no action

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: 9/15/77

Project Title: "Conceptual Design of a Solar Total Energy-Large Scale Experiment." (Phase II)

Project No: E-15-605 (Sub-projects are A-2014/Bomar/ASL and E-16-622/Craig/AE)

Project Director: Dr. J. R. Williams

Sponsor: Westinghouse Electric Corporation; Advanced Energy Systems Division

Agreement Period: From 5/26/77 Until 9/26/77
(Phase II only)

Type Agreement: Subcontract No. 59-CZR-41023
(under ERDA Prime Contract No. EG-77-C-04-3988)

Amount:
$10,112 (E-15-605, Engineering College)
2,384 (E-16-622, Aerospace)
13,183 (A-2014, ASL)
$25,679 TOTAL

Reports Required: Cost Management Plan; Technical Status Reports, Final Report

Sponsor Contact Person (s):

Technical Matters

J. J. Buggy, Project Manager
Westinghouse Electric Corporation
P. O. Box 10864
Pittsburgh, PA 15236

Contractual Matters
(thru OCA)

J. A. Rush, Senior Subcontract Administrator
Westinghouse Electric Corporation
Advanced Energy Systems Division
P. O. Box 10864
Pittsburgh, PA 15236

Defense Priority Rating: N/A

Assigned to: College of Engineering (School/Laboratory)

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Project Code (GTRI)
Other

CA-3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

110 action

SPONSORED PROJECT TERMINATION

Date: 11/15/77

Project Title: "Conceptual Design of a Solar Total Energy-Large Scale Experiment."

Project No: A-2014 (Sub-project under E-15-605/Williams/Eng. Col.)

Project Director: S. H. Bomar

Sponsor: Westinghouse Electric Corporation; Advance Energy Systems Division

Effective Termination Date: 9/26/77

Clearance of Accounting Charges: 9/26/77

Grant/Contract Closeout Actions Remaining:

- _ Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ____________

Assigned to: Applied Sciences Laboratory (School/Laboratory)

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CA-4 (3/76)

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Monthly technical status report 1

A-2014

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 2, 1977

Mr. J. J. Buggy
Westinghouse Advanced Energy Systems
P. O. Box 10864
Pittsburgh, Pennsylvania 15236 & Cost Report

Subject: Conceptual Design of a Solar Total Energy-Large Scale Experiment, Fort Hood, Texas; Monthly Technical Status Report No. 2 covering the period July 1 through July 31, 1977 (Westinghouse Subcontract 59-CZR-41023, Georgia Tech Project A-2014).

Gentlemen:

I. Contract Objective

The objective of this subcontract is to perform a conceptual design for the high temperature thermal storage system in ERDA's Solar Total Energy-Large Scale Experiment No. 1 at Fort Hood, Texas. The high temperature thermal storage system will act as an energy buffer device between the collectors and the load, so that the total energy system can receive solar energy whenever it is available from the collectors and can supply energy to the load in response to load demand. This subcontract supports the Westinghouse prime contract for conceptual design of the complete STE-LSE.

II. Progress Summary

Task 1.0 Project Management

A meeting was held at Georgia Tech on July 12 between J. J. Buggy and Georgia Tech Engineering Experiment Station personnel to discuss plans for the July 28-29 Interim Design Review and other management details. Mr. Buggy left a copy of a proposed format for cost-benefit analyses for comment, and the document was reviewed and found acceptable from the viewpoint of thermal storage. Mr. Buggy also left an outline of the Phase III work plan for comment by Georgia Tech and this item was found acceptable. Mr. Buggy discussed a change in work scope to reduce program costs; this item has not yet been handled because Dr. Richard Williams was not available to review his portion of Georgia Tech's subcontract.

A project meeting in preparation for the Interim Design Review was held at the Westinghouse Advanced Energy Systems Division on July 22. At this time the material to be covered in the review was discussed and agreement was reached on certain technical characteristics of the high temperature thermal storage system.

The Interim Design Review was conducted on July 28-29 at the Westinghouse offices. The technical material presented at the review is described below.

Task 2.0 System Requirements Analysis

A set of "maximum" and "minimum" output energy rates from thermal storage to the steam generation heat exchangers were furnished to Georgia Tech by Westinghouse for use in estimating the capacity of the storage system. These data were then coupled with typical daily input energy profiles in order to identify the mismatch between storage inputs and outputs and thereby identify the storage capacity required to perform a daily buffering operation. This led to a minimum storage capacity of 10 million Btu and a maximum capacity of 75 million Btu.

Task 3.0 Conceptual Design

Using the above capacities as upper and lower limits, several storage system options were sized with respect to tank and storage media requirements; the options included petroleum oil (Caloria HT-43), Therminol-66, pressurized water, and molten salt (three-component eutectic mixture HITEC or Partherm 290). Current costs of tanks and storage media were plotted as functions of storage capacity (tanks and media are the predominant costs in the system) and the conclusion was reached that system costs increase in the order: petroleum oil, molten salt, Therminol-66, and pressurized water. Telephone contacts with tank manufacturers showed that tanks for the water system are prohibitive in cost because of water's high vapor pressure at the proposed storage temperatures. However, the choice among the other three systems depends upon other system requirements, especially the upper storage temperature.

Flow schematics and cost estimates were prepared for the oil, Therminol-66 and salt systems. The costs were based on recent information for prices of components and included rough sizing of items such as valves and piping. Within the limits of accuracy inherent in such estimates, the oil and salt concepts are about equal in initial cost and either would be useable in the STE-LSE thermal storage system. This information was covered in the Interim Design Review.

A three-tank storage concept has been identified by Westinghouse which has technical advantages for operation of the STE-LSE system. It is expected that data for system sizing will be sent to Georgia Tech and studies similar to those described above will be conducted; minimum operating temperatures will probably be too low for use of a molten salt storage concept because the risk of solidification of the salt will become relatively high.

III. Changes

The proposed change in contract scope will be evaluated in view of the remaining work to be accomplished and the change negotiated with Westinghouse.

IV. Problem Areas

No significant problem areas are recognized at this time.

V. Open Items

The scope change is open at this time. Storage energy outputs for the three-tank concept are needed by Georgia Tech. The costs of heat exchangers to interface between a collector field fluid such as Therminol-66 and oil or molten salt in the storage system are to be estimated by Georgia Tech to identify the cost delta from pressurized water exchangers used in the previous estimates.

Respectfully submitted,

Steve H. Bomar, Jr.
Project Director

jw

Mr. J. J. Buggy
Westinghouse Advanced Energy Systems
P. O. Box 10864
Pittsburgh, Pennsylvania 15236

ERDA (7-76)

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U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

COST MANAGEMENT REPORT

1. Contract Title	2. Reporting Period	3. Contract Number
Conceptual Design of a Solar Total Energy-Large Scale Experiment	July 1 through July 31, 1977	59-CZR-41023

4. Contractor (name and address)	5. Cost Plan Date	6. Contract Start Date / 7. Contract Complete Date
Georgia Tech Research Institute, Administration Building Georgia Institute of Technology, Atlanta, Georgia 30332	Proposal	June 16, 1977 / Sept. 30, 1977

8. Government Funding	9. Contractor Funding	10. Number of Invoices Billed	11. Frequency	12. Number of Invoices Paid	13. Total Invoice Amounts Billed	14. Total Payment Received

15. Identification Number	16. Reporting Category (e.g., contract line item or work breakdown structure element)	17. Costs Accrued (dollars) During Reporting Period Actual a	Planned b	Cumulative to Date Actual c	Planned d	18. Projected Accrued Costs Subsequent Reporting Period a	Balance of Fiscal Year b	Total Contract c	19. Negotiated Contract Cost	20. Variance	21. Outstanding Commitments
1.0	Project Management										
1.1	Management Plan			167	313						
1.2	Design Rev. & Conf.	1,037	313	1,037	313						
1.3	Reporting	317	313	484	626						
3.0	Conceptual Design										
3.2	Sys. Ref. Concep. Des.	424	469	729	938						
3.3	Performance Analysis	962	469	962	938						
3.7	Cost Est. & Schedules	978	469	978	938						
3.8	Tech. & Mgmt. Plan	145	313	145	626						
22	Total	3,863	2,346	4,502	4,692						

23. Remarks

24. Dollars Expressed In: dollars

25. Signature of Contractor's Project Manager and Date: Steve H. Bomar, Jr. August 2, 1977

26. Signature of Government Technical Representative and Date:

Monthly technical status report 3

A-2014

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

October 4, 1977

Mr. J. J. Buggy
Westinghouse Advanced Energy Systems
P. O. Box 10864
Pittsburgh, Pennsylvania 15236

Subject: Conceptual Design of a Solar Total Energy-Large Scale Experiment, Fort Hood, Texas; Monthly Technical Status Report No. 4 covering the period September 1 through September 30, 1977 (Westinghouse Subcontract 59-CZR-41023, Georgia Tech Project A-2014).

Gentlemen:

I. Contract Objective

The objective of this subcontract is to perform a conceptual design for the high temperature thermal storage system in ERDA's Solar Total Energy-Large Scale Experiment No. 1 at Fort Hood, Texas. The high temperature thermal storage system will act as an energy buffer device between the collectors and the load, so that the total energy system can receive solar energy whenever it is available from the collectors and can supply energy to the load in response to load demand. This subcontract supports the Westinghouse prime contract for conceptual design of the complete STE-LSE.

II. Progress Summary

A man-hour and cost budget and a pricing proposal for Phase III effort on the Thermal Storage System was submitted to Westinghouse on August 26, 1977. A man-hour and cost budget for Phase IV was submitted on August 30, 1977.

A Thermal Storage System Cost Report was submitted about September 1 and the thermal storage input for the Westinghouse Final Technical Report was submitted on September 15.

Steve H. Bomar, Jr. of Georgia Tech attended the Westinghouse team design review in Albuquerque on September 14 and 15.

Task 2.0 System Requirements Analysis

The technical effort on this task was completed in August; no effort was expended in September.

Task 3.0 Conceptual Design

The Thermal Storage System conceptual design was substantially completed in August. Activities in September consisted of support for the Westinghouse final design review and support of final report preparation.

III. Changes

No changes are anticipated.

IV. Problem Areas

No problem areas exist.

V. Open Items

The contract is completed and no open items related to Phase II exist.

Respectfully submitted,

Steve H. Bomar, Jr.
Project Director

dr

Mr. J. J. Buggy
Westinghouse Advanced Energy Systems
P. O. Box 10864
Pittsburgh, Pennsylvania 15236

FORM ERDA ____
(7-76)

U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Page ____ of ____

COST MANAGEMENT REPORT

1. Contract Title	2. Reporting Period	3. Contract Number
Conceptual Design of a Solar Total Energy-Large Scale Experiment	Sept. 1 through Sept. 30, 1977	59-CZR-41023

4. Contractor (name and address)	5. Cost Plan Date	6. Contract Start Date / 7. Contract Completion Date
Georgia Tech Research Institute, Administration Building, Georgia Institute of Technology, Atlanta, Georgia 30332	Proposal	6. June 16, 1977 7. Sept. 30, 1977

8. Government Funding	9. Contractor Funding	10. Number of Invoices Billed	11. Frequency	12. Number of Invoices Paid	13. Total Invoice Amounts Billed	14. Total Payment Received

15. Identification Number	16. Reporting Category (e.g., contract line item or work breakdown structure element)	17. Costs Accrued: During Reporting Period, Actual a	During Reporting Period, Planned b	Cumulative to Date, Actual c	Cumulative to Date, Planned d	18. Projected Accrued Costs: Subsequent Reporting Period a	Balance of Fiscal Year b	Total Contract c	19. Negotiated Contract Cost	20. Variance	21. Outstanding Commitments
1.0	Project Management										
1.1	Management Plan			167	313						
1.2	Des. Rev. & Conf.	626	313	1,663	626						
1.3	Reports	1,564	469	2,674	1,408						
2.0	Sys. Requirm't. Anal.										
2.7	Reliability			78	78						
3.0	Conceptual Design										
3.2	Sys. Ref. Concep. Des.	391	704	1,902	2,111						
3.3	Performance Analysis		469	1,705	1,876						
3.4	Operational Plan	156	313	469	626						
3.5	Component Dev. Plan	156	156	469	313						
3.7	Cost Est. & Schedules		469	1,760	1,876						
3.8	Tech. & Mgmt. Plan		313	771	1,252						
27	Total	2,893	3,206	11,658	10,479						

23. Remarks	24. Dollars Expressed In:
Contract value authorized in Westinghouse TWX of June 9, 1977: $13,183. Reduction negotiated August 5, 1977: $1,500. Final Contract value: $11,683.	dollars

25. Signature of Contractor's Project Manager and Date	26. Signature of Government Technical Representative and Date
Steve H. Bomar, Jr. October 4, 1977	

A-0014

SOLAR TOTAL ENERGY-LARGE SCALE EXPERIMENT

STE-LSE

PHASE II

FORT HOOD, TEXAS

THERMAL STORAGE SUBSYSTEM COST REPORT

SOLAR TOTAL ENERGY-LARGE SCALE EXPERIMENT
STE-LSE
PHASE II
FORT HOOD, TEXAS

THERMAL STORAGE SUBSYSTEM COST REPORT

SUBMITTED TO

ADVANCED ENERGY SYSTEM DIVISION
WESTINGHOUSE ELECTRIC CORPORATION

Contributors

A. H. Roy

C. A. Murphy

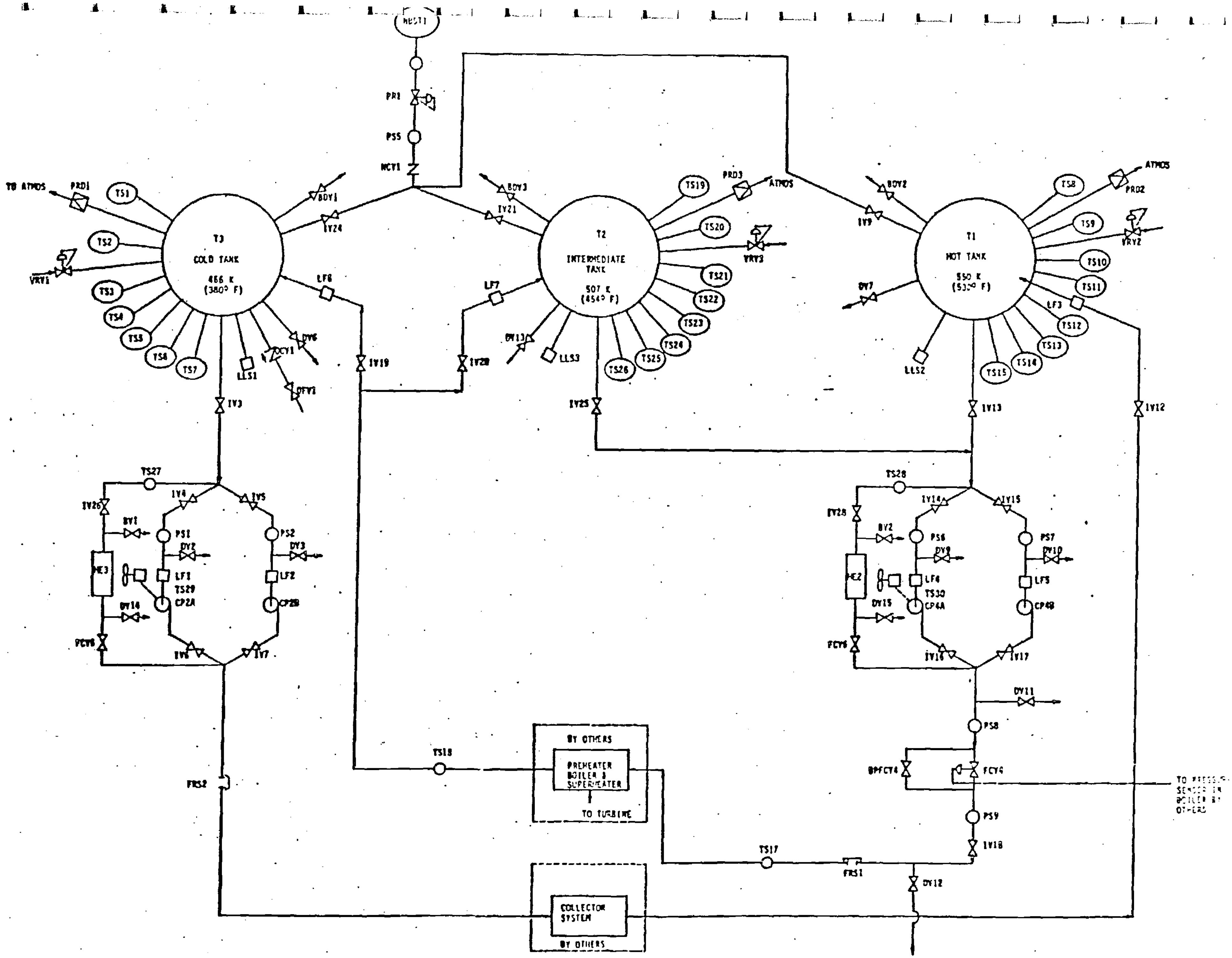
GLOSSARY OF ACRONYMS

BDV	-	Blow Down Valve
BPFCV	-	Bypass Flow Control Valve
BV	-	Bleed Valve
CP	-	Circulation Pump
HE	-	Heat Exchanger
DV	-	Drain Valve
FCV	-	Flow Control Valve
FRS	-	Flow Rate Sensor
IV	-	Isolation Valve
LF	-	Line Filter
LLS	-	Liquid Level Sensor
NBST	-	Nitrogen Blanket Storage Tank
NCV	-	Nitrogen Check Valve
OCV	-	Oil Check Valve
OFV	-	Oil Fill Valve
PR	-	Pressure Regulator
PRD	-	Pressure Rupture Disc
PS	-	Pressure Sensor
T	-	Tank
TS	-	Temperature Sensor
VRV	-	Vacuum Relief Valve

TABLE OF CONTENTS

SECTION I

SCHEMATIC DIAGRAM AND COST SUMMARY

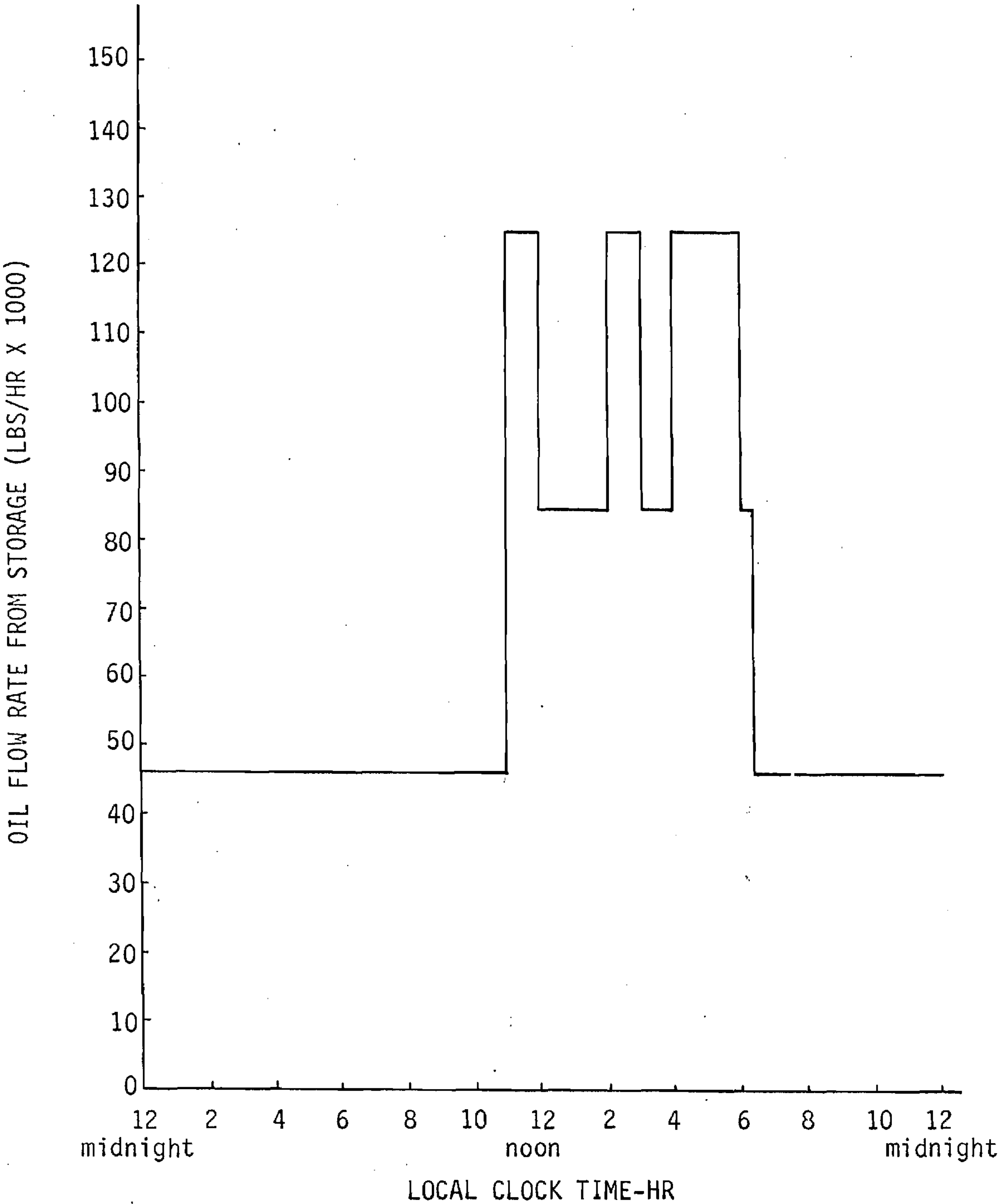

HBST1
PR1
PS5
NCV1
TO ATMOS
PRD1
TS1
TS2
TS3
TS4
TS5
TS6
TS7
VRV1
T3
COLD TANK
466 K
(380° F)
BDV1
IV24
LF6
LLS1
DV6
OCV1
OFV1
IV3
IV19
IV20
LF7
IV21
BDV3
T2
INTERMEDIATE
TANK
507 K
(454° F)
DV13
LLS3
TS19
PRD3
ATMOS
TS20
VRV3
TS21
TS22
TS23
TS24
TS25
TS26
IV25
BDV2
IV9
T1
HOT TANK
550 K
(530° F)
ATMOS
TS8
PRD2
TS9
VRV2
TS10
TS11
DV7
LF3
TS12
TS13
TS14
TS15
LLS2
IV13
IV12
TS27
IV26
IV4
IV5
BV1
PS1
PS2
DV2
DV3
HE3
LF1
LF2
TS29
CP2A
CP2B
DV14
FCV6
IV6
IV7
TS28
IV28
IV14
IV15
BV2
PS6
PS7
DV9
DV10
HE2
LF4
LF5
TS30
DV15
CP4A
CP4B
FCV5
IV16
IV17
DV11
PS8
BPFCV4
FCV4
PS9
IV18
TS18
BY OTHERS
PREHEATER
BOILER &
SUPERHEATER
TO TURBINE
TS17
FRS1
DV12
FRS2
COLLECTOR
SYSTEM
BY OTHERS

COST SUMMARY FOR HIGH TEMPERATURE THERMAL STORAGE CONCEPT

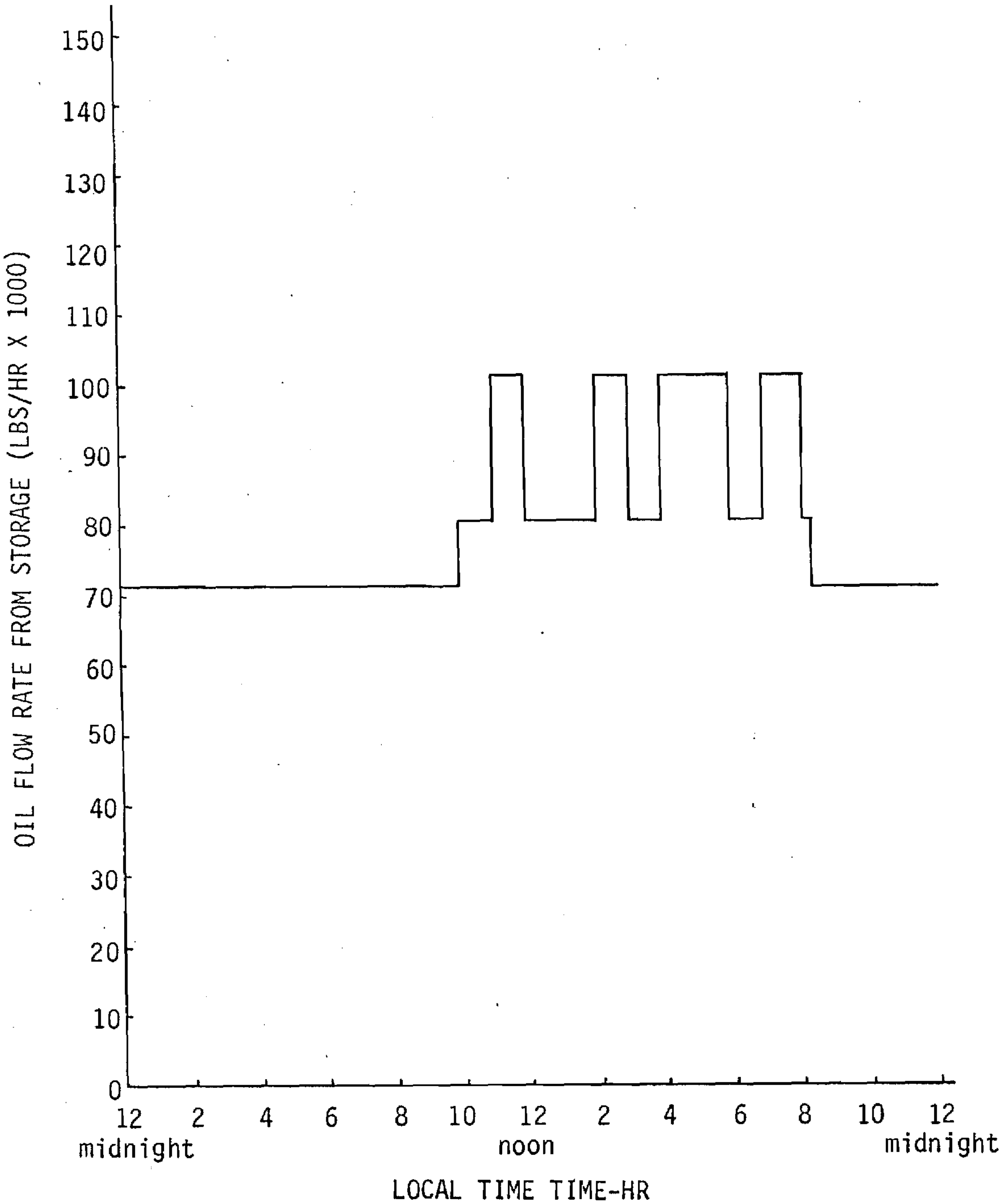
ITEM		COST
Tanks & Foundation		564,000.00
Storage Media (Caloria HT-43)		170,128.00
Pumps		18,644.00
Valves, Rupture Discs, Filters		55,683.51
Instrumentation		12,515.93
Heat Exchangers		296.00
Nitrogen Blanketing System		17,090.65
Labor (including 20 percent for subcontracting)		20,462.42
	Total	$858,820.51

SECTION II

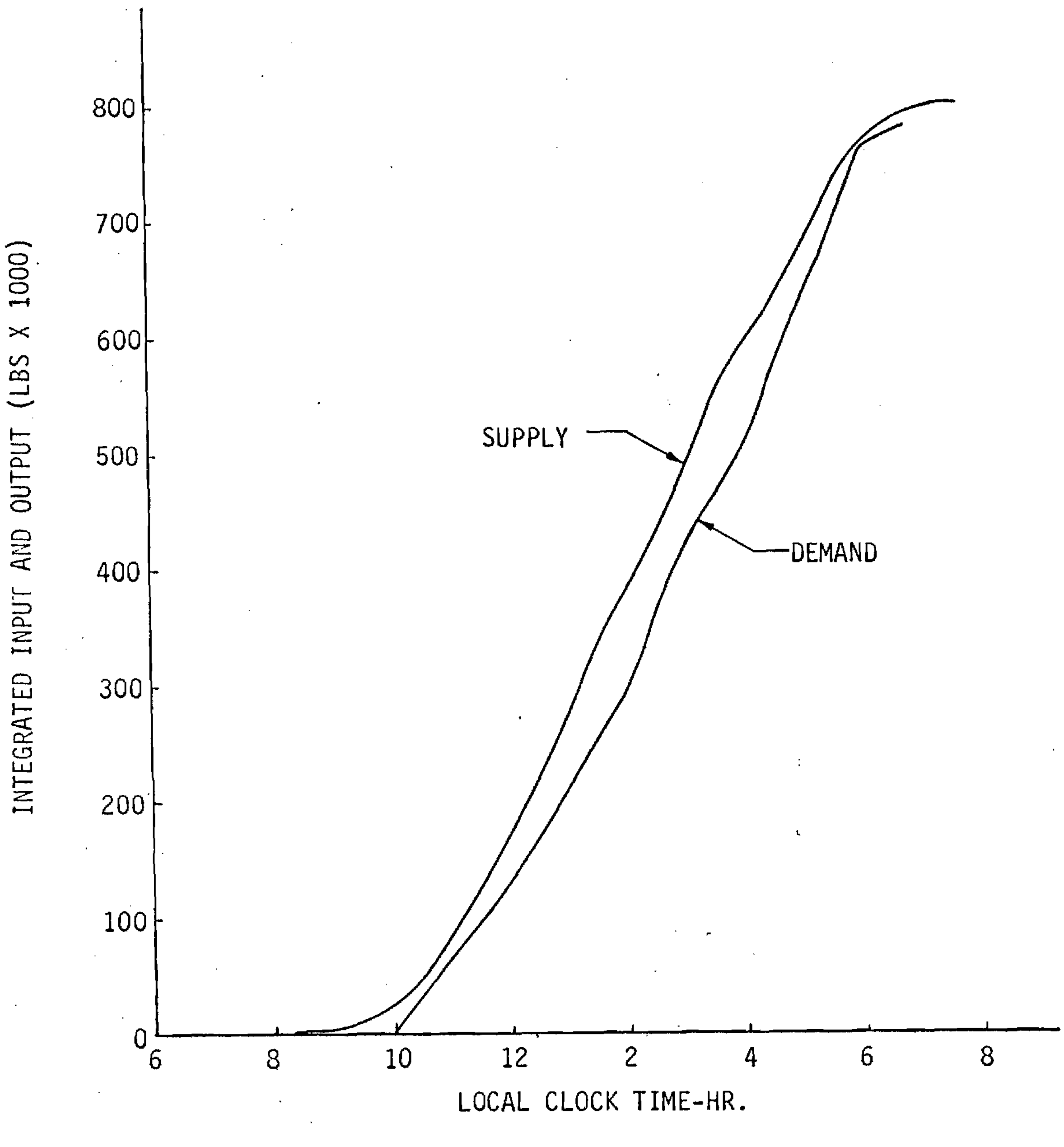
STORAGE FLUID SUPPLY AND DEMAND MODES FOR FT. HOOD, TEXAS



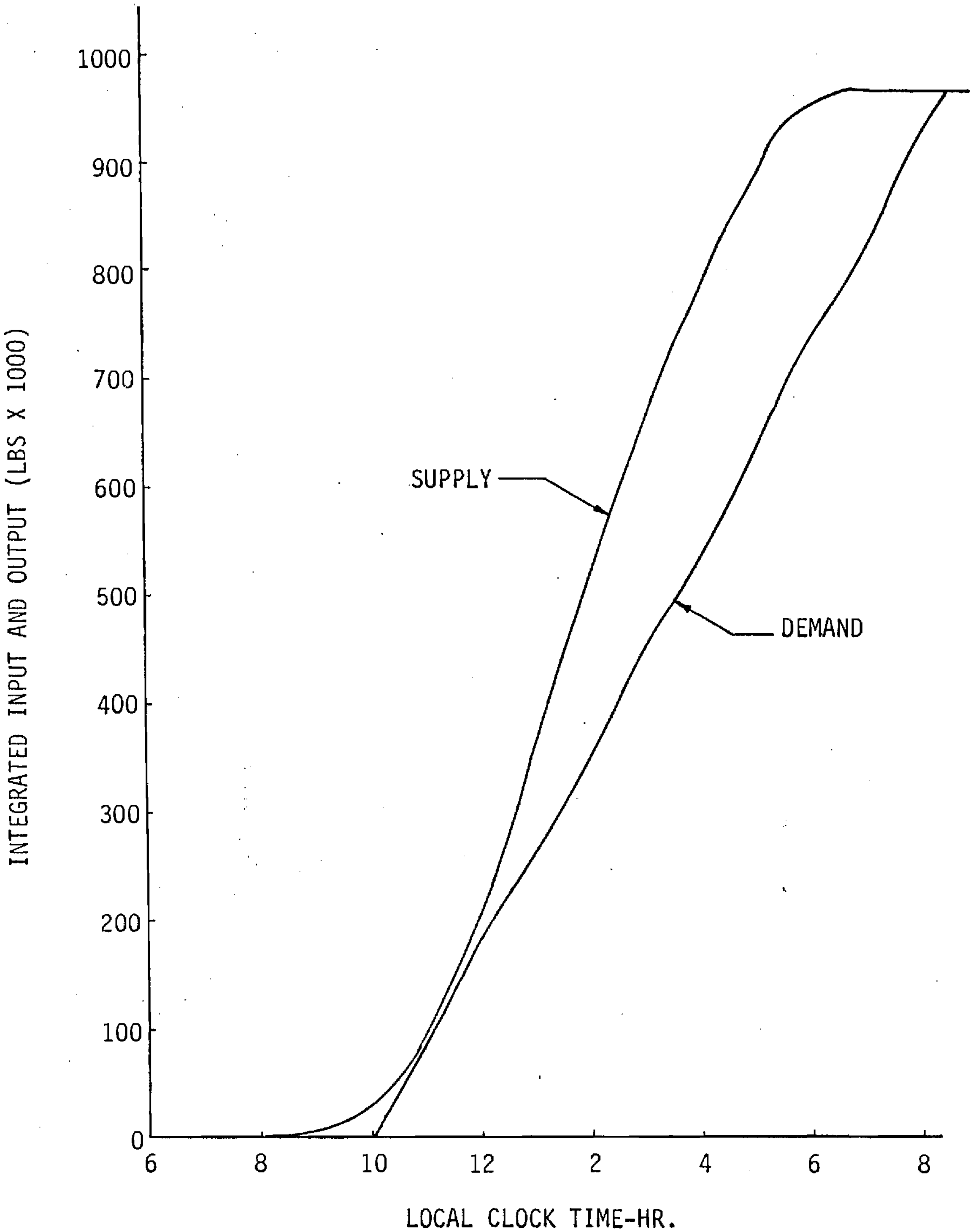
Demand Load from High-Temperature Storage (Summer).



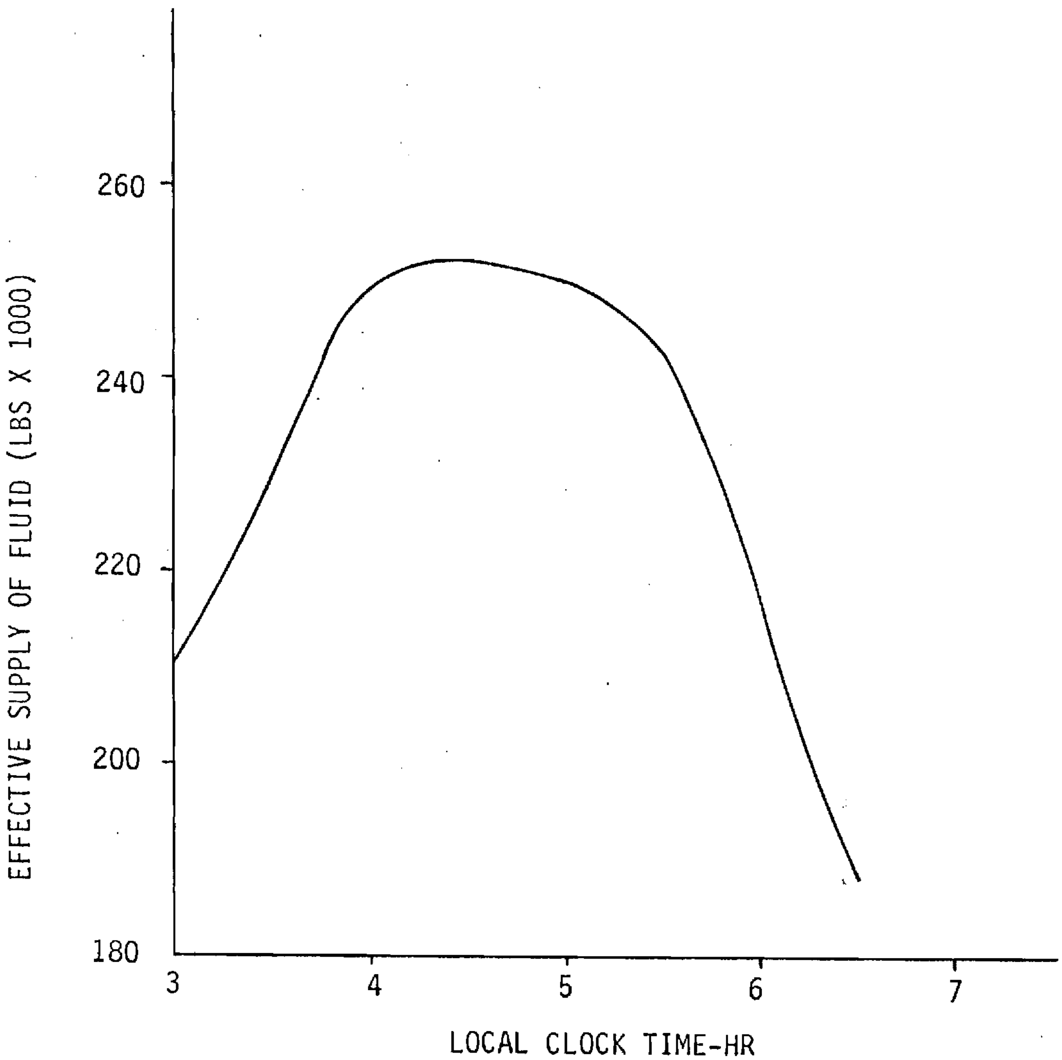
Demand Load from High-Temperature Storage (Winter).



Integrated Supply to and Demand from High-Temperature Storage (Summer).



Integrated Supply to and Demand from High-Temperature Storage (Winter).



Effective Supply of Fluid to the Hot Tank.

SECTION III

TANK SPECIFICATIONS

STORAGE TANK SPECIFICATION

Tank Designation	T1	T2	T3
Service	Exxon Caloria HT-43	Exxon Caloria HT-43	Exxon Caloria HT-43
Proposed Type	Sphere	Sphere	Sphere
Volume - (gals)	77,100	215,000	215,000
Diameter (ft)	27	38	38
Density @ Operating Temperature - lb/ft^3	43.2	44.9	46.4
Temperature - Operating - ^oF	530	454	380
- Maximum - ^oF	550	474	400
Pressure - Operating - psig	15	15	15
- Maximum - psig	25	25	25

SECTION IV

COMPONENTS LISTING AND PRICES

Prices indicated herein do not include the following:

1. Air Systems for actuating the valves.

2. Piping System (except piping for nitrogen blanketing system).

3. Insulation for piping and tanks.

4. Hangers and structural supports.

5. Freight for equipment and components.

	COMPONENTS	$/UNIT	LABOR $/UNIT	TOTAL
BDV1	A 2" pneumatic actuated Valtek Mark I valve used during blow down of the cold oil tank T3.	890.00	74.94	964.94
BVD2	A 2" pneumatic actuated Valtek Mark I valve used during blow down of the hot oil tank T1.	890.00	74.94	964.94
BDV3	A 2" pneumatic actuated Valtek Mark I valve used during blow down of the intermediate oil tank T2.	890.00	74.94	964.94
BPFCV4	A 2" electric actuated Valtek Mark I valve used to regulate the flow of oil from the pumps (CP4A/CP4B) to the heat exchangers during discharge cycle startup.	1,414.54	93.68	1,508.22
BV1	A 3/4" Hancock valve used to bleed a bypass oil cooler (HE3) and associated piping.	29.40	37.47	66.87
BV2	A 3/4" Hancock valve used to bleed a bypass oil cooler (HE2) and associated piping.	29.40	37.47	66.87
CP2A	A centrifugal pump to circulate heat transfer oil from T3 through collector system to T1 during system charge cycle. Pumping rate 1.06×10^5 L/S (468 gpm). Total head 75.6 m (248 ft) of liquid pumped.	3,349.00	1,080.48	4,429.48
CP2B	An auxiliary centrifugal pump used to circulate heat transfer oil T3 through collector system to T1 during system charge cycle. Pumping rate 1.06×10^5 L/S (468 gpm). Total head 75.6 m (248 ft) of liquid pumped.	3,349.00	1,080.48	4,429.48

	COMPONENTS	$/UNIT	LABOR $/UNIT	TOTAL
CP4A	A centrifugal pump used to circulate heat transfer oil from either T1 to T2 or T2 to T3 through heat exchangers during system discharge cycle. Pumping rate 3.70 x 10^4 L/S (427 gpm). Total heat 132.3 m (434 ft) of liquid pumped.	5,973.00	1,080.48	7,053.48
CP4B	A auxiliary centrifugal pump used to circulate heat transfer oil from either T1 to T2 or T2 to T3 through heat exchangers during system discharge cycle. Pumping rate 3.70 x 10^4 L/S (427 gpm). Total head 132.3 m (434 ft) of liquid pumped.	5,973.00	1,080.48	7,053.48
HE2	Air-cooled heat exchanger used to cool heat transfer oil and pumps when system is at no flow condition. Total heat exchanged 8.8 x 10^3 watts (3.0 x 10^4 Btu/hr).	171.00	100.00	271.00
HE3	Air-cooled heat exchanger used to cool heat transfer oil and pumps when system is at no flow condition. Total heat exchanged 4.7 x 10^4 watts. (1.6 x 10^5 Btu/hr).	125.00	100.00	225.00
DV2	A 3/4" Hancock valve used to drain the charge cycle primary oil pump CP2A.	29.40	37.47	66.87
DV3	A 3/4" Hancock valve used to drain the charge cycle auxiliary oil pump CP2B.	29.40	37.47	66.87
DV6	A 3" Masoneilan valve used to drain cold tank T3.	806.61	112.42	919.03
DV7	A 3" Masoneilan valve used to drain hot tank T1.	806.61	112.42	919.03

	COMPONENTS	$/UNIT	LABOR $/UNIT	TOTAL
DV9	A 3/4" Hancock valve used to drain the discharge cycle primary pump CP4A.	29.40	37.47	66.87
DV10	A 3/4" Hancock valve used to drain the discharge cycle auxiliary pump CP4A.	29.40	37.47	66.87
DV11	A 3/4" Hancock valve used to drain the discharge cycle oil feed line.	29.40	37.47	66.87
DV12	A 3/4" Hancock valve used to drain the discharge cycle oil feed line.	29.40	37.47	66.87
DV13	A 3" Masoneilan valve used to drain the intermediate tank T2.	806.61	112.42	919.03
DV14	A 3/4" Hancock valve used to drain a bypass oil cooler (HE3) and associated piping.	29.40	37.47	66.87
DV15	A 3/4" Hancock valve used to drain a bypass oil cooler (HE2) and associated piping.	29.40	37.47	66.87
FCV4	A 4" electric actuated Valtek Mark I valve used during system discharge to regulate the flow of oil from the pumps (CP4A/CP4B) to the heat exchangers.	2,754.00	149.89	2,903.89
FCV5	A 1" manually operated Hancock valve used to regulate the by-pass flow from the charge cycle pumps (CP2A/CP2B) through the bypass oil cooler (HE3).	44.80	37.47	82.27
FCV6	A 1" manually operated Hancock valve used to regulate the by-pass flow from the discharge cycle pumps (CP4A/CP4B) through the bypass oil cooler (HE2).	44.80	37.47	82.27

	COMPONENTS	$/UNIT	LABOR $/UNIT	TOTAL
FRS1 & 2	A differential pressure flow measurement device in the discharge and charge circuit respt. It uses an annubar with differential pressure transmitter (Foxboro Model No. E13DH), and square-root extractor.	2,620.00	66.00	5,339.00
IV3	A 6" pneumatic actuated Valtek Mark I valve used to isolate the cold oil storage tank from the remainder of the thermal storage subsystem.	2,496.00	224.83	2,720.83
IV4	A 6" pneumatic actuated Valtek Mark I valve used to isolate the primary oil pump (CP2A) from the cold oil tank (T3) and the auxiliary oil pump (CP2B).	2,496.00	224.83	2,720.83
IV5	A 6" pneumatic actuated Valtek Mark I valve used to isolate the auxiliary oil pump (CP2B) from the cold oil tank (T3) and the primary oil pump (CP2A).	2,496.00	224.83	2,720.83
IV6	A 4" pneumatic actuated Valtek Mark I valve used to isolate the primary oil pump (CP2A) from the collector system and the auxiliary oil pump (CP2B).	1,629.61	149.89	1,779.50
IV7	A 4" pneumatic actuated Valtek Mark I valve used to isolate the auxiliary oil pump (CP2B) from the collector system and the primary oil pump (CP2A).	1,629.61	149.89	1,779.50
IV9	A 4" pneumatic actuated Valtek Mark I valve used to block the oil tank (T1) equalizer line during nitrogen blow down.	1,629.61	149.89	1,779.50

	COMPONENT	$/UNIT	LABOR $/UNIT	TOTAL
IV13	A 6" pneumatic actuated Valtek Mark I valve used to isolate the hot oil storage tank from the remainder of the system.	2,496.00	224.83	2,720.83
IV14	A 6" pneumatic actuated Valtek Mark I valve used to isolate the primary oil pump (CP4A) from the oil tanks (T1/T2) and the auxiliary oil pump (CP4B).	2,496.00	224.83	2,720.83
IV15	A 6" pneumatic actuated Valtek Mark I valve used to isolate the auxiliary oil pump (CP4B) from the oil tanks (T1/T2) and the primary oil pump (CP4A).	2,496.00	224.83	2,720.83
IV16	A 4" pneumatic actuated Valtek Mark I valve used to isolate the primary oil pump (CP4A) from the heat exchangers and the auxiliary oil pump (CP4B).	1,629.61	149.89	1,779.50
IV17	A 4" pneumatic actuated Valtek Mark I valve used to isolate the auxiliary oil pump (CP4B) from the heat exchangers and the primary oil pump (CP4A).	1,629.61	149.89	1,779.50
IV18	A 4" pneumatic actuated Valtek Mark I valve used to isolate the oil pumps (CP4A/CP4B) from the heat exchangers.	1,629.61	149.89	1,779.50
IV19	A 4" pneumatic actuated Valtek Mark I valve used to isolate heat exchangers and oil tank (T2) from the cold oil tank (T3).	1,629.61	149.89	1,779.50
IV20	A 4" pneumatic actuated Valtek Mark I valve used to isolate heat exchangers and oil tank (T3) from the intermediate oil tank (T2)	1,629.61	149.89	1,779.50

	COMPONENTS	$/UNIT	LABOR $/UNIT	TOTAL
IV21	A 4" pneumatic actuated Valtek Mark I valve used to block the oil tank (T2) equalizer line during nitrogen blow down.	1,629.61	149.89	1,779.50
IV24	A 4" pneumatic actuated Valtek Mark I valve used to block the oil tank (T3) equalizer line during nitrogen blow down.	1,629.61	149.89	1,779.50
IV25	A 6" pneumatic actuated Valtek Mark I valve used to isolate the intermediate oil storage tank from the remainder of the system.	2,496.00	224.83	2,720.83
IV26	A 1" pneumatic actuated Valtek Mark I valve used to isolate the bypass oil cooler (HE3) from the oil pumps (CP2A/CP2B).	728.67	37.47	766.14
IV27	A 1" pneumatic actuated Valtek Mark I valve used to isolate the bypass oil cooler (HE2) from the oil pumps (CP4A/CP4B).	728.67	37.47	766.14
LF1	A strainer used to protect the inlet of the charge cycle primary oil pump (CP2A).	1,390.00	224.83	1,614.83
LF2	A strainer used to protect the inlet of the charge cycle auxiliary oil pump (CP2B).	1,390.00	224.83	1,614.83
LF3	A strainer used to filter the oil going to the hot tank (T1) during charge cycle.	585.00	149.89	734.89
LF4	A strainer used to protect the inlet of the discharge cycle primary oil pump (CP4A).	1,390.00	224.83	1,614.83
LF5	A strainer used to protect the inlet of the discharge cycle auxiliary oil pump (CP2B).	1,390.00	224.83	1,614.83
LF6	A strainer used to filer the oil going to the cold tank (T3) during discharge cycle.	585.00	149.89	734.89

	COMPONENT	$/UNIT	LABOR $/UNIT	TOTAL
PS1,2, 6,7,8 & 9	An industrial type pressure transducer and transmitter (Foxboro Model No. E11GM) used to measure differential pressure in the system.	615.00	33.00	3,888.00
T1	Spherical oil storage tank, carbon steel, diameter 8.23 m (27 ft), volume 292 M^3 (77,100 gals), operating temperature 550 K (530° F), operating pressure 205 kpa (30 psia), design pressure 274 kpa (40 psia).			164,000.00
T2	Spherical oil storage tank, carbon steel, diameter 10.97 m (36 ft), volume 814 M^3 (215,000 gals), operating temperature 570 K (474° F), operating pressure 205 kpa (30 psia), design pressure 274 kpa (40 psia).			200,000.00
T3	Spherical oil storage tank, carbon steel, diameter 10.97 m (36 ft), volume 814 M^3 (215,000 gals), operating temperature 466 K (380° F), operating pressure 205 kpa (30 psia), design pressure 274 kpa (40 psia).			200,000.00
TS1,2,3, 4,5,6,7, 8,9,10, 11,12,13, 14,15,17, 18,19,20, 21,22,23, 24,25,26, 27,28,29 & 30	Type J iron-constantine thermocouple for temperature measurements. Pipe temperature measurements are planned to be in wells inserted to approximately one-half of the pipe diameter. Tank temperature measurements are planned to be in wells inserted approximately 36 inches into the tank.	55.17	23.42	2,279.11

	COMPONENT	$/UNIT	LABOR $/UNIT	TOTAL
LF7	A strainer used to filter the oil going to the intermediate tank (T2) during discharge cycle.	585.00	149.89	734.89
LLS1,2 & 3	A differential pressure liquid level measurement device in three oil storage tanks (T1/T2/T3). It uses a combination of pressure transducer and transmitter (Foxboro Model No. E13DM).	662.00	33.00	2,085.00
NBST1	Nitrogen blanket system. To supply nitrogen to tanks T1/T2/T3, includes liquid nitrogen tank, vaporizer & piping (900 gals)	17,090.65	4,611.41	21,702.06
NCV1	A 3/8" check valve used to prevent back flow from the oil storage tanks (T1/T2/T3) into the nitrogen blanketing supply system.	36.24	23.42	59.66
OCV1	A 3" valve used to prevent back flow from the oil storage tank (T3) during filling.	588.90	112.42	701.32
OFV1	A 3" Masoneilan valve used to fill the cold oil tank (T3).	806.61	112.42	919.03
PR1	A regulator to control the nitrogen blanketing pressure in the oil storage tanks (T1/T2/T3).	71.05	23.42	94.47
PRD1	A rupture disc to prevent over pressurization of the cold oil storage tank (T3).	634.00	187.36	821.36
PRD2	A rupture disc to prevent over pressurization of the hot oil storage tank (T1).	634.00	187.36	821.36
PRD3	A rupture disc to prevent over pressurization of the intermediate oil storage tank (T2).	634.00	187.36	821.36

	COMPONENT	$/UNIT	LABOR $/UNIT	TOTAL
VRV1	A 2" Circle seal valve to prevent buckling of the cold oil storage tank (T3) due to cooling of the ullage gas coupled with nitrogen system failure.	32.10	74.94	107.04
VRV2	A 2" Circle seal valve to prevent buckling of the hot oil storage tank (T1) due to cooling of the ullage gas coupled with nitrogen system failure.	32.10	74.94	107.04
VRV3	A 2" Circle seal valve to prevent buckling of the intermediate oil storage tank (T2) due to cooling of the ullage gas coupled with nitrogen system failure.	32.10	74.94	107.04

Caloria HT-43 @ 98¢/gal (173,600 gals)		170,128.00
Total cost of Labor =	$17,052.02	
Add 20% contract cost		20,462.42
Total cost of equipment		668,230.09
	Total Cost	$858,820.51

SECTION V

COMPONENT COST DATA SHEETS

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 1

Component Name: BDV1, 2 & 3

Component Description: (include brief description including quantities for cost traceability)

Blow Down Valve - Pneumatic Actuated

Design Life: 20 yrs

		1 Plant*	10 Plants*	100 Plants*
Capital Cost:				
Unit Cost:	$890	$2,670	$24,030	$213,600
Vendor Engrg:	Roy Freeman Associates			
First Tooling Cost:		0	0	0
Delivery (weeks)		4-6	4-6	15-18
Salvage Value (after 20 yrs)		-	-	-
Spare Parts: Quantity/Description	plugs, seat rings gasket, positioner			
Cost		$534	$4,806	$42,720
Maintenance Cost ($/Yr) (if required)		-	-	-

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 2

Component Name: BPFCV4

Component Description: (include brief description including quantities for cost traceability)

Bypass Flow Control Valve - Electric Actuated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $1,414.54	$1,414.54	$12,731.00	$113,163
Vendor Engrg: Roy Freeman Associates			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	6-8	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: plugs, seat rings, gaskets positioner Quantity/Description			
Cost	354.00	3,183.00	28,291
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 3

Component Name: BV 1 & 2

Component Description: (include brief description including quantities for cost traceability)

Bleed Valve

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $29.40	$58.80	$428	$4,070
Vendor Engrg: Jay Instrument & Specialty (Hancock valve)			
First Tooling Cost:	0	0	0
Delivery (weeks)	1	3-5	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	2 packings	20 packings	200 packings
Cost	$ 2.94	$ 21	$ 204
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 4

Component Name: CP2A & 2B

Component Description: (include brief description including quantities for cost traceability)

Centrifugal circulation pumps for charge circuit

Design Life: 20 yrs

		1 Plant*	10 Plants*	100 Plants*
Capital Cost:				
Unit Cost:	$3,349	$6,698	$66,645	$569,330
Vendor Engrg:	Dean Brothers			
First Tooling Cost:		0	0	0
Delivery (weeks)		12-14	14-18	14-18
Salvage Value (after 20 yrs)		-	-	-
Spare Parts:	gasket, bellows bearing & seal kits			
Quantity/Description				
Cost		$670	$5,332	$28,467
Maintenance Cost ($/Yr) (if required)				

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 5

Component Name: CP4A & 4B

Component Description: (include brief description including quantities for cost traceability)

Centrifugal circulation pumps for discharge circuit

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $5,973	$11,946	$113,487	$1,015,410
Vendor Engrg: Dean Brothers			
First Tooling Cost:			
Delivery (weeks)	13-14	14-18	14-18
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: gasket, bellows, bearing & seal kits Quantity/Description			
Cost	$ 1,195	$9,080	$50,771
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 6

Component Name: HE2

Component Description: (include brief description including quantities for cost traceability)

Air cooled heat exchanger used to cool heat transfer oil

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $171	$ 342	$3,078	$ 29,070
Vendor Engrg: Aerofin Corporation			
First Tooling Cost:	-	-	-
Delivery (weeks)	4-6	4-6	10-12
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	-	-	-
Cost			
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 7

Component Name: HE3

Component Description: (include brief description including quantities for cost traceability)

Air cooled heat exchanger used to cool heat transfer oil

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $125	$ 250	$2,250	$21,250
Vendor Engrg: Aerofin Corporation			
First Tooling Cost:	-	-	-
Delivery (weeks)	4-6	4-6	10-12
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	-	-	-
Cost			
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 8

Component Name: DV 2, 3, 9, 10, 11, 12, 14 & 15

Component Description: (include brief description including quantities for cost traceability)

Drain valve

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $29.40	$235.20	$1,714	$16,280
Vendor Engrg: Jay Instrument & Specialty (Hancock valve)			
First Tooling Cost:	0	0	0
Delivery (weeks)	1	3-5	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	6 packings	50 packings	500 packings
Cost	$ 12	$60	$6,512
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 9

Component Name: DV 6, 7 & 13

Component Description: (include brief description including quantities for cost traceability)

Drain valve

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $806.61	$2,420	$21,780	$205,700
Vendor Engrg: Masoneilan			
First Tooling Cost:	0	0	0
Delivery (weeks)	3-5	3-5	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	2 trims 2 packings	20 trims 20 packings	200 trims 200 packings
Cost	$ 484	$ 4,356	$ 41,140
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 10

Component Name: FCV 4

Component Description: (include brief description including quantities for cost traceability)

Flow Control Valve - Electric Actuated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $2,754	$2,754	$24,786	$220,320
Vendor Engrg: Roy Freeman Associates			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	6-8	20-24
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: plugs, seat rings, gasket positioner Quantity/Description			
Cost	$826	$7,436	$66,096
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 11

Component Name: FCV 5, 6

Component Description: (include brief description including quantities for cost traceability)

Flow Control Valve (manually operated)

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $44.80	$89.60	$653	$6,202
Vendor Engrg: Jay Instrument and Specialty (Hancock valve)			
First Tooling Cost:	0	0	0
Delivery (weeks)	1	3-5	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	2 packings	20 packings	200 packings
Cost	$4.50	$33	$310
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 12

Component Name: FRS 1 & 2

Component Description: (include brief description including quantities for cost traceability)

Flow Rate Sensor (consists of annubar, differential pressure transmitters and square root extractor)

Design Life: 10 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $2,620	$5,240	$49,780	$445,400
Vendor Engrg: The Foxboro Company (Quotation obtained during price estimation of Pilot Plant, May 1977)			
First Tooling Cost:	0	0	0
Delivery (weeks)	18-20	20-26	20-26
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: sq. root extractor, D.P. transmitter — Quantity/Description			
Cost	$1,180	$11,210	$100,300
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 13

Component Name: IV 3, 4, 5, 13, 14, 15 & 25

Component Description: (include brief description including quantities for cost traceability)

Isolation Valve - Pneumatic Actuated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $2,496	$17,472	$157,248	$1,397,760
Vendor Engrg: Roy Freeman Associates			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	6-8	20-24
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: plugs, seat rings, gaskets, positioner Quantity/Description			
Cost	$3,494	$31,450	$279,552
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 14

Component Name: IV 6, 7, 9, 16, 17, 18, 19, 20, 21, 24

Component Description: (include brief description including quantities for cost traceability)

Isolation Valve - Pneumatic Actuated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $1,629.61	$16,296	$146,665	$1,303,688
Vendor Engrg: Roy Freeman Associates			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	12-14	20-24
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: plugs, seat rings, gaskets, positioner Quantity/Description			
Cost	$2,444	$22,000	$195,553
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 15

Component Name: IV 26 & 27

Component Description: (include brief description including quantities for cost traceability)

Isolation Valve - Pneumatic Actuated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $728.67	$1,457.34	$13,116	$116,587
Vendor Engrg: Roy Freeman Associates			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	4-6	15-18
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: plugs, seat rings, gasket, positioner Quantity/Description			
Cost	$364	$3,279	$29,147
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 16

Component Name: LF 1, 2, 4 & 5

Component Description: (include brief description including quantities for cost traceability)

Line Filters to protect charge and discharge cycle pumps

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $1,390	$5,560	$50,040	$444,800
Vendor Engrg: Mueller Steam Specialty (Quotation obtained during price estimation of pilot plant, May 1977).			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	4-6	10-12
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: 1 filter			
Quantity/Description			
Cost	$1,390	$12,510	$111,200
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 17

Component Name: LF 3, 6 & 7

Component Description: (include brief description including quantities for cost traceability)

Line Filters to filter oil going to tanks T1/T2/T3

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $585	$1,755	$15,795	$140,400
Vendor Engrg: Mueller Steam Specialty (Quotation obtained during price estimation of pilot plant, May 1977).			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-6	4-6	10-12
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: 1 filter			
Quantity/Description			
Cost	$585	$5,265	$46,800
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 18

Component Name: LLS 1, 2 & 3

Component Description: (include brief description including quantities for cost traceability)

Liquid Level Sensors on Tanks T1/T2/T3 (consists of liquid level transmitter)

Design Life: 10 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $662.00	$1,986	$18,867	$168,810
Vendor Engrg: The Foxboro Company (Quotation obtained during price estimation of pilot plant, May 1977).			
First Tooling Cost:	0	0	0
Delivery (weeks)	18-20	20-26	20-26
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: level transmitter Quantity/Description			
Cost	$662	$6,289	$56,270
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 19

Component Name: NBST

Component Description: (include brief description including quantities for cost traceability)

Nitrogen Blanketing Storage System

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $17,090.65	$17,090.65	$153,816	$1,367,252
Vendor Engrg: Linde Division, Union Carbide Corp.			
First Tooling Cost:	-	-	-
Delivery (weeks)	1-2	2-4	7-9
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:	-	-	-
Quantity/Description			
Cost			
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 20

Component Name: NCV 1

Component Description: (include brief description including quantities for cost traceability)

Nitrogen Check Valve

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $36.24	$36.24	$362.40	$3,262
Vendor Engrg: Circle-Seal Valve			
First Tooling Cost:	0	0	0
Delivery (weeks)	4-5	4-5	6-8
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:	-	-	-
Quantity/Description			
Cost			
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 21

Component Name: OCV 1

Component Description: (include brief description including quantities for cost traceability)

Oil Check Valve

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $588.80	$588.80	$5,888	$51,200
Vendor Engrg: Consolidated Pipe and Supply			
First Tooling Cost:	0	0	0
Delivery (weeks)	8	8	12
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	1 trim 1 packing	10 trim 10 packing	100 trim 100 packing
Cost	$147.20	$1,472	$12,800
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 22

Component Name: OFV 1

Component Description: (include brief description including quantities for cost traceability)

Oil Fill Valve - manually operated

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $806.61	$806.61	$7,259	$68,562
Vendor Engrg: Masoneilan			
First Tooling Cost:	0	0	0
Delivery (weeks)	3-5	3-5	12-14
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	1 trim 1 packing	10 trims 10 packings	100 trims 100 packings
Cost	$161	$1,452	$13,712
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 23

Component Name: PR 1

Component Description: (include brief description including quantities for cost traceability)

Pressure Regulator on the Nitrogen Blanketing System

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $71.05	$71.05	$675	$6,039
Vendor Engrg: Pye-Barker & Co.			
First Tooling Cost:	0	0	0
Delivery (weeks)	2-3	4-6	8-10
Salvage Value (after 20 yrs)	-	-	-
Spare Parts:			
Quantity/Description	-	-	-
Cost			
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 24

Component Name: PRD 1, 2 & 3

Component Description: (include brief description including quantities for cost traceability)

Pressure Rupture Discs with Vacuum Support System

Design Life: 20 yrs

		1 Plant*	10 Plants*	100 Plants*
Capital Cost:				
Unit Cost:	$663.30	$1,990	$17,720	$137,500
Vendor Engrg:	W. R. Flack Co.			
First Tooling Cost:				
Delivery (weeks)		2-3	4-6	8-10
Salvage Value (after 20 yrs)		-	-	-
Spare Parts: Quantity/Description	1 rupture disc & vacuum support			
Cost		$310	$2,658	$20,625
Maintenance Cost ($/Yr) (if required)				

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 25

Component Name: PS 1, 2, 6, 7, 8 & 9

Component Description: (include brief description including quantities for cost traceability)

Pressure Sensors (consists of gauge pressure transmitter)

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $615.00	$3,690	$35,055	$313,650
Vendor Engrg: The Foxboro Company (Quotation obtained during price estimation of pilot plant, May 1977)			
First Tooling Cost:	0	0	0
Delivery (weeks)	18-20	20-26	20-26
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: pressure transmitter Quantity/Description			
Cost	$615	$11,685	$104,550
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 26

Component Name: T1/T2/T3

Component Description: (include brief description including quantities for cost traceability)

T1 - Hot Tank 27' Diameter
T2 - Intermediate Tank 38' Diameter
T3 - Cold Tank 38' Diameter

Design Life: 20 yrs

		1 Plant*	10 Plants*	100 Plants*
Capital Cost:	T1	$164,000		
Unit Cost:	T2	$200,000	$4.9 x 10^6	$44.5 x 10^6
	T3	$200,000		
Vendor Engrg: Pittsburgh - Des Moins Steel Company				
First Tooling Cost:				
Delivery (weeks)		40	104	156
Salvage Value (after 20 yrs)				
Spare Parts:		-	-	-
Quantity/Description		-	-	-
Cost				
Maintenance Cost ($/Yr) (if required)				

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 27

Component Name: TS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 & 28

Component Description: (include brief description including quantities for cost traceability)

Temperature Sensor (consists of sensing element)

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $55.17	$1,490	$14,155	$126,650
Vendor Engrg: The Foxboro Company (Quotation obtained during price estimation of pilot plant, May 1977)			
First Tooling Cost:	0	0	0
Delivery (weeks)	18-20	18-20	20-26
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: sensing element			
Quantity/Description			
Cost	$552	$5,243	$46,907
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

ATTACHMENT 2

COST DATA SHEET

Equipment List No. 28

Component Name: VRV 1, 2 & 3

Component Description: (include brief description including quantities for cost traceability)

Vacuum Relief Valve (circle seal valve)

Design Life: 20 yrs

Capital Cost:	1 Plant*	10 Plants*	100 Plants*
Unit Cost: $32.10	$96.30	$867	$8,185
Vendor Engrg: Pacific Valves, Inc. (Quotation obtained during price estimation of pilot plant)			
First Tooling Cost:	0	0	0
Delivery (weeks)	2-3	2-3	6-8
Salvage Value (after 20 yrs)	-	-	-
Spare Parts: spare valve			
Quantity/Description			
Cost	$32.10	$289	$2,728
Maintenance Cost ($/Yr) (if required)			

*These units should be assumed to be ordered as single procurements i.e., 10 at a time or 100 at a time.

SECTION VI

VENDORS SUPPORTING INFORMATION

CABLE PITTDESMOIN
TELEX 086-734

ENGINEERS / FABRICATORS / CONSTRUCTORS

PITTSBURGH-DES MOINES STEEL COMPANY

NEVILLE ISLAND ■ PITTSBURGH, PENNSYLVANIA 15225 ■ PHONE: (412) 331-3000

August 22, 1977

Georgia Tech University
Engineering Experiment Station
Applied Science Lab.
Atlanta, GA 30332

Attention: Dr. A. H. Ray

Gentlemen:

Based on the information given over the phone, PDM is pleased to quote the following ROM budget prices:

1.	27'ø carbon steel "hot" tank	$170,000
2.	38'ø carbon steel "intermediate" tank	$210,000
3.	38'ø carbon steel "cold" tank	$210,000

These prices include all design, drafting, project management, materials, fabrication, field erection, testing, foundations, painting, and insulation.

A single one module system of three tanks would cost about $590,000.

Ten such modules, or 30 tanks $5,200,000. One hundred modules, or 300 tanks $47,200,000.

PDM would be pleased to look at your system requirements, also. Should solid inquiries result from this work, your needs may result in a "turn-key" facility. Keep this in mind if you do require further information on the subject.

As far as schedule goes, a module (3 tanks) can be erected and tested within 40 weeks from the date of award.

We hope this information supports your requirements. Design drawings can be forwarded at your request. Continued good luck on your project. Keep us informed as to your progress.

Very truly yours,

PITTSBURGH-DES MOINES STEEL COMPANY
SYSTEMS GROUP

Keith L. Jansen
Contracting Engineer

bab

DEAN BROTHERS PUMPS INC.

MANUFACTURERS OF PUMPING MACHINERY FOR INDUSTRY

Please send reply to:

DEAN BROTHERS PUMPS, INC.
P. O. Box 11731—Atlanta, Georgia 30305, Phone (Area Code 404) 237-3837

August 23, 1977

Mr. Charlie Murphy
Georgia Institute of Technology
Solar Energy Programs
Hinman Research Bldg.
Atlanta, Georgia 30332

Dear Mr. Murphy:

The enclosed quotation #TJ 82377 confirms phone quotation to you by Mr. Wm. B. Wylly last week.

If you or your people have any questions please call.

Regards,

Tom G. Johnson

TBJ:m

Enclosure

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS, IND. 46202

323 W. TENTH ST.

CENTRIFUGAL PUMP QUOTATION

CUSTOMER Ga. Tech

REQUISITION OR INQUIRY No. ______

ATTENTION Mr. Charlie Murphy

QUOTATION NUMBER TJ 82377

PAGE 1 OF 2 PAGES

DATE 8-23-77

	ITEM NUMBER	1	2		
	QUANTITY	2	2		
	PUMP SIZE AND TYPE	3x4x8½ R434	2x3x13½ R440		
	SECTION DRAWING NUMBER	01919E	01945A		
	CIRCULAR NUMBER	C-1440			
	DIMENSION DRAWING	R-1021	R-4021		
	DIRECTION OF ROTATION	CCW	CCW		
	HYDROSTATIC TEST PSIG	850	750		
	CURVE NUMBER / IMPELLER DIA IN.	R3085A1 / 7¾	R20135B1 / 10⅝		
	CONDITIONS OF SERVICE				
	LIQUID	Hot Oil	→		
	CAPACITY GPM	470	430		
	TOTAL HEAD FT.	250	435		
	PUMPING TEMPERATURE °F.	380	} →		
	SP. GR. AT PUMPING TEMPERATURE	0.72			
5	VISCOSITY AT PUMPING TEMPERATURE	Negl.			
6	VAPOR PRESSURE PSIA	NS			
7	SUCTION PRESSURE PSIG	NS			
8	NPSH AVAILABLE/REQUIRED FT.	NS / 13'	/ 12'		
9	SPEED RPM	3500	→		
0	EFFICIENCY %	72	70		
1	BHP - CONDITION POINT - MAX.	29.6 - 40.0	55 - 70		
2	RECOMMENDED DRIVER HP/FRAME SIZE	40 / 324TS	75 / 365TS		
3	MATERIAL CLASS	40	} →		
4	CASING	Cast Steel			
5	IMPELLER	Cast Iron			
6	CASE RINGS	Hardenable Iron			
7	PUMP SHAFT	Alloy Steel			
8	SHAFT SLEEVE	316 SS			
29	PACKING GLAND	Cast Steel			
30	BASE PLATE	Fab Steel			
31	COUPLING	Woods			
32	COUPLING GUARD	Rolled Steel			
33	STUFFING BOX SEALING Single inside unbalanced				
34	carbon vs Niresist				
35	SK-1417				
36	CASING VENT Self DRAIN Yes				
37	TEST & INSPECTION CODE NOS.				

	PRICES (SEE CONDITIONS OF SALE ATTACHED)	UNIT	EXTEN.	UNIT	EXTEN.	UNIT	EXTEN.	UNIT	EXTEN.
38	PUMP ONLY					(1) NOTE			
39	BASE PLATE					−	5% $	FOR	40 UNI
40	COUPLING	2604.		4227.		−	15% $	FOR	400 "
41	COUPLING GUARD								
42	STUFFING BOX SEALING					deduct		pump $	only.
43									
44									
45	DRIVER 3/60/230-460	745.		1746.					
46	TEFC								
47									
48	SHIPPING WEIGHT WITH DRIVER-EACH	1134#		1738#					
49	ESTIMATED FREIGHT-EACH								
50	SHIPMENT	18 to 20 WEEKS FRO							

... SHIPMENT PROMISED IS NOT GUARANTEED AND DATE ... FROM RECEIPT AT INDIANAPOLIS OF COMPLETE MANUFACTURING IN...

ROY FREEMAN ASSOCIATES, INC.
MANUFACTURERS REPRESENTATIVES
2150 PARKLAKE DRIVE ATLANTA, GEORGIA 30345
TEL. (404) 938-1227

August 24, 1977

Georgia Tech Engineering
Experiment Station
308 Hinman Bldg.
Atlanta, Georgia 30332

Attention: Mr. A. H. Roy

Subject: ERDA - Solar Research Projects

Gentlemen:

Confirming our telephone conversations, we are pleased to send you the attached preliminary quotation for estimating prices covering Valtek Control Valves for HiTec #43 for 50 psig working pressure at approximately 550°F. working temperature.

During our conversations, I did not include the air filter on the air supply, but I believe this should be included as an accessory which you would need to make sure the air supply to the cylinder actuator and valve positioner is good clean dry air.

We have simply used an estimating price for control valves with electric actuators by deducting the price of the pneumatic actuator and then doubling the price of the valve as a rough rule of thumb. To get exact pricing for electric actuators, it will be necessary for us to know detailed specifications regarding the electric actuators which you require.

All orders are subject to acceptance by Valtek, Inc. at their office in Provo, Utah, and all quantity discounts would be negotiated based on exact requirements, etc.

We certainly appreciate this opportunity of supplying this information to you and look forward to working with you accordingly. If we can be of additional help or service in any way, please do not hesitate to contact us.

Sincerely yours,

Roy Freeman

RF:la
attached

cc: Vernon Marks
Provo, Utah

OY FREEMAN ASSOCIATES, INC. 332-1227
ENGINEERED EQUIPMENT TEL. (404) 261-9065

3166 MAPLE DRIVE N. E. ATLANTA, GEORGIA 30305
2150 Parklake Drive Atlanta, Georgia 30345

): Georgia Tech
Engineering Experiment Station
308 Hinman Bldg.
Atlanta, Ga. 30332
ttn: A. H. Roy

Date: 3/24/77
Quotation No: 77-858
Reference: ERDA-Solar Research Projects

hank you for your Inquiry and we are pleased to offer our Quotation or your consideration as follows:

OB: Provo, Utah Terms: 1/4% 10, Net 30

hipping Schedule: See Below

Quantity	Description	Unit Price
3	2" Size Valtek Mark I Control Valves with pneumatic Cylinder actuator, Cast Carbon Steel A216 Grade WCB Body, 600 lb. ANSI, Schedule 40, Socket weld end connections, 316 S.S. Trim, 316 S.S./ Asbestos Spiral Gaskets, Bolted Bonnet with extension for high temperature service, Grafoil Guides, Graphite Asbestos packing, ductile iron yoke, 4-way side mounted valve positioner, 3-15 psi signal, 100 psi air supply & air supply filter.	925.50
7	6" Size Valtek Mark I Control Valves same as above except 150 lb. ANSI Body with Schedule 40 Butt-weld end connections.	2,531.60
10	4" Size Valtek Mark I Control Valve same as Item 2.	1,665.00

Prices are firm for 30 days and do not include any Federal, State, or Local Excise or Sales Taxes. Orders are subject to acceptance by the Manufacturer at their home office. We thank you for the opportunity to Quote and hope that we are favored with your Order.

Please make your Orders to: Valtek, Inc.
c/o ROY FREEMAN ASSOCIATES, INC.

cc: Vernon Marks
Valtek, Inc.

Respectfully submitted by:

Quantity	Description	Unit Price
1	4" Size Valtek Mark I Control Valves, same as Item 3 except with Electric Motor Actuator	$ 2,547.00
1	2" Size Valtek Mark I Same as Item 4.	1,414.50

Note: Above Prices for Valves w/Electric Actuators are for Engineering Estimates only. Pricing can be accomplished on electric actuators only after receipt of complete specifications & requirements.

Shipping Schedules:

(1) Valves with pneumatic actuators- approximately 8 to 10 weeks.

(2) Valves with electric actuators- approximately 16 to 20 weeks (depending on availability of electric actuators)

Quantity Discounts are subject to factory approval depending on exact shipping requirements and total number of valves. However, for 10 plants using valves as above, there would probably be a quantity discount of approximately 10% based on receipt of agreement covering entire quantity.