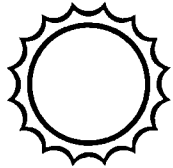


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Sandia Laboratories
Solar Energy



San Francisco
Operations
Office

SOLAR THERMAL POWER

**Large
Power
Systems
Applications**

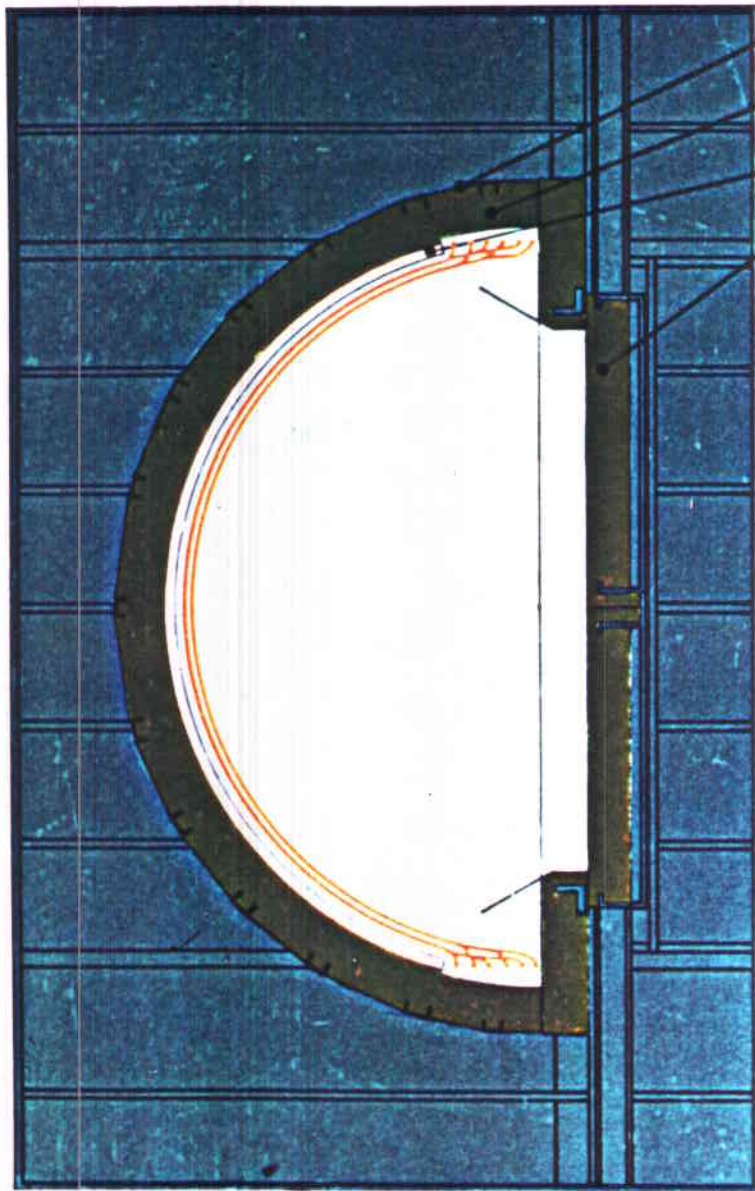
**STATUS LETTER FOR
APRIL 1979**

J. J. BARTEL, EDITOR
LARGE POWER SYSTEMS DIVISION
SANDIA LABORATORIES, LIVERMORE

ROBERT W. HUGHEY, DIRECTOR
SOLAR ENERGY DIVISION
SAN FRANCISCO OPERATIONS

The Photograph --

IEA - Interatom CRS - Solar Power Plant Cavity Receiver design. At the design point, 1700 kW of energy will be directed through the 3 x 3 m aperture located 43 m above ground level and eventually converted to an output of 500 kWe. DOE and its contractors are providing technical and programmatic assistance to the International Energy Agency and its "Operating Agents" DFVLR.

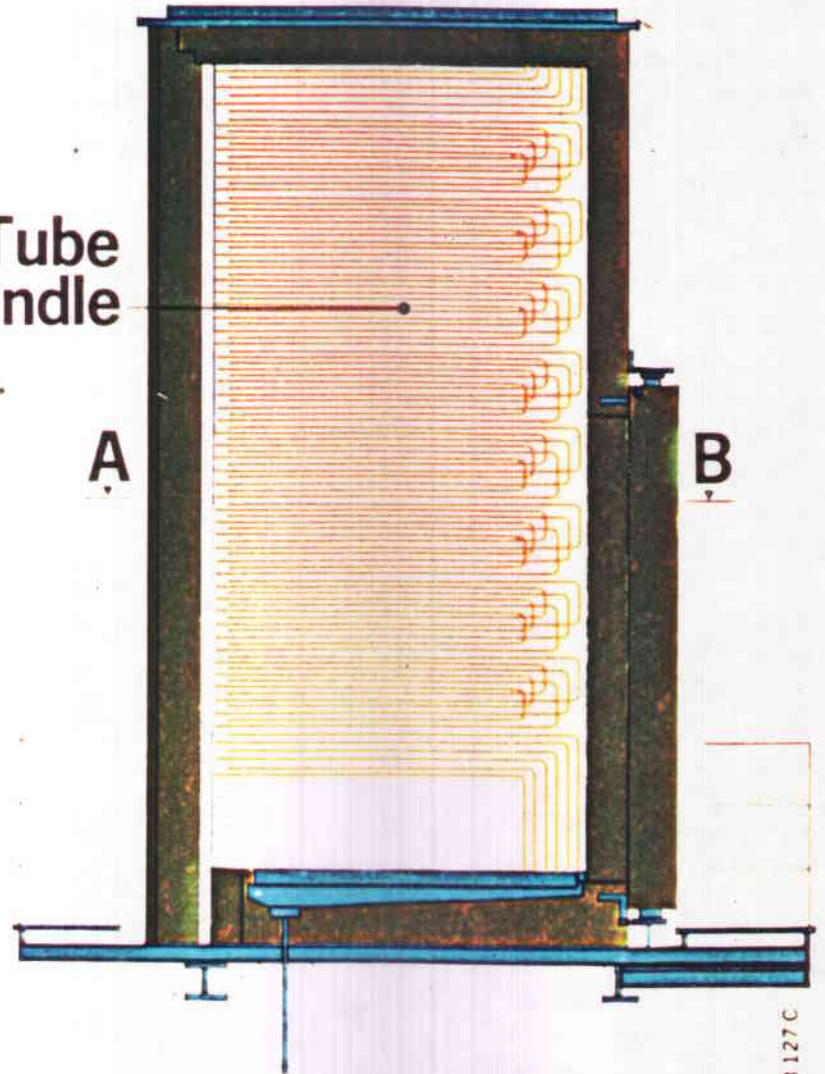


Receiver housing
Insulation
Ceramic wall
Door

Tube
bundle

A

B



Cross section A-B

PROGRAM ELEMENT SUMMARY

LARGE POWER SYSTEMS APPLICATIONS

This report, issued monthly, covers the portion of the Solar Thermal Power Systems which is directed toward large-scale systems applications -- primarily Central Receiver system applications to electrical power generation at 10 MWe and above, but also with consideration of direct, high temperature thermal applications and of alternative collector configurations. The Central Receiver concept employs a field of individually guided mirrors called heliostats that redirect the sun's energy to a receiver mounted on top of a tower. In the receiver, the radiant solar energy is absorbed in a circulating fluid and is then transported to an electrical power generation subsystem or to an industrial thermal process; excess thermal energy may be stored for later use, if operationally desirable and economically justifiable. Alternative systems for large-scale energy collection, such as linear central receivers with single-axis heliostats and individual, distributed collectors in manifolded arrays, are also under study.

Responsibility for managing the development and assessment of large solar thermal power systems for various applications has been delegated by DOE Headquarters to the San Francisco Operations Office; technical management is drawn from Sandia Laboratories, Livermore, the Aerospace Corporation, and other public and private organizations. The Large Power Systems Applications program element is organized according to a work breakdown structure which includes: Overall planning and coordination activities; storage-coupled systems; utility repowering/industrial retrofit systems; solar/non-solar hybrid systems; and programmatic support to the 10-MWe Solar Thermal Pilot Plant construction project.

HIGHLIGHTS

Major Accomplishments

- General Electric Company and Energy Systems Group personnel traveled to West Germany to review the IEA sodium central receiver design. (page 3)
- A study comparing central receiver systems with several distributed systems over a range of process heat applications is nearing completion. (page 3)
- Calculations done for the Focus on Goals workshop held last month in Denver indicate that Advanced Central Receiver-produced electricity will be economically competitive with coal produced electricity in the Southwestern U.S. (page 3)
- Sandia hosted a solar source, high temperature process heat technical meeting. (page 3)
- SAN and Sandia prepared an integrated input for Solar Large Power Systems for the Multi-Year Program Plan (MYPP) for Solar Thermal Power Systems. (page 4)

MILESTONE STATUS

Milestones Accomplished

- Preliminary draft of the Large Solar Power Systems technology document released. (page 4)
- Initiated Alternate Central Receiver, Phase 2, work. (page 4)

Milestones Missed

- None

MILESTONE SCHEDULE AND STATUS REPORT

ID-- LARGE POWER SYSTEMS		WBS- 1.0 SYSTEM APPLIC													REPORTING PERIOD												
		START 10/01/78 END 09/30/79													04/01/79 THRU 04/30/79												
		FY 79													FY 80				FY 81				82				
		O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	Q2	Q3	Q4	Q1	Q2	Q3	Q4			PL	AC
01.01.00	GENERAL ACTIVITIES																										
01.01.01	---PLANNING AND AD-HOC TASKS			▽B			▽C	▽D				▽E										▽G			12	12	
01.01.02	---UNSOLICITED PROPOSALS	▽B					△B					▽C													12	12	
01.02.00	STORAGE COUPLED SYSTEMS																										
01.02.01	---SYSTEMS ANALYSIS/PLANNING																					▽C		△	20	20	
01.02.02	---RECEIVER TESTING	▽B					▽C																		100	100	
01.02.03	---ALT CENTRAL RECEIVER SYSTEM					▽B	▽C															▽E	▽F		△	20	20
01.02.04	---LINE FOCUS SYSTEM STUDIES	▽B																				▽G	▽H			26	26
01.03.00	REPOWERING/INDUSTRIAL RETROFIT																										
01.03.01	---SYSTEMS ANALYSIS/PLANNING																					▽D			15	15	
01.03.02	---REPOWERING/RETROFIT CONCEPT	▽B					▽C																▽E			36	36
01.03.03	---W SYN EPRI UTILITY-E STUDY																									44	44
01.04.00	HYBRID POWER SYSTEMS																										
01.04.01	---SYSTEMS ANALYSIS/PLANNING																					▽C		△	20	20	
01.04.02	---HYBRID PWR SYSTEMS STUDIES	▽B																				▽G	▽H			27	27
01.04.03	---UTILITY COOPERATIVE PROGRAM																					▽E			12	12	
01.04.04	---DOE/BU-REC HYB NETWK STUDY																					▽C	▽D		△	31	31
01.04.05	---W UTIL/TECH SENS ANALYSIS																						▽D			47	47
01.05.00	10MWE PILOT PLANT																										
01.05.01	---STMPO OPERATIONS																							▽E	15	15	
01.05.02	---PP OPERATIONAL TESTING																							▽D	15	15	

IDENT	DESCRIPTION	-----DATES-----			
		START	PROGRESS	PLAN COMP	ACT COMP
01.01.00.A	GENERAL ACTIVITIES				
01.01.01.A	---PLANNING AND AD-HOC TASKS	10/01/78	04/30/79	09/30/83	
01.01.01.B	B MIRVAL CODE ISSUE			12/15/78	03/10/79
01.01.01.C	C TECHNOLOGY DOCUMENT DRAFT			03/15/79	03/15/79
01.01.01.D	D UTILITY DOCUMENT DRAFT	03/01/79		04/10/79	
01.01.01.E	E AOP/APP DRAFT			07/15/79	
01.01.01.F	F TECHNOLOGY COMPARISON			11/30/79	
01.01.01.G	G TECHNOLOGY COMPARISON			11/30/80	
01.01.02.A	---UNSOLICITED PROPOSALS	10/01/78	04/30/79	09/30/83	
01.01.02.B	B START SRI MESOSCALE STUDY			10/01/78	10/01/78
01.01.02.C	C SRI STUDY/INITIAL RESULTS			05/30/79	
01.01.02.D	D SRI STUDY COMPLETE			09/29/79	
01.02.00.A	STORAGE COUPLED SYSTEMS				
01.02.01.A	---SYSTEMS ANALYSIS/PLANNING	10/01/78	04/30/79	09/30/81	
01.02.01.B	B TECHNOLOGY COMPARISON			11/30/79	
01.02.01.C	C TECHNOLOGY COMPARISON			11/30/80	
01.02.02.A	---RECEIVER TESTING	10/01/78	02/01/79	02/01/79	02/01/79
01.02.02.B	B BOEING TEST START			10/16/78	10/16/78
01.02.02.C	C BOEING TEST COMPLETE		02/01/79	02/01/79	02/01/79
01.02.03.A	---ALT CENTRAL RECEIVER SYSTEM	10/01/78	04/30/79	09/30/81	
01.02.03.B	B SELECT PHASE 2 CONTRACTORS			02/01/79	02/21/79
01.02.03.C	C START PHASE 2 ACTIVITIES			03/01/79	
01.02.03.D	D PHASE 2 STATUS REVIEW			11/01/79	
01.02.03.E	E PHASE 2 COMPLETE			09/30/80	
01.02.03.F	F DECISION TO CONT PHASE 3			11/30/80	
01.02.04.A	---LINE FOCUS SYSTEM STUDIES	10/01/78	04/30/79	12/30/80	
01.02.04.B	B START PHASE 1 ACTIVITIES			10/01/78	10/01/78
01.02.04.C	C PHASE 2 PROPOSALS DUE			08/30/79	
01.02.04.D	D PHASE 1 COMPLETE			09/28/79	
01.02.04.E	E PHASE 2 EVALUATION COMPLETE			10/30/79	
01.02.04.F	F START PHASE 2 ACTIVITIES			11/30/79	
01.02.04.G	G PHASE 2 COMPLETE			09/30/80	
01.02.04.H	H DECISION TO COMPETE PHASE 3			12/30/80	
01.03.00.A	REPOWERING/INDUSTRIAL RETROFIT				
01.03.01.A	---SYSTEMS ANALYSIS/PLANNING	10/01/78	04/30/79	09/30/82	
01.03.01.B	B SERI STRATEGY ANALYSIS COMP			07/30/79	
01.03.01.C	C TECHNOLOGY COMPARISON			11/30/79	
01.03.01.D	D TECHNOLOGY COMPARISON			11/30/80	
01.03.02.A	---REPOWERING/RETROFIT CONCEPT	10/01/78	04/30/79	05/20/80	
01.03.02.B	B PNM STUDY COMPLETE			10/01/78	10/01/78
01.03.02.C	C RELEASE CONCEPT STUDY RFP			03/01/79	03/01/79
01.03.02.D	D START CONCEPT STUDIES			08/15/79	
01.03.02.E	E CONCEPT STUDIES COMPLETE			05/15/80	
01.03.03.A	---W SYN EPRI UTILITY-E STUDY	01/15/79	04/30/79	09/15/79	
01.03.03.B	B START WORK			05/01/79	
01.03.03.C	C UTILITY SELECTION			07/01/79	
01.03.03.D	D STUDY COMPLETE			09/15/79	
01.04.00.A	HYBRID POWER SYSTEMS				
01.04.01.A	---SYSTEMS ANALYSIS/PLANNING	10/01/78	04/30/79	09/30/81	
01.04.01.B	B TECHNOLOGY COMPARISON			11/30/79	
01.04.01.C	C TECHNOLOGY COMPARISON			11/30/80	
01.04.02.A	---HYBRID PWR SYSTEMS STUDIES	10/01/78	04/30/79	11/30/80	
01.04.02.B	B START PHASE 1 ACTIVITIES			10/01/78	10/01/78
01.04.02.C	C PHASE 2 PROPOSALS DUE			08/30/79	
01.04.02.D	D PHASE 1 COMPLETE			09/28/79	
01.04.02.E	E PHASE 2 EVALUATION COMPLETE			10/30/79	
01.04.02.F	F START PHASE 2 ACTIVITIES			11/30/79	
01.04.02.G	G PHASE 2 COMPLETE			09/15/80	
01.04.02.H	H DECISION TO COMPETE PHASE 3			11/30/80	
01.04.03.A	---UTILITY COOPERATIVE PROGRAM	10/01/78	04/30/79	09/30/83	
01.04.03.B	B EPRI/W MARKET SURVEY			02/28/79	02/28/79
01.04.03.C	C DOE/EPRI PP DECISION			03/15/80	
01.04.04.A	---DOE/90-REC HYB NETWK STUDY	12/01/78	04/30/79	04/01/80	
01.04.04.B	B START NETWORK STUDY			02/09/79	02/09/79
01.04.04.C	C COMPLETE NETWORK STUDY			11/30/79	
01.04.04.D	D STUDY COMPLETION RESCHEDULE			02/01/80	
01.04.04.E	E FINAL REPORT			04/01/80	
01.04.05.A	---W UTIL/TECH SENS ANALYSIS	10/01/78	04/30/79	12/30/79	
01.04.05.B	B SCOPE OF WORK DEFINED			03/01/79	03/01/79
01.04.05.C	C START WORK			05/01/79	
01.04.05.D	D STUDY COMPLETE			12/30/79	
01.05.00.A	10MWE PILOT PLANT				
01.05.01.A	---STNPO OPERATIONS	10/01/78	04/30/79	09/30/82	
01.05.01.B	B START COLLECTOR CONTRACTS				
01.05.01.C	C START FACILITY DESIGN				
01.05.01.D	D START HELIOSTAT WORK			12/01/79	
01.05.01.E	E TURBINE ROLL			12/30/81	
01.05.01.F	F END ACCEPTANCE TEST			06/30/82	
01.05.02.A	---PP OPERATIONAL TESTING	10/01/78	04/30/79	09/30/82	
01.05.02.B	B TEST PLAN			04/30/79	
01.05.02.C	C TEST PLAN RESCHEDULED			05/31/79	
01.05.02.D	D TEST REQUIREMENTS			09/30/79	
01.05.02.E	E TEST PROCEDURES			09/30/81	
01.05.02.F	F BEGIN OPERATIONAL TESTING			07/01/82	

END OF PLOTS

MAJOR ACCOMPLISHMENTS

IEA Sodium Central Receiver Design Receiver* (WBS 01.01.01-Planning and Ad-hoc Tasks)

Representatives of Energy Systems Group and General Electric attended the IEA-SSPS meeting in Cologne, Germany, on April 10-11, 1979. They reviewed the IEA-SSPS design, and submitted comments on how the design could be modified to better support the U. S. program. Sandia is preparing a recommendation on this project for DOE/HQ.

Comparison of Solar Thermal Technologies for Process Heat (WBS 01.01.01-Planning and Ad-hoc Tasks)

A comparison of central receivers with several distributed collector technologies for a range of process heat applications is nearing completion. The study is examining a range of applications (200°F to 2000°F) and system sizes (30 MW_t to 1500 MW_t). The study has three goals. First, the technical and phenomenological differences between technologies and applications will be identified. Second, technical uncertainties and the need for R and D will be identified. Finally, projections of energy cost from the various technologies for the applications will be made. Central receivers are being compared with parabolic troughs and dishes. The majority of this analysis will be completed in mid-June.

Presentation at "Focus on Goals" Workshop (WBS 01.01.01-Planning and Ad-hoc Tasks)

The Focus on Goals Workshop organized was held in Denver on April 24 and 25. A presentation was given showing the estimated capital and busbar energy costs of the Molten Salt Advanced Central Receiver System. These costs were then compared with those of a coal-fired electric plant in the Southwest U.S. It was shown that the ACR plant is economically competitive and is cheaper than the coal-fired plant over a wide range of believable economic scenarios.

Technical Meeting On High Temperature Process Heat Applications (WBS 01.01.01-Planning and Ad-hoc Tasks)

On April 4, a meeting was held at Sandia Livermore to discuss potential high temperature (>2000°F) process heat applications for solar thermal systems. The laboratories represented were SLL, SERI, SPL, LLL, and Aerospace. Electrical generation and synthetic fuel production were identified as the

*IEA activities are reported here as well as in the Central Receiver Technology Status Letter because of the close relationship of this project with the SAN operation.

best candidate processes for solar thermal applications. There was also general agreement that several high-temperature fuel and chemical processes may be adaptable to direct solar utilization in the future.

Large Solar Power Systems Technology Document
(WBS 01.01.01-Planning and Ad-hoc Tasks)

Sandia is preparing a document summarizing the systems being developed by the Department of Energy's Large Solar Thermal Central Power System Program. Included are the technical concepts upon which the systems are based and, to the extent possible, estimated cost, performance, and Sandia assessment of the concepts. The document will provide potential users with an overview of present technologies and those technologies that will be available within the next few years. The document was released in draft form to prospective bidders on the Repowering/Retrofit RFP.

Input to MYPP
(WBS 01.01.01)

SAN and SLL prepared a draft input for the Solar Large Power systems program for the TPS MYPP for FY 80-84, integrating the SAND Systems Applications and the SLL Technology Development elements. This input, along with other inputs, was discussed and critiqued at a meeting in Denver on April 23, chaired by Gerry Braun, and subsequently redrafted.

Alternate Central Receiver Phase II
Contract Work
(WBS 01.02.03)

General Electric and Martin Marietta initiated Phase II Alternate Central Receiver contracts work on advance authorization. GE re-evaluated the merits of two-header and three-header designs. These studies show that it may be desirable to use the two-header configuration.

Martin Marietta is re-evaluating the merits of cavity and external receiver configurations. Martin Marietta and GE are scheduled to discuss their respective receiver experiments with the CRTF personnel on May 15 and 16 at Sandia, Albuquerque.

Repowering/Retrofit Schedule 44 Inputs

SAN prepared and forwarded to Headquarters program and procurement organizations the draft Schedule 44's, one for solar repowering (utility project) and one for the solar industrial retrofit project. These delineate project construction costs with the initial year for line item funding being FY1981.

FISCAL STATUS

Obligations (B/A): The SAN Financial Plan remained unchanged for April at \$8770K in operating fund obligation authority. Adding the \$2780K transferred to SLL and the \$850K in PE&D funds allocated in February, total obligation authority for Large Power Systems Applications stands at \$12,400K.

Obligations for April were \$543K vs. a planned \$0K. Cumulative obligations, at \$4781K, are low by \$3729K (44%) with respect to the January 5 revision to the FY 79 Annual Procurement Plan. Nearly all of the indicated variance represents delay in award of the Alternate Central Receiver Phase II contracts, now scheduled for June-July. A second revision to the FY 79 APP was submitted to HQ April 13, and will be exhibited on future obligation status charts when approved.

Cost Status (B/O): Costing authority remained unchanged for April at \$12,860 in operating funds. Adding the \$850K in PE&D funds allocated in February, total costing authority for Large Power Systems Applications stands at \$13,710K.

Costs accrued for April were \$811K vs. a planned \$658K. Cumulative costs for April, at \$3902K, are currently \$148K (4%) above planned costs.

Current Status for SLL (LPSA) through April 30, 1979 is \$1,780K BA authorized. Year to date costs are \$1,242K. Reserve for salaries internal support, and other commitments is 617K, for a total of \$1,859K. This apparent over-commitment will be rectified when funds, which were transferred from DOE to SLL in March, will eventually appear on the SLL Fin Plan.

OVERALL LPSA OBLIGATION STATUS

U.S. DEPARTMENT OF ENERGY

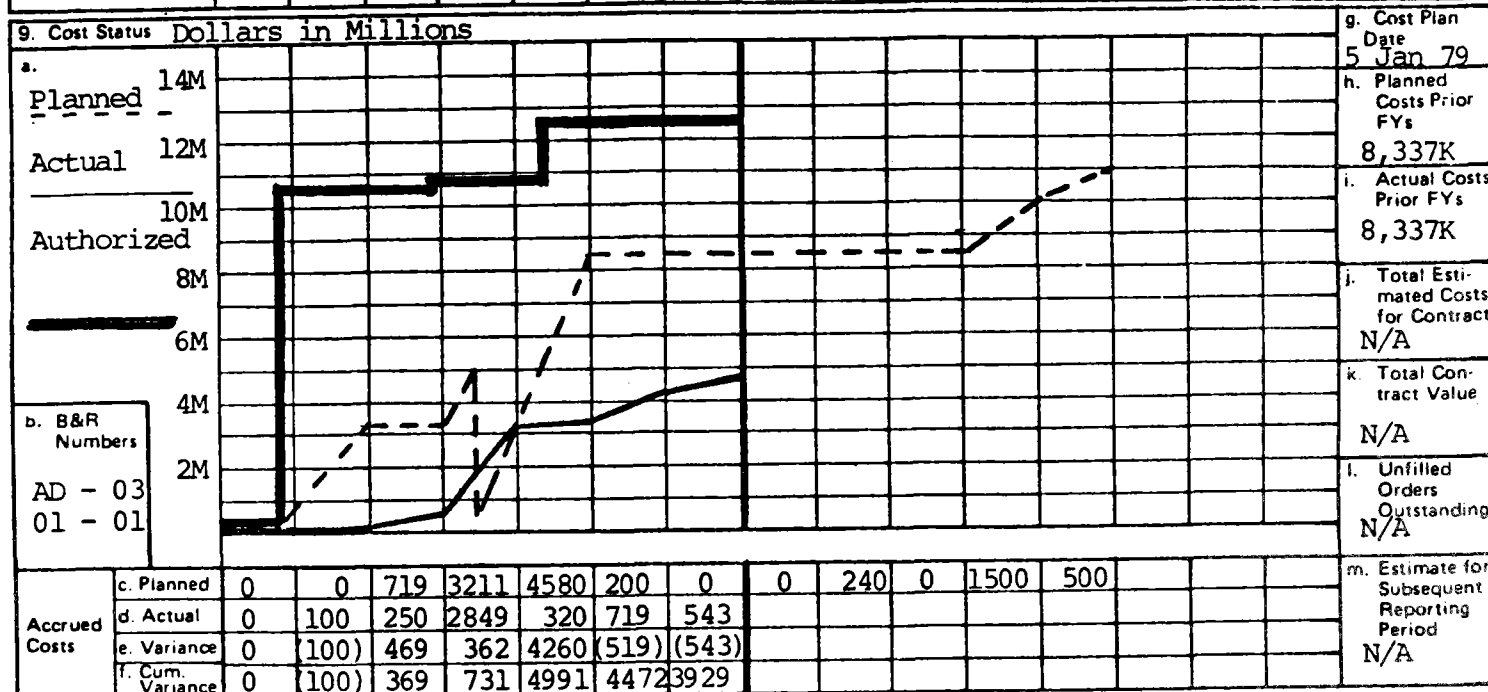
CONTRACT MANAGEMENT SUMMARY REPORT

FORM DOE 636
(1/78)

FORM APPROVED
OMB NO. 38R-0190

1. Contract Identification Large Power Systems Applications	2. Reporting Period <u>1 April</u> through <u>30 April</u>	3. Contract Number N/A
4. Contractor (Name and Address) San Francisco Operations Office		5. Contract Start Date N/A
		6. Contract Completion Date N/A

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	8. FY 79
-----------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	----------



NOTE: Revision #2 to the FY 79 Annual Procurement Plan, submitted to HQ April 13, reflects (a) the additional \$1450K allocated in February for Repowering/Industrial Retrofit studies and (b) update of the planned procurement schedule for the remainder of the year. Upon approval of the APP revision, it will be used as the basis for future Obligation Status reporting.

SAN COST STATUS

U.S. DEPARTMENT OF ENERGY

FORM DOE 536
(1/78)

CONTRACT MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 38R-0190

1. Contract Identification LARGE POWER SYSTEMS APPLICATIONS (WBS-1.0)										2. Reporting Period 1 April through 30 April					3. Contract Number N/A				
4. Contractor (Name and Address) SAN FRANCISCO OPERATIONS OFFICE															5. Contract Start Date N/A				
															6. Contract Completion Date N/A				
7. Months		O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	& FY 79		
9. Cost Status Dollars in Thousands																			
a. Planned		14																	
Actual		12																	
Authorized		10																	
b. B&R Numbers		AD - 03																	
		01 - 01																	
g. Cost Plan Date 24 Jan. 79																			
h. Planned Costs Prior FYs 4,345 K																			
i. Actual Costs Prior FYs 2,650 K																			
j. Total Estimated Costs for Contract N/A																			
k. Total Contract Value N/A																			
l. Unfilled Orders Outstanding N/A																			
Accrued Costs		c. Planned	364	508	544	575	550	555	658	686	694	656	786	4070					
		d. Actual	230	697	550	548	618	448	811										
		e. Variance	134	(189)	(6)	27	(68)	107	(153)										
		f. Cum. Variance	134	(55)	(61)	(34)	(102)	5	(148)										
m. Estimate for Subsequent Reporting Period N/A																			

NOTE: Costing authority shown is total for Large Power Systems Applications program element; cost plan does not include \$2,180K transferred to SLL for Technical Management/Support (see next chart), or \$600K for Technology Development (see CRTD Status Letter).

U.S. DEPARTMENT OF ENERGY

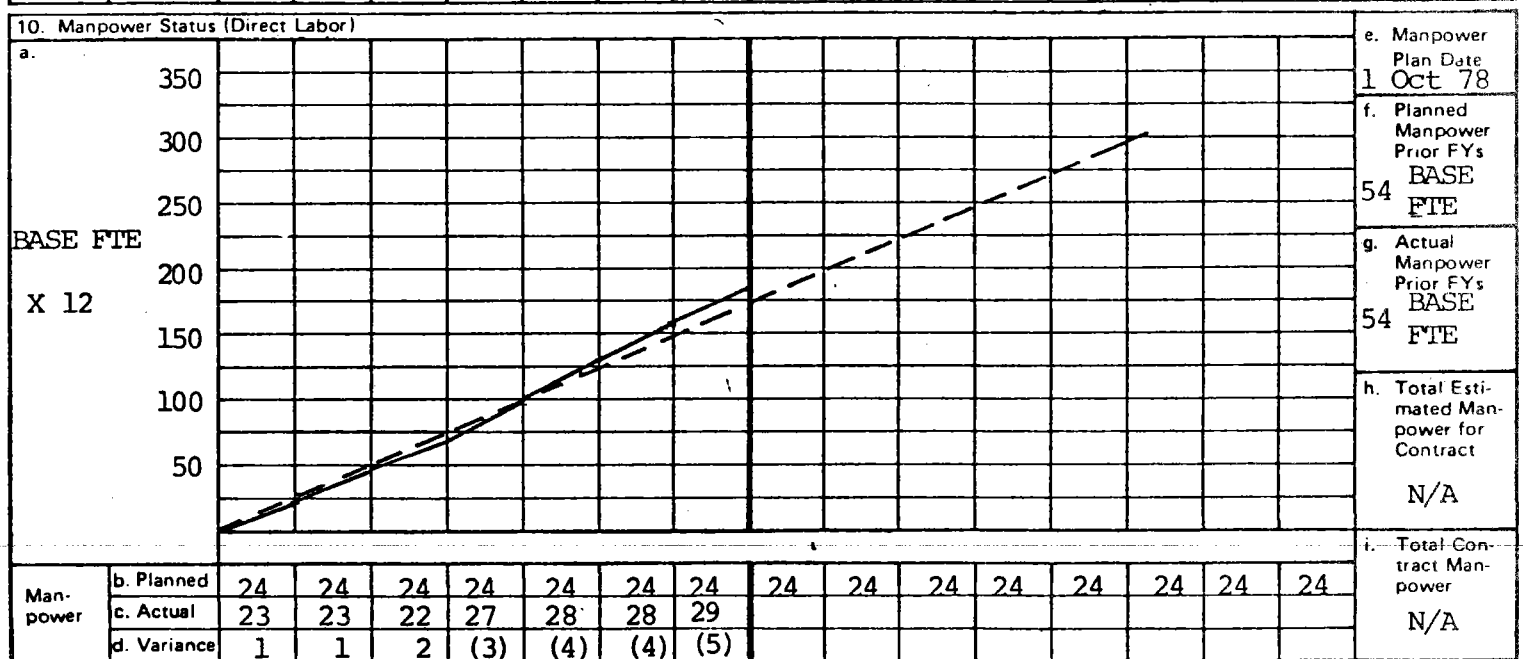
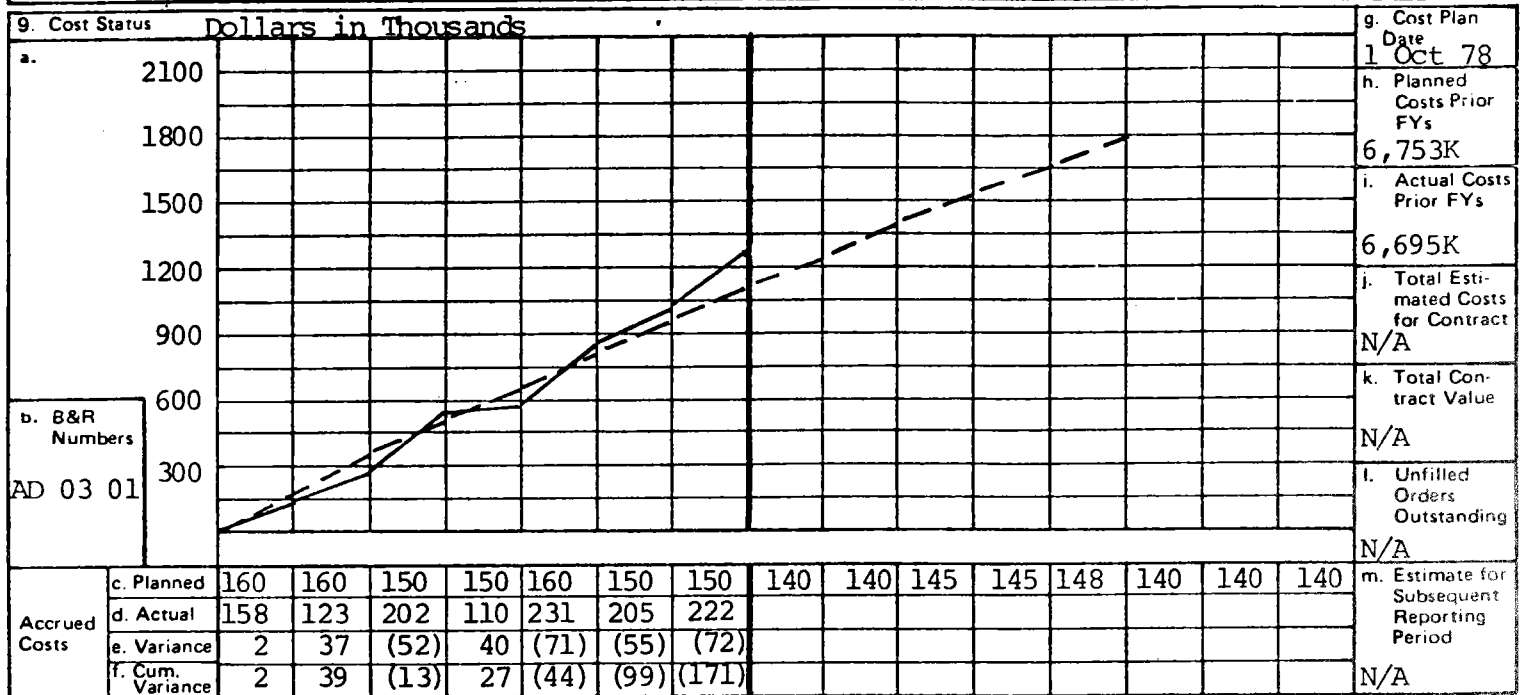
FORM DOE 536
(1/78)

CONTRACT MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 38R-0190

1. Contract Identification SOLAR LARGE POWER SYSTEMS APPLICATIONS	2. Reporting Period 1 April through 30 April	3. Contract Number AD 03 01 837
4. Contractor (Name and Address) SANDIA LABORATORIES, LIVERMORE, CALIF.		5. Contract Start Date FY-75
		6. Contract Completion Date N/A

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	8. FY 79
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