DOE/SF/19441--T15

P-1085-029

UNITED STATES DEPARTMENT OF ENERGY

San Francisco Field Office

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SPACE-R THERMIONIC
SPACE NUCLEAR POWER SYSTEM

Design and Technology Demonstration

Contract: DE-AC03-92SF19441

Monthly Report for 8/1/94 to 9/1/94

Space Power, Incorporated
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STATUS REPORT

CONTRACT TITLE AND NUMBER:

TI-SNPS Design and Technology Demonstration
DE-AC03-92SF19441

Report No. P-1085-029
Report Period: 08/1/94 - 09/1/94

CONTRACTOR NAME: SPACE POWER INCORPORATED
621 River Oaks Parkway
San Jose, CA 95134

CONTRACT PERIOD: 9/24/92-1/24/95

1. CONTRACT OBJECTIVE:

The objective of this program is to design, develop, demonstrate, and advance the technology for thermionic space nuclear power system (TI-SNPS) to meet key functional requirements with reliable 5 ~ 40 kWe output and 18-month near-term/10-year long-term goals. A 40 kWe TI-SNPS point design will be prepared, and key technologies and critical components supporting that design will be validated. This program will produce an assessed design of a 40 kWe-EOL space nuclear power system that:

1. Minimizes the potential safety risk to population, workers and environment (ALARA).
2. Provides the high reliability required by spacecraft designers formulating high value space systems (0.95) over system lifetime.
3. Provides the high performance necessary to enable high powered missions with currently available and planned near-term boosters and electric propulsion systems; 15-30 W/Kg EOL and compact enough to be incorporated into Atlas II/Centaur launch vehicle to 800 Km circular orbits at 28° inclination.
4. Provides the proven lifetime potential of 18 months, and a near-term lifetime of 5 years with a 10 year lifetime design goal.
5. Can be developed within the decade at a minimum development cost and at minimum technical and budget risk based upon proven technology.

Phase I will provide for the performance of parametric trade studies and demonstration of key technologies, resulting in a preferred conceptual design for the TI-SNPS. The focus of the tasks is technology validation driven by the system design.

2. DESIGN FEATURES

The Space Power Advanced Core-length Element-Reactor (SPACE-R) TI-SNPS power system concept is built on the foundation of proven flight tested technology, from the Topaz, RORSAT, and SNAP-10A programs, and is enhanced by modern technical advancements to produce a design that fully meets or exceeds all of the desired requirements. The guiding principals of the design are: assured safety during all program phases, minimization of risk of development, maximization of performance and clear definition of program plan to achieve the desired performance goals. These goals are met, under the constraints of the guiding principals, using an optimal mix of US and Russian technologies that incorporates the best features of both.

In brief, the SPACE-R design is based on the demonstrated thermionic converter with UO_2 fuel, 800-900 K NaK heat transport system, stainless steel structure, beryllium metal reflector/control, and cold $\text{LiH}_{0.99}$ neutron shield protected by hot $\text{ZrH}_{1.8}$ gamma-fast neutron shield. Safety and performance are enhanced by the use of the single-cell core length thermionic converters, which allow the fabrication and any remaining qualification testing to occur in an unfueled condition, and to provide for ease of venting of gaseous fission products. Safety and performance are also enhanced by the use of beryllium-contained YH_{1.75} moderator, which can produce a zero moderator temperature coefficient as well as reduced release of hydrogen. These and other enhancements incorporated in the design represent only minimal increases in development risk of the concept which are justified by the large potential payoffs. The maturity level of the present concept design and technology is supported by the preponderance of flight-tested and/or extensively ground-tested components in the design and the aforementioned development risks.

The SPACE-R key design features include the following:

- 1) Utilization of the CIS developed predistributed, self-venting UO_2 fuel in Topaz II type core-length converters. The monocrystal moly alloy emitter (with CVD 110 W^{184} overlay) of Topaz II and the moly collector are slightly increased in thickness and diameter, and shortened slightly to permit an output power increase from 180 watts peak electric per element to 320 watts peak electric per element. The shorter core, better end reflectors and fuel axial redistribution resulting from higher power density and lower fuel smear density also improve the axial power flattening and contributes to the higher power

output. The thermal power of SPACE-R TFE's is about 20% greater than in Topaz II TFE's. The Topaz II type single cell thermionic fuel elements are fully testable.

- 2) Good reflector leakage control is maintained in the larger 46 cm diameter SPACE-R core, versus 26 cm diameter Topaz II core, by diluting the hydride moderator with approximately 50% beryllium. The beryllium also serves as the primary hydrogen containment barrier. It's effectiveness is enhanced by substituting $\text{YH}_{1.75}$ for the $\text{ZrH}_{1.85}$ of Topaz II. The use of $\text{YH}_{1.75}$ is made possible by the Be dilution and by a higher fuel loading. Use of $\text{YH}_{1.75}$ decreases the hydrogen overpressure of $\text{ZrH}_{1.85}$ by 4 orders of magnitude. The use of Be-clad $\text{YH}_{1.75}$ can also alter the moderator temperature coefficient from positive in Topaz I and II to essentially zero in SPACE-R thus potentially enhancing the core safety.
- 3) The SPACE-R core is reflected with 10 cm of beryllium metal that incorporates 12 rotating poison-backed drums for safety and reactivity control as in the SNAP-4, SNAP-6, Topaz I, and Topaz II reactors. Extra control is available if rotating half drums as in SNAP-10A are incorporated for safety drums without shield or mass penalty.
- 4) The SPACE-R is cooled by a primary pumped liquid metal coolant in accordance with established power plant practice. The preferred coolant is state-of-the-art liquid metal NaK-78 at 825-925 K. These are the temperature limits for reliable 20 year life stainless steel and superalloy systems. The NaK is circulated by a static high reliability electromagnetic pump.
- 5) Radiator consists of multiple parallel NaK loops to provide full ground testability with low technical risk. These secondary NaK loops are pumped by a multi-throated EM pump with redundant magnets for reliability. High conductivity carbon-fibre-reinforced carbon fins are bonded to each secondary NaK loop. All secondary NaK loops and carbon-carbon fins are redundant. The SPACE-R system can continue to operate at full power after nearly 50% of the radiator tubing has been destroyed. The radiator also serves as a meteoroid bumper to scatter the projectile. This bumper plus a beryllium layer on the primary NaK piping protect the primary NaK loop and components below the shield. The remaining primary NaK cooling system is protected from meteorite or hostile damage by being buried within the shield and the 4 inch thick Be reflectors.

- 6) The SPACE-R primary shadow shield incorporates a B_4C and $ZrH_{1.8}$ fast neutron scatter, absorption and gamma shield. Its principal purpose is to remove the heat generated by radiation absorption and to protect the LiH shield from excessive helium generation, neutron damage and consequent swelling and pressure buildup. The radiation fluences entering the LiH in 10 years are reduced to those experienced by the cold (400 K) SNAP-10A and Topaz shields, in one year and 2 years of operation respectively, without damage. Due to the low temperature of operation and subsequent low dissociation pressures and low hydrogen diffusion rates, meteorite damage or penetration to shield containment will not lead to system failure. Primary NaK piping is insulated and buried in the shield to protect the primary loop from space debris and pellets.
- 7) Control remains simplified by maintaining constant power and temperature output from the reactor. Variations in payload demand are accommodated by a shunt regulator that is capable of converting excess power to heat for radiation to space.

3. CONTRACT PROGRESS IN AUGUST (BY REPORTING ELEMENT)

1.1 Program Plan and Management

Planning scenarios for reduced FY94 funding levels were prepared and studied to assess the impact on program tasks. The SPACE-R contract was modified by DOE to reflect the uncertainty in FY94 funding. All further work on the Conceptual Design Review, Reactor Assembly Fabrication Demonstration, and the SC-320 TFE delivery and performance testing were deleted. Also, the FY94 Technical Progress Report was deleted.

A paper titled "SPACE-R 40 kWe SNPS Technology Demonstration" was presented at the 29th IECEC Conference in Monterey, CA.

1.5 Key Technology Identification and Demonstration

Monocrystal Alloy 1-D Creep Testing (Lutch)

This task is completed.

Monocrystal Alloy 2-D Creep Testing (Lutch)

The 2000-hour Mo-6%Nb monocrystal alloy two-dimensional creep testing was completed by Lutch. The specimen tube internal pressure was 16 atmospheres at 1873 K with corresponding applied stress of 15 MPa. The total strain after 2000 hours was just under 2%. The result confirms good creep resistance of Mo-6%Nb, and compares favorably with the 1-D results.

Be/YH_x Moderator Irradiation Demonstration (Lutch)

The seven irradiation moderator specimens have been exposed to about 40% of the required fluence; these samples are now expected to receive an additional 10% fluence over the specified minimum. This task is on schedule.

Moderator Hydrogen Containment Demonstration (SPI)

Four Be/YH_x moderator specimens for hydrogen containment testing were fabricated and delivered to SPI via Aeroflot at the San Francisco Airport in good condition. In a separate transmittal, the properties of the beryllium were described in detail.

The Transpector residual gas analyzer for the measurement of hydrogen partial pressure was received from Leybold-Inficon. The beryllium oxidation problem in the brazing furnace was eliminated by controlled heating.

The moderator containment test facility was wrapped with bead heaters and insulated. The system was then baked at 200 C and a vacuum test carried out with good results. The Transpector residual gas analyzer was installed in the test facility. The system was again baked at 200 C to reduce water vapor in the system. About 30 g of YH_{1.75} in an open beryllium container was loaded in the test stand, and the system was pumped down in preparation for a hydrogen partial pressure calibration test.

Nuclear Metals, Inc. delivered the beryllium tubes and end caps for the brazed moderator test samples. Brazing trials with Lithobraz 925 continued on beryllium samples.

LLNL completed the machining and annealing of the beryllium moderator parts for laser welding. LLNL carried out laser welding trials on extruded beryllium which had been annealed at 800 C. There was no evidence of cracks parallel to the tube axis in contrast to numerous small cracks observed in the welded unannealed tube. However, a large crack developed in the tube mid-section (away from the welding zone) which was probably caused by a defect in the material.

1.8 Critical Component Definition and Demonstration

High Performance Single Cell TFE Fabrication and Demonstration (Lutch/SPI)

Modifications to the TFE Rig Stand at the TSET facility were reviewed by Kent Koester with Victor Androsov (Lutch) and Phillips Laboratory personnel. All upgrades required for the demonstration testing of the SC-320 TFE have been completed. These include the installation of a TMP-500 turbomolecular pump, an improved forevacuum pump, changes to the plumbing, calibration of the cesium system, increase in the capacity of the TISA heater system and of the load cables. In addition, the Russian data acquisition system has been completely upgraded with American equipment and new software. A hot vacuum shakedown test was observed with a TOPAZ-II TFE. The test plans of the high performance TFE were reviewed with Frank Thome and Frank Wyant. Facility upgrades plus the installation of special TFE fabrication equipment are on schedule.

Meetings were held at SPI with Prof. Yu. Nikolaev and Dr. A. Gontar of Lutch. The schedule for the TFE performance test at Phillips Laboratory was discussed in detail. TFE fabrication is scheduled for completion in August with hot vacuum tests at Lutch scheduled for mid-September. Delivery of the TFE, final assembly at the TSET facility, check-out tests, out-gassing, and performance testing of the TFE were put on hold due to the funding uncertainty.

TFE Interconnection and Reactor Vessel Fabricability Demonstration (B&W/SPI)

This task was deleted due to the funding uncertainty.

3.1 Special Studies

The bi-modal team continued the evaluation of nine concepts in terms of meeting Air Force mission requirements. Norm Gunther was given bi-modal team responsibility for nuclear analysis and design. He prepared an outline of required LANL support and communicated it to Dr. Mike Houts. The bi-modal team will present a two-day review of the conceptual design studies on September 7-8.

Nuclear analysis continued to quantify the water immersion characteristics of the various bi-modal concepts under consideration. A meeting was held with Dr. Richard Mason of LANL, a fuels and reactor materials expert.

A preliminary analysis of a Topaz-II derivative bi-modal concept was conducted. This concept appears to meet or exceed the bi-modal program performance goals. Nuclear analysis on this concept indicates that it appears to be "inherently safe" in water immersion for both launch accidents and end-of-life reentry without relying on safety rods or other mechanical remedies. The bi-modal team met with N. N. Ponomarev-Stepnoi to discuss the possibility of a joint program. Arrangements were initiated for a Russian team to travel to Albuquerque for one month in September/October to discuss and plan this joint effort.

J. Kent Koester
Program Manager

Hyop S. Rhee
Chief Project Engineer

Attachments: Funding Status
 Funding Status by Time Period
 Cost Change Reconciliation

FUNDING STATUS

REPORTING ELEMENT	FUNDING AUTHORIZED TO DATE	ACCRUED COST & OUTSTANDING COMMITMENTS	EAC AUTHORIZED WORK	FORECAST NOT YET AUTHORIZED	FORECAST ALL OTHER WORK	TOTAL FUNDING REQUIREMENTS	FUNDS CARRYOVER	NET FUNDS REQUIRED
TOTAL FUNDING	\$4,112,999	\$3,969,386	\$11,111,119	\$0	\$0	\$11,111,119	\$0	\$11,111,119

FUNDING STATUS BY TIME PERIOD

ITEM	ACTUAL TO DATE	SELECTED PERIOD (MO, FY)				AT COMPLETION
		FISCAL YEAR 93		FY 94	FY 95	
		Balance FY 93	Funds Carryover			
1. Accrued Cost	\$3,883,886	\$0	\$0	\$4,000,000	\$4,000,000	\$11,111,119
2. Outstanding Commitments	\$85,500	\$0		\$0	\$0	\$0
3. Total	\$3,969,386			\$4,000,000	\$4,000,000	\$11,111,119
4. Termination Costs		---	---	---	---	---
5. Forecast of Billing to the Government	\$4,112,999	\$0	\$0	\$4,000,000	\$4,000,000	\$11,111,119

COST CHANGE RECONCILIATION

CONTRACT NUMBER: DE-AC03-92SF19441

ORIGINAL CONTRACT VALUE: \$11,111,119

SUPPLEMENTAL AGREEMENTS:

NONE \$0

SUBTOTAL \$0

PRESENT CONTRACT VALUE \$11,111,119

Changes authorized but not finalized \$0

Anticipated (Over) or Underun \$0

SUBTOTAL \$0

CONTRACTOR ESTIMATE \$11,111,119

Changes Under Consideration but Not Authorized \$0

Changes To Be Proposed \$0

SUBTOTAL \$0

TOTAL FUNDS REQUIRED \$11,111,119

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

3. IDENTIFICATION NUMBER DE-AC03-92SF19441				2. PROGRAM/PROJECT TITLE THERMIONIC REACTOR				3. REPORTING PERIOD 8/1/94 - 8/31/94															
4. PARTICIPANT NAME AND ADDRESS SPACE POWER, INC. 621 RIVER OAKS PARKWAY SAN JOSE, CA 95134								5. START DATE 9/24/92															
								6. COMPLETION DATE 1/24/95															
7. FY	93	8. MONTHS		FY 93	O	N	D	J	F	M	A	M	J	J	A	S	O	N					
9. COST STATUS																							
a. \$ Expressed in:				\$23M																			
THOUSANDS																							
b. Budget & Reporting No.				N/A																			
c. Cost Plan Date				3/4/93																			
d. Actual Costs																							
Prior Years				3149.7																			
e. Planned Costs																							
Prior Years				0																			
f. Total Estimated Cost																							
for Contract				10385.9																			
g. Total Contract Value				11111.1																			
h. Estimated Subsequent																							
Reporting Period				384.4																			
g. Planned				335.9	395.6	646.9	438.5	509.8	281.0	485.8	275.7	432.0	314.3	292.1	292.3	405.1	259.3	217.4					
Accrued																							
Costs				207.1	223.1	222.7	11.9	73.5	55.7	36.6	251.6	60.6	54.2	123.5	76.9								
i. Variance				128.8	172.5	424.2	426.6	436.3	225.3	449.2	24.0	371.4	260.1	168.6	215.4								
j. Cumulative Variance				1970.8	2143.3	2567.6	2994.2	3430.5	3655.7	4105.0	4129.0	4500.4	4760.5	4929.1	5144.5								
10. LABOR STATUS				120,000																			
a. Labor Expressed in:				HOURS																			
b. Labor Plan Date				3/4/93																			
c. Planned Labor Prior																							
Fiscal Years				0																			
d. Actual Labor Prior																							
Fiscal Years				19158																			
e. Total Estimated Labor																							
for Contract				60,180																			
f. Total Contract Labor				60,180																			
LEGEND																							
Planned: - - - - -																							
Actual: - - - - -																							
Projected: - - - - -				0																			
g. Planned				2000	2260	2270	2230	2300	2300	2280	2260	2300	2470	2280	2460	2380	1990	1100					
Labor																							
h. Actual				1550	1241	639	82	219	259	238	523	404	521	621	412								
i. Variance				450	1019	1631	2148	2081	2041	2042	1737	1896	1949	1659	2048								
j. Cumulative Variance				450	1469	3100	5248	7329	9370	11412	13149	15045	16994	18653	20701								
11. MILESTONES				STATUS																			
a. 1.1 Program Plan																							
b. 1.5 Ky Tech ID/D																							
c. 1.8 Cr Comp D&D																							
d. 1.9 CoDR																							
e. 3.1 Ph I Studies																							
f.																							
g.																							
12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE				9/29/94																			

1. TITLE THERMIONIC SPACE NUCLEAR POWER SYSTEM						2. REPORTING PERIOD 08/01/94-08/31/94			3. IDENTIFICATION NUMBER DE-AC03-92SF19441					
4. PARTICIPANT NAME AND ADDRESS SPACE POWER, INC. 621 RIVER OAKS PARKWAY SAN JOSE, CA 95134						5. COST PLAN DATE 3/4/93			6. START DATE SEPT. 24, 1992					
									7. COMPLETION DATE 1/24/95					
8 ELEMENT CODE	9 REPORTING ELEMENT	10. ACCRUED COSTS				11. ESTIMATED ACCRUED COSTS							12. Total Contract Value	13. Variance
		Reporting Period		Cumulative to Date		a. Subsequent Reporting Period	b. Balance of Fiscal Year	c. 95 (1)	(2)	(3)	d. Fiscal Years to Completion	e. Total		
		a Actual	b Plan	c Actual	d Plan									
2														
1.1	Program Plan and Mgmt	11.0	22.3	553.7	558.1	22.3	44.7	73.8				694.5	650.9	(43.6)
1.2	Parametric Trade Studies	0	0	717.8	657.4	0	0	0				717.8	657.4	(60.4)
1.3	Point Design	0		547.3	347.1	0	0	0				547.3	1108.4	561.1
1.4	Design Assessment	0	50.7	5.5	667.8	37.7	79.3	3.7				126.2	687.7	561.6
1.5	Key Technologies	19.7	44.5	296.8	2063.2	55.8	101.1	243.1				696.8	2023.6	1326.8
1.6	Failure Modes and Effects	0	0	8.3	923.4	0	0	0				8.3	198.9	190.5
1.7	Flight Planning Document	0	31.2	2.4	74.5	30.7	60.6	71.5				165.2	224.3	59.1
1.8	Critical Components Defn. & Demo	2.6	81.5	388.1	905.7	169.9	245.1	202.7				1005.9	2342.4	1336.5
1.9	CoDR and Reporting	0	36400	0.1	338.1	68.0	125.4	150.3				343.7	374.1	30.4
1.0	SUBTOTAL	33.3	266.7	2520.1	6535.3	384.4	656.1	745.1				4305.8	8267.7	3962.0
3.1	Phase I Special Studies	0	25.4	22.2	283.9	20.7	41.4	65.2				149.5	388.3	238.8
3.2	Bimodal Workshop	0	0	2.9	2.9	0	0					2.9	4.0	1.1
3.3	Bimodal On-site Work	13.6	11.0	41.5	22.0	11.0	65.9	65.2				152.4	392.3	261.7
3.0	SUBTOTAL	13.6	36.4	66.6	308.8	416.1	107.3	65.2				155.3	396.3	
	G & A	23.9	88.9	1037.1	2156.4	114.6	197.2	216.1				1565.0	4220.7	2655.7
	FCCM	0.1	1.2	6.3	21.1	1.2	2.4	2.1				12.0	45.3	33.3
	Fee	5.9	32.3	253.7	685.4	41.6	71.6	82.1				448.9	1665.2	1216.2
14 TOTAL		76.9	400.1	3883.9	9420.2	552.8	993.2	1110.6				6484.2	14591.3	8128.9
15 DOLLARS EXPRESSED IN THOUSANDS		16 SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE [Signature] 9/29/94					17 SIGNATURE OF PARTICIPANT'S AUTHORIZED FINANCIAL REPRESENTATIVE AND DATE [Signature] 9/27/94							

OMB 1901-1400

[illegible]

1. TITLE		2. REPORTING PERIOD		3. IDENTIFICATION NUMBER																							
THERMIONIC REACTOR		8/1/94 - 8/31/94		DE-AC03-92SF19441																							
4. PARTICIPANT NAME AND ADDRESS				5. START DATE																							
SPACE POWER, INC. 621 RIVER OAKS PARKWAY SAN JOSE, CA 95134				SEPT. 24, 1992																							
				6. COMPLETION DATE																							
				1/24/95																							
7. ELEMENT CODE	8. REPORT- ING ELEMENT	9. DURATION																FY	FY	10. PERCENT COMPLETE							
		GFY 94												GFY 95				GFY 96						a.	b.		
		O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	Q2	Q3	Q4	Q1	Q2	Q3	Q4	97		Plan	Actual
1.1	Program Plan																			85	85						
1.2	Para Trades																			100	100						
1.3	Point Design																			100	100						
1.4	Dsn Assess																			100	100						
1.5	Ky Tech ID/D																			76	76						
1.6	Failure Modes																			0	0						
1.7	Flt Plng Doc																			0	0						
1.8	Cr Comp D&D																			74	74						
1.9	CoDR																			0	0						
3.1	Ph I Studies																			15	15						
																				0	0						

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

M Koester 9/29/94

U.S. Department of Energy
Milestone Log

Element Code	Description	Planned Completion Date	Actual Completion Date	Comments
1.1.A	Program Plan, Phase I Work Plan, QA Plan	12-4-92	12-4-92	
1.1.B	Semiannual Report	04-15-93	05-07-93	
1.1.C	Semiannual Report	10-15-93	12-1-93	
1.1.F	Critical Component Definition	11-25-94		
1.1	Complete Program Mgmt.	01-25-95		
1.2	Trade Study Report	02-24-93	08-25-93	
1.3	Complete point design	06-30-94	12-6-93	
1.4	Complete assessment	09-30-94	12-6-93	
1.5	Complete Key tech ID/D	01-25-95		
1.6	Complete FMEA	06-30-94		Task deleted
1.7	Flight planning document	11-25-94		Task deleted
1.8	Complete Critical Components D&D	01-25-95		
1.9.A	CODR Package	11-10-94		Task deleted
1.9.B	CODR	11-25-94		Task deleted
1.9	CODR Final Report	01-25-95		Task deleted
2.1.A	Update Phase II Plan	02-25-95		Option deleted
2.1.B	Semiannual Report	07-25-95		Option deleted
2.1	Complete Program Management	01-25-96		Option deleted
2.2	Complete Preliminary Design	11-25-96		Option deleted
2.3	Complete Critical Component Demonstration	01-25-96		Option deleted
2.4	Complete Design Assessment	12-25-95		Option deleted

Element Code	Description	Planned Completion Date	Actual Completion Date	Comments
2.5	PSAR	11-25-95		Option deleted
2.6.A	PDR Package	01-10-96		Option deleted
2.6.B	PDR	01-25-96		Option deleted
2.6	PDR Final Report	01-25-96		Option deleted
3.1.A	Environmental Assessment Report	12-30-92	01-14-93	Extension to 1/15/93 Approved
3.1	Complete Phase I Special Studies	01-25-95		
3.2	Complete Phase II Special Studies	01-25-96		Option deleted

Reports Distribution List

Report/Plan	Form Number	Frequency	Addressee and No. of Copies*
Management Plan	None	X,O,C	A,B,E,F,G,H,I,J,K,L,M
Milestone Plan	1332.3	X,O,C	A,B,E,F,G,H,I,J,K,L,M
Labor Plan	1332.4	X,O,C	A,B,E,F,G,H,I,J,K,L,M
Cost Plan	1332.7	X,O,C	A,B,D,E,F,G,H,I,J,K,L,M
WBS Dictionary Part I	1332.10	X,O,C	A,B,E,F,G,H,I,J,K,L,M
WBS Dictionary Part II	1332.11	X,O,C	A,B,E,F,G,H,I,J,K,L,M
Milestone Schedule	1332.3	M	A,B,E,F,G,H,I,J,K,L,M
Labor Management Report	1332.8	M	A,B,E,F,G,H,I,J,K,L,M
Cost Management Report	1332.9	M	A,B,D,E,F,G,H,I,J,K,L,M
Status Report	none	M	A,B,E,F,G,H,I,J,K,L,M
Summary Report	1332.2	M	A,B,E,F,G,H,I,J,K,L,M
WBS Cost Perf. Report 1	1332.12	M	Deleted
WBS Cost Perf. Report 2	1332.13	M	Deleted
WBS Cost Perf. Report 3	1332.14	M	Deleted
Notice of Energy RD&D	DOE 538	O,Y	A,B,J
Conference Record	none	A	A,B,E,F,G,H,I,J,K,L,M
Hot Line Report	none	A	A,B,E,F,G,H,I,J,K,L,M
Topical Report	none	A	A,B,E,F,G,H,I,J,K,L,M,N,O,P
Technical Progr. Report	none	S	A,B,E,F,G,H,I,J,K,L,M,N,O,P
Final Technical Report	none	F	A,B,E,F,G,H,I,J,K,L,M,N,O,P
Subcontracting Report	SF-294**	S	B,C
Summary Subcontract Rpt	SF-295***	Y	B,C
Contractor Data Rqmts List (CDRL)	none	A	A,B,E,F,G,H,I,J,K,L,M,N,O,P