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NUROC3A Volume 3

Parameter Study of Dual-Mode Space Nuclear Fission Solid Core Power and Propulsion Systems

AMS Report No. 1239c

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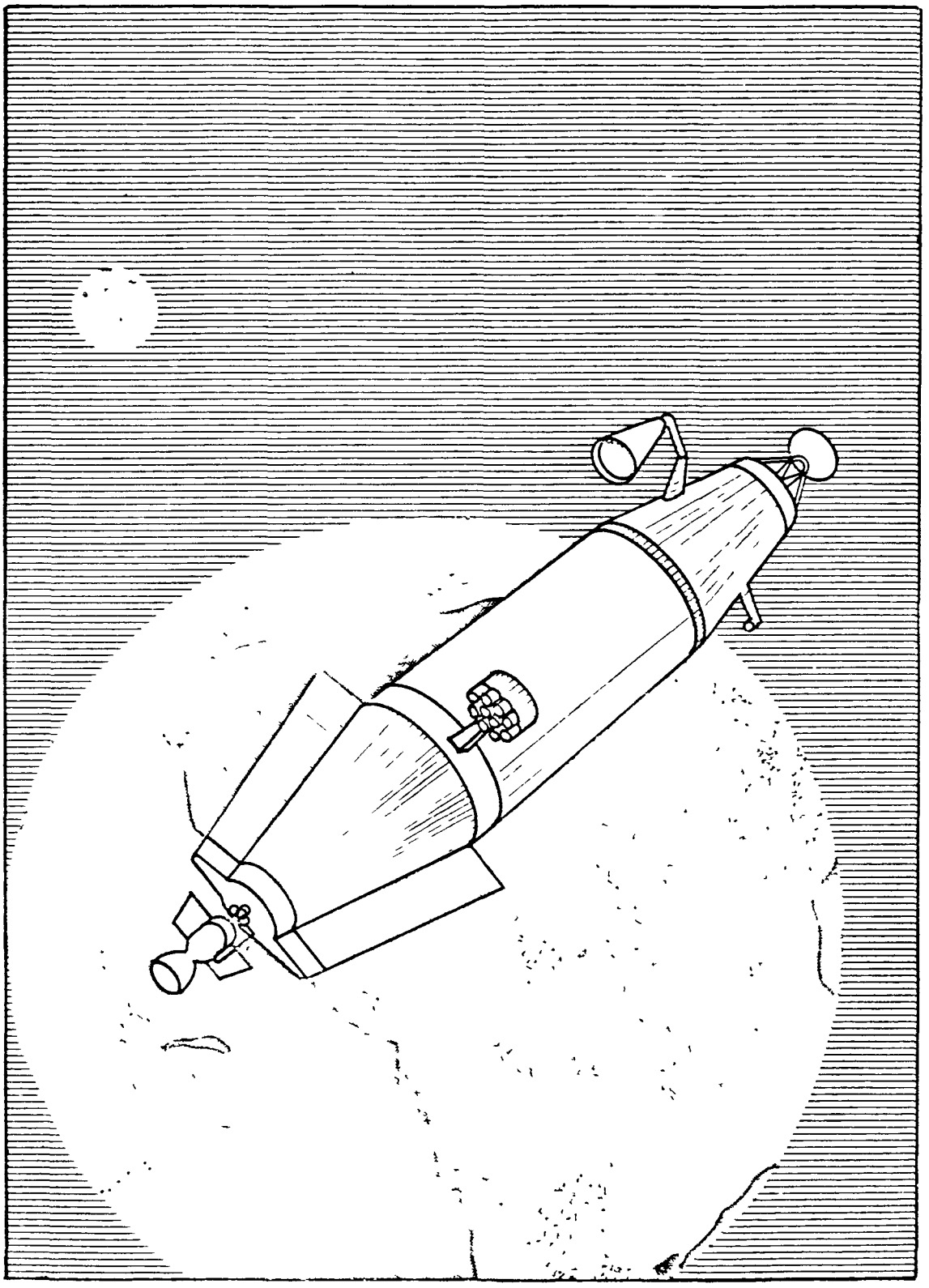

FRONTISPIECE Advanced Spacecraft Propelled by a Dual-Mode, Space Nuclear Fission Solid Core Power and Propulsion System in Geocentric Orbit

ABSTRACT

The NUROC3A systems analysis code was designed to provide the user with performance characteristics of the dual-mode space nuclear fission solid core power and propulsion systems. This report describes utilization of the NUROC3A code to produce a detailed parameter study of the dual mode system.

The parameter study defines performance characteristics over a wide range of input geometries and statepoints. A sensitivity study was also developed to achieve better understanding of the NUROC3A code characteristics. The performance characteristics generated in these studies are sufficiently interesting to warrant further analysis of the dual-mode propulsion/power concept, particularly in the areas of mission analysis and improved system characterization.

The mathematical model developed in NUROC3A Volume 1 (Reference 1) was the basis for the NUROC3A code presented in NUROC3A Volume 2 (Reference 2). The analysis and presentation of the characteristics of NUROC3A appear in this volume.

It is important to note that this study, by intention, does not incorporate any design analyses, but rather constitutes only a first-order conceptual approach to advanced solid-core nuclear fission dual-mode systems. It should not, therefore, be construed as representing an optimum or even a practicable system, and it is expected to undergo major revisions in both its analytical and numerical characteristics as a result of future efforts.

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I. INTRODUCTION

This report describes the sensitivity and parameter studies conducted with the systems analysis code NUROC3A, including a detailed output of the reference engine used, graphic results of the sensitivity study, a discussion and table listing of the parameter study and associated output, sorted lists of the usuable engines from the parameter study and detailed outputs for certain selected engine configurations derived from the sorted lists. Although preliminary conclusions are drawn from these data, it should be noted that the parameter study was designed to give only a general exercise of the NUROC3A code and specific conclusions should be the result of further analysis.

II. REFERENCE ENGINE

The concept of a solid core nuclear rocket was initially of interest as a method of extending the performance capabilities beyond those of chemical rockets. If the primary advantage of this system (effective jet velocities of up to 10,000 m/sec) can be supplemented by an engine designed not only for propulsion, but also electric power generation, then mission capabilities are substantially enhanced. This dual-mode nuclear power and propulsion system is the focus of AMS Reports 1239a-c (NUROC3A, Vols. 1-3).

Figure 1 shows the system configuration which uses dynamic power conversion (either noble-gas Brayton of liquid-metal Rankine) cycles. Each of the subsystems shown in this figure is described in detail in the mathematical model presented in NUROC3A Volume 1 (Reference 1).

Table 1 is a detailed output for the reference engine used in both the sensitivity and parameter studies, using data presently stored in NUROC3A. The engine that most closely approximates the reference engine is Number 122 in the parameter study, although because of certain rounding and convergence differences inherent in the single-precision NUROC3A code, there are a few slight differences in output between the detailed output list of Table 1 and the characteristics listed in Tables 2 and 3.

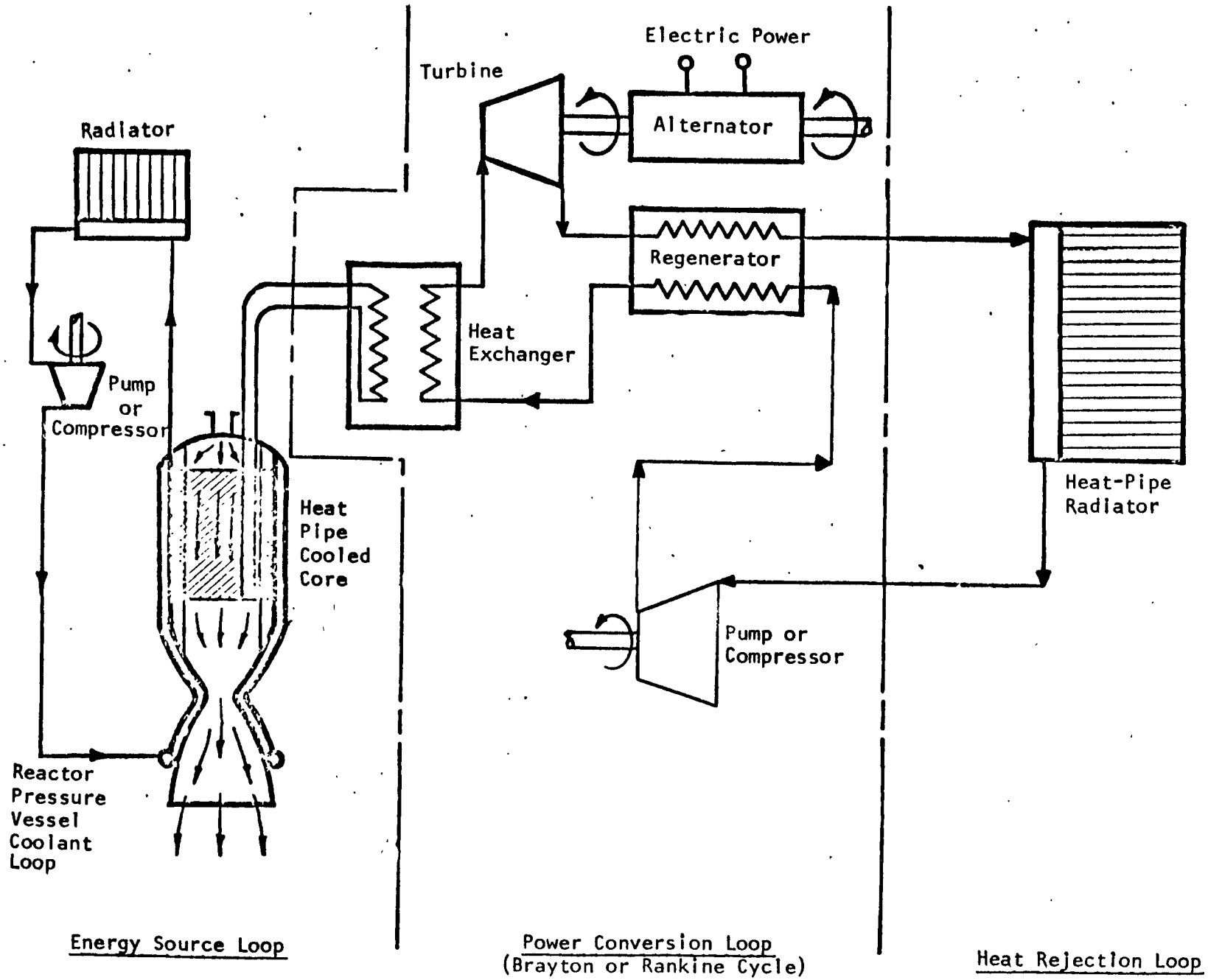

Figure 1 Dual-Mode Solid-Core Nuclear Power/Propulsion Concept Utilizing a Brayton or Rankine Cycle

Table 1

Detailed Output for the Reference Engine

LIST OF INPUT PARAMETERS

REACTOR CORE PARAMETERS AND CONSTRAINTS

AR	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMENSION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLRC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.29919
RI	REFLECTOR THICKNESS, M	0.14696
ZNPn	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCFF	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID, W1/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VHFLT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

Table 1 (continued)

Reference Engine Number 122

LIST OF INPUT PARAMETERS

NOZZLE AND PROPULSIVE PARAMETERS

ANC	NOZZLE COOLING JACKET AREA, M**2	0.50000
ANCZ	NOZZLE SURFACE AREA, M**2	0.70000
APATIO	NOZZLE EXIT TO THROAT AREA RATIO	200.00000
ETAN	NOZZLE EFFICIENCY	0.97000

TEMPERATURE AND PRESSURE CONSTRAINTS AND PARAMETERS

PC	STAGNATION PRESSURE IN CHAMBER, N/CM**2	300.00000
PTNK	PRESSURE IN PROPELLANT TANK, N/CM**2	13.80000
TC	TOTAL CORE EXIT TEMPERATURE, K	3000.00000
TMMAX	MAXIMUM PERMISSIBLE CORE MATERIAL TEMPERATURE, K	3600.00000
TWMAX	MAXIMUM PERMISSIBLE COOLING CHANNEL WALL TEMPERATURE, K	3500.00000
ZMNCJ	MACH NUMBER IN CONDUIT	0.65000

PRESSURE SHELL PARAMETERS

DMPS	PRESSURE SHELL COOLANT MASS FLOW, KG/SEC	0.30000
TPST	TEMPERATURE OF COOLANT ENTERING PRESSURE SHELL, K	200.00000
TRT	TEMPERATURE OF PRESSURE SHELL WALL, K	800.00000

MISSION DESCRIPTION

MSNAME	DESTINATION	MARS
IOPF	MISSION	AN ORBITER
TIMM	TRIP TIME, DAYS	125.00000
TIMP	POWERED TIME AT DESTINATION, S	0.0
ITM	RATIO OF THRUSTING TIME TO MISSION DURATION	0.0
CQ	RATIO OF REACTOR POWER DURING COAST PHASE TO FULL POWER	0.10000
PQ	RATIO OF REACTOR POWER AT PLANET TO FULL POWER	1.00000

Table 1 (continued)

Reference Engine Number 122

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.37528
DM	MASS FLOW, HYDROGEN, KG/S	5.16805
F	THRUST, KILONEWTONS	47.64653
FLXMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	33.53175
QC	CORE POWER REMOVED BY COOLANT, MWT	236.45651
QHP	HEAT PIPE POWER, MWT	3.54332
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.42462
QR	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	9348.94531
VJE	EFFECTIVE JET VELOCITY , M/SEC	9219.43750
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	0.50000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	1.85192
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.10862
QRPM	TOTAL REACTOR POWER IN POWER MODE, MWT	1.96054
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.26999

Table 1 (continued)

Reference Engine Number 122

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	2888.05103
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	234.92847
TSI	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	234.92847
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	117.99071
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	28.71201
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	339.51123
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	3158.91846
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	3205.46753
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	333.64380
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	359.67188
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	395.00635
DELPC	CORE PRESSURE DROP, N/CM**2	33.64389
DELPSF	SIDE REFLECTOR PRESSURE DROP, N/CM**2	26.02818
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	35.33440
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	221.70883
TPSR	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMPMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	2051.22925

Table 1 (continued)

Reference Engine Number 122

PROPULSION AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	373.997	357.706	2005.051
0.053	504.157	476.063	2011.586
0.089	650.685	611.203	2017.892
0.124	811.418	761.131	2023.875
0.160	983.987	923.636	2029.448
0.196	1165.845	1096.321	2034.527
0.231	1354.311	1276.638	2039.039
0.267	1546.603	1461.928	2042.916
0.302	1739.884	1649.456	2046.102
0.338	1931.307	1836.460	2048.549
0.373	2118.046	2020.178	2050.222
0.409	2297.346	2197.901	2051.095
0.444	2466.563	2367.009	2051.156
0.480	2623.200	2525.005	2050.403
0.516	2764.947	2669.558	2048.849
0.551	2889.714	2798.540	2046.515
0.587	2995.660	2910.044	2043.437
0.622	3081.219	3002.426	2039.660
0.658	3145.135	3074.326	2035.239
0.693	3186.462	3124.681	2030.239
0.729	3204.590	3152.750	2024.735
0.765	3199.254	3158.118	2018.808
0.800	3170.528	3140.704	2012.544
0.836	3118.839	3100.767	2006.037
0.871	3044.950	3038.895	1999.383

Table 1 (continued)

Reference Engine Number 122

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	9.46820
ZMPFS2	PUMP MATERIAL MASS, KG	4.32779
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	13.79598
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.53041
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	63.07385
ZMN	TOTAL NOZZLE MASS, KG	249.92767
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	147.25154
ZMVA	VALVES AND ACTUATORS MASS, KG	98.50711
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	56.04535
ZMSP	SUPPORT PLATE MASS, KG	102.04555
ZMM	INSULATION AND DUCTING MASS, KG	45.44746
ZMRO	OTHER HARDWARE MASS, KG	147.49301
ZMRP	PERIPHERAL STRUCTURE MASS, KG	115.06822
ZMCFE	FUEL ELEMENT MASS, KG	639.66162
ZMCS	CORE STRUCTURE MASS, KG	443.75635
ZMSRS	SIDE REFLECTOR MASS, KG	508.19897
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	274.16895
ZMPV	PRESSURE VESSEL MASS, KG	108.94572
ZMR	TOTAL REACTOR MASS, KG	2237.29248
ZMENG	ENGINE MASS, KG	2802.82007
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	9.46820
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.40895
ZMPSCR	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	34.89078
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	46.76791
ZMES	ENGINE SYSTEM MASS, KG	2849.58789
PCSM	POWER CONVERSION SYSTEM MASS, KG	995.19897
WPSUM	TOTAL RADIATOR MASS, KG	3968.37549
ZMTOT	TOTAL SYSTEM MASS, KG	7813.16016

Table 1 (continued)

Reference Engine Number 122

POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	0.50000
QHPPM	HEAT PIPE POWER, MWT	1.85192
X	TEMPERATURE RATIO	0.33000
TB1	COMPRESSOR INLET TEMPERATURE, K	468.59985
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	627.18408
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	1079.75977
TSUBM	TURBINE INLET TEMPERATURE, K	1420.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1169.59912
TB6P	RADIATOR INLET TEMPERATURE, K	654.30469
ETAS	SYSTEM EFFICIENCY	0.26999
ETACY	CYCLE EFFICIENCY	0.33087

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

PSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	1.23917
TBES(1)	MEAN TEMPERATURE, K	536.31079
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	551.37183
WRI(1)	MASS, KG	2876.51196

AUXILIARY RADIATOR

PSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.10147
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	209.28912
WRI(2)	MASS, KG	1091.86353

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	760.66089
WRSUM	TOTAL RADIATOR MASS, KG	3968.37549
PCSM	POWER CONVERSION SYSTEM MASS, KG	995.19897

Table 1 (continued)

Reference Engine Number 122

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	9.92715
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	15.62632
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00004

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	16.72049
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	6.09824

III. SENSITIVITY STUDY

To identify the most significant input variables for the NUROC3A parameter study and their proper ranges, five input parameters were selected and deviations from their reference engine values were fed into the NUROC3A computer code. Only one parameter was changed at a time; that is, no engine contained more than one deviated parameter. All other parameters were those of the reference engine.

Table 2 shows the selected input variables, their reference values, the points used in the sensitivity study, and the output variables along with their reference engine values. Figures 2 through 9 show the results of the sensitivity study, indicating the deviations in output parameters resulting from a given deviation in the selected input parameter. The point (0,0) represents the reference engine case in each of the figures.

Table 2

List of Inputs and Outputs used in NUROC3A Sensitivity Study

Inputs to Sensitivity Study

Input Variable	Reference Value	% Points Used
Electric Power (QE), MWe	0.5	±50, ±25, ±20, ±15, ±10, ±5
Turbine Inlet Temperature (TSUBM), K	1420	±15, ±10, ±5, ±2.5
Power Conversion System Temperature Ratio (X)	0.33	±25, ±20, ±15, ±10, ±5
Core Power Density (QD), MWt/m^3	1000	±50, ±25, ±20, ±15, ±10, ±5
Chamber Temperature (TC), K	3000	±15, ±10, ±5

Outputs of Sensitivity Study

Output Variable	Reference Value
Total System Mass (ZMTOT), kg	7814.09
Thrust (F), kN	47.63
Effective Jet Velocity (VJE), m/s	9221.0
Specific Mass Power Generator System (SPMGEN), kg/kWe	9.93
Specific Thrust, Total System (SPTMT), N/kg	6.10
Specific Mass Total System (SPMMT), kg/kWe	17.16

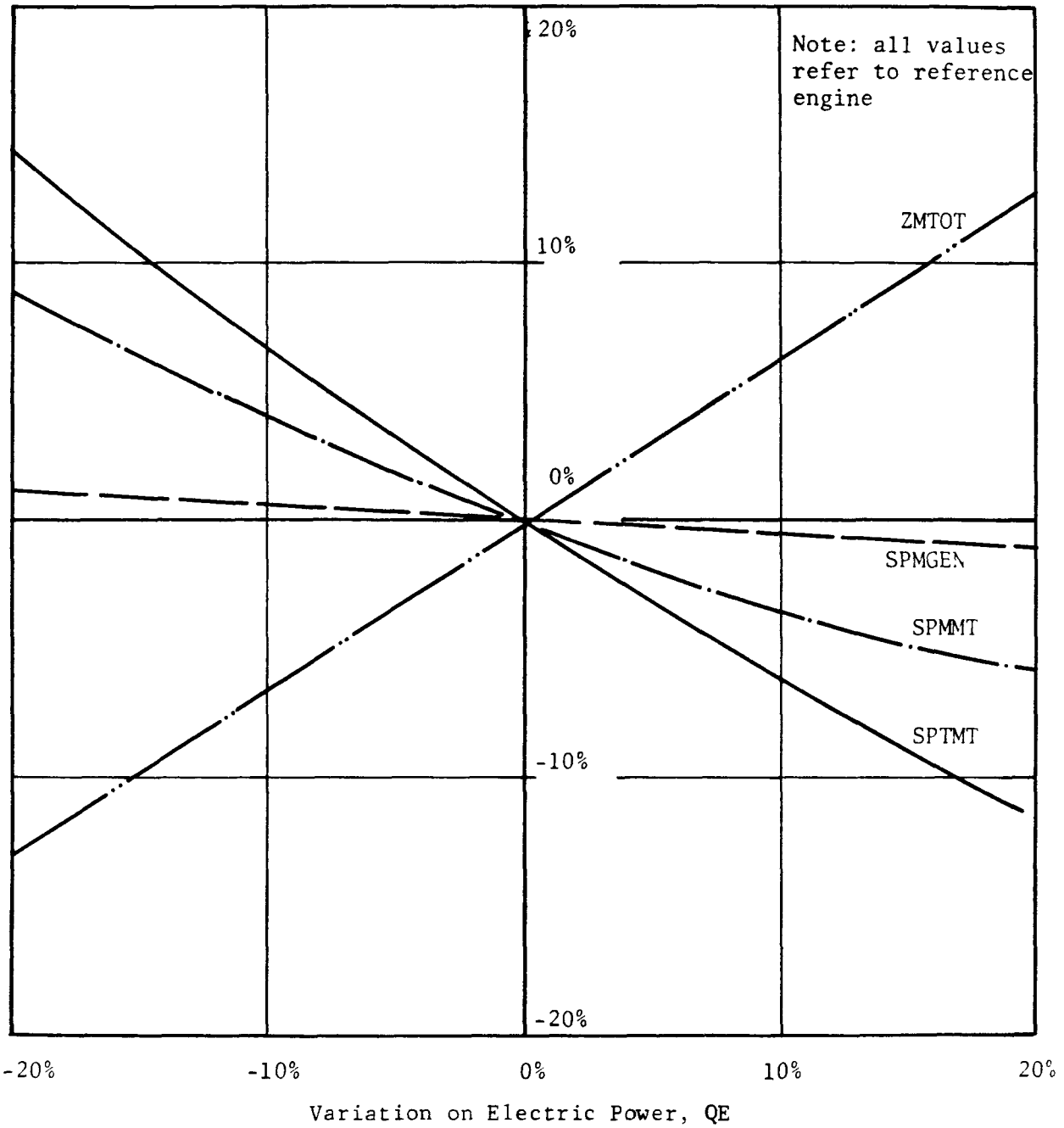

Figure 2 Sensitivity of NUROC3A Code to 20% Deviations of Electric Power

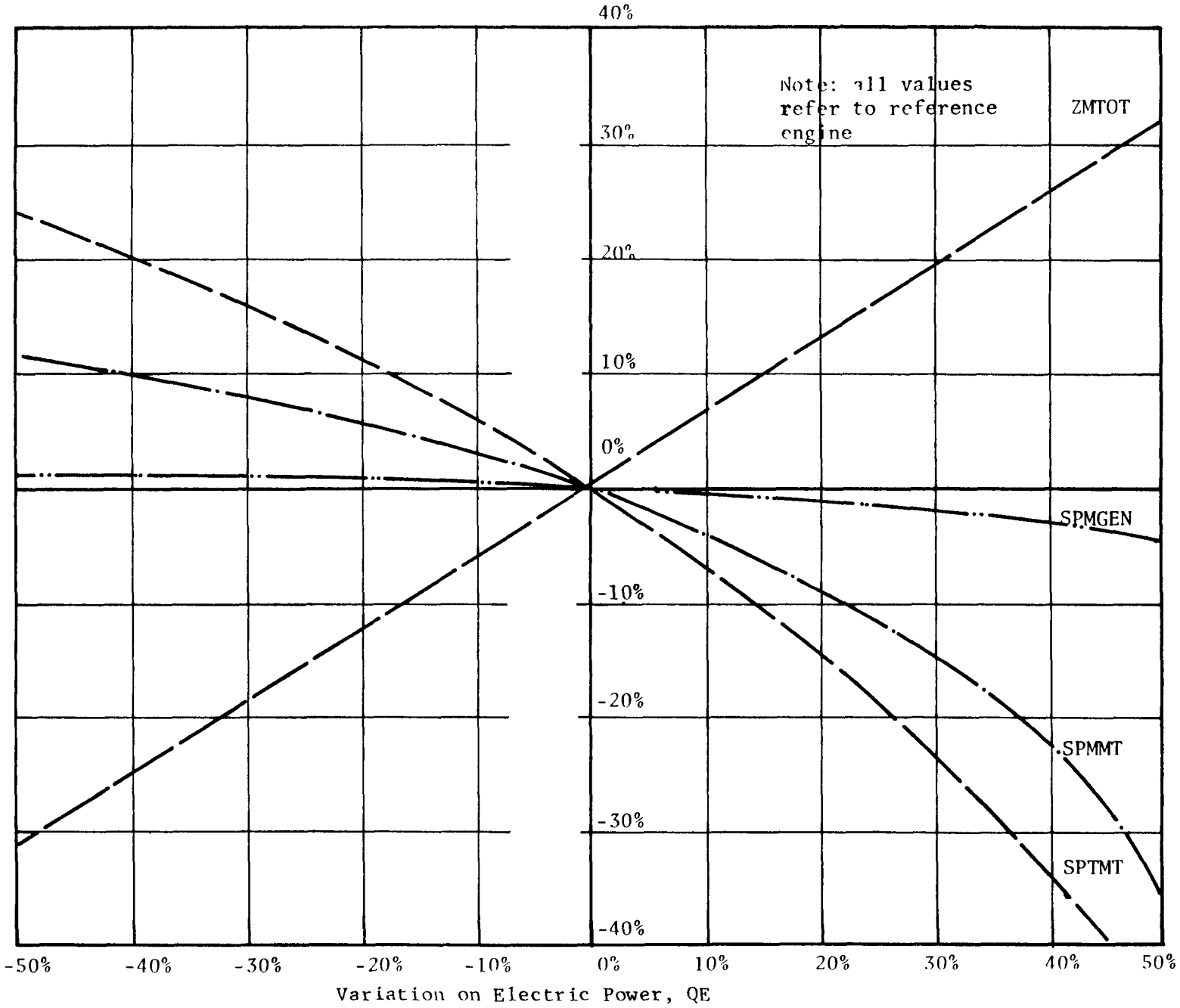

Figure 3 Sensitivity of NUROC3A Code to 50% Deviations on Electric Power

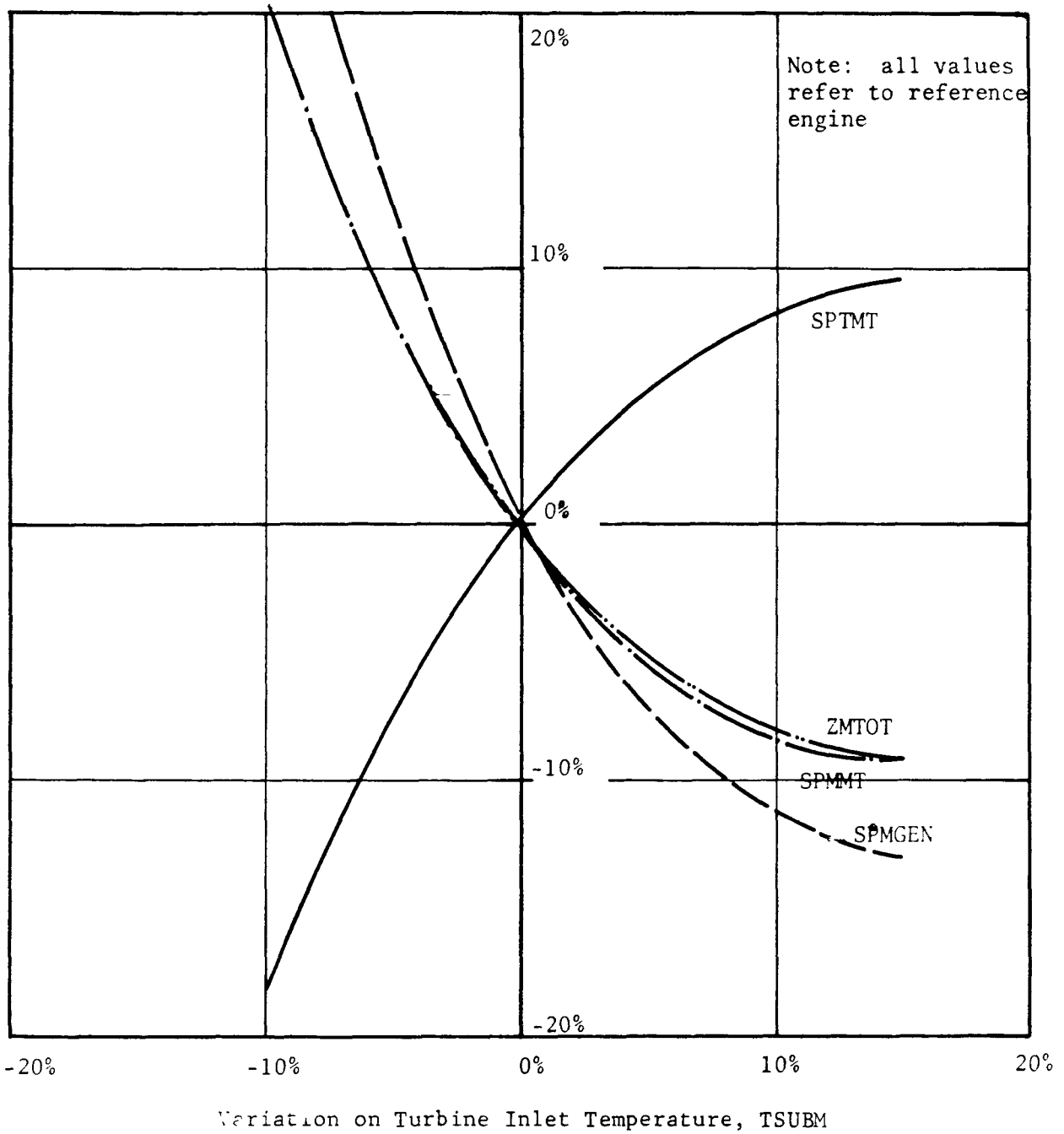

Figure 4 Sensitivity of NUROC3A Code to 20% Deviations of Turbine Inlet Temperature

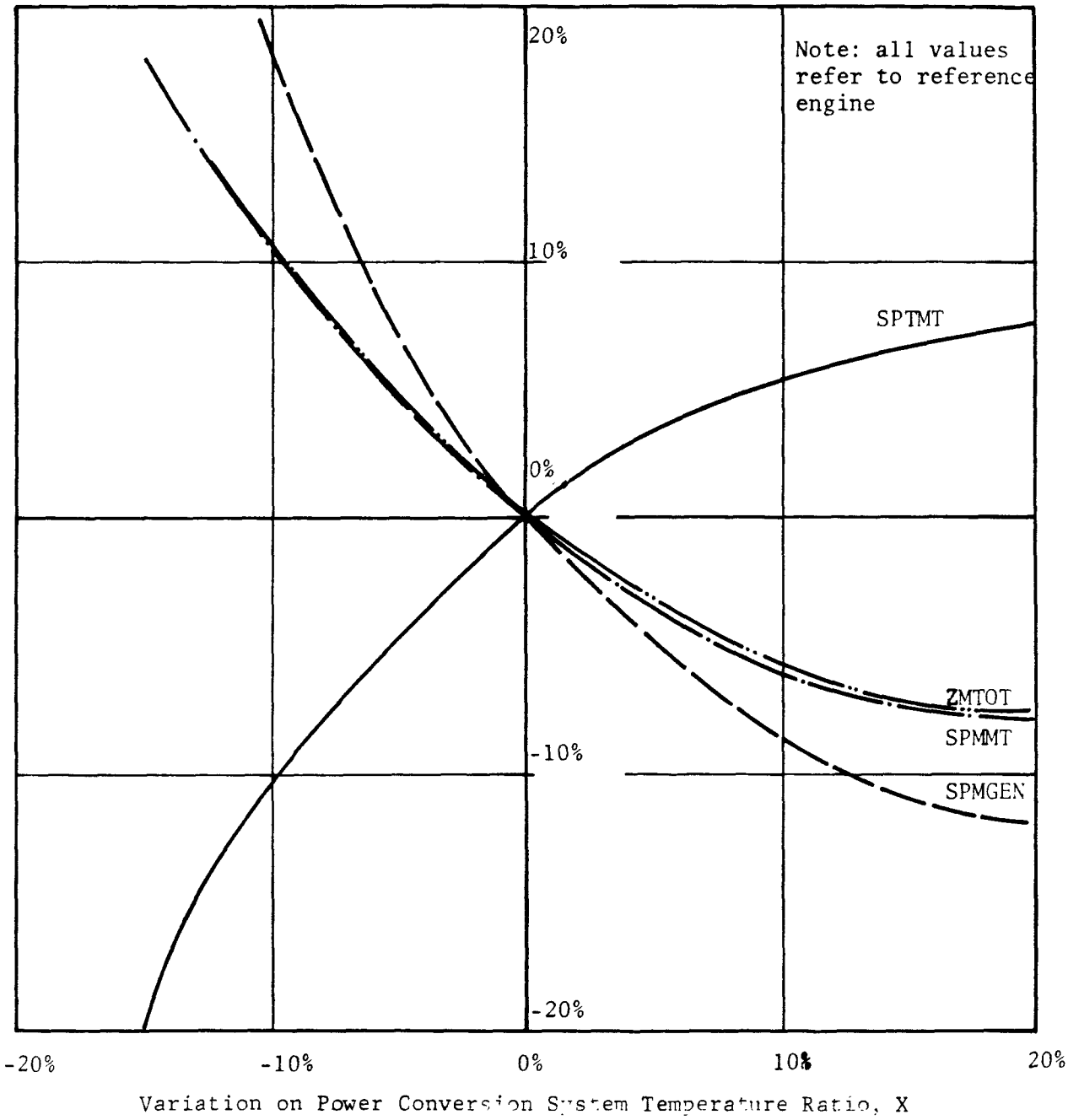

Figure 5 Sensitivity of NUROC3A Code to 20% Deviations of the Power Conversion System Temperature Ratio

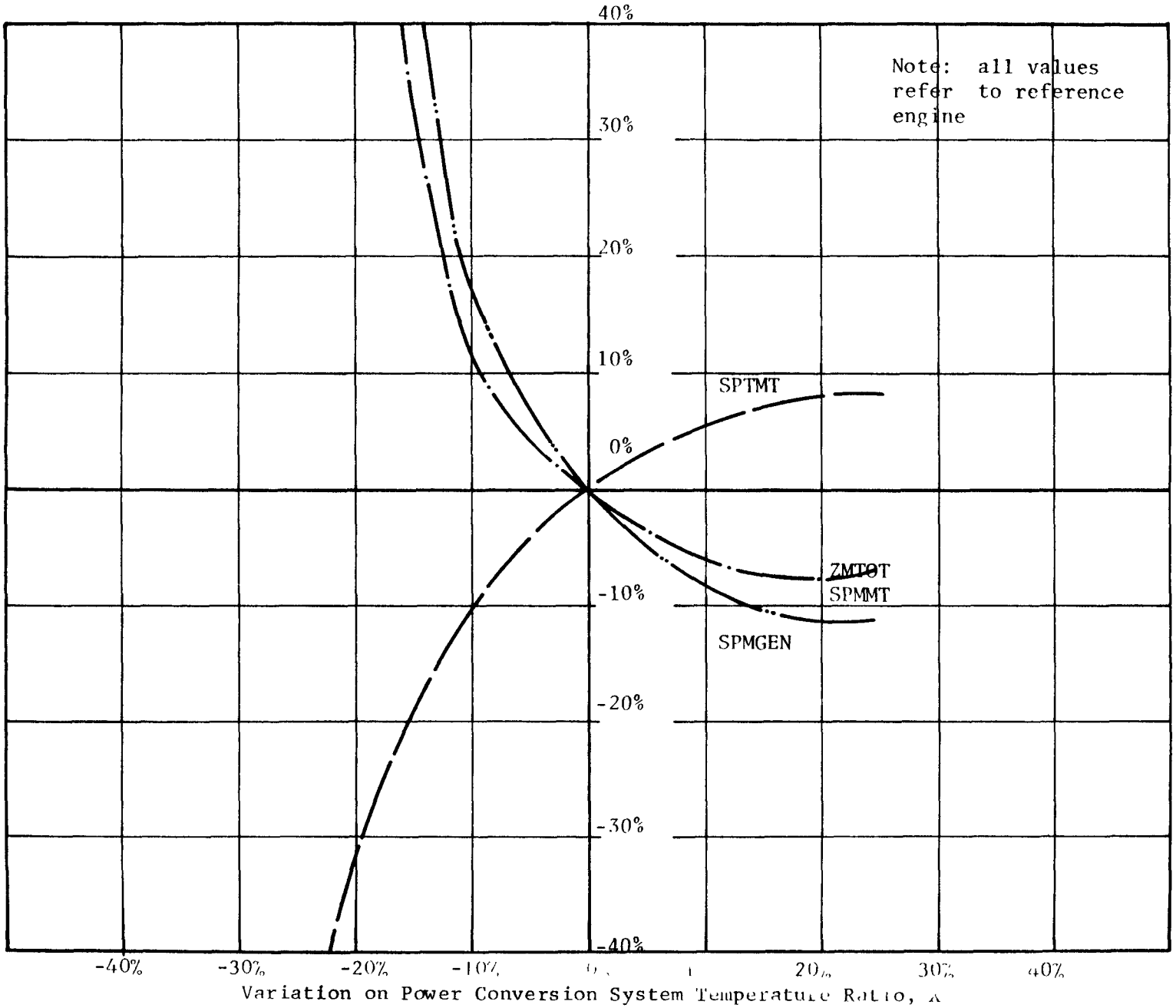

Figure 6 Sensitivity of NUROC3A Code to 50% Deviations of the Power Conversion System Temperature Ratio

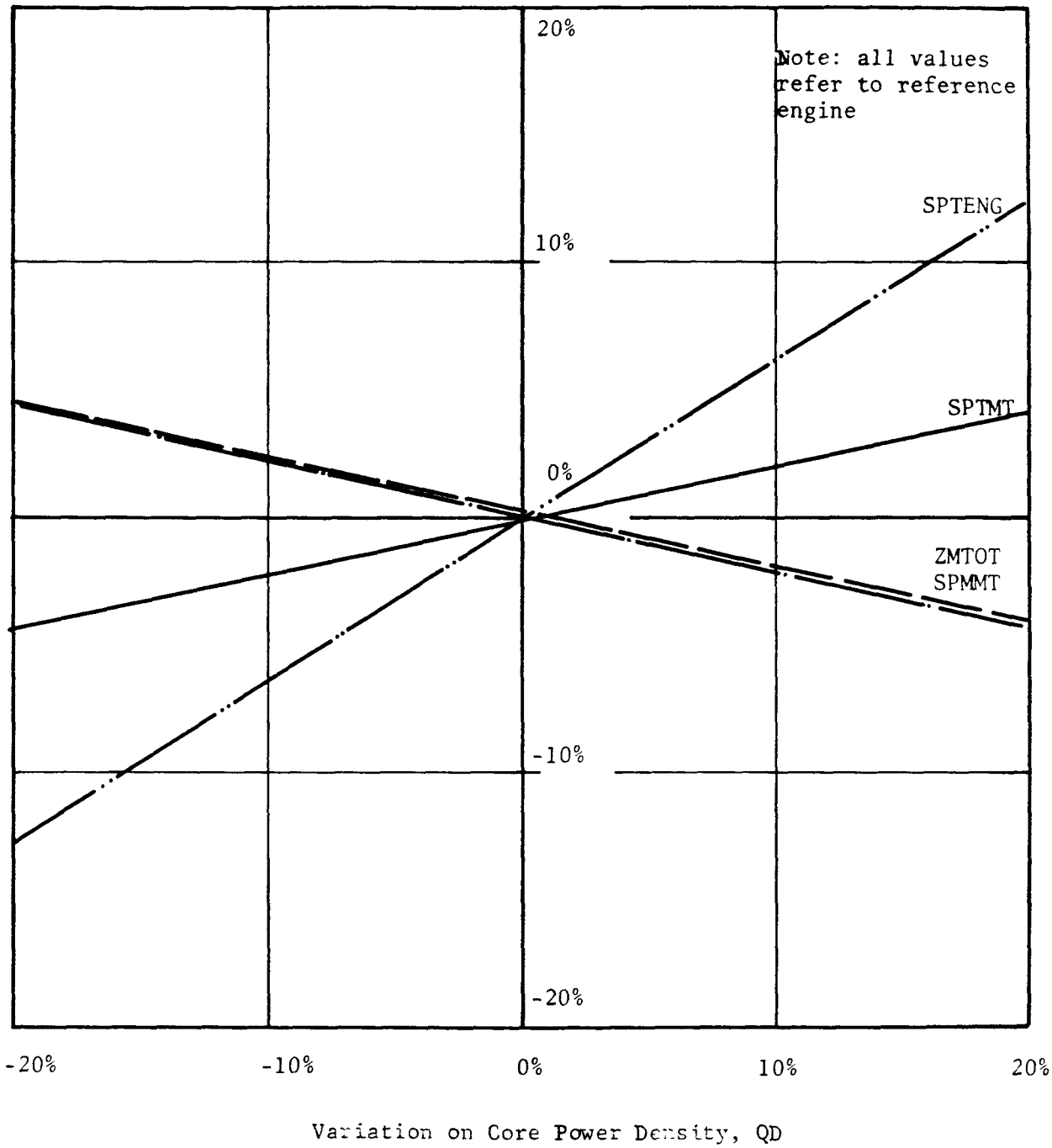

Figure 7 Sensitivity of NUROC3A Code to 20% Deviations of the Core Power Density

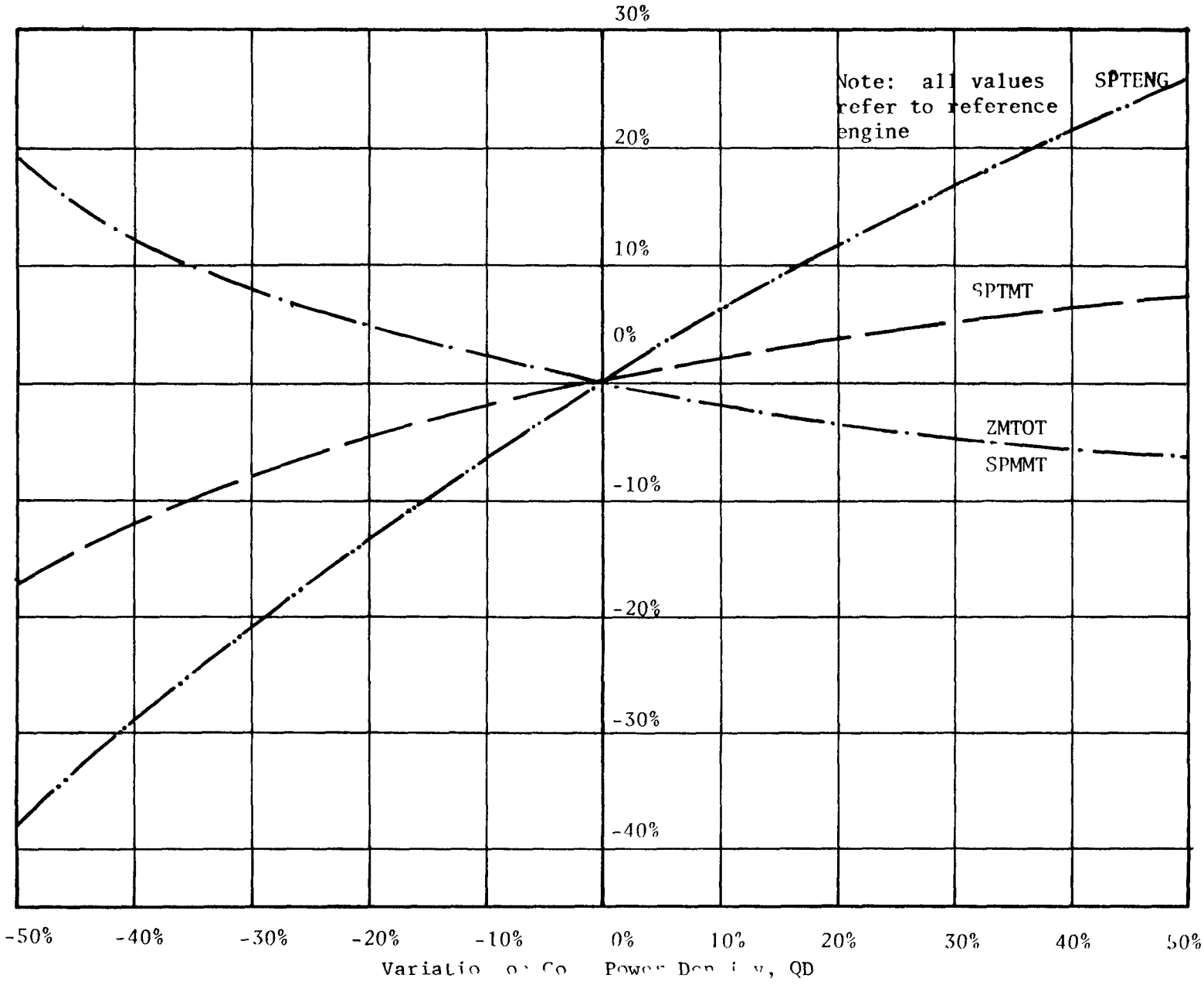

Figure 8 Sensitivity of NUROC3A Code to 50% Deviations of the Core Power Density

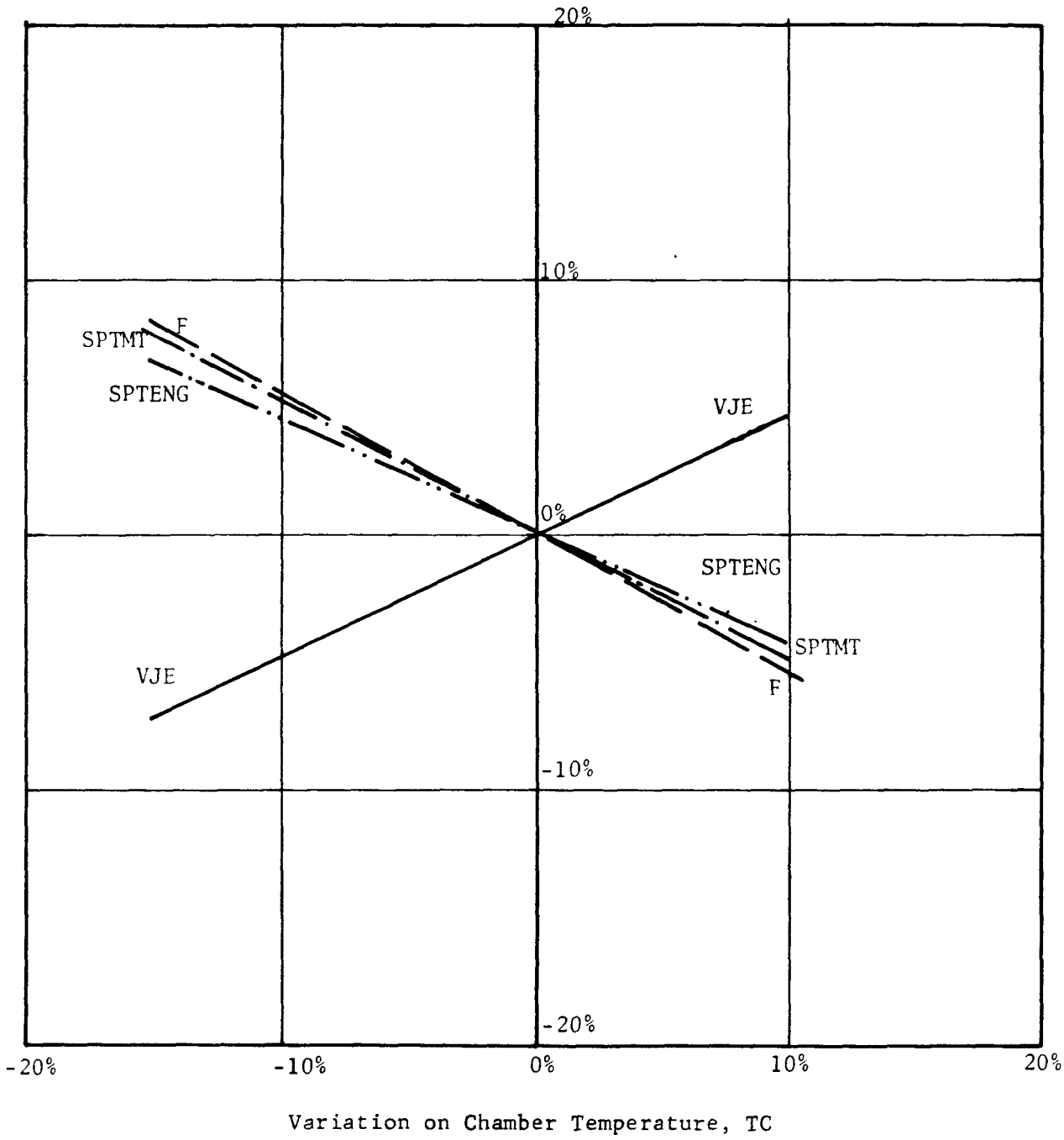

Figure 9 Sensitivity of NUROC3A Code to 20% Deviations of Chamber Temperature

IV. PARAMETER STUDY

A. Introduction

To examine the effect of input parameter variations on engine performance, this study expands upon the sensitivity study, again utilizing the reference engine (as of 7/10/76), by considering variations of the input parameters as shown in Table 3.

Table 3

Variations on Input Parameters Used in the Parameter Study

Input Parameter	Variation	Reference Value
Electric Power (QE), MWe	0.1, 0.5, 1.0	0.5
Turbine Inlet Temperature (TSUBM), K	1300, 1420, 1600	1420
Power Conversion Temperature Ratio (X)	0.25, 0.33, 0.50	0.33
Core Power Density* (QD), MWt/M^3	500, 1000, 1500	1000
Chamber Temperature (TC), K	2700, 3000, 3300	3000

The parameter study incorporates all possible combinations of the input parameters in Table 3. Each combination is assigned a unique number, so that one may identify a given design by simply citing or referring to its engine number. A complete list of engines and their input parameters appears in the serial list of APPENDIX B.

B. Associated Computer Codes

To facilitate the presentation of output parameters for the 243 engine designs, two separate special-purpose programs were introduced,

*Note that as indicated in the flow chart of NUROC3A in AMS Report 1239b (Reference 2), the reactor radius (RC) is computed directly from the core power density (QD).

FRNTEND and PSORT. These programs are very specific in nature, and are included for the sole purpose of documenting exactly how the parameter study was run. Listings of the programs are found in APPENDIX A.

The purpose of the program FRNTEND was to create the large number of namelist inputs for the NUROC3A code necessary to analyze the 243 engine designs in the parameter study. The program PSORT was used to provide sorted lists of the selected performance parameters mentioned in Section IV.A.

The IBM System 360 Job Control Language used to run the parameter study is shown in Tables 4 and 5.

C. Results of the Parameter Study

1. Sorted Lists

Seven output parameters were identified to represent engine performance (Table 6).

The programs PSORT and FRNTEND were used to sort the engines listed in Table 3 in increasing (or decreasing) values of four of these parameters, VJE, ZMTOT, SPMMT, SPTMT. The sorted lists are shown in APPENDIX C.

2. Selection of Specific Engines

To better examine the behavior of the code and the characteristics of the NUROC3A dual-mode system concept, certain engines were selected from the sorted lists of APPENDIX C for more detailed examination. Table 7 summarizes the reasons for selecting these engines and their key numbers; the complete outputs for these engines appear in APPENDIX D.

Table 4

Job Control Language for Running NUROC3A Parameter Study

```
(Begin all statements in Column 1 except INCLUDE statements start in column 2.)
//JOB  <Job card details>
//*PASSWORD  <Password>
// EXEC  FORTGLG
//LKED.SYSLIB  DD  DSNAME = U.G1192.SNPPSA.COSTER, DISP=SHR
//             DD  DSNAME = SYS1. FORTLIB, DISP=SHR
//LKED.SYSIN   DD  *
  INCLUDE SYSLIB(FRNTEND)
//GO.FTØ9FØØ1  DD  DUMMY
[//GO.FT11FØØ1 DD  UNIT=SYSDA, SPACE=(CYL,(,21)), DISP=(NEW,PASS),]
//             DCB=(RECFM=FB, BLKSIZE=3520, LRECL=80), DSN=&&TEMP
//GO.SYSIN     DD  *
       <data for Frntend (see page    )>
// EXEC  FORTGLG
//LKED.SYSIN   DD  *
       <all include statements (see table    )>
//GO.FTØ5FØØ1  DD  DSN=&&TEMP, DISP=(OLD, DELETE)
//GO.FTØSFØØ1  DD  SYSOUT=U, DCB=(RECFM=FBA, LRECL=133, BLKSIZE=399)
//GO.FT1ØFØØ1  DD  DSN=U.D5406.NUOUT6, DISP=(OLD,KEEP)
//                UNIT=2314, VOL=SER=AMS206,
// EXEC  FORTGLG
//LKED.SYSLIB  DD  DSN=U.G1192.SNPPSA.COSTER, DISP=SHR
//             DD  DSN=SYS1.FORTLIB, DISP=SHR
//LKED.SYSIN   DD  *
INCLUDE SYSLIB(PSORT)
INCLUDE SYSLIB(SORT)
//GO.FTØ5FØØ1
           <data to control PSORT (see page    )>
//GO.FTØ9FØØ1  DD  SYSOUT=U, DCB=(RECFM=FBA, LRECL=133, BLKSIZE=399)
//GO.FT1ØFØØ1  DD  DSN=U.D5406.NUOUT6, DISP=SHR, UNIT=2314, VOL=SER=AMS206,
//                 DCB=(RECFM=FB, BLKSIZE=3520, LRECL=80)
```

Table 5

Set of INCLUDE Statements Used in Table 4

(All INCLUDE Statements Begin in Column 2)

```
INCLUDE  SYSLIB(MAINUR)
INCLUDE  SYSLIB(BLKNUR)
INCLUDE  SYSLIB(CRITCK)
INCLUDE  SYSLIB(ENERGY)
INCLUDE  SYSLIB(PRESUR)
INCLUDE  SYSLIB(HETPIP)
INCLUDE  SYSLIB(NOZZLE)
INCLUDE  SYSLIB(CYCLE)
INCLUDE  SYSLIB(RADIAT)
INCLUDE  SYSLIB(POWER)
INCLUDE  SYSLIB(NUMASS)
INCLUDE  SYSLIB(NUOUT1)
INCLUDE  SYSLIB(NUOUT2)
INCLUDE  SYSLIB(NUOUT3)
INCLUDE  SYSLIB(NUOUT4)
INCLUDE  SYSLIB(NUOUT5)
INCLUDE  SYSLIB(NUOUT6)
INCLUDE  SYSLIB(CONVERT)
INCLUDE  SYSLIB(SOLVE2)
INCLUDE  SYSLIB(SOLVE)
```

Table 6

List of Selected Output Variables for the Parameter Study

Output Parameter	Reference Engine Value
Thrust (F), kn	47.54
Effective Jet Velocity, VJE m/s	9220.48
Total System Mass, ZMTOT, kg	7814.09
Total System Mass/Power Plant Output (SPMMT), kg/kWe	15.62
Total Power Conversion System Mass/Power Plant Output (SPMGEN), g/kWe	9.93
Thrust/Total Engine Mass (SPTENG), N/kg	16.72
Thrust/Total System Mass (SPTMT), N/kg	6.10

Table 7

Selected Engines from NUROC3A Parameter Study

Engine No.	QE MWe	QD MWt/m^3	X -	TSUBM K	TC K	PCI N/cm^2	F kN	VJE m/s	ZMTMAX K	ZMTOT kg	SPTMT N/kg	SPMMT kg/kWe	Comments
Ref.	0.5	1000	0.33	1420	3000	333.6	47.63	9221	2951	7814	6.10	15.6	Ref. Engine
Parameter Study Range	0.1 0.5 1.0	500 1000 1500	0.25 0.33 0.50	1300 1420 1600	2700 3000 3300			9640 (8771)		36882 (3397)	14.59 (1.2.1	81.87 (10.96)	MAX (MIN)
70	0.1	1500	0.33	1600	2700	338.0	10.36	8776	2951	3451	14.59	34.51	Max SPTMT
71	0.5	1500	0.33	1600	2700	381.1	50.40	8776	2951	7316	6.88	14.63	Max SPTMT QQE=.5
217	0.1	1500	0.25	1300	3300	368.0	15.41	9640	3568	3872	7.73	58.72	Max VJE
232	0.1	1500	0.33	1600	3300	368.5	15.42	9640	3568	3397	13.37	33.97	Min ZMTOT
234	1.0	1500	0.33	1600	3300	368.5	15.41	9640	3568	10964	1.14	10.96	Min SPMMT

List of Symbols Used

QE	Electric Power	TC	Chamber Temperature	ZMTMAX	Maximum Core Material Temperature
QD	Core Power Density	PCI	Total pressure, core Entrance	ZMTOT	Total System Mass
X	Power Conversion Temperature Ratio	F	Thrust	SPTMT	Specific Thrust, Total System
TSUBM	Turbine Inlet Temperature	VJE	Effective Exhaust Velocity	SPMMT	Specific Mass, Total System

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. The preliminary NUROC3A code described in References 1 and 2 has been proved workable and consistent by the parameter study described in this volume.
2. The sorted list (APPENDIX C) and detailed outputs of selected engines (APPENDIX D) indicate that performance characteristics of the dual-mode space nuclear fission solid-core system are sufficiently promising for certain classes of missions to warrant further attention. This conclusion is necessarily tempered by the highly preliminary nature of the analysis on which the computer code is based.

B. Recommendations

1. The coarseness and sketchiness of the present analysis (Ref. 1) require that additional attention be given to improving the characterization of the engine system, particularly the various power generation subsystems.
2. Mission analyses should be performed for specific missions, probably involving both planetocentric and heliocentric maneuvers, in order to define quantitatively the usefulness of the dual-mode concept. Such analyses should incorporate an improved version of NUROC3A (see Recommendation 1) and should be formulated to permit direct comparisons with alternative approaches; e.g., a combination of chemical rockets and reactor-powered electric powerplants.

REFERENCES

1. Grey, J., Chow, S. and Layton, J. P., NUROC3A Volume 1, Mathematical Model for the Analysis of Dual-Mode Space Nuclear Fission Solid-Core Power and Propulsion Systems, AMS Report No. 1239a, Princeton University, 30 June 1976.

2. Nichols, R. A. and Layton, J. P., NUROC3A Volume 2, NUROC3A Computer Code and Users' Guide for the Preliminary Analysis of Dual-Mode Space Nuclear Fission Solid Core Power and Propulsion Systems, AMS Report No. 1239b, Princeton University, 30 September 1976.

APPENDIX A Listing of Associated Computer Codes

```
*****************************************************************

                FRNTEND

THIS ROUTINE IS USED TO SET UP THE NAMELISTS FOR THE PARAMETER
STUDY.  THE VALUES FOR THE VARIABLES QE, TSUBM, X, QD, AND TC
ARE READ IN THROUGH NAMELIST/IN/ AND ARE STORED IN $QE, $TSUBM,
$X, $QD, AND $TC.  OTHER VARIABLES ARE FOUND IN NAMELIST INBUG AND
ONCE WHICH ARE USEFUL FOR CONTROLLING THE NUROC3A PARAMETER STUDY.
THE PROGRAM OUTPUTS NAMELISTS INBUG AND ONCE ALONG WITH 243
SETS OF NAMELISTS DEFINE, INDATA, AND INPUT.  THE 243 NAMELIST
SETS DEFINE 243 ROCKET ENGINE/POWER CONVERSION SYSTEM COMBINATIONS
CORRESPONDING TO ALL COMBINATIONS OF THE THREE VALUES FOR THE
FIVE VARIABLES QE, TSUBM, X, QD, AND TC.

INPUT VARIBLES FOR CONTROLLING THE OPERATION OF FRNTEND ARE AS
FOLLOWS :

     LISTS = UNIT NUMBER OF DEVICE WHICH NUROC3A WILL READ NAME-
             LISTS FROM.

     NPRT  = UNIT NUMBER OF DEVICE RECEIVING MESSAGE OUTPUT FROM
             FRNTEND.

*****************************************************************
      LOGICAL*1 OUT1,OUT2,OUT3,OUT4,OUT5,OUT6,BB1(10),BB2(10),BB3(10)
      DIMENSION $QE(3),$TSUBM(3),$X(3),$QD(3),$TC(3)
      NAMELIST/IN/$QE,$TSUBM,$X,$QD,$TC,LISTS,NPRT,NIN,ICASES,NUM
     .,OUT1,OUT2,OUT3,OUT4,OUT5,OUT6,BB1,BB2,BB3,NSTART,NTAPE,NPRNT
      NAMELIST/INBUG/BB1,BB2,BB3
      NAMELIST/ONCE/ ICASES,OUT1,OUT2,OUT3,OUT4,OUT5,OUT6
     .,NSTART,NTAPE,NPRNT
      NAMELIST/INDATA/QE,QD,TC,TSUBM,X
      DATA BB1/10*.FALSE./,BB2/10*.FALSE./,BB3/10*.FALSE./
      LISTS=11
      NPRT=6
      NIN=5
      NUM=1
      NSTART=1
      NTAPE=10
      NPRNT=6
      READ(NIN,IN)
      WRITE(NPRT,IN)
      WRITE(NPRT,9010)
      WRITE(LISTS,INBUG)
      WRITE(LISTS,ONCE)
      DO 10 I1=1,3
      DO 10 I2=1,3
      DO 10 I3=1,3
      DO 10 I4=1,3
      DO 10 I5=1,3
      QE=$QE(I5)
```

```
      READ(5,RIN,END=500)
      GO TO 10
500   WRITE(MSG,8000)
8000  FORMAT('**WARNING**-- NAMELIST RIN LEFT OUT')
      REWIND 5
10    WRITE(MSG,RIN)
      NNP=NPRMS+1
C
C READ IN HEADING LABLES
C
      READ(5,7000,END=520) (LB1(I),LB2(I),I=1,NNP)
7000  FORMAT(2A8)
      GO TO 15
520   WRITE(MSG,8010)NNP
8010  FORMAT('0 **WARNING**--EXPECTING ',I2,' PARAMETER LABLES BUT NONE
     .FOUND')
15    CONTINUE
      WRITE(MSG,8020) (LB1(I),LB2(I),I=1,NNP)
8020  FORMAT(1X,2A8)
C
C  COMMENCE READING AND STORING ENGINE DATA  1 READ/ENGINE
C
      DO 100 I=1,ICS
C
C  READ ONE ENGINE
C
      READ(INTP,TAP2,END=510)
C
C
C  COUNT ENGINES READ IN
      KNT=KNT+1
C
C  SET UP POINTER ARRAY FOR ENGINE DATA
C
      INDX(I)=KNT
C
C  STORE ENGINE DATA
C
      NUMA(I)=NUMBER
      DO 110 J=1,NPRMS
      PARMS(I,J)=PRMS(J)
110   CONTINUE
100   CONTINUE
      GO TO 16
510   WRITE(MSG,8015)ICS,KNT
8015  FORMAT('**NOTE**-',I4,' ENGINES EXPECTED, ',I4,' ENGINES FOUND,
     .MISSING ENGINES WERE INVALID')
```


A 2

```
*****************************************************************
                    PSORT

ICS=MAX NUMBER OF ENGINES EXPECTED
INTP=UNIT NUMBER OF DEVICE STORING ENGINE DATA
LNUMBE - LSPTMT = VARIABLES TO DETERMINE WHICH PARAMETERS ARE SORTED
      0 MEANS NO SORT, 1 MEANS SORT MAX TO MIN, 2 MEANS SORT MIN TO
NPRNT = UNIT NUMBER FOR PARAMETER STUDY PRINTOUT
MSG = UNIT NUMBER FOR MESSAGE PRINTOUT
LB1,LB2 = LABELS FOR HEADING, INPUT AFTER NAMELIST RIN
NPRMS = NUMBER OF PARAMETERS INPUT AND OUTPUT, EXCLUDING ENG. NO.

*****************************************************************
      REAL*8 XDATE
      REAL*8 LB1(20),LB2(20)
      COMMON/IPS/LNUMBE,LQE,LTSUBM,LX,LQD,LTC,LF,LVJE,LZMTOT,LSPMGE,
     .LSPMMT,LSPTEN,LSPTMT
      COMMON/PS/QE,TSUBM,X,QD,TC,F,VJE,ZMTOT,SPMGEN,SPMMT,SPTENG,SPTMT
      EQUIVALENCE (LPRMS(1),LNUMBE)
      EQUIVALENCE (PRMS(1),QE)
      DIMENSION INDX(750),PARMS(750,12),PRMS(12),LPRMS(13),NUMB(750)
      NAMELIST/TAPE/NUMBER,QE,TSUBM,X,QD,TC,F,VJE,ZMTOT,SPMGEN,SPMMT,
     .SPTENG,SPTMT
      NAMELIST/RIN/ICS,INTP,LNUMBE,LQE,LTSUBM,LX,LQD,LTC,LF,LVJE,LZMTOT
     .LSPMGE,LSPMMT,LSPTEN,LSPTMT,NPRNT,MSG
      CALL DATE(XDATE)
      MSG=9
      ICS=1
      KNT=0
      NPRNT=6
      INTP=10
      NPRMS=12
      NNP=13
C
C  INITIALIZE SORT CONTROL VARIABLES
C
      DO 50 I=1,NNP
      LPRMS(I)=0
50    CONTINUE
      LNUMBE=0
C
C  INITIALIZE NO. OF ENGINES/PAGE TO 39
C
      MASK=39
C
C  INITIALIZE ENGINE COUNTER TO 39 TO FORCE INITIAL PAGE SKIP
C
      NACT=39
C
C  READ PROGRAM CONTROL DATA
C
```

```
      ISUBM=$ISUBM(I4)
      X=$X(I3)
      QD=$QD(I2)
      TC=$TC(I1)
      WRITE(NPRT,9000) NUM,QE,ISUBM,X,QD,TC
```

```
      WRITE(IISTS,9020)
      WRITE(IISTS,INDATA)
      WRITE(IISTS,9030)
      NUM=NUM+1
10    CONTINUE
      STOP
9000  FORMAT(' ',5X,'ENGINE ',I4,'      QE=',F10.7,' ISUBM=',F10.4,
     .' X=',F10.7,' QD=',F10.4,' TC=',F10.4)
9010  FORMAT('1')
9020  FORMAT(' &DEFINE    &END')
9030  FORMAT(' &INPUT &END')
      END
```

```
16    CONTINUE
      IF (KNT .LE. 0) GO TO 200
C
C  SORT AND PRINT OUT PARAMETER STUDIES AS SPECIFIED BY INPUT
C
      DO 120 K1=1,NNP
      K=K1-1
      NACT=MASK
C
C  SKIP SORT OF PARAMETERS NOT DESIRED
C
      IF (LPRMS(K1).EQ.0) GO TO 120
C
C  SPECIAL SKIP FOR SERIAL LIST
C
      IF (K.LE.0) GO TO 135
      CALL SORT (INDX,PARMS(1,K),KNT)
C
C  PRINT OUT ONE SORTED PARAMETER STUDY
C
135   DO 140 M=1,KNT

      M1=M
C
C  IF LPRMS(K1) = 2, PRINT IN ORDER FROM LOW TO HIGH
C
      IF(K1 .EQ. 1) GO TO 136
      IF (LPRMS(K1).EQ.1) M1=KNT+1-M
136   CONTINUE
      IF (NACT.LT.MASK) GO TO 130
      NACT=0
C
C  PRINT HEADING
C
      WRITE (NPRNT,9000)
      WRITE (NPRNT,9010)
      WRITE (NPRNT,9020)
      WRITE (NPRNT,9030) XDATE
      WRITE (NPRNT,9040)
      WRITE (NPRNT,9050) LB1(K1),LB2(K1)
      WRITE (NPRNT,9060)
      WRITE (NPRNT,9065)
130   INX=INDX(M1)
      WRITE(NPRNT,9070) NUMA(INX),(PARMS(INX,L),L=1,NPRMS)
      NACT=NACT+1
140   CONTINUE
120   CONTINUE
121   WRITE(MSG,8050)
8050  FORMAT('  NORMAL TERMINATION')
      STOP
200   WRITE(MSG,9080)
```

```
9080  FORMAT(' ** ATTENTION ** -- NO ENGINE DATA FOUND, OUTPUT',
     . ' TABLES WITHHELD')
      GO TO 121
 9000 FORMAT('1')
 9010 FORMAT('0',/)
 9020 FORMAT(' ',50X,'THE AEROSPACE SYSTEMS LABORATORY',/,56X,'PRINCET
     1 UNIVERSITY')
 9030 FORMAT('0',87X,A3)
 9040 FORMAT('0',37X,
     1'DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM')
 9050  FORMAT(' ',37X,'NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-',
     . 2A8)
 9060  FORMAT('0',15X,'ENG',4X,'QE',4X,'TSUBM',4X,'X',6X,'QD',6X,'TC',
     .10X,'F',6X,'VJE',5X,'ZMTOT',3X,'SPMGEN',3X,'SPMMT',4X,'SPTENG',
     .4X,'SPTMT')
 9065  FORMAT(' ',15X,'NO.',4X,'MWE',5X,'K',11X,'MWT/M3',4X,'K',11X,
     .'KN',5X,'M/S',6X,'KG ',4X,'KG/KWE',3X,'KG/KWE',4X,'N/KG',
     .5X,'N/KG'/)
 9070  FORMAT(' ',15X,I3,3X,F4.2,3X,F5.0,3X,F4.2,3X,F5.0,3X,F5.0,
     .6X,F5.2,2X,F6.0,3X,F6.0,3X,F6.3,3X,F6.3,3X,F6.3,3X,F6.3)
      END
```

```
      SUBROUTINE SORT(LIST,XPMR,LNG)
*****************************************************************

                SORT

THIS ROUTINE STORES IN ARRAY LIST THE INDICES OF THE FIRST ING
ELEMENTS OF THE ARRAY XPMR IN ORDER OF THEIR VALUE FROM SMALLEST
TO LARGEST.

*****************************************************************
      DIMENSION LIST(50),XPMR(50)
C
C
      IF(LNG .LT. 2) RETURN
      IPT = 2
4     I1=IPT
      I2=IPT-1
      M1=LIST(IPT)
3     IF(XPMR(LIST(IPT)) .GE. XPMR(LIST(I2))) GO TO 6
      IF(I2 .LE. 1) GO TO 5
      I2=I2-1
      GO TO 3
6     I2=I2+1
1     IF(I1 .LE. I2) GO TO 2
5     LIST(I1)=LIST(I1-1)
      I1=I1-1
      GO TO 1
2     LIST(I2)=M1
      IF(IPT .GE. LNG) RETURN
      IPT=IPT+1
      GO TO 4
      END
```

07/14/76

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
1	0.10	1300.	0.25	500.	2700.	50.50	8775.	8187.	36.617	81.871	11.160	6.169
2	0.50	1300.	0.25	500.	2700.	50.48	8776.	20920.	32.733	41.839	11.086	2.413
3	1.00	1300.	0.25	500.	2700.	50.48	8776.	36882.	32.296	36.882	11.007	1.369
4	0.10	1420.	0.25	500.	2700.	50.48	8776.	7562.	30.358	75.625	11.151	6.675
5	0.50	1420.	0.25	500.	2700.	50.48	8776.	18067.	27.028	36.134	11.087	2.794
6	1.00	1420.	0.25	500.	2700.	50.48	8776.	31240.	26.653	31.240	11.007	1.616
7	0.10	1600.	0.25	500.	2700.	50.48	8776.	6147.	16.204	61.471	11.151	8.212
8	0.50	1600.	0.25	500.	2700.	50.48	8776.	11591.	14.076	23.182	11.087	4.355
9	1.00	1600.	0.25	500.	2700.	50.48	8776.	18423.	13.837	18.423	11.007	2.740
10	0.10	1300.	0.33	500.	2700.	50.38	8776.	6189.	16.596	61.889	11.123	8.140
11	0.50	1300.	0.33	500.	2700.	50.38	8776.	11701.	14.270	23.402	11.033	4.305
12	1.00	1300.	0.33	500.	2700.	50.38	8776.	18620.	14.008	18.620	10.922	2.705
13	0.10	1420.	0.33	500.	2700.	50.38	8776.	5877.	13.473	58.766	11.122	8.572
14	0.50	1420.	0.33	500.	2700.	50.38	8776.	10294.	11.456	20.588	11.033	4.894
15	1.00	1420.	0.33	500.	2700.	50.38	8776.	15842.	11.230	15.842	10.922	3.190
16	0.10	1600.	0.33	500.	2700.	50.38	8776.	5714.	11.845	57.138	11.122	8.816
17	0.50	1600.	0.33	500.	2700.	50.38	8776.	9594.	10.056	19.188	11.033	5.251
18	1.00	1600.	0.33	500.	2700.	50.38	8776.	14467.	9.855	14.467	10.922	3.482
19	0.10	1300.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
20	0.50	1300.	0.50	500.	2700.	48.59	8771.	15010.	20.370	30.020	10.070	3.237
21	1.00	1300.	0.50	500.	2700.	48.59	8771.	25190.	20.051	25.190	9.455	1.929
22	0.10	1420.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
23	0.50	1420.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
24	1.00	1420.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
25	0.10	1600.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
26	0.50	1600.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
27	1.00	1600.	0.50	500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
28	0.10	1300.	0.25	1000.	2700.	50.49	8776.	6516.	36.617	65.164	17.685	7.748
29	0.50	1300.	0.25	1000.	2700.	50.49	8776.	19240.	32.733	38.479	17.572	2.624
30	1.00	1300.	0.25	1000.	2700.	50.49	8776.	35193.	32.296	35.193	17.430	1.435
31	0.10	1420.	0.25	1000.	2700.	50.49	8776.	5890.	30.358	58.903	17.687	8.572
32	0.50	1420.	0.25	1000.	2700.	50.49	8776.	16387.	27.028	32.774	17.572	3.081
33	1.00	1420.	0.25	1000.	2700.	50.49	8776.	29550.	26.653	29.550	17.430	1.709
34	0.10	1600.	0.25	1000.	2700.	50.49	8776.	4475.	16.204	44.750	17.687	11.283
35	0.50	1600.	0.25	1000.	2700.	50.49	8776.	9911.	14.076	19.822	17.572	5.094
36	1.00	1600.	0.25	1000.	2700.	50.49	8776.	16733.	13.837	16.733	17.430	3.017
37	0.10	1300.	0.33	1000.	2700.	50.39	8776.	4516.	16.596	45.156	17.645	11.160
38	0.50	1300.	0.33	1000.	2700.	50.44	8776.	10017.	14.270	20.035	17.499	5.035
39	1.00	1300.	0.33	1000.	2700.	50.44	8776.	16924.	14.008	16.924	17.302	2.980

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
40	0.10	1420.	0.33	1000.	2700.	50.39	8776.	4203.	13.473	42.033	17.645	11.989
41	0.50	1420.	0.33	1000.	2700.	50.44	8776.	8611.	11.456	17.221	17.499	5.858
42	1.00	1420.	0.33	1000.	2700.	50.44	8776.	14145.	11.230	14.145	17.302	3.566
43	0.10	1600.	0.33	1000.	2700.	50.39	8776.	4041.	11.845	40.406	17.645	12.472
44	0.50	1600.	0.33	1000.	2700.	50.44	8776.	7911.	10.056	15.821	17.499	6.376
45	1.00	1600.	0.33	1000.	2700.	50.44	8776.	12770.	9.855	12.770	17.302	3.950
46	0.10	1300.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
47	0.50	1300.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
48	1.00	1300.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
49	0.10	1420.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
50	0.50	1420.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
51	1.00	1420.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
52	0.10	1600.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
53	0.50	1600.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
54	1.00	1600.	0.50	1000.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
55	0.10	1300.	0.25	1500.	2700.	50.49	8776.	5928.	36.617	59.275	22.283	8.518
56	0.50	1300.	0.25	1500.	2700.	50.49	8776.	18647.	32.733	37.295	22.134	2.708
57	1.00	1300.	0.25	1500.	2700.	50.52	8776.	34597.	32.296	34.597	21.964	1.460
58	0.10	1420.	0.25	1500.	2700.	50.49	8776.	5302.	30.358	53.015	22.284	9.524
59	0.50	1420.	0.25	1500.	2700.	50.49	8776.	15795.	27.028	31.590	22.134	3.197
60	1.00	1420.	0.25	1500.	2700.	50.52	8776.	28954.	26.653	28.954	21.964	1.745
61	0.10	1600.	0.25	1500.	2700.	50.49	8776.	3886.	16.204	38.862	22.284	12.992
62	0.50	1600.	0.25	1500.	2700.	50.49	8776.	9319.	14.076	18.638	22.134	5.418
63	1.00	1600.	0.25	1500.	2700.	50.52	8776.	16137.	13.837	16.137	21.964	3.131
64	0.10	1300.	0.33	1500.	2700.	50.36	8776.	3926.	16.596	39.260	22.222	12.828
65	0.50	1300.	0.33	1500.	2700.	50.40	8776.	9423.	14.270	18.846	22.026	5.348
66	1.00	1300.	0.33	1500.	2700.	50.40	8776.	16323.	14.008	16.323	21.771	3.087
67	0.10	1420.	0.33	1500.	2700.	50.36	8776.	3614.	13.473	36.137	22.222	13.937
68	0.50	1420.	0.33	1500.	2700.	50.40	8776.	8016.	11.456	16.032	22.026	6.297
69	1.00	1420.	0.33	1500.	2700.	50.40	8776.	13544.	11.230	13.544	21.771	3.721
70	0.10	1600.	0.33	1500.	2700.	50.36	8776.	3451.	11.845	34.510	22.222	14.594
71	0.50	1600.	0.33	1500.	2700.	50.40	8776.	7316.	10.056	14.632	22.026	6.888
72	1.00	1600.	0.33	1500.	2700.	50.40	8776.	12170.	9.855	12.170	21.771	4.141
73	0.10	1300.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
74	0.50	1300.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
75	1.00	1300.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
76	0.10	1420.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
77	0.50	1420.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
78	1.00	1420.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTRNG N/KG	SPTMT N/KG
79	0.10	1600.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
80	0.50	1600.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
81	1.00	1600.	0.50	1500.	2700.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
82	0.10	1300.	0.25	500.	3000.	47.26	9220.	8154.	36.617	81.540	10.519	5.795
83	0.50	1300.	0.25	500.	3000.	47.26	9219.	20885.	32.733	41.769	10.460	2.263
84	1.00	1300.	0.25	500.	3000.	47.26	9219.	36848.	32.296	36.848	10.384	1.283
85	0.10	1420.	0.25	500.	3000.	47.26	9219.	7528.	30.358	75.278	10.522	6.278
86	0.50	1420.	0.25	500.	3000.	47.26	9219.	18032.	27.028	36.064	10.460	2.621
87	1.00	1420.	0.25	500.	3000.	47.26	9219.	31205.	26.653	31.205	10.384	1.515
88	0.10	1600.	0.25	500.	3000.	47.26	9219.	6112.	16.204	61.124	10.522	7.732
89	0.50	1600.	0.25	500.	3000.	47.26	9219.	11556.	14.076	23.113	10.460	4.090
90	1.00	1600.	0.25	500.	3000.	47.26	9219.	18388.	13.837	18.388	10.384	2.570
91	0.10	1300.	0.33	500.	3000.	47.26	9219.	6154.	16.596	61.545	10.515	7.679
92	0.50	1300.	0.33	500.	3000.	47.26	9219.	11666.	14.270	23.333	10.430	4.051
93	1.00	1300.	0.33	500.	3000.	47.26	9219.	18586.	14.008	18.586	10.325	2.543
94	0.10	1420.	0.33	500.	3000.	47.26	9219.	5842.	13.473	58.421	10.515	8.030
95	0.50	1420.	0.33	500.	3000.	47.26	9219.	10260.	11.456	20.519	10.430	4.607
96	1.00	1420.	0.33	500.	3000.	47.26	9219.	15807.	11.230	15.807	10.325	2.990
97	0.10	1600.	0.33	500.	3000.	47.26	9219.	5679.	11.845	56.794	10.515	8.322
98	0.50	1600.	0.33	500.	3000.	47.26	9219.	9560.	10.056	19.119	10.430	4.944
99	1.00	1600.	0.33	500.	3000.	47.26	9219.	14433.	9.855	14.433	10.325	3.275
100	0.10	1300.	0.50	500.	3000.	46.18	9216.	6867.	23.211	68.675	10.158	6.725
101	0.50	1300.	0.50	500.	3000.	46.36	9217.	14983.	20.370	29.967	9.662	3.094
102	1.00	1300.	0.50	500.	3000.	46.36	9217.	25163.	20.051	25.163	9.068	1.842
103	0.10	1420.	0.50	500.	3000.	46.18	9216.	6409.	19.629	64.093	10.158	7.205
104	0.50	1420.	0.50	500.	3000.	46.36	9217.	12904.	16.212	25.808	9.662	3.593
105	1.00	1420.	0.50	500.	3000.	46.36	9217.	21052.	15.940	21.052	9.068	2.202
106	0.10	1600.	0.50	500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
107	0.50	1600.	0.50	500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
108	1.00	1600.	0.50	500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
109	0.10	1300.	0.25	1000.	3000.	47.62	9221.	6485.	36.617	64.849	16.868	7.344
110	0.50	1300.	0.25	1000.	3000.	47.63	9221.	19208.	32.733	38.416	16.761	2.480
111	1.00	1300.	0.25	1000.	3000.	47.63	9221.	35161.	32.296	35.161	16.623	1.355
112	0.10	1420.	0.25	1000.	3000.	47.63	9221.	5859.	30.358	58.587	16.872	8.129
113	0.50	1420.	0.25	1000.	3000.	47.63	9221.	16355.	27.028	32.711	16.760	2.912
114	1.00	1420.	0.25	1000.	3000.	47.63	9221.	29519.	26.653	29.518	16.623	1.613
115	0.10	1600.	0.25	1000.	3000.	47.63	9221.	4443.	16.204	44.433	16.872	10.719
116	0.50	1600.	0.25	1000.	3000.	47.63	9221.	9379.	14.076	19.759	16.760	4.821
117	1.00	1600.	0.25	1000.	3000.	47.63	9221.	16702.	13.837	16.702	16.623	2.852

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
118	0.10	1300.	0.33	1000.	3000.	47.63	9221.	4485.	16.596	44.845	16.860	10.620
119	0.50	1300.	0.33	1000.	3000.	47.63	9221.	9986.	14.270	19.972	16.705	4.769
120	1.00	1300.	0.33	1000.	3000.	47.63	9221.	16892.	14.008	16.892	16.516	2.819
121	0.10	1420.	0.33	1000.	3000.	47.63	9221.	4172.	13.473	41.722	16.860	11.415
122	0.50	1420.	0.33	1000.	3000.	47.63	9221.	8579.	11.456	17.158	16.705	5.551
123	1.00	1420.	0.33	1000.	3000.	47.63	9221.	14113.	11.230	14.113	16.516	3.375
124	0.10	1600.	0.33	1000.	3000.	47.63	9221.	4009.	11.845	40.095	16.860	11.879
125	0.50	1600.	0.33	1000.	3000.	47.63	9221.	7879.	10.056	15.758	16.705	6.045
126	1.00	1600.	0.33	1000.	3000.	47.63	9221.	12739.	9.855	12.739	16.516	3.739
127	0.10	1300.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
128	0.50	1300.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
129	1.00	1300.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
130	0.10	1420.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
131	0.50	1420.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
132	1.00	1420.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
133	0.10	1600.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
134	0.50	1600.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
135	1.00	1600.	0.50	1000.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
136	0.10	1300.	0.25	1500.	3000.	47.78	9221.	5897.	36.617	58.969	21.374	8.102
137	0.50	1300.	0.25	1500.	3000.	47.78	9221.	18617.	32.733	37.234	21.230	2.566
138	1.00	1300.	0.25	1500.	3000.	47.78	9221.	34566.	32.296	34.566	21.050	1.382
139	0.10	1420.	0.25	1500.	3000.	47.78	9221.	5271.	30.358	52.709	21.376	9.064
140	0.50	1420.	0.25	1500.	3000.	47.78	9221.	15764.	27.028	31.529	21.230	3.031
141	1.00	1420.	0.25	1500.	3000.	47.78	9221.	28923.	26.653	28.923	21.050	1.652
142	0.10	1600.	0.25	1500.	3000.	47.78	9221.	3856.	16.204	38.555	21.376	12.392
143	0.50	1600.	0.25	1500.	3000.	47.78	9221.	9288.	14.076	18.577	21.230	5.144
144	1.00	1600.	0.25	1500.	3000.	47.78	9221.	16106.	13.837	16.106	21.050	2.966
145	0.10	1300.	0.33	1500.	3000.	47.78	9221.	3896.	16.596	38.964	21.360	12.262
146	0.50	1300.	0.33	1500.	3000.	47.78	9221.	9393.	14.270	18.786	21.158	5.086
147	1.00	1300.	0.33	1500.	3000.	47.78	9221.	16293.	14.008	16.293	20.910	2.932
148	0.10	1420.	0.33	1500.	3000.	47.78	9221.	3584.	13.473	35.841	21.360	13.331
149	0.50	1420.	0.33	1500.	3000.	47.78	9221.	7986.	11.456	15.973	21.158	5.982
150	1.00	1420.	0.33	1500.	3000.	47.78	9221.	13515.	11.230	13.515	20.910	3.535
151	0.10	1600.	0.33	1500.	3000.	47.78	9221.	3421.	11.845	34.213	21.360	13.965
152	0.50	1600.	0.33	1500.	3000.	47.78	9221.	7286.	10.056	14.572	21.158	6.557
153	1.00	1600.	0.33	1500.	3000.	47.78	9221.	12140.	9.855	12.140	20.910	3.936
154	0.10	1300.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
155	0.50	1300.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
156	1.00	1300.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROCJA, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGPN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
157	0.10	1420.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
158	0.50	1420.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
159	1.00	1420.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
160	0.10	1600.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
161	0.50	1600.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
162	1.00	1600.	0.50	1500.	3000.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
163	0.10	1300.	0.25	500.	3300.	44.46	9636.	8126.	36.617	81.261	9.959	5.471
164	0.50	1300.	0.25	500.	3300.	44.47	9636.	20857.	32.733	41.713	9.904	2.132
165	1.00	1300.	0.25	500.	3300.	44.47	9636.	36820.	32.296	36.820	9.831	1.208
166	0.10	1420.	0.25	500.	3300.	44.47	9636.	7500.	30.358	74.998	9.962	5.930
167	0.50	1420.	0.25	500.	3300.	44.47	9636.	18004.	27.029	36.008	9.903	2.470
168	1.00	1420.	0.25	500.	3300.	44.47	9636.	31177.	26.653	31.177	9.831	1.426
169	0.10	1600.	0.25	500.	3300.	44.47	9636.	6084.	16.204	60.844	9.962	7.309
170	0.50	1600.	0.25	500.	3300.	44.47	9636.	11528.	14.076	23.057	9.903	3.857
171	1.00	1600.	0.25	500.	3300.	44.47	9636.	18360.	13.837	18.360	9.831	2.422
172	0.10	1300.	0.33	500.	3300.	44.47	9636.	6126.	16.596	61.265	9.956	7.259
173	0.50	1300.	0.33	500.	3300.	44.47	9636.	11639.	14.270	23.277	9.874	3.821
174	1.00	1300.	0.33	500.	3300.	44.47	9636.	18558.	14.008	18.558	9.774	2.336
175	0.10	1420.	0.33	500.	3300.	44.47	9636.	5814.	13.473	58.141	9.956	7.649
176	0.50	1420.	0.33	500.	3300.	44.47	9636.	10232.	11.456	20.464	9.874	4.346
177	1.00	1420.	0.33	500.	3300.	44.47	9636.	15779.	11.230	15.779	9.774	2.818
178	0.10	1600.	0.33	500.	3300.	44.47	9636.	5651.	11.845	56.514	9.956	7.869
179	0.50	1600.	0.33	500.	3300.	44.47	9636.	9532.	10.056	19.063	9.874	4.666
180	1.00	1600.	0.33	500.	3300.	44.47	9636.	14405.	9.855	14.405	9.774	3.087
181	0.10	1300.	0.50	500.	3300.	44.29	9636.	6846.	23.211	68.463	9.788	6.469
182	0.50	1300.	0.50	500.	3300.	44.49	9635.	14961.	20.370	29.922	9.316	2.974
183	1.00	1300.	0.50	500.	3300.	44.47	9636.	25142.	20.051	25.142	8.735	1.769
184	0.10	1420.	0.50	500.	3300.	44.29	9636.	6388.	18.629	63.881	9.788	6.933
185	0.50	1420.	0.50	500.	3300.	44.49	9635.	12882.	16.212	25.763	9.316	3.454
186	1.00	1420.	0.50	500.	3300.	44.47	9636.	21031.	15.940	21.031	8.735	2.114
187	0.10	1600.	0.50	500.	3300.	44.29	9636.	6052.	15.270	60.522	9.788	7.318
188	0.50	1600.	0.50	500.	3300.	44.49	9635.	11383.	13.215	22.766	9.316	3.909
189	1.00	1600.	0.50	500.	3300.	44.47	9636.	18074.	12.984	18.074	8.735	2.460
190	0.10	1300.	0.25	1000.	3300.	45.15	9639.	6459.	36.617	64.594	16.140	6.990
191	0.50	1300.	0.25	1000.	3300.	45.16	9639.	19183.	32.733	38.365	16.035	2.354
192	1.00	1300.	0.25	1000.	3300.	45.16	9639.	35136.	32.296	35.136	15.902	1.285
193	0.10	1420.	0.25	1000.	3300.	45.16	9639.	5833.	30.358	58.333	16.142	7.741
194	0.50	1420.	0.25	1000.	3300.	45.16	9639.	16330.	27.028	32.660	16.035	2.765
195	1.00	1420.	0.25	1000.	3300.	45.16	9639.	29493.	26.653	29.493	15.902	1.531

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
196	0.10	1600.	0.25	1000.	3300.	45.16	9639.	4418.	16.204	44.179	16.142	10.222
197	0.50	1600.	0.25	1000.	3300.	45.16	9639.	9854.	14.076	19.708	16.035	4.583
198	1.00	1600.	0.25	1000.	3300.	45.16	9639.	16676.	13.837	16.676	15.902	2.708
199	0.10	1300.	0.33	1000.	3300.	45.16	9639.	4459.	16.596	44.591	16.131	10.127
200	0.50	1300.	0.33	1000.	3300.	45.16	9639.	9960.	14.270	19.921	15.982	4.534
201	1.00	1300.	0.33	1000.	3300.	45.16	9639.	16867.	14.008	16.867	15.799	2.677
202	0.10	1420.	0.33	1000.	3300.	45.16	9639.	4147.	13.473	41.468	16.131	10.890
203	0.50	1420.	0.33	1000.	3300.	45.16	9639.	8554.	11.456	17.107	15.982	5.279
204	1.00	1420.	0.33	1000.	3300.	45.16	9639.	14088.	11.230	14.088	15.799	3.205
205	0.10	1600.	0.33	1000.	3300.	45.16	9639.	3984.	11.845	39.841	16.131	11.335
206	0.50	1600.	0.33	1000.	3300.	45.16	9639.	7854.	10.056	15.707	15.982	5.750
207	1.00	1600.	0.33	1000.	3300.	45.16	9639.	12713.	9.855	12.713	15.799	3.552
208	0.10	1300.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
209	0.50	1300.	0.50	1000.	3300.	44.35	9636.	13199.	20.370	26.398	14.714	3.360
210	1.00	1300.	0.50	1000.	3300.	44.35	9636.	23288.	20.051	23.288	13.701	1.904
211	0.10	1420.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
212	0.50	1420.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
213	1.00	1420.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
214	0.10	1600.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
215	0.50	1600.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
216	1.00	1600.	0.50	1000.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
217	0.10	1300.	0.25	1500.	3300.	45.41	9640.	5872.	36.617	58.723	20.543	7.733
218	0.50	1300.	0.25	1500.	3300.	45.42	9640.	18592.	32.733	37.184	20.404	2.443
219	1.00	1300.	0.25	1500.	3300.	45.42	9640.	34541.	32.296	34.541	20.229	1.315
220	0.10	1420.	0.25	1500.	3300.	45.42	9640.	5246.	30.358	52.463	20.546	8.657
221	0.50	1420.	0.25	1500.	3300.	45.42	9640.	15740.	27.028	31.479	20.404	2.885
222	1.00	1420.	0.25	1500.	3300.	45.42	9640.	28898.	26.653	28.898	20.229	1.572
223	0.10	1600.	0.25	1500.	3300.	45.42	9640.	3831.	16.204	38.309	20.546	11.855
224	0.50	1600.	0.25	1500.	3300.	45.42	9640.	9264.	14.076	18.527	20.404	4.902
225	1.00	1600.	0.25	1500.	3300.	45.42	9640.	16082.	13.837	16.082	20.229	2.824
226	0.10	1300.	0.33	1500.	3300.	45.42	9640.	3872.	16.596	38.717	20.530	11.730
227	0.50	1300.	0.33	1500.	3300.	45.42	9640.	9368.	14.270	18.737	20.334	4.848
228	1.00	1300.	0.33	1500.	3300.	45.42	9640.	16269.	14.008	16.269	20.093	2.792
229	0.10	1420.	0.33	1500.	3300.	45.42	9640.	3559.	13.473	35.594	20.530	12.759
230	0.50	1420.	0.33	1500.	3300.	45.42	9640.	7962.	11.456	15.923	20.334	5.704
231	1.00	1420.	0.33	1500.	3300.	45.42	9640.	13490.	11.230	13.490	20.093	3.367
232	0.10	1600.	0.33	1500.	3300.	45.42	9640.	3397.	11.845	33.967	20.530	13.370
233	0.50	1600.	0.33	1500.	3300.	45.42	9640.	7262.	10.056	14.523	20.334	6.254
234	1.00	1600.	0.33	1500.	3300.	45.42	9640.	12115.	9.855	12.115	20.093	3.749

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SERIAL LIST

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
235	0.10	1300.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
236	0.50	1300.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
237	1.00	1300.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
238	0.10	1420.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
239	0.50	1420.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
240	1.00	1420.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
241	0.10	1600.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
242	0.50	1600.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						
243	1.00	1600.	0.50	1500.	3300.	HEAT PIPE TEMP. BELOW TURBINE INLET TEMP.						

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-VJE SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPIENG N/KG	SPTMT N/KG
217	0.10	1300.	0.25	1500.	3300.	45.41	9640.	5872.	36.617	58.723	20.543	7.733
234	1.00	1600.	0.33	1500.	3300.	45.42	9640.	12115.	9.855	12.115	20.093	3.749
233	0.50	1600.	0.33	1500.	3300.	45.42	9640.	7262.	10.056	14.523	20.334	6.254
232	0.10	1600.	0.33	1500.	3300.	45.42	9640.	3397.	11.845	33.967	20.530	13.370
231	1.00	1420.	0.33	1500.	3300.	45.42	9640.	13490.	11.230	13.490	20.093	3.367
230	0.50	1420.	0.33	1500.	3300.	45.42	9640.	7962.	11.456	15.923	20.334	5.704
229	0.10	1420.	0.33	1500.	3300.	45.42	9640.	3559.	13.473	35.594	20.530	12.759
228	1.00	1300.	0.33	1500.	3300.	45.42	9640.	16269.	14.009	16.269	20.093	2.792
227	0.50	1300.	0.33	1500.	3300.	45.42	9640.	9368.	14.270	18.737	20.334	4.848
226	0.10	1300.	0.33	1500.	3300.	45.42	9640.	3872.	16.596	38.717	20.530	11.730
225	1.00	1600.	0.25	1500.	3300.	45.42	9640.	16082.	13.837	16.082	20.229	2.824
224	0.50	1600.	0.25	1500.	3300.	45.42	9640.	9264.	14.076	18.527	20.404	4.902
223	0.10	1600.	0.25	1500.	3300.	45.42	9640.	3831.	16.204	38.309	20.546	11.855
222	1.00	1420.	0.25	1500.	3300.	45.42	9640.	28898.	26.653	28.898	20.229	1.572
221	0.50	1420.	0.25	1500.	3300.	45.42	9640.	15740.	27.028	31.479	20.404	2.885
220	0.10	1420.	0.25	1500.	3300.	45.42	9640.	5246.	30.358	52.462	20.546	8.657
219	1.00	1300.	0.25	1500.	3300.	45.42	9640.	34541.	32.296	34.541	20.229	1.315
218	0.50	1300.	0.25	1500.	3300.	45.42	9640.	18592.	32.733	37.184	20.404	2.443
190	0.10	1300.	0.25	1000.	3300.	45.15	9639.	6459.	36.617	64.594	16.140	6.990
192	1.00	1300.	0.25	1000.	3300.	45.16	9639.	35136.	32.296	35.136	15.902	1.285
207	1.00	1600.	0.33	1000.	3300.	45.16	9639.	12713.	9.855	12.713	15.799	3.552
206	0.50	1600.	0.33	1000.	3300.	45.16	9639.	7854.	10.056	15.707	15.982	5.750
205	0.10	1600.	0.33	1000.	3300.	45.16	9639.	3984.	11.845	39.841	16.131	11.335
204	1.00	1420.	0.33	1000.	3300.	45.16	9639.	14088.	11.230	14.088	15.799	3.205
203	0.50	1420.	0.33	1000.	3300.	45.16	9639.	8554.	11.456	17.107	15.982	5.279
202	0.10	1420.	0.33	1000.	3300.	45.16	9639.	4147.	13.473	41.468	16.131	10.890
201	1.00	1300.	0.33	1000.	3300.	45.16	9639.	16867.	14.008	16.867	15.799	2.677
200	0.50	1300.	0.33	1000.	3300.	45.16	9639.	9960.	14.270	19.921	15.982	4.534
199	0.10	1300.	0.33	1000.	3300.	45.16	9639.	4459.	16.596	44.591	16.131	10.127
198	1.00	1600.	0.25	1000.	3300.	45.16	9639.	16676.	13.837	16.676	15.902	2.708
197	0.50	1600.	0.25	1000.	3300.	45.16	9639.	9854.	14.076	19.708	16.035	4.583
196	0.10	1600.	0.25	1000.	3300.	45.16	9639.	4418.	16.204	44.179	16.142	10.222
195	1.00	1420.	0.25	1000.	3300.	45.16	9639.	29493.	26.653	29.493	15.902	1.531
194	0.50	1420.	0.25	1000.	3300.	45.16	9639.	16330.	27.028	32.660	16.035	2.765
193	0.10	1420.	0.25	1000.	3300.	45.16	9639.	5833.	30.358	58.333	16.142	7.741
191	0.50	1300.	0.25	1000.	3300.	45.16	9639.	19183.	32.733	38.365	16.035	2.354
163	0.10	1300.	0.25	500.	3300.	44.46	9636.	8126.	36.617	81.261	9.959	5.471
189	1.00	1600.	0.50	500.	3300.	44.47	9636.	18074.	12.984	18.074	8.735	2.460
186	1.00	1420.	0.50	500.	3300.	44.47	9636.	21031.	15.940	21.031	8.735	2.114

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-VJE SORT

ENG NO.	QE MWE	TSUBM K	X	OD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
183	1.00	1300.	0.50	500.	3300.	44.47	9636.	25142.	20.051	25.142	8.735	1.769
165	1.00	1300.	0.25	500.	3300.	44.47	9636.	36820.	32.296	36.820	9.831	1.208
180	1.00	1600.	0.33	500.	3300.	44.47	9636.	14405.	9.855	14.405	9.774	3.087
179	0.50	1600.	0.33	500.	3300.	44.47	9636.	9532.	10.056	19.063	9.874	4.666
178	0.10	1600.	0.33	500.	3300.	44.47	9636.	5651.	11.845	56.514	9.956	7.869
177	1.00	1420.	0.33	500.	3300.	44.47	9636.	15779.	11.230	15.779	9.774	2.818
176	0.50	1420.	0.33	500.	3300.	44.47	9636.	10232.	11.456	20.464	9.874	4.346
175	0.10	1420.	0.33	500.	3300.	44.47	9636.	5814.	13.473	58.141	9.956	7.649
174	1.00	1300.	0.33	500.	3300.	44.47	9636.	18558.	14.008	18.558	9.774	2.396
173	0.50	1300.	0.33	500.	3300.	44.47	9636.	11639.	14.270	23.277	9.874	3.821
172	0.10	1300.	0.33	500.	3300.	44.47	9636.	6126.	16.596	61.265	9.956	7.259
171	1.00	1600.	0.25	500.	3300.	44.47	9636.	18360.	13.837	18.360	9.831	2.422
170	0.50	1600.	0.25	500.	3300.	44.47	9636.	11528.	14.076	23.057	9.903	3.857
169	0.10	1600.	0.25	500.	3300.	44.47	9636.	6084.	16.204	60.844	9.962	7.309
168	1.00	1420.	0.25	500.	3300.	44.47	9636.	31177.	26.653	31.177	9.831	1.426
167	0.50	1420.	0.25	500.	3300.	44.47	9636.	18004.	27.028	36.008	9.903	2.470
166	0.10	1420.	0.25	500.	3300.	44.47	9636.	7500.	30.358	74.998	9.962	5.930
164	0.50	1300.	0.25	500.	3300.	44.47	9636.	20857.	32.733	41.713	9.904	2.132
210	1.00	1300.	0.50	1000.	3300.	44.35	9636.	23288.	20.051	23.288	13.701	1.904
209	0.50	1300.	0.50	1000.	3300.	44.35	9636.	13199.	20.370	26.398	14.714	3.360
187	0.10	1600.	0.50	500.	3300.	44.29	9636.	6052.	15.270	60.522	9.788	7.318
184	0.10	1420.	0.50	500.	3300.	44.29	9636.	6388.	18.629	63.881	9.788	6.933
181	0.10	1300.	0.50	500.	3300.	44.29	9636.	6846.	23.211	68.463	9.788	6.469
188	0.50	1600.	0.50	500.	3300.	44.49	9635.	11383.	13.215	22.766	9.316	3.909
185	0.50	1420.	0.50	500.	3300.	44.49	9635.	12882.	16.212	25.763	9.316	3.454
182	0.50	1300.	0.50	500.	3300.	44.49	9635.	14961.	20.370	29.922	9.316	2.974
136	0.10	1300.	0.25	1500.	3000.	47.78	9221.	5897.	36.617	58.969	21.374	8.102
152	0.50	1600.	0.33	1500.	3000.	47.78	9221.	7286.	10.056	14.572	21.158	6.557
150	1.00	1420.	0.33	1500.	3000.	47.78	9221.	13515.	11.230	13.515	20.910	3.535
148	0.10	1420.	0.33	1500.	3000.	47.78	9221.	3584.	13.473	35.841	21.360	13.331
146	0.50	1300.	0.33	1500.	3000.	47.78	9221.	9393.	14.270	18.786	21.158	5.086
144	1.00	1600.	0.25	1500.	3000.	47.78	9221.	16106.	13.837	16.106	21.050	2.966
142	0.10	1600.	0.25	1500.	3000.	47.78	9221.	3856.	16.204	38.555	21.376	12.392
140	0.50	1420.	0.25	1500.	3000.	47.78	9221.	15764.	27.028	31.529	21.230	3.031
138	1.00	1300.	0.25	1500.	3000.	47.78	9221.	34566.	32.296	34.566	21.050	1.382
153	1.00	1600.	0.33	1500.	3000.	47.78	9221.	12140.	9.855	12.140	20.910	3.936
151	0.10	1600.	0.33	1500.	3000.	47.78	9221.	3421.	11.845	34.213	21.360	13.965
149	0.50	1420.	0.33	1500.	3000.	47.78	9221.	7986.	11.456	15.973	21.158	5.982
147	1.00	1300.	0.33	1500.	3000.	47.78	9221.	16293.	14.008	16.293	20.910	2.932

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-VJE SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
145	0.10	1300.	0.33	1500.	3000.	47.78	9221.	3896.	16.596	38.964	21.360	12.263
143	0.50	1600.	0.25	1500.	3000.	47.78	9221.	9288.	14.076	18.577	21.230	5.144
141	1.00	1420.	0.25	1500.	3000.	47.78	9221.	28923.	26.653	28.923	21.050	1.652
139	0.10	1420.	0.25	1500.	3000.	47.78	9221.	5271.	30.358	52.709	21.376	9.064
137	0.50	1300.	0.25	1500.	3000.	47.78	9221.	18617.	32.733	37.234	21.230	2.566
109	0.10	1300.	0.25	1000.	3000.	47.62	9221.	6485.	36.617	64.849	16.868	7.344
126	1.00	1600.	0.33	1000.	3000.	47.63	9221.	12739.	9.855	12.739	16.516	3.739
125	0.50	1600.	0.33	1000.	3000.	47.63	9221.	7879.	10.056	15.758	16.705	6.045
124	0.10	1600.	0.33	1000.	3000.	47.63	9221.	4009.	11.845	40.095	16.860	11.879
123	1.00	1420.	0.33	1000.	3000.	47.63	9221.	14113.	11.230	14.113	16.516	3.375
122	0.50	1420.	0.33	1000.	3000.	47.63	9221.	8579.	11.456	17.158	16.705	5.551
121	0.10	1420.	0.33	1000.	3000.	47.63	9221.	4172.	13.473	41.722	16.860	11.415
120	1.00	1300.	0.33	1000.	3000.	47.63	9221.	16892.	14.008	16.892	16.516	2.819
119	0.50	1300.	0.33	1000.	3000.	47.63	9221.	9986.	14.270	19.972	16.705	4.769
118	0.10	1300.	0.33	1000.	3000.	47.63	9221.	4485.	16.596	44.845	16.860	10.620
117	1.00	1600.	0.25	1000.	3000.	47.63	9221.	16702.	13.837	16.702	16.623	2.852
116	0.50	1600.	0.25	1000.	3000.	47.63	9221.	9879.	14.076	19.759	16.760	4.821
115	0.10	1600.	0.25	1000.	3000.	47.63	9221.	4443.	16.204	44.433	16.872	10.719
114	1.00	1420.	0.25	1000.	3000.	47.63	9221.	29519.	26.653	29.518	16.623	1.613
113	0.50	1420.	0.25	1000.	3000.	47.63	9221.	16355.	27.028	32.711	16.760	2.912
112	0.10	1420.	0.25	1000.	3000.	47.63	9221.	5859.	30.358	58.587	16.872	8.129
111	1.00	1300.	0.25	1000.	3000.	47.63	9221.	35161.	32.296	35.161	16.623	1.355
110	0.50	1300.	0.25	1000.	3000.	47.63	9221.	19208.	32.733	38.416	16.761	2.480
82	0.10	1300.	0.25	500.	3000.	47.26	9220.	8154.	36.617	81.540	10.519	5.795
84	1.00	1300.	0.25	500.	3000.	47.26	9219.	36848.	32.296	36.848	10.384	1.283
99	1.00	1600.	0.33	500.	3000.	47.26	9219.	14433.	9.855	14.433	10.325	3.275
98	0.50	1600.	0.33	500.	3000.	47.26	9219.	9560.	10.056	19.119	10.430	4.944
97	0.10	1600.	0.33	500.	3000.	47.26	9219.	5679.	11.845	56.794	10.515	8.322
96	1.00	1420.	0.33	500.	3000.	47.26	9219.	15807.	11.230	15.807	10.325	2.990
95	0.50	1420.	0.33	500.	3000.	47.26	9219.	10260.	11.456	20.519	10.430	4.607
94	0.10	1420.	0.33	500.	3000.	47.26	9219.	5842.	13.473	58.421	10.515	8.090
93	1.00	1300.	0.33	500.	3000.	47.26	9219.	18586.	14.008	18.586	10.325	2.543
92	0.50	1300.	0.33	500.	3000.	47.26	9219.	11666.	14.270	23.333	10.430	4.051
91	0.10	1300.	0.33	500.	3000.	47.26	9219.	6154.	16.596	61.545	10.515	7.679
90	1.00	1600.	0.25	500.	3000.	47.26	9219.	18388.	13.837	18.388	10.384	2.570
89	0.50	1600.	0.25	500.	3000.	47.26	9219.	11556.	14.076	23.112	10.460	4.090
88	0.10	1600.	0.25	500.	3000.	47.26	9219.	6112.	16.204	61.124	10.522	7.732
87	1.00	1420.	0.25	500.	3000.	47.26	9219.	31205.	26.653	31.205	10.384	1.515
86	0.50	1420.	0.25	500.	3000.	47.26	9219.	18032.	27.028	36.064	10.460	2.621

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-VJE SORT

ENG NO.	QE MWE	TSUBM K	X	OD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
85	0.10	1420.	0.25	500.	3000.	47.26	9219.	7528.	30.358	75.278	10.522	6.278
83	0.50	1300.	0.25	500.	3000.	47.26	9219.	20985.	32.733	41.769	10.460	2.263
105	1.00	1420.	0.50	500.	3000.	46.36	9217.	21052.	15.940	21.052	9.068	2.202
104	0.50	1420.	0.50	500.	3000.	46.36	9217.	12904.	16.212	25.808	9.662	3.593
102	1.00	1300.	0.50	500.	3000.	46.36	9217.	25163.	20.051	25.163	9.068	1.842
101	0.50	1300.	0.50	500.	3000.	46.36	9217.	14983.	20.370	29.967	9.662	3.094
103	0.10	1420.	0.50	500.	3000.	46.18	9216.	6409.	18.629	64.093	10.158	7.205
100	0.10	1300.	0.50	500.	3000.	46.18	9216.	6867.	23.211	68.675	10.158	6.725
55	0.10	1300.	0.25	1500.	2700.	50.49	8776.	5928.	36.617	59.275	22.283	8.518
28	0.10	1300.	0.25	1000.	2700.	50.49	8776.	6516.	36.617	65.164	17.685	7.748
62	0.50	1600.	0.25	1500.	2700.	50.49	8776.	9319.	14.076	18.638	22.134	5.419
59	0.50	1420.	0.25	1500.	2700.	50.49	8776.	15795.	27.028	31.590	22.134	3.197
56	0.50	1300.	0.25	1500.	2700.	50.49	8776.	18647.	32.733	37.295	22.134	2.708
61	0.10	1600.	0.25	1500.	2700.	50.49	8776.	3886.	16.204	38.862	22.284	12.992
58	0.10	1420.	0.25	1500.	2700.	50.49	8776.	5302.	30.358	53.015	22.284	9.524
2	0.50	1300.	0.25	500.	2700.	50.48	8776.	20920.	32.733	41.839	11.086	2.413
44	0.50	1600.	0.33	1000.	2700.	50.44	8776.	7911.	10.056	15.821	17.499	6.376
41	0.50	1420.	0.33	1000.	2700.	50.44	8776.	8611.	11.456	17.221	17.499	5.858
38	0.50	1300.	0.33	1000.	2700.	50.44	8776.	10017.	14.270	20.035	17.499	5.035
45	1.00	1600.	0.33	1000.	2700.	50.44	8776.	12770.	9.855	12.770	17.302	3.950
42	1.00	1420.	0.33	1000.	2700.	50.44	8776.	14145.	11.230	14.145	17.302	3.566
39	1.00	1300.	0.33	1000.	2700.	50.44	8776.	16924.	14.008	16.924	17.302	2.980
18	1.00	1600.	0.33	500.	2700.	50.38	8776.	14467.	9.855	14.467	10.922	3.482
17	0.50	1600.	0.33	500.	2700.	50.38	8776.	9594.	10.056	19.188	11.033	5.251
16	0.10	1600.	0.33	500.	2700.	50.38	8776.	5714.	11.845	57.138	11.122	8.816
15	1.00	1420.	0.33	500.	2700.	50.38	8776.	15842.	11.230	15.842	10.922	3.180
14	0.50	1420.	0.33	500.	2700.	50.38	8776.	10294.	11.456	20.588	11.033	4.894
13	0.10	1420.	0.33	500.	2700.	50.38	8776.	5877.	13.473	58.766	11.122	8.572
12	1.00	1300.	0.33	500.	2700.	50.38	8776.	18620.	14.008	18.620	10.922	2.705
11	0.50	1300.	0.33	500.	2700.	50.38	8776.	11701.	14.270	23.402	11.033	4.305
63	1.00	1600.	0.25	1500.	2700.	50.52	8776.	16137.	13.837	16.137	21.964	3.131
60	1.00	1420.	0.25	1500.	2700.	50.52	8776.	28954.	26.653	28.954	21.964	1.745
57	1.00	1300.	0.25	1500.	2700.	50.52	8776.	34597.	32.296	34.597	21.964	1.460
36	1.00	1600.	0.25	1000.	2700.	50.49	8776.	16733.	13.837	16.733	17.430	3.017
35	0.50	1600.	0.25	1000.	2700.	50.49	8776.	9911.	14.076	19.822	17.572	5.094
34	0.10	1600.	0.25	1000.	2700.	50.49	8776.	4475.	16.204	44.750	17.687	11.283
33	1.00	1420.	0.25	1000.	2700.	50.49	8776.	29550.	26.653	29.550	17.430	1.709
32	0.50	1420.	0.25	1000.	2700.	50.49	8776.	16387.	27.028	32.774	17.572	3.081
31	0.10	1420.	0.25	1000.	2700.	50.49	8776.	5890.	30.358	58.903	17.687	8.572

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-VJE SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
30	1.00	1300.	0.25	1000.	2700.	50.49	8776.	35193.	32.296	35.193	17.430	1.435
29	0.50	1300.	0.25	1000.	2700.	50.49	8776.	19240.	32.733	38.479	17.572	2.624
10	0.10	1300.	0.33	500.	2700.	50.38	8776.	6189.	16.596	61.889	11.123	8.140
9	1.00	1600.	0.25	500.	2700.	50.48	8776.	18423.	13.837	18.423	11.007	2.740
8	0.50	1600.	0.25	500.	2700.	50.48	8776.	11591.	14.076	23.182	11.087	4.355
7	0.10	1600.	0.25	500.	2700.	50.48	8776.	6147.	16.204	61.471	11.151	8.212
6	1.00	1420.	0.25	500.	2700.	50.48	8776.	31240.	26.653	31.240	11.007	1.616
5	0.50	1420.	0.25	500.	2700.	50.48	8776.	18067.	27.028	36.134	11.087	2.794
4	0.10	1420.	0.25	500.	2700.	50.48	8776.	7562.	30.358	75.625	11.151	6.675
3	1.00	1300.	0.25	500.	2700.	50.48	8776.	36882.	32.296	36.882	11.007	1.369
43	0.10	1600.	0.33	1000.	2700.	50.39	8776.	4041.	11.845	40.406	17.645	12.472
40	0.10	1420.	0.33	1000.	2700.	50.39	8776.	4203.	13.473	42.033	17.645	11.989
37	0.10	1300.	0.33	1000.	2700.	50.39	8776.	4516.	16.596	45.156	17.645	11.160
72	1.00	1600.	0.33	1500.	2700.	50.40	8776.	12170.	9.855	12.170	21.771	4.141
71	0.50	1600.	0.33	1500.	2700.	50.40	8776.	7316.	10.056	14.632	22.026	6.888
69	1.00	1420.	0.33	1500.	2700.	50.40	8776.	13544.	11.230	13.544	21.771	3.721
68	0.50	1420.	0.33	1500.	2700.	50.40	8776.	8016.	11.456	16.032	22.026	6.287
66	1.00	1300.	0.33	1500.	2700.	50.40	8776.	16323.	14.008	16.323	21.771	3.087
65	0.50	1300.	0.33	1500.	2700.	50.40	8776.	9423.	14.270	18.846	22.026	5.348
70	0.10	1600.	0.33	1500.	2700.	50.36	8776.	3451.	11.845	34.510	22.222	14.594
67	0.10	1420.	0.33	1500.	2700.	50.36	8776.	3614.	13.473	36.137	22.222	13.937
64	0.10	1300.	0.33	1500.	2700.	50.36	8776.	3926.	16.596	39.260	22.222	12.828
1	0.10	1300.	0.25	500.	2700.	50.50	8775.	8187.	36.617	81.871	11.160	6.169
21	1.00	1300.	0.50	500.	2700.	48.59	8771.	25190.	20.051	25.190	9.455	1.929
20	0.50	1300.	0.50	500.	2700.	48.59	8771.	15010.	20.370	30.020	10.070	3.237

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-ZMTOT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
232	0.10	1600.	0.33	1500.	3300.	45.42	9640.	3397.	11.845	33.967	20.530	13.370
151	0.10	1600.	0.33	1500.	3000.	47.78	9221.	3421.	11.845	34.213	21.360	13.965
70	0.10	1600.	0.33	1500.	2700.	50.36	8776.	3451.	11.845	34.510	22.222	14.594
229	0.10	1420.	0.33	1500.	3300.	45.42	9640.	3559.	13.473	35.594	20.530	12.759
148	0.10	1420.	0.33	1500.	3000.	47.78	9221.	3584.	13.473	35.841	21.360	13.331
67	0.10	1420.	0.33	1500.	2700.	50.36	8776.	3614.	13.473	36.137	22.222	13.937
223	0.10	1600.	0.25	1500.	3300.	45.42	9640.	3831.	16.204	38.309	20.546	11.855
142	0.10	1600.	0.25	1500.	3000.	47.78	9221.	3856.	16.204	38.555	21.376	12.392
226	0.10	1300.	0.33	1500.	3300.	45.42	9640.	3872.	16.596	38.717	20.530	11.730
61	0.10	1600.	0.25	1500.	2700.	50.49	8776.	3886.	16.204	38.862	22.284	12.992
145	0.10	1300.	0.33	1500.	3000.	47.78	9221.	3896.	16.596	38.964	21.360	12.262
64	0.10	1300.	0.33	1500.	2700.	50.36	8776.	3926.	16.596	39.260	22.222	12.828
205	0.10	1600.	0.33	1000.	3300.	45.16	9639.	3984.	11.845	39.841	16.131	11.335
124	0.10	1600.	0.33	1000.	3000.	47.63	9221.	4009.	11.845	40.095	16.860	11.879
43	0.10	1600.	0.33	1000.	2700.	50.39	8776.	4041.	11.845	40.406	17.645	12.472
202	0.10	1420.	0.33	1000.	3300.	45.16	9639.	4147.	13.473	41.468	16.131	10.890
121	0.10	1420.	0.33	1000.	3000.	47.63	9221.	4172.	13.473	41.722	16.860	11.415
40	0.10	1420.	0.33	1000.	2700.	50.39	8776.	4203.	13.473	42.033	17.645	11.989
196	0.10	1600.	0.25	1000.	3300.	45.16	9639.	4418.	16.204	44.179	16.142	10.222
115	0.10	1600.	0.25	1000.	3000.	47.63	9221.	4443.	16.204	44.433	16.872	10.719
199	0.10	1300.	0.33	1000.	3300.	45.16	9639.	4459.	16.596	44.591	16.131	10.127
34	0.10	1600.	0.25	1000.	2700.	50.49	8776.	4475.	16.204	44.750	17.687	11.283
118	0.10	1300.	0.33	1000.	3000.	47.63	9221.	4485.	16.596	44.845	16.860	10.620
37	0.10	1300.	0.33	1000.	2700.	50.39	8776.	4516.	16.596	45.156	17.645	11.160
220	0.10	1420.	0.25	1500.	3300.	45.42	9640.	5246.	30.358	52.462	20.546	8.657
139	0.10	1420.	0.25	1500.	3000.	47.78	9221.	5271.	30.358	52.709	21.376	9.064
58	0.10	1420.	0.25	1500.	2700.	50.49	8776.	5302.	30.358	53.015	22.284	9.524
178	0.10	1600.	0.33	500.	3300.	44.47	9636.	5651.	11.845	56.514	9.956	7.869
97	0.10	1600.	0.33	500.	3000.	47.26	9219.	5679.	11.845	56.794	10.515	8.322
16	0.10	1600.	0.33	500.	2700.	50.38	8776.	5714.	11.845	57.138	11.122	8.816
175	0.10	1420.	0.33	500.	3300.	44.47	9636.	5814.	13.473	58.141	9.956	7.649
193	0.10	1420.	0.25	1000.	3300.	45.16	9639.	5833.	30.358	58.333	16.142	7.741
94	0.10	1420.	0.33	500.	3000.	47.26	9219.	5842.	13.473	58.421	10.515	8.090
112	0.10	1420.	0.25	1000.	3000.	47.63	9221.	5859.	30.358	58.587	16.872	8.129
217	0.10	1300.	0.25	1500.	3300.	45.41	9640.	5872.	36.617	58.723	20.543	7.733
13	0.10	1420.	0.33	500.	2700.	50.38	8776.	5877.	13.473	58.766	11.122	8.572
31	0.10	1420.	0.25	1000.	2700.	50.49	8776.	5890.	30.358	58.903	17.687	8.572
136	0.10	1300.	0.25	1500.	3000.	47.78	9221.	5897.	36.617	58.969	21.374	8.102
55	0.10	1300.	0.25	1500.	2700.	50.49	8776.	5928.	36.617	59.275	22.283	8.518

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-ZMTOT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
187	0.10	1600.	0.50	500.	3300.	44.29	9636.	6052.	15.270	60.522	9.788	7.318
169	0.10	1600.	0.25	500.	3300.	44.47	9636.	6084.	16.204	60.844	9.962	7.309
88	0.10	1600.	0.25	500.	3000.	47.26	9219.	6112.	16.204	61.124	10.522	7.732
172	0.10	1300.	0.33	500.	3300.	44.47	9636.	6126.	16.596	61.265	9.956	7.259
7	0.10	1600.	0.25	500.	2700.	50.48	8776.	6147.	16.204	61.471	11.151	8.212
91	0.10	1300.	0.33	500.	3000.	47.26	9219.	6154.	16.596	61.545	10.515	7.679
10	0.10	1300.	0.33	500.	2700.	50.38	8776.	6189.	16.596	61.889	11.123	8.140
184	0.10	1420.	0.50	500.	3300.	44.29	9636.	6388.	18.629	63.881	9.788	6.933
103	0.10	1420.	0.50	500.	3000.	46.18	9216.	6409.	18.629	64.093	10.158	7.205
190	0.10	1300.	0.25	1000.	3300.	45.15	9639.	6459.	36.617	64.594	16.140	6.990
109	0.10	1300.	0.25	1000.	3000.	47.62	9221.	6485.	36.617	64.849	16.868	7.344
28	0.10	1300.	0.25	1000.	2700.	50.49	8776.	6516.	36.617	65.164	17.685	7.748
181	0.10	1300.	0.50	500.	3300.	44.29	9636.	6846.	23.211	68.463	9.788	6.469
100	0.10	1300.	0.50	500.	3000.	46.18	9216.	6867.	23.211	68.675	10.158	6.725
233	0.50	1600.	0.33	1500.	3300.	45.42	9640.	7262.	10.056	14.523	20.334	6.254
152	0.50	1600.	0.33	1500.	3000.	47.78	9221.	7286.	10.056	14.572	21.158	6.557
71	0.50	1600.	0.33	1500.	2700.	50.40	8776.	7316.	10.056	14.632	22.026	6.888
166	0.10	1420.	0.25	500.	3300.	44.47	9636.	7500.	30.358	74.998	9.962	5.930
85	0.10	1420.	0.25	500.	3000.	47.26	9219.	7528.	30.358	75.278	10.522	6.278
4	0.10	1420.	0.25	500.	2700.	50.48	8776.	7562.	30.358	75.625	11.151	6.675
206	0.50	1600.	0.33	1000.	3300.	45.16	9639.	7854.	10.056	15.707	15.982	5.750
125	0.50	1600.	0.33	1000.	3000.	47.63	9221.	7879.	10.056	15.758	16.705	6.045
44	0.50	1600.	0.33	1000.	2700.	50.44	8776.	7911.	10.056	15.821	17.499	6.376
230	0.50	1420.	0.33	1500.	3300.	45.42	9640.	7962.	11.456	15.923	20.334	5.704
149	0.50	1420.	0.33	1500.	3000.	47.78	9221.	7986.	11.456	15.973	21.158	5.982
68	0.50	1420.	0.33	1500.	2700.	50.40	8776.	8016.	11.456	16.032	22.026	6.287
163	0.10	1300.	0.25	500.	3300.	44.46	9636.	8126.	36.617	81.261	9.959	5.471
82	0.10	1300.	0.25	500.	3000.	47.26	9220.	8154.	36.617	81.540	10.519	5.795
1	0.10	1300.	0.25	500.	2700.	50.50	8775.	8187.	36.617	81.871	11.160	6.169
203	0.50	1420.	0.33	1000.	3300.	45.16	9639.	8554.	11.456	17.107	15.982	5.279
122	0.50	1420.	0.33	1000.	3000.	47.63	9221.	8579.	11.456	17.158	16.705	5.551
41	0.50	1420.	0.33	1000.	2700.	50.44	8776.	8611.	11.456	17.221	17.499	5.858
224	0.50	1600.	0.25	1500.	3300.	45.42	9640.	9264.	14.076	18.527	20.404	4.902
143	0.50	1600.	0.25	1500.	3000.	47.78	9221.	9288.	14.076	18.577	21.230	5.144
62	0.50	1600.	0.25	1500.	2700.	50.49	8776.	9319.	14.076	18.638	22.134	5.418
227	0.50	1300.	0.33	1500.	3300.	45.42	9640.	9368.	14.270	18.737	20.334	4.848
146	0.50	1300.	0.33	1500.	3000.	47.78	9221.	9393.	14.270	18.786	21.158	5.086
65	0.50	1300.	0.33	1500.	2700.	50.40	8776.	9423.	14.270	18.846	22.026	5.348
179	0.50	1600.	0.33	500.	3300.	44.47	9636.	9532.	10.056	19.063	9.874	4.666

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-ZMTOT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	P KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
98	0.50	1600.	0.33	500.	3000.	47.26	9219.	9560.	10.056	19.119	10.430	4.944
17	0.50	1600.	0.33	500.	2700.	50.38	8776.	9594.	10.056	19.188	11.033	5.251
197	0.50	1600.	0.25	1000.	3300.	45.16	9639.	9854.	14.076	19.708	16.035	4.583
116	0.50	1600.	0.25	1000.	3000.	47.63	9221.	9879.	14.076	19.759	16.760	4.821
35	0.50	1600.	0.25	1000.	2700.	50.49	8776.	9911.	14.076	19.822	17.572	5.094
200	0.50	1300.	0.33	1000.	3300.	45.16	9639.	9960.	14.270	19.921	15.982	4.534
119	0.50	1300.	0.33	1000.	3000.	47.63	9221.	9986.	14.270	19.972	16.705	4.769
38	0.50	1300.	0.33	1000.	2700.	50.44	8776.	10017.	14.270	20.035	17.499	5.035
176	0.50	1420.	0.33	500.	3300.	44.47	9636.	10232.	11.456	20.464	9.874	4.346
95	0.50	1420.	0.33	500.	3000.	47.26	9219.	10260.	11.456	20.519	10.430	4.607
14	0.50	1420.	0.33	500.	2700.	50.38	8776.	10294.	11.456	20.588	11.033	4.894
188	0.50	1600.	0.50	500.	3300.	44.49	9635.	11383.	13.215	22.766	9.316	3.908
170	0.50	1600.	0.25	500.	3300.	44.47	9636.	11528.	14.076	23.057	9.903	3.857
89	0.50	1600.	0.25	500.	3000.	47.26	9219.	11556.	14.076	23.112	10.460	4.090
8	0.50	1600.	0.25	500.	2700.	50.48	8776.	11591.	14.076	23.182	11.087	4.355
173	0.50	1300.	0.33	500.	3300.	44.47	9636.	11639.	14.270	23.277	9.874	3.821
92	0.50	1300.	0.33	500.	3000.	47.26	9219.	11666.	14.270	23.333	10.430	4.051
11	0.50	1300.	0.33	500.	2700.	50.38	8776.	11701.	14.270	23.402	11.033	4.305
234	1.00	1600.	0.33	1500.	3300.	45.42	9640.	12115.	9.855	12.115	20.093	3.749
153	1.00	1600.	0.33	1500.	3000.	47.78	9221.	12140.	9.855	12.140	20.910	3.936
72	1.00	1600.	0.33	1500.	2700.	50.40	8776.	12170.	9.855	12.170	21.771	4.141
207	1.00	1600.	0.33	1000.	3300.	45.16	9639.	12713.	9.855	12.713	15.799	3.552
126	1.00	1600.	0.33	1000.	3000.	47.63	9221.	12739.	9.855	12.739	16.516	3.739
45	1.00	1600.	0.33	1000.	2700.	50.44	8776.	12770.	9.855	12.770	17.302	3.950
185	0.50	1420.	0.50	500.	3300.	44.49	9635.	12882.	16.212	25.763	9.316	3.454
104	0.50	1420.	0.50	500.	3000.	46.36	9217.	12904.	16.212	25.808	9.662	3.593
209	0.50	1300.	0.50	1000.	3300.	44.35	9636.	13199.	20.370	26.398	14.714	3.360
231	1.00	1420.	0.33	1500.	3300.	45.42	9640.	13490.	11.230	13.490	20.093	3.367
150	1.00	1420.	0.33	1500.	3000.	47.78	9221.	13515.	11.230	13.515	20.910	3.535
69	1.00	1420.	0.33	1500.	2700.	50.40	8776.	13544.	11.230	13.544	21.771	3.721
204	1.00	1420.	0.33	1000.	3300.	45.16	9639.	14088.	11.230	14.088	15.799	3.205
123	1.00	1420.	0.33	1000.	3000.	47.63	9221.	14113.	11.230	14.113	16.516	3.375
42	1.00	1420.	0.33	1000.	2700.	50.44	8776.	14145.	11.230	14.145	17.302	3.566
180	1.00	1600.	0.33	500.	3300.	44.47	9636.	14405.	9.855	14.405	9.774	3.087
99	1.00	1600.	0.33	500.	3000.	47.26	9219.	14433.	9.855	14.433	10.325	3.275
18	1.00	1600.	0.33	500.	2700.	50.38	8776.	14467.	9.855	14.467	10.922	3.482
182	0.50	1300.	0.50	500.	3300.	44.49	9635.	14961.	20.370	29.922	9.316	2.974
101	0.50	1300.	0.50	500.	3000.	46.36	9217.	14983.	20.370	29.967	9.662	3.094
20	0.50	1300.	0.50	500.	2700.	48.59	8771.	15010.	20.370	30.020	10.070	3.237

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-ZMTOT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
221	0.50	1420.	0.25	1500.	3300.	45.42	9640.	15740.	27.028	31.479	20.404	2.885
140	0.50	1420.	0.25	1500.	3000.	47.78	9221.	15764.	27.028	31.529	21.230	3.031
177	1.00	1420.	0.33	500.	3300.	44.47	9636.	15779.	11.230	15.779	9.774	2.818
59	0.50	1420.	0.25	1500.	2700.	50.49	8776.	15795.	27.028	31.590	22.134	3.197
96	1.00	1420.	0.33	500.	3000.	47.26	9219.	15807.	11.230	15.807	10.325	2.990
15	1.00	1420.	0.33	500.	2700.	50.38	8776.	15842.	11.230	15.842	10.922	3.180
225	1.00	1600.	0.25	1500.	3300.	45.42	9640.	16082.	13.837	16.082	20.229	2.824
144	1.00	1600.	0.25	1500.	3000.	47.78	9221.	16106.	13.837	16.106	21.050	2.966
63	1.00	1600.	0.25	1500.	2700.	50.52	8776.	16137.	13.837	16.137	21.964	3.131
228	1.00	1300.	0.33	1500.	3300.	45.42	9640.	16269.	14.008	16.269	20.093	2.792
147	1.00	1300.	0.33	1500.	3000.	47.78	9221.	16293.	14.008	16.293	20.910	2.932
66	1.00	1300.	0.33	1500.	2700.	50.40	8776.	16323.	14.008	16.323	21.771	3.087
194	0.50	1420.	0.25	1000.	3300.	45.16	9639.	16330.	27.028	32.660	16.035	2.765
113	0.50	1420.	0.25	1000.	3000.	47.63	9221.	16355.	27.028	32.711	16.760	2.912
32	0.50	1420.	0.25	1000.	2700.	50.49	8776.	16387.	27.028	32.774	17.572	3.081
198	1.00	1600.	0.25	1000.	3300.	45.16	9639.	16676.	13.837	16.676	15.902	2.708
117	1.00	1600.	0.25	1000.	3000.	47.63	9221.	16702.	13.837	16.702	16.623	2.852
36	1.00	1600.	0.25	1000.	2700.	50.49	8776.	16733.	13.837	16.733	17.430	3.017
201	1.00	1300.	0.33	1000.	3300.	45.16	9639.	16867.	14.008	16.867	15.799	2.677
120	1.00	1300.	0.33	1000.	3000.	47.63	9221.	16892.	14.008	16.892	16.516	2.819
39	1.00	1300.	0.33	1000.	2700.	50.44	8776.	16924.	14.008	16.924	17.302	2.980
167	0.50	1420.	0.25	500.	3300.	44.47	9636.	18004.	27.028	36.008	9.903	2.470
86	0.50	1420.	0.25	500.	3000.	47.26	9219.	18032.	27.028	36.064	10.460	2.621
5	0.50	1420.	0.25	500.	2700.	50.48	8776.	18067.	27.028	36.134	11.087	2.794
189	1.00	1600.	0.50	500.	3300.	44.47	9636.	18074.	12.984	18.074	8.735	2.460
171	1.00	1600.	0.25	500.	3300.	44.47	9636.	18360.	13.837	18.360	9.831	2.422
90	1.00	1600.	0.25	500.	3000.	47.26	9219.	18388.	13.837	18.388	10.384	2.570
9	1.00	1600.	0.25	500.	2700.	50.48	8776.	18423.	13.837	18.423	11.007	2.740
174	1.00	1300.	0.33	500.	3300.	44.47	9636.	18558.	14.008	18.558	9.774	2.396
93	1.00	1300.	0.33	500.	3000.	47.26	9219.	18586.	14.008	18.586	10.325	2.543
218	0.50	1300.	0.25	1500.	3300.	45.42	9640.	18592.	32.733	37.184	20.404	2.443
137	0.50	1300.	0.25	1500.	3000.	47.78	9221.	18617.	32.733	37.234	21.230	2.566
12	1.00	1300.	0.33	500.	2700.	50.38	8776.	18620.	14.008	18.620	10.922	2.705
56	0.50	1300.	0.25	1500.	2700.	50.49	8776.	18647.	32.733	37.295	22.134	2.708
191	0.50	1300.	0.25	1000.	3300.	45.16	9639.	19183.	32.733	38.365	16.035	2.354
110	0.50	1300.	0.25	1000.	3000.	47.63	9221.	19208.	32.733	38.416	16.761	2.480
29	0.50	1300.	0.25	1000.	2700.	50.49	8776.	19240.	32.733	38.479	17.572	2.624
164	0.50	1300.	0.25	500.	3300.	44.47	9636.	20857.	32.733	41.713	9.904	2.132
83	0.50	1300.	0.25	500.	3000.	47.26	9219.	20885.	32.733	41.769	10.460	2.263

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-ZMTOT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
2	0.50	1300.	0.25	500.	2700.	50.48	8776.	20920.	32.733	41.839	11.086	2.413
186	1.00	1420.	0.50	500.	3300.	44.47	9636.	21031.	15.940	21.031	8.735	2.114
105	1.00	1420.	0.50	500.	3000.	46.36	9217.	21052.	15.940	21.052	9.068	2.202
210	1.00	1300.	0.50	1000.	3300.	44.35	9636.	23288.	20.051	23.288	13.701	1.904
183	1.00	1300.	0.50	500.	3300.	44.47	9636.	25142.	20.051	25.142	8.735	1.769
102	1.00	1300.	0.50	500.	3000.	46.36	9217.	25163.	20.051	25.163	9.068	1.842
21	1.00	1300.	0.50	500.	2700.	48.59	8771.	25190.	20.051	25.190	9.455	1.929
222	1.00	1420.	0.25	1500.	3300.	45.42	9640.	28898.	26.653	28.898	20.229	1.572
141	1.00	1420.	0.25	1500.	3000.	47.78	9221.	28923.	26.653	28.923	21.050	1.652
60	1.00	1420.	0.25	1500.	2700.	50.52	8776.	28954.	26.653	28.954	21.964	1.745
195	1.00	1420.	0.25	1000.	3300.	45.16	9639.	29493.	26.653	29.493	15.902	1.531
114	1.00	1420.	0.25	1000.	3000.	47.63	9221.	29519.	26.653	29.518	16.623	1.613
33	1.00	1420.	0.25	1000.	2700.	50.49	8776.	29550.	26.653	29.550	17.430	1.709
168	1.00	1420.	0.25	500.	3300.	44.47	9636.	31177.	26.653	31.177	9.831	1.426
87	1.00	1420.	0.25	500.	3000.	47.26	9219.	31205.	26.653	31.205	10.384	1.515
6	1.00	1420.	0.25	500.	2700.	50.48	8776.	31240.	26.653	31.240	11.007	1.616
219	1.00	1300.	0.25	1500.	3300.	45.42	9640.	34541.	32.296	34.541	20.229	1.315
138	1.00	1300.	0.25	1500.	3000.	47.78	9221.	34566.	32.296	34.566	21.050	1.382
57	1.00	1300.	0.25	1500.	2700.	50.52	8776.	34597.	32.296	34.597	21.964	1.460
192	1.00	1300.	0.25	1000.	3300.	45.16	9639.	35136.	32.296	35.136	15.902	1.285
111	1.00	1300.	0.25	1000.	3000.	47.63	9221.	35161.	32.296	35.161	16.623	1.355
30	1.00	1300.	0.25	1000.	2700.	50.49	8776.	35193.	32.296	35.193	17.430	1.435
165	1.00	1300.	0.25	500.	3300.	44.47	9636.	36820.	32.296	36.820	9.831	1.208
84	1.00	1300.	0.25	500.	3000.	47.26	9219.	36848.	32.296	36.848	10.384	1.283
3	1.00	1300.	0.25	500.	2700.	50.48	8776.	36882.	32.296	36.882	11.007	1.369

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPMMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
234	1.00	1600.	0.33	1500.	3300.	45.42	9640.	12115.	9.855	12.115	20.093	3.749
153	1.00	1600.	0.33	1500.	3000.	47.78	9221.	12140.	9.855	12.140	20.910	3.936
72	1.00	1600.	0.33	1500.	2700.	50.40	8776.	12170.	9.855	12.170	21.771	4.141
207	1.00	1600.	0.33	1000.	3300.	45.16	9639.	12713.	9.855	12.713	15.799	3.552
126	1.00	1600.	0.33	1000.	3000.	47.63	9221.	12739.	9.855	12.739	16.516	3.739
45	1.00	1600.	0.33	1000.	2700.	50.44	8776.	12770.	9.855	12.770	17.302	3.950
231	1.00	1420.	0.33	1500.	3300.	45.42	9640.	13490.	11.230	13.490	20.093	3.367
150	1.00	1420.	0.33	1500.	3000.	47.78	9221.	13515.	11.230	13.515	20.910	3.535
69	1.00	1420.	0.33	1500.	2700.	50.40	8776.	13544.	11.230	13.544	21.771	3.721
204	1.00	1420.	0.33	1000.	3300.	45.16	9639.	14088.	11.230	14.088	15.799	3.205
123	1.00	1420.	0.33	1000.	3000.	47.63	9221.	14113.	11.230	14.113	16.516	3.375
42	1.00	1420.	0.33	1000.	2700.	50.44	8776.	14145.	11.230	14.145	17.302	3.566
180	1.00	1600.	0.33	500.	3300.	44.47	9636.	14405.	9.855	14.405	9.774	3.087
99	1.00	1600.	0.33	500.	3000.	47.26	9219.	14433.	9.855	14.433	10.325	3.275
18	1.00	1600.	0.33	500.	2700.	50.38	8776.	14467.	9.855	14.467	10.922	3.482
233	0.50	1600.	0.33	1500.	3300.	45.42	9640.	7262.	10.056	14.523	20.334	6.254
152	0.50	1600.	0.33	1500.	3000.	47.78	9221.	7286.	10.056	14.572	21.158	6.557
71	0.50	1600.	0.33	1500.	2700.	50.40	8776.	7316.	10.056	14.632	22.026	6.888
206	0.50	1600.	0.33	1000.	3300.	45.16	9639.	7854.	10.056	15.707	15.982	5.750
125	0.50	1600.	0.33	1000.	3000.	47.63	9221.	7879.	10.056	15.758	16.705	6.045
177	1.00	1420.	0.33	500.	3300.	44.47	9636.	15779.	11.230	15.779	9.774	2.818
96	1.00	1420.	0.33	500.	3000.	47.26	9219.	15807.	11.230	15.807	10.325	2.990
44	0.50	1600.	0.33	1000.	2700.	50.44	8776.	7911.	10.056	15.821	17.499	6.376
15	1.00	1420.	0.33	500.	2700.	50.38	8776.	15842.	11.230	15.842	10.922	3.180
230	0.50	1420.	0.33	1500.	3300.	45.42	9640.	7962.	11.456	15.923	20.334	5.704
149	0.50	1420.	0.33	1500.	3000.	47.78	9221.	7986.	11.456	15.973	21.158	5.982
68	0.50	1420.	0.33	1500.	2700.	50.40	8776.	8016.	11.456	16.032	22.026	6.297
225	1.00	1600.	0.25	1500.	3300.	45.42	9640.	16082.	13.837	16.082	20.229	2.824
144	1.00	1600.	0.25	1500.	3000.	47.78	9221.	16106.	13.837	16.106	21.050	2.966
63	1.00	1600.	0.25	1500.	2700.	50.52	8776.	16137.	13.837	16.137	21.964	3.131
228	1.00	1300.	0.33	1500.	3300.	45.42	9640.	16269.	14.008	16.269	20.093	2.792
147	1.00	1300.	0.33	1500.	3000.	47.78	9221.	16293.	14.008	16.293	20.910	2.932
66	1.00	1300.	0.33	1500.	2700.	50.40	8776.	16323.	14.008	16.323	21.771	3.087
198	1.00	1600.	0.25	1000.	3300.	45.16	9639.	16676.	13.837	16.676	15.902	2.708
117	1.00	1600.	0.25	1000.	3000.	47.63	9221.	16702.	13.837	16.702	16.623	2.852
36	1.00	1600.	0.25	1000.	2700.	50.49	8776.	16733.	13.837	16.733	17.430	3.017
201	1.00	1300.	0.33	1000.	3300.	45.16	9639.	16867.	14.008	16.867	15.799	2.677
120	1.00	1300.	0.33	1000.	3000.	47.63	9221.	16892.	14.008	16.892	16.516	2.819
39	1.00	1300.	0.33	1000.	2700.	50.44	8776.	16924.	14.008	16.924	17.302	2.980

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPMMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
203	0.50	1420.	0.33	1000.	3300.	45.16	9639.	8554.	11.456	17.107	15.982	5.279
122	0.50	1420.	0.33	1000.	3000.	47.63	9221.	8579.	11.456	17.158	16.705	5.551
41	0.50	1420.	0.33	1000.	2700.	50.44	8776.	8611.	11.456	17.221	17.499	5.858
189	1.00	1600.	0.50	500.	3300.	44.47	9636.	18074.	12.984	18.074	8.735	2.460
171	1.00	1600.	0.25	500.	3300.	44.47	9636.	18360.	13.837	18.360	9.831	2.422
90	1.00	1600.	0.25	500.	3000.	47.26	9219.	18388.	13.837	18.388	10.384	2.570
9	1.00	1600.	0.25	500.	2700.	50.48	8776.	18423.	13.837	18.423	11.007	2.740
224	0.50	1600.	0.25	1500.	3300.	45.42	9640.	9264.	14.076	18.527	20.404	4.902
174	1.00	1300.	0.33	500.	3300.	44.47	9636.	18558.	14.008	18.558	9.774	2.396
143	0.50	1600.	0.25	1500.	3000.	47.78	9221.	9288.	14.076	18.577	21.230	5.144
93	1.00	1300.	0.33	500.	3000.	47.26	9219.	18586.	14.008	18.586	10.325	2.543
12	1.00	1300.	0.33	500.	2700.	50.38	8776.	18620.	14.008	18.620	10.922	2.705
62	0.50	1600.	0.25	1500.	2700.	50.49	8776.	9319.	14.076	18.638	22.134	5.418
227	0.50	1300.	0.33	1500.	3300.	45.42	9640.	9368.	14.270	18.737	20.334	4.848
146	0.50	1300.	0.33	1500.	3000.	47.78	9221.	9393.	14.270	18.786	21.158	5.086
65	0.50	1300.	0.33	1500.	2700.	50.40	8776.	9423.	14.270	18.846	22.026	5.348
179	0.50	1600.	0.33	500.	3300.	44.47	9636.	9532.	10.056	19.063	9.874	4.666
98	0.50	1600.	0.33	500.	3000.	47.26	9219.	9560.	10.056	19.119	10.430	4.944
17	0.50	1600.	0.33	500.	2700.	50.38	8776.	9594.	10.056	19.188	11.033	5.251
197	0.50	1600.	0.25	1000.	3300.	45.16	9639.	9854.	14.076	19.708	16.035	4.583
116	0.50	1600.	0.25	1000.	3000.	47.63	9221.	9879.	14.076	19.759	16.760	4.821
35	0.50	1600.	0.25	1000.	2700.	50.49	8776.	9911.	14.076	19.822	17.572	5.094
200	0.50	1300.	0.33	1000.	3300.	45.16	9639.	9960.	14.270	19.921	15.982	4.534
119	0.50	1300.	0.33	1000.	3000.	47.63	9221.	9986.	14.270	19.972	16.705	4.769
38	0.50	1300.	0.33	1000.	2700.	50.44	8776.	10017.	14.270	20.035	17.499	5.035
176	0.50	1420.	0.33	500.	3300.	44.47	9636.	10232.	11.456	20.464	9.874	4.346
95	0.50	1420.	0.33	500.	3000.	47.26	9219.	10260.	11.456	20.519	10.430	4.607
14	0.50	1420.	0.33	500.	2700.	50.38	8776.	10294.	11.456	20.588	11.033	4.894
186	1.00	1420.	0.50	500.	3300.	44.47	9636.	21031.	15.940	21.031	8.735	2.114
105	1.00	1420.	0.50	500.	3000.	46.36	9217.	21052.	15.940	21.052	9.068	2.202
188	0.50	1600.	0.50	500.	3300.	44.49	9635.	11383.	13.215	22.766	9.316	3.908
170	0.50	1600.	0.25	500.	3300.	44.47	9636.	11528.	14.076	23.057	9.903	3.857
89	0.50	1600.	0.25	500.	3000.	47.26	9219.	11556.	14.076	23.112	10.460	4.090
8	0.50	1600.	0.25	500.	2700.	50.48	8776.	11591.	14.076	23.182	11.087	4.355
173	0.50	1300.	0.33	500.	3300.	44.47	9636.	11639.	14.270	23.277	9.874	3.821
210	1.00	1300.	0.50	1000.	3300.	44.35	9636.	23288.	20.051	23.288	13.701	1.904
92	0.50	1300.	0.33	500.	3000.	47.26	9219.	11666.	14.270	23.333	10.430	4.051
11	0.50	1300.	0.33	500.	2700.	50.38	8776.	11701.	14.270	23.402	11.033	4.305
183	1.00	1300.	0.50	500.	3300.	44.47	9636.	25142.	20.051	25.142	8.735	1.769

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPMMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
102	1.00	1300.	0.50	500.	3000.	46.36	9217.	25163.	20.051	25.163	9.068	1.842
21	1.00	1300.	0.50	500.	2700.	48.59	8771.	25190.	20.051	25.190	9.455	1.929
185	0.50	1420.	0.50	500.	3300.	44.49	9635.	12882.	16.212	25.763	9.316	3.454
104	0.50	1420.	0.50	500.	3000.	46.36	9217.	12904.	16.212	25.808	9.662	3.593
209	0.50	1300.	0.50	1000.	3300.	44.35	9636.	13199.	20.370	26.398	14.714	3.360
222	1.00	1420.	0.25	1500.	3300.	45.42	9640.	28898.	26.653	28.898	20.229	1.572
141	1.00	1420.	0.25	1500.	3000.	47.78	9221.	28923.	26.653	28.923	21.050	1.652
60	1.00	1420.	0.25	1500.	2700.	50.52	8776.	28954.	26.653	28.954	21.964	1.745
195	1.00	1420.	0.25	1000.	3300.	45.16	9639.	29493.	26.653	29.493	15.902	1.531
114	1.00	1420.	0.25	1000.	3000.	47.63	9221.	29519.	26.653	29.518	16.623	1.613
33	1.00	1420.	0.25	1000.	2700.	50.49	8776.	29550.	26.653	29.550	17.430	1.709
182	0.50	1300.	0.50	500.	3300.	44.49	9635.	14961.	20.370	29.922	9.316	2.974
101	0.50	1300.	0.50	500.	3000.	46.36	9217.	14983.	20.370	29.967	9.662	3.094
20	0.50	1300.	0.50	500.	2700.	48.59	8771.	15010.	20.370	30.020	10.070	3.237
168	1.00	1420.	0.25	500.	3300.	44.47	9636.	31177.	26.653	31.177	9.831	1.426
87	1.00	1420.	0.25	500.	3000.	47.26	9219.	31205.	26.653	31.205	10.384	1.515
6	1.00	1420.	0.25	500.	2700.	50.48	8776.	31240.	26.653	31.240	11.007	1.616
221	0.50	1420.	0.25	1500.	3300.	45.42	9640.	15740.	27.028	31.479	20.404	2.885
140	0.50	1420.	0.25	1500.	3000.	47.78	9221.	15764.	27.028	31.529	21.230	3.031
59	0.50	1420.	0.25	1500.	2700.	50.49	8776.	15795.	27.028	31.590	22.134	3.197
194	0.50	1420.	0.25	1000.	3300.	45.16	9639.	16330.	27.028	32.660	16.035	2.765
113	0.50	1420.	0.25	1000.	3000.	47.63	9221.	16355.	27.028	32.711	16.760	2.912
32	0.50	1420.	0.25	1000.	2700.	50.49	8776.	16387.	27.028	32.774	17.572	3.081
232	0.10	1600.	0.33	1500.	3300.	45.42	9640.	3397.	11.845	33.967	20.530	13.370
151	0.10	1600.	0.33	1500.	3000.	47.78	9221.	3421.	11.845	34.213	21.360	13.965
70	0.10	1600.	0.33	1500.	2700.	50.36	8776.	3451.	11.845	34.510	22.222	14.594
219	1.00	1300.	0.25	1500.	3300.	45.42	9640.	34541.	32.296	34.541	20.229	1.315
138	1.00	1300.	0.25	1500.	3000.	47.78	9221.	34566.	32.296	34.566	21.050	1.382
57	1.00	1300.	0.25	1500.	2700.	50.52	8776.	34597.	32.296	34.597	21.964	1.460
192	1.00	1300.	0.25	1000.	3300.	45.16	9639.	35136.	32.296	35.136	15.902	1.285
111	1.00	1300.	0.25	1000.	3000.	47.63	9221.	35161.	32.296	35.161	16.623	1.355
30	1.00	1300.	0.25	1000.	2700.	50.49	8776.	35193.	32.296	35.193	17.430	1.435
229	0.10	1420.	0.33	1500.	3300.	45.42	9640.	3559.	13.473	35.594	20.530	12.759
148	0.10	1420.	0.33	1500.	3000.	47.78	9221.	3584.	13.473	35.841	21.360	13.331
167	0.50	1420.	0.25	500.	3300.	44.47	9636.	18004.	27.028	36.008	9.903	2.470
86	0.50	1420.	0.25	500.	3000.	47.26	9219.	18032.	27.028	36.064	10.460	2.621
5	0.50	1420.	0.25	500.	2700.	50.48	8776.	18067.	27.028	36.134	11.087	2.794
67	0.10	1420.	0.33	1500.	2700.	50.36	8776.	3614.	13.473	36.137	22.222	13.937
165	1.00	1300.	0.25	500.	3300.	44.47	9636.	36820.	32.296	36.820	9.831	1.208

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPMMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMP N/KG
84	1.00	1300.	0.25	500.	3000.	47.26	9219.	36848.	32.296	36.848	10.384	1.383
3	1.00	1300.	0.25	500.	2700.	50.48	8776.	36882.	32.296	36.882	11.007	1.369
218	0.50	1300.	0.25	1500.	3300.	45.42	9640.	18592.	32.733	37.184	20.404	2.443
137	0.50	1300.	0.25	1500.	3000.	47.78	9221.	18617.	32.733	37.234	21.230	2.566
56	0.50	1300.	0.25	1500.	2700.	50.49	8776.	18647.	32.733	37.295	22.134	2.708
223	0.10	1600.	0.25	1500.	3300.	45.42	9640.	3831.	16.204	38.309	20.546	11.855
191	0.50	1300.	0.25	1000.	3300.	45.16	9639.	19183.	32.733	38.365	16.035	2.354
110	0.50	1300.	0.25	1000.	3000.	47.63	9221.	19208.	32.733	38.416	16.761	2.480
29	0.50	1300.	0.25	1000.	2700.	50.49	8776.	19240.	32.733	38.479	17.572	2.624
142	0.10	1600.	0.25	1500.	3000.	47.78	9221.	3856.	16.204	38.555	21.376	12.392
226	0.10	1300.	0.33	1500.	3300.	45.42	9640.	3872.	16.596	38.717	20.530	11.730
61	0.10	1600.	0.25	1500.	2700.	50.49	8776.	3886.	16.204	38.862	22.284	12.992
145	0.10	1300.	0.33	1500.	3000.	47.78	9221.	3896.	16.596	38.964	21.360	12.262
64	0.10	1300.	0.33	1500.	2700.	50.36	8776.	3926.	16.596	39.260	22.222	12.828
205	0.10	1600.	0.33	1000.	3300.	45.16	9639.	3984.	11.845	39.841	16.131	11.335
124	0.10	1600.	0.33	1000.	3000.	47.63	9221.	4009.	11.845	40.095	16.860	11.879
43	0.10	1600.	0.33	1000.	2700.	50.39	8776.	4041.	11.845	40.406	17.645	12.472
202	0.10	1420.	0.33	1000.	3300.	45.16	9639.	4147.	13.473	41.468	16.131	10.990
164	0.50	1300.	0.25	500.	3300.	44.47	9636.	20857.	32.733	41.713	9.904	2.132
121	0.10	1420.	0.33	1000.	3000.	47.63	9221.	4172.	13.473	41.722	16.860	11.415
83	0.50	1300.	0.25	500.	3000.	47.26	9219.	20885.	32.733	41.769	10.460	2.263
2	0.50	1300.	0.25	500.	2700.	50.48	8776.	20920.	32.733	41.839	11.086	2.413
40	0.10	1420.	0.33	1000.	2700.	50.39	8776.	4203.	13.473	42.033	17.645	11.989
196	0.10	1600.	0.25	1000.	3300.	45.16	9639.	4418.	16.204	44.179	16.142	10.222
115	0.10	1600.	0.25	1000.	3000.	47.63	9221.	4443.	16.204	44.433	16.872	10.719
199	0.10	1300.	0.33	1000.	3300.	45.16	9639.	4459.	16.596	44.591	16.131	10.127
34	0.10	1600.	0.25	1000.	2700.	50.49	8776.	4475.	16.204	44.750	17.687	11.283
118	0.10	1300.	0.33	1000.	3000.	47.63	9221.	4485.	16.596	44.845	16.860	10.620
37	0.10	1300.	0.33	1000.	2700.	50.39	8776.	4516.	16.596	45.156	17.645	11.160
220	0.10	1420.	0.25	1500.	3300.	45.42	9640.	5246.	30.358	52.462	20.546	8.657
139	0.10	1420.	0.25	1500.	3000.	47.78	9221.	5271.	30.358	52.709	21.376	9.064
58	0.10	1420.	0.25	1500.	2700.	50.49	8776.	5302.	30.358	53.015	22.284	9.524
178	0.10	1600.	0.33	500.	3300.	44.47	9636.	5651.	11.845	56.514	9.956	7.869
97	0.10	1600.	0.33	500.	3000.	47.26	9219.	5679.	11.845	56.794	10.515	8.322
16	0.10	1600.	0.33	500.	2700.	50.38	8776.	5714.	11.845	57.138	11.122	8.816
175	0.10	1420.	0.33	500.	3300.	44.47	9636.	5814.	13.473	58.141	9.956	7.649
193	0.10	1420.	0.25	1000.	3300.	45.16	9639.	5833.	30.358	58.333	16.142	7.741
94	0.10	1420.	0.33	500.	3000.	47.26	9219.	5842.	13.473	58.421	10.515	8.090
112	0.10	1420.	0.25	1000.	3000.	47.63	9221.	5859.	30.358	58.587	16.872	8.129

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPMMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPIENG N/KG	SPTMT N/KG
217	0.10	1300.	0.25	1500.	3300.	45.41	9640.	5872.	36.617	58.723	20.543	7.733
13	0.10	1420.	0.33	500.	2700.	50.38	8776.	5877.	13.473	58.766	11.122	8.572
31	0.10	1420.	0.25	1000.	2700.	50.49	8776.	5890.	30.358	58.903	17.687	8.572
136	0.10	1300.	0.25	1500.	3000.	47.78	9221.	5897.	36.617	58.969	21.374	8.102
55	0.10	1300.	0.25	1500.	2700.	50.49	8776.	5928.	36.617	59.275	22.283	8.518
187	0.10	1600.	0.50	500.	3300.	44.29	9636.	6052.	15.270	60.522	9.788	7.318
169	0.10	1600.	0.25	500.	3300.	44.47	9636.	6084.	16.204	60.844	9.962	7.309
88	0.10	1600.	0.25	500.	3000.	47.26	9219.	6112.	16.204	61.124	10.522	7.732
172	0.10	1300.	0.33	500.	3300.	44.47	9636.	6126.	16.596	61.265	9.956	7.259
7	0.10	1600.	0.25	500.	2700.	50.48	8776.	6147.	16.204	61.471	11.151	8.212
91	0.10	1300.	0.33	500.	3000.	47.26	9219.	6154.	16.596	61.545	10.515	7.679
10	0.10	1300.	0.33	500.	2700.	50.38	8776.	6189.	16.596	61.889	11.123	8.140
184	0.10	1420.	0.50	500.	3300.	44.29	9636.	6388.	18.629	63.881	9.788	6.933
103	0.10	1420.	0.50	500.	3000.	46.18	9216.	6409.	18.629	64.093	10.158	7.205
190	0.10	1300.	0.25	1000.	3300.	45.15	9639.	6459.	36.617	64.594	16.140	6.990
109	0.10	1300.	0.25	1000.	3000.	47.62	9221.	6485.	36.617	64.849	16.868	7.344
28	0.10	1300.	0.25	1000.	2700.	50.49	8776.	6516.	36.617	65.164	17.685	7.748
181	0.10	1300.	0.50	500.	3300.	44.29	9636.	6846.	23.211	68.463	9.788	6.469
100	0.10	1300.	0.50	500.	3000.	46.18	9216.	6867.	23.211	68.675	10.158	6.725
166	0.10	1420.	0.25	500.	3300.	44.47	9636.	7500.	30.358	74.998	9.962	5.930
85	0.10	1420.	0.25	500.	3000.	47.26	9219.	7528.	30.358	75.278	10.522	6.278
4	0.10	1420.	0.25	500.	2700.	50.48	8776.	7562.	30.358	75.625	11.151	6.675
163	0.10	1300.	0.25	500.	3300.	44.46	9636.	8126.	36.617	81.261	9.959	5.471
82	0.10	1300.	0.25	500.	3000.	47.26	9220.	8154.	36.617	81.540	10.519	5.795
1	0.10	1300.	0.25	500.	2700.	50.50	8775.	8187.	36.617	81.871	11.160	6.169

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPTMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
70	0.10	1600.	0.33	1500.	2700.	50.36	8776.	3451.	11.845	34.510	22.222	14.594
151	0.10	1600.	0.33	1500.	3000.	47.78	9221.	3421.	11.845	34.213	21.360	13.965
67	0.10	1420.	0.33	1500.	2700.	50.36	8776.	3614.	13.473	36.137	22.222	13.937
232	0.10	1600.	0.33	1500.	3300.	45.42	9640.	3397.	11.845	33.967	20.530	13.370
148	0.10	1420.	0.33	1500.	3000.	47.78	9221.	3584.	13.473	35.841	21.360	13.331
61	0.10	1600.	0.25	1500.	2700.	50.49	8776.	3886.	16.204	38.862	22.284	12.392
64	0.10	1300.	0.33	1500.	2700.	50.36	8776.	3926.	16.596	39.260	22.222	12.828
229	0.10	1420.	0.33	1500.	3300.	45.42	9640.	3559.	13.473	35.594	20.530	12.759
43	0.10	1600.	0.33	1000.	2700.	50.39	8776.	4041.	11.845	40.406	17.645	12.472
142	0.10	1600.	0.25	1500.	3000.	47.78	9221.	3856.	16.204	38.555	21.376	12.392
145	0.10	1300.	0.33	1500.	3000.	47.78	9221.	3896.	16.596	38.964	21.360	12.262
40	0.10	1420.	0.33	1000.	2700.	50.39	8776.	4203.	13.473	42.033	17.645	11.989
124	0.10	1600.	0.33	1000.	3000.	47.63	9221.	4009.	11.845	40.095	16.860	11.879
223	0.10	1600.	0.25	1500.	3300.	45.42	9640.	3831.	16.204	38.309	20.546	11.855
226	0.10	1300.	0.33	1500.	3300.	45.42	9640.	3872.	16.596	38.717	20.530	11.730
121	0.10	1420.	0.33	1000.	3000.	47.63	9221.	4172.	13.473	41.722	16.860	11.415
205	0.10	1600.	0.33	1000.	3300.	45.16	9639.	3984.	11.845	39.841	16.131	11.335
34	0.10	1600.	0.25	1000.	2700.	50.49	8776.	4475.	16.204	44.750	17.687	11.283
37	0.10	1300.	0.33	1000.	2700.	50.39	8776.	4516.	16.596	45.156	17.645	11.160
202	0.10	1420.	0.33	1000.	3300.	45.16	9639.	4147.	13.473	41.468	16.131	10.890
115	0.10	1600.	0.25	1000.	3000.	47.63	9221.	4443.	16.204	44.433	16.872	10.719
118	0.10	1300.	0.33	1000.	3000.	47.63	9221.	4485.	16.596	44.845	16.860	10.620
196	0.10	1600.	0.25	1000.	3300.	45.16	9639.	4418.	16.204	44.179	16.142	10.222
199	0.10	1300.	0.33	1000.	3300.	45.16	9639.	4459.	16.596	44.591	16.131	10.127
58	0.10	1420.	0.25	1500.	2700.	50.49	8776.	5302.	30.358	53.015	22.284	9.524
139	0.10	1420.	0.25	1500.	3000.	47.78	9221.	5271.	30.358	52.709	21.376	9.064
16	0.10	1600.	0.33	500.	2700.	50.38	8776.	5714.	11.845	57.138	11.122	8.816
220	0.10	1420.	0.25	1500.	3300.	45.42	9640.	5246.	30.358	52.462	20.546	8.657
13	0.10	1420.	0.33	500.	2700.	50.38	8776.	5877.	13.473	58.766	11.122	8.572
31	0.10	1420.	0.25	1000.	2700.	50.49	8776.	5890.	30.358	58.903	17.687	8.572
55	0.10	1300.	0.25	1500.	2700.	50.49	8776.	5928.	36.617	59.275	22.283	8.518
97	0.10	1600.	0.33	500.	3000.	47.26	9219.	5679.	11.845	56.794	10.515	8.322
7	0.10	1600.	0.25	500.	2700.	50.48	8776.	6147.	16.204	61.471	11.151	8.212
10	0.10	1300.	0.33	500.	2700.	50.38	8776.	6189.	16.596	61.889	11.123	8.140
112	0.10	1420.	0.25	1000.	3000.	47.63	9221.	5859.	30.358	58.587	16.872	8.129
136	0.10	1300.	0.25	1500.	3000.	47.78	9221.	5897.	36.617	58.969	21.374	8.102
94	0.10	1420.	0.33	500.	3000.	47.26	9219.	5842.	13.473	58.421	10.515	8.090
178	0.10	1600.	0.33	500.	3300.	44.47	9636.	5651.	11.845	56.514	9.956	7.869
28	0.10	1300.	0.25	1000.	2700.	50.49	8776.	6516.	36.617	65.164	17.685	7.748

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM

NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPTMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
193	0.10	1420.	0.25	1000.	3300.	45.16	9639.	5833.	30.358	58.333	16.142	7.741
217	0.10	1300.	0.25	1500.	3300.	45.41	9640.	5872.	36.617	58.723	20.543	7.733
88	0.10	1600.	0.25	500.	3000.	47.26	9219.	6112.	16.204	61.124	10.522	7.732
91	0.10	1300.	0.33	500.	3000.	47.26	9219.	6154.	16.596	61.545	10.515	7.679
175	0.10	1420.	0.33	500.	3300.	44.47	9636.	5814.	13.473	58.141	9.956	7.649
109	0.10	1300.	0.25	1000.	3000.	47.62	9221.	6485.	36.617	64.849	16.868	7.344
187	0.10	1600.	0.50	500.	3300.	44.29	9636.	6052.	15.270	60.522	9.788	7.318
169	0.10	1600.	0.25	500.	3300.	44.47	9636.	6084.	16.204	60.844	9.962	7.309
172	0.10	1300.	0.33	500.	3300.	44.47	9636.	6126.	16.596	61.265	9.956	7.259
103	0.10	1420.	0.50	500.	3000.	46.18	9216.	6409.	18.629	64.093	10.158	7.205
190	0.10	1300.	0.25	1000.	3300.	45.15	9639.	6459.	36.617	64.594	16.140	6.990
184	0.10	1420.	0.50	500.	3300.	44.29	9636.	6388.	18.629	63.881	9.788	6.933
71	0.50	1600.	0.33	1500.	2700.	50.40	8776.	7316.	10.056	14.632	22.026	6.898
100	0.10	1300.	0.50	500.	3000.	46.18	9216.	6867.	23.211	68.675	10.158	6.725
4	0.10	1420.	0.25	500.	2700.	50.48	8776.	7562.	30.358	75.625	11.151	6.675
152	0.50	1600.	0.33	1500.	3000.	47.78	9221.	7286.	10.056	14.572	21.158	6.557
181	0.10	1300.	0.50	500.	3300.	44.29	9636.	6846.	23.211	68.463	9.788	6.469
44	0.50	1600.	0.33	1000.	2700.	50.44	8776.	7911.	10.056	15.821	17.499	6.376
68	0.50	1420.	0.33	1500.	2700.	50.40	8776.	8016.	11.456	16.032	22.026	6.287
85	0.10	1420.	0.25	500.	3000.	47.26	9219.	7528.	30.358	75.278	10.522	6.278
233	0.50	1600.	0.33	1500.	3300.	45.42	9640.	7262.	10.056	14.523	20.334	6.254
1	0.10	1300.	0.25	500.	2700.	50.50	8775.	8187.	36.617	81.871	11.160	6.169
125	0.50	1600.	0.33	1000.	3000.	47.63	9221.	7879.	10.056	15.758	16.705	6.045
149	0.50	1420.	0.33	1500.	3000.	47.78	9221.	7986.	11.456	15.973	21.158	5.982
166	0.10	1420.	0.25	500.	3300.	44.47	9636.	7500.	30.358	74.998	9.962	5.930
41	0.50	1420.	0.33	1000.	2700.	50.44	8776.	8611.	11.456	17.221	17.499	5.858
82	0.10	1300.	0.25	500.	3000.	47.26	9220.	8154.	36.617	81.540	10.519	5.795
206	0.50	1600.	0.33	1000.	3300.	45.16	9639.	7854.	10.056	15.707	15.982	5.750
230	0.50	1420.	0.33	1500.	3300.	45.42	9640.	7962.	11.456	15.923	20.334	5.704
122	0.50	1420.	0.33	1000.	3000.	47.63	9221.	8579.	11.456	17.158	16.705	5.551
163	0.10	1300.	0.25	500.	3300.	44.46	9636.	8126.	36.617	81.261	9.959	5.471
62	0.50	1600.	0.25	1500.	2700.	50.49	8776.	9319.	14.076	18.638	22.134	5.418
65	0.50	1300.	0.33	1500.	2700.	50.40	8776.	9423.	14.270	18.846	22.026	5.348
203	0.50	1420.	0.33	1000.	3300.	45.16	9639.	8554.	11.456	17.107	15.982	5.279
17	0.50	1600.	0.33	500.	2700.	50.38	8776.	9594.	10.056	19.188	11.033	5.251
143	0.50	1600.	0.25	1500.	3000.	47.78	9221.	9288.	14.076	18.577	21.230	5.144
35	0.50	1600.	0.25	1000.	2700.	50.49	8776.	9911.	14.076	19.822	17.572	5.094
146	0.50	1300.	0.33	1500.	3000.	47.78	9221.	9393.	14.270	18.786	21.158	5.086
38	0.50	1300.	0.33	1000.	2700.	50.44	8776.	10017.	14.270	20.035	17.499	5.035

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPTMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
98	0.50	1600.	0.33	500.	3000.	47.26	9219.	9560.	10.056	19.119	10.430	4.944
224	0.50	1600.	0.25	1500.	3300.	45.42	9640.	9264.	14.076	18.527	20.404	4.902
14	0.50	1420.	0.33	500.	2700.	50.38	8776.	10294.	11.456	20.588	11.033	4.894
227	0.50	1300.	0.33	1500.	3300.	45.42	9640.	9368.	14.270	18.737	20.334	4.848
116	0.50	1600.	0.25	1000.	3000.	47.63	9221.	9879.	14.076	19.759	16.760	4.821
119	0.50	1300.	0.33	1000.	3000.	47.63	9221.	9986.	14.270	19.972	16.705	4.769
179	0.50	1600.	0.33	500.	3300.	44.47	9636.	9532.	10.056	19.063	9.874	4.666
95	0.50	1420.	0.33	500.	3000.	47.26	9219.	10260.	11.456	20.519	10.430	4.607
197	0.50	1600.	0.25	1000.	3300.	45.16	9639.	9854.	14.076	19.708	16.035	4.583
200	0.50	1300.	0.33	1000.	3300.	45.16	9639.	9960.	14.270	19.921	15.982	4.534
8	0.50	1600.	0.25	500.	2700.	50.48	8776.	11591.	14.076	23.182	11.087	4.355
176	0.50	1420.	0.33	500.	3300.	44.47	9636.	10232.	11.456	20.464	9.874	4.346
11	0.50	1300.	0.33	500.	2700.	50.38	8776.	11701.	14.270	23.402	11.033	4.305
72	1.00	1600.	0.33	1500.	2700.	50.40	8776.	12170.	9.855	12.170	21.771	4.141
89	0.50	1600.	0.25	500.	3000.	47.26	9219.	11556.	14.076	23.112	10.460	4.090
92	0.50	1300.	0.33	500.	3000.	47.26	9219.	11666.	14.270	23.333	10.430	4.051
45	1.00	1600.	0.33	1000.	2700.	50.44	8776.	12770.	9.855	12.770	17.302	3.950
153	1.00	1600.	0.33	1500.	3000.	47.78	9221.	12140.	9.855	12.140	20.910	3.936
188	0.50	1600.	0.50	500.	3300.	44.49	9635.	11383.	13.215	22.766	9.316	3.908
170	0.50	1600.	0.25	500.	3300.	44.47	9636.	11528.	14.076	23.057	9.903	3.857
173	0.50	1300.	0.33	500.	3300.	44.47	9636.	11639.	14.270	23.277	9.874	3.821
234	1.00	1600.	0.33	1500.	3300.	45.42	9640.	12115.	9.855	12.115	20.093	3.749
126	1.00	1600.	0.33	1000.	3000.	47.63	9221.	12739.	9.855	12.739	16.516	3.739
69	1.00	1420.	0.33	1500.	2700.	50.40	8776.	13544.	11.230	13.544	21.771	3.721
104	0.50	1420.	0.50	500.	3000.	46.36	9217.	12904.	16.212	25.808	9.662	3.593
42	1.00	1420.	0.33	1000.	2700.	50.44	8776.	14145.	11.230	14.145	17.302	3.566
207	1.00	1600.	0.33	1000.	3300.	45.16	9639.	12713.	9.855	12.713	15.799	3.552
150	1.00	1420.	0.33	1500.	3000.	47.78	9221.	13515.	11.230	13.515	20.910	3.535
18	1.00	1600.	0.33	500.	2700.	50.38	8776.	14467.	9.855	14.467	10.922	3.482
185	0.50	1420.	0.50	500.	3300.	44.49	9635.	12882.	16.212	25.763	9.316	3.454
123	1.00	1420.	0.33	1000.	3000.	47.63	9221.	14113.	11.230	14.113	16.516	3.375
231	1.00	1420.	0.33	1500.	3300.	45.42	9640.	13490.	11.230	13.490	20.093	3.367
209	0.50	1300.	0.50	1000.	3300.	44.35	9636.	13199.	20.370	26.398	14.714	3.360
99	1.00	1600.	0.33	500.	3000.	47.26	9219.	14433.	9.855	14.433	10.325	3.275
20	0.50	1300.	0.50	500.	2700.	48.59	8771.	15010.	20.370	30.020	10.070	3.237
204	1.00	1420.	0.33	1000.	3300.	45.16	9639.	14088.	11.230	14.088	15.799	3.205
59	0.50	1420.	0.25	1500.	2700.	50.49	8776.	15795.	27.028	31.590	22.134	3.197
15	1.00	1420.	0.33	500.	2700.	50.38	8776.	15842.	11.230	15.842	10.922	3.190
63	1.00	1600.	0.25	1500.	2700.	50.52	8776.	16137.	13.837	16.137	21.964	3.131

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPTMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
101	0.50	1300.	0.50	500.	3000.	46.36	9217.	14983.	20.370	29.967	9.662	3.094
66	1.00	1300.	0.33	1500.	2700.	50.40	8776.	16323.	14.008	16.323	21.771	3.087
180	1.00	1600.	0.33	500.	3300.	44.47	9636.	14405.	9.855	14.405	9.774	3.087
32	0.50	1420.	0.25	1000.	2700.	50.49	8776.	16387.	27.028	32.774	17.572	3.081
140	0.50	1420.	0.25	1500.	3000.	47.78	9221.	15764.	27.028	31.529	21.230	3.031
36	1.00	1600.	0.25	1000.	2700.	50.49	8776.	16733.	13.837	16.733	17.430	3.017
96	1.00	1420.	0.33	500.	3000.	47.26	9219.	15807.	11.230	15.807	10.325	2.990
39	1.00	1300.	0.33	1000.	2700.	50.44	8776.	16924.	14.008	16.924	17.302	2.980
182	0.50	1300.	0.50	500.	3300.	44.49	9635.	14961.	20.370	29.922	9.316	2.974
144	1.00	1600.	0.25	1500.	3000.	47.78	9221.	16106.	13.837	16.106	21.050	2.966
147	1.00	1300.	0.33	1500.	3000.	47.78	9221.	16293.	14.008	16.293	20.910	2.932
113	0.50	1420.	0.25	1000.	3000.	47.63	9221.	16355.	27.028	32.711	16.760	2.912
221	0.50	1420.	0.25	1500.	3300.	45.42	9640.	15740.	27.028	31.479	20.404	2.885
117	1.00	1600.	0.25	1000.	3000.	47.63	9221.	16702.	13.837	16.702	16.623	2.852
225	1.00	1600.	0.25	1500.	3300.	45.42	9640.	16082.	13.837	16.082	20.229	2.824
120	1.00	1300.	0.33	1000.	3000.	47.63	9221.	16892.	14.008	16.892	16.516	2.819
177	1.00	1420.	0.33	500.	3300.	44.47	9636.	15779.	11.230	15.779	9.774	2.818
5	0.50	1420.	0.25	500.	2700.	50.48	8776.	18067.	27.028	36.134	11.087	2.794
228	1.00	1300.	0.33	1500.	3300.	45.42	9640.	16269.	14.008	16.269	20.093	2.792
194	0.50	1420.	0.25	1000.	3300.	45.16	9639.	16330.	27.028	32.660	16.035	2.765
9	1.00	1600.	0.25	500.	2700.	50.48	8776.	18423.	13.837	18.423	11.007	2.740
198	1.00	1600.	0.25	1000.	3300.	45.16	9639.	16676.	13.837	16.676	15.902	2.708
56	0.50	1300.	0.25	1500.	2700.	50.49	8776.	18647.	32.733	37.295	22.134	2.708
12	1.00	1300.	0.33	500.	2700.	50.38	8776.	18620.	14.008	18.620	10.922	2.705
201	1.00	1300.	0.33	1000.	3300.	45.16	9639.	16867.	14.008	16.867	15.799	2.677
29	0.50	1300.	0.25	1000.	2700.	50.49	8776.	19240.	32.733	38.479	17.572	2.624
86	0.50	1420.	0.25	500.	3000.	47.26	9219.	18032.	27.028	36.064	10.460	2.621
90	1.00	1600.	0.25	500.	3000.	47.26	9219.	18388.	13.837	18.388	10.384	2.570
137	0.50	1300.	0.25	1500.	3000.	47.78	9221.	18617.	32.733	37.234	21.230	2.566
93	1.00	1300.	0.33	500.	3000.	47.26	9219.	18586.	14.008	18.586	10.325	2.543
110	0.50	1300.	0.25	1000.	3000.	47.63	9221.	19208.	32.733	38.416	16.761	2.480
167	0.50	1420.	0.25	500.	3300.	44.47	9636.	18004.	27.028	36.008	9.903	2.470
189	1.00	1600.	0.50	500.	3300.	44.47	9636.	18074.	12.984	18.074	8.735	2.460
218	0.50	1300.	0.25	1500.	3300.	45.42	9640.	18592.	32.733	37.184	20.404	2.443
171	1.00	1600.	0.25	500.	3300.	44.47	9636.	18360.	13.837	18.360	9.831	2.422
2	0.50	1300.	0.25	500.	2700.	50.48	8776.	20920.	32.733	41.839	11.086	2.413
174	1.00	1300.	0.33	500.	3300.	44.47	9636.	18558.	14.008	18.558	9.774	2.396
191	0.50	1300.	0.25	1000.	3300.	45.16	9639.	19183.	32.733	38.365	16.035	2.354
83	0.50	1300.	0.25	500.	3000.	47.26	9219.	20885.	32.733	41.769	10.460	2.263

DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A, SPACE NUCLEAR SYSTEM PARAMETER STUDY-SPTMT SORT

ENG NO.	QE MWE	TSUBM K	X	QD MWT/M3	TC K	F KN	VJE M/S	ZMTOT KG	SPMGEN KG/KWE	SPMMT KG/KWE	SPTENG N/KG	SPTMT N/KG
105	1.00	1420.	0.50	500.	3000.	46.36	9217.	21052.	15.940	21.052	9.068	2.202
164	0.50	1300.	0.25	500.	3300.	44.47	9636.	20857.	32.733	41.713	9.904	2.132
186	1.00	1420.	0.50	500.	3300.	44.47	9636.	21031.	15.940	21.031	8.735	2.114
21	1.00	1300.	0.50	500.	2700.	48.59	8771.	25190.	20.051	25.190	9.455	1.929
210	1.00	1300.	0.50	1000.	3300.	44.35	9636.	23288.	20.051	23.288	13.701	1.904
102	1.00	1300.	0.50	500.	3000.	46.36	9217.	25163.	20.051	25.163	9.068	1.842
183	1.00	1300.	0.50	500.	3300.	44.47	9636.	25142.	20.051	25.142	8.735	1.769
60	1.00	1420.	0.25	1500.	2700.	50.52	8776.	28954.	26.653	29.954	21.964	1.745
33	1.00	1420.	0.25	1000.	2700.	50.49	8776.	29550.	26.653	29.550	17.430	1.709
141	1.00	1420.	0.25	1500.	3000.	47.78	9221.	28923.	26.653	28.923	21.050	1.652
6	1.00	1420.	0.25	500.	2700.	50.48	8776.	31240.	26.653	31.240	11.007	1.616
114	1.00	1420.	0.25	1000.	3000.	47.63	9221.	29519.	26.653	29.518	16.623	1.613
222	1.00	1420.	0.25	1500.	3300.	45.42	9640.	28898.	26.653	28.898	20.229	1.572
195	1.00	1420.	0.25	1000.	3300.	45.16	9639.	29493.	26.653	29.493	15.902	1.531
87	1.00	1420.	0.25	500.	3000.	47.26	9219.	31205.	26.653	31.205	10.384	1.515
57	1.00	1300.	0.25	1500.	2700.	50.52	8776.	34597.	32.296	34.597	21.964	1.460
30	1.00	1300.	0.25	1000.	2700.	50.49	8776.	35193.	32.296	35.193	17.430	1.435
168	1.00	1420.	0.25	500.	3300.	44.47	9636.	31177.	26.653	31.177	9.831	1.426
138	1.00	1300.	0.25	1500.	3000.	47.78	9221.	34566.	32.296	34.566	21.050	1.382
3	1.00	1300.	0.25	500.	2700.	50.48	8776.	36882.	32.296	36.882	11.007	1.369
111	1.00	1300.	0.25	1000.	3000.	47.63	9221.	35161.	32.296	35.161	16.623	1.355
219	1.00	1300.	0.25	1500.	3300.	45.42	9640.	34541.	32.296	34.541	20.229	1.315
192	1.00	1300.	0.25	1000.	3300.	45.16	9639.	35136.	32.296	35.136	15.902	1.285
84	1.00	1300.	0.25	500.	3000.	47.26	9219.	36848.	32.296	36.848	10.384	1.283
165	1.00	1300.	0.25	500.	3300.	44.47	9636.	36820.	32.296	36.820	9.831	1.208

APPENDIX D: Code Output for Selected Engines

Maximum SPTMT

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

LIST OF INPUT PARAMETERS PAGE 1 OF 2

REACTOR CORE PARAMETERS AND CONSTRAINTS

AR	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMENSION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLRC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.24429
RT	REFLECTOR THICKNESS, M	0.14696
ZNHH	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCHP	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID, WT/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VAPLT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

LIST OF INPUT PARAMETERS

NOZZLE AND PROPULSIVE PARAMETERS

ANC	NOZZLE COOLING JACKET AREA, M**2	0.50000
ANOZ	NOZZLE SURFACE AREA, M**2	0.70000
ARATIO	NOZZLE EXIT TO THROAT AREA RATIO	200.00000
ETAN	NOZZLE EFFICIENCY	0.97000

TEMPERATURE AND PRESSURE CONSTRAINTS AND PARAMETERS

PC	STAGNATION PRESSURE IN CHAMBER, N/CM**2	300.00000
PTNK	PRESSURE IN PROPELLANT TANK, N/CM**2	13.80000
TC	TOTAL CORE EXIT TEMPERATURE, K	2700.00000
TMMAX	MAXIMUM PERMISSIBLE CORE MATERIAL TEMPERATURE, K	3600.00000
TWMAX	MAXIMUM PERMISSIBLE COOLING CHANNEL WALL TEMPERATURE, K	3500.00000
ZMNRJ	MACH NUMBER IN CONDUIT	0.65000

PRESSURE SHELL PARAMETERS

DMPS	PRESSURE SHELL COOLANT MASS FLOW, KG/SEC	0.30000
TPSI	TEMPERATURE OF COOLANT ENTERING PRESSURE SHELL, K	200.00000
TRT	TEMPERATURE OF PRESSURE SHELL WALL, K	800.00000

MISSION DESCRIPTION

MSNAME	DESTINATION	MARS
IORB	MISSION	AN ORBITER
TIMM	TRIP TIME, DAYS	125.00000
TIMP	POWERED TIME AT DESTINATION, S	0.0
TTM	RATIO OF THRUSTING TIME TO MISSION DURATION	0.0
CQ	RATIO OF REACTOR POWER DURING COAST PHASE TO FULL POWER	0.10000
PQ	RATIO OF REACTOR POWER AT PLANET TO FULL POWER	1.00000

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NUROC3A CODE ENGINE NUMBER = 70

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.35994
DM	MASS FLOW, HYDROGEN, KG/S	5.73885
F	THRUST, KILONEWTONS	50.36398
FLXMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	22.35452
QC	CORE POWER REMOVED BY COOLANT, MWT	237.67632
QHP	HEAT PIPE POWER, MWT	2.32352
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.54685
QR	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	8899.25000
VJE	EFFECTIVE JET VELOCITY , M/SEC	8775.96875
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	0.10000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	0.40164
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.07963
QRPM	TOTAL REACTOR POWER IN POWER MODE, MWT	0.48126
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.24898

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	2616.89600
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	218.31763
TSR	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	218.31763
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	113.90334
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	29.20918
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	307.63501
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	2873.48511
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	2951.36084
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1675.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	381.04028
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	415.12622
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	455.90845
DELPC	CORE PRESSURE DROP, N/CM**2	81.04048
DELPSR	SIDE REFLECTOR PRESSURE DROP, N/CM**2	34.08589
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	40.78229
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 3 OF 5

STATE POINT DATA (CONTINUED)

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	215.91469
TPSR	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMPMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	1881.72778

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUFOC3A CODE ENGINE NUMBER = 70

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	364.019	339.456	1866.706
0.053	495.970	453.612	1868.832
0.089	642.079	582.551	1870.883
0.124	800.192	724.372	1872.829
0.160	967.976	876.983	1874.642
0.196	1142.957	1038.132	1876.294
0.231	1322.552	1205.443	1877.762
0.267	1504.113	1376.446	1879.024
0.302	1684.961	1548.620	1880.060
0.338	1862.431	1719.426	1880.856
0.373	2033.904	1886.345	1881.400
0.409	2196.847	2046.911	1881.684
0.444	2348.862	2198.761	1881.704
0.480	2487.704	2339.651	1881.459
0.516	2611.325	2467.505	1880.954
0.551	2717.903	2580.436	1880.194
0.587	2805.862	2676.777	1879.193
0.622	2873.908	2755.109	1877.964
0.658	2921.038	2814.277	1876.526
0.693	2946.554	2853.406	1874.900
0.729	2950.082	2871.921	1873.109
0.765	2931.568	2869.547	1871.181
0.800	2891.284	2846.317	1869.143
0.836	2829.830	2802.581	1867.026
0.871	2748.104	2738.975	1864.862

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	11.07935
ZMPFS2	PUMP MATERIAL MASS, KG	4.64085
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	15.72021
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.46599
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	66.67122
ZMN	TOTAL NOZZLE MASS, KG	253.46062
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	142.25079
ZMVA	VALVES AND ACTUATORS MASS, KG	115.26956
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	44.58713
ZMSP	SUPPORT PLATE MASS, KG	91.19423
ZMM	INSULATION AND DUCTING MASS, KG	36.41200
ZMRO	OTHER HARDWARE MASS, KG	127.60623
ZMRP	PERIPHERAL STRUCTURE MASS, KG	93.95287
ZMCFE	FUEL ELEMENT MASS, KG	426.44141
ZMCS	CORE STRUCTURE MASS, KG	295.83789
ZMSPS	SIDE REFLECTOR MASS, KG	433.33032
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	202.13800
ZMPV	PRESSURE VESSEL MASS, KG	95.18042
ZMR	TOTAL REACTOR MASS, KG	1674.48682
ZMENG	ENGINE MASS, KG	2245.77490
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	11.07935
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.58321
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	6.99318
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	20.65573
ZMES	ENGINE SYSTEM MASS, KG	2266.43042
PCSM	POWER CONVERSION SYSTEM MASS, KG	328.09912
WRSUM	TOTAL RADIATOR MASS, KG	685.41382
ZMTOT	TOTAL SYSTEM MASS, KG	3279.94336

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 70

POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA PAGE 1 OF 1

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	0.10000
QHPPM	HEAT PIPE POWER, MWT	0.40164
X	TEMPERATURE RATIO	0.33000
TB1	COMPRESSOR INLET TEMPERATURE, K	527.99976
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	706.68628
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	1216.63330
TSUBM	TURBINE INLET TEMPERATURE, K	1600.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1317.86084
TB6P	RADIATOR INLET TEMPERATURE, K	737.24487
ETAS	SYSTEM EFFICIENCY	0.24898
ETACY	CYCLE EFFICIENCY	0.33087

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

RSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	0.26875
TBES(1)	MEAN TEMPERATURE, K	606.57080
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	70.32674
WRI(1)	MASS, KG	366.89502

AUXILIARY RADIATOR

RSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.02960
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	61.05392
WRI(2)	MASS, KG	318.51880

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	131.38066
WRSUM	TOTAL RADIATOR MASS, KG	685.41382
PCSM	POWER CONVERSION SYSTEM MASS, KG	328.09912

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NUROC3A CODE ENGINE NUMBER = 70

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST PAGE 1 OF 1

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	10.13514
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	32.79947
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00001

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	22.22171
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	15.35514

Maximum SPTMT
@QE=500 KWe

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROCC3A CODE ENGINE NUMBER = 71

LIST OF INPUT PARAMETERS PAGE 1 OF 2

REACTOR CORE PARAMETERS AND CONSTRAINTS

AP	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMENSION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLRC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.24429
RT	REFLECTOR THICKNESS, M	0.14696
ZNHH	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCHP	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID,WT/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VAPLT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

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NUROC3A CODE ENGINE NUMBER = 71

LIST OF INPUT PARAMETERS

NOZZLE AND PROPULSIVE PARAMETERS

ANC	NOZZLE COOLING JACKET AREA, M**2	0.50000
ANCZ	NOZZLE SURFACE AREA, M**2	0.70000
ARATIO	NOZZLE EXIT TO THROAT AREA RATIO	200.00000
ETAN	NOZZLE EFFICIENCY	0.97000

TEMPERATURE AND PRESSURE CONSTRAINTS AND PARAMETERS

PC	STAGNATION PRESSURE IN CHAMBER, N/CM**2	300.00000
PTNK	PRESSURE IN PROPELLANT TANK, N/CM**2	13.80000
TC	TOTAL CORE EXIT TEMPERATURE, K	2700.00000
TMMAX	MAXIMUM PERMISSIBLE CORE MATERIAL TEMPERATURE, K	3600.00000
TWMAX	MAXIMUM PERMISSIBLE COOLING CHANNEL WALL TEMPERATURE, K	3500.00000
ZMNRJ	MACH NUMBER IN CONDUIT	0.65000

PRESSURE SHELL PARAMETERS

DMPS	PRESSURE SHELL COOLANT MASS FLOW, KG/SEC	0.30000
TPSI	TEMPERATURE OF COOLANT ENTERING PRESSURE SHELL, K	200.00000
TRT	TEMPERATURE OF PRESSURE SHELL WALL, K	800.00000

MISSION DESCRIPTION

MSNAME	DESTINATION	MARS
IORB	MISSION	AN ORBITER
TIMM	TRIP TIME, DAYS	125.00000
TIMP	POWERED TIME AT DESTINATION, S	0.0
TTM	RATIO OF THRUSTING TIME TO MISSION DURATION	0.0
CQ	RATIO OF REACTOR POWER DURING COAST PHASE TO FULL POWER	0.10000
PQ	RATIO OF REACTOR POWER AT PLANET TO FULL POWER	1.00000

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NUROC3A CODE ENGINE NUMBER = 71

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 1 OF 5

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.35994
DM	MASS FLOW, HYDROGEN, KG/S	5.74238
F	THRUST, KILONEWTONS	50.39543
FLXMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	22.35452
QC	CORE POWER REMOVED BY COOLANT, MWT	237.83322
QHP	HEAT PIPE POWER, MWT	2.16661
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.54733
QR	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	8809.33203
VJE	EFFECTIVE JET VELOCITY , M/SEC	8776.05078
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	0.50000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	1.85192
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.09983
QRPM	TOTAL REACTOR POWER IN POWER MODE, MWT	1.95175
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.26999

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PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	2616.94385
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	218.20679
TSR	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	218.20679
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	113.85670
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	29.21013
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	307.64063
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	2873.53320
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	2951.47021
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1700.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	381.13232
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	415.23145
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	456.02417
DELPC	CORE PRESSURE DROP, N/CM**2	81.13239
DELPSR	SIDE REFLECTOR PRESSURE DROP, N/CM**2	34.09918
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	40.79269
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 71

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	219.95187
TPSF	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMTMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	2176.84351

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 71

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	363.943	339.364	2107.576
0.053	495.921	453.535	2117.379
0.089	642.057	582.490	2126.838
0.124	800.196	724.326	2135.813
0.160	968.005	876.952	2144.171
0.196	1143.010	1038.116	2151.791
0.231	1322.628	1205.441	2158.558
0.267	1504.209	1376.458	2164.374
0.302	1685.076	1548.644	2169.153
0.338	1862.561	1719.462	2172.823
0.373	2034.046	1886.390	2175.332
0.409	2197.001	2046.967	2176.642
0.444	2349.023	2198.823	2176.733
0.480	2487.869	2339.719	2175.604
0.516	2611.490	2467.575	2173.273
0.551	2718.064	2580.506	2169.773
0.587	2806.019	2676.848	2165.156
0.622	2874.055	2755.177	2159.489
0.658	2921.175	2814.344	2152.858
0.693	2946.675	2853.465	2145.359
0.729	2950.184	2871.971	2137.103
0.765	2931.650	2869.587	2128.211
0.800	2891.347	2846.350	2118.816
0.836	2829.866	2802.599	2109.056
0.871	2748.116	2738.981	2099.074

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 71

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	11.08957
ZMPFS2	PUMP MATERIAL MASS, KG	4.64276
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	15.73233
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.46526
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	66.71283
ZMN	TOTAL NOZZLE MASS, KG	253.50150
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	142.25079
ZMVA	VALVES AND ACTUATORS MASS, KG	115.37590
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	44.59134
ZMSP	SUPPORT PLATE MASS, KG	91.22867
ZMM	INSULATION AND DUCTING MASS, KG	36.42142
ZMRO	OTHER HARDWARE MASS, KG	127.65009
ZMRP	PERIPHERAL STRUCTURE MASS, KG	93.95287
ZMCFE	FUEL ELEMENT MASS, KG	426.44141
ZMCS	CORE STRUCTURE MASS, KG	295.83789
ZMSRS	SIDE REFLECTOR MASS, KG	433.33032
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	202.13800
ZMPV	PRESSURE VESSEL MASS, KG	95.20451
ZMR	TOTAL REACTOR MASS, KG	1674.55444
ZMENG	ENGINE MASS, KG	2246.00610
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	11.08957
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.58427
ZMPSCR	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	28.36049
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	42.03433
ZMES	ENGINE SYSTEM MASS, KG	2288.04028
PCSM	POWER CONVERSION SYSTEM MASS, KG	1640.49854
WRSUM	TOTAL RADIATOR MASS, KG	2783.59033
ZMTOT	TOTAL SYSTEM MASS, KG	6712.12891

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUPOC3A CODE ENGINE NUMBER = 71

POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA PAGE 1 OF 1

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	0.50000
QHPPM	HEAT PIPE POWER, MWT	1.85192
X	TEMPERATURE RATIO	0.33000
TB1	COMPRESSOR INLET TEMPERATURE, K	527.99976
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	706.68628
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	1216.63330
TSUBM	TURBINE INLET TEMPERATURE, K	1600.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1317.86084
TB6P	RADIATOR INLET TEMPERATURE, K	737.24487
ETAS	SYSTEM EFFICIENCY	0.26999
ETACY	CYCLE EFFICIENCY	0.33087

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

RSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	1.23917
TBES(1)	MEAN TEMPERATURE, K	606.57080
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	324.27124
WRI(1)	MASS, KG	1691.72681

AUXILIARY RADIATOR

RSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.10147
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	209.28912
WRI(2)	MASS, KG	1091.86353

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	533.56030
WRSUM	TOTAL RADIATOR MASS, KG	2783.59033
PCSM	POWER CONVERSION SYSTEM MASS, KG	1640.49854

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUPOC3A CODE ENGINE NUMBER = 71

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST PAGE 1 OF 1

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	8.84817
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	13.42426
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00003

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	22.02559
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	7.50812

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

LIST OF INPUT PARAMETERS PAGE 1 OF 2

REACTOR CORE PARAMETERS AND CONSTRAINTS

AR	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMENSION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLPC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.24429
RR	REFLECTOR THICKNESS, M	0.14696
ZNHP	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCHP	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID, WT/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VAPIT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.35994
DM	MASS FLOW, HYDROGEN, KG/S	4.71101
F	THRUST, KILONEWTONS	45.41530
FLYMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	22.35452
QC	CORE POWER REMOVED BY COOLANT, MWT	235.81877
QHP	HEAT PIPE POWER, MWT	4.18107
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.43406
QR	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	9775.67188
VJE	EFFECTIVE JET VELOCITY , M/SEC	9640.25000
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	0.10000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	0.28858
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.07805
QRPM	TOTAL REACTOR POWER IN POWER MODE, MWT	0.36663
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.34652

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUPOC3A CODE ENGINE NUMBER = 217

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	3157.71338
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	298.42285
TSR	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	298.42285
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	171.13972
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	29.08978
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	371.21191
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	3494.76001
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	3568.99854
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	368.31909
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	401.80835
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	441.28247
DELPC	CORE PRESSURE DROP, N/CM**2	68.31918
DELPSR	SIDE REFLECTOR PRESSURE DROP, N/CM**2	33.48940
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	39.47398
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 3 OF 5

STATE POINT DATA (COTINUED)

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	215.59998
TPSR	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMPMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	1858.72192

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	464.093	439.722	1847.928
0.053	616.041	574.014	1849.456
0.089	785.382	726.319	1850.930
0.124	969.618	894.390	1852.328
0.160	1166.032	1075.750	1853.631
0.196	1371.726	1267.721	1854.818
0.231	1583.667	1467.473	1855.873
0.267	1798.728	1672.058	1856.779
0.302	2013.736	1878.459	1857.523
0.338	2225.521	2083.634	1858.095
0.373	2430.958	2284.553	1858.486
0.409	2627.016	2478.252	1858.690
0.444	2810.807	2661.879	1858.705
0.480	2979.615	2832.719	1858.529
0.516	3130.952	2988.255	1858.166
0.551	3262.586	3126.194	1857.620
0.587	3372.575	3244.499	1856.901
0.622	3459.297	3341.426	1856.018
0.658	3521.473	3415.546	1854.984
0.693	3558.181	3465.760	1853.816
0.729	3568.888	3491.337	1852.529
0.765	3553.432	3491.895	1851.144
0.800	3512.036	3467.420	1849.680
0.836	3445.319	3418.282	1848.159
0.871	3354.260	3345.202	1846.603

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	8.24039
ZMPFS2	PUMP MATERIAL MASS, KG	4.06871
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	12.30910
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.58330
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	60.12016
ZMN	TOTAL NOZZLE MASS, KG	247.02687
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	142.25079
ZMVA	VALVES AND ACTUATORS MASS, KG	85.73299
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	43.65543
ZMSP	SUPPORT PLATE MASS, KG	86.14857
ZMP	INSULATION AND DUCTING MASS, KG	33.67212
ZMRO	OTHER HARDWARE MASS, KG	119.82069
ZMRP	PERIPHERAL STRUCTURE MASS, KG	93.95287
ZMCFE	FUEL ELEMENT MASS, KG	426.44141
ZMCS	CORE STRUCTURE MASS, KG	295.83789
ZMSRS	SIDE REFLECTOR MASS, KG	433.33032
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	202.13800
ZMPV	PRESSURE VESSEL MASS, KG	92.12689
ZMR	TOTAL REACTOR MASS, KG	1663.64746
ZMENG	ENGINE MASS, KG	2194.62256
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	8.24039
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.26474
ZMPSCR	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	5.32748
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	15.83261
ZMES	ENGINE SYSTEM MASS, KG	2210.45508
PCSM	POWER CONVERSION SYSTEM MASS, KG	112.99979
WRSUM	TOTAL RADIATOR MASS, KG	2904.65234
ZMTOT	TOTAL SYSTEM MASS, KG	5228.10547

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NUROC3A CODE ENGINE NUMBER = 217

POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA PAGE 1 OF 1

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	0.10000
QHPPM	HEAT PIPE POWER, MWT	0.28858
X	TEMPERATURE RATIO	0.25000
TB1	COMPRESSOR INLET TEMPERATURE, K	325.00000
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	456.89404
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	956.63354
TSUBM	TURBINE INLET TEMPERATURE, K	1300.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1031.02979
TB6P	RADIATOR INLET TEMPERATURE, K	485.60083
ETAS	SYSTEM EFFICIENCY	0.34652
ETACY	CYCLE EFFICIENCY	0.46049

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

RSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	0.15569
TBES(1)	MEAN TEMPERATURE, K	366.64160
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	495.71167
WRI(1)	MASS, KG	2586.13354

AUXILIARY RADIATOR

RSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.02960
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	61.05392
WRI(2)	MASS, KG	318.51880

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	556.76538
WRSUM	TOTAL RADIATOR MASS, KG	2904.65234
PCSM	POWER CONVERSION SYSTEM MASS, KG	112.99979

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 217

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST PAGE 1 OF 1

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	30.17654
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	52.28111
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00002

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	20.54567
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	8.68676

Minimum total mass

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUPOC3A CODE ENGINE NUMBER = 232

LIST OF INPUT PARAMETERS PAGE 1 OF 2

REACTOR CORE PARAMETERS AND CONSTRAINTS

AR	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMENSION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLPC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.24429
RT	REFLECTOR THICKNESS, M	0.14696
ZNHH	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCHP	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID, WT/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VAPLT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 232

LIST OF INPUT PARAMETERS

NOZZLE AND PROPULSIVE PARAMETERS

ANC	NOZZLE COOLING JACKET AREA, M**2	0.50000
ANOZ	NOZZLE SURFACE AREA, M**2	0.70000
APATIO	NOZZLE EXIT TO THROAT AREA RATIO	200.00000
ETAN	NOZZLE EFFICIENCY	0.97000

TEMPERATURE AND PRESSURE CONSTRAINTS AND PARAMETERS

PC	STAGNATION PRESSURE IN CHAMBER, N/CM**2	300.00000
PTNK	PRESSURE IN PROPELLANT TANK, N/CM**2	13.80000
TC	TOTAL CORE EXIT TEMPERATURE, K	3300.00000
TMMAX	MAXIMUM PERMISSIBLE CORE MATERIAL TEMPERATURE, K	3600.00000
TWMAX	MAXIMUM PERMISSIBLE COOLING CHANNEL WALL TEMPERATURE, K	3500.00000
ZMNRJ	MACH NUMBER IN CONDUIT	0.65000

PRESSURE SHELL PARAMETERS

DMPS	PRESSURE SHELL COOLANT MASS FLOW, KG/SEC	0.30000
TPSI	TEMPERATURE OF COOLANT ENTERING PRESSURE SHELL, K	200.00000
TRT	TEMPERATURE OF PRESSURE SHELL WALL, K	800.00000

MISSION DESCRIPTION

MSNAME	DESTINATION	MARS
IORB	MISSION	AN ORBITER
TIMM	TRIP TIME, DAYS	125.00000
TIMP	POWERED TIME AT DESTINATION, S	0.0
TTM	RATIO OF THRUSTING TIME TO MISSION DURATION	0.0
CQ	RATIO OF REACTOR POWER DURING COAST PHASE TO FULL POWER	0.10000
PQ	RATIO OF REACTOR POWER AT PLANET TO FULL POWER	1.00000

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 232

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.35994
DH	MASS FLOW, HYDROGEN, KG/S	4.71066
F	THRUST, KILONEWTONS	45.41295
FIXMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	22.35452
QC	CORE POWER REMOVED BY COOLANT, MWT	235.81134
QHP	HEAT PIPE POWER, MWT	4.18849
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.43471
QT	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	9775.89844
VJE	EFFECTIVE JET VELOCITY , M/SEC	9640.47656
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	0.10000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	0.40164
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.07963
QTPM	TOTAL REACTOR POWER IN POWER MODE, MWT	0.48126
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.24898

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUPOC3A CODE ENGINE NUMBER = 232

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	3157.85986
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	301.84692
TSR	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	301.84692
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	174.70500
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	29.09526
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	371.22925
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	3494.61987
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	3568.87207
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	368.46484
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	402.41821
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	441.95215
DELPC	CORE PRESSURE DROP, N/CM**2	68.46509
DELPSR	SIDE REFLECTOR PRESSURE DROP, N/CM**2	33.95319
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	39.53389
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

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PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 3 OF 5

STATE POINT DATA (COTINUED)

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	215.91469
TPSR	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMPMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	1881.72778

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NUFOC3A CODE ENGINE NUMBER = 232

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	467.384	443.013	1866.706
0.053	619.198	577.173	1868.832
0.089	788.385	729.324	1870.883
0.124	972.448	897.223	1872.829
0.160	1168.672	1078.393	1874.642
0.196	1374.164	1270.161	1876.294
0.231	1585.891	1469.700	1877.762
0.267	1800.730	1674.064	1879.024
0.302	2015.512	1880.240	1880.060
0.338	2227.072	2085.189	1880.856
0.373	2432.284	2285.883	1881.400
0.409	2628.124	2479.365	1881.684
0.444	2811.705	2662.781	1881.704
0.480	2980.317	2833.426	1881.459
0.516	3131.471	2988.779	1880.954
0.551	3262.941	3126.552	1880.194
0.587	3372.785	3244.713	1879.193
0.622	3459.384	3341.516	1877.964
0.658	3521.460	3415.537	1876.526
0.693	3558.097	3465.680	1874.900
0.729	3568.759	3491.210	1873.109
0.765	3553.283	3491.748	1871.181
0.800	3511.898	3467.284	1869.143
0.836	3445.214	3418.179	1867.026
0.871	3354.219	3345.162	1864.862

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NUROC3A CODE ENGINE NUMBER = 232

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	8.23945
ZMPFS2	PUMP MATERIAL MASS, KG	4.06851
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	12.30796
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.58334
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	60.11708
ZMN	TOTAL NOZZLE MASS, KG	247.02383
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	142.25079
ZMVA	VALVES AND ACTUATORS MASS, KG	85.72325
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	43.65889
ZMSP	SUPPORT PLATE MASS, KG	86.20979
ZMM	INSULATION AND DUCTING MASS, KG	33.67117
ZMPO	OTHER HARDWARE MASS, KG	119.88097
ZMRP	PERIPHERAL STRUCTURE MASS, KG	93.95287
ZMCFE	FUEL ELEMENT MASS, KG	426.44141
ZMCS	CORE STRUCTURE MASS, KG	295.83789
ZMSRS	SIDE REFLECTOR MASS, KG	433.33032
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	202.13800
ZMPV	PRESSURE VESSEL MASS, KG	92.26669
ZMR	TOTAL REACTOR MASS, KG	1663.84766
ZMENG	ENGINE MASS, KG	2194.81226
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	8.23945
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.26463
ZMPSCR	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	6.99318
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	17.49725
ZMES	ENGINE SYSTEM MASS, KG	2212.30933
PCSM	POWER CONVERSION SYSTEM MASS, KG	328.09912
WRSUM	TOTAL RADIATOR MASS, KG	685.41382
ZMTOT	TOTAL SYSTEM MASS, KG	3225.82227

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POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA PAGE 1 OF 1

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	0.10000
QHPPM	HEAT PIPE POWER, MWT	0.40164
X	TEMPERATURE RATIO	0.33000
TB1	COMPRESSOR INLET TEMPERATURE, K	527.99976
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	706.68628
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	1216.63330
TSUBM	TURBINE INLET TEMPERATURE, K	1600.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1317.86084
TB6P	RADIATOR INLET TEMPERATURE, K	737.24487
ETAS	SYSTEM EFFICIENCY	0.24898
ETACY	CYCLE EFFICIENCY	0.33087

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

RSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	0.26875
TBES(1)	MEAN TEMPERATURE, K	606.57080
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	70.32674
WRI(1)	MASS, KG	366.89502

AUXILIARY RADIATOR

RSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.02960
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	61.05392
WRI(2)	MASS, KG	318.51880

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	131.38066
WRSUM	TOTAL RADIATOR MASS, KG	685.41382
PCSM	POWER CONVERSION SYSTEM MASS, KG	328.09912

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 232

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST PAGE 1 OF 1

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	10.13514
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	32.25826
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00001

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	20.52739
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	14.07795

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LIST OF INPUT PARAMETERS PAGE 1 OF 2

REACTOR CORE PARAMETERS AND CONSTRAINTS

AR	REACTOR AREA, M**2	0.58820
CHX	FUEL ELEMENT HEX-FLAT DIMEN-SION, CM	4.00000
CL	CORE LENGTH, M	0.88900
CLRC	TOTAL REACTOR CYLINDRICAL LENGTH, M	1.52400
DCC	CORE COOLANT PASSAGE DIAMETER, CM	0.30000
IFUEL	URANIUM FUEL ISOTOPE	U - 233
RC	CORE RADIUS, M	0.24429
RT	REFLECTOR THICKNESS, M	0.14696
ZNHH	NUMBER OF PROPELLANT PASSAGES PER FUEL ELEMENT	60.00000

HEAT PIPE PARAMETERS AND CONSTRAINTS

HTCHP	HEAT TRANSFER COEFFICIENT, HEAT PIPE SOLID/SOLID,WT/CM**2 K	0.10000
RI	RADIUS OF HEAT PIPE INNER CAVITY, CM	0.0
RO	RADIUS OF HEAT PIPE, CM	2.50000
THPMAX	MAXIMUM HEAT PIPE MATERIAL TEMP-ERATURE, K	1800.00000
TI	THICKNESS OF HEAT PIPE INNER WALL, CM	0.0
TOS	THICKNESS OF OUTER SKIN, CM	0.10000
TOW	THICKNESS OF HEAT PIPE WICK, CM	0.50000
VAPLT	LATENT HEAT OF VAPORIZATION OF HEAT PIPE FLUID, MEGAJOULES	1.96400
W	FRACTION OF WICK VOLUME OCCUPIED BY LIQUID	0.90000

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LIST OF INPUT PARAMETERS

NOZZLE AND PROPULSIVE PARAMETERS

ANC	NOZZLE COOLING JACKET AREA, M**2	0.50000
ANCZ	NOZZLE SURFACE AREA, M**2	0.70000
ARATIO	NOZZLE EXIT TO THROAT AREA RATIO	200.00000
ETAN	NOZZLE EFFICIENCY	0.97000

TEMPERATURE AND PRESSURE CONSTRAINTS AND PARAMETERS

PC	STAGNATION PRESSURE IN CHAMBER, N/CM**2	300.00000
PTNK	PRESSURE IN PROPELLANT TANK, N/CM**2	13.80000
TC	TOTAL CORE EXIT TEMPERATURE, K	3300.00000
TMMAX	MAXIMUM PERMISSIBLE CORE MATERIAL TEMPERATURE, K	3600.00000
TWMAX	MAXIMUM PERMISSIBLE COOLING CHANNEL WALL TEMPERATURE, K	3500.00000
ZMNPJ	MACH NUMBER IN CONDUIT	0.65000

PRESSURE SHELL PARAMETERS

DMPS	PRESSURE SHELL COOLANT MASS FLOW, KG/SEC	0.30000
TPSI	TEMPERATURE OF COOLANT ENTERING PRESSURE SHELL, K	200.00000
TRT	TEMPERATURE OF PRESSURE SHELL WALL, K	800.00000

MISSION DESCRIPTION

MSNNME	DESTINATION	MARS
IOPB	MISSION	AN ORBITER
TIMM	TRIP TIME, DAYS	125.00000
TIMP	POWERED TIME AT DESTINATION, S	0.0
TTM	RATIO OF THRUSTING TIME TO MISSION DURATION	0.0
CQ	RATIO OF REACTOR POWER DURING COAST PHASE TO FULL POWER	0.10000
PQ	RATIO OF REACTOR POWER AT PLANET TO FULL POWER	1.00000

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 234

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

OVERALL DATA SUMMARY

PROPULSIVE MODE

CRIT	EFFECTIVE MULTIPLICATION FACTOR (MUST BE GREATER THAN 1)	2.35994
DM	MASS FLOW, HYDROGEN, KG/S	4.71066
F	THRUST, KILONEWTONS	45.41295
FLXMAX	MAXIMUM ALLOWABLE HEAT PIPE POWER FLUX, MWT	22.35452
QC	CORE POWER REMOVED BY COOLANT, MWT	235.81134
QHP	HEAT PIPE POWER, MWT	4.18849
QNC	NOZZLE COOLANT JACKET POWER, MWT	30.00000
QP	PUMP POWER, MWT	0.43471
QR	TOTAL REACTOR POWER, MWT	250.00000
QSR	SIDE REFLECTOR POWER, MWT	9.99999
VJ	VELOCITY OF EXHAUST JET, M/SEC	9775.89844
VJE	EFFECTIVE JET VELOCITY , M/SEC	9640.47656
ZMJ	MACH NUMBER AT THE NOZZLE EXIT	6.84950

POWER MODE

QE	ELECTRIC POWER, MWE	1.00000
QFE	FAN ELECTRIC POWER, MWE	0.05409
QHPPM	HEAT PIPE POWER IN POWER MODE, MWT	3.66872
QPS	PRESSURE SHELL GASEOUS COOLANT POWER, MWT	0.12513
QRPM	TOTAL REACTOR POWER IN POWER MODE, MWT	3.79385
ETAS	POWER CONVERSION SYSTEM EFFICIENCY	0.27257

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 234

PROPULSIVE AND POWER MODE OUTPUT PARAMETERS

STATE POINT DATA

PROPULSIVE MODE

TC2	TOTAL TEMPERATURE AT THE NOZZLE ENTRANCE, K	3157.85986
TCI	TOTAL TEMPERATURE AT THE CORE ENTRANCE, K	301.84692
TSP	TOTAL TEMPERATURE AT THE SIDE REFLECTOR EXIT, K	301.84692
TNC	TOTAL TEMPERATURE AT THE COOLANT JACKET EXIT, K	174.70500
TP	TOTAL TEMPERATURE AT THE PUMP EXIT, K	29.09526
TNE	STATIC TEMPERATURE AT THE NOZZLE EXIT, K	371.22925
WTMAX	ACTUAL COOLING WALL MAXIMUM TEMPERATURE, K	3494.61987
ZMTMAX	ACTUAL MAXIMUM CORE MATERIAL TEMPERATURE, K	3568.87207
THP	HEAT PIPE MATERIAL TEMPERATURE, K	1800.00000
PCI	TOTAL PRESSURE AT THE CORE INLET, N/CM**2	368.46484
PNC	PRESSURE AT THE COOLANT JACKET EXIT, N/CM**2	402.41821
PP	TOTAL PRESSURE AT PUMP EXIT N/CM**2	441.95215
DELPC	CORE PRESSURE DROP, N/CM**2	68.46509
DELPSR	SIDE REFLECTOR PRESSURE DROP, N/CM**2	33.95319
DELPNC	NOZZLE COOLANT PASSAGE PRESSURE DROP, N/CM**2	39.53389
PNE	STATIC PRESSURE AT THE NOZZLE EXIT, N/CM**2	0.04384

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PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 3 OF 5

STATE POINT DATA (COTINUED)

POWER MODE

TPSO	TEMPERATURE OF THE COOLANT LEAVING THE PRESSURE SHELL, K	225.00935
TPSR	TEMPERATURE OF THE COOLANT LEAVING THE RADIATOR, K	191.78391
TMPMAX	MAXIMUM CORE MATERIAL TEMPERATURE IN THE POWER MODE, K	2546.54175

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PROPULSIVE AND POWER MODE OUTPUT PARAMETERS PAGE 4 OF 5

STATE POINT DATA (COTINUED)

	|-----PROPULSIVE MODE-----|	|---POWER MODE---|
CORE LENGTH (METERS)	CORE MATERIAL TEMPERATURE (K)	GAS PASSAGE WALL TEMPERATURE, (K)	CORE MATERIAL TEMPERATURE (K)
0.018	467.384	443.013	2409.321
0.053	619.198	577.173	2428.740
0.089	788.385	729.324	2447.478
0.124	972.448	897.223	2465.258
0.160	1168.672	1078.393	2481.817
0.196	1374.164	1270.161	2496.911
0.231	1585.891	1469.700	2510.318
0.267	1800.730	1674.064	2521.840
0.302	2015.512	1880.240	2531.306
0.338	2227.072	2085.189	2538.578
0.373	2432.284	2285.883	2543.548
0.409	2628.124	2479.365	2546.142
0.444	2811.705	2662.781	2546.323
0.480	2980.317	2833.426	2544.087
0.516	3131.471	2988.779	2539.468
0.551	3262.941	3126.552	2532.534
0.587	3372.785	3244.713	2523.387
0.622	3459.384	3341.516	2512.162
0.658	3521.460	3415.537	2499.025
0.693	3558.097	3465.680	2484.169
0.729	3568.759	3491.210	2467.813
0.765	3553.283	3491.748	2450.200
0.800	3511.898	3467.284	2431.588
0.836	3445.214	3418.179	2412.252
0.871	3354.219	3345.162	2392.477

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NUROC3A CODE ENGINE NUMBER = 234

SYSTEM MASS BREAKDOWN

ZMPFS1	PIPING MATERIAL MASS, KG	8.23945
ZMPFS2	PUMP MATERIAL MASS, KG	4.06851
ZMPFS	PROPELLANT FEED SYSTEM MASS, KG	12.30796
ZMNC	CONVERGENT NOZZLE SYSTEM MASS, KG	73.58334
ZMND	COOLED PORTION DIVERGENT NOZZLE MASS, KG	113.32341
ZMS	UNCOOLED NOZZLE SKIRT MASS, KG	60.11708
ZMN	TOTAL NOZZLE MASS, KG	247.02383
ZMIC	INSTRUMENTS AND CONTROLS MASS, KG	142.25079
ZMVA	VALVES AND ACTUATORS MASS, KG	85.72325
ZMTS	THRUST AND GIMBAL ASSEMBLY MASS, KG	43.65889
ZMSP	SUPPORT PLATE MASS, KG	86.20979
ZMF	INSULATION AND DUCTING MASS, KG	33.67117
ZMRO	OTHER HARDWARE MASS, KG	119.88097
ZMRP	PERIPHERAL STRUCTURE MASS, KG	93.95287
ZMCFE	FUEL ELEMENT MASS, KG	426.44141
ZMCS	CORE STRUCTURE MASS, KG	295.83789
ZMSRS	SIDE REFLECTOR MASS, KG	433.33032
ZMSHD	INTERNAL (FRONT) SHIELD MASS, KG	202.13800
ZMPV	PRESSURE VESSEL MASS, KG	92.26669
ZMR	TOTAL REACTOR MASS, KG	1663.84766
ZMENG	ENGINE MASS, KG	2194.81226
ZMPSCP	PRESSURE VESSEL COOLANT SYSTEM PIPING MASS, KG	8.23945
ZMPSCF	PRESSURE VESSEL COOLANT SYSTEM FAN MASS, KG	2.26463
ZMPSCR	PRESSURE VESSEL COOLANT SYSTEM RADIATOR MASS, KG	55.12773
ZMPSC	PRESSURE VESSEL COOLANT SYSTEM MASS, KG	65.63181
ZMES	ENGINE SYSTEM MASS, KG	2260.44385
PCSM	POWER CONVERSION SYSTEM MASS, KG	3280.99731
WRSUM	TOTAL RADIATOR MASS, KG	5422.56641
ZMTOT	TOTAL SYSTEM MASS, KG	10964.00391

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 234

POWER CONVERSION SYSTEM/RADIATOR OUTPUT DATA PAGE 1 OF 1

BRAYTON CYCLE DATA

QE	POWER PLANT OUTPUT, MWE	1.00000
QHPPM	HEAT PIPE POWER, MWT	3.66872
X	TEMPERATURE RATIO	0.33000
TB1	COMPRESSOR INLET TEMPERATURE, K	527.99976
TB2P	REGENERATOR INLET TEMPERATURE (HIGH PRESSURE SIDE), K	706.68628
TB3P	HEAT EXCHANGER INLET TEMPERATURE, K	1216.63330
TSUBM	TURBINE INLET TEMPERATURE, K	1600.00000
TB5P	REGENERATOR INLET TEMPERATURE (LOW PRESSURE SIDE), K	1317.86084
TB6P	RADIATOR INLET TEMPERATURE, K	737.24487
ETAS	SYSTEM EFFICIENCY	0.27257
ETACY	CYCLE EFFICIENCY	0.33087

ORIENTATION

NON-ORIENTED FLAT PLANE RADIATORS WITH HEAT PIPE EXTENSIONS

PO	PROBABILITY OF NON-RUPTURE	0.99000

PRIMARY RADIATOR

RSP	REDUNDANCY	0.28000
QSUBP	HEAT REJECTION, MWT	2.45485
TBES(1)	MEAN TEMPERATURE, K	606.57080
TSI(1)	SINK TEMPERATURE, K	287.26465
ATI(1)	HEAT TRANSFER AREA, M**2	642.39380
WRI(1)	MASS, KG	3351.37451

AUXILIARY RADIATOR

RSA	REDUNDANCY	0.28000
QSUBA	HEAT REJECTION, MWT	0.19248
TBES(2)	MEAN TEMPERATURE, K	392.69678
TSI(2)	SINK TEMPERATURE, K	287.26465
ATI(2)	HEAT TRANSFER AREA, M**2	397.00781
WRI(2)	MASS, KG	2071.19434

SUMMARY

ATO	TOTAL RADIATOR SURFACE AREA, M**2	1039.40161
WRSUM	TOTAL RADIATOR MASS, KG	5422.56641
PCSM	POWER CONVERSION SYSTEM MASS, KG	3280.99731

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DUAL MODE SOLID CORE NUCLEAR SPACE POWER/PROPULSION SYSTEM
NUROC3A CODE ENGINE NUMBER = 234

PERFORMANCE PARAMETERS - SPECIFIC MASS, SPECIFIC THRUST PAGE 1 OF 1

SPECIFIC MASS DATA

SPMGEN	(POWER SYSTEM MASS + RADIATOR MASS) / POWER PLANT OUTPUT , KG/KWE	8.70356
SPMMT	TOTAL SYSTEM MASS / POWER PLANT OUTPUT , KG/KWE	10.96400
SPMKIN	TOTAL SYSTEM MASS / EXHAUST KINETIC ENERGY, KG/KWM	0.00005

SPECIFIC THRUST DATA

SPTENG	THRUST / TOTAL ENGINE MASS, NT/KG	20.09027
SPTMT	THRUST / TOTAL SYSTEM MASS, NT/KG	4.14200

APPENDIX E Conversion of International System (SI) to English Units

NOTE: Multiply quantity in units on left of equal sign by factor on right to give equivalent quantity in units on right.

Length:

1 metre (m) = 3.281 feet (ft)
= 39.37 inches (in)
= 0.54×10^{-3} nautical miles (n.mi)

Area:

$1\ m^2 = 10.76\ ft^2$

Volume:

$1\ m^3 = 35.31\ ft^3$

Mass:

1 kilogram (kg) = 0.0685 slugs (sl)
= 2.205 pounds mass (lbm)

Density:

$1\ kg/m^3 = 1.940 \times 10^{-3}\ sl/ft^3$

Speed:

1 m/s* = 1.944 n.mi/h
= 3.281 ft/s

Force, Weight, Thrust:

1 newton (N)** = 0.2248 pounds force (lbf)

Pressure:

1 pascal (Pa)*** = 9.869×10^{-6} atmospheres
= 1.450×10^{-4} lbf/in^2
= 1.0×10^{-5} bar

Energy, Work & Heat:

1 joule (J)+ = 0.738 ft lbf
= 9.48×10^{-4} Btu

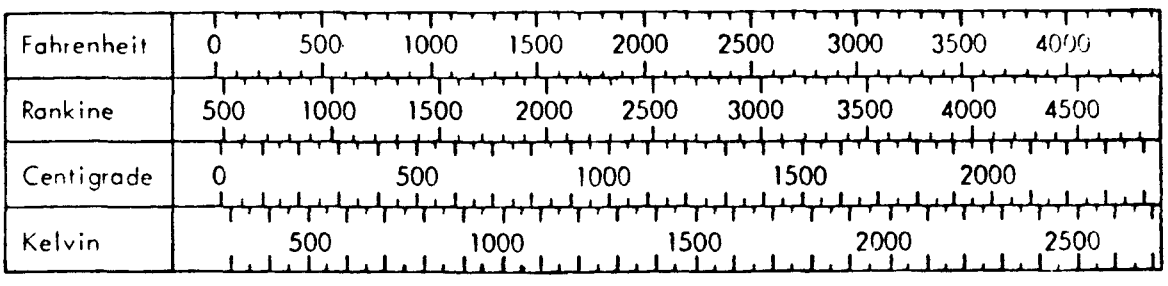
Power:

1 watt (W)++ = 1.341×10^{-3} horsepower (550 ft lbf/s)
= 3.412 Btu/h
= 0.7376 ft lbf/s

Thermal Power Density:

$1\ Wt/m^3 = 2.832 \times 10^{-2}\ Wt/ft^3$

Temperature



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* s-second, h-hour

** $1\ N \equiv 1\ kg\ m/s^2$

*** $1\ Pa \equiv 1\ N/m^2$, $1\ MPa = 100\ N/cm^2$

\+ $1\ J \equiv 1\ N\ m$

++ $1\ W \equiv 1\ J/s$ For thermal power use Wt, for electric power use We, for mechanical power use Wm, etc.

Reference: Hopkins, R. A., The International (SI) Metric System and How It Works, Third Edition, Polymetric Services Inc., Tarzana, CA. 91356