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NASA CR 53504

MONTHLY PROGRESS REPORT NO. 5

Covering Period from December 1, 1963 to December 31, 1963

Contract NAS 3-2789

BRAYTON CYCLE SOLAR COLLECTOR

DESIGN STUDY PROGRAM

Item II. A.

OTS PRICE

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THOMPSON RAMO WOOLDRIDGE INC.
New Product Research
Cleveland, Ohio

Project 512-004235-08

January 13, 1964
Date

0830
Department

1.0 PROGRESS DURING THE REPORTING PERIOD

1.1 General Comments

A technical review of the Brayton cycle concentrator study program and a presentation of the resulting recommended design concept was made at NASA Lewis. The detailed design layout was started which includes the detailed fabrication and handling considerations.

Micrometeoroid erosion specimens were delivered to NASA Lewis and the erosion experiment parameters were recommended and discussed.

Progress accomplished in the major task areas will now be presented.

1.2 Performance Analysis

Computer solutions of the solar reflector performance continued to investigate the various design parameters and performance map characteristics. The cases shown in Table I have been run or are being computed. The computer program also has the capability of calculating the flux distribution on any arbitrary cavity receiver configuration - including the effects of vignetting through the aperture. The following cavity configurations are being investigated:

1. Spherical
2. Cylinderical
3. Conical
4. Double Cone

Further and more detailed concentrator surface error evaluations have been made. Indications are that with developmental improvements in tooling and fabrication techniques a surface error model of 4' to 6' standard deviation (8' to 12' max. deviation) can be obtained. These estimates also include the space environmental errors.

1.3 Structural Analysis

Structural analysis and design considerations were summarized for the presentation to NASA and as the initial inputs to the detailed concentrator design layout. All structural members have been sized and detailed stress and stability calculation have been made.

1.4 Thermal Analysis

Transient temperature characteristics of the recommended honeycomb sandwich design have been calculated. Typical results for the concentrator with no special radiation control is shown in Figure 1. The variation of ΔT through the thickness is seen to be a maximum at the end of the sun portion of the orbit. Transient temperature conditions for other locations on the concentrator and for the support ring will be plotted to complete the transient temperature map.

1.5 Micrometeoroid Erosion Investigation

Reflectivity measurements were completed and the specimens and data were delivered to NASA Lewis.

The following is a summary of the initial reflectivity measurement results:

	Solar Reflectance
Aluminum substrate/Pure aluminum coating	91%
Aluminum/Epoxy coat/Aluminum (600 Å)	93%
Aluminum/Epoxy coat/Aluminum (2000 Å)	93%
Aluminum/Epoxy/Aluminum (600 Å)/SiO (2300 Å)	89%
Aluminum/Epoxy/SiO (3000 Å)/Aluminum (600 Å/SiO (2300 Å)	89%
Aluminum/Epoxy/SiO (3000 Å)/Aluminum (600 Å)SiO (2 μ)	86%

The low value for the thick SiO coating (2 μ) may be due to instability of the film which was observed as a frosting of the specimen over a period of several days after deposition. This is thought to be caused by the present limited temperature control of the substrate during deposition which may lead to residual stresses in the film and the associated crazing condition.

2.0 PROBLEM AREAS AND CORRECTIVE ACTION

Load and structural design condition determinations based upon the specified launch and space environment are difficult to determine. The resulting dynamic stress and stability conditions are even more difficult and in some cases impractical to predict analytically. Based upon these observations, model testing is recommended as an additional design tool.

Although the honeycomb design concept provides a large margin of safety for the load environment unknowns, optimized design must be based upon developmental testing.

3.0 WORK TO BE PERFORMED DURING THE NEXT MONTH

As shown in the attached task schedule, all analysis tasks will be completed. The preliminary design layout will be completed and submitted for NASA approval.

TABLE I

PARAMETRIC STUDY CASES

Rim Angle	Radial Std. Dev.	Circum Std. Dev.	Misorien.	Focal Plane Misplacement
45°	9'	0	0	0
50°	9'	0	0	0
55°	9'	0	0	0
60°	9'	0	0	0
65°	9'	0	0	0
70°	9'	0	0	0
50°	9'	0	.25°	0
60°	9'	0	.25°	0
65°	9'	0	.25°	0
55°	9'	4.5'	0	0
55°	9'	4.5'	.25°	0
55°	6'	3'	0	0
55°	6'	3'	.25°	0
55°	6'	0	0	0
55°	6'	0	.25°	0
55°	0	0	0	0
55°	0	0	.25°	0
55°	4'	0	0	0
55°	4'	0	.25°	0
55°	6'	3'	.10°	0
55°	6'	3'	.5°	0
55°	6'	3'	1.0°	0
55°	6'	3'	0	+.5"
55°	6'	3'	0	+1.0"
55°	6'	3'	.25°	+1.0"

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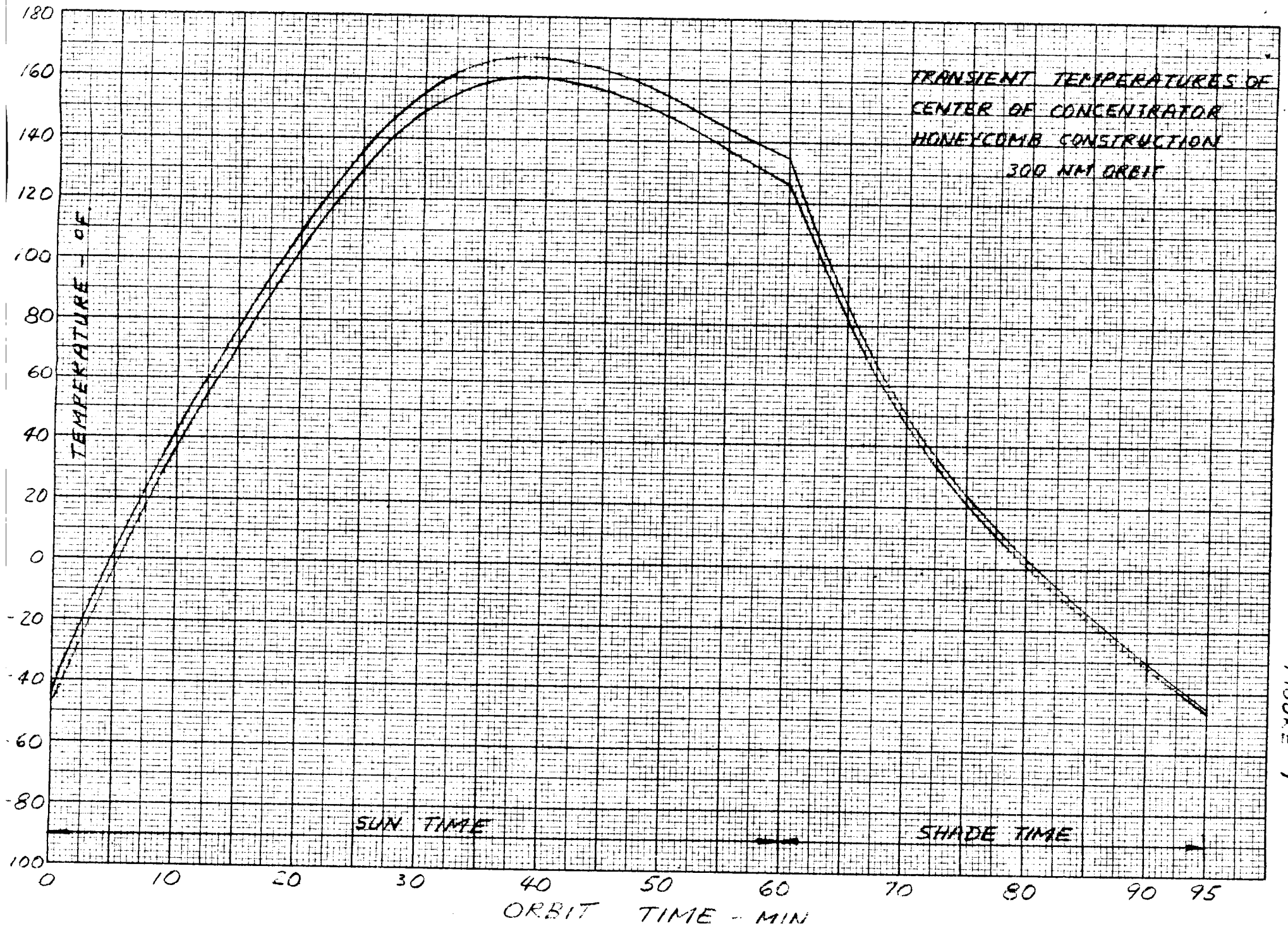


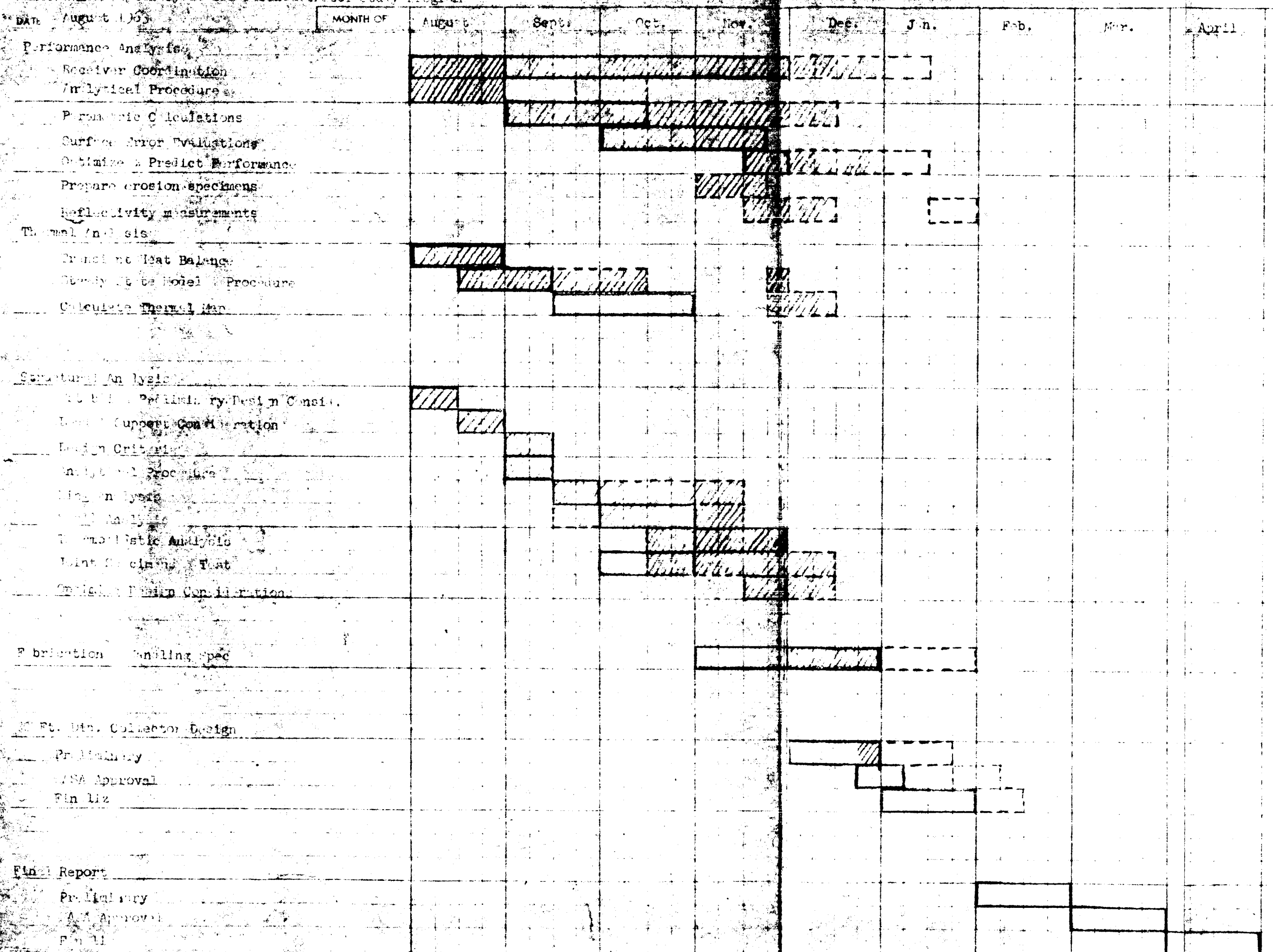
FIGURE 1

PROJECT [illegible]

TASK SCHEDULE [redacted]

Project Title: Brayton Cycle Solar Concentrator Study Program

DATE: August 1963



Per cent of Task Completion

95
100
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