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DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150525

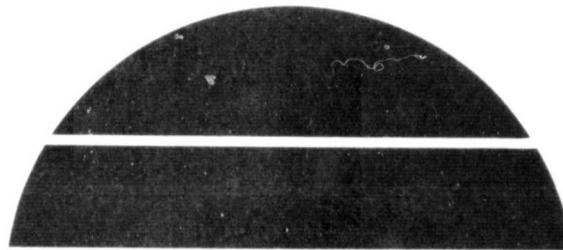
QUARTERLY REPORTS ON PROTOTYPE SOLAR HEATING AND
HOT WATER SYSTEMS

Prepared by

Colt, Inc. of Southern California
71-590 San Jacinto Drive
Rancho Mirage, California 92270

under Contract NAS8-32242 with

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812
for the Department of Energy



(NASA-CR-150525) PROTOTYPE SOLAR HEATING
AND HOT WATER SYSTEMS Quarterly Report
(Colt, Inc. of Southern California) 26 p HC
A03/MF A01 CSCI 10A

N78-17482

Unclas

G3/44 05681

U.S. Department of Energy



Solar Energy

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1. REPORT NO. DOE/NASA CR-150525		2. GOVERNMENT ACCESSION NO.		3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE Quarterly Reports on Prototype Solar Heating and Hot Water Systems				5. REPORT DATE January 1978	
				6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S)				8. PERFORMING ORGANIZATION REPORT #	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Colt Inc. of Southern California 71-590 San Jacinto Drive Rancho Mirage, California 92270				10. WORK UNIT NO.	
				11. CONTRACT OR GRANT NO. NASS-32242	
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546				13. TYPE OF REPORT & PERIOD COVERED Contractor Report	
				14. SPONSORING AGENCY CODE	
15. SUPPLEMENTARY NOTES <p style="text-align: center;">This work was done under the technical management of Mitchell Cash, Marshall Space Flight Center, Alabama.</p>					
16. ABSTRACT <p style="text-align: center;">This report contains four quarterly reports that cover the progress made in the development of a solar hot water and space heating system. It provides the program schedules, technical status and other program activities from October 6, 1976 through September 30, 1977.</p>					
17. KEY WORDS			18. DISTRIBUTION STATEMENT Unclassified-Unlimited <i>William A. Brooksbank, Jr.</i> WILLIAM A. BROOKSBANK, JR. Manager, Solar Heating & Cooling Projects Of		
19. SECURITY CLASSIF. (of this report) Unclassified		20. SECURITY CLASSIF. (of this page) Unclassified		21. NO. OF PAGES 24	22. PRICE NTIS

INTRODUCTION

This document is a collection of four quarterly status reports from Colt, Inc., covering the period from October 6, 1976, through September 30, 1977. Colt, under NASA/MSFC Contract NAS8-32242, is developing two prototype solar heating and hot water systems consisting of the following sub-systems: collector, storage, control, transport, hot water, and auxiliary energy.

The two systems are being installed at Yosemite, California and Pueblo, Colorado.

Cost information has been removed.

First Quarterly Status Report

COLT HEATING & HOT WATER HEATING SOLAR PROGRAM

NASA Contract NAS8-32242

For the Time Period

October 6 to November 30, 1976

COLT INC.
OF SOUTHERN CALIFORNIA
ENERGY SYSTEMS DIVISION



December 7, 1976

COLT INC. OF SOUTHERN CALIFORNIA

71-590 San Jacinto Drive

Rancho Mirage, California 92270

Paul S. Wheeler

Paul S. Wheeler
Project Engineer

Bill D. Hunter

Bill D. Hunter
Project Manager

1.0 Summary

This is the first quarterly progress report under NASA Contract NAS8-32242 to Colt Inc. for the development of a solar hot water heating and space heating system. This report covers the period from October 6 to December 6, 1976, a period of two months. This report provides a status of current scheduling and provides an inclusive summary of the current technical status.

2.0 Contract

This paragraph has been deleted.

3.0 Schedules

Figure 2 shows the current program schedule, which is a compressed schedule to permit implementation of deliverable hardware at the operational test sites for the 1977 heating season. Colt is proceeding on this schedule without slippage, nor the requirement for internal schedule adjustments.

4.0 Technical Performance

Three of the four design uncertainties identified in the Colt proposal have been analyzed and incorporated into the design to the extent that they are no longer considered uncertainties.

FIGURE 2-

PROGRAM SCHEDULE

1976 1977
 OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

DEVELOPMENT PLAN - SUBMISSION & COMPLETION
 VERIFICATION PLAN - SUBMISSION & COMPLETION
 QUALITY ASSURANCE PLAN - SUBMISSION & COMPLET.
 SYSTEM PERF. SPECS. - SUBMISSION & COMPLETION
 CONTRACT GO-AHEAD
 PRELIMINARY DEVELOPMENT DESIGN
 SYSTEMS HAZARDS ANALYSIS
 SPECIAL HANDLING INSTALLATION, & MAINT. TOOLS
 SUBMISSION OF TRAINING PROGRAM
 VERIFICATION TEST PLAN (TEST PROCEDURES)
 PRELIMINARY DESIGN REVIEW
 PREPARE PROCUREMENT SPECIFICATIONS
 QUALIFICATION & ACCEPTANCE TEST PROCEDURES
 PROCURE & FABRICATE VERIFICATION TEST SYSTEM
 TEST EQUIPMENT BUILD-UP
 TEST FACILITY INSTRUMENTATION CERTIFICATION
 VERIFICATION DEVELOPMENT TESTING
 PREPARE VERIFICATION TEST REPORT
 SPARE PARTS LIST
 INSTALLATION, OPERATION & MAINTENANCE MANUAL
 PROTOTYPE DESIGN REVIEW
 CERTIFICATION GUIDE LINE DOCUMENT
 PROCURE TWO DELIVERABLE SYSTEMS
 ESTABLISH BASELINE CONFIGURATIONS
 PREPARE QUALIFICATION ANALYSIS REPORT
 CERTIFICATION TESTING
 ACCEPTANCE TEST PLAN
 FABRICATE TWO DELIVERABLE SYSTEMS
 DESIGN DATA BROCHURE
 ACCEPTANCE TEST TWO DELIVERABLE SYSTEMS
 FIRST ARTICLE REVIEW
 ACCEPTANCE DATA PACKAGE
 PACKAGING
 DELIVERY OF SYSTEMS (SHIP)

PLANNED
 ▲ INITIATE
 ▼ COMPLETE

ACCOMPLISHED
 ○ POSSIBLE SLIP
 ● ACTUAL SLIP

PROGRAM SCHEDULE
 AS OF

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The first uncertainty was the selective surface coating versus a painted surface when considering single and double layers of glazing. The selective surface and a single layer of glazing was chosen because of performance and cost. Previous test data has shown this combination to be substantially better than the double glazing with the nonselective surface.

The second uncertainty was the steel thermal storage tank. The trade-off being considered was the cost of the steel tank versus lower cost alternatives. It was agreed in contract negotiation to implement a lower cost, concrete tank in the Colt verification system, and a steel tank to be in one of the operational test sites. Cost and performance data is now available on both tank configurations. The concrete tank, where available geographically, will be an economic advantage in selection.

The third uncertainty involved a flexible connection from the collector to the collector manifold. The decision has been made to go with all copper manifolds and connections. These connections will be 1/2" tubing which will be installed with a gradual radius to provide for flexing during thermal expansions.

The fourth uncertainty involved the thermostat tolerances which are yet to be assessed during Verification Development

Testing.

The major design activities have been centered around meeting the requirements for the Preliminary Design Review and establishing the configuration for Verification Testing. The collector design was modified to incorporate an isolated collector surface from the supporting structure. The collector width was decreased to permit installation between roof joists 24" on center. The heat exchanger designed for the thermal storage tank was finalized. The design incorporates four (4) flat, plate coil heat exchangers manifolded into a single bank unit to be placed on the bottom of the thermal storage tank.

Colt has elected to use, in every instance possible, the same instrumentation in Verification Development Testing that will be used for the Operational Test Sites. This has resulted in a change in Verification Development Test instrumentation; however, this change is expected to provide an easier transition from Verification Testing to the configuration that will be employed at the Operational Test Sites.

The forecast of coming activities shows the preliminary design review as being of primary significance in that, during this review, it is anticipated that the Operational Test Sites will be named. Coordination for installation at the Operational Test Sites is expected to be a major undertaking. The second

significant activity taking place in the forthcoming quarter will be the procurement and initial installation of the Verification Test equipment.

There are currently no anticipated problems or difficulties on the solar program. All activities are proceeding without problems or slowups.

The following data has been submitted during this reporting period:

1. Preliminary Training Program
2. Quality Assurance Plan
3. Verification Plan
4. System Hazards Analysis
5. Colt Interface with the Proposed Instrumentation Plan
6. Special Handling, Installation, Maintenance and Tools List
7. Recommendations for Prototype Design Review
8. Component Materials in Contact with Heat Transfer Fluid

There were no meetings or travel involved in this reporting period.

There have been no tests conducted during this reporting period.

Second Quarterly Status Report

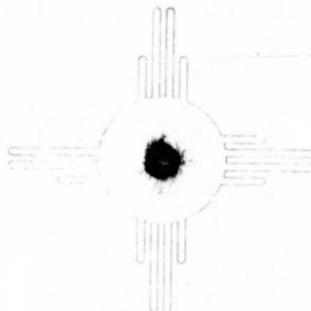
COLT HEATING & HOT WATER HEATING SOLAR PROGRAM

NASA Contract NAS8-32242

For the Time Period

December 1, 1976 through February 28, 1977

COLT INC.
OF SOUTHERN CALIFORNIA
ENERGY SYSTEMS DIVISION



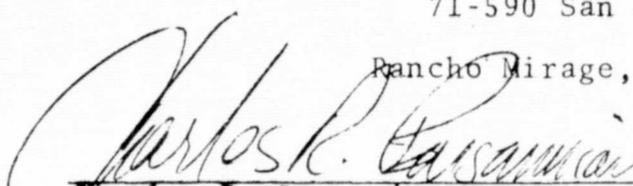
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March 22, 1977

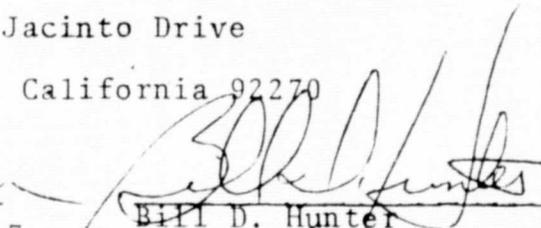
COLT INC. OF SOUTHERN CALIFORNIA

71-590 San Jacinto Drive

Rancho Mirage, California 92270



Charles R. Barsamian
Project Engineer



Bill D. Hunter
Project Manager

1.0 Summary

This is the second quarterly progress report under NASA Contract NAS8-32242 to Colt, Inc. for the development of a solar hot water heating and space heating system. This report covers the period from December 1, 1976 to February 28, 1977, a period of three months. This report provides a status of current scheduling and provides an inclusive summary of the current technical status.

2.0 Contract

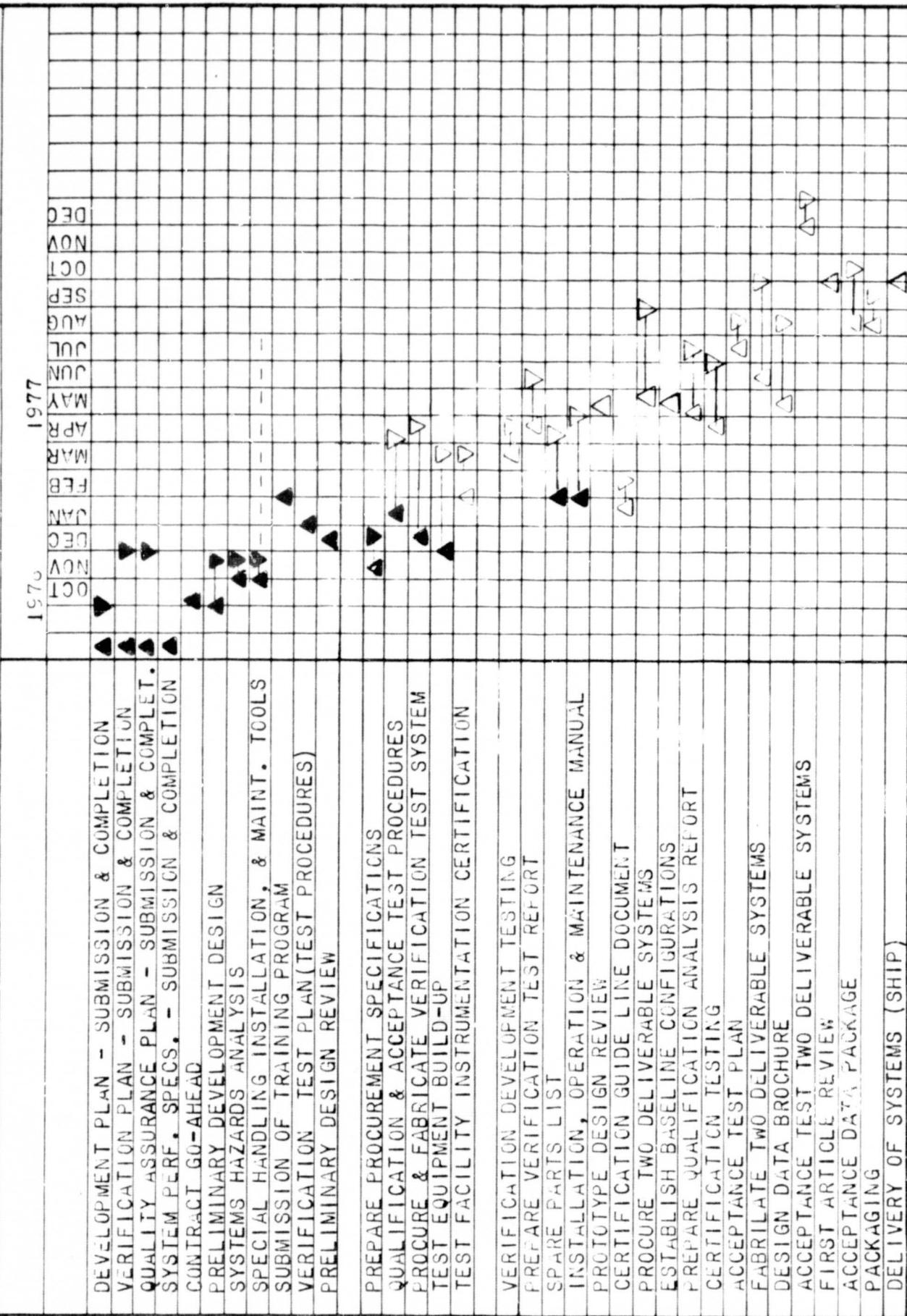
There is currently one change proposal (PCN AH-00209) under submittal to NASA for certification testing. The assignment of Contractor Code was received on December 17, 1976. The Review Item Discrepancies from the Preliminary Design Review were received on December 16, 1976 with NASA signature.

3.0 Schedules

Figure 2 shows the current program schedule, which is a compressed schedule to permit implementation of deliverable hardware at the Operational Test sites for the 1977 heating season. Colt is proceeding on this schedule with some slippages created by manufacturers' delivery times. Adjustments are being made to maintain operational site delivery schedule.

FIGURE 4-2

PROGRAM SCHEDULE



PLANNED
 ▲ INITIATE
 ▼ COMPLETE
 ACCOMPLISHED
 ○ POSSIBLE SLIP
 ● ACTUAL SLIP
 ▲ FIRST RESCHEDULE

PROGRAM SCHEDULE
 AS OF

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4.0 Technical Performance

The last design uncertainty identified in the Colt proposal involving room thermostat temperature spreads has been analyzed and solved. The solution has been incorporated into the design. The proposal referred to the two-stage thermostat tolerances currently known to be available, advising that the temperature spread could likely not be in the customary comfort range. The uncertainty has been resolved by incorporating a second Temperature Switch within the control circuit and by eliminating the second stage within the thermostat. This combination will provide even heating without the annoying "room cool down" necessary to activate the second stage within the thermostat.

The major design activities have been centered around the Verification Testing System buildup. All purchase orders were negotiated and placed with component vendors.

Excessive supply lead times for some components has forced a later completion date than was originally anticipated. The schedule reflects currently expected completion dates. The Solar Test Facility was constructed and is complete except for the installation of the collector panels and related manifolding.

The Data Acquisition equipment was received and has been

installed and tested. Instrumentation connection is being readied for installation and the logic for test programming is being prepared.

The Visitors' Center East Auditorium in the Yosemite National Park has been selected as one Operational Test Site. Preliminary concept and architectural integration designs have been generated for current review.

The forecast of coming activities shows the completion of the verification test system and test commencement as being of primary significance. A second significant endeavor will be the approval of the Yosemite design and selection of the second operational test site.

There are currently no difficulties being encountered. No data has been submitted during this reporting period nor have there been any tests conducted.

The Preliminary Design Review meeting and Quarterly Design Review meeting was held on December 20, 1976 at the Colt facility. Those present were:

Mr. Mitch Cash, NASA
Mr. Irwin Simon, NASA
Mr. Val Fogel, NASA
Mr. Stan Moore, Los Alamos Scientific Laboratories
Mr. Bill Hunter, Colt, Inc.
Mr. Paul Wheeler, Colt, Inc.

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This Second Quarterly Review was held at Yosemite in conjunction with a coordination meeting at the proposed Yosemite Operational Test Site. The point was made that NASA was limited on funds and could not fund the certification testing as proposed by Colt. It was agreed that certification of performance would be an outgrowth of NASA's system performance evaluation of the operational test site via the site data acquisition system if the certification program is not funded by NASA. In general terms, the possibility of Colt obtaining independent laboratory certification of the system's safety was discussed. If undertaken, the safety certification will be out of the contracted program scope and would be an expense to Colt.

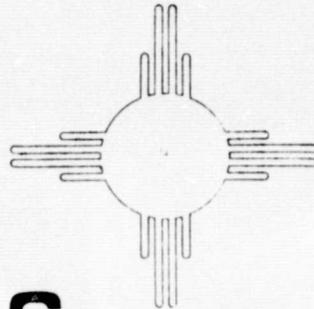
Third Quarterly Status Report

COLT HEATING & HOT WATER HEATING SOLAR PROGRAM

NASA Contract NAS 8-32242

For the Time Period

April 1, 1977 thru June 30, 1977



COLT INC.
OF SOUTHERN CALIFORNIA
ENERGY SYSTEMS DIVISION

July 13, 1977

A handwritten signature in cursive script, appearing to read 'Charles R. Barsamian', written over a horizontal line.

Charles R. Barsamian
Project Engineer

A handwritten signature in cursive script, appearing to read 'Bill D. Hunter', written over a horizontal line.

Bill D. Hunter
Project Manager

71-590 SAN JACINTO DRIVE/RANCHO MIRAGE, CALIFORNIA 92270 (714) 346-8033

1.0 Summary

This is the third Quarterly Progress Report under NASA Contract NAS 8-32242 to Colt Inc. for the development of a solar hot water heating and space heating system. This report covers the period from April 1, 1977 to June 30, 1977, a period of three months. This report provides a status of current scheduling and provides an inclusive summary of the current technical status.

2.0 Contract

The Prototype Design Review was conducted at the Colt facility on May 9, 1977. Review Item Discrepancies #Colt 20 - 39 were delivered and discussed during this review. Subsequently received was RID #Colt 40. Colt indicated actions taken and resubmitted these RID's on June 8, 1977.

The Prototype Design Review was conducted at the Colt facility on May 9, 1977. Those in attendance were:

Mr. Mitch Cash, NASA

Mr. Bill Hunter, Colt Inc.

Mr. Chuck Barsamian, Colt Inc.

The collector problems involving cost and weight were discussed during the review, as were the RID's #Colt 20 - 39. The Yosemite project scheduling was also discussed.

A second Design Review was conducted at the Colt facility on June 28, 1977, to cover design changes in the collector

made by Colt. Those in attendance were:

Mr. Mitch Cash, NASA

Mr. Erwin Simon, NASA

Mr. Dwight Wendell, National Park Service

Mr. Bill Hunter, Colt Inc.

Mr. Paul Wheeler, Colt Inc.

Mr. Chuck Barsamian, Colt Inc.

The RID's #Colt 41 - 51, concerning the collector redesign, were discussed and appropriate suggestions made. Colt has indicated the action taken in each case and will resubmit these RID's on July 13, 1977, for approval.

Also discussed, during this review, was the Yosemite Operational Test Site installation schedule. This scheduling was of major concern as current bidding and construction time might prohibit the targeted collector installation before first snow fall.

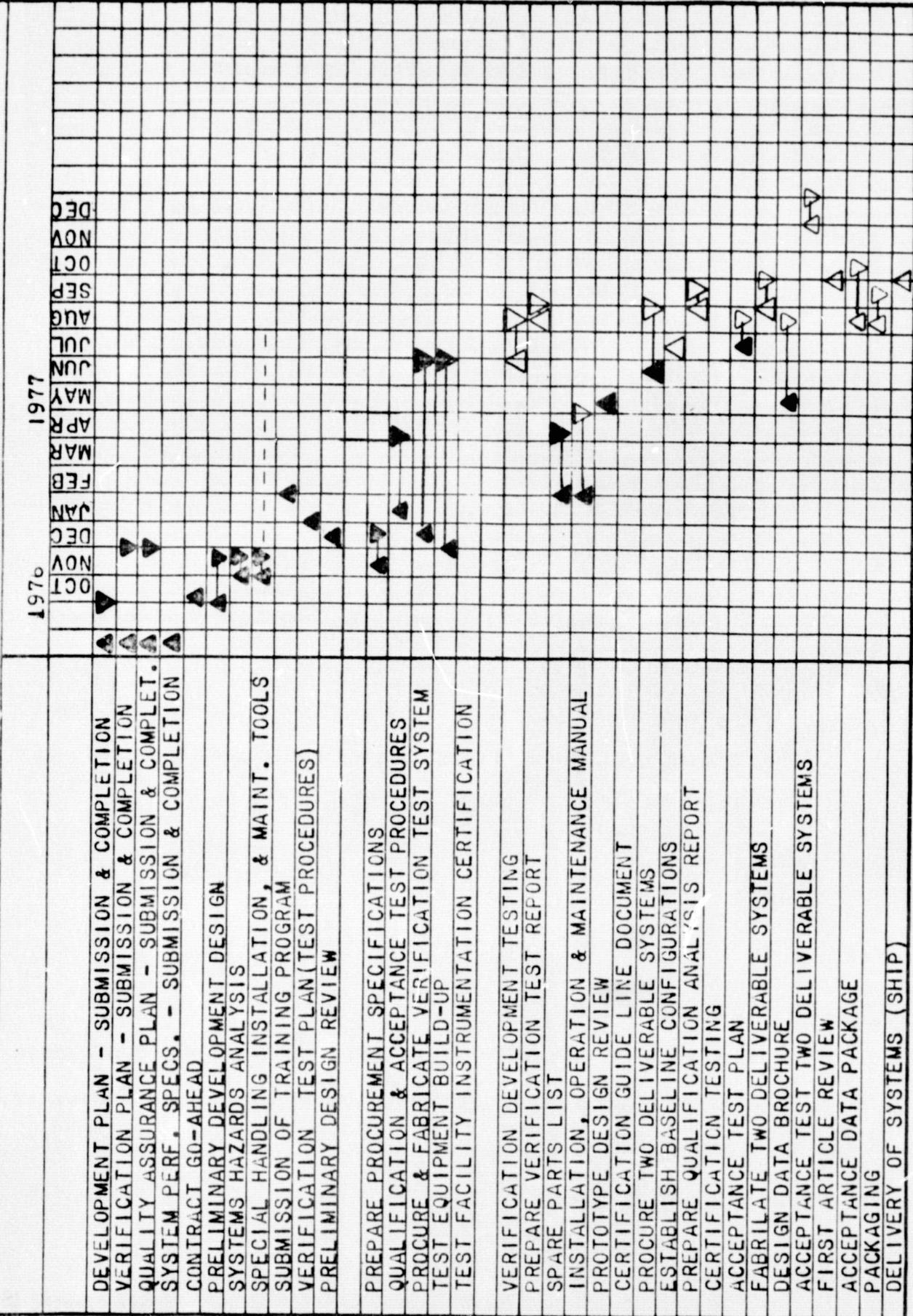
There are currently no change proposals in progress.

3.0 Schedules

Figure 2 indicates the current program schedule. Colt is proceeding on this schedule without slippage. However, this schedule had been previously adjusted to reflect slippages caused by excessive manufacturers' lead times

FIGURE 2

PROGRAM SCHEDULE



PROGRAM SCHEDULE
AS OF

PLANNED
 ▲ INITIATE
 ▼ COMPLETE

ACCOMPLISHED
 ▲ INITIATE
 ▼ COMPLETE

○ POSSIBLE SLIP
 ● ACTUAL SLIP
 ▲ FIRST RESCHEDULE

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and also severe damage incurred during shipment of component parts to Colt.

4.0 Technical Status

The overall technical status is progressing without difficulty. Verification Test hardware buildup has proceeded according to internal scheduling and is complete. The data acquisition equipment and instrumentation with related temperature and flow sensors has been installed and programmed for information retrieval. Initial program testing and debugging has been conducted.

The Colt collector is in the final stage of the redesign necessitated by excessive weight and cost of the original steel panel and housing. The new collector will be tested, and all results will be compared to existing efficiencies which will be determined by Verification Testing of the present Colt collector.

The Amtrac High Speed Test Facility in Pueblo, Colorado, has tentatively been selected as the second Operational Test Site.

The following data has been submitted during this reporting period:

All Schematic and Engineering drawings

The Verification Status Summary

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The amended Verification Status Summary
The Installation, Operation &
Maintenance Manual outline
The System Installation drawings
The Spare Parts list.

This Third Quarterly Review was held at the Colt Facility in Rancho Mirage on August 5, 1977. Those in attendance were:

Mr. Mitch Cash, NASA
Mr. John Massey, NASA
Mr. Paul Wheeler, Colt Inc.
Mr. Charles Barsamian, Colt Inc.

Mr. Cash raised several areas of concern with the installation scheduled for the Yosemite Operational Test Site. These were discussed and solutions were suggested and will be acted upon by Colt Inc. Plans were made for a Design Review to be conducted at Yosemite on August 10.

Also discussed during this review were the preliminary drawings for the Pueblo Installation. An August 30 design review was scheduled. October 3 has been set as the tentative date for the First Article Review.

Performance and Safety Certification was discussed. Colt Inc. will gather information and make preliminary arrangements to certify both the performance and safety of the Verification Test Hardware Installation at Rancho Mirage.

Fourth Quarterly Status Report

COLT HEATING & HOT WATER HEATING SOLAR PROGRAM

NASA Contract NAS 8-32242

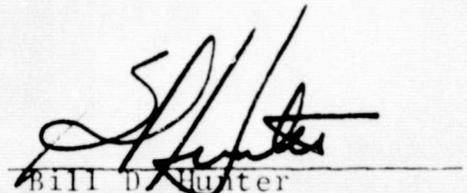
For the Time Period

July 1, 1977 thru September 30, 1977

COLT INC.
OF SOUTHERN CALIFORNIA
ENERGY SYSTEMS DIVISION

November 21, 1977


Charles R. Barsamian
Project Engineer


Bill D. Hunter
Project Manager

71 590 SAN JACINTO DRIVE/RANCHO MIRAGE, CALIFORNIA 92270 (714) 346-8033

1.0 Summary

This is the Fourth Quarterly Progress Report under NASA Contract NAS 8-32242 to Colt Inc. for the development of a solar hot water heating and space heating system. This report covers the period from July 1, 1977 to September 30, 1977, a period of three months. This report provides a status of current scheduling and provides an inclusive summary of the current technical status.

2.0 Contract

A Design Review was conducted at the Yosemite Operational Test Site on August 10, 1977. Those in attendance were:

Mr. Les Arnberger, Yosemite National Park

Mr. Zoltan Muttnyansky, West. Reg. Off., Nat'l Parks Service

Mr. Mark Cardosa, Creegan & D'Angelo, San Jose, CA

Mr. Dwight Wendell, National Parks Service, Denver, CO

Mr. Bob Gunner, NASA, Marshall Space Flight Center, AL

Mr. Mitch Cash, NASA, Marshall Space Flight Center, AL

Mr. Bill Rothchild, National Parks Service, Denver, CO

Mr. Tom Hayes, Spa Plumbing

Mr. Paul Wheeler, Colt Inc.

Building modifications and the location of the Thermal Storage Building were discussed and finalized.

A Design Review was conducted at the Pueblo Operational Test Site on August 31, 1977.

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The Thermal Storage vessel location was discussed and finalized. Decisions regarding specific component suppliers were discussed and finalized. The installation contractor was chosen and is:

MacIndoe Plumbing & Heating, Inc.
110 West 2nd Street
Pueblo, CO

A Design Review was conducted at the Colt Facility on September 15, 1977. Those in attendance were:

Mr. Mitch Cash, NASA, Marshall Space Flight Center

Mr. Bill Hunter, Colt Inc., Rancho Mirage

Mr. Charles R. Barsamian, Colt Inc., Rancho Mirage

General design modifications were discussed and implemented.

3.0 Schedules

Figure 2 indicates the current program schedule. Colt Inc. is proceeding on this schedule without slippage. However this schedule has been previously adjusted to reflect the following:

- a) Slippage caused by the Colt collector redesign
- b) Slippage in the National Park Service schedule for building modifications
- c) Slippage in the Department of Transportation schedule for building modifications.

4.0 Technical Status

The overall technical status is progressing without difficulty. Verification Test hardware buildup has been completed.

The data acquisition program has been tested and "debugged." Full data collecting and graphing capability has been achieved.

FIGURE 2

PROGRAM SCHEDULE

1976 1977 1978

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
DEVELOPMENT PLAN - SUBMISSION & COMPLETION	▲																
VERIFICATION PLAN - SUBMISSION & COMPLETION	▲																
QUALITY ASSURANCE PLAN - SUBMISSION & COMPLET.	▲																
SYSTEM PERF. SPECS. - SUBMISSION & COMPLETION	▲																
CONTRACT GO-AHEAD		▲															
PRELIMINARY DEVELOPMENT DESIGN		▲															
SYSTEMS HAZARDS ANALYSIS		▲															
SPECIAL HANDLING INSTALLATION, & MAINT. TOOLS		▲															
SUBMISSION OF TRAINING PROGRAM				▲													
VERIFICATION TEST PLAN (TEST PROCEDURES)				▲													
PRELIMINARY DESIGN REVIEW				▲													
PREPARE PROCUREMENT SPECIFICATIONS				▲													
QUALIFICATION & ACCEPTANCE TEST PROCEDURES				▲													
PROCURE & FABRICATE VERIFICATION TEST SYSTEM				▲													
TEST EQUIPMENT BUILD-UP				▲													
TEST FACILITY INSTRUMENTATION CERTIFICATION				▲													
VERIFICATION DEVELOPMENT TESTING																	
PREPARE VERIFICATION TEST REPORT																	
SPARE PARTS LIST																	
INSTALLATION, OPERATION & MAINTENANCE MANUAL																	
PROTOTYPE DESIGN REVIEW																	
CERTIFICATION GUIDELINE DOCUMENT																	
PROCURE TWO DELIVERABLE SYSTEMS																	
ESTABLISH BASELINE CONFIGURATIONS																	
PREPARE QUALIFICATION ANALYSIS REPORT																	
CERTIFICATION TESTING																	
ACCEPTANCE TEST PLAN																	
FABRICATE TWO DELIVERABLE SYSTEMS																	
DESIGN DATA BROCHURE																	
ACCEPTANCE TEST TWO DELIVERABLE SYSTEMS																	
FIRST ARTICLE REVIEW																	
ACCEPTANCE DATA PACKAGE																	
DELIVERY OF SYSTEMS (SHIP)																	

PLANNED
 ▲ INITIATE
 ▽ COMPLETE

ACCOMPLISHED
 ▲ INITIATE
 ▼ COMPLETE

○ POSSIBLE SLIP
 ● ACTUAL SLIP
 △ FIRST RESCHEDULE

PROGRAM SCHEDULE
 AS OF

The Amtrac Speed Test Facility in Pueblo, Colorado was finalized as the second Operational Test Site. The system component hardware was procured and fabricated, in preparation for the First Article Review and shipment to Pueblo.

Final preliminary drawings of the Yosemite Operational Test Site were sent to all parties concerned. The Yosemite hardware components were procured and fabrication has been initiated.

The following data has been submitted during this reporting period:

Change proposal #AII00342, September 16, 1977.