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Monthly Progress Report No. 1

SOYBEAN DRYING USING HEAT FROM SOLAR ENERGY

July 1976

TELEDYNE
BROWN ENGINEERING

Cummings Research Park • Huntsville, Alabama 35807

MONTHLY PROGRESS REPORT NO. 1
PERIOD: 26 MAY 1976 THROUGH 2 JULY 1976

SOYBEAN DRYING USING HEAT FROM SOLAR ENERGY

July 1976

Prepared For

DIVISION OF SOLAR ENERGY
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
20 MASSACHUSETTS AVE.
WASHINGTON, D.C. 20545

Contract No. E(40-1)-5122

Prepared By

SYSTEMS ENGINEERING PROJECTS DEPARTMENT
ADVANCED PROJECTS
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HUNTSVILLE, ALABAMA

ABSTRACT

Solar energy, as a heat supplement for large amounts of grain processing is feasible with present technology with either liquid or solar collectors. Requirements necessary to establish design criteria for a soybean drying process line utilizing solar energy are identified.

Approved

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. INTRODUCTION

The Teledyne Brown Engineering Company (TBE) has been contracted by the U.S. Energy Research and Development Administration to provide for the analysis, design, fabrication, testing and demonstration of a solar energy drying process for soybeans. A conventional grain dryer will be used to process the soybeans; however, it will derive the energy required to heat the drying air principally from a solar collection and storage system.

A three phase program has been defined: Phase I will be a nine month program to design and analyze a solar drying process; Phase II, lasting one year, will be used to fabricate and install the system, and during Phase III, operational data will be acquired over a period of fifteen months to permit a comparison with a conventional fuel operated facility.

Phase I was initiated on June 26, 1976 with the fundamental objectives to: (a) identify and synthesize the most cost-effective solar drying system for the Gold Kist soybean processing plant in Decatur, Alabama, and (b) prepare detailed design and performance specifications. To satisfy these objectives, TBE has teamed with the Reisz Engineering Company for the generation of preliminary designs and Gold Kist, Incorporated for consultation support. Figure 1-1 illustrates the methodology to be followed to meet the program objective.

PHASE I

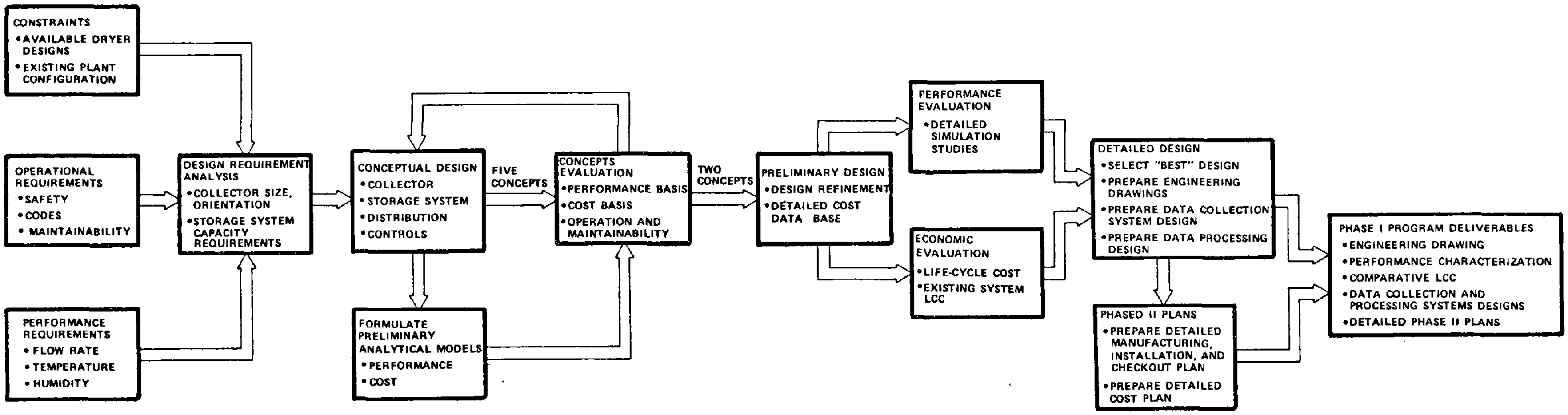


FIGURE 1-1

2. PROGRAM STATUS

2.1 SCHEDULE

The overall program schedule for Phase I is shown in Figure 2-2. During this reporting period, Task I (Requirements Definition) was initiated and completed as scheduled. Work was also initiated on Task II Conceptual Design. Requirements impacting on system design have been identified and are documented in Reisz Engineering Company's Progress Report, subject; Requirements Definition for Soybean Drying Process Using Solar Energy at the Gold Kist Soy Facility, Decatur, Alabama. This document gives the design guidelines for both systems and components, and facilities and sites. It includes functional, mechanical, structural, safety, durability/ reliability and maintainability guidelines.

2.2 DESIGN CONSTRAINTS

Certain design constraints have been identified. For example, some of these are:

2.2.1 There must be no interference with existing Gold Kist operations.

2.2.2 The design must be for a permanent system installation.

2.2.3 Subsystems must be basically off-the-shelf and state-of-the-art items although items may be scaled to meet interface requirements.

2.2.4 The appearance of all structures must be compatible with existing structures and surrounding facilities.

2.2.5 The system must be reasonably protected from vandals, birds, environmental factors and other hazards.

2.3 REQUIREMENTS

2.3.1 Drying may be defined as the removal of moisture usually to a point at which its moisture content comes into near equilibrium with the moisture content of the drying air. The main factors which are indicative of the condition of the soybean are its moisure content and temperature, and also the degree of deviation of these values from equilibrium values. It is important that the temperature of the drying environment be limited otherwise degradation of desirable bean characteristics will result. Because of these factors, a complete understanding of soybean operational requirements had to be identified prior to designing a solar heat drying system. To permit a total system simulation, Gold Kist engineering personnel are conducting a literature survey for modeling the drying process. Results obtained of the thermodynamic process, coupled with the operational and performance requirements determined during Task I will dictate the solar heat drying system to be designed. It has been reaffirmed that solar energy, as a heat supplement for a large amount of grain processing, is feasible with present technology with either liquid or air solar collectors. For lesser amounts of grain processing solar energy can be a prime source of heat, supplemented with other energy sources. Present grain processing concepts currently operate with a variety of heat sources (oil, gas, electricity) and readily change from one source to another, and may use combinations of heat sources. Solar heat may be considered as another heat source when available.

2.3.2 Many variations in design are still open to study such as liquid and air collectors and the optimum size of dryer (i.e. 3,000 bushel/hour or 500 bushel/hour dryer). Design variations will be synthesized during Task II (Conceptual Designs), which is presently underway.

2.3.3 The Gold Kist plant facility at Decatur, Alabama has adequate space and facilities for solar collectors and additional dryers with related handling equipment. The present structure will support additional construction for a solar energy supplemental heat source.

2.4 PROGRAM COST

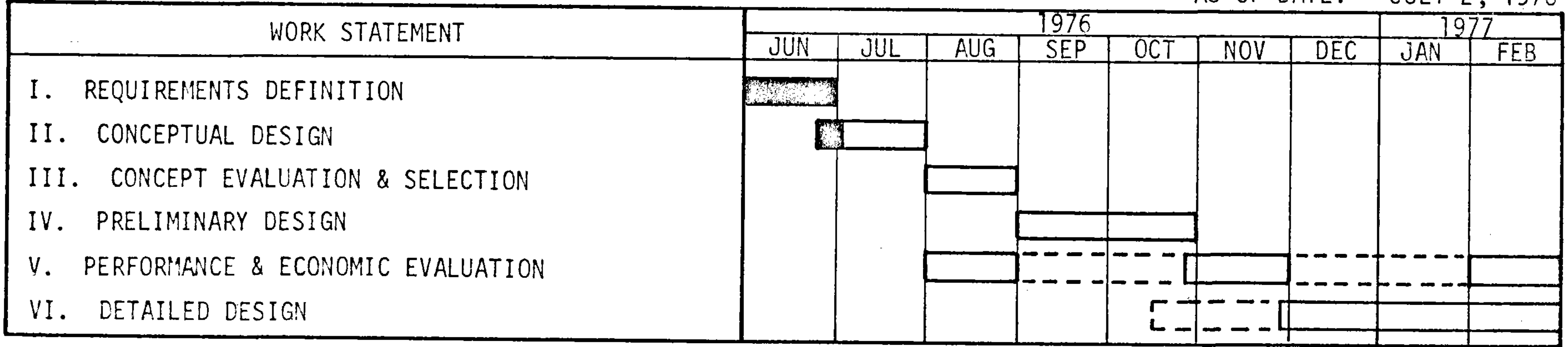
The program is under its cost projections, primarily due to billing lead times and fewer manhours required for consulting services than anticipated. The unfavorable manhour variance is a result of a larger participation in the ERDA sponsored "Solar Industrial Process Heat Workshop" than planned. The increase in manhours for Task I will result in a reduction of manhours during subsequent tasks by a like amount. Estimated manhours for completion of the contract will be on target.

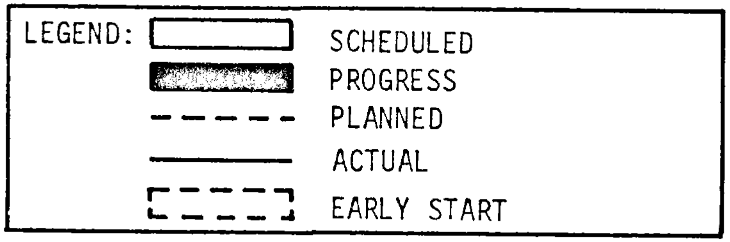
PROJECT PLAN AND PROGRESS REPORT

SOYBEAN DRYING USING HEAT FROM SOLAR ENERGY

SCHEDULE

AS OF DATE: JULY 2, 1976





PROGRAM PLAN

		BUDGET	MANHOURS
TOTAL PROGRAM		$286,764	5,150
REPORTING PERIOD	PLANNED	33,724	330
	SPENT	28,806	384
	VARIANCE*	4,918	(54)
CUMULATIVE TO DATE	PLANNED	33,724	330
	SPENT	28,806	384
	VARIANCE*	4,918	(54)
NEXT REPORTING PERIOD	PLANNED	44,622	522

*FAVORABLE (UNFAVORABLE)

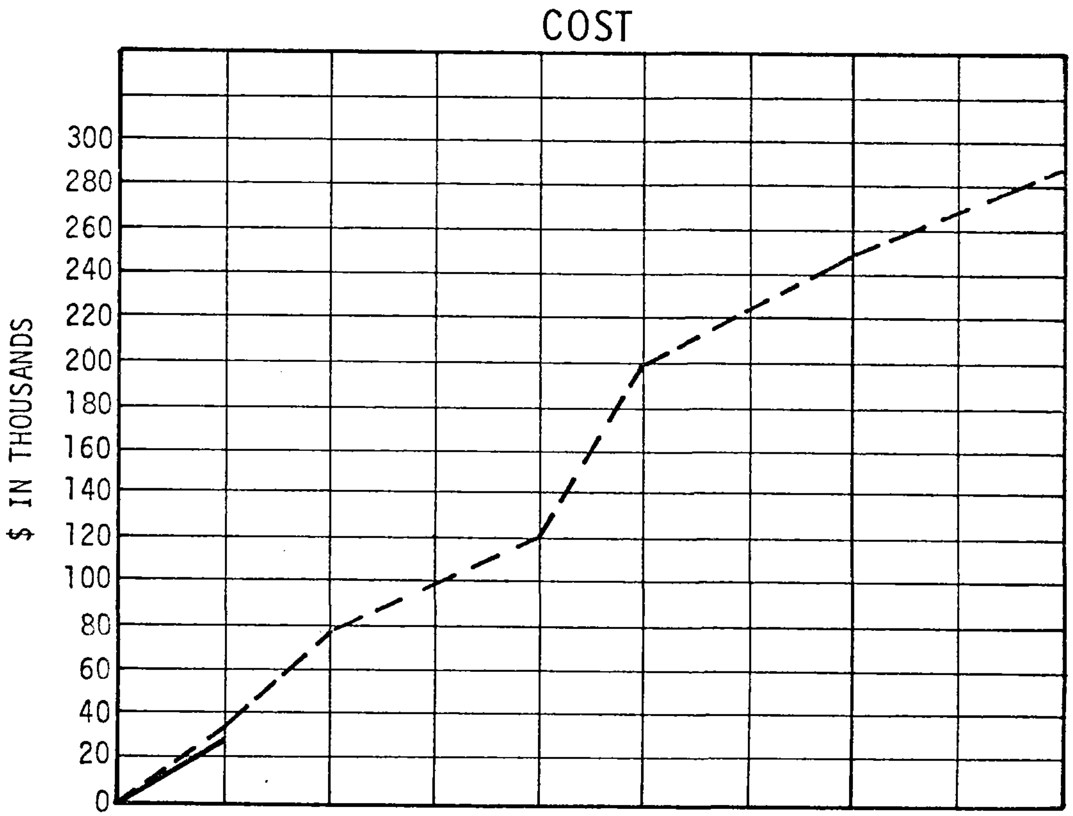


FIGURE 2-2

3. PLANNED ACTIVITY

3.1 The major activity is now in transition from the data and acquisition effort of Task I to that of conceptual design. As noted from Figure 1, five conceptual designs which meet the requirements established in Task I will be synthesized. Tradeoffs of various approaches to collection design, storage system design and distribution system design, as well as the balancing of various components parameters, will be conducted to maximize cost effectiveness. Different operating modes will be considered for each of the concepts with the objective of maximizing performance and minimizing initial costs. Tradeoffs and optimizations will be conducted using preliminary math models of major subsystem functional characteristics and costs. The synthesization and presentation of the five conceptual designs will be conducted in three phases: (1) development of a data base for synthesis, (2) synthesis of the five conceptual designs, and (3) preparation of engineering descriptions of the conceptual designs.

3.2 Planned costs and manhour loadings for the next reporting period are shown at Figure 2-2.

4. PROBLEMS ENCOUNTERED

At this time, no significant problems have been encountered. While all items investigated have not been fully resolved, continued application and study would appear to lead to satisfactory solutions.

5. ACTIONS REQUIRED BY ERDA

Attention is invited to Article II of the contract pertaining to subcontracts. As per Par 3, Article II, contracting officer approval is required for work to be accomplished by subcontract. A time and materials subcontract with Reisz Engineering Company was forwarded to the ERDA Contracting Officer on May 26, 1976. Formal approval of this contract has not been received.