

5105-99 #49
Solar Thermal Power Systems Project
Parabolic Dish Systems Development

JPL Parabolic Dish Development Bimonthly Technical Status Report

No. 49



August - September 1984

Prepared for
U.S. Department of Energy
Through an Agreement with
National Aeronautics and Space Administration
by
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL D-521, Issue 13

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JET PROPULSION LABORATORY
SOLAR THERMAL POWER SYSTEMS

PARABOLIC DISH PROJECT
BI-MONTHLY TECHNICAL STATUS REPORT

AUGUST - SEPTEMBER 1984

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

PARABOLIC DISH PROJECT
BI-MONTHLY STATUS REPORT

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EXECUTIVE SUMMARY

CONCENTRATOR DEVELOPMENT

- o A major shipment of computer and auxiliary test equipment was made in mid-August to Sandia National Laboratories, Albuquerque (SNLA). This essentially completes the property transfer to SNLA. A few remaining items at Edwards Test Station will be shipped later as required by SNLA, and some mirror and receiver materials are being retained at JPL for future program support to SNLA.

ORGANIC RANKINE DEVELOPMENT

- o All major issues with Ford on Contract 955637 have been resolved. The contract is essentially complete. All documentation including drawings, reports and aperture cards have been delivered to JPL and transmitted to Sandia National Laboratories, Albuquerque (SNLA), and the contract is in final closeout.

STIRLING CYCLE MODULE

- o The Vanguard I module realized automated, hands-off operational status on August 7. Since that time it has not required an operator for routine functions from sunrise-to-sunset including slewing on and off sun, and tracking through cloudy skies.
- o By August 15, a final draft of the Activities and Accomplishments in Dish/Stirling-Electric Power System Advanced Development at JPL by United Stirling AB during the fiscal years 1978-84 was circulated to the reviewers. The comprehensive report covers the selection process resulting in the present day Dish/Stirling Electric Power System commercial ventures.
- o DOE/AL and Advanco Corporation have agreed to extend the Vanguard I test program through FY 1985. The project management plan has been revised to define tasks to be performed by Advanco over the coming fiscal year. These task titles are nondestructive quality assurance tests, system reliability tests, preventive maintenance plan and demonstration, in addition to test plans and procedures, information transfer, and test reports.
- o At the EPRI sponsored Vanguard I test planning conference at Southern California Edison's (SCE) Palm Springs Service Center on August 17, Rockwell's Energy Technology Engineering Center (under contract at EPRI) proposed 54 operational tests for the Vanguard Dish/Stirling Electric Power System.
- o Advanco Corporation reported on the activity and accomplishments of the Vanguard I project at the 19th Intersociety Energy Conversion Conference at San Francisco on August 20. The Dish/Stirling-Electric

Power System accomplishments were well received by the IECEC attendees who also had the opportunity to attend nine sessions devoted to Stirling-engine advanced development.

- o A draft of the final report of the Vanguard Solar Parabolic Dish/Stirling Engine Module Project by Advanco Corporation was submitted to DOE/AL for review. JPL found the draft report to describe the power conversion unit performance in an excellent manner. However, the PCU test results were not compared to the expected performance or related to specific test goals. The Vanguard solar concentrator unit weight growth from the proposed 5,273 kg (excluding PCU and foundation) to the reported actual 10,400 kg was not discussed or explained by Advanco.
- o Advanco Corporation received an IR-100 Award Plaque for the Vanguard Project achievements in 1984 at Chicago on September 20.

REPORTS

- o Concentrator Optical Characterization Using Computer Mathematical Modelling and Point Source Optical Testing, by E. W. Dennison, S. L. John and G. F. Trentelman, DOE/JPL-1060-77, September 15, 1984.
- o Software Used with the Flux Mapper at the Solar Parabolic Dish Test Site, by C. Miyazono, DOE/JPL-1060-78, September 15, 1984

CONCENTRATOR DEVELOPMENT

Accomplishments

- o A major shipment of computer and auxiliary test equipment was made in mid-August to Sandia National Laboratories, Albuquerque (SNLA). This essentially completes the property transfer to SNLA. A few remaining items at Edwards Test Station will be shipped later as required by SNLA, and some mirror and receiver materials are being retained at JPL for future program support to SNLA.

Plans for the Next Two Months

- o Final disposition of all remaining materials at JPL will be made as DOE/SNLA directs.

ORGANIC RANKINE DEVELOPMENT

Accomplishments

- o All major issues with Ford on Contract 955637 have been resolved. The contract is essentially complete. All documentation including drawings, reports and aperture cards have been delivered to JPL and transmitted to Sandia National Laboratories, Albuquerque (SNLA), and the contract is in final closeout.

STIRLING CYCLE MODULE

Accomplishments

August

- o The Vanguard I module realized automated, hands-off operational status on August 7. Since that time it has not required an operator for routine functions from sunrise-to-sunset including slewing on and off sun, and tracking through cloudy skies.
- o By August 15, a final draft of the Activities and Accomplishments in Dish/Stirling-Electric Power System Advanced Development at JPL by United Stirling AB during the fiscal years 1978-84 was circulated to the reviewers. The comprehensive report covers the selection process resulting in the present day Dish/Stirling Electric Power System commercial ventures.

STIRLING CYCLE MODULE

(Continued)

- o DOE/AL and Advanco Corporation have agreed to extend the Vanguard I test program through FY 1985. The project management plan has been revised to define tasks to be performed by Advanco over the coming fiscal year. These task titles are nondestructive quality assurance tests, system reliability tests, preventive maintenance plan and demonstration, in addition to test plans and procedures, information transfer, and test reports.
- o At the EPRI sponsored Vanguard I test planning conference at Southern California Edison's (SCE) Palm Springs Service Center on August 17, Rockwell's Energy Technology Engineering Center (under contract at EPRI) proposed 54 operational tests for the Vanguard Dish/Stirling Electric Power System.
- o The tests can be classified as 33 acceptance tests, 19 operational tests, and 2 quality assurance tests. Since DOE/AL has considered the Vanguard I accepted in June 1984, and has achieved fully operational status by September 1984 - only the two quality assurance tests requested by EPRI must be coordinated with the ongoing DOE sponsored quality assurance tests.
- o During the second week in August, the Vanguard I cavity subassembly of the solar receiver assembly was disassembled and recently-discovered black oxide material was removed. The cavity subassembly was then reassembled later in the week before completely automatic operation began on August 13. After ten days of operation with 67 hours on-sun time about 0.5 grams of black oxide material was again collected from the receiver cavity. The source of the black oxide material was not directly found, but evidence strongly suggests the source to be the engine heat exchanger tubing - consisting of 78 tubes with total mass of 2,184 grams.
- o Advanco Corporation reported on the activity and accomplishments of the Vanguard I project at the 19th Intersociety Energy Conversion Conference at San Francisco on August 20. The Dish/Stirling-Electric Power System accomplishments were well received by the IECEC attendees who also had the opportunity to attend nine sessions devoted to Stirling-engine advanced development.

September

- o A draft of the final report of the Vanguard Solar Parabolic Dish/Stirling Engine Module Project by Advanco Corporation was submitted to DOE/AL for review. JPL found the draft report to describe the power conversion unit performance in an excellent manner. However, the PCU test results were not compared to the expected performance or related to specific test goals. The Vanguard solar concentrator unit weight growth from the proposed 5,273 kg (excluding PCU and foundation) to the reported actual 10,400 kg was not discussed or explained by Advanco.

- o Upon exportation, The United States Customs Service could not identify or find certain USAB owned spare parts or tools imported over the past three years for Dish/Stirling-Electric Power Conversion Unit tests on the test bed concentrators at the Edwards Air Force Base, CA. Since JPL was liable for the equipment received on temporary imports bonds, the import duty had to be paid to the U. S. Government for the crates found to have missing parts or tools before they could be released for shipment.
- o The Vanguard I began a two-week performance test on September 14 marking the fall equinox. However, on September 19 the SCE grid experienced a failure causing power loss at the Rancho Mirage site. As programmed, the emergency solar concentrator unit slew mechanism torqued the PCU away from the concentrated sunlight. However, a large gear dropped from the slew mechanism shaft. In the ensuing moments, a solenoid-pin-puller remained energized and burned. The voltage surge associated with the grid power loss event apparently damaged three circuit elements on the engine control and display subassemblies. These circuits elements were not repaired and replaced until October 5 so the Vanguard I did not complete the fall equinox test sequence.
- o Advanco Corporation received an IR-100 Award Plaque for the Vanguard Project achievements in 1984 at Chicago on September 20.

Plans for the Next Two Months

- o A test plan and test procedure to execute the DOE/AL prescribed quality assurance, reliability demonstration, and preventive maintenance demonstration for Vanguard I will be prepared by the Advanco Corporation.
- o DOE and Advanco will continue to cooperate with the EPRI and Rockwell ETEC to supply raw data tapes from on-going operations and to demonstrate certain features of the Vanguard I.
- o McDonnell Douglas will erect the Dish/Stirling Electric Power System module at their Huntington Beach, CA facility.

REPORTS

Published

September

- o Concentrator Optical Characterization Using Computer Mathematical Modelling and Point Source Optical Testing, by E. W. Dennison, S. L. John and G. F. Trentelman, DOE/JPL-1060-77, September 15, 1984.
- o Software Used with the Flux Mapper at the Solar Parabolic Dish Test Site, by C. Miyazono, DOE/JPL-1060-78, September 15, 1984

Planned Publications

October

- o Development and Testing of Parabolic Dish Concentrator No. 1
- o History and Operating Experience at the Parabolic Dish Test Site

- o Reversible Chemical Reactions for Transport and Storage

November

- o Concentrator Control System Development
- o Flux Mapper for Parabolic Dish Concentrators
- o Overview of Software Development at the PDTS

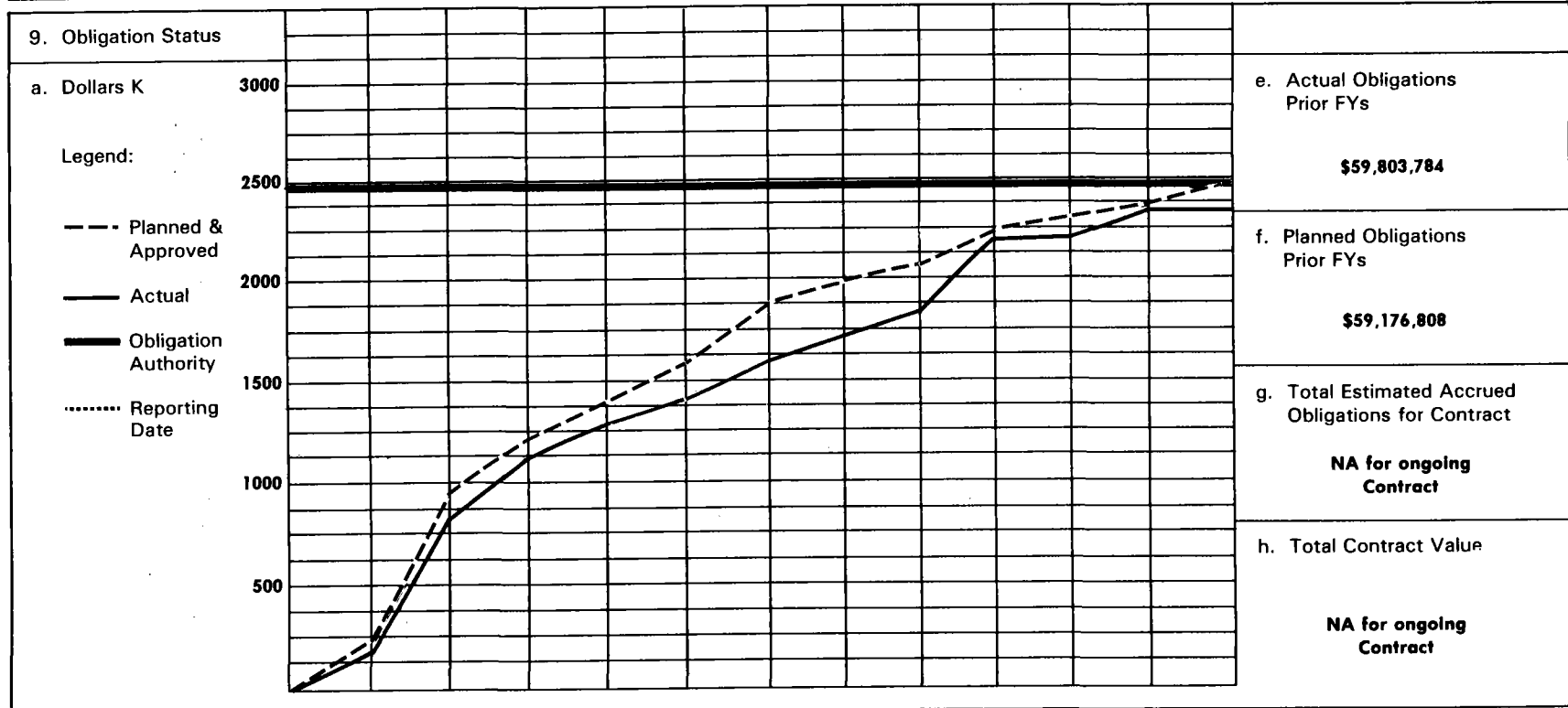
REMAINING REPORTS

- o Organic Rankine-Cycle Module Development
- o Stirling - Cycle Module Development
- o Brayton - Cycle Module Development
- o Design and Testing of Receivers for Parabolic Dish Modules
- o Bearing Development for the Organic Rankine-Cycle Engine
- o Comparison of Engines for Parabolic Dish Systems
- o Summary Assessment of Solar-Thermal Parabolic Dish Technology for Electrical Power Generation
- o Techno-Economic Projections and Markets
- o Concentrator Design Using Analytical Models Radiometer Field-of-View Management
- o Calorimetry Testing of a Parabolic Dish Concentrator
- o Stirling Engine Test Data
- o Dish Analysis Procedure Using a Programmable Calculator

PARABOLIC DISH PROJECT

TOTAL \$K (OBLIGATIONS)

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 84
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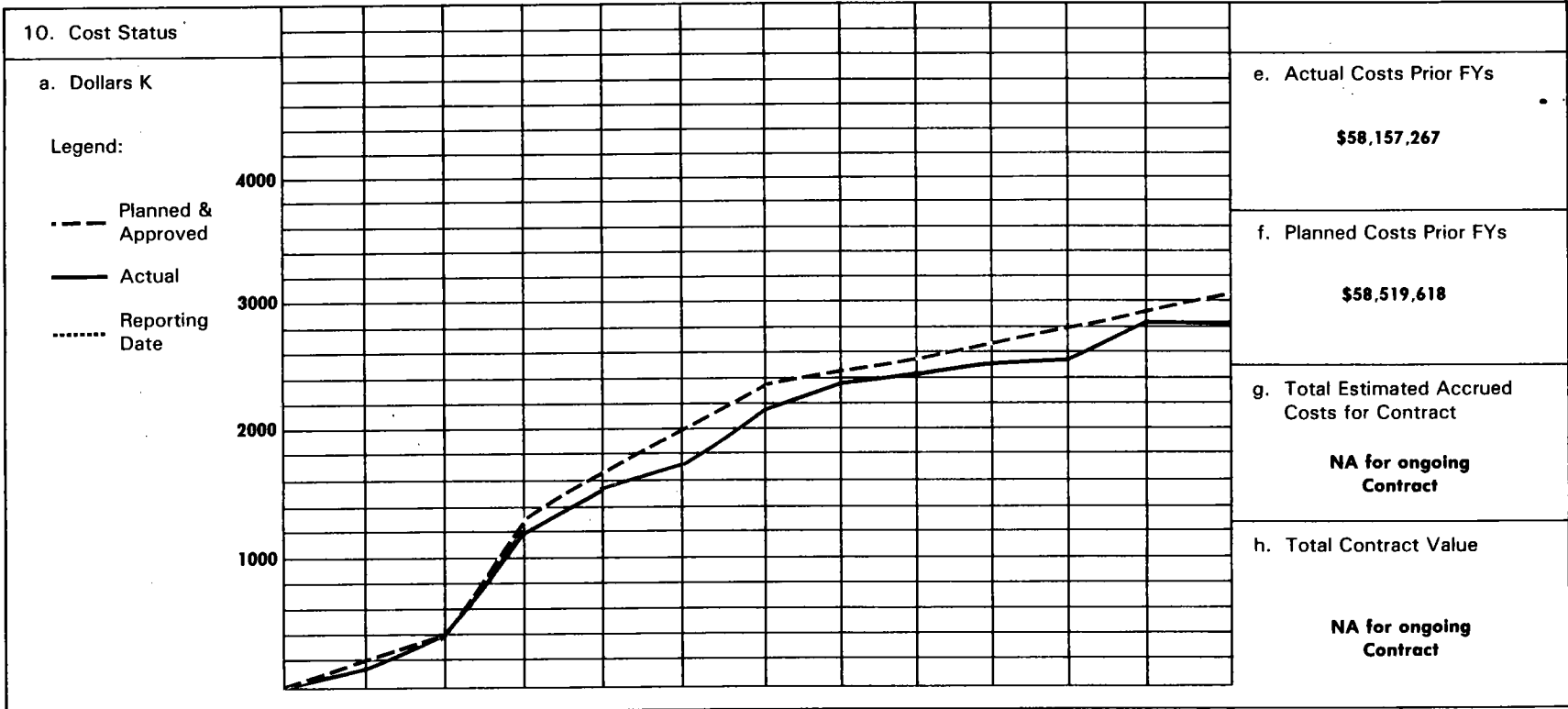
Accrued Obligations	b. Planned	230	700	265	192	192	238	128	128	162	65	65	81	b. Planned
	c. Actual	148	682	284	157	137	196	133	85	346	21	82	4	c. Actual
	d. Variance	<82>	<18>	19	<35>	<55>	<42>	5	<43>	184	<44>	17	<77>	d. Variance

12. Remarks

PARABOLIC DISH PROJECT

TOTAL \$K
(COSTS)

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 84
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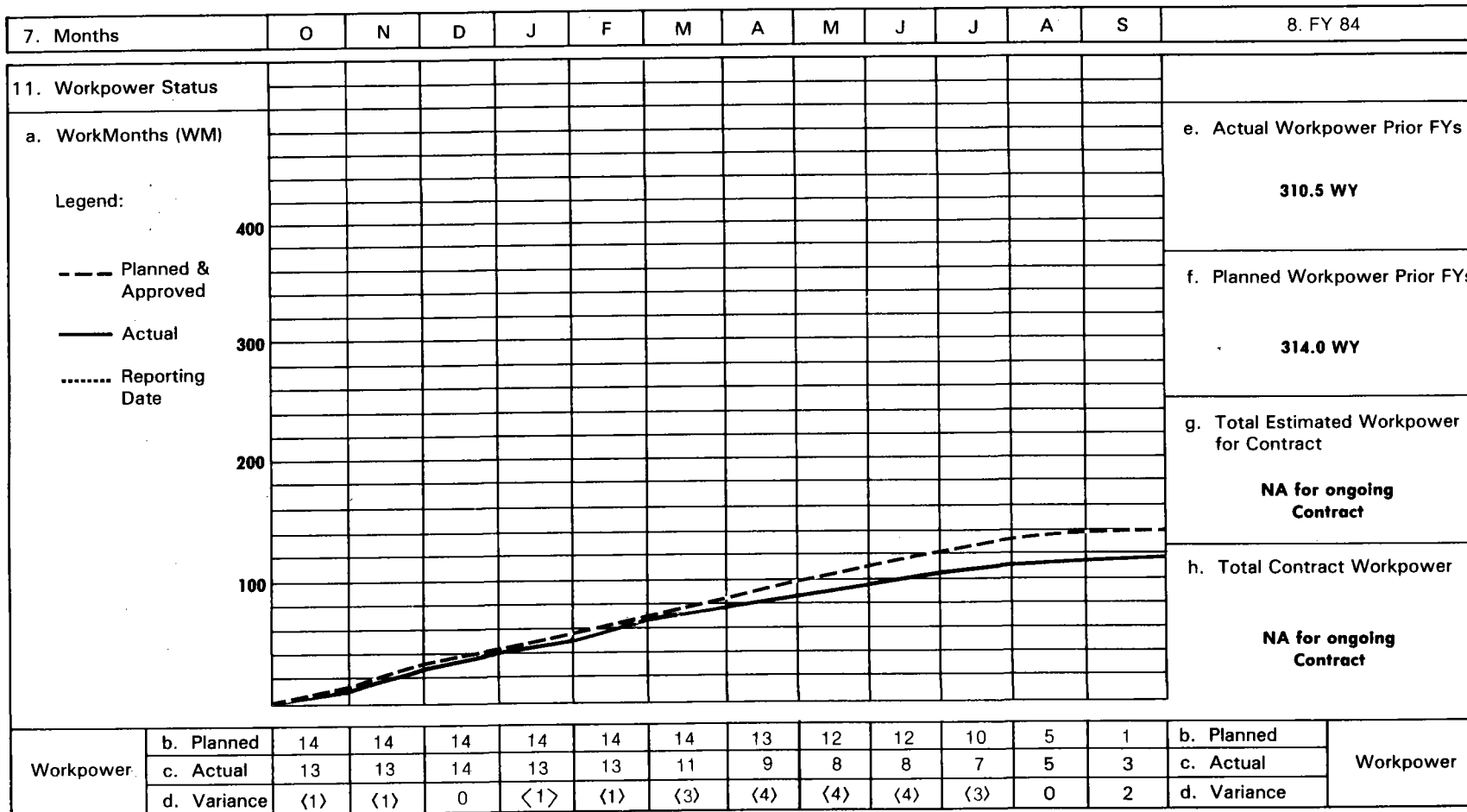


Accrued Costs	b. Planned	200	200	900	322	322	402	105	105	132	111	112	140	b. Planned	Accrued Costs
	c. Actual	165	205	863	283	176	442	214	88	86	5	337	4	c. Actual	
	d. Variance	<35>	5	<37>	<39>	<146>	40	109	<17>	<46>	<106>	225	<136>	d. Variance	

12. Remarks

PARABOLIC DISH PROJECT

TOTAL WORKPOWER (MANMONTHS)



12. Remarks

SOLAR PARABOLIC DISH PROJECT

JET PROPULSION LABORATORY
 4800 Oak Grove Drive
 Pasadena, California 91109

FY 1984

SCHEDULED NOTES

- A. Completed 100-hour PCS-1 hot test at B-N
- B. Transferred responsibility to SNLA
- C. DOE/FACC negotiations for SC-1 terminated
- D. Complete technical closeout of JPL/FACC subcontract
- E. Complete Vanguard I module installation
- F. Complete checkout of Vanguard Module
- G. Complete Vanguard performance evaluation
- H. Transfer responsibility to SNLA
- I. Complete Vanguard endurance tests
- J. Transferred 2nd generation technology responsibility to SNLA
- K. Initiate testing of DTM subsystems
- L. Complete installation of LaJet concentrator at Sanders Associates.
- M. Critical design review
- N. Complete fabrication of SABC module
- O. Provide support to DOE on evaluation of PON proposals.
- P. TBC-1 moved to SNLA
- Q. Support SNLA to bring TBC-1 on line
- R. Closedown PDTs
- S. Publish report on dish techno-economic projections.
- T. Publish report on dish overview assessment.
- U. Move TBC-2 to SNLA
- V. Move PDC-1 to SNLA

MILESTONES

		O	N	D	J	F	M	A	M	J	J	A	S
1	Organic Rankine Module	A▲	B▲						D△			D▲	
2	Development												
3	Stirling Module Development			E▲		F▲				G*▲	H▲		I*▲
4													
5	Brayton Module Development	J▲		K▲			L▲		M▲				N▲
6													
7	Small Community Experiments		B▲					O△					
8													
9	Innovative Concentrator PON	B▲						O△					
10													
11	Test Operations			P▲			U▲	V▲	R▲	Q▲			
12													
13	Documentation										**	S△	T△
14													
15													
16													
17													
18													
19													
20													

NOTES

- * This schedule incorporates a three month extension requested by Advanco Corporation
- ** Rescheduled to November

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