-OM(3)	WUL 1002139100000000000000000000000000000000	220 IF (NTARG-4) 221.221.222 221 AL = 0. DL = 0. GO TO 223	222 N = NTARG DJD = (T+TO1/24.+2436934.5 CALL PLANET GO TO 230	$\begin{array}{r} 223 \text{ IF (NTARG) } 230.2241230 \\ 224 \text{ DJD} = (1+10)/24.+2436934.5 \\ DT = (DJD-2433281.5)/365.25 \\ HDT = DT/2. \end{array}$	EM =(22.34945E-5)+.13526E-8*HDT EN = 9.7169267E-541E-9*HDT D0 229 I=1.10 A = AL	D = DL DAT = EM+EN*SINF(A)*TANF(D) DDT = EN*COSF(A) AL = -DT*DDT	DL= -DT*DDT AL = (AL+A)/2. DL = (DL+D)/2. IF (ABSF(A-AL)-5E-8) 228,229
--	--	---	---	--	--	---	---

229 CONTINUÉ
AL = (AL+6.2831853)
DL = (DL+1.5707963)
230 AL = AL*57.29578 '
DL = DL*57.29578
0 = 1 + 10
WOT 10,280,AL,DL
280 FORMAT (1H04X,38HRIGHT ASCENSION OF TARGET NORTH POLE =1PE15.7/1H0
14X,34HDECLINATION OF TARGET NORTH POLE =E15.7)
IF (PM(1)) 231,232,232
231 PUNCH 260,PM(1)
GO TO 233
232 PUNCH 261,PM(1)
G 233 IF (PM(2)) 234,235,235
234 PUNCH 262,PM(2)
G0 T0 236
235 PUNCH 263,PM(2)
236 IF (PM(3)) 237,238,238
237 PUNCH 264,PM(3)
G0 T0 239
238 PUNCH 265,PM(3)
239 IF (PM(4)) 240,241,241
240 PUNCH 266,PM(4)
60 T0 242
241 PUNCH 267,PM(4)
242 IF (PM(5)) 243,244,244
243 PUNCH 268,PM(5)
, GO TO 245
244 PUNCH 269,PM(5)

245 IF(PM(6))246,247,247
246 PUNCH 270.PM(6)
60 T0 248
247 PUNCH 271,PM(6)
248 PUNCH 272.1
IF (AL) 249,250,250
249 PUNCH 273,AL
60 TO 251
250 PUNCH 274.AL
251 IF (DL) 252,253,253
252 PUNCH 275, DL
60 T0 2
253 PUNCH 276.DL
GO TO 2
u 260 FORMAT (5X,6H1UPSIF12X,1PE14.7)
to the set format (5x,6H1UPSIF12x,1PE13.7)
262 FORMAT (5X,6H1LAMIF12X,1PE14.7)
263 FORMAT (5X,6H1LAMIF12X,1PE13.7)
264 FORMAT (5X,6HIGAMIF12X,1PE14.7)
265 FORMAT (5X,6HIGAMIFI2X,IPEI3.7)
266 FORMAT (5X,7H1UPSIF111X,1PE14.7)
267 FORMAT (5X,7H1UPSIF111X,1PE13.7)
268 FORMAT (5X,7H1LAMIF111X,1PE14.7)
269 FORMAT (5X,7H1LAMIF111X,1PE13.7)
270 FORMAT (5X,7HIGAMIFIIIX,IPE14.7)
271 FORMAT (5X,7H1GAMIF111X,1PE13.7)
272 FORMAT (5X,6HITIUPH12X,1PE13.7)
273 FORMAT (5X,6HIALPND12X,1PE14.7)
274 FORMAT (5X,6H1ALPND12X,1PE13.7)
275 FURMAT (5X.6HIDELND12X.1PE14.7)

.

4.2 PROGRAM II

This program is a modification of the N-body subroutine in Deck #1. Vehicle ground traces (i.e. longitude, latitude), the central angle, and the elevation and azimuth of the velocity vector are given. Also the option is available for having positions, velocities and acceleration in units of AU, AU/HR, AU/HR^2 or MILES, FT/SEC, FT/SEC².

4.2.1 COMPUTER INPUT

N-BODY TRAJECTORY

Read Statement 1

FORTRAN	
---------	--

Sy	mb	ols

Field l (x)	KGT	code digit to determine whether or not
		ground traces are to be computed.
		(1 = yes; Ø = no)*
2 (x)	KLMS	code digit to determine units of output
		$(1 \rightarrow \text{output in miles, ft/sec and ft/sec}^2;$
		$\emptyset \rightarrow \text{output in AU, AU/hr, AU/hr}^2$)

Read Statement 2 (used only if field 2 of read statement 1 is = 1)

Field l	CONVI	conversion factor from AU to miles
		= 9.2956509E+07
2	CONV2	conversion factor from AU/hr to ft/sec
		= 1.3633621E+08
3	CONV 3	conversion factor from AU/hr 2 to
		$ft/sec^2 = 3.7871170E+04$

These conversion factors can of course be changed to suit anyone's particular needs. If one is interested in obtaining position coordinates in kilometers rather than miles or AU, the proper conversion factor could be read in as CONV1 but since KLMS would then = 1, the alphanumeric printout of the beginning of the output would state DISTANCE IS IN MILES, VELOCITY IS IN FT PER SEC, ETC even though this is not the case. This is due to the format of the output statement.

*Ø=zero

Read Statement 3 (used only if field 1 of read statement 1 is =1)								
Field	1	GHRA		Greenwich hour angle at O ^h ET on the day of departure in degrees and decimals of a degree				
ĩ	2	OMGE	ω_{\oplus}	angular velocity of the earth = .262516 rad/hour				
:	3	τττο		tape hours from O ^h ET Jan. 1, 1960 of the Greenwich hour angle at O ^h ET on the day of departure				
Read Statemer	nt 4							
Field	1	G(2)	k ²	Gravitational constant = 5.1373647E-07 (rad/hr) ²				
	2	WTE	M⊕	the mass of the earth = 3.0034424E-06 (solar mass units) SMU				
3	3	RADE	R⊕	R_{\odot} ; the radius of the earth = .426636E-04 (AU)				
4	4	WTV	m v	mass of the vehicle (usually zero) solar mass units				
!	5	OBJ	J'	oblateness constant for the earth = $JM_{\oplus} R_{\oplus}^2 = 8.8609392E-18 \text{ SMU(AU)}^2$				
Read Statemer	nt 5							
Field	1	EMAX	D ₁ max	maximum distance from Earth, A.U.				
i	2	GMAX	D ₂ max	maximum distance from target, A.U.				
:	3	SMAX	D ₃ max	maximum distance from Sun, A.U.				
	4	TMAX	Т	trip time, hours				
	5	ТО	t s	date of departure, hours from Jan. 1960, O ^h UT				
Read Statemer	nt 6							
Field	1 (x)	NCKE		control digit indicating computing scheme, 0 = Cowell, 1 = Encke				
:	2 (x)	MSDT		control digit indicating selection of integration time step interval, 0 = doubling and halving procedure, 1 = three fixed Λ t's				

.

٠

3 (x) MET		control digit indicating whether computing scheme (Cowell, Encke) is to be switched, 0 = retain original scheme, 1 = switch schemes on test
4 (x) NOUT	n	print digit n indicates print every n integrations
.5 (:	x) NOSW		control digit, 0 = retain initial origin, l = switch origins on test
Read Statement	7 (used only if F	ield 2 of re	ead statement 6 is one (1))
Field l	DTA	Δt ₁	Δt within 3 radii of origin, hours
2	DTB	Δt_2	Δ t within 100 radii of origin, hours
3	DTC	Δt_3	Δt > 100 radii from origin, hours
Read Statement	8 (used only if F	ield 2 of re	ead statement 6 is zero (0))
Field 1	DT	t.	initial Δ t, hours
2	DTMAX	t	maximum Δ t, hours
3	EPl	E	value to test accuracy of integration, A.U.
Read Statement	9		
Field 1 (:	<) N	N _b	number of bodies other than the Earth to be included in the study (Earth is always included)
2 (:	x) NEWORG		code digit for origin planet
3 (:	x) NTARG		code digit for destination planet
Read Statement	10		
N _b sets o	f data, each inc	luding	
Field l (x) NB(I)		code digit of body
2	WT(I)		mass of body, solar mass units
3	RAD(I)		radius of body, A.U.
Read Statement	11		
Field l	PM(1)	x_)	position coordinates with respect
2	PM(2)	y ₀	to origin at burnout, A.U.
3	PM(3)	z)	
4	PM(4)	*_)	velocity components with respect
5	PM(5)	ÿ {	to origin at burnout, A. U. /hour
6	PM(6)	_گ)	
		58	

The code digits for the planets are as follows:

0	Earth	5	Mars
1	Sun	6	Jupiter
2	Moon	7	Saturn
3	Mercury	8	Uranus
4	Venus	9	Neptune

4.2.2 COMPUTER OUTPUT

Initially (dependent on the input parameters KMLS and CONV1, CONV2 and CONV3) the units of position velocity and acceleration will be stated.

Then the following information is printed out after every n integration steps, where n is an input control parameter

- 1. Flight time, hours from start of trajectory
- 2. Table time, hours from beginning of tape
- 3. Time increment of integration step, hours
- 4. Planetary code digit of body at the origin
- Acceleration components of the vehicle with respect to the origin, in desired units
- 6. Velocity components of the vehicle with respect to the origin, in desired units
- 7. Position coordinates of the vehicle with respect to the origin, in desired units
- 8. Position coordinates of the vehicle with respect to the Earth, in desired units
- 9. Position coordinates of the vehicle with respect to the target, in desired units
- Position coordinates of the vehicle with respect to the Sun, in desired units

Then, if KGT = 1

- 11. Ground trace longitude and latitude (degrees)
- 12. Control angle (Degrees)
- 13. Elevation and aximuth of velocity vector (degrees)

4.2.3 SAMPLE PROBLEM

PROGRAM II (N-Body Program with Ground Traces)

Earth to Moon Trajectory

CARD

1	X1,1*
2	F9.2956509E+7,1.3633621E+8,.378711694E+5*
3	F336.2766,.262516,75888.0*
4	F5.13736490E-7,3.00344220E-6, .4266E-4,0.0,8.8609392E-18*
5	F2.0,2.0,80.0,75902.422*
6	X0,0,0,1,0*
7	F.25, 2.0, 4.0E-10*
8	X2, 0, 2*
9	X1,F1.0,4.655E-3*
10	X2,F3.6942027E-8,1.1625090E-05*
11	F-2.9325021E-06,3.8733136E-05,2.0975379E-05*
12	F-2-6227989E-04-2-3734089E-06-3-3926081E-06*

N BODY TRAJECTORY	
GENERAL ELECTRIC CO.	
M.S.V.D.	
STARTING TABLE TIME = 75902.422	
URIGIN IS BUDY O MASS = 3.003442E-06	
DESTINATION IS BUDY 2 MASS = 3.694203E-08	
MASS OF VEHICLE = 0.	
OTHER BODIES ARE-	
BUDY 1 MASS = 1.000000E 00	
GRAVITATIONAL CONSTANT = 5.137365E-07	
EPSILON OF INTEGRATION = 4.00E-10 MAXIMUM DELTA T =	2.0
COWELL METHOD IS USED	
THE ORIGIN IS FIXED	
REENWICH HOUR ANGLE= 336.2765999 TIME= 75888.000	
ISTANCE IS IN MILES	
ELOCITY IS IN FT PER SEC	
CCELERATION IS IN FT PER SEC PER SEC	
ONVERSION FACTORS 0.9295651E 08 0.1363362E 09 0.3787117E 05	

.

The next page is only the first part of the run to show the ground trace print, etc.

ACCELERATION					ACCELERATION	/.13209955 00 -2.4672750E 01	-1.3357479E 01 2.8948811E 01	650738		ACCELERATION 1.1123988F 01	-2.1777266E 01	2.7129447E 01	134693		ACCELERATION	1.3683321E 01 -1.8267772E 01	-9.8161864E 00 2.4845569E 01	255589		ACCELERATION	1.5140319E 01 -1.1505080E 01	-6.1242596E 00 1.9977554E 01	890680
ND. 0 VELUCITY	-3.51582405 04 -3.2358157E 02 -4.65535325 02	3.5762701E 04	TRAL ANGLE≈ -0.	ND. 0	VELOCITY	-3.2055691E 03	-2.0254362E 03 3.5440342E 04	TRºL ANGLE= 10.4	ND. 0	VELOCIIY -3.4196995F 04	-5.8272898E 03	3.4860315E 04	TRAL ÅNGLE≈ ZU.4	ND. 0	VELOCITY	-3.2788030E 04 -8.0825922E 03	-4.6567338E 03 3.4089123E 04	TRAL ANGLE= 29.6	0 •ON	VELOCITY	-2.9469001E 04 -1.1407630E 04	-6.4360687E 03 3.2248705E 04	TRAL ANGLE= 45.4
250 CENTER IS CENTER	-2./239316E U2 3.6004971E 03 1.94979805 03	4.1036080E 03	98-8672438 CEN 92-4655409	016 CENTER IS	CENTER	-1.0299048E U3 3.5625724E 03	1.9231061E 03 4.1774497E 03	87.5419502 CEN	016 CENTER 1S	CENTER -1.7704708E 03	3.4657611E 03	4.3153851E 03	77.0768948 CEN 02.9033747	016 CENTER IS	CENTER	-2.4846004E 03 3.3168705E 03	1.7778628E 03 4.5095083E 03	67.7708359 CEN	031 CENTER IS	CENTER	-3.8122293E 03 2.8961671E 03	1.5385471E 03 5.0287178E 03	52.7711344 CEN 12 5865353
DELTA T≈ 0.2 SUN 8.51205026.07	-1.5740930F 07	9.3874781E 07	LONGITUDE=	DELTA T= 0.(SUN 8 EN JOERNE DA	-3.6297972E 07	-1.5740208E 07 9.3874086E 07	LONGITUDE= -{ Azimuth= -{	DELTA 1= 0.(SUN 8.5129694E 07	-3.6296342E 07 -1 5730518E 07	9.3873433E 07	LONGITUDE= - AZIMUTH= 1(DELTA T= 0.	SUN	8.5129821E 01 -3.6294764E 07	-1.5738855E 07 9.3872827E 07	LONGITUDE= -(AZIMUTH= 1(DELTA T= 0.	SUN	-3.6291733E 07	-1.5737597E 07 9.3871771E 07	
TIME= 75902.422 TARGET 1.91719346 05	1.1768294E 05 6.0719026F 04	Z+3300725E 05	UDE= 28.3686197 ION= 2.999993	TIME= 75902.453	TARGET	1.1769815E 05	6.0722002E 04 2.3235849E 05	UDE= 27.4099581 10N= 8.1457831	TIME= 75902.484	TARGET 1.9013755E 05	1.1765446E 05 6.0693089E 04	2.3168623E 05	UDE= 25.5987666 ION= 13.0350755	TIME= 75902.516	TARGET	1.8938143E U5 1.1755867E 05	6.0636074E 04 2.3100238E 05	UDE= 23.2190573 10N= 17.5590794	TIME= 75902.578	TARGET	I.8790970E US	6.0456053E 04 Z.2963832E 05	UDE= 11.8154576 TON= 25.3381155
0. TAPE JM EARTH 2.7259516F 02	3.6004971E 03	••1036080E 03	TRACE LATIT /ECTOR ELEVAT	0.0313 TAPE	DM EARTH	3.5625724E 03	9231061E 03 1774497E 03	TRACE LATIT /ECTOR ELEVAT	0.0625 TAPE	JM EARTH 1.7704708E 03	3.4657611E 03	+•3153851E 03	TRACE LATIT /ECTOR ELEVAT	0.0938 TAPE	JM EARTH	2.4846004E 03 1.3168705E 03	L.7778628E 03	TRACE LATIT JECTOR ELEVAT	0.1563 TAPE	DM EARTH	3.8122293E U3 2.8961671E U3	1.5385471E 03 5.0287178E 03	TRACE LATIT JECTOR FIFVAT
TIME= POSIT FRE X ~2		R	GROUND VELOCITY V	TIME=	POSIT FR(< >	8	GROUND VELOCITY V	THE	POSIT FRI	> ~		GROUND VELOCITY V	TIME=	POSIT FRC	× >	M 8	GROUND VELDCITY V	= JWI I	POSIT FRU	× >	Z R	GROUND VELOCITY V

4.2.4 LISTING

.

•

This listing is the input routine for Program II. N-body MAIN is called at the end.

N-BODY WITH OPTIONS FOR GROUND TRACES OUTPUT IN MILES AND FTY SEC.

	C KGT=1, GROUND TRACES, O. NONE KMLS=1, OUTPUT IN MILES, O. A.U., S	
1	C DEAD CONVERSION FROM A 11.5 EDD DISTANCE VELOCITY, ACCELEDATION	-
	C READ CURVERSION FROM AND STANDE FALLOCITIERCELLANDAU	
1	1{WM(6),ZIDM),(WM15),YIDM),(WL(1),XIL),(WL(2),YIL),(WL(3),ZIL),	
1	2(WL(4),XIDL),(WL(5),YIDL),(WL(6),ZIDL)	
	DAC PX(9,67),PY(9,67),PZ(9,67),TL(67),RKM(4,6),RKL(4,6),NB(9),	
	1WT(9),RAD(9),X(9),Y(9),Z(9),DIS(9),DIST(9),PM(6),PL(6),PPM(6),	
	2PP1161.0M(6).01(61.WM(6).W(16).XX(9).YY(9).77(9).TI(6).Ct(6)	
	COMMONI NEWORG. 758. ENV. ELV. ENV. ELV. EN7. EL 7. AN. AL. BM. BL. CM. CL	
	COMMON NORCANTARC NEEDEN NAMENNA T TO THAY DIMAY HAEDT WITE WITH MEM.	
I.	CUMPIUN NURGENTARGENSUNENNENNENNEN FEIDELMAAGUTHAAGHAPUTENTUS HIVENUUR 1977 AD C. MTAD.C. ZTAD.C. CCEN. MCEN. CNAM. CNAM. CNAM. GADI. DADI. DADI. HIVE HIVE	
Ì	IXIAKG, YIAKG, ZIAKG, SLEN, VLEN, SMAX, GMAX, EMAX, KAUI, KAUZ, KAUE, HIA,	
	2NBE, NBT, NBS, RADURG, SAM, SBM, SCM, SAL, SBL, SCL, XIM, XIL, YIM, YIL, ZIM,	
	3ZIL,XIDM,XIDL,YIDM,YIDL,ZIDM,ZIDL,RM,RL,RR,RO,SS,RRM,RRL,IEM,IEL,	
ĺ	4GMX, GLX, GMY, GLY, GMZ, GLZ, SUMX, SULX, SUMY, SULY, SUMZ, SULZ, FM, FL, GN, GL,	
Ì	5HM+HL+RKR+SSS+XM+YM+ZM+A+BX+BY+BZ+WRM+WRL+RCM+RCL+ROM+ROL+RPPM+	_
	6XPM+XPL+YPM+YPL+ZPM+ZPL+	
	7KOB.VNZ.MEDT.MSDT.MDT.NOT.MET.NOUT.NCKE.TSAV.DTA.DTB.DTC.EP1	
	N(C)(2), WTS(2)	
1	DAG GAZIJWIJAZJ DAG GACAADIZI VAATIZI VAATIZI ZAATIZI HAANGIZI HAANGIZI	
I	- UAL = SUGUUVIDI (AUU) (2) (12) (12) (2) (2) (2) (2) (2) (2) (2) (2) (2) (
	2P12(2),E(2),XMJ(2),CCUN(2),XN(2)	
	COMMON A1,A2,FJ1,FJ2,SFJ1,SFJ2,CFJ1,CFJ2,S1,S2,EPS1	
	COMMON DT, DTME, RPM	
i	DAC SM(6), SL(6), XMJP(2)	
ļ	COMMON OBJ. TSAVE, REA. RTA. RSN. HPI. THPI. KK. NOSW. POM(6). POL(6). ERR	
	COMMON RPA.GHRA.OMGE.TTTO.KGT.KMLS	
i	F(0) = J(2)	
	EPSI = 1.0E = 11	
	B $P_{1} = 202622077325$	
	B = PI(2) = 147042055061	
	B $PI2 = 203622077325$	
	B = P12(2) = 150042055061	
	B $HPL = 201622077325$	
	THPI = 203455457437	
÷	2 REWIND 26	
) RITZ-3- KGT-KMIS	
	TE/KMIC1112.113.112	
	$\frac{1}{2} \qquad 112 \text{KII2} 3 \text{LUVVI} \text{LUVVVI} \text{LUVVVVI} \text{LUVVVI} \text{LUVVVVI} \text{LUVVVVI} \text{LUVVVV} LUVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV$	
!	$^{\prime}$ 113 1F(KG()102,103,102	
	$\frac{3}{102} R11 2_{\pm}3_{\pm}GHRA_{\pm}UMGE_{\pm}111U^{-5}$	
}	4 103 RIT 2, 3, G(2), WTE, RADE, WTV, UBJ 4	
	<u>/ 3 FORMAT (E9.5)</u>	
	4 RIT 2,3,EMAX,GMAX,SMAX,TMAX,TO	
	5 RIT 2,3,NCKE, MSDT, MET, NOUT, NOSW	
	⁹ / IF (MSDT) 6, 7, 6	
t.	6 RIT 2.3.DTA.DTB.DTC	
	FRASE DT	
	7 PIT 2, 3, DT. DTMAY, FP1	
	I NII CADUUTUNATERI Usent - NT/2	
ĺ	$\qquad \qquad $	
	B KII Zajana Newuku niaku	
	$RIT 2_{9}3_{9}(NB(I)_{9}WI(I)_{4}RAD(I)_{5}I = I_{4}N)$	
i.	9 RIT 2,3, (PM(I),I=1,6)	
	ERASE T	

64

4 JUN 1963 N-BODY WITH OPTIONS FOR GROUND TRACE, DUTPUT IN MILES AND FT/SEC. FI E14.71 SEC) I.N TIME=F10.3/3 15 PER E14.7,3H VELOCITY SEC PER ANGLE=F12.7.9H E14.7,3H MILES/34H0 FT N ERASE NOT. NORG. PL. SL(4) & SL(5). SL(6) END(1,1,0,0,0,0,1,1,1,0,1,0,0,0,0,0) IS FAC TORS IN HOUR ACCELERATION HDT 10. 108.CONVI.CONV2.CONV3 107 FORMAT(27H0 DISTANCE IS **CONVERSION** GREENWICH 104 NDT, 10, 101, GHRA, TTTO GHRA=GHRA+ .017453293 IF(KGT)104.111.104 III IF(KMLS)106,11,106 IF (TEM) 12,2,12 I PER SEC/48HO FORMAT(27H0 108 FORMAT(26H0 CALL TITLE 106 WOT 10,107 12 CALL NBODY CALL ORGN NBT = NBTCALL SETI G = -G(2)KK = 67G0 T0 2 11 101

PAGE 2

4.3 PROGRAM III

This program is a modification of the N-body subroutine of Program I. A complete 6 x 6 differential correction matrix is computed by integration and may be printed out with each integration step. There is also a differential correction procedure (improved over that of Program I) for the computation of interplanetary trajectories.

There is an option to print out at each nth integration step the incremental sensitivity matrix $H_{t,t-\Delta t}$ and/or the sensitivity matrix $H_{t,o}$.

The final sensitivity matrix H is always printed out as well as its inverse. This inverse is the "theoretical" inverse, obtained by rearranging the components of H as follows:

- 1	/H ₄ -	H_2^T	
H Î	\ ^{-H} 3	н ₁ /	

4.3.1 COMPUTER INPUT

Read Statement 1

Field l (x)	KWC	k	<pre>control digit for sensitivity coefficients. If k = 1, coefficients are computed. If k = 0, no coefficients are computed. (i.e. same as option 2 in deck #1).</pre>	
2 (x)	KNOP		control digit for intermediate print of incremental sensitivity coefficients. The program prints them after every KNOP integration steps.	
3 (x)	KNOPP		control digit for intermediate print- out of total sensitivity coefficient matrix. Program prints after every KNOPP th integration step.	
4 (x)	NOOFT		This is a dummy number with no meaning. Simple set it equal to one (1).	
Read Statement 2				
Field l	АК		the limiting ratio of $\Delta V/Vo$. Section 3.4 of the report explains this in detail.	
-	Read Statement 3			
---	------------------	------	-----------------------	--
	Field 1	G(2)	k ²	gravitational constant = 5.1373647E-0; (rad/hr) ²
	2	WTE	M	mass of Earth = 3.0034424×10^{-6} , solar mass units
	3	RADE	R ⊕ _e	equatorial radius of the Earth = $.42635078 \times 10^{-4}$, A.U.
	4	WTV	m	mass of the vehicle, solar mass units
	5	OBJ	J'	oblateness constant for the Earth = $JM_{\oplus}R_{\oplus}$ = 8.8632361 x 10 ⁻¹⁸ , (solar mass units) (A.U.) ²
	Read Statement 4			
	Field l	EMAX	D ₁ max	maximum distance from Earth, A.U.
	2	GMAX	D ₂ max	maximum distance from target, A.U.
	3	SMAX	D ₃ max	maximum distance from Sun, A.U.
	4	TMAX	Т0	trip time, hours
	5	ТО	t s	date of departure, hours from Jan. 1960, O ^h UT
	Read Statement 5			
	Field 1 (x)	NCKE		control digit indicating computing scheme, 0 = Cowell, 1 = Encke; This must be = 0 if k = 1
	2 (x)	MSDT		control digit indicating selection of integration time step interval, 0 = doubling and halving procedure, 1 = three fixed Δt 's
	3 (x)	MET		control digit indicating whether computing scheme (Cowell, Encke) is to be switched, 0 + retain original scheme, 1 = switch schemes on test
	4 (x)	NOUT	n	print digit n indicates print every n integrations
	5 (x)	NOSW		control digit, 0 = retain initial origin, l = switch origins on test

Read Statement 6 (If field 2 of rea	ad statemer	at 5 = 1)
Field 1	DTA	Δt_1	Δt within 3 radii of origin, hours
2	DTB	Δt_2	Δ t within 100 radii of origin, hours
3	DTC	Δt ₃	Δ t 100 radii from origin, hours
Read Statement 7 (If field 2 of rea	ad stateme	nt 5 = 0)
Field l	DT	Δt_{i}	initial Δ t, hours
2	DT MAX	Δt_{\max}	maximum Δt , hours
3	EPl	£	value to test accuracy of integration, A.U.
Read Statement 8			
Field 1 (x)	Ν	N _b	number of bodies other than the Earth to be included in the study (Earth is always included)
2 (x)	NEWORG		code digit for origin planet
3 (x)	NTARG		code digit for destination planey
Read Statement 9			
N _b set	s of data, each	including	
Field 1 (x)	NB(I)		code digit of body
2	WT(I)		mass of body, solar mass units
3	RAD(I)		radius of body, A.U.
Read Statement 10			
Field 1	PM(1)	x	
2	PM(2)	У _О	position coordinates with respect
3	PM(3)	z o	to origin at burnout, A.U.
4	PM(4)	x	
5	PM(5)	ŷ	velocity components with respect
6	PM(6)	ž o	to origin at burnout, A.U./hour

I

ļ

The planetary code digits are as follows:

0	Earth	5	Mars
1	Sun	6	Jupiter
2	Moon	7	Saturn
3	Mercury	8	Uranus
4	Venus	9	Neptune

4.3.2 COMPUTER OUTPUT

The following information is printed out after every n integration steps where n is an input control parameter.

- 1. Flight time, hours from start of trajectory
- 2. Table time, hours from beginning of tape
- 3. Time increment of integration step, hours
- 4. Planetary code digit of body at the origin
- 5. Acceleration components of the vehicle with respect to the origin, A.U./hr²
- Velocity components of the vehicle with respect to the origin,
 A.U./hr
- 7. Position coordinates of the vehicle with respect to the origin, A.U.
- 8. Position coordinates of the vehicle with respect to the Earth, A.U.
- 9. Position coordinates of the vehicle with respect to the target, A.U.
- 10. Position coordinates of the vehicle with respect to the Sun, A.U.

The intermediate printout of the incremental sensitivity coefficients (the matrix $H_{t,t-\Delta t}$) is determined by Field 2 of read statement #1, KNOP. (This printout is not shown in the sample output).

The printout of the sensitivity coefficients over the entire trajectory is controlled by Field 3 of read statement #1 KNOPP. On the sample output KNOPP = 1 since we get the matrix at each step. The form is standard; e.g.



4.3.3 SAMPLE INPUT

.

PROGRAM III (N-Body Program with Sensitivity Coefficients) Earth to Moon Trajectory

CARD

1	X1, 500, 1, 1*
2	F1.*
3	F5.137365E-07, 2.9991126E-6,.4266E-4,0,8.8609392E-18*
4	F1.0,1.0,1.1,56.6816,62163.147*
5	X0,0,1,0*
6	F.25,2.0,4.00E-10*
7	X2,0,2
8	X1, F1.0, 4.655E-3*
9	X2,F3.6821513E-8,1.1625E-5*
10	-1.4158093E-05,3.7906955E-05,1.7647465E-05
11	-2.5124908E-04,-4.8551250E-05,-6.2786291E-05
is not shown in	its entirety. Only the first few lines of output and the

This run is not shown in its entirety. Only the first few lines of output and the last few lines are here included for the sake of brevity.

N BUDY TRAJECTORY

GENERAL ELECTRIC CC.

M. S. V.D.

STARTING TABLE TIME = 62163.147

ORIGIN IS BODY 0 MASS = 2.999112E-06

DESTINATION IS BODY 2 MASS = 3.682151E-08

MASS OF VEHICLE = 0.

OTHER BODIES ARE-

BODY 1 MASS = 1.000000E00

GRAVITATIONAL CONSTANT = 5.137365E-07

2.0 H MAXIMUM DELTA T EPSILON OF INTEGRATION = 4.00E-10

COWELL METHOD IS USED

THE ORIGIN IS FIXED

	Y ACCELERATION E-04 0. E-05 0. E-05 0.		506E-05 -4.0847932E-05	810E-02 8.3881941E-05	941E-05 3.1198310E-32	303E-03 -4.0226670E-C3	042E 00 7.6894564E-53	796E-03 9.9493721E-01		Y ACCELERATIUN E-04 3.7115522E-04 E-05 -6.1227905E-04 E-05 -2.6455582E-04		957E-04 -3.4383577E-C4	143E-02 5.7818004E-04	523E-04 6.2063202E-32	055E-02 -1.6704380E-02	136E 00 2.4770575E-02	942E-02 9.7844802E-01		Y ACCELERATION E-04 4.4931533E-04 E-05 -5.1731261E-04 E-05 -2.0316047E-04 E-04		087E-03 -1.1492530E-03	096E-02 I.6433I04E-03	462E-03 9.2232393E-02	287E-02 -3.5479904.E-02	
NU. 0	VELOCITY -2.51249086 -4.85512508 -6.27862916 2.63487086		-9.06015	3.13468	8.38819	-9.05053	1.00880	7.6891	ND. C	VELOCITY -2.4139702E -6.8825986E -7.1912190E 2.6111472E		-1-96140	6-31451	5.77855	-3-9847(1.02671	2.47409	NO. 0	VELOCIT -2.28465196 -8.65242498 -7.92287998 2.56826788		-2.78850	9.5480	1049.1	0300	
250 GENIER IS	CENFER -1.4158093E-05 3.7906955E-05 1.7647465E-05 4.4145463E-05		3.1204879E-02	-9.0601506E-05	-4.C847932Ê-05	9.9632887E-01	-9.0420599E-03	-4.0182299E-03	016 CENTER IS	CENTER -2.1865273E-05 3.6067478E-05 1.5538511E-05 4.4948842E-05		6.2304120E-02	-1-9459535E-04	-3.4270/17E-04	9.9585277E-01	-3.9650556E-02	-1.6601427E-02	016 CENTER IS	CENTER -2.9213232E-05 3.3632378E-05 1.3171923E-05 4.6454808E-05		9.3625498E-02	-2.1615297E-03	-1.1382602E-03	1.0123323E 00	
vellA I= 0	SUN -6.7672139E-C1 6.5750413E-01 2.8512670E-61 9.8567780E-01	0.0313	<u>-3.7484464E-03</u>	8.3972808E-03	9.9519646E-01	-2.4917760E-01	5.1553691E-01	-3.1461631E-01	DELTA 1= 0.(SUN -6.7674575E-01 6.5748811E-01 2.8511844E-01 9.8568145E-01	0.0313	-1.5861890E-02	3.0776298E-02	9.8005217E-01	-5.2647002E-01	<u>8.9378510E-01</u>	-6.5642517E-01	DELTA T= 0.(SUN -6.7676975E-01 6.5747150E-01 2.8510992E-01 9.8568439E-01	0.0313	-3.647552E-02	6.2911824E-02	9.5422200E-01	-7.8759773E-01	
7E TIME= 62163.147	TARGET 1.3166374E-03 1.9807961E-03 9.3058257E-04 2.5540304E-03	313 DELTA T=	-8.2220472E-03	1.0097650E 00	8-3959109E-03	-5-5378598E-01	5.9659289E-01	5.1536752E-01	JE TIME= 62163.178	TAKGET 1.3082857E-03 1.9793299E-03 9.2870773E-64 2.5479122E-03	525 DELTA I=	-3,5798635E-02	1.0353447E 00	3.0744398E-02	-1.2215165E 00	1.0088245E 00	8.9139770E-01	PE TIME= 62163.209	TARGET 1.3002930E-03 1.9772679E-03 9.2657518E-04 2.5414350E-03	938 DELTA I=	-8.4751801E-02	1.0709154E 00	6.2702003E-02	-1.9081708E 00	
11ME= 0. 1AF	POSIT FROM EARTH X -1.4158093E-05 Y 3.7906955E-05 Z 1.7647465E-05 R 4.4145463E-05	11ME= 0.03	9.9511271E-01	-8.2129490E-03	-3.7436818E-03	-2.1272934E-01 -	-5.5265160E-01	-2.4858870E-01	TIME= 0.0313 TAF	POSTT FROM EARTH x -2.1865273E-05 y 3.6067478E-05 z 1.5538511E-05 R 4.4948842E-05	TIME= 0.00	9.8568630E-01	-3.5587001E-02	-1.5751028E-02	-2.8610641E-01	-1.2056819E 00	-5.1817459 E -01	TIME= 0.0625 TA	POSIT FROM EARTH X -2.9213232E-05 Y 3.3632378E-05 Z 1.3171923E-05 R 4.6454808E-05	TIME= 0.0'	9.7974215E-01	-8.3360339E-02	-3.5746535E-02		

-7.5219689E-01 1.	•1332428E 00 1	-9.9361595E-01	-3.483841 ÌE-02	4.2896857E-02	9.5065448E-01
TIME= 0.0938 TAPE	TIME= 62163.241	DELTA T= 0.0	16 CENTER IS NI	.	
POSIT FROM EARTH X - 3.6125793E-05	TARGET 1.2927357E-03	-6.7679332E-01	CENTER -3.6125793E-05	VELUCITY -2.1374815E-04	ACCELEAATION 4.8604773E-04
Y 3.0692832E-05 Z 1.0506817E-05 R 4.8575595E-05	1.9747013E-03 9.2424402E-04 2.5347263E-03	6.5745438E-01 2.8510121E-01 9.8568664E-01	3.0692832E-05 1.0606817E-05 4.8575995E-05	-1.0106199E-04 - -8.4624488E-05 - 2.5112367E-04	4.1296899E-04 1.4307391E-04
TIME= 0.156	3 DELTA T=	0.0625			
1.0020923E 00 -2	•4323299E-01	-9.9153382E-02	1.5963816E-01	-1.2312696E-02	-4.5970401E-03
~2.3027675E-01	.1526092E UD	1.4289540E-01	-1.2000891E-02	1.6063780E-01	5.1840840E-03
-9.2364120F-02	.4094178E-01	8.7331368E-01	-4.4336312E-03	5.1370726E-03	1.4930355E-01
8.3479197E-01 -3.	.1127384E 00	-1.1896242E 00	1.1149166E 00	-2.1603715E-01	-7.3140742E-02
-2.7725676E 00 1.	.3050466E 00	1.3678850E 00	-2.0617557E-01	1.0350196E 00	6.6754824E-02
-1.0113593E 00 1.	•3166050E 00	-1.5683395E 00	-6.7972495E-02	6.5268596E-02	8.7208666E-01
TIME= 0.1563 TAPE	TIME= 62163.303	DELTA T= 0.0	31 CENTER IS N	0.0	
POSIT FROM EARTH	TARGET	SUN	CENTER	VELOCITY	ACCELERATION
X -4.8531545E-05 Y 2.3698334E-05 Z 5.1061518E-06	1.2790399E-03 1.9684521E-03 9.1921101E-04	-6.7683904E-01 6.5741901E-01 2.8508341E-01	-4.8531545E-05 2.3698334E-05 5.1061518E-C6	-1.8343106E-04 -1.2083829E-04 -9.0420239E-05	4.6868095-04 -2.28924805-04 -4.94438925-05
R 5.4249375E-05	2.52105056-03	9.8568929E-01	5.4249375E-05	2.3753876E-04	
IIME= 0.218	I8 DELTA I≈	0.0625			
1.0862437E 00 -4,	••6701584E-01	-1.8207365E-01	2.3440159E-01	-2.9432717E-02	-9.8879658E-53
-4.1882846E-01 1.	.2285352E 00	2.2991745E-01	-2.7899013E-02	2.2389198E-01	9.5902399E-03
-1.5682190E-01 2.	• 2265597E-01	7.6185311E-01	-9.0842406E-03	9.3592352E-03	2.0137389E-01
1.8457109E 00 -3.	••9969683E 00	-1.4440558E 00	1.2845136E 00	-3.2637626E-01	-9.2426989E-02
-3.1850623E 00 1.	.0990972E 00	1.3966257E 00	-2.9492689E-01	9.8348801E-01	7.1933687E-U2
-1.0185956E 00 1.	.2143645E 00	-1.9710157E 00	-7-5947804E-02	6.7200899E-02	7.8490094E-01
TIME= 0.2188 TAPE	: TIME= 62163.366	DELTA T= 0.0	31 CENTER IS N	о • сл	
PCSIT FROM EARTH x -5.9122831E-05 Y 1.5788746E-05 Z -6.0101537E-07 R 6.1197670E-05	TARGET 1.2671581E-03 1.9612870E-03 9.1397114E-04 2.5075245E-03	SUN -6.7688296E-01 6.5738276E-01 2.8506541E-01 9.8569007E-01	CENTER -5.9122831E-05 1.5788746E-05 -6.0101537E-07 6.1197670E-05	VELOCITY -1.5623821E-04 -1.3099295E-04 -9.1654633E-05 2.2353993E-04	ACCE LERATION 3.9769906E - 04 -1.0623143E - 04 4.0356363E - 06
TIME= 0.281	3 ĎEĽTAŤT=	0.0625	or a communication of the communication		
1.2293C80E C0 -7.	'.3738809E−01	-2.7785272E-01	3.2058837E-01	-5.2326981E-02	-1.5713766E-02
-6.2095968E-Cl 1.	.2883639€ 00	3.1590221E-01	-4.7819266E-02	2.8314417E-01	1.4002269E-02
-2.1684305E-01 2.	••9837126E-01	6.2989929E-01	-1.33519306-02	1.3324076E-02	2.4759422E-01
2.6977088E 00 -4.	••6186562E ÜC	-1.6103842E 00	1.4736097E 00	-4.0007635E-01	-9.1042049E-32
-3.2344553F ()) B.	.100136F-01	1.3471240F 00	-3.3459190E-01	9.1096845E-01	6.8599030E-J2

· . –1						2	2	1	2	2	1
7 .0576470E- C		ACCELERATION 3.2185598E-04	-3.5177096E-05 2.9786098F-05			-2.0980921E-5	1.8147248E-0	2.8957640E-D	-1-5801409E-0	6.4212712E-0	6.3993692E-3
5.8758484E-02	0. 0	VELOCITY -1.3378810E-04	-1.3519555E-04 -9.0489997E-05	2.1063127E-04		-7.8755630E-02	3.3772700E-01	l.6658830E-02	-4.4095457E-01	8.3627487E-01	4.7961699E-02
-5.6738 <u>6</u> 59E-02	031 CENTER IS N	CENTER -6.8161374E-05	7.4473313E-06 -6.3013486E-06	6.8855956E-05		4.1837436E-01	-6.8852581E-02	-1.57932776-02	1.6525159E 00	-3.3268C13E-01	-1.9100823E-02
-2.2320133E 00	DELTA T= 0.(-6.7692532E-01	6.5734604E-01 2.8504741E-01	9.8568946E-01	0.0625	-3.8243797E-01	3.9770705E-01	4.8481009E-01	-1.7308763E 00	1.2676750E 00	-2.3984624E 00
1.1396807E 00	E TIME= 62163.428	TARGET 1.2568285E-03	1.9536894E-03 9.0873775E-04	2.4944587E-03	38 DELTA T=	1.0406901E 00	1.3296705E 00	3.6449257E-01	5.0633135E 00	5.1336232E-,01	9.7374555E-01
-8.8773286E-01	TIME= 0.2813 TAP	POSIT FROM EARTH X -6.8161374E-05	Y 7.4473313E-06 Z -6.3013486E-06	R 6.8855956E-05	TIME= 0.34	1.4190557E 00 -	-8.1992807E-01	-2.6676555E-01		-3.1070003E 00	-7.0599151E-01

.

•

TIME= 56.6563 TAP	PE TIME= 62219.803	r:LTA T= 0.0	31 CENTER IS N	0.0	
DSIT FROM EARTH X -1.4902017E-05 Y -2.3059363E-03	TARGET 4.8799018E-06 -8.3186023E-06	SUN -7.0633873E-01 6.2889123E-01	CENTER -1.4902017E-05 -2.3059363E-03	VELDCITY -3.1966136E-05 -2.8756910E-05	ACCELERATION -4.2260607E-05 7.2229898E-05
Z -1.1894106E-03 R Z.5946602E-03	-8.6810032E-06 1.2975839E-05	2.7252977E-01 9.8422104E-01	-1.1894106E-03 2.5946602E-03	1.2097918E-06 4.3014618E-05	1.5273956E-0 5
11ME= 56.61	719 DELTA T=	0.0156			
- 4.8688013E 02 -	-1.0351425E 03	-4.2530309E 02	3.9224710E 02	4.3041454E 01	7.8587552E 01
- 2.4977703E 02	-6.3664722E 02	-2.7634847E 02	2.3535028E 02	4.0774745E 01	5.5316250E 01
T.9807284E 00	-3,2162763E 01	-5.4980786E 01	I.4688702E 01	8.1674490E 00	0 8.5253605E 00
- 2.1479413E 02	-3.5390219E 02	-5.3116207E 01	1-3149495E 02	-5.4621966E 00	1.1352690E C1
-6.2709739E 02	I.4732052E 03	5.7325200E 02	-5.4491510E 02	-7.6073621E 01	-1-1531609E C2
-6.6400387E 02	1.3015897E 03	5.6520330E 02	-5.0426905E 02	-4.2875652E 0	-9.6688808E 01
TIME= 56.6719 TAF	PE 11ME= 62219.819	DELTA T= 0.0	JOB CENTER IS N	0.0	
0517 FRUM EARTH X -1.5406358E-05	TARGET 3.9934957E-06	SUN -7.0634723E-01	CENTER -1.5406358E-05	VELDC1TY -3.2570680E-05	ACCELERATION -3.5017208E-05 .4017208E-05
Y -2.3063766E-03 Z -1.1893824E-03 R 2.5950416E-03	-8.1521441E-00 -8.6249201E-06 1.2920827E-05	0.20003005-01 2.7252658E-01 9.8422123E-01	-2.5950416E-03 -1.1893824E-03 -2.5950416E-03	2.3908473E-06 4.2752605E-05	7.57413156-05
TIME= 56.61	797 DELTA T=	0.0078			
4.8842117E 02 -	-1.0375957E 03	-4.2558095E 02	3.9315686E 02	4.2982404E 0	T.8650478E 01
2.4482486E 02 -	-6.Z504684E 02	-2.1184946E 02	2.3105894E 02	4.0180686E 0	[<u>5.4411415E 01</u>
-3.1936958E 00	-2.2063054E 01	-5.0602677E 01	I0. 360£6170.I	7.8411946E 00	7.7783188E CO
1.7973280E 02	=2_7391481E 02	-1°-1989134E 01	- 7.0132811E C2	-9.6462337E 0	0 4.7521189E 00
-6.4026901E 02	1.4955560E 03	5.7808105E 02	-5.5331773E 02	-7.5950762E 0	
-6.6027926E 02	1.2831223E 03	5.5524868E 02	-4.9776436E 02	-4.0607410E 0	L -9.4489591E 01
TIME= 56.6797 TA	PE_TIME=_62219_827	DELTA T= 0.0	JO4 CENTER IS N	0.0	
0511 FRUM EARTH X -1.5661846E-05	TARGE1 3.5469750E-06	-7.0635151E-01	CENTER -1.5661846E-05	VELOCITY -3.28293076-05	ACCELERATION -3.1170436E-05 7.00703275506
Y = 2.3065898E=03 Z = 1.1893615E=03 R 2.5952230E=03	-8.9628155E-06 -8.5899955E-06 1.2911279E-05	6.2887947E-01 2.7252501E-01 9.8422137E-01	-2.5065898E-03 -1.1893615E-03 -2.5952230E-03	-2.69809125-09 2.9821968E-06 4.2598433E-05	1.56023406-05
11ME= 56.6	1816 DELIA I=	0-020			
4.8876414E 02	-I.0381110E 03	-4.2560750E 02	3+9334734E 02	4.2962550E	1 7.8658144E C1
Z.4357145E 02	-6.2212117E 02	-2.7071956E 02	Z+2997649E 02	4.0032420E 0	I 5.4184224E 51
-4-4820193E 00	-1.9562155E UI	-4.9520928E UI	9.8029618E 00	1.1624689E 0	0 7.5943601E 30
1.7085285E 02	-2.5376743E 02	-9.1917830E 00	9.3727722E 01	-1.0683213E 0	1 3.1004267E 30
-6.4319358E DZ	1.5002601E 03	5.7889857E 02	-5.5508782E 02	-7,5868684E 0	1 -1.1639709E 02

-9-3880231.E 01	· · · ·	ACCELERATION -3.0189842E-05 7.9442545E-05 7.5521260E-05	and communication and a support of the second
-4.0005352E 01	0.0	VELOCITY -3.2889231E-05 -2.6826200E-05 3.1297873E-06 4.2557515E-05	
-4.9585199£ 02	001 CENTER IS N	CENTER -1.5726025E-05 -2.3066424E-03 -1.1893555E-03 2.5952673E-03	
5.5244088E 02	DELTA T= 0.	SUN -7.0635256E-01 6.2887849E-01 2.7252460E-01 9.8422139E-01	Announced and a second and the annual second and the second second second second second second second second se
1.2777480E 03	PE TIME= 62219.829	TARGET 3.4350378E-06 -9.0146786E-06 -8.5805367E-06 1.2910830E-05	
-6.5900266E 02	TIME = 56.6816 TA	PCSIT FROM EARTH X -1.5726025E-05 Y -2.3066424E-03 Z -1.1893555E-03 R 2.5952673E-03	DESIRED TIME

•

•

eee* SENSITIVITY CUEFFICIENT MATRIX +++	-I.0381110E 03 -4.2560750E 02 3.9334734E 02 4.2962550E 01 7.8658144E 01	-6.2212117E 02 -2.7071956E 02 2.2997649E 02 4.0032420E 01 5.4184224E 01	-1.9562155E 01 -4.9520928E 01 9.8029618E 00 7.7624689E 00 7.5943601E 00	-2.5376743E 02 -9.1917830E 00 9.3727722E 01 -1.0683213E 01 3.1004267E 00	1.5002601E 03 5.7889857E 02 -5.5508782E 02 -7.5868684E 01 -1.1639709E 02	1.2777480E 03 5.5244088E 02 -4.9585199E 02 -4.0005352E 01 -9.3880231E 01	**** INVERSE MATRIX ****	-5.5508782E 02 -4.9585199E 02 -3.9334734E 02 -2.2997649E 02 -9.8029618E 00	-1.5868684E 01 -4.0005352E 01 -4.2962550E 01 -4.0032420E 01 -7.7624689E 00	-1.1639709E 02 -9.3880231E 01 -7.8658144E 01 -5.4184224E 01 -7.5943601E 00	6.4319358E 02 6.5900266E 02 4.8876414E 02 2.4357145E 02 -4.4820793E 00	-1.5002601E 03 -1.2777480E 03 -1.0381110E 03 -6.2212117E 02 -1.9562155E 01	-5.7889857E 02 -5.5244088E 02 -4.2560750E 02 -2.7071956E 02 -4.9520928E 01	
eee SENSITIVITY	-I.0381110E 03 -4.256075	-6.2212117E 02 -2.707195	-1.9562155E 01 -4.952092	-2.5376743E 02 -9.191783	1.5002601E 03 5.788985	1.2777480E 03 5.524408	**** INVERSE MATH	-5.5508782E 02 -4.958515	-7-5868684E 01 -4-000535	-1.1639709E 02 -9.388023	· 6.4319358E 02 6.590020	-1.5002601E 03 -1.277748	-5.7889857E 02 -5.524408	
	4.8876414E 02	2.4357145E 02	-4.4820793E 00	1.7085285E 02	-6.4319358E 02	-6.5900266E 02		9.372772E 01	-1.0683213E 01	3.1004267E 00	-1.7085285E 02	Z.5376743E 02	9.1917830E 00	

4.3.4 LISTING

This is the listing for Program III with the n-body calling sequences and the differential correction routine.

	FOULVALENCE(WM(1).XIM).(WM(2).YIM).(WM(3).ZIM).(WM(4).XIDM)	•
	1(WM(6),71CM), (WM(5), Y10M), (W(1), X1(), (W(2), Y1(), (W(3), Z1)	.
	2(W(6))/210(7)/(W(6))/(10(7)/(0))/(0)/(0)/(0)/(0)/(0)/(0)/(0)/(0)/(
	DAC DV/0.67) DV/0.671 D7/0.671 T1/671 DKW/4.61 DKI/4.61 NB/	51.
	$ \begin{array}{c} DAC P(A(S(C(T(S(C(T(S(C(S(C(S(C(S(C(S(C(S(C(S(C(S(S(C(S(S(C(S(S(S(S(S(S(S(S$	5).
	$\frac{1}{2001}$	
	200000 00000 200 500 500 500 500 500 500	,
	CUMMUN NEWUKG, ZEK, FMX, FLX, FMY, FLY, FMZ, FLZ, AM, AL, DM, DL, GM, GL, GH, GH, GL, GH, GH, GH, GH, GH, GH, GH, GH, GH, GH	TV MCM
	COMMON NURGENTARGENSUNENENNENNE I ULETAAS UIMAAS HAFUTENICEN	
	1XTARG, YTARG, ZTARG, SCEN, VCEN, SMAX, GMAX, EMAX, RAD1, RAD2, RADE, W	
	2NBE, NBT, NBS, RADORG, SAM, SBM, SCM, SAL, SBL, SLL, XIM, XIL, YIM, YIL,	21Mg
	3ZIL, XIDM, XIDL, YIDM, YIDL, ZIDM, ZIDL, RM, RL, RR, RU, SS, RRM, RRL, TE	4,1EL,
	4GMX, GLX, GMY, GLY, GMZ, GLZ, SUMX, SULX, SUMY, SULY, SUMZ, SULZ, FM, FL	;GM;GL;
	5HM, HL, RRR, SSS, XM, YM, ZM, A, BX, BY, BZ, WRM, WRL, RCM, RCL, ROM, ROL, R	PPM,
	6XPM, XPL, YPM, YPL, ZPM, ZPL,	·
	7KOB, VNZ, HEDT, MSDT, MDT, NOT, MET, NOUT, NCKE, TSAV, DTA, DTB, DTC, EP	1
	DAC G(2).WTS(2)	
	DAC SOGODD(6),XDOT(2),YDOT(2),ZDOT(2),WRONG(6),QX(2)	
	1,QY(2),QZ(2),XP(2),YP(2),ZP(2),XDOTP(2),YDOTP(2),ZDOTP(2),P	[[2].
	2PI2(2),F(2),XMJ(2),CCON(2),XN(2)	
	COMMON A1.A2.FJ1.FJ2.SFJ1.SFJ2.CFJ1.CFJ2.S1.S2.EPS1	
	COMMON DI-DIME-RPM	
	DAC SM(6) SI(6) XMJP(2)	
	COMMON OBJ. TSAVE. REA. RTA. RSN. HPI. THPI.KK. NOSW. POM(6) . POL(6)	- ERR
	CONMON PPA	
	COMMON DADAWI2.21. DADBI (2.3). DRDRM(3.3). RRDRI (3.3).	
	10C004/2 21 0C001 (2.21.00084/2.3).00081 (3.3)	
	$\frac{1}{1} \left(\frac{1}{1} \right) = \frac{1}{1} \left(\frac{1}{1} \right) = \frac{1}$	
	COMMON APLS(S); AVELA(S); NDA(10); AWIA(10); ANADA(10); NDET	
	$\frac{1}{2}$	
	DIMENSION IRARI(3 , 3), irdri(3 , 3)	
	MGM=512	
В	P1=202622077325	
. 8	P1(2)=14/042055061	
e Trans	P12=203622077325	
3	PI2(2)=150042055061	
В	HPI=201622077325	
8	THPI=203455457437	
	2 REWIND 26	
	RIT 2,3,KWC,KNOP,KNOPP,NOOFT	
	RIT 2,3, AK	
	RIT 2,3,G(2),WTE,RADE,WTV,OBJ	
	3 FORMAT(E9.5)	
	4 RIT 2,3, EMAX,GMAX,SMAX,TMAX,TO	
	5 RIT 2,3, NCKE, MSDT, MET, NOUT, NUSW	
	IF(MSDT)6,7,6	
	6 RIT2,3, DTA, DTB, DTC	
	ERASE DT	
	GO TO 8	
	7 RIT 2,3, CT, DTMAX, EP1	
<u> </u>	HAFDT=DT/2.	
	8 RIT 2.3. N.NEWORG, NTARG	
	RIT2.3.(NB(I),WT(I),RAD(I),I=I,N)	
	RIT 2.3. $(PM(1), I=1.6)$	
r	*****SAVE INITIAL CONDITIONS****	
~		

_....

	61	D0 601 I=1,6
	501	XYZO(I)=PM(I)
		VO=SQRTF(PM(4)+PM(4)+PM(5)+PM(5)+PM(6)+PM(6))
	-	DD = 604 I = 1.N
		JK=I
		IE (NEWORG-NB(1))604.612.604
	504	
	512	WW=WT(JK)
	<u> </u>	VESC=SORTE(2,+G(2)+WW/SORTE(PM(1)++2+PM(2)++2+PM(3)++2))
•		TEIKWC150.51.50
	50	
	50	
	,	
		AWIA(1) = WI(1)
		AKAUA(1)=KAU(1)
	~	
		ANAUANNII/-NAUE CDACE DADDM DADDI DODDM DODDI DÉDDM.DEDDI DODDI DODDI
		DO 24 I+1 2
		$DADDM(T T) + 1 \Delta$
<u> </u>		RARDH(1)1/-1.0
	24	
	51	
	71	
		Grand (2)
		$ERASE_{NOI} \cap NORG_{PL} SL(4) SL(5) SL(6)$
	11	CALL ORGN
	•••	KK=67
		NRT=NRT
		IF(TEM)12.2.12
	12	CALL NBOCY
		IF(ERR)55.2.55 = test GAL MEACT
	55	IF(KWC)52,53,52
	52	CONTINUE
C		SET UP INVERSE MATRIX
		DO 60 I=1.3
		DO 59 J=1,3
		TRARI(I,J)=RDRBM(J,I)
		TRBRI(I,J)=-RBRBM(J,I)
		TRCRI(I,J)=-RCRBM(J,I)
-		TRDRI(I,J)=RARBN(J,I)
	59	CONTINUE
-	60	CONTINUE
	_	WOT 10,230
	<u></u>	WOT 10,231, (RARBM(1,1),1=1,3), (RBRBM(1,J),J=1,3)
		WOT 10,231, (RARBM(2,1), I=1,3), (RBRBM(2, J), J=1,3)
	_	WOT 10,231, (RARBM(3,1),1=1,3), (RBRBM(3,J),J=1,3)

•

~

		WOT 10,231,(RCRBM(1,I),I=1,3),(RDRBM(1,J),J=1,3)	
		WOT 10,231, (RCRBM(2,1),1=1,3), (RDRBM(2,J),J=1,3)	
		WOT 10.231.(RCRBM(3.I).I=1.3).(RDRBM(3.J).J=1.3)	
		WOT 10.232	
		WOT $10,231,(TRARI(1,1),1=1,3),(TRBRI(1,1),1=1,3)$	
		WOT 10,231,(TPAPI/2,1),(z),(z),(TPRPI/2,1),(z),(z),(z),(z),(z),(z),(z),(z),(z),(z	
		$WOT = 10_{2}21_{1}(TRACT(2_{1})_{1}(-1_{1})_{1}(TROCT(2_{1})_{1}(-1_{1}))$	
		$\frac{101}{102} \frac{102}{102} \frac{1000}{100} 100$	
		NUT 10 221 / TOCO //2 IV /-1 2V / TOCO //2 IV /-1 2V	
		$\frac{WU1}{10} \frac{10}{21} \frac{11}{1000} \frac{11}{10} \frac$	
		WUI 10;231;((KUK1(3;1);(*1;3);(1KUK1(3;J);J*1;3) CONTINUE	
	_ 53		
C		***** DIFFERENTIAL CORRECTIONS#####	
		NR=3	
		NC=4	
		REWIND 26	
		FGH(1,4)=-XTARG	
		FGH(2,4)=-YTARG	
		FGH(3+4)=-ZTARG	
_		DO 600 I=1,3	
		DO 600 J=1,3	
	600	FGH(I,J)=RBRBM(I,J)	
		CALL MATINV(FGH,NR,NC)	
		DO 602 J=1,3	
	602	PM(J)=XYZO(J)	
		DD 603 J=4,6	
 ,	603	PM(J) = XYZO(J) + FGH(J - 3, 4)	
С		**** TEST CHANGE IN VELOCITY *****	
		V1=SQRTF(PM(4).##2+PM(5)##2+PM(6)##2)	
		DV1=SQRTF(FGH(1,4)**2+FGH(2,4)**2+FGH(3,4)**2)	
		IF(V1-VESC)606,606,605	
	605	IF(ABSF(DV1)-AK+V0)61,607,607	
	607	DVIP=AK+V0	
		J=1	
	609	CONST=DV1P/DV1	
	•••	DXP = CONST = EGH(1.4)	
		DYP=CDNSI+FGH(2,4)	
		D7P = CONST + EGH(3, 4)	
		PM(5)=XY70(5)+BYP	
		PN/61=XY7//61+170	
		V1=\$00TF/DM/41++2+DM/51++2+DM/61++21	
		CO TO (6)C.611.1	
	610	TE/V1_VECC14A0 4A0 41	
	2010		
	000	917-10003*9C3C 9-3 afyy20161-0y6yy20151-0y4yy20161-0711041	
		C=V0+V0-V1F+V1F CV10-(-V-SODTE(D=D=4 =C))/2	
		DVIP=(-D-34KIF(D+D-4++C///2+	
		J≖Z CO TO 400	
	606	IF (ABSF(UVI) AR # VU) OU / OUD + OUD	
	230	TUKMAILINI, 52X, 40M#### SENSIIIVIIT LUEFFILIENI MAIKIX	****)
	231	FUKMAILING, 1POE19.77	
	232	FURMAITIHO, 32X, 29H++++ INVERSE MATRIX ++++)	
		END(1+1+0+0+0+1+1+0+1+0+0+0+0+0+0+0)	

5. REFERENCES

- "Generalized Interplanetary Trajectory Study," by J. P. deVries, coordinator, General Electric, Technical Information Series R60SD465, Class III, August 1960. (Air Force Contract AF 33(616)-6296, Project 1431, Task 14014.)
- 2. "Generalized Interplanetary Trajectory Study, Part II and Supplement I," by J. P. deVries, coordinator. General Electric, Technical Information Series R61SD047, Class III, January 1961. (Air Force Contract AF 33(616)-6296, Project 1431, Task 14014.)

Bldg. 5, Rm. 363 l River Road Schenectady, N.Y. GE Tempo Library (2) 735 State Street Santa Barbara, Calif. GE Electronics Park Library Bldg. 3, Rm. 143 Syracuse, N.Y. Attn: Catherine Lukens, Librarian GE Small Aircraft Engine Dept. Bldg. 2-40M 1000 Western Ave. West Lynn 3, Mass. Attn: Dr. C.W. Smith, Library GE Technical Library Military Communications Dept. Bldg. 2-6 P.O. Box 129 Oklahoma City, Oklahoma Attn: June B. Sitterly, Librarian Space Technology Center Valley Forge M9551 L. Steg F. Wendt M9543 A. Zizmont M7047C T. Coffin M7023E D. Delpo U3035 M2626 F. Nicholson J. deVries (30) M7047E M2626 J. Weinstein G. Rawlings U3113 U3113 D. Stephenson M7035 A. Harrison (2) M9114 S. Voltz L. Chasen (10 & tissue) L1343 Bldg. #5 W. Pauson Bldg. #5 H. Lieske CCF #6

G. Ellis

K. Reside

GE Tech. Data Center (2 & 6 TIS pages)

CCF #6



SPACE SCIENCES LABORATORY MISSILE AND SPACE DIVISION

TECHNICAL INFORMATION SERIES NO. AUTHOR SUBJECT CLASSIFICATION R64SD7 J.P. deVries Space Mechanics DATE T. Coffin January 1964 G. E. CLASS TITLE THREE COMPUTER PROGRAMS FOR Ħ N-BODY TRAJECTORIES AND INTER-GOV. CLASS PLANETARY TRAJECTORIES None REPRODUCIBLE COPY FILED AT MSD LIBRARY. NO. PAGES DOCUMENTS LIBRARY UNIT. 84 VALLEY FORGE SPACE TECHNOLOGY CENTER, KING OF PRUSSIA, PA.

VALLEY FORGE SPACE TECHNOLOGY CENTER, KING OF PRUSSIA, PA. 84 SUMMARY This report contains complete input instructions, operating instructions and sample problems with com-

puter output for three IBM-7094 Computer Programs. The Programs and their essential features are:

- II) N-Body Trajectory Program.
- III) N-Body Program with Sensitivity Coefficients and Differential Correction.

A full description of Program I is available in reference 1 and 2. This report presents an outline of the pertinent sections of those references, to facilitate their use. Full descriptions and analyses are presented for those features that distinguish Programs II and III from Program I.

KEY WORDS

N-Body Program, interplanetary trajectories, differential correction, sensitivity coefficients

BY CUTTING OUT THIS RECTANGLE AND FOLDING ON THE CENTER LINE, THE ABOVE INFORMATION CAN BE FITTED INTO A STANDARD CARD FILE

trolling her Wendt AUTHOR COUNTERSIGNED